2016 WATER SYSTEM PLAN

CITY OF FERNDALE

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TABLE OF CONTENTS

ABBREVIATIONS xii

EXECUTIVE SUMMARY S-1

GENERAL S-1

DESCRIPTION OF WATER SYSTEM S-1

BASIC PLANNING DATA AND WATER DEMAND FORECASTING S-2

Table S-1, City of Ferndale Water Use Projections S-2

SYSTEM ANALYSIS S-2

CONSERVATION PROGRAM, WATER RIGHTS ANALYSIS, SYSTEM RELIABILITY, AND INTERTIES S-3

Conservation Program S-3

Water Rights S-3

System Reliability S-3

Interties S-3

SOURCE WATER PROTECTION S-3

OPERATION AND MAINTENANCE PROGRAM S-3

DISTRIBUTION FACILITIES DESIGN AND CONSTRUCTION STANDARDS S-4

IMPROVEMENT PROGRAM S-4

FINANCIAL PROGRAM S-4

CHAPTER 1 DESCRIPTION OF WATER SYSTEM 1-1

1.0 OBJECTIVE 1-1

1.1 OWNERSHIP AND MANAGEMENT 1-1

1.1.1 Water System Name 1-1

1.1.2 Type of Ownership 1-1

1.1.3 Management Structure and Decision Making Process 1-1

1.1.4 Water Facilities Inventory Report (WFI) 1-1

1.2 SYSTEM HISTORY AND BACKGROUND 1-1

1.2.1 History of Water System Development and Growth 1-1

Table 1-1, City of Ferndale, Existing Water Rights 1-2

1.2.2 Geography 1-3

1.2.3 Neighboring/Adjacent Purveyors 1-3

1.2.4 Ordinances/Bylaws 1-3

1.3 INVENTORY OF EXISTING FACILITIES 1-3
1.3.1 General Description and Major Components 1-3
Source 1-3
Table 1-2, City of Ferndale Water Supply (2015) 1-4
Treatment 1-4
Storage 1-4
Distribution System 1-4
Pump Stations 1-4
Table 1-3, City of Ferndale Pumping Capacity 1-5
Current Operations 1-5
1.3.2 Service Connections 1-6
Table 1-4, Active Service Connections 1-6
1.3.3 Existing Interties 1-6
1.4 RELATED PLANS 1-6
1.4.1 Inconsistencies with Related Plans 1-6
1.4.2 Applicable Agency Comments 1-6
1.4.3 Adjacent Purveyors 1-6
1.5 SERVICE AREA INFORMATION AND MAPS 1-7
1.5.1 Service Area 1-7
1.5.2 Retail Service Area 1-7
1.5.3 Zoning and Land Use 1-7
Table 1-5, Gross Area Calculations, Existing City Limits (2015) 1-8
1.6 SERVICE AREA POLICIES 1-9
1.6.1 Future Service Area 1-9
1.6.2 Service Area Agreements 1-9
1.6.3 Wholesaling Water 1-9
1.6.4 Wheeling Water 1-9
1.6.5 Annexation 1-9
1.6.6 Direct Connection and Satellite/Remote Systems 1-9
1.6.7 Design and Performance Standards 1-9
1.6.8 Surcharge for Outside Customers 1-9
1.6.9 Formation of Local Improvements Districts 1-10
1.6.10 UGA 1-10
1.6.11 Late-Comer Agreements 1-10

1.6.12 Oversizing 1-10
1.6.13 Cross-Connection Control Program 1-10
1.6.14 Extension 1-10
1.7 CONDITIONS OF SERVICE 1-10
1.7.1 Connection Fee Schedule 1-10
Table 1-6, City of Ferndale Bi-Monthly Rates, Single Family/Duplexes 1-11
Table 1-7, City of Ferndale Bi-Monthly Rates, Multi-Family, Commercial/Non-Residential, and Industrial 1-11
1.8 COMPLAINTS 1-11
1.8.1 Policy and Process to Deal with Complaints 1-11
1.8.2 Record Keeping 1-11
1.9 DUTY TO SERVE 1-11
1.9.1 Conditions of Service 1-11
1.9.2 Service Requests 1-12
1.9.3 System Capacity for New Service 1-12
1.9.4 Time Extensions and Disputes 1-12
1.10 CONSISTENCY 1-13
1.10.1 Local Agencies 1-13
Exhibit 1, City of Ferndale Pressure Zone Map 1-14
Exhibit 2, City of Ferndale Service and Retail Services Areas 1-15
Exhibit 3, City of Ferndale Zoning Map 1-16
CHAPTER 2 BASIC PLANNING DATA AND WATER DEMAND FORECASTING 2-1
2.0 OBJECTIVE 2-1
2.1 CURRENT POPULATION, SERVICE CONNECTIONS, WATER USE, AND EQUIVALENT RESIDENTIAL UNITS 2-1
2.1.1 Current Population 2-1
Table 2-1, Population (1980-2015) 2-1
2.1.2 Total Service Connections 2-1
Table 2-2, Total Service Connections 2-1
2.1.3 Water Use Data Collection 2-2
Table 2-3, Annual Well Water Production, MG 2-2
Table 2-4, Annual Finished Water Production, MG 2-2
Table 2-5, Metered Use by Customer Class, MG 2-2
Unmetered Water 2-3

Table 2-6, Unmetered Water, MG 2-3
Unaccounted for Water 2-3
2.1.4 Equivalent Residential Units (ERUs) 2-3
Single-Family Residences 2-3
Table 2-7, Single-Family Residential Water Use 2-4
Multi-Family Residences 2-4
Table 2-8, Multi-Family Residential Water Use 2-4
Commercial/Industrial Connections 2-5
Table 2-9, Commercial/Industrial Connection Characteristics 2-5
Table 2-10, Commercial/Industrial Connection Breakdown 2-5
Low Use Commercial/Industrial Connections 2-6
Table 2-11, Low Use Commercial/Industrial Water Use 2-6
High Use Commercial/Industrial Connections 2-6
Table 2-12, High Use Commercial/Industrial Water Use 2-6
Irrigation Connections 2-7
Table 2-13, Typical Irrigation Water Use 2-7
Maximum Day Demand 2-7
Figure 2-1, Water Delivered to the Distribution System, MG 2-8
Figure 2-2, Bi-Monthly Water Delivered to the Distribution System, MG 2-9
Table 2-14, Peaking Factors 2-9
2.1.5 Seasonal Variations by Customer Class 2-9
Single-Family Residences 2-9
Figure 2-3, Bi-monthly Single-Family Use 2-10
Multi-Family Residences 2-10
Figure 2-4, Bi-monthly Multi-Family Use 2-11
Commercial/Industrial Connections 2-11
Figure 2-5, Bi-monthly Commercial / Industrial Use 2-11
Irrigation Connections 2-12
Figure 2-6, Bi-monthly Commercial / Industrial Use 2-12
2.2 PROJECTED LAND USE, FUTURE POPULATION, AND WATER DEMAND 2-12
2.2.1 Projected Land Use 2-12
2.2.2 Projected Population 2-12
Table 2-15, Population Projections 2-13
2.2.3 Projected Service Connections 2-13

Table 2-16, Service Connection Projections 2-13
2.2.4 Projected ERUs 2-14
Table 2-17, ERU Projections 2-14
2.2.5 Projected Non-Revenue Water 2-14
2.2.6 Water Demand Forecasting 2-15
Table 2-18, Forecasted Water Demands 2-15
Figure 2-7, Projected Water Use, ADD 2-16
Figure 2-8, Projected Water Use, MDD 2-16
Figure 2-9, Projected Annual Water Use, AC-FT/YR 2-17
2.3 WATER PRODUCTION AND SUPPLY 2-17
2.3.1 Monthly and Annual Production 2-17
Table 2-19, Monthly and Annual Water Production, MG 2-18
2.3.2 Other Systems Supplied 2-18
Exhibit 4, City of Ferndale Planning District Map 2-19
CHAPTER 3 SYSTEM ANALYSIS 3-1
3.0 OBJECTIVE 3-1
3.1 SYSTEM DESIGN STANDARDS 3-1
3.1.1 Water Quality Parameters 3-1
3.1.2 Average and Maximum Day Demands 3-1
Average Day Demand 3-1
Table 3-1, ERU Equivalents 3-1
Maximum Day Demand 3-1
3.1.3 Peak Hour Demand 3-1
3.1.4 Storage Requirements 3-2
3.1.5 Fire Flow Rate and Duration 3-2
Table 3-2, Fire Flow Requirements 3-2
3.1.6 Minimum System Pressure 3-2
3.1.7 Telemetry Systems 3-3
3.1.8 Backup Power Requirements 3-3
3.1.9 Valve and Hydrant Spacing 3-3
Valves 3-3
Hydrants 3-3
3.1.10 Water Mains 3-3
Residential Zones 3-3

Commercial, Industrial, and Intuitional Zones 3-3
Maximum Velocities 3-4
3.1.11 Other System Policies that Affect Performance and Design 3-4
3.2 WATER QUALITY ANALYSIS 3-4
3.3 SYSTEM INVENTORY, DESCRIPTION, AND ANALYSIS 3-4
3.3.1 Source 3-4
General Description and Condition 3-4
Source Capacity Analysis 3-5
3.3.2 Water Treatment 3-5
General Description and Condition 3-5
Water Treatment Capacity Analysis 3-5
Figure 3-1, Project Water Use and Treatment Capacity, MDD 3-6
3.3.3 Storage 3-6
General Description and Condition 3-6
Storage Capacity Analysis 3-7
3.3.4 Distribution System 3-7
General Description and Condition 3-7
Pressure Zones 3-7
Exhibit 5, City of Ferndale Pressure Zone Schematic 3-8
Table 3-3, Pressure Zone Elevations 3-9
Axton Road Pressure Zone 3-9
Table 3-4, Axton Road Pressure Zone - PRV Settings 3-9
Bakerview Pressure Zone 3-9
Ferndale Terrace Zone 3-10
Table 3-5, Ferndale Terrace Pressure Zone - PRV Settings 3-10
Main Pressure Zone 3-10
Table 3-6, Main Pressure Zone - PRV Settings 3-11
Mid Pressure Zone 3-11
Table 3-7, Mid Pressure Zone - PRV Settings 3-12
Mid-Sub Pressure Zone 3-12
Table 3-8, Mid-Sub Pressure Zone, PRV Settings 3-12
Hydraulic Capacity Analysis 3-12
Table 3-9, Model Calibration Results, WTP Pumps Off 3-13
Table 3-10, Model Calibration Results, WTP Pumps On 3-14

Peak Hour Analysis 3-14
Fire Suppression System Analysis 3-15
Table 3-11, Fire Suppression System Analysis 3-16
3.4 SUMMARY OF SYSTEM DEFICIENCIES 3-16
3.4.1 Water Rights 3-16
3.4.2 Water Quality 3-16
3.4.3 Source 3-16
3.4.4 Storage 3-16
3.4.5 Distribution System 3-17
3.5 ANALYSIS OF DEFINED IMPROVEMENT PROJECTS 3-17
Table 3-12, Existing System Deficiencies 3-17
CHAPTER 4 WATER USE EFFICIENCY PROGRAM AND WATER RESOURCE ANALYSIS 4-1
4.0 OBJECTIVE 4-1
4.1 WATER USE EFFICIENCY PROGRAM 4-1
4.1.1 Current Program 4-1
4.1.2 Estimated Water Savings 4-1
Table 4-1, Estimated Water Savings 4-2
4.2 SOURCE AND SERVICE METERS 4-2
4.2.1 Source Meters 4-2
4.2.2 Service Meters 4-2
4.3 WATER RIGHT EVALUATION 4-2
4.3.1 Water Right Self-Assessment 4-2
Table 4-2, City of Ferndale, Existing Water Rights 4-3
4.3.2 Water Rights, Current Water Usage, and Projected Needs 4-3
Figure 4-1, Yearly System Usage 4-4
Table 4-3, Forecasted Water Demands 4-5
4.4 SOURCE OF SUPPLY ANALYSIS 4-5
4.4.1 Water Supply and Demand Characteristics 4-5
Figure 4-2, Water Delivered to the Distribution System, MG 4-6
Single-Family Residences 4-6
Multi-Family Residences 4-6
Commercial/Industrial Connections 4-6
Irrigation Connections 4-6

Figure 4-3, 2015 Usage by Customer Class 4-7
Water Rights Self Assessment – Existing Status 4-8
Water Rights Self Assessment – 6 Year Forecast 4-9
Water Rights Self Assessment – 20 Year Forecast 4-10
CHAPTER 5 SOURCE WATER PROTECTION 5-1
5.0 OBJECTIVE 5-1
5.1 WELLHEAD PROTECTION PROGRAM 5-1
CHAPTER 6 OPERATION AND MAINTENANCE PROGRAM 6-1
6.0 OBJECTIVE 6-1
6.1 INTRODUCTION 6-1
6.2 WATER SYSTEM MANAGEMENT AND PERSONNEL 6-1
6.3 OPERATOR CERTIFICATION 6-1
6.3.1 Classification of Public Water System 6-1
Water Treatment Plant 6-1
Table 6-1, Water Treatment Plant Classification 6-2
Distribution System 6-2
Table 6-2, Water Treatment Plant Classification 6-2
Requirements 6-2
Current Staff and Certification 6-3
Table 6-3, Staff Certifications and Contract Information 6-3
6.4 SYSTEM OPERATION AND CONTROL 6-3
6.4.1 Identification of Major System Components 6-3
6.4.2 Routine System Operation 6-4
Groundwater 6-4
Telemetry 6-4
Treatment 6-4
Storage 6-5
Pumps 6-5
Water Treatment Plant 6-5
Pump Station No. 1 6-5
Church Rd. Pump Station 6-5
Bakerview Pump Station 6-5
Transmission/Distribution System 6-6
6.4.3 Preventative Maintenance 6-6

6.4.4 Equipment, Supplies, and Chemical Listing 6-6
Table 6-4, Risk Assessment Contact Numbers 6-6
6.5 COMPREHENSIVE MONITORING (REGULATORY COMPLIANCE) PLAN 6-7
Table 6-5, Water Quality Monitoring Requirements 6-7
6.5.1 Coliform Monitoring Plan, Water Quality Monitoring and Ground Water Rule 6-9
6.6 EMERGENCY RESPONSE PROGRAM 6-9
6.6.1 Water System Personnel Emergency Call-up List 6-9
Table 6-6, Emergency Contact List 6-10
6.6.2 Notification Procedures 6-10
6.6.3 Vulnerability Assessment 6-11
6.6.4 Contingency Operational Plan 6-11
6.7 SAFETY PROCEDURES 6-12
6.8 SANITARY SURVEY 6-12
6.9 CROSS-CONNECTION CONTROL PROGRAM 6-12
6.10 CUSTOMER COMPLAINT RESPONSE PROGRAM 6-12
6.11 RECORDKEEPING AND REPORTING 6-13
6.12 O&M IMPROVEMENTS 6-13
6.13 REFERENCED PLANS AND DOCUMENTS 6-13
CHAPTER 7 DISTRIBUTION FACILITIES DESIGN AND CONSTRUCTION STANDARDS 7-1
7.0 OBJECTIVE 7-1
7.1 INTRODUCTION 7-1
7.2 PROJECT REVIEW PROCEDURES 7-1
7.2.1 Basic Requirements 7-2
7.2.2 Additional Requirements – Municipal Projects (Outside Design) 7-2
7.2.3 Additional Requirements – Private Projects 7-2
7.3 WATER SYSTEM STANDARDS 7-3
7.4 STANDARD DETAILS 7-9
7.5 CONSTRUCTION CERTIFICATION AND FOLLOW-UP PROCEDURES 7-10
CHAPTER 8 IMPROVEMENT PROGRAM 8-1
8.0 OBJECTIVE 8-1
8.1 PRIORITIZING IMPROVEMENTS 8-1
8.1.1 Identification of System Improvements 8-1
8.1.2 Assessment of Alternatives 8-1

Source and Treatment....8-1
Storage Reservoirs....8-1
Distribution System....8-2
8.2 IMPROVEMENT SCHEDULE....8-3
Table 8-1, Recommended Improvements....8-4
CHAPTER 9 FINANCIAL PROGRAM....9-1
9.0 OBJECTIVE....9-1
9.1 PAST AND PRESENT FINANCIAL STATUS....9-1
9.1.1 Available Revenue Sources....9-1
9.1.2 Allocation of Revenue Sources....9-1
Table 9-1, Recommended Improvements....9-2
9.1.3 Program Justification....9-4
9.2 ASSESSMENT OF RATES....9-4
Figure 9-2, Capital Improvement Program....9-5
Figure 9-3, Six and Twenty Year Operating Budget....9-6
City of Ferndale 2016 Water Fund Budget....9-7
CHAPTER 10 MISCELLANEOUS DOCUMENTS....10-1
10.0 OBJECTIVE....10-1
APPENDICES....A-1
A. AGENCY COMMENTS....A-2
B. WATER FACILITIES INVENTORY (WFI) FORM AND ORDINANCES....A-3
C. SEPA DETERMINATION OF NON-SIGNIFICANCE....A-4
D. CONSISTENCY DETERMINATION....A-5
E. CROSS-CONNECTION CONTROL....A-6
F. CONSTRUCTION STANDARDS....A-7
G. HYDRAULIC ANALYSIS....A-8
H. WATER QUALITY....A-9
I. WATER RIGHTS....A-10
J. WATER TREATMENT PLANT....A-11
K. INTERTIES....A-12
L. FERNDALE URBAN GROWTH AREAS – WATER AVAILABILITY....A-13
M. ANNEXATION BLUEPRINT....A-14
N. WATER SUPPLY AND STORAGE ANALYSIS....A-15
O. WELLHEAD PROTECTION PLAN....A-16

P. SANITARY SURVEY A-17
Q. WATER SYSTEM MAP A-18

ABBREVIATIONS

AC ..... Authorized consumption

ac-ft/year ..... Acre-feet per year

ADD ..... Average day demand

ANSI ..... American National Standards Institute

APWA ..... American Public Works Association

ASHRAE ..... American Society of Heating, Refrigeration, and Air Conditioning Engineers

ASCE ..... American Society of Civil Engineers

ASME ..... American Society of Mechanical Engineers

ASTM ..... American Society for Testing and Materials

AWWA ..... American Water Works Association

BPS ..... Booster pump station

CFR ..... Code of Federal Regulations

CRS ..... Capacity-related storage

CSV ..... Cycle stop valve

CT ..... Chlorine concentration x time

DBP ..... Disinfection byproduct

DE ..... Diatomaceous earth

DOH ..... Department of Health

DS ..... Dead storage

DSL ..... Distribution system leakage

DVGW ..... *Deutsche Vereinigung des Gas und Wasserfaches*

EDB ..... Ethylene Dibromide

EPA ..... Environmental Protection Agency

EPS ..... Extended-period simulation

ERU ..... Equivalent residential unit

ES ..... Equalizing storage

ETV ..... Environmental testing verification

fps ..... Feet per second

FSS ..... Fire suppression storage

GAC ..... Granular activated carbon

gpd ..... Gallons per day

gpm ..... Gallons per minute

GW ..... Groundwater

GWI ..... Groundwater under the direct influence of surface water

HAA5 ..... Haloacetic acids (five)

IESWTR ..... Interim Enhanced Surface Water Treatment Rule

IOC ..... Inorganic chemical

L&I ..... Department of Labor and Industries

LID ..... Local improvement district

LT1ESWTR ..... Long Term 1 Enhanced Surface Water Treatment Rule

LT2ESWTR ..... Long Term 2 Enhanced Surface Water Treatment Rule

MCL ..... Maximum contaminant level

MDD ..... Maximum day demand

MF ..... Multiplying factor

MGD ..... Million gallons per day

mg/L ..... Milligrams per liter

MMAD ..... Maximum month's average day demand

MPA ..... Microscopic particulate analysis

MPDES ..... National pollutant discharge elimination system

MRDLs ..... Maximum residual disinfectant levels

NPDES ..... National Primary Discharge Elimination System

NSF ..... NSF International (formerly National Sanitation Foundation)

NTU ..... Turbidity range

O&M ..... Operations and maintenance

ÖNORM ..... *Österreichisches Normungsinstitut*

OS ..... Operational storage

OSHA ..... Occupational Safety and Health Administration

PAC ..... Powdered activated carbon

PHD ..... Peak hourly demand

POE ..... Point-of-entry

POU ..... Point-of-use

PRV.....Pressure reducing valve, Pressure relief valve

psi.....Pounds per square inch

psig .....Pounds per square inch gauge

Q_a.....Water Right, Maximum Annual Volume

Q_i.....Water Right, Maximum Instantaneous Flow Rate

RCW .....Revised Code of Washington

RED .....Reduction equivalent dose

RO.....Reverse osmosis

RPBA .....Reduced-pressure backflow assembly

RSSCT.....Rapid small-scale column test

SB .....Standby storage

SCA.....Sanitary control area

SCADA .....Supervisory Control and Data Acquisition

SEPA .....State Environmental Policy Act

SOC .....Synthetic organic chemical

SMACNA .....Sheet Metal and Air Conditioning Contractors National Association

SW .....Surface water

SWSMP .....Small water system management program

TDS.....Total dissolved solids

TOC .....Total organic carbon

TP.....Total water produced and purchased

TS.....Total storage

TTHM.....Total trihalomethane

UPC .....Uniform Plumbing Code

USC .....University of Southern California

UV .....Ultraviolet

UVDGM .....Ultraviolet Disinfection Guidance Manual

VOC .....Volatile organic chemical

WAC.....Washington Administrative Code

WHPA .....Wellhead protection area

WISHA.....Washington Industrial Safety and Health Act

WSDM .....Water System Design Manual

WSDOE .....Washington State Department of Ecology

WSDOT .....Washington State Department of Transportation

WSDSHS.....Washington State Department of Social and Health Services

WSP.....Water system plan

WTP.....Water treatment plant

WUE.....Water use efficiency

WWTP .....Waste water treatment plant

USEPA.....U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

GENERAL

The principal goal of the City of Ferndale (City) 2016 Water System Plan (Plan) is to make the best use of the City's available resources in order to provide high quality service and protect the health of the City's customers for the 6 and 20 year planning periods. The Plan consists of ten (10) chapters, as follows.

DESCRIPTION OF WATER SYSTEM

The City of Ferndale owns and manages its water system for municipal water supply purposes that include a broad range of water uses including residential, low and high use commercial and industrial, and irrigation uses. The water system is a Group A Water System (ID 24850M).

The City's provides water service to 5,498 customers. These customers are served by the following:

- Source .....City Wells
  - Douglas Rd. Well.....1,300 gpm
  - Shop Well.....870 gpm
- Water Rights
    - Instantaneous …….. 2,930 gpm
    - Annual ……2,140 Acre Ft. per Year
- Treatment.....Ferndale Water Treatment Plant, 4.13 mgd (2,870 gpm) capacity
  - An August 18, 2014 letter from the Washington State Department of Health (DOH) states that the City's total treatment plant capacity would be "greater than the water right limitation" of 2,870 gpm at that time. Current water rights are 2,930 gpm, therefore 2,870 gpm is a conservative assessment of the City's treatment capacity.
- Storage
  - Tank No. 1 (Thornton Rd.), Capacity.....950,000 gallons
  - Tank No. 2 (Bakerview Tank).....1,760,000 gallons
  - WTP Clear Well .....304,000 gallons
- Pumping.....Ferndale Water Treatment Plant
  - WTP
    - 2 pumps, 1,600 gpm each
    - 1 pump, 3,250 gpm
  - Pump Station No. 1
    - 2 pumps, 850 gpm each
  - Church Rd. Pump Station
    - 2 pumps, 800 gpm each
  - Bakerview Pump Station
    - 4 pumps, 1,373 gpm each
- Distribution System
  - Approximately 73 miles of water main (<2 inch to 20 inch diameter)
  - 17 Pressure Reducing Valves
  - 6 Pressure Zones

BASIC PLANNING DATA AND WATER DEMAND FORECASTING

The City's historical growth from 2012 to 2015 and growth projections by the City's Planning Department were used for developing projected water use demands for the 6 and 20 year planning periods. Water use demands are presented in terms of average day demand (ADD), maximum day demand (MDD), peak hourly demand (PHD). and annual use, acre ft. per year (AFY). Existing and projected demands can be seen in Table S-1 below.

Table S-1, City of Ferndale Water Use Projections

Year	Population	Active Connections	ADD (MGD)	MDD (MGD)	PHD (GPM)	ANNUAL (AFY)
2015	12,920	5,498	1.21	2.07	2,366	1,356
2022	14,965	6,425	1.51	2.63	2,983	1,688
2036	20,072	8,936	1.88	3.28	3,716	2,112

Note: Water Use Projections are considered to include conservation measures

An Equivalent Residential Unit (ERU) is defined as the amount of water consumed by a typical full-time single family residence. It is a unit of measure used to equate non-residential or multi-family residential water usage to a specific number of single family residences. An ERU is system specific. The City's bi-monthly meter readings were used to quantify an ERU. These readings indicate:

1 ERU = 175 gpd

Note: This figure is based on bi-monthly meter readings from 2012 to 2015 and may change in the future.

Water consumption is approximately 65% single-family residences, 12% multi-family residences, 18% commercial/industrial, and 5% irrigation.

SYSTEM ANALYSIS

The City's wells produce groundwater that is in compliance with all primary maximum contaminant levels (MCL), but exceeds the secondary MCL for manganese. Although not a contaminant, the groundwater is also hard, which is an annoyance and an aesthetic issue for the public. The raw groundwater is delivered directly to the City's WTP where is it treated via greensand filtration and reverse osmosis before being delivered to the distribution system.

The City's water system was evaluated with respect to standards and requirements of the Washington State Department of Health (DOH) and City of Ferndale. The results are summarized as follows:

- Water Rights – adequate through 2036. Additional Rights required at that time.
- Source – Well capacity adequate until approximately 2032.
- Treatment – adequate beyond 3036
- Storage – adequate until 3036 by DOH recommendations, but deficient by Ferndale goals
- Distribution System – Address existing deficiencies

CONSERVATION PROGRAM, WATER RIGHTS ANALYSIS, SYSTEM RELIABILITY, AND INTERTIES

Conservation Program

The City has modified past water use efficiency goals to reduce seasonal outdoor use for the next six years. During peak water use month (June through September) customers are asked to voluntarily reduce outdoor water use.

The City provided notice of this conservation program to its customers via the local newspapers, bill inserts, homeowner association newsletters, and the City's web page (www.cityofferndale.org). The City also made available, for free, upon request, to any Ferndale water customer a rain/watering gauge that measures the number of inches of water applied during irrigation.

Water Rights

The City has several water rights from existing wells to use for the City's municipal drinking water. Comparing the City's ADD and the maximum annual volume allowed by the City's water rights (Q_a=2,140 ac-ft/yr) the City has sufficient water rights to meet water demands for the 6 and 20 year planning periods.

System Reliability

Distribution, pumping, and storage facilities are adequate to meet the City's municipal water demands. Several areas in the City have been identified as unable to meet the required fire suppression demands. Improvements needed to provide fire suppression demands to these areas are identified in Table 8-1 in Chapter 8.

The City is dedicated to upgrading, replacing, and maintaining its facilities as necessary. As other capital projects and development occurs, the City constantly reviews its comprehensive plans and works closely with developers to ensure that water system improvements provide system reliability and meet applicable fire suppression demands.

Interties

The City has fairly recently switched from surface water to groundwater as the source for the distribution system. As a result, the system had been greatly modified and has currently left the City with no emergency interties. The City is exploring interties with several surrounding water systems. These interties are discussed in the City's *Water Supply and Storage Alternative Analysis* report found in Appendix N.

SOURCE WATER PROTECTION

The City has completed a wellhead protection plan which can be found in Appendix O.

OPERATION AND MAINTENANCE PROGRAM

The water system is managed through the City's Public Works Department. Responsibilities include general oversight of all activities, budget formulation, implementation of the improvement program, contact with the public/press, responding to complaints, and review/approval of billings. The Public Works Director

is also responsible for responding to emergencies related to the water system and development/implementation of the cross-connection control program.

The Chief Water Treatment Plant Operator/Distribution Manager's main responsibility is to operate and maintain the water treatment plant so that Maximum Contaminant Levels (MCLs) and Maximum Residual Disinfectant Levels (MRDLs) are satisfied in accordance with WAC 246-290-310. As the water treatment plant operator, duties include preventative maintenance at the treatment plant and water quality monitoring. As the water distribution manager responsibilities include operating and maintaining the City's water system including reservoirs, pump stations, valves, and piping within public right-of-way or easements.

DISTRIBUTION FACILITIES DESIGN AND CONSTRUCTION STANDARDS

The City's design and construction standards for their water system are currently being updated. Copies of the standards are in Chapter 7 and draft copies of the standard details are in Appendix F. The City requires approved Construction Plans, Specifications and, under certain conditions, a Project Report per WAC 246-290-110, for projects when water system additions, modifications or improvements are made to the City's system. An exemption for new distribution and transmission mains has been requested in accordance with WAC 246-290-120.

IMPROVEMENT PROGRAM

The City's Improvement Program summarizes the improvements planned over the course of the 6 and 20 year planning period. System improvements are generally classified as source, pumping facilities, storage, and distribution system improvements.

FINANCIAL PROGRAM

The City's Water Capital Improvement Improvements have been budgeted over the next 20 years, along with projected water system revenues and expenses, including bond income and repayment. The income and expense schedule, along with reserve funds, shows that the City is able to fund and construct the scheduled capital improvement projects.

Several options are available to fund capital improvements project including, but not limited to:

- Increases in water rates, connection fees, and facility charges
- State or Federal loans and/or grants
- Formation of Local Improvement Districts (LIDs)
- Issuance of revenue bonds

CHAPTER 1
DESCRIPTION OF WATER SYSTEM

1.0 OBJECTIVE

The objective of this chapter is to provide basic information that will serve as a foundation for developing a comprehensive program that will meet current and future water system needs. Statutory authority is contained in Chapter 246-290-100 WAC, Chapter 246-293-250 WAC, and Chapter 246-295 WAC.

1.1 OWNERSHIP AND MANAGEMENT

1.1.1 Water System Name

The Ferndale water system is a Group A Community Water System (ID 24850M).

1.1.2 Type of Ownership

The type of ownership is "Municipal".

1.1.3 Management Structure and Decision Making Process

The City of Ferndale (City) is responsible for water system planning, operation, maintenance, and quality control. The City's Department of Public Works has standards and specifications for the water system.

The Director of Public Works oversees the operation and maintenance of the water system. Responsibilities include budget formulation, cross-connection control, safety, implementation of capital improvements, and coordination OF the operations of the water department.

The City's Water Treatment Plant (WTP) is staffed by certified operators. Operators are responsible for producing and maintaining required water quality, plant operations, preventative maintenance, water quality monitoring, and responding to water quality complaints and water quality emergencies.

The Water and Sewer Department, under the direction of Public Works Director, is responsible for operation and maintenance of the physical facilities of the water system including the WTP, reservoirs, pump stations, pipelines, and pressure reducing valves (PRVs).

1.1.4 Water Facilities Inventory Report (WFI)

A copy of the most current WFI, updated May 9, 2016 can be found in Appendix B.

1.2 SYSTEM HISTORY AND BACKGROUND

1.2.1 History of Water System Development and Growth

The City obtained water right certificates (GWC 1513 and GWC 3058) for two wells at the City shop (near Legoe Ave. and Washington St.) for 1,870 gallons per minute (gpm) and 2,055 acre feet/year (af/yr) in the early 1950's. These wells were installed and served as the primary source of water for the City. Public Utility District No. 1 constructed a facility in the early 1970's that obtains water from the Nooksack River at

River Mile 5.5. Its function was to provide clarified water to Intalco Aluminum Corporation, the Elder Road Water Association, and properties in the vicinity of the PUD's transmission system.

In 1971 the City obtained a permit to add a third well (G1-00720P) near Douglas Rd. and Main St. It was permitted for 1,000 gpm and 1,614 af/yr. This well has not been installed.

In 1974 the City and PUD 1 entered into an agreement whereby PUD 1 would provide the City up to three (3.0) Million Gallons per Day (MGD). In turn, the City constructed a WTP in 1975 south of the PUD facility to further treat the water and supply the City. Once the City's WTP was operational the City relegated the wells at the City Shop for use during emergency conditions.

In the early 1990's, the City relocated one well (GWC 1513) from the City Shop to the Douglas Road site to accommodate construction of a library. That well was installed and tested but never connected to the system. It has a capacity of 1,300 gpm.

In 2001, the Agreement between the City and the PUD was amended to increase the amount of water available to the City to 4.5 MGD and 4,033 af/yr.

In 2012, the City and the PUD reached an agreement to end water service. The City returned to their own well system as the primary source of water. The existing well at the City Shop, and the relocated well at Douglas Rd. were brought online and piped to the City's existing WTP where the water is treated for hardness and manganese.

In 2014 the City acquired the Central City water system, including their water right (GWC 7700), well and storage tank. New water mains were installed, replacing the Central City water mains, and the entire system was tied into the City distribution system. The Central City well is currently inactive, but is available to be connected into the City's system.

In 2014 the City filed an application to consolidate withdrawal locations of all of the City's sources for their four water rights and allow flexibility among three existing points of withdrawal and additional future points of withdrawal. The Department of Ecology approved the application in 2016 with the provision that withdrawal from all four water rights shall not exceed 2,140 acre feet per year.

Water rights held by the City are defined in Table 1-1.

Table 1-1, City of Ferndale, Existing Water Rights

Cert./Permit	Date	Location	Location	Quantity	Comments
G1-*03899C (GWC 3058)	2/28/55	City Shop	SW¼, SE¼, S19, T39N, R2E	870 gpm 440 af/yr	Serves as City's water source
G1-*02509C (GWC 1513)	5/9/52	Douglas Rd.	SE¼, NW¼, S30, T39N, R2E	1,000 gpm 1,615 af/yr	Serves as City's water source
G1-00720P	7/22/71	Douglas Rd.	SE¼, NW¼, S30, T39N, R2E	1,000 gpm 1,614 af/yr	Not Installed
G1-*10690C (GWC 7700)	3/10/70	Central City	Govt' Lot 1 S19, T39N, r2E	60 gpm 85 af/yr	Not Connected

Source: Washington State Department of Ecology, Water Resources, August, 2015.

A superseding permit from the Washington State Department of Ecology, dated June 8, 2004, limits the maximum instantaneous withdrawal rate from GWC 1513 and C1-00720P to 1,300 gpm. This permit also limits the total annual quantity from all three wells to 2,055 af/yr.

1.2.2 Geography

The geography of the Ferndale area ranges from flood plain lowlands in the eastern portion to plateaus that end abruptly in the cliffs at the edge of Puget Sound along the western edge. The area displays characteristics of glaciation and alluvial deposits adjacent to the Nooksack River. Ground elevations range from 15 to 360 feet.

1.2.3 Neighboring/Adjacent Purveyors

The City shares borders with the following water systems:

- Aldergrove Water Association
- Belfern West
- City of Bellingham
- Custer Water Association
- Double L Mobile Home Park
- Fairfield MHP
- Ferndale Mobile Village
- Grandview Center
- Malloy Rd. Mobile Home Park
- Mt. View Water Association
- Northwest Water Association
- Orchard Water Association
- River Road Water Association
- Thornton Water Association
- Zoller Water System
- Public Utility District No. 1 of Whatcom County

The City is its own purveyor.

1.2.4 Ordinances/Bylaws

The City's ordinances and bylaws are reference and discussed where appropriate throughout the water system plan. Copies of the ordinances and bylaws are included in Appendix B.

1.3 INVENTORY OF EXISTING FACILITIES

1.3.1 General Description and Major Components

Source

The City withdraws water from wells located at the City Shop and the Douglas Rd. Well Site and pumps the water in dedicated water mains to the City's WTP. Table 1-1 shows the City's water rights for the wells.

The wells may be rerouted to pump directly into the distribution system in case of emergency.

Table 1-2, City of Ferndale Water Supply (2015)

Source	Water Rights, Q_i (gpm)	Installed Capacity (gpm)	Installed Capacity (MGD)
Well at City Shop	870	870	1.25
Well at Douglas Rd.	1,000 300	1,300	1.87
Future Well at Douglas Rd.	700	0	0
Well at Central City	60	0	0
Total	2,930	2,170	3.12

Treatment

The City provides treatment for manganese and hardness at the WTP. Greensand filters are used to treat for manganese while reverse osmosis is used to treat for hardness and manganese. Raw water from the City's wells is split between the two treatment processes, treated, and then combined before entering the distribution system. An August 18, 2014 letter from the Washington State Department of Health (DOH) states that the City's total treatment plant capacity would be "greater than the water right limitation" of 2,870 gpm at that time. Current water rights are 2,930 gpm, therefore 2,870 gpm is a conservative assessment of the City's treatment capacity.

Therefore, the current capacity of the City's WTP is:

Treatment Capacity = 2,870 gpm = 4.13 MGD

Storage

The City's water system includes a 950,000 gallon concrete tank (Reservoir No. 1) near the intersection of Thornton Road and Vista Drive, a 1.7 MG steel tank (Reservoir No. 2) south of Thornton Road, and the finished water clear well at the City's water treatment plant with a capacity of 304,400 gallons. Current storage totals 2.95 MG. Reservoirs 1 and 2 were constructed in 1975 and 1980, respectively. The City's water treatment plant was constructed in 1975.

Distribution System

The transmission/distribution system including piping, pumps, and valves evolved as the City grew. Transmission and distribution mains range from 2 to 20 inches in diameter

The City currently operates approximately 73 miles of distribution system via six (6) pressure zones. The zones are maintained with tank levels, pumps, pressure reducing valves, and isolation valves. The pressure zones are visible on Exhibit 1 at the end of this chapter.

The City's present Washington Survey and Rating Bureau fire rating is Class 5 on a scale of 1 to 10 with 1 being the highest (best).

Pump Stations

The system has four (4) booster pump stations including the WTP. Historical data for the other pump stations in the system follows. Pump data is provided in Table 1-3, the locations of the pump stations are shown on the water system map.

- Pump Station No. 1 was constructed in 1975 adjacent to Reservoir No. 1, north of Thornton Road, east of Vista Drive.
- Church Road Pump Station was added as part of ULID No. 5 in 1980. It is located in the northwest quadrant of the Church Road/Mountain View Road intersection.
- The Bakerview Pump Station was constructed in 2008 adjacent to Reservoir No. 2. It serves the Bakerview Pressure Zone from Reservoir No. 2.
- The City's WTP directly serves the City's Main and Axton Pressure Zones, and indirectly serves the remaining pressure zones through the City's other pump stations and reservoirs.

Table 1-3, City of Ferndale Pumping Capacity

Location	Pump No.	Q (gpm)	TDH (ft)
Water Treatment Plant	1	1,600	250
	2	1,600	250
	3	3,250	250
PS # 1 (Thornton Rd.)	1	850	280
	2	850	280
Church Rd. PS	1	800	356
	2	800	356
Bakerview PS	1	1,373	50
	2	1,373	50
	3	1,373	50
	4	1,373	50

Current Operations

- The City's wells pump directly to the WTP where the water is treated via greensand filters and reverse osmosis. The treated water is stored in the clear well.
- When the level in Reservoir No. 1 drops to a set point (1.5 feet below full tank level), a signal is sent to the WTP to turn on the WTP pumps and fill the reservoir. The pumps will meet the system demand while filling the reservoir. The pumps will turn off once the tank is full.
- When the level in Reservoir No. 2 drops 1 foot below full tank level the Church Rd. Pump Station will begin to fill Reservoir No. 2, but only when the pumps at the WTP are also called to run. When the level in Reservoir No. 2 drops to a set point (1.3 feet below full tank level), a signal is sent to Pump Station No. 1 to turn on and fill the reservoir.
- The Bakerview Pump Station pumps from Reservoir No. 2 to maintain constant pressure in the Bakerview Pressure Zone.

1.3.2 Service Connections

Active service connections through October 2015 are shown in Table 1-4.

Table 1-4, Active Service Connections

Category	Number of Active Service Connections
Single Family Residences	4,286
Multi-Family Residences	93 (861 Units)
Commercial/Industrial	289
Irrigation	62
Total	4,730

Source: City of Ferndale, November 10, 2015.

1.3.3 Existing Interties

The City does not have interties with adjacent service areas to obtain water. However, it does have agreements with the Water Associations cited in Section 2.2.3. Copies of the agreements can be found in Appendix K.

Each agreement stipulates that the City will provide water to the Association(s) during emergency situations for a period of less than one calendar month. Allowances were made for the City to supply water on a permanent basis provided the Association(s) are subject to established City rules and regulations.

1.4 RELATED PLANS

The water system plan provided herein is based on the following planning documents:

- "2006 Water System Plan, City of Ferndale", Reichhardt & Ebe Engineering, Inc., 2006
- "Water Softening Project Report", Wilson Engineering, LLC, 2013
- "Urban Growth Area Review", City of Ferndale, 2015
- "Annexation Blueprint, Annexation Phasing Plan: 2014-2034", City of Ferndale, 2016
- "Ferndale Urban Growth Areas – Water Availability" Reichhardt & Ebe Engineering, 2016
- "Water Supply and Storage Analysis" Reichhardt & Ebe Engineering, 2016

1.4.1 Inconsistencies with Related Plans

This Water System Plan is consistent with the City of Ferndale's comprehensive planning efforts.

1.4.2 Applicable Agency Comments

Comments from agencies regarding the relationship of this Water Master Plan Update to other plans have been solicited and are appended.

1.4.3 Adjacent Purveyors

The Water Associations listed in Section 1.2.3 were sent the Draft Water System Plan Update. Pertinent issues have been incorporated.

1.5 SERVICE AREA INFORMATION AND MAPS

1.5.1 Service Area

The City's existing Service Area consists of all land within the City Limits, plus areas outside of the City Limits which, under previous policies, were allowed water extensions without being annexed. This service area has been re-defined as all areas within the Ferndale City Limits and Urban Growth Areas, plus existing customers in areas outside of the City Limits. Where overlaps occur with other water purveyors, the City will allow the other purveyors to serve their areas until annexation occurs and/or the City and the purveyor agree to allow the City to take over service.

1.5.2 Retail Service Area

The City's Retail Service Area consists of all area with within the City Limits, plus areas outside of the City Limits which, under previous policies, were allowed water extensions without being annexed, less an area north of the intersection of Kona Ct. and Malloy Ave. While this area is identified as within City Limits it is not included in the City's Retail Service Area as the City is unable to provide service in a timely and reasonable manner. Future water mains in this area are assumed to be constructed by the developers as development occurs. .

The City's Service Area and Retail Service Area can be seen on Exhibit 2 at the end of this Chapter.

1.5.3 Zoning and Land Use

Zoning and land use designations for existing conditions are show on the Official Zoning Map (see Exhibit 3). Land use falls into sixteen (16) categories ranging from "City Center" to "Floodway". Existing areas within each category in the year 2014 are presented in Table 1-5. Approximately 40% of the land within the current city limits is designated for residential purposes. The remainder is for commercial, industrial, and public/institutional uses except for land identified as floodway.

Table 1-5, Gross Area Calculations, Existing City Limits (2015)

Type	Acreage (ac)	% of Total
City Center	33.9	0.74
Gateway Development District	77.6	1.70
Highway Commercial	1.6	0.04
Mixed Use Commercial District	527.7	11.57
General Business	386.9	8.48
Regional Retail	209.4	4.59
Manufacturing	354.6	7.78
Light Industrial	159.0	3.49
RS 6-Single Family Dwelling	286.7	6.29
RS 8-Single Family Dwelling	1,084.1	23.77
RS 10-Single Family Dwelling	199.5	4.37
Urban Residential	82.0	1.80
RM 1.5-Multiple Dwelling	267.6	5.87
Residential Office	147.1	3.23
Public/Institutional	629.5	13.80
Floodway	113.1	2.48
Total	4,560.3	100.00

Source: City of Ferndale, September 2015

Discussion:

Interstate 5 divides the City in a north/south direction. In addition, the Nooksack River traverses in a northeast to southwest direction intersecting Interstate 5 between the Portal Way and Main St, interchanges. The following comments are made:

- The majority of development south of the river is primarily commercial and/or industrial. A pocket of residential development is situated east of the interstate, just north Smith Road. The area to the east of the city limits is unincorporated, mostly residential tracts. An area in the northeast quadrant of the intersection of I-5 and Slater Rd. is urban growth area and urban growth area reserve.
- The area north of the river, east of I-5 is largely commercial property along the highway bounded by high and low-density residential development. An adjacent area to the north is listed as urban growth area reserve.
- Development west of the river includes a band of industrial property adjacent to the interstate and primarily low-density residential property to the west. A pocket bounded by Hovander Road, Cherry Street, Washington Street and Hamlin Avenue comprises the core of the City's existing commercial district. The remaining area to the north and west is split between medium and high residential development and single-family residences.
- A comparison of land use within the City proper and what is proposed through UGA, indicates that growth to the west will be low-density residential. In contrast the area further north along Interstate 5 will likely be commercial and industrial development.

1.6 SERVICE AREA POLICIES

1.6.1 Future Service Area

Future service areas are identified and discussed in the City's Report titled *Ferndale Urban Growth Areas – Water Availability*. A copy of this report can be found in Appendix L.

1.6.2 Service Area Agreements

Copies of existing agreements with Water Associations and the City are included in Appendix K. See Section 2.3.2 for additional information.

1.6.3 Wholesaling Water

The City of Ferndale does not wholesale water to other utilities.

1.6.4 Wheeling Water

The City of Ferndale does not wheel water.

1.6.5 Annexation

The City has created an annexation blueprint in order to manage anticipated growth and related capital facilities. The annexation schedule is based on the capital facilities elements of the City's comprehensive plan, and the capital projects needed to meet the objectives of each of those elements. The annexation blueprint in attached in Appendix M.

The City has identified sixteen (16) potential annexation areas. The City has also identified the timing that the annexation of these areas may occur, and therefore when additional capital projects may be required. The City has developed a report entitled *Ferndale Urban Growth Areas – Water Availability* that analyzes each of the potential annexation areas and provides water demands, fire flow requirements, and the water infrastructure required to serve them. A copy of this report can be found in Appendix L.

1.6.6 Direct Connection and Satellite/Remote Systems

The City requires Developers to connect to sewers as a prerequisite to water service, and also requires developers to connect to water service prior to receiving sewer service. Developments in areas currently with water but not sewer service are exempt from the sewer service connection requirement.

1.6.7 Design and Performance Standards

New developments or subdivisions within the Ferndale service area are required to be served by the City system. Minimum standards for all water related construction within the existing City limits and outside the City limits but within the UGA must be in accordance with the current Development Standards and the Water System Plan.

1.6.8 Surcharge for Outside Customers

Customers outside of City Limits, including water associations served on an emergency basis are assessed a 50% surcharge above City customer rates.

1.6.9 Formation of Local Improvements Districts

The City will cooperate with any group wishing to form a LID or a ULID to improve water service facilities within City limits. The City will review the formation of either type of improvement district.

1.6.10 UGA

Areas outside the current retail service area that do not have an adequate water supply will be served via extensions of the City's system as the expansion occurs. Areas currently served by independent water purveyors will remain as is until the City agrees to assimilate them.

1.6.11 Late-Comer Agreements

Late-comer agreements may be allowed by the City Council, which performs the following functions:

- Review estimated construction costs provided by the Developer before construction begins and estimate probable percent payback;
- Examine actual costs provided by the Developer and the Developer's proposed payback analysis; and,
- Once construction is completed, bring costs forward and finalize the payback.

1.6.12 Oversizing

The City will design and install or require developer installation of water mains sized to accommodate future development.

1.6.13 Cross-Connection Control Program

The City adopted Cross Connection Control Ordinance 1416 in 2006. See Appendix B.

1.6.14 Extension

Policy and Development Standards for the City provide that new water service be limited to the existing city limits. Areas in the UGA must annex before obtaining City services. Ordinance 1344, Section 13.38.070 (included in Appendix B) provides that: *"The City will only extend such services to areas outside of the established UGA when supported by the County-Wide Planning Policies".* The City does not have satellite agreements with surrounding water associations and doesn't intend to become a Satellite Manage Agency.

1.7 CONDITIONS OF SERVICE

1.7.1 Connection Fee Schedule

The connection fee for water service is $5,553 per ERU plus the cost of the meter, established by Ordinance 1764 passed on February 4, 2013. This ordinance is included is Appendix B.

Water rates and fees for the City of Ferndale are presented in the tables below.

Table 1-6, City of Ferndale Bi-Monthly Rates, Single Family/Duplexes

Ordinance	Date Passed	Base Fee	Meter Rate			
			1-25 ccf	26-50 ccf	51-150 ccf	151+ ccf
1599	August 2, 2010	$12.78	$2.98	$3.30	$3.91	$3.30
1801	October, 7, 2013	$13.44	$3.14	$3.47	$4.11	$3.47
1921	November 2, 2015	$14.81	$3.47	$3.84	$4.53	$3.84

Source: City of Ferndale Municipal Code

Table 1-7, City of Ferndale Bi-Monthly Rates, Multi-Family, Commercial/Non-Residential, and Industrial

Ordinance	Date Passed	Base Fee	Meter Rate			
			1-25 ccf	26-50 ccf	51-150 ccf	151+ ccf
1599	August 2, 2010	$12.78 (≤1 inch) $40.00 (>1 inch)	$2.98	$3.30	$3.91	$3.30
1801	October, 7, 2013	$13.44 (≤1 inch) $42.06 (>1 inch)	$3.14	$3.47	$4.11	$3.47
1921	November 2, 2015	$14.81 (≤1 inch) $46.44 (>1 inch)	$3.47	$3.84	$4.53	$3.84

Source: City of Ferndale Municipal Code

The out of City surcharge on rate and fees is 50 percent

1.8 COMPLAINTS

1.8.1 Policy and Process to Deal with Complaints

The City responds to customer complaints using the A*WWA Water Quality Complaint Investigator's Field Guide*. In addition, the City offers the customer a site visit where the City' will examine and analyze the water. Two staff members conduct the site visits for quality control and safety. If necessary, once the site visit is complete and lab tests and observations are finished, the Chief Operator will follow up with a customer consultation.

1.8.2 Record Keeping

All complaints are recorded by the Public Works Department, complete with notes of actions taken.

1.9 DUTY TO SERVE

1.9.1 Conditions of Service

Water service is normally provided only to properties within the Corporate Limits. Properties outside the Corporate Limits, but within the Urban Growth Areas (UGA) must first be annexed. Ordinance 1344 dealing with annexation is included in Appendix B. Properties outside of the UGA which are adjacent to existing City water mains may be given service for health concerns (i.e. failing private well). The City, in

accordance with WAC 246-290-106 Duty to Provide Service, will provide water to any new industrial, commercial, or residential use provided that:

- The property is within the Retail Service Area
- The City has adequate water rights, source capacity, storage, and distribution system capacity to serve the specific development or use
- The property owner, applicant or developer will construct or finance specific improvements required for adequate service for their project
- The improvements for the project will be constructed in accordance with all local plans, standards and regulations of the City, including the Water System Plan
- The water will be used for legal purposes, and not in violation of federal, state or local laws
- Water for irrigation purposes will be on an interruptible basis

1.9.2 Service Requests

Individual service requests for water are part of the building permit process, or the subdivision platting process. Prior to recording a new subdivision, the applicants must install all utilities at their cost. Water utilities normally include the water mains, service lines to the property line, fire hydrants, air vac valves and meters. When specific users apply for building permits, water service is included as part of the application. When water mains must be extended to serve the properties, the developer must go through the developer extension process, which includes design and construction of the facilities, generally at his or her expense. Payback agreements are available. The City reviews developer plans to ensure that City Standards are met and that the facilities conform to Comprehensive Plans. The water facilities are constructed, inspected, and tested in accordance with the City's Standards and WAC 264-290. Design and Construction Standards are included in Chapter 7.

1.9.3 System Capacity for New Service

Water Rights and Water Treatment Capabilities are considered to be adequate for the projected 20 year planning period. Water storage facilities are considered adequate for the 6 year planning period and slightly deficient for the 20 year planning period, in accordance with DOH recommendations, as seen in Table 3 of the *Water Supply and Storage Analysis in Appendix N*. The City has expressed a goal of supplying two days of standby storage in the future at which point additional storage will be required within the 6 year planning period.

The water distribution system is in need of upgrading in several areas due to aging and undersized piping. These are listed in the Recommended Improvement table on the Water System Map. Water mains must be extended into the UGA before service can be provided. Generally these will be developer funded as the City annexes the UGAs. The Water System Plan Map shows the general location and size of the facilities required to serve the new areas. ULIDs may be utilized under certain conditions to provide extensions of service.

1.9.4 Time Extensions and Disputes

Extension of facilities for water service are normally the responsibility of the private developers who finance them. The City does not generally impose time restrictions on such private work, and therefore does not need to grant time extensions. On City financed and constructed Capital Improvements, the Contract Documents for such work provide mechanisms for extension of time. Time extensions due to weather, change in scope or other such items are normally granted.

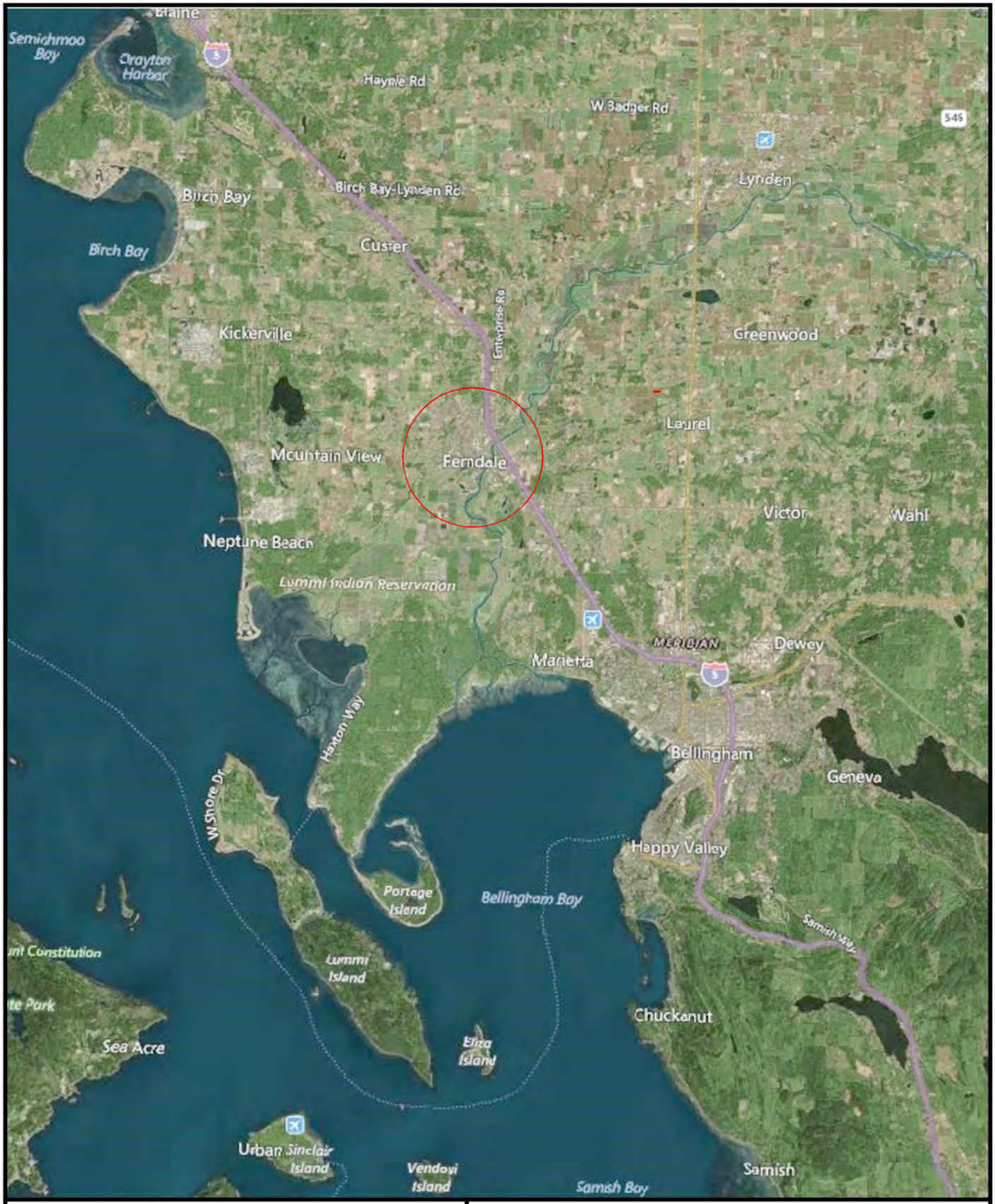
In cases where development of areas in the UGA are dependent upon the City to construct facilities such as water storage tanks, booster pumps or transmission mains, the City will budget and schedule the improvements. Development dependent upon such improvements must be coordinated with City schedules.

Water service to certain areas can be denied because of such factors as lack of capacity for fire flows in undersized mains, the area requesting service is outside of the City UGA or is in a remote location where service has not yet been extended. In these cases where service is denied by staff, the applicant can appeal to the City Council.

1.10 CONSISTENCY

1.10.1 Local Agencies

This Water System Plan and Local Government Consistency Determination forms have been submitted to the City of Ferndale, Whatcom County Planning Department and WRIA 1 for review and approval. Copies of the submitted forms are in Appendix D. Comments, if any, can be found in Appendix A.



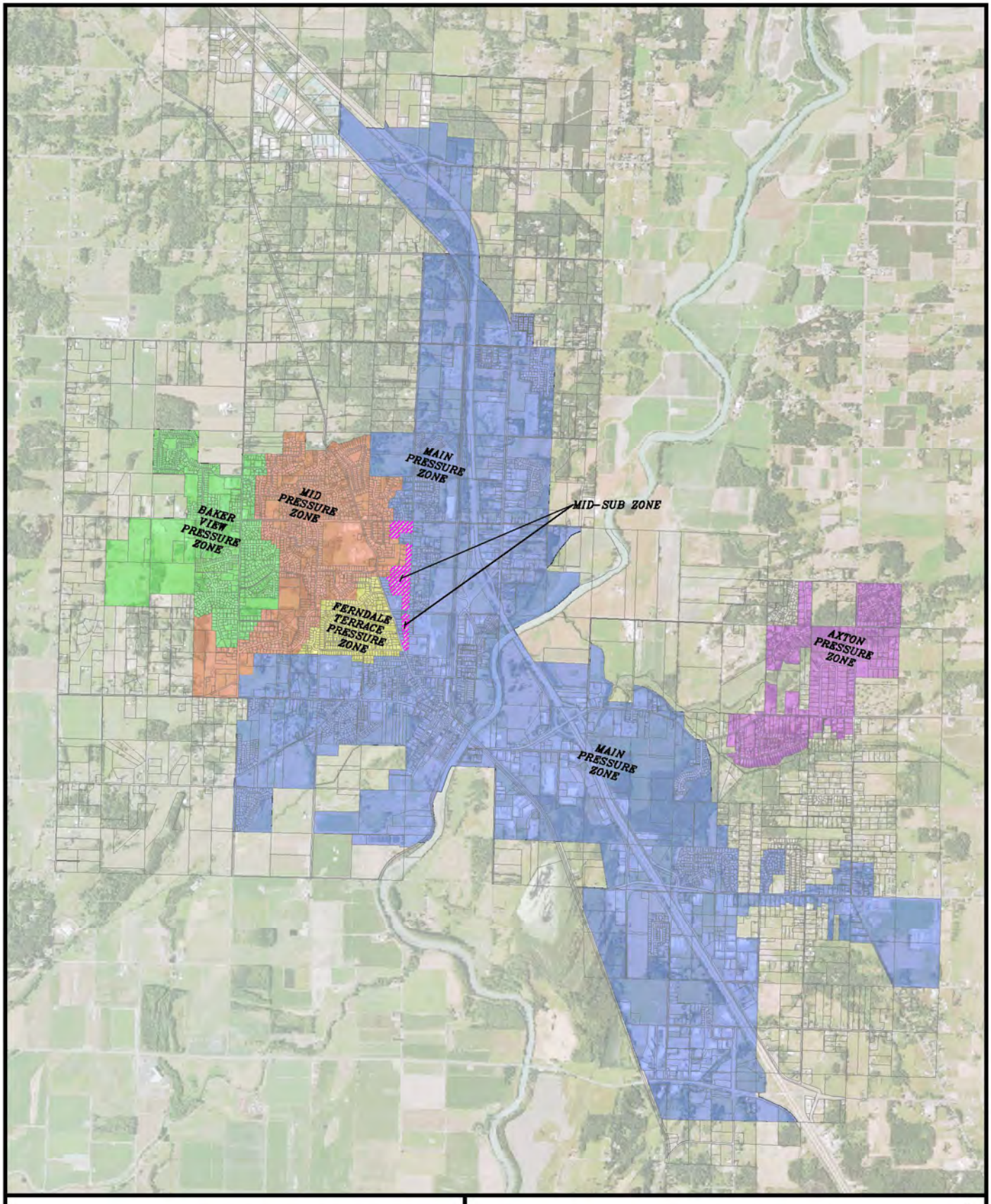
Reichhardt & Ebe
ENGINEERING INC

423 Front St, Lynden, WA 98264 (360) 354-3687
813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713

CITY OF FERNDALE
VICINITY MAP

DATE: 12/30/16

NTS



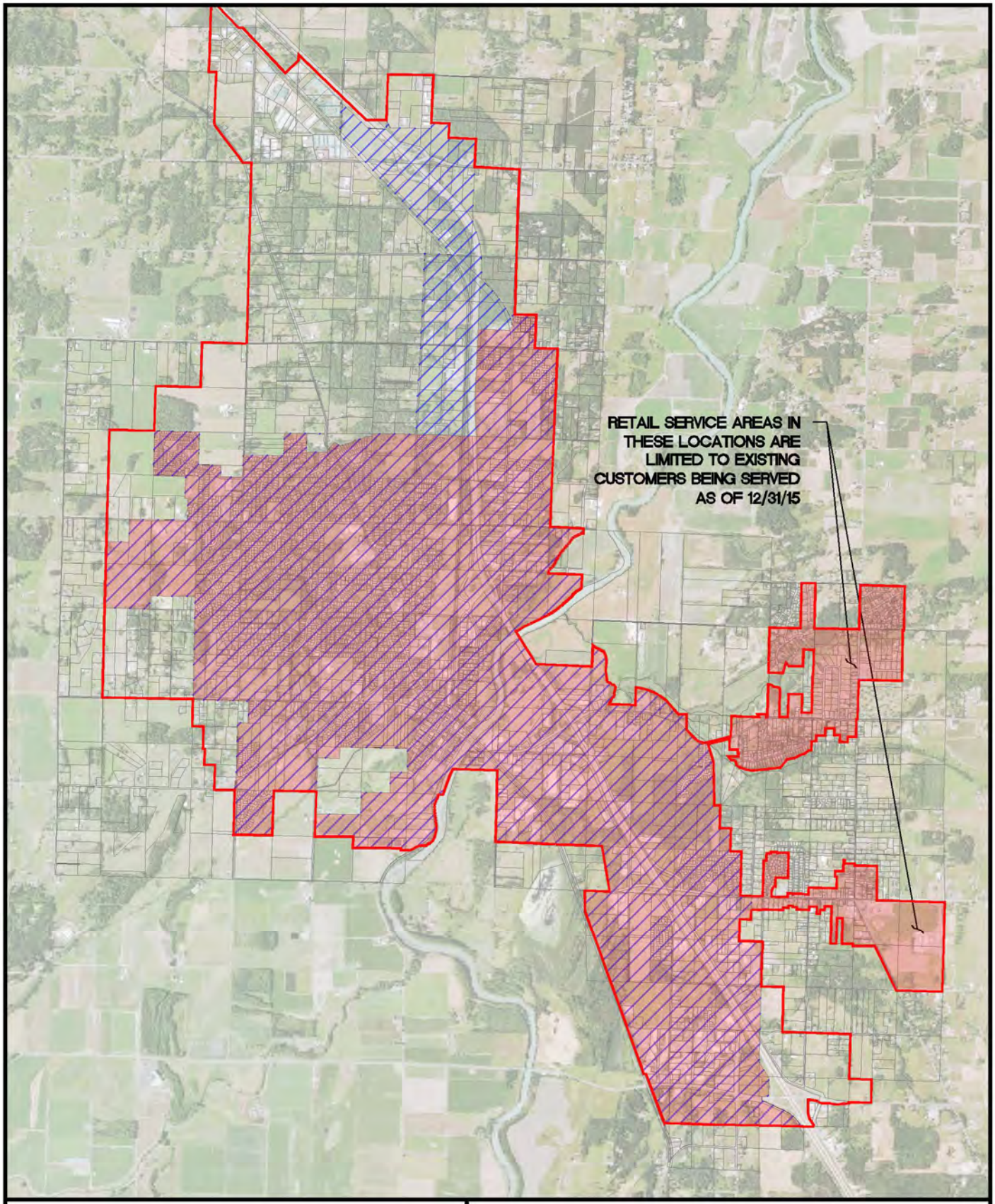
R&E Reichhardt & Ebe ENGINEERING INC

423 Front St, Lynden, WA 98264 (360) 354-3687
813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713

EXHIBIT 1
PRESSURE ZONES

LEGEND
——— = CITY LIMITS
——— = PRESSURE ZONE

DATE: 05/13/16 SCALE: 1"=4000'



R&E Reichhardt & Ebe ENGINEERING INC

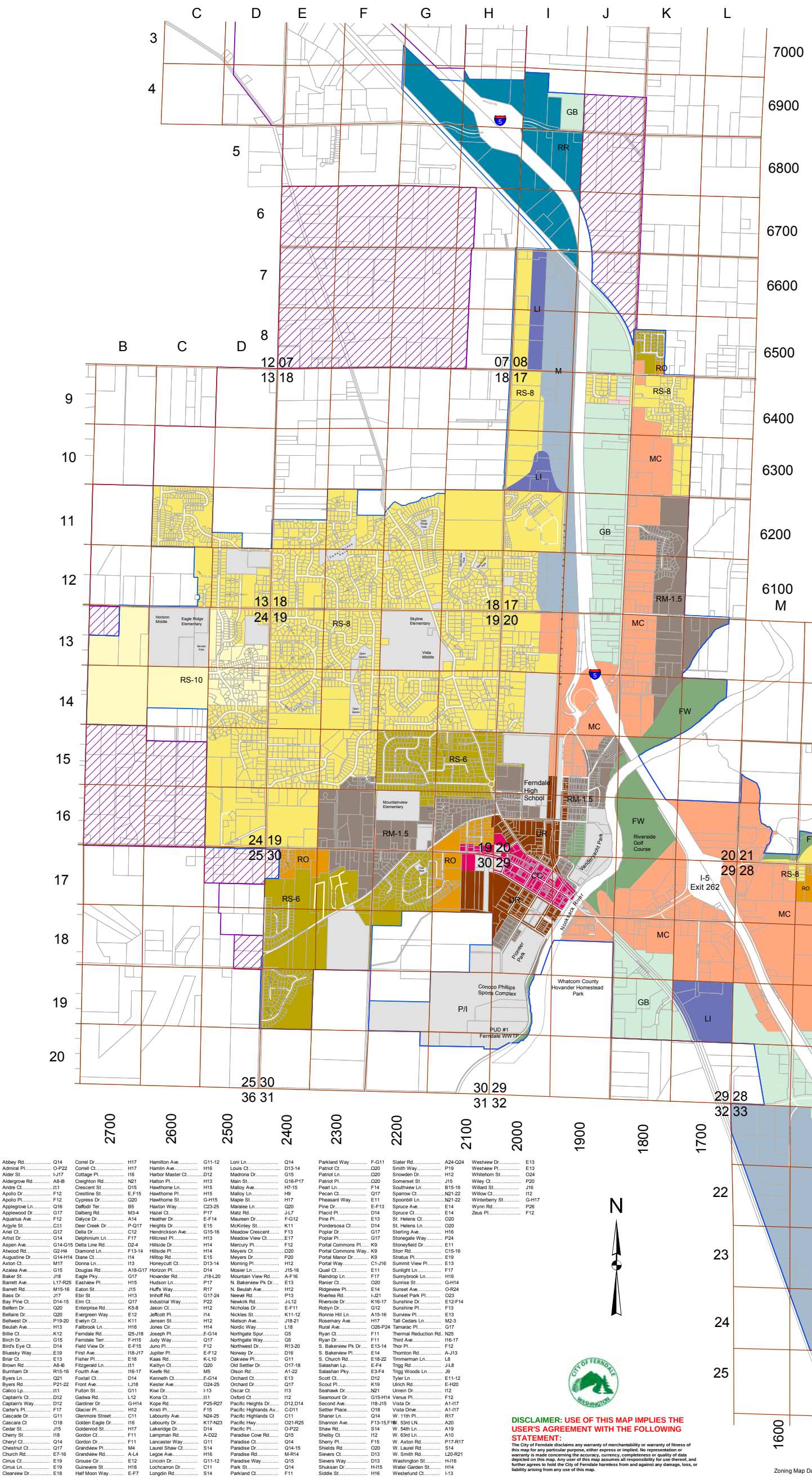
423 Front St, Lynden, WA 98264 (360) 354-3687
813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713

EXHIBIT 2
SERVICE AREAS

LEGEND
- = RETAIL SERVICE AREA
- = FERNDALE CITY LIMITS
- = SERVICE AREA (UGA AND UGA RESERVE BOUNDARIES)

DATE: 12/1/16 SCALE: 1"=4000'

Official Zoning
City of Ferndale, WA



Legend

- City Limits
- Urban Growth Area
- Urban Reserve
- Current Land Parcels

Official Zoning (December 2015)

- City Center
- RS 6-Single Family Dwelling
- RS 8-Single Family Dwelling
- RS 10-Single Family Dwelling
- Public/Institutional
- Regional Retail
- General Business
- Highway Commercial
- Gateway Development District
- Mixed Use Commercial District
- Light Industrial
- Manufacturing
- Urban Residential
- RM 1.5-Multiple Dwelling
- Residential Office
- Floodway

Abbey Rd..... Q14
Admiral Pl..... O-P22
Alder St..... I-J17
Aldergrove Rd..... A8-I8
Andre Ct..... I11
Apollo Dr..... F12
Apollo Pl..... F12
Applegrove Ln..... Q16
Applewood Dr..... G17
Aquarius Ave..... F12
Argyle St..... C11
Ariel Ct..... G17
Artist Dr..... G14
Aspen Ave..... G14-G15
Atwood Rd..... G2-H4
Augustine Dr..... G14-H14
Axton Ct..... M17
Azalea Ave..... G15
Baker St..... J18
Barrett Ave..... L17-R25
Barrett Rd..... M15-16
Bass Dr..... J17
Bay Pine Ct..... D14-15
Belfern Dr..... Q20
Bellaire Dr..... Q20
Bellwest Dr..... P19-20
Beulah Ave..... H13
Billie Ct..... K12
Birch Dr..... G15
Bird's Eye Ct..... D14
Bluesky Way..... E19
Briar Ct..... E13
Brown Rd..... A6-I6
Burnham Dr..... R15-16
Byers Ln..... Q21
Byers Rd..... P21-22
Calico Lp..... I11
Captain's Ct..... D12
Captain's Way..... D12
Carter's Pl..... F17
Cascade Dr..... G11
Cascara Ct..... O18
Cedar St..... I15
Cherry St..... I18
Cheryl Ct..... Q14
Chestnut Ct..... Q17
Church Rd..... E7-16
Cirrus Ct..... E19
Cirrus Ln..... E19
Clearview Dr..... E18
Correl Dr..... H17
Correll Ct..... H17
Cottage Pl..... I16
Creighton Rd..... N21
Crescent St..... D15
Crestline St..... E,F15
Cypress Dr..... Q20
Daffodil Ter..... B5
Dalberg Rd..... M3-4
Dalyce Dr..... A14
Deer Creek Dr..... P-Q17
Della Dr..... C12
Delphinium Ln..... F17
Delta Line Rd..... D2-4
Diamond Ln..... F13-14
Diane Ct..... I14
Donna Ln..... I13
Douglas Rd..... A18-G17
Eagle Pky..... G17
Eastview Pl..... H15
Eaton St..... J15
Ebir St..... H13
Elm Ct..... Q17
Enterprise Rd..... K5-8
Evergreen Way..... E12
Evelyn Ct..... K11
Fallbrook Ln..... H16
Ferndale Rd..... I25-J18
Ferndale Terr..... F-H15
Field View Dr..... E-F15
First Ave..... I18-J17
Fisher Pl..... E18
Fitzgerald Ln..... J11
Fourth Ave..... I16-17
Foxtail Ct..... D14
Front Ave..... I,J18
Fulton St..... G11
Gadwa Rd..... L12
Gardiner Dr..... G-H14
Glacier Pl..... H12
Glenmore Street..... C11
Golden Eagle Dr..... I16
Goldenrod St..... H17
Gordon Ct..... H11
Gordon Dr..... F11
Grandview Pl..... M4
Grandview Rd..... A-L4
Grouse Cir..... E12
Guinevere St..... H16
Half Moon Way..... E-F7
Hamilton Ave..... G11-12
Hamlin Ave..... H16
Harbor Master Ct..... D12
Hatton Pl..... H13
Hawthorne Ln..... H15
Hawthorne Pl..... H15
Hawthorne St..... G-H15
Haxton Way..... C23-25
Hazel Ct..... P17
Heather Dr..... E-F14
Heights Dr..... E15
Hendrickson Ave..... G15-16
Hillcrest Pl..... H13
Hillside Dr..... H14
Hillside Pl..... H14
Hilltop Rd..... E15
Honeycutt Ct..... D13-14
Horizon Pl..... D14
Hovander Rd..... J18-L20
Hudson Ln..... P17
Huffs Way..... R17
Imhoff Rd..... G17-24
Industrial Way..... P22
Jason Ct..... H12
Jeffcott Pl..... I14
Jensen St..... H12
Jones Cir..... H14
Joseph Pl..... F-G14
Judy Way..... Q17
Juno Pl..... F12
Jupiter Pl..... E-F12
Kaas Rd..... K-L10
Kaitlyn Ct..... Q20
Keefe Rd..... M5
Kenneth Ct..... F-G14
Kester Ave..... O24-25
Kiwi Dr..... I-13
Kona Ct..... I11
Kope Rd..... P25-R27
Kristi Pl..... F15
Labounty Ave..... N24-25
Labounty Dr..... K17-N23
Lakeridge Dr..... D14
Lampman Rd..... A-D22
Lancaster Way..... G11
Laurel Shaw Ct..... S14
Legoe Ave..... H16
Lincoln Dr..... G11-12
Lochcarron Dr..... C11
Longdin Rd..... S14
Loni Ln..... Q14
Louis Ct..... D13-14
Madrona Dr..... G15
Main St..... G16-P17
Malloy Ave..... H7-15
Malloy Ln..... H9
Maple St..... H17
Maralee Ln..... Q20
Matz Rd..... J-L7
Maureen Dr..... F-G12
McKinley St..... K11
Meadow Crescent..... F13
Meadow View Ct..... E17
Mercury Pl..... F12
Meyers Ct..... O20
Meyers Dr..... P20
Morning Pl..... H12
Mosier Ln..... J15-16
Mountain View Rd..... A-F16
N. Bakerview Pk Dr..... E13
N. Beulah Ave..... H12
Neevel Rd..... P13
Newkirk Rd..... J-L12
Nicholas Dr..... E-F11
Nickles St..... K11-12
Nielson Ave..... J18-21
Nordic Way..... L18
Northgate Spur..... G5
Northgate Way..... G5
Northwest Dr..... R13-20
Norway Dr..... D16
Oakview Pl..... G11
Old Settler Dr..... O17-18
Olson Rd..... A1-22
Orchard Ct..... E13
Orchard Dr..... Q17
Oscar Ct..... I13
Oxford Ct..... I12
Pacific Heights Dr..... D12,D14
Pacific Highlands Av.. C-D11
Pacific Highlands Ct C11
Pacific Hwy..... O21-R25
Pacific Pl..... O-P22
Paradise Cove Rd..... Q15
Paradise Ct..... Q14
Paradise Dr..... Q14-15
Paradise Rd..... M-R14
Paradise Way..... Q15
Park St..... Q14
Parkland Ct..... F11
Parkland Way..... F-G11
Patriot Ct..... Q20
Patriot Ln..... Q20
Patriot Pl..... Q20
Pearl Ln..... F14
Pecan Ct..... Q17
Pheasant Way..... E11
Pine Dr..... E-F13
Placid Pl..... D14
Pine Pl..... E13
Pondersosa Ct..... D14
Poplar Dr..... G17
Poplar Pl..... G17
Portal Commons Pl..... K9
Portal Commons Way.. K9
Portal Manor Dr..... K9
Portal Way..... C1-J16
Quail Ct..... E11
Raindrop Ln..... F17
Ranier Ct..... O20
Ridgeview Pl..... E14
Riverlea Rd..... I-J21
Riverside Dr..... K16-17
Robyn Dr..... G12
Ronnie Hill Ln..... A15-16
Rosemary Ave..... H17
Rural Ave..... O26-P24
Ryan Ct..... F11
Ryan Dr..... F11
S. Bakerview Pk Dr.... E13-14
S. Bakerview Pl..... E14
S. Church Rd..... E18-22
Salashan Lp..... E-F4
Salashan Pky..... E3-F4
Scott Ct..... D12
Scout Pl..... K19
Seahawk Dr..... N21
Seamount Dr..... G15-H14
Second Ave..... I18-J15
Settler Place..... O18
Shaner Ln..... Q14
Shannon Ave..... F13-15,F19
Shaw Rd..... S14
Shelby Ct..... I12
Sherry Pl..... F15
Shields Rd..... O20
Sievers Ct..... D13
Sievers Way..... D13
Shuksan Dr..... H-I15
Siddle St..... H16
Slater Rd..... A24-Q24
Smith Way..... P19
Snowden Dr..... H12
Somerset St..... J15
Southview Ln..... B15-16
Sparrow Ct..... N21-22
Spoonbill Ln..... N21-22
Spruce Ave..... E14
Spruce Ct..... E14
St. Helens Ct..... O20
St. Helens Ln..... O20
Sterling Ave..... H16
Stonegate Way..... P24
Stoneyfield Dr..... E11
Storr Rd..... C15-16
Stratus Pl..... E19
Summit View Pl..... E13
Sunlight Ln..... F17
Sunnybrook Ln..... H16
Sunrise St..... G-H14
Sunset Ave..... O-R24
Sunset Park Pl..... O23
Sunshine Dr..... E12-F14
Sunshine Pl..... F13
Sunview Pl..... E13
Tall Cedars Ln..... M2-3
Tamarac Pl..... G17
Thermal Reduction Rd.. N25
Third Ave..... I16-17
Thor Pl..... F12
Thornton Rd..... A-J13
Timmerman Ln..... L8
Trigg Rd..... J-L8
Trigg Woods Ln..... J9
Tyler Ln..... E11-12
Ulrich Rd..... E-H20
Unrein Dr..... I12
Venus Pl..... F12
Vista Dr..... A1-I17
Vista Drive..... A1-I17
W. 11th Pl..... R17
W. 53rd Ln..... A20
W. 54th Ln..... A19
W. 63rd Ln..... A10
W. Axton Rd..... P17-R17
W. Laurel Rd..... S14
W. Smith Rd..... L20-R21
Washington St..... H-I16
Water Garden St..... H14
Westerlund Ct..... I-13
Westview Dr..... E13
Westview Pl..... E13
Whitehorn St..... O24
Wiley Ct..... P20
Willard St..... J16
Willow Ct..... I12
Winterberry St..... G-H17
Wynn Rd..... P26
Zeus Pl..... F12

N

DISCLAIMER: USE OF THIS MAP IMPLIES THE USER'S AGREEMENT WITH THE FOLLOWING STATEMENT:

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Zoning Map Date: December 2015

1,800 900 0 1,800 Feet

EXHIBIT 3
CITY ZONING MAP

CHAPTER 2
BASIC PLANNING DATA AND WATER DEMAND FORECASTING

2.0 OBJECTIVE

The objective of this chapter is to define basic planning data, future land use and future water demands, so that purveyors can adequately plan to accommodate their water needs. Statutory authority is included in RCW 90.03.290, RCW 90.54.020, RCW 70.116, Chapter 246-293 WAC and WAC 246-290-100.

2.1 CURRENT POPULATION, SERVICE CONNECTIONS, WATER USE, AND EQUIVALENT RESIDENTIAL UNITS

2.1.1 Current Population

Population data for Ferndale from 1980 to 2015 is provided in Table 2-1. Currently the City averages 2.6 to 2.7 people per household for both single-family and multi-family residences.

Table 2-1, Population (1980-2015)

Year	Population
1980	3,855
1990	5,398
2000	8,758
2010	11,415
2013	11,831
2014	12,710
2015	12,920

Source: Washington State Office of Financial Management
City of Ferndale, May 2016

2.1.2 Total Service Connections

The table below provides a breakdown of the different customer classes served by the City. The City does not supply water for agricultural use.

Table 2-2, Total Service Connections

Customer Class	2012	2013	2014	2015[1]
Single-Family Residential	3,986	4,134	4,236	4,331
Multi-Family Residential	85	93	94	94
Commercial/Industrial	296	299	312	313
Irrigation	62	63	71	73
Total	4,429	4,589	4,713	4,811

Source: City of Ferndale, November, 2015
[1]2015 Data is through October 2015
Connections for Multi-Family reflects the physical number of connections. Table 2-16 reflects the number of Multi-Family units.

2.1.3 Water Use Data Collection

Records regarding well production, water entering the water treatment plant, filter backwash, reverse osmosis reject, and water leaving the water treatment plant are collected electronically and can be retrieved for various periods of time. Service meter data is collected bi-monthly for each of the customer classes

Metered and/or calculated water use from March of 2012 through December of 2015 are presented in the following tables.

Table 2-3, Annual Well Water Production, MG

	2012[1]	2013	2014	2015
Shop Well	169.99	200.77	158.03	90.49
Douglas Well	147.38	190.10	252.00	346.01
Total (MG)	317.37	390.87	410.03	436.50
Monthly (MGD)				
Average	1.04	1.07	1.12	1.20
Peak	1.40	1.61	1.52	1.73

[1]Records begin in March 2012 for individual well production
Source: City of Ferndale, February 2016

Table 2-4, Annual Finished Water Production, MG

	2012[1]	2013	2014	2015
Water Produced (MG)	383.68	390.87	410.03	436.50
Less Filter Backwash	14.07	10.45	10.07	4.94
Less RO Reject	n/a	n/a	5.82	27.04
Finished Water (MG)	369.61	380.42	394.14	404.52
Monthly (MGD)				
Average	1.01	1.04	1.08	1.11
Peak	1.37	1.58	1.48	1.62

[1]Indicates production for all of 2012 (well startup was December 2011, individual well production records began in March 2012)

Table 2-5, Metered Use by Customer Class, MG

Customer Class	2012	2013	2014	2015[1]
Single-Family Residential	202.54	205.56	211.99	232.25
Multi-Family Residential	41.96	37.02	37.14	36.67
Commercial/Industrial	51.49	59.07	68.30	59.94
Irrigation	12.05	12.01	14.18	30.90
Total	308.04	313.66	331.61	359.76

[1]Records for November/December 2015 are estimated from previous years
Source: City of Ferndale, November 2015

Unmetered Water

Unmetered water is the finished water (or water delivered to the distribution system) less the water sold. Unmetered water includes unaccounted for water which is discussed later. In the table below, the water produced for 2012 includes water produced before the wells were brought into production.

Table 2-6, Unmetered Water, MG

	2012[1]	2013	2014	2015
Finished Water	369.61	380.42	394.14	404.51
Water Sold	308.04	313.66	331.61	359.76
Unmetered Water	61.57	66.76	62.53	44.75

[1]Indicates production for all of 2012 (well startup was December 2011, individual well production records began in March 2012)

Unaccounted for Water

Unaccounted for water is the finished water (or water delivered to the distribution system) less the water sold and less the water that can be accounted for. Accounted for water is estimated for operations including filling the City's street sweeper and vactor truck, use at the City's sewage lagoon, filling and flushing for newly constructed water mains, system flushing, fire department use, and any known or reported water main breaks. Approximately 80% to 85% of the unmetered water can be accounted for, meaning that roughly 15% to 20% of the unmetered water is unaccounted for.

For the system as a whole, the unmetered, accounted for water makes up approximately 10% to 15% of the finished water, while the unmetered, unaccounted for water makes up approximately 4% to 5% of the finished water. For the equivalent residential unit calculations in Tables 2.7 through 2.13, 15% and 5% will be added to average day demands to account for unmetered accounted for and unmetered unaccounted for water respectively.

2.1.4 Equivalent Residential Units (ERUs)

An ERU is defined as the amount of water consumed by a typical full-time single family residence. It is a unit of measure used to equate non-residential or multi-family residential water usage to a specific number of single family residences. An ERU is system specific. The City's bi-monthly meter readings can be used to quantify an ERU.

At the time of this report, bi-monthly meter readings did not exist for the November/December 2015 billing period. Therefore, the average water use for November/December was estimated by using the average use for the same time period from the last three years.

Single-Family Residences

The City's bi-monthly meter readings were analyzed to determine the number of active connections. The active connections were adjusted to compensate for home sales, vacancies, etc. The adjusted active connections are labeled "equivalent active connections" and are used to calculate the ADD for single-family residential in the table below. The number of "equivalent active connections" is not the same as the total number of connections.

Table 2-7, Single-Family Residential Water Use

	2012	2013	2014	2015
Water Used (gal)	202,544,188	205,556,384	211,993,672	232,251,133
Active Conn.	3,944	4,071	4,169	4,286
Equivalent Active Conn.	3,838	3,949	4,058	4,173
GPD/Conn.	144.58	142.61	143.13	152.48
Accounted For	15%	15%	15%	15%
Unaccounted For	5%	5%	5%	5%
GPD/Conn.	173.50	171.13	171.76	182.98

In the years 2012 through 2014, average use was fairly consistent averaging 172.13 gpd/connection. 2015 was an unusually hot and dry year. As a result, the average demand is markedly higher at 182.98 gpd/connection. The four year average is 174.84 gpd/connection. Therefore, 175 gpd/connection will be considered the average day demand for one ERU.

1 SF Connection = 1 ERU = 175 gpd

The City has met the water use efficiency goal of 5% for 2012 through 2014 and is anticipated to meet the goal for 2015. Therefore the current water use is considered to include conservation

Multi-Family Residences

Table 2-8, Multi-Family Residential Water Use

	2012[1]	2013	2014	2015
Water Used (gal)	36,136,628	37,019,268	37,141,940	36,666,212
Active Conn.	85	91	93	93
Active Units	833	853	861	861
GPD/Unit	118.85	118.90	118.19	116.67
Accounted For	15%	15%	15%	15%
Unaccounted For	5%	5%	5%	5%
GPD/Unit	142.62	142.68	141.83	140.00

[1]March/April bi-monthly value adjusted to value of remaining years

The four year average for multi-family units is 141.78 gpd/unit. Similar to the singly-family connections, a higher value will be used to account for unseasonable hot and dry years. A multi-family unit is considered to use 145 gpd/unit.

The conversion to ERUs is:

$$\frac{\text{MF Use}}{\text{SF Use}} = \frac{145\,\frac{\text{gpd}}{\text{conn}}}{175\,\frac{\text{gpd}}{\text{unit}}} = 0.8$$

1 MF Connection = 0.8 ERU/UNIT

Commercial/Industrial Connections

Typical commercial and industrial use varies greatly throughout the City. The table below demonstrates the variation in use for the commercial and industrial connections.

Table 2-9, Commercial/Industrial Connection Characteristics

	2012	2013	2014	2015
Total Conn.	296	299	312	313
Active Conn.	277	282	283	289
Minimum GPD/Conn.	2.05	2.05	4.10	2.05
Maximum GPD/Conn.	31,905.79	50,771.78	67,428.61	27,205.34
Average GPD/Conn.	476.62	541.26	599.78	524.64
Median GPD/Conn.	135.25	133.21	132.18	139.35

As seen in the table above, a large gap exists between the minimum and maximum use with half of all connections below the median of approximately 135 gpd. Based on this information, the high use commercial and industrial connections were considered separate from the low use commercial and industrial connections. To be considered a high use commercial and industrial connection, the use must be larger than 1,000 gpd.

Table 2-10, Commercial/Industrial Connection Breakdown

	2012	2013	2014	2015
Total Active Conn.	277	282	283	289
Low Use Conn.	251	255	252	257
Low Use (%)	90.6%	90.4%	89.0%	88.9%
High Use Conn.	26	27	31	32
High Use (%)	9.4%	9.6%	11.0%	11.1%

Low Use Commercial/Industrial Connections

Table 2-11, Low Use Commercial/Industrial Water Use

	2012	2013	2014	2015
Water Used (gal)	18,558,628	19,169,744	18,960,304	20,871,195
Active Conn.	251	255	252	257
Equivalent Active Conn.	236	237	238	242
GPD/Conn.	215.45	221.60	218.26	236.29
Accounted For	15%	15%	15%	15%
Unaccounted For	5%	5%	5%	5%
GPD/Conn.	258.54	265.92	261.91	283.55

The four year average for low use commercial and industrial connections is 267.48 gpd/connection. Similar to the singly-family connections, a higher value will be used to account for unseasonable hot and dry years. A low use commercial and industrial connection is considered to use 270 gpd/connection.

The conversion to ERUs is:

$$\frac{\text{Low C/I Use}}{\text{SF Use}} = \frac{270\,\frac{\text{gpd}}{\text{conn}}}{175\,\frac{\text{gpd}}{\text{conn}}} \approx 1.5$$

1 Low Use C/I Connection = 1.5 ERUs

High Use Commercial/Industrial Connections

Table 2-12, High Use Commercial/Industrial Water Use

	2012	2013	2014	2015
Water Used (gal)	32,935,936	39,900,564	49,342,568	39,066,793
Active Conn.	26	27	31	32
Equivalent Active Conn.	26	26.67	31	30.50
GPD/Conn.	3,470.59	4,099.37	4,360.81	3,509.26
Accounted For	15%	15%	15%	15%
Unaccounted For	5%	5%	5%	5%
GPD/Conn.	4,164.71	4,919.24	5,232.97	4,211.11

The four year average for high use commercial and industrial connections is 4,632.01 gpd/connection. A higher value will be used to account for unseasonable hot and dry years. A high use commercial and industrial connection is considered to use 4,635 gpd/connection.

The conversion to ERUs is:

$$\frac{\text{High C/I Use}}{\text{SF Use}} = \frac{4{,}635\,\frac{\text{gpd}}{\text{conn}}}{175\,\frac{\text{gpd}}{\text{conn}}} \approx 26.5$$

1 High Use C/I Connection = 26.5 ERUs

Irrigation Connections

Irrigation use is fairly low except during the summer months. Typical use starts to rise during the May/June bi-monthly period, peaks during the July/August bi-monthly period, and declines during the September/October bi-monthly period.

Irrigation can be viewed as an interruptible use as the City could impose strict watering restrictions if the water supply is stressed and cannot keep up with demand. Since irrigation is an interruptible use, the City's water use was calculated without irrigation added.

Table 2-13, Typical Irrigation Water Use

	2012	2013	2014	2015
Water Used (gal)	12,052,524	12,009,888	14,179,836	30,902,623
Active Conn.	53	51	55	62
Equivalent Active Conn.	31	28	27	36
GPD/Conn.	1,065.18	1,175.14	1,438.85	2,351.80
Accounted For	15%	15%	15%	15%
Unaccounted For	5%	5%	5%	5%
GPD/Conn.	1,278.22	1,410.16	1,726.62	2,822.16

The four year average for typical irrigation connections is 1,809.29 gpd/connection. An irrigation connection is considered to use 1,810 gpd/connection.

$$\frac{\text{Irr Use}}{\text{SF Use}} = \frac{1{,}810\,\frac{\text{gpd}}{\text{conn}}}{175\,\frac{\text{gpd}}{\text{conn}}} \approx 10.3$$

1 IRR Connection = 10.3 ERUs

Maximum Day Demand

The maximum day demand (MDD) is the largest single day demand of the system for the year. The City does not collect water use data daily. However the City does monitor the amount of water delivered to the distribution system electronically and can produce that data on a variety of time scales. For MDD calculations, daily water production records from the peak month were used to determine the largest single day demand of the distribution system. This largest single day demand was compared to the ADD for the year to calculate a peaking factor.

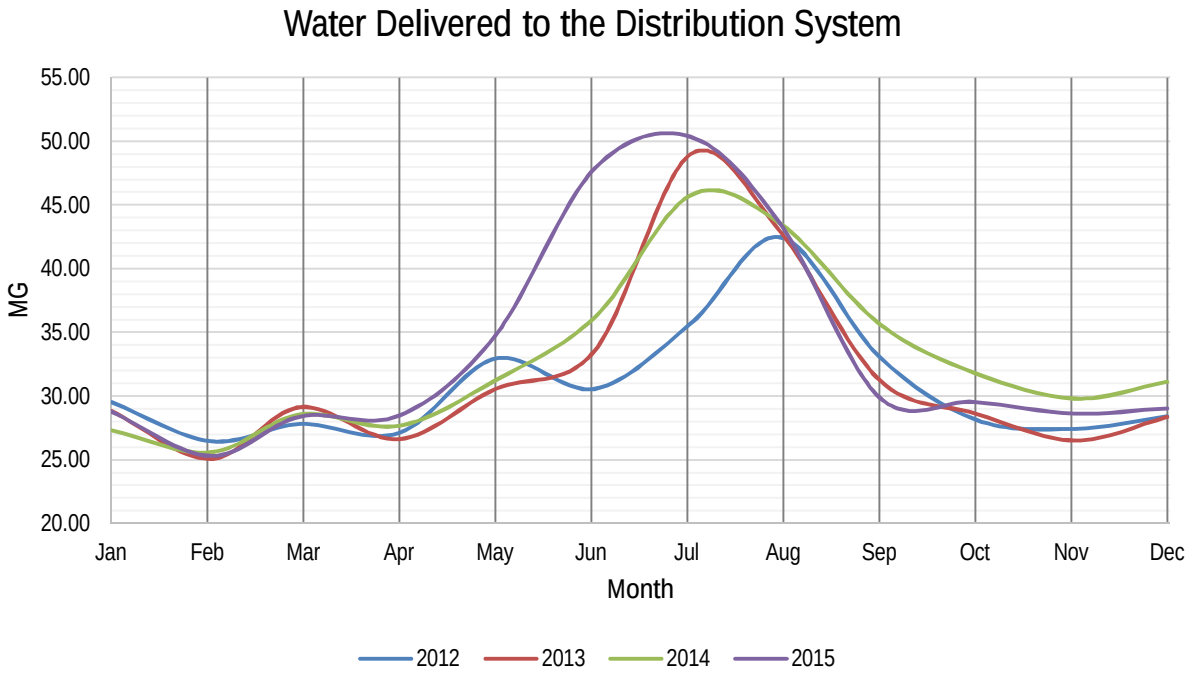


Figure 2-1, Water Delivered to the Distribution System, MG

Since water use is recorded in bi-monthly intervals, the water delivered to the distribution system shown in Figure 2-1 can be adapted to present in the same bi-monthly interval to allow for comparison with bi-monthly water use seen in the Figures in Section 2.1.5.

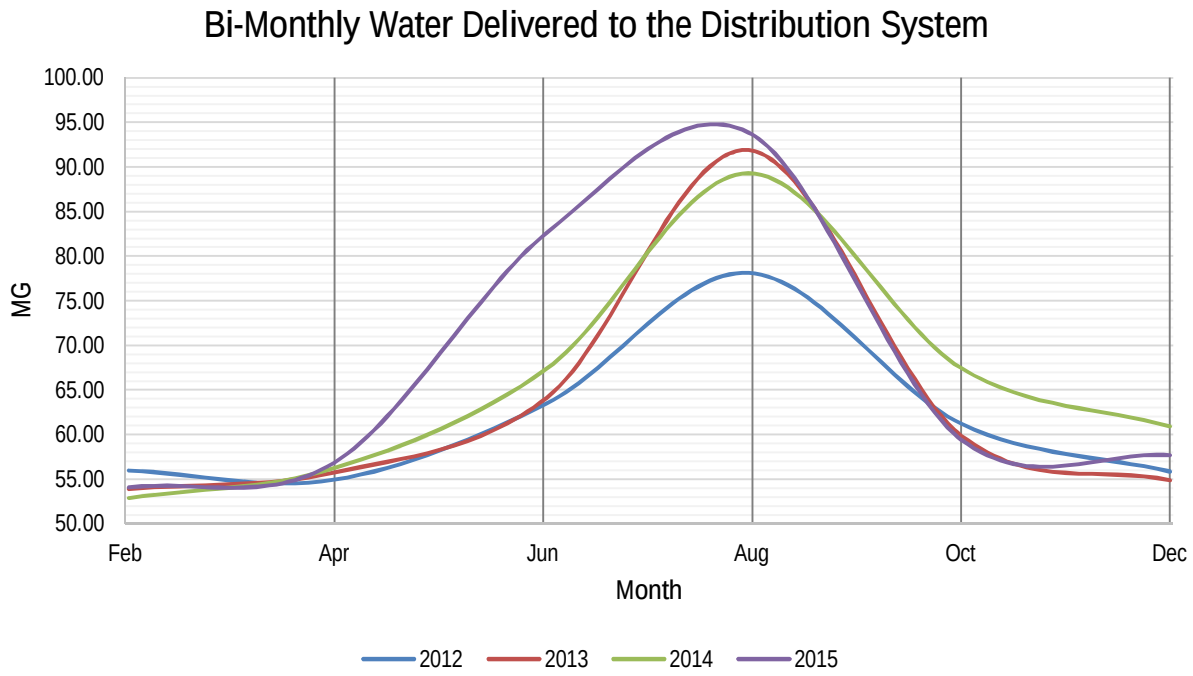


Figure 2-2, Bi-Monthly Water Delivered to the Distribution System, MG

Table 2-14, Peaking Factors

	2012	2013	2014	2015
Maximum Month	August	July	July	July
Max. Day Production (MG)	1.68	1.85	1.83	1.98
Average Year Production (MG)	1.01	1.04	1.08	1.11
Peaking Factor	1.66	1.78	1.69	1.71

The four year average for the peaking factor is 1.73. Using this peaking factor, the MDD for one ERU is:

$$175\ \frac{gpd}{ERU} \times 1.73 = 302.75\ \frac{gpd}{ERU} \approx 305\ \frac{gpd}{ERU}$$

This figure includes use by irrigation connections. If the irrigation connections were removed from the MDD calculations, the peaking factor does not significantly change. The peaking factor would drop to approximately 1.67. Therefore, a peaking factor of 1.73 will be used in MDD calculations.

185 gpd/ERU is considered to be the average day demand for an ERU without conservation. This figure assumes 10% unaccounted for water. The MDD without conservation is approximately 325 gpd/ERU.

2.1.5 Seasonal Variations by Customer Class

Single-Family Residences

Single-family use accounts for approximately 65% of the water sold by the City, and is the most seasonally variable use of the customer classes. Generally demand follows the increases in the spring, peaks during

the summer months, and then begins to drop as fall approaches. Average bi-monthly use is roughly 35 MG, peak bi-monthly use averages 45 MG. There is a notable difference in 2015 due to the unseasonably hot and dry conditions. For 2015, demand was higher than normal in during the spring months, then peaked notably higher than previous summer months. The figure below clearly shows the relationship between 2015 and the previous years.

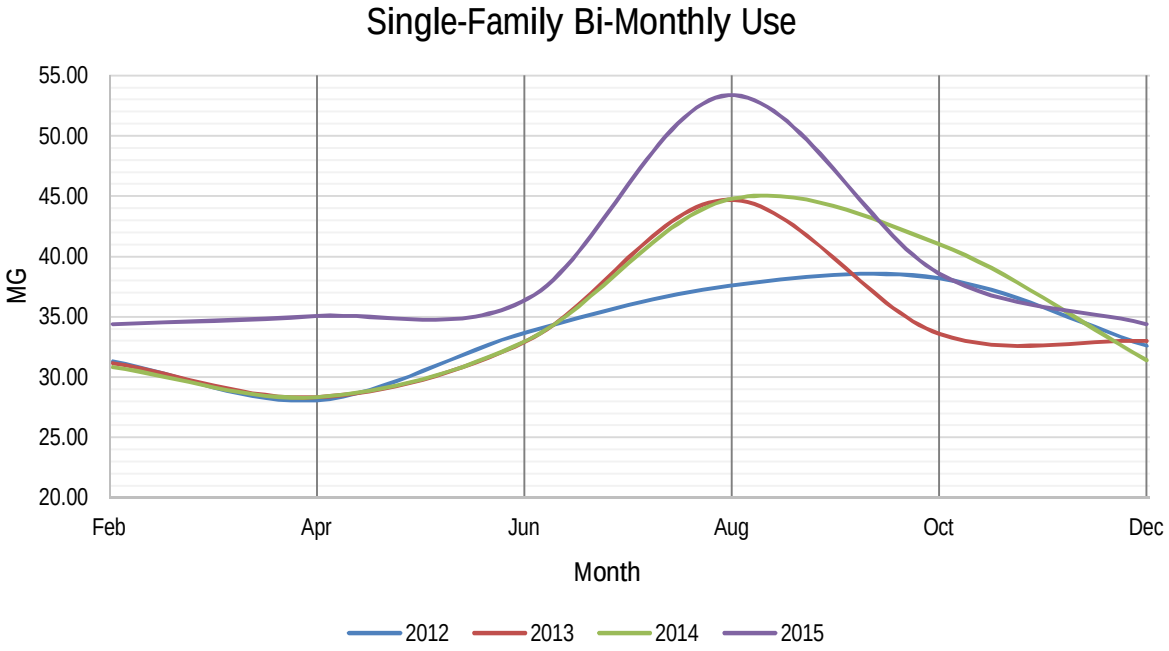


Figure 2-3, Bi-monthly Single-Family Use

Multi-Family Residences

Multi-family use accounts for approximately 12% of the water sold by the City. Demand follows the typical seasonal peak, however the peaks are not as drastic as those seen in the single-family demands. Average bi-monthly use is more or less 6 MG, while the average peak bi-monthly use is slightly over 7MG.

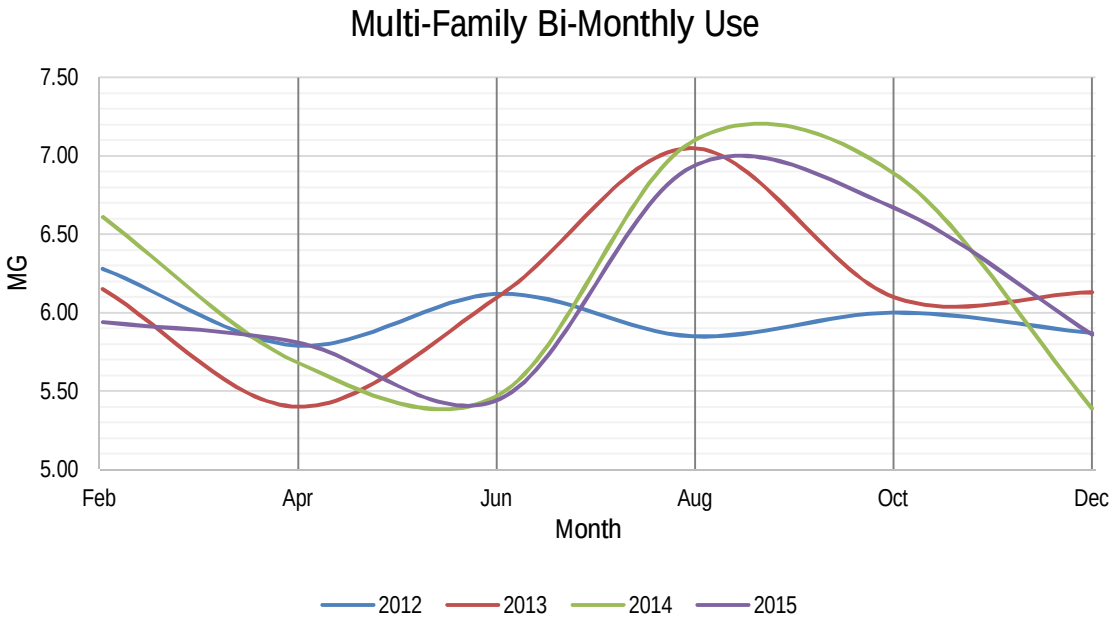


Figure 2-4, Bi-monthly Multi-Family Use

Commercial/Industrial Connections

Commercial and Industrial use accounts for approximately 18% of the water sold by the City. Average bi-monthly use is just under 10 MG; the average peak bi-monthly use is slightly under 12 MG. Generally, use is consistent with a slight increase in use during the summer months.

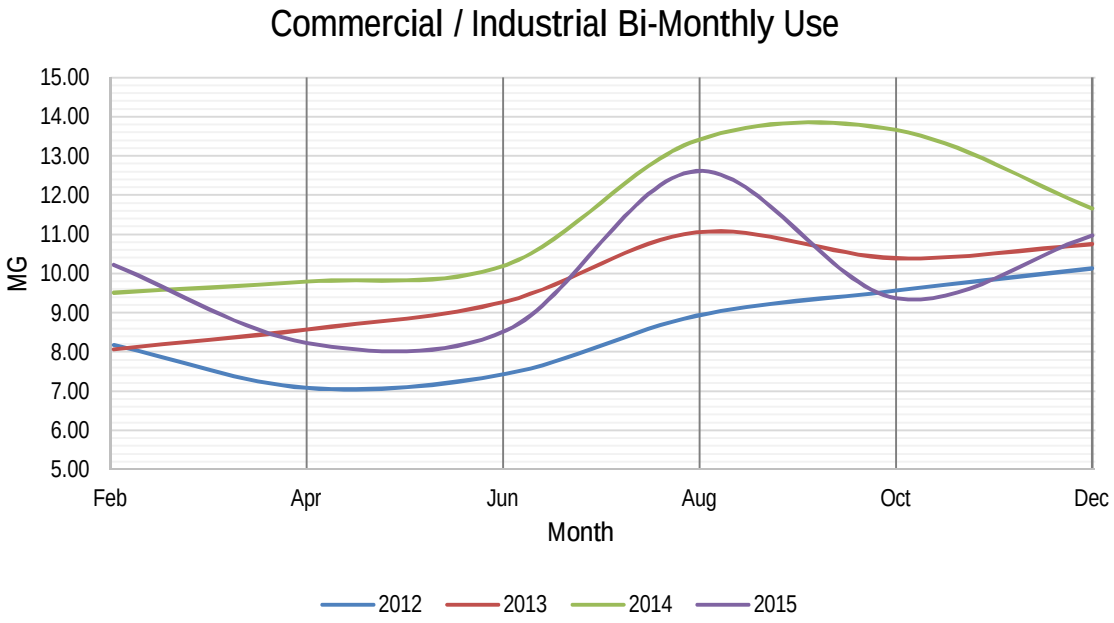


Figure 2-5, Bi-monthly Commercial / Industrial Use

Irrigation Connections

Irrigation use accounts for approximately 5% of the water sold by the City. Average bi-monthly use is just under 3 MG; the average peak bi-monthly use is slightly under 15 MG. Use is very minimal throughout the beginning of the year and begins to increase around April and peak in August.

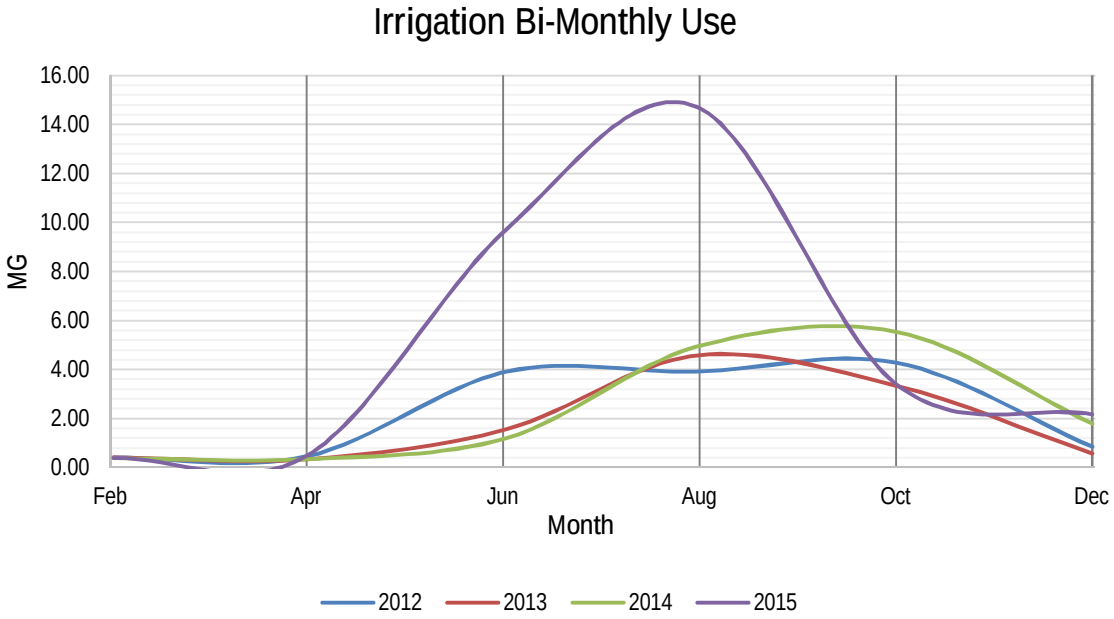


Figure 2-6, Bi-monthly Commercial / Industrial Use

2.2 PROJECTED LAND USE, FUTURE POPULATION, AND WATER DEMAND

2.2.1 Projected Land Use

Projected land use as it related to the City's water system is discussed in the City's *Ferndale Urban Growth Areas – Water Availability* report. A copy of the report is included in Appendix L.

2.2.2 Projected Population

The City is divided into eight planning districts, see Exhibit 4 at the end of this Chapter. The district lines roughly correspond to the City's current zoning. Based on that zoning, each of the districts has been assigned a growth rate by the City's Planning Department. Using the growth rates, the population for each district, and the City as a whole, can be calculated. Population projections are listed in the table below.

Table 2-15, Population Projections

Year	District								Total Pop.
	1	2	3	4	5	6	7	8	
2013	269	333	759	1,403	7,311	1,036	508	212	11,831
2014	282	352	817	1,518	7,831	1,131	548	231	12,710
2015	283	354	829	1,555	7,936	1,165	560	238	12,920
2016	283	357	847	1,600	8,079	1,208	574	246	13,194
2017	283	360	865	1,646	8,224	1,252	589	255	13,474
2018	284	363	883	1,693	8,371	1,298	604	264	13,760
2019	284	366	902	1,741	8,521	1,346	619	273	14,052
2020	284	369	921	1,790	8,673	1,395	635	283	14,350
2021	285	372	940	1,840	8,827	1,445	651	294	14,654
2022	285	375	960	1,892	8,984	1,498	667	304	14,965
2036	290	417	1,278	2,776	11,455	2,431	937	488	20,072
Growth Rate	0.33%	0.98%	2.29%	3.01%	1.97%	3.78%	2.70%	3.69%	2.32%

2.2.3 Projected Service Connections

Using the growth rate of 2.32%, as seen in Table 2-15 above, to project the number of service connections is not accurate. Single-family homes may develop at a faster pace than commercial and industrial businesses. The City's Planning Department provided growth rates for households and employment for each of the eight district mentioned in Section 2.2.2. These growth rates can be used to project the number of service connections. The projections are seen below in Table 2-16.

Table 2-16, Service Connection Projections

Year	Active Connections					Total
	Single-Family	Multi-Family	Commercial / Industrial		Irrigation	
			Low Use	High Use		
2013	4,071	853	255	27	51	5,257
2014	4,169	861	252	31	55	5,368
2015	4,286	861	257	32	62	5,498
2016	4,365	880	278	34	64	5,621
2017	4,446	898	300	37	66	5,747
2018	4,529	917	323	40	68	5,877
2019	4,614	935	347	43	70	6,009
2020	4,701	954	372	46	72	6,145
2021	4,790	973	398	49	74	6,284
2022	4,881	991	425	52	76	6,425
2036	6,420	1,307	980	116	113	8,936

2.2.4 Projected ERUs

Table 2-17, ERU Projections

Year	ERUs				Total
	Single-Family	Multi-Family	Commercial / Industrial	Irrigation	
2013	4,071	682	1,008	525	6,286
2014	4,169	689	1,149	567	6,574
2015	4,286	689	997	639	6,611
2016	4,365	704	1,074	659	6,802
2017	4,446	719	1,153	680	6,998
2018	4,529	733	1,232	700	7,194
2019	4,614	748	1,307	721	7,390
2020	4,701	763	1,380	742	7,586
2021	4,790	778	1,578	762	7,908
2022	4,881	793	2,150	783	8,607
2036	6,420	1,046	2,722	1,164	11,352

2.2.5 Projected Non-Revenue Water

The City's unaccounted for water historically ranges from 4.3% to 4.7%. The City's goal is to keep unaccounted for water under 5%. As this goal is currently being met, the City has no further plans to reduce unaccounted for water, but rather maintain unaccounted for water under 5%.

2.2.6 Water Demand Forecasting

Table 2-18, Forecasted Water Demands

			ADD (MGD)		MDD (MGD)		PHD (GPM)		Annual (AC-FT/YR)	
Year	Total Population	ERUs	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons
2013	11,831	6,286	1.08	1.08	1.91	1.91	2,194	2,194	1,205	1,205
2014	12,710	6,574	1.13	1.13	1.91	1.91	1,300	1,300	1,265	1,265
2015	12,920	6,611	1.21	1.21	2.07	2.07	2,366	2,366	1,356	1,356
2016	13,194	6,802	1.19	1.26	2.07	2.21	2,371	2,526	1,334	1,410
2017	13,474	6,998	1.22	1.29	2.13	2.27	2,438	2,596	1,372	1,451
2018	13,760	7,194	1.26	1.33	2.19	2.34	2,504	2,667	1,411	1,491
2019	14,052	7,390	1.29	1.37	2.25	2.40	2,571	2,738	1,449	1,532
2020	14,350	7,586	1.33	1.40	2.31	2.47	2,637	2,809	1,488	1,573
2021	14,654	7,908	1.38	1.46	2.41	2.57	2,746	2,925	1,551	1,639
2022	14,965	8,607	1.51	1.59	2.63	2.80	2,983	3,177	1,688	1,784
2036	20,072	10,770[1]	1.88	1.99	3.28	3.50	3,716	3,958	2,112	2,232

[1]By the year 2036 it is assumed that reclaimed water will make up approximately 50% of the irrigation ERUs (582 ERUs). The Demand figures above in Table 2-18 account for this.

In the graphs below, a fairly significant increase in demand occurs during the year 2021 and 2022. This increase represents the new jail facility. For the purpose of this study, it was assumed that approximately 20% of the estimated demand of 110,000 gpd for the new jail facility will occur in 2021. This would account for water demand for construction and a small portion of the facility coming online. The remaining 80% is assumed to occur during 2022.

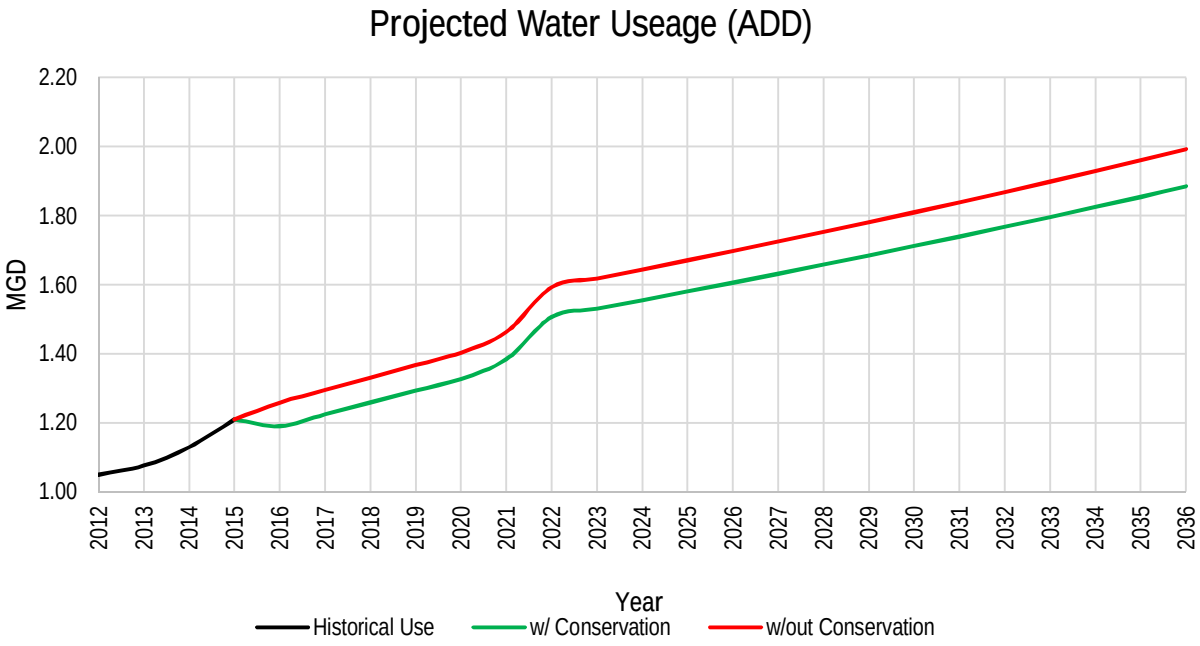


Figure 2-7, Projected Water Use, ADD

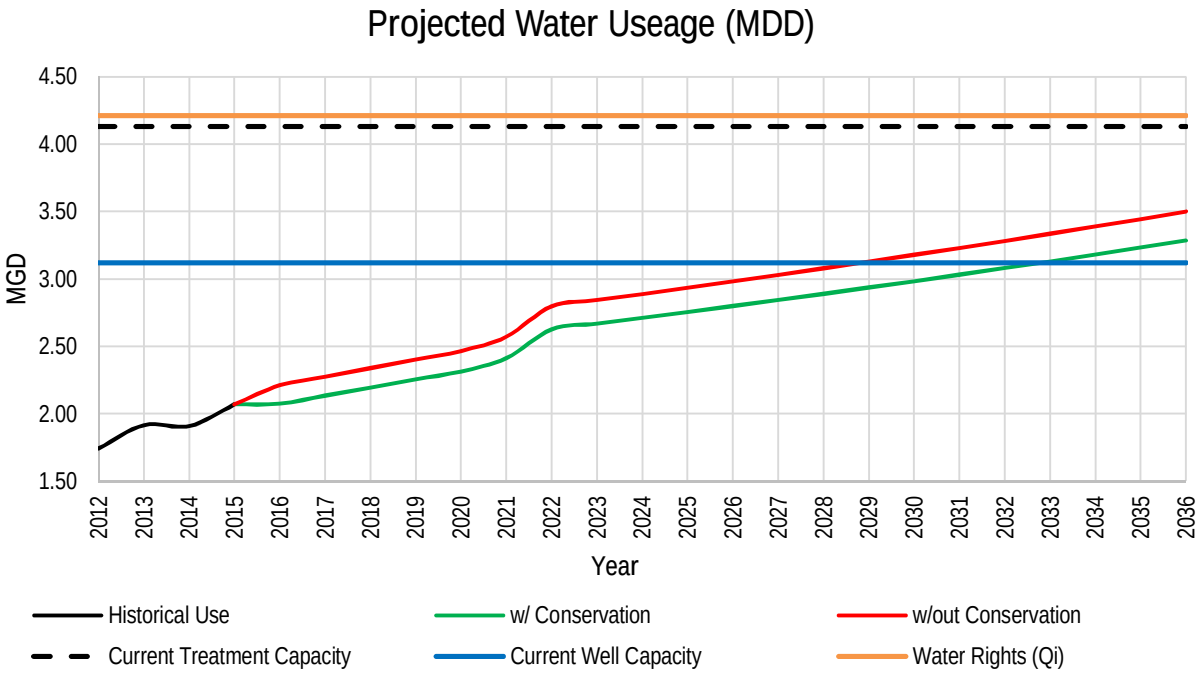


Figure 2-8, Projected Water Use, MDD

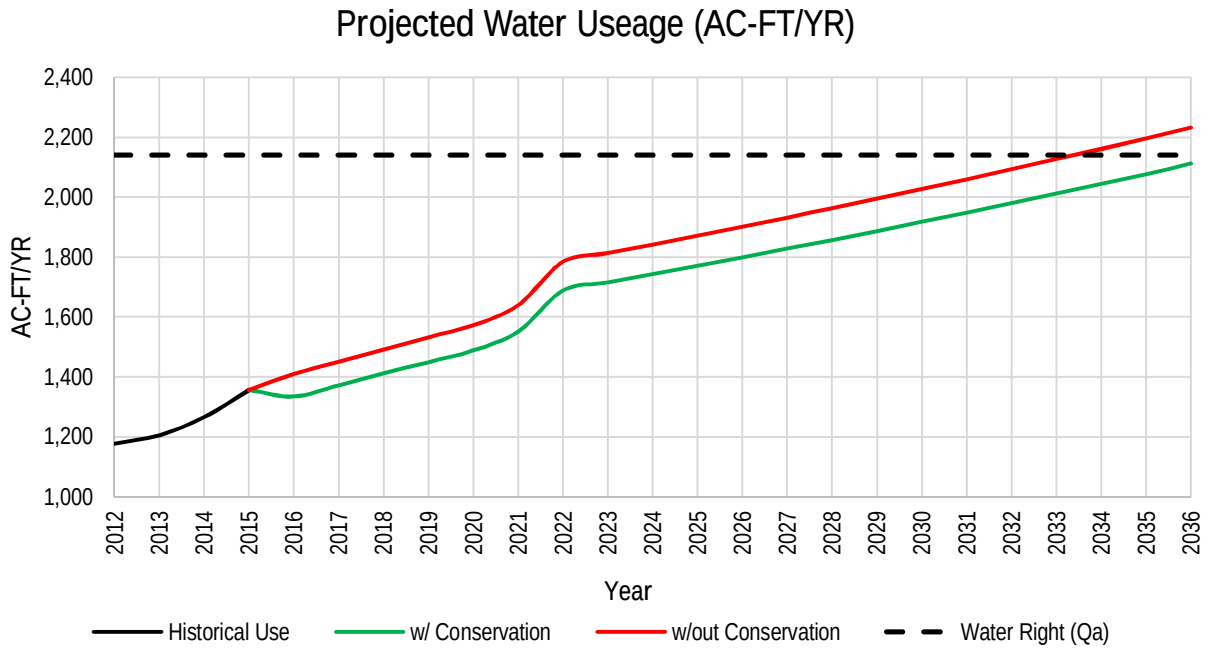


Figure 2-9, Projected Annual Water Use, AC-FT/YR

2.3 WATER PRODUCTION AND SUPPLY

2.3.1 Monthly and Annual Production

As discussed in Chapter 1, the City withdraws water from wells located at the City Shop and along Douglas Rd. The water is metered both at each well and prior to treatment at the water treatment plant. Monthly and yearly totals from each well are listed below.

Table 2-19, Monthly and Annual Water Production, MG

	2012		2013		2014		2015	
Month	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well
January	0	0	20,044	9,753	11,653	16,424	12,963	18,146
February	0	0	17,448	8,455	10,976	15,379	10,602	16,742
March	9,888	13,274	20,843	10,267	12,239	17,100	11,528	19,158
April	9,880	17,152	18,390	8,920	11,746	16,578	11,623	19,257
May	13,088	21,028	19,020	12,270	13,465	18,693	13,083	24,416
June	12,566	19,298	20,113	14,273	15,998	21,443	13,993	36,822
July	16,377	19,930	22,057	27,815	14,842	32,414	9,520	44,060
August	23,287	20,150	16,437	27,333	14,306	30,416	6,115	40,504
September	25,066	9,249	11,860	20,049	12,239	24,548	80	32,429
October	22,132	7,189	11,586	17,614	13,072	20,778	398	31,921
November	18,546	9,897	10,827	16,307	13,531	18,588	112	31,265
December	19,158	10,209	12,149	17,039	13,965	19,637	471	31,286
Total	169,988	147,376	200,774	190,095	158,032	251,998	90,488	346,006
Combined Total	317,364		390,869		410,030		436,494	

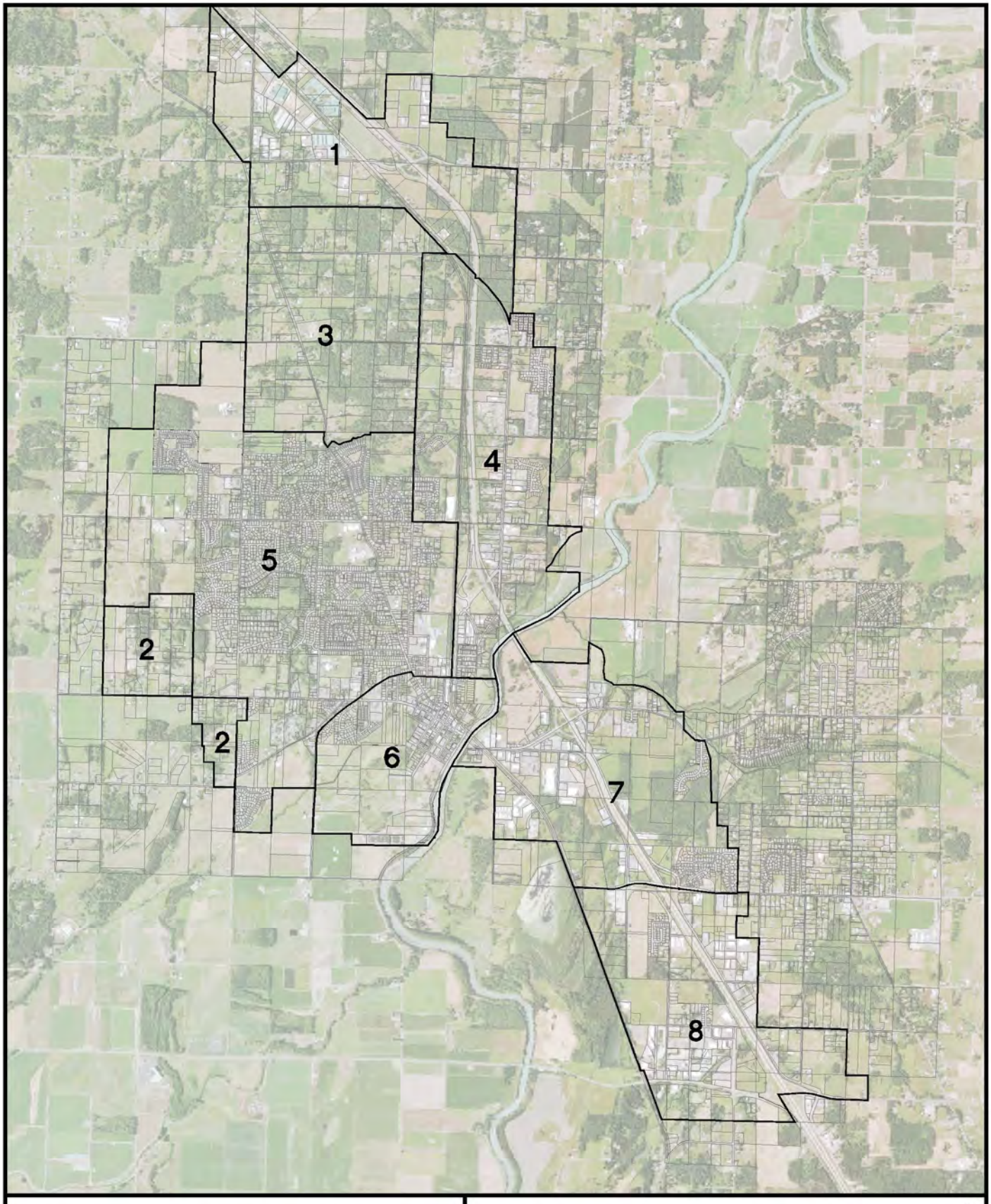
Water supply characteristics generally follow system demand. Figure 2-1 displays the total water delivered to the distribution system since 2012. Demand typically increases in the spring, peaks during the summer months, and then begins to drop as fall approaches. There is a notable difference in 2015 due to the unseasonably hot and dry conditions. The increase in supply began earlier than it had it the past as well as peaked higher than in the past. Projected water supply and demands have been adjusted to account for this if the conditions of 2015 are to persist.

2.3.2 Other Systems Supplied

A list of the neighboring and adjacent purveyors are listed in Section 1.2.3. The City has agreements in place with 4 of the water systems to supply water during emergency situations. These water systems are:

- Thornton Water Association
- Northwest Water Association
- North Star Water Association
- Mountain View Water Association

The agreement with the Northwest Water Association provides that the City supply the Association as a permanent supply, however the City is seldom used as a supply since the Association has existing wells and City water is more expensive. Copies of the agreements with the neighboring and adjacent purveyors can be found in Appendix K.



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EXHIBIT 4

CITY PLANNING DISTRICTS

LEGEND
——— = CITY LIMITS
——— = CITY DISTRICTS

DATE: 05/13/16 SCALE: 1"=4000'

CHAPTER 3
SYSTEM ANALYSIS

3.0 OBJECTIVE

The objective of this chapter is to determine if the existing system facilities are capable of supplying sufficient quality and quantity of water to meet existing and projected demands as identified in *Chapter 2, Basic Planning Data and Water Demand Forecasting*. Statutory authority is included in Chapter 246-290 WAC.

3.1 SYSTEM DESIGN STANDARDS

3.1.1 Water Quality Parameters

City water supplies must comply with the standards of water quality identified in WAC 246-290-310. The Regional Aquifer, the source for the City's existing wells, is presumed to be the source for future wells and tends to have problems with hardness, manganese and ammonia. New water supplies should be blended or treated if necessary in order to provide high quality drinking water.

3.1.2 Average and Maximum Day Demands

Average Day Demand

The average day demand (ADD) for each type of customer is calculated in Chapter 2. The average day demand for a single-family residence is 175 gpd/ERU. The ERU conversion for each type of customer is summarized in Table 3-1.

Table 3-1, ERU Equivalents

Customer	ERU/Connection
Single-Family Residential	1.0
Multi-Family Residential	0.8
Typical Commercial/Industrial	1.5
Large Commercial/Industrial	Calculated
Irrigation	10.3

Maximum Day Demand

The maximum day demand (MDD) is the largest single day demand of the system for the year. Water systems are designed so that together the source, treatment, and equalizing storage can meet the MDD for the water system. The MDD factor is the ratio between the maximum day and the average day demands. The MDD factor of 1.73 is calculated in Chapter 2.

3.1.3 Peak Hour Demand

The peak hourly demand (PHD) is the maximum demand of the system in a single hour. PHD is used to size equalizing storage, transmission lines, distribution mains, and pumping facilities. The PHD is calculated using Equation 5-1 of the Department of Health's (DOH) *Water System Design Manual, December 2009* as seen below.

$$PHD = \frac{MDD}{1440}[(C)(N)+F]+18$$

Since the City of Ferndale has more than 500 ERUs; C = 1.6 and F = 225. N represents the number of ERUs and can be found in Table 2-17 in Chapter 2. MDD is 305 gpd/ERU as calculated Chapter 2.

3.1.4 Storage Requirements

The required volume of storage includes five (5) storage components; operating, equalizing, standby, dead, and fire suppression storage. The City can exclude the standby or fire suppression component, whichever is smaller, from the total storage requirement. However in order to provide adequate fire protection for institutional uses such as a jail or hospital, storage facilities shall include both fire suppression storage and standby storage.

New tanks shall be reinforced pre-tensioned concrete or steel, and shall be sized to service the entire area within the present and future service area they will serve. Tanks shall be fitted with separate fill lines and a manifold or other system to insure good circulation within the tank. Water level shall be controlled by a telemetry/SCADA system.

3.1.5 Fire Flow Rate and Duration

Fire flow standards set by the Ferndale Department of Public Works in cooperation with the Fire Department and the Washington State Survey and Rating Bureau are provided below.

Table 3-2, Fire Flow Requirements

Classification	Fire Flow (gpm)	Duration (hours)
Residential	1,000	2
Multi-Family	2,000	2
Commercial	3,000	3
Institutional	3,000	4
Industrial	3,000	4

It is the City's goal to provide the fire flows shown in Table 3-2 to the corresponding zoned areas throughout the distribution system. These figures do not represent actual fire flow requirements for structures and developments, which must be calculated in accordance with fire codes.

3.1.6 Minimum System Pressure

In accordance with the DOH, the system must be able to provide no less than 30 psi at all service connections during peak hour demand flows when all equalizing storage is depleted. The system must meet this minimum pressure at all existing and proposed service water meters. The City has set a goal of no less 40 psi under the same conditions. Some properties at higher elevations in the various pressure zones may not be able to meet this requirement and will be allowed to install individual booster pumps.

Under fire flow conditions, the City's strives to provide no less than 20 psi at all points throughout the distribution system. As a worst case scenario, the system should be able to provide this minimum pressure under fire flow conditions plus maximum day demand when all equalizing and fire flow storage is depleted.

Improvements to meet the City's goal of providing no less than 20 psi under these fire flow conditions have been identified on the Water System Map and are discussed in Chapter 8.

Distribution system pressure should not exceed 80 psi during normal operation conditions. Individual pressure reducing valves should be provided for services that will exceed this pressure.

3.1.7 Telemetry Systems

Pump stations and storage tanks should be monitored and controlled by a SCADA system.

3.1.8 Backup Power Requirements

New pump stations serving pressure zones without storage facilities should be constructed with backup generators.

3.1.9 Valve and Hydrant Spacing

Valves

Valves shall be placed on each main at a junction point and shall be spaced along the water main at intervals not to exceed:

- 500 feet for mains 10 inches in diameter or larger
- 800 feet for mains less than 10 inches in diameter

All valves shall be resilient seat gate valves.

Hydrants

Hydrants shall be spaced at no greater than 300 feet intervals along public street or approved fire access routes. Shorter intervals may be required by the Public Works Director.

3.1.10 Water Mains

Water mains shall be ductile iron and shall meet the following criteria:

Residential Zones

The minimum size water main shall be eight (8) inches in diameter with an average gridded spacing not to exceed 1,500 feet. Pipes less than eight (8) inches in diameter may be allowed by the Public Works Director when future extension is not anticipated, such as in a cul-de-sac, provided the main does not serve a fire hydrant.

Commercial, Industrial, and Intuitional Zones

Water main construction/reconstruction shall be done pursuant to a design that, when fully implemented, will provide the fire flow requirements of the City's fire protection and comprehensive plan standards. When improvements require increased fire flow requirements, the applicant shall upgrade the water system to support the changes. The minimum water main size shall be twelve (12) inches in diameter unless a hydraulic analysis shows the required flows can be met with a smaller diameter, and no further extensions can be made.

Maximum Velocities

A maximum velocity of no more than eight (8) feet per second under peak hour demand conditions is allowed. Maximum velocities of no more than ten (10) feet per second may occur under fire flow conditions, for short main sections, or piping in pump and valve station facilities.

3.1.11 Other System Policies that Affect Performance and Design

All system improvements must meet standards and specifications of the Washington State Department of Health, American Public Works Association and City of Ferndale, and be designed, constructed and operated in accordance with good engineering practice.

3.2 WATER QUALITY ANALYSIS

The standards for water quality are set forth by the DOH in Chapter 246-290 of the WAC. Water quality is generally good with the exception of manganese and hardness. While manganese is not a primary contaminant it is a secondary contaminant. Secondary contaminants do not pose a health threat but create other problems:

- Aesthetic effects — undesirable tastes or odors;
- Cosmetic effects — effects which do not damage the body but are still undesirable
- Technical effects — damage to water equipment or reduced effectiveness of treatment for other contaminants

The City controls manganese through the use of greensand filters and reverse osmosis, and hardness through the use of reverse osmosis. Water quality reports are included in Appendix H. The City's Coliform Monitoring Plan is also included in Appendix H.

3.3 SYSTEM INVENTORY, DESCRIPTION, AND ANALYSIS

3.3.1 Source

General Description and Condition

The City uses groundwater to supply the distribution system. The City currently has two active wells sites; Douglas Rd. and the City Shop. The groundwater is in compliance with all primary maximum contaminant levels (MCL), but does exceed the secondary MCL for manganese. Although not a contaminant, the groundwater is also hard, which is an annoyance and an aesthetic issue for the public. In a 2013 project report for water softening, arsenic was noted as being the primary contaminant of greatest concern. The MCL for arsenic is 0.010 mg/L, the water chemistry in April of 2013 showed arsenic levels at 0.003 and 0.004 mg/L for the Douglas Rd. well and the City Shop well respectively.

The Douglas Well is rated at 1,300 gpm and the City Shop Well is rated at 870 gpm. Although the Water Right GWC 1513 for the Douglas well states that the maximum withdrawal rate is 1,000 gpm, under Application 12073, the DOE allows an additional 300 gpm from Water Permit G1-00720P to be withdrawn from GWC 1513. Copies of the water rights documents are found in Appendix I.The Douglas Well and City Shop Well pump into a dedicated main that runs directly to the City's water treatment plant. This dedicated line was constructed in 2011 of both ductile iron water main within the City limits and PVC water main

outside of the City limits. The water main is considered to be in good condition. The treated water is pumped from the clearwell storage into the distribution system. In an emergency, the wells can bypass the treatment plant and pump directly into the distribution system.

Source Capacity Analysis

The City's two existing well, Douglas Well and City Shop Well can meet Maximum Day Demand until the year 2032, at which time additional well and pumping capacity will be required. This is shown on Figure 3.1 below. Existing water rights allow the City to meet Maximum Day demand well beyond the 20 year planning period. Water Rights Self Assessment forms located in Chapter 4 show the forecasted maximum instantaneous demands will not exceed the water rights for the 20 year planning period. The Maximum Annual Volume is forecast to be adequate through the 20 year planning period, but additional water rights may be required beyond this period. The City and Whatcom County plan on a new jail facility being built in 2021 and 2022. At that point either additional storage or source water will be required. This is addressed in the *Water Supply and Storage Alternative Analysis* found in Appendix N. It is assumed that the City will have additional water well sources capable of pumping the full amount of 2930 gpm allowed in the water rights, which will reduce the amount of equalizing storage required.

3.3.2 Water Treatment

General Description and Condition

As previously mentioned, the City's raw water exceeds the secondary MCL for manganese and is considered to be hard. The City treats for both of these items through a combination of greensand filters and reverse osmosis.

The City uses eight greensand filters in a parallel configuration to remove manganese and reverse osmosis to remove hardness. Chlorine is added to the raw water prior to the greensand filters. The raw water is split between the greensand filters and the reverse osmosis, treated, and then blended together before more chlorine is added to attain the desired residual.

Water testing requirements and water quality reports are found in Appendix H.

Water Treatment Capacity Analysis

The City has the ability to treat water at the pumping rate of the wells less filter backwash and reverse osmosis reject water. Historically, filter backwash has been approximately 3% of the water produced by the wells, however once the City had the ability to treat with reverse osmosis in 2014, the amount of filter backwash decreased. In 2015, the filter backwash averaged 1.1% of the water produced by the wells. Reverse osmosis reject water has averaged 6.1% of the water produced by the wells for 2015. Based on these figures, the City has the ability to deliver the following:

Treatment Capacity = 2,870 gpm = 4.13 MGD

The DOH's *Water System Design Manual, December 2009* states that the source for a water system must be able to meet the water system's MDD. Figure 3.1 below shows the projected MDD as calculated in Chapter 2, and compares it to the City's treatment capacity.

Under current conditions (with conservation) the City has sufficient treatment capacity for the 20 year planning period.

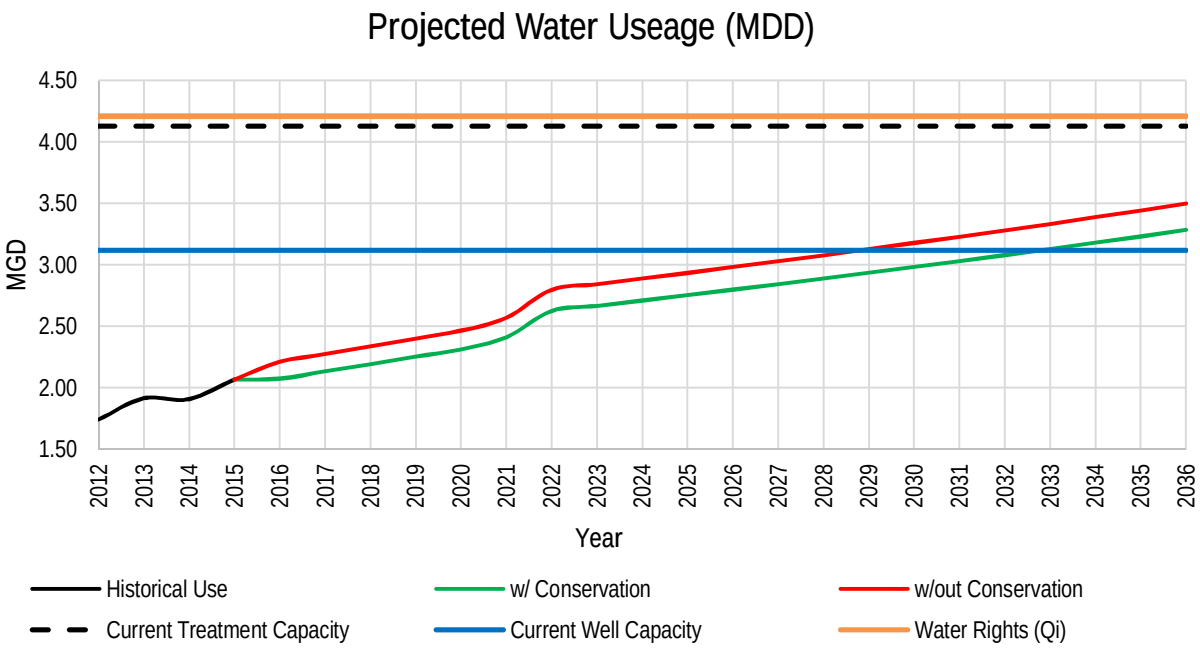


Figure 3-1, Project Water Use and Treatment Capacity, MDD

3.3.3 Storage

General Description and Condition

Storage Tank 1 is a 950,000 gallon concrete tank serving the Main Pressure Zone and the Axton Pressure Zone. These two zones represent approximately 70% of the water system and corresponding ERU's.

Storage Tank 2 is a 1.7 million gallon steel tank serving all of the higher pressure zones, and supplementing Tank 1 and the lower pressure zones through pressure reducing valves. The higher Bakerview zone utilizes booster pumps drawing from Tank 2 to supply adequate pressure. Tank 2 serves approximately 30% of the water system and corresponding ERU's.

The Finished Water Clear Well at the City's Water Treatment Plant is essentially an underground concrete reservoir with a capacity of approximately 304,400 gallons. Water is pumped from the clear well to serve the Main Pressure Zone and the Axton Pressure Zone. The higher pressure zones may also utilize the clear well through the City's other storage tanks and pump stations. A raw water well is directly adjacent to the finished water clear well, and is not currently used. The raw water well was used to receive raw water when the City purchased water from the PUD. The raw water well could be hydraulically connected to the finished water clear well and increase the overall storage capacity at the treatment plant by approximately 150,000 gallons, for a total of 454,400 gallons.
Storage requirements consist of the following components:

1. Operational Storage (OS). OS is the volume of the tank devoted to supplying the water system while, under normal operating conditions, the sources of supply are in "off" status.
2. Equalizing Storage (ES). ES is the volume of the tank required to meet peak system demands in excess of the source capacity.
3. Standby Storage (SB). SB is the volume of the tank that provides a measure of reliability in case the source fails or uncommon situations impose higher demands than predicted
4. Fire Suppression Storage (FSS). FSS is the volume of water required to supply the largest fire demand without affecting the amount of water available for equalizing storage.
5. Dead Storage (DS). DS is the volume of water which cannot be used by the system because of low pressure.

Total storage requirements are the sum of the operating, equalizing, the larger of standby storage and fire suppression storage, and dead storage.

Operating storage consists of the top 1.5 feet of the tank. Equalizing storage is the difference between the peak hour demand and the pumping capacity of the fill pumps for each tank for a time period of two and one half hours. Standby storage is two days of storage for the average day demand, multiplied by the number of ERU's. Fire storage is the maximum fire demand imposed on the system, which is 3,000 gpm for a 4 hour period. The fire storage can be included within the standby storage. The larger of standby or fire storage is used in the calculations for tank size and capacity. Dead storage is not a factor because of the ability to pump from both tanks.

Storage Capacity Analysis

In general, the City will require additional storage for the 6 and 20 year planning periods. Assuming 200 gpd/ERU, and source capacity of 2930 gpm (maximum allowed under current Water Rights) no additional storage will be required for the 6 year planning period, but a deficit of approximately 0.1 million gallons will occur by the year 2036. The City's goal of providing 400 gpd/ERU will require additional storage within the 6 year planning period and approximately 2.5 million gallons by the year 2036. A detailed analysis of the City's storage capacity and future requirements can be found in the City's *Water Supply and Storage Alternative Analysis*. See Appendix N.

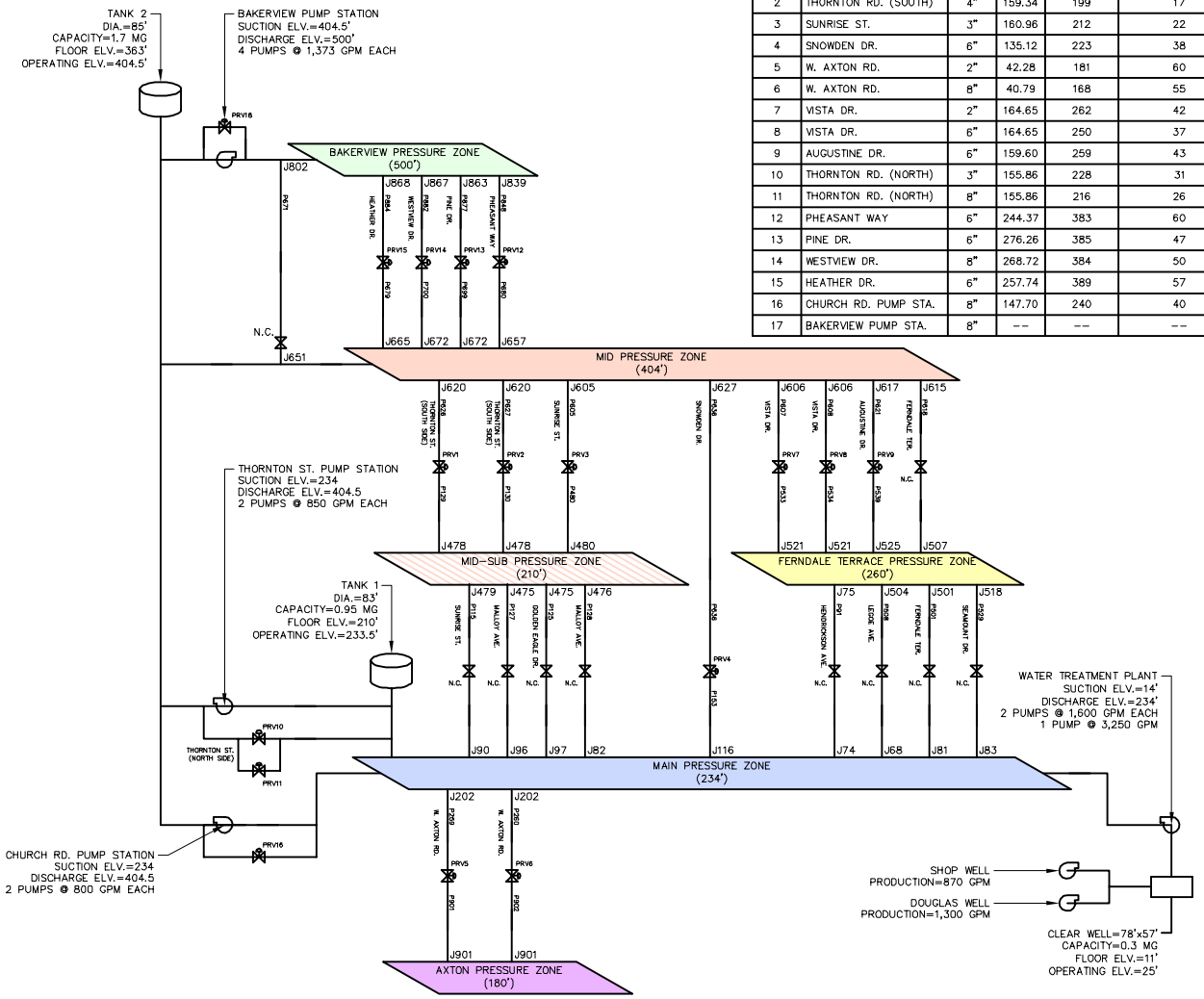
3.3.4 Distribution System

General Description and Condition

Pressure Zones

The City's water system has six pressure zones as shown below. These zones will be expanded as required to serve the City's UGAs. Additional zones will be created as required by system pressure requirements, if necessary.

Pressure zone boundaries are shown on the water system distribution map and Exhibit 1 in Chapter 1..



PRV#	LOCATION	SIZE	ELV.	SETTING	
				HGL (FT)	PRESSURE (PSI)
1	THORNTON RD. (SOUTH)	1.5"	159.34	210	22
2	THORNTON RD. (SOUTH)	4"	159.34	199	17
3	SUNRISE ST.	3"	160.96	212	22
4	SNOWDEN DR.	6"	135.12	223	38
5	W. AXTON RD.	2"	42.28	181	60
6	W. AXTON RD.	8"	40.79	168	55
7	VISTA DR.	2"	164.65	262	42
8	VISTA DR.	6"	164.65	250	37
9	AUGUSTINE DR.	6"	159.60	259	43
10	THORNTON RD. (NORTH)	3"	155.86	228	31
11	THORNTON RD. (NORTH)	8"	155.86	216	26
12	PHEASANT WAY	6"	244.37	383	60
13	PINE DR.	6"	276.26	385	47
14	WESTVIEW DR.	8"	268.72	384	50
15	HEATHER DR.	6"	257.74	389	57
16	CHURCH RD. PUMP STA.	8"	147.70	240	40
17	BAKERVIEW PUMP STA.	8"	--	--	--

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813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

EXHIBIT 5
CITY OF FERNDALE
PRESSURE ZONE SCHEMATIC

DATE: 10/17/16

Table 3-3, Pressure Zone Elevations

Pressure Zone	Approx. Static Elevation Head (ft)
Axton Road	180
Bakerview	500
Ferndale Terrace	260
Main	234
Mid	404
Mid-Sub	210

Axton Road Pressure Zone

The Axton Road Pressure Zone is at the eastern edge of the service area. It is supplied by a 10 inch water main along Main St./Axton Rd. from the City's Water Treatment Plant and Tank No. 1. Pressure reducing valves are utilized to reduce the pressure from the Main Pressure Zone. This zone is outside of the City Limits and Urban Growth boundaries. The system was installed many years ago and although operated and maintained by the City, new services will not be allowed in the future except for health concerns, (i.e. failing private well).

The following pressure reducing valves supply the Axton Road Pressure Zone.

Table 3-4, Axton Road Pressure Zone - PRV Settings

Location	Diameter (in)	Setting (psi)
W. Axton Rd.	2	60
W. Axton Rd.	8	55

Bakerview Pressure Zone

The Bakerview Pressure Zone is located at the western edge of the service area. This zone is bounded by Church Road, Bakerview Park Drive, and Westview Drive to the east, and the City limits to the west, and serves two schools. The zone is supplied by the Bakerview Pump Station, pumping from Tank No. 2. The following facilities are located in the Bakerview Pressure Zone:

- Pumping.....Bakerview Pump Station, 4 pumps with Variable Frequency Drives, each 1,373 gpm at 50 feet TDH

The pump station is controlled by the pressure in the Bakerview Pressure Zone. The lead pump is set to run continuously. If the lead pump cannot maintain the set point pressure, the pumps are sequentially activated to maintain pressure.

Emergency connections from the Bakerview Pressure Zone to local water associations are provided through pressure reducing valves as shown on water system map. Associations with emergency connections include Mountain View, and Thornton Road Water Associations.

Ferndale Terrace Zone

Ferndale Terrace Zone is supplied from the Mid Pressure Zone on Vista Dr. and Augustine Dr. through pressure reducing valves. This pressure zone is also connected to the Mid Pressure Zone, although the valves located near Ferndale Terrace and Fieldview Dr. connecting the two zones remain closed. Due to pressure fluctuations in the distribution system, this area is prone to rupturing of the aged asbestos cement pipes, therefore the conditions and settings of the pressure reducing valves are critical in maintaining the integrity of this pressure zone.

This pressure zone could potentially be included in the Main Pressure Zone if the asbestos cement water mains in the area were replaced.

The following pressure reducing valves supply the Ferndale Terrace Pressure Zone.

Table 3-5, Ferndale Terrace Pressure Zone - PRV Settings

Location	Diameter (in)	Setting (psi)
Vista Dr.	2	42
Vista Dr.	6	37
Augustine Dr.	6	43

Main Pressure Zone

The Main Pressure Zone extends from the southern portions of the service area, through the downtown area and the northern portion of the service area. The Main Pressure Zone is supplied by the pumps at the water treatment plant which pump directly into the system and fill Tank No. 1, which in turn supplies the system when the pumps are off. If the zone pressure drops below a preset level, pressure reducing valves open to supply the system from the Mid Pressure Zone and Tank No. 2. The following facilities are located in the Main Pressure Zone:

- Source ..... City Wells
  - Douglas Rd. Well
  - Shop Well
- Treatment..... Ferndale Water Treatment Plant, 4.13 mgd capacity
- Storage..... Tank No. 1 (Thornton Rd.)
  - Capacity..... 950,000 gallons
  - Construction..... Concrete
  - Floor Elevation..... 210.0 feet
  - Max Water Surf Elv..... 234.0
  - Diameter..... 83 feet
- Pumping.....Ferndale Water Treatment Plant
  - 2 pumps, 1,600 gpm at 250 feet TDH for each pump
  - 1 pump, 3,250 gpm at 250 feet TDH

The pumps at the Water Treatment Plant are controlled by the water level in Tank No. 1. The pumps are shut down when Tank No 1 has been filled. The set point to initiate lead pump operation is 1.5 feet below tank full level for Tank No1.

The following pressure reducing valves supply the Main Pressure Zone from the Mid Pressure Zone and Tank No. 2 if the pressure drops below the valve set point:

Table 3-6, Main Pressure Zone - PRV Settings

Location	Diameter (in)	Setting (psi)
Snowden Dr.	6	38
Thornton Rd. (North Side)	3	31
Thornton Rd. (North Side)	8	26
Church Rd. Pump Station	8	25

Mid Pressure Zone

The Mid Pressure Zone covers the upland area of the northwestern part of the service area. The zone is normally supplied from Tank No. 2, together with Pump Station No. 1 (near Tank 1), and the Church Rd. Pump Station.

The following facilities are located in the Mid Pressure Zone:

- Storage..... Tank No. 2 (near Bakerview Pump Station)
  - Capacity..... 1.7 million gallons
  - Construction ..... Steel
  - Floor Elevation..... 363.0 feet
  - Max Water Surf Elv..... 404.5 feet
  - Diameter..... 85 feet
- Pumping
  - Pump Station No. 1..... 2 pumps, each 850 gpm at 280 feet TDH
  - Church Rd. PS..... 2 pumps, each 800 gpm at 356 feet TDH

The operation of Pump Station No. 1 and the Church Road Pump Station is controlled by the water level in Tank No. 2. A drop in water level of 1.5 feet from full will initiate operation of either Pump Station No. 1 or the Church Road Pump Station, at the plant operator's option.

An altitude valve at Tank No. 1 shuts off influent water when the water reaches the maximum operating level. This valve is currently not in service. The water level is currently controlled by telemetry.

The following pressure reducing valves supply the Mid Pressure Zone from the Bakerview Pressure Zone if the pressure drops below the valve set point.

Table 3-7, Mid Pressure Zone - PRV Settings

Location	Diameter (in)	Setting (psi)
Pheasant Way	6	60
Pine Dr.	6	47
Westview Dr.	8	50
Heather Dr.	6	57

There is an emergency water connection from the Mid Pressure Zone to the Northstar Water Association as shown on the water system map.

Mid-Sub Pressure Zone

The Mid-Sub Pressure Zone covers a small area along Malloy Ave. The area bounded by Thornton Rd. to the north, Ferndale Terrace to the south, and Malloy Ave. to the east. This pressure zone is supplied by the Mid Pressure Zone through pressure reducing valves.

The following pressure reducing valves supply the Mid-Sub Pressure Zone.

Table 3-8, Mid-Sub Pressure Zone, PRV Settings

Location	Diameter (in)	Setting (psi)
Thornton Rd. (South Side)	1.5	22
Thornton Rd. (South Side)	4	17
Sunrise St.	3	22

Hydraulic Capacity Analysis

A hydraulic model of the existing system was created using the *WaterCAD* computer program created by Haestad Methods. The model was run for existing conditions, and deficiencies were noted and included in the improvement program presented in Chapter 8. A copy of the model and description of the conditions under which it was run, including fire demand, are located in Appendix G. The model was also run for future development, and used to estimate and analyze requirements for the Short, Mid and Long Term Urban Growth Areas. The results are presented in the "Ferndale Urban Growth Areas – Water Availability" report included in Appendix L, and shows the pipe location and size required to serve each UGA Annexation Area. It also shows the upgrades to the existing distribution system that may be required.

The model of the existing system was created using information from water system drawings provided by the City. Future demands for storage and source were based upon the City's growth projections. However the location and progression of growth is not easily predicted because of the diverse locations of the UGAs. Therefore separate models were constructed for different growth conditions. Because there are so many different conditions, the individual models are not included in Appendix G. Rather, the water system model is constructed in such a manner that specific development and growth can be easily analyzed and added as it occurs.

Calibration is an essential part of developing a useful hydraulic model. For the City's model, field measurements were collected from fire hydrants in several different areas of the City. Each hydrant used

for flow testing was opened completely and water discharged from the large pumping port. The flow was measured with calibrated pitot testing equipment. While performing the hydrant testing the static and residual pressures were monitored at several points throughout the system. During the testing several other variables were monitored including tank levels, pump status, and pressure reducing valve status. The conditions observed in the field were reproduced in the hydraulic model under 2015 average day demands. Pipe diameters and pipe materials were confirmed by City staff and added to the hydraulic model. The C factor and minor losses in the model were adjusted to match the actual flow results as closely as possible.

The table below shows the comparison between field measurements and the hydraulic model results.

Table 3-9, Model Calibration Results, WTP Pumps Off

Test No.	Location (node)	Static Pressure (psi)			Hydrant Flow (gpm)	Residual Pressure (psi)		
		Field	Model	Diff.		Field	Model	Diff.
1	S. Church Rd. (J41)	88	87.60	-0.40	1,902	--	--	--
	Blue Sky Way (J42)	90	89.22	-0.78	0	60	58.05	-1.95
	Church Rd. (J20)	36	36.30	0.30	0	20	19.67	-0.33
2	Portal Way (J151)	71	74.47	3.47	1,720	--	--	--
	Portal Way (J152)	71	74.04	3.04	0	42	40.31	-1.69
	Church Rd. (J20)	35	38.78	3.78	0	27	27.54	0.57
3	Smith Rd. (J297)	55	57.63	2.63	1,481	--	--	--
	Windward School (J321)	56	58.55	2.55	0	34	34.57	0.57
	Church Rd. (J20)	36	38.48	2.48	0	28	29.38	1.38
4	Rural Ave. (J281)	86	83.74	-2.26	1,873	--	--	--
	Rural Ave. (J282)	83	84.04	1.04	0	52	50.64	-1.36
	Church Rd. (J20)	35	38.39	3.39	0	23	25.4	2.40

The average psi difference for the model's static conditions is 1.6 psi, and less than 1 psi for the residual pressures compared to field measurements. The next step was to test the model under conditions where the pumps at the treatment plant were on. The table below shows the comparison between field measurements and the hydraulic model results.

Table 3-10, Model Calibration Results, WTP Pumps On

Test No.	Location (node)	Pump Flow (gpm)	Static Pressure (psi)			Hydrant Flow (gpm)	Residual Pressure (psi)		
			Field	Model	Diff.		Field	Model	Diff.
5	S. Church Rd. (J41)	2,550	96	100.63	4.63	2,014	--	--	--
	Blue Sky Way (J42)	2,550	96	102.26	6.26	0	69	69.66	0.66
	Church Rd. (J20)	2,550	45	49.34	4.34	0	30	32.89	2.89
6	Portal Way (J151)	2,447	80	83.89	3.89	1,931	--	--	--
	Portal Way (J152)	2,447	80	83.46	3.46	0	50	46.8	-3.2
	Church Rd. (J20)	2,447	42	45.75	3.75	0	36	39.68	3.68
7	Smith Rd. (J297)	2,340	60	67.33	7.33	1,622	--	--	--
	Windward School (J321)	2,340	62	68.25	6.25	0	38	42.72	4.72
	Church Rd. (J20)	2,340	38	48.27	10.27	0	37	39.99	2.99
8	Rural Ave. (J281)	2,350	90	93.41	3.41	1,987	--	--	--
	Rural Ave. (J282)	2,350	90	93.71	3.71	0	63	62.77	-0.23
	Church Rd. (J20)	2,350	42	48.15	6.15	0	36	39.63	3.63

The average psi difference for the model's static conditions is just over 5 psi, and less than 2 psi for the residual pressures compared to field measurements. Field pressure measurements with the pumps on fluctuated during the tests. The static pressures fluctuated more, probably because the pumps were on and system demands were low. In this condition relatively small changes in demand can cause the pressure to change. The pressures shown were the best estimates of average. An emphasis was placed on the residual pressures as that more closely represents a large demand condition such as a fire. Based on the pressure differences from the tables above, the model is considered to be calibrated.

Peak Hour Analysis

Water systems must maintain a minimum pressure of 30 psi in the distribution system under peak hour demand conditions, and under the condition that all equalizing storage is depleted and all sources are operating in accordance with WAC 246-290-230(5). The City's development standards state that the minimum pressures allowed by the City is 40 psi under instantaneous demand. Instantaneous demand is interpreted to be equivalent to peak hour demand.

The model shows the City can provide the desired 40 psi at all locations with the exception of the following locations:

- Near the intersection of Church Rd. and Main St. and near Meadow View Ct.
- Sunrise St. between Vista Dr. and Malloy Ave. (in the Mid-Sub Pressure Zone)

Although these locations do not meet to City's requirement of 40 psi, they do meet the minimum DOH requirement of 30 psi.

Projected 6 year demands increase the peak hourly demands of the system, but do not significantly impact the City's ability to provide the desired 40 psi pressure. The model does not show any additional areas that do not meet the City's requirements of 40 psi.

Projected 20 year demands increase the peak hourly demands even more, but again do not significantly impact the City's ability to provide the desired 40 psi pressure. The model shows the following areas, in addition to the areas listed above, do not meet the 40 psi pressure requirement:

- Near the intersection of Seamount Dr. and Vista Dr.
- Near the intersection of Hillside Dr. and Malloy Ave. (in the Mid-Sub Pressure Zone)

Again, although these locations do not meet to City's requirement of 40 psi, they do meet the minimum DOH requirement of 30 psi.

Fire Suppression System Analysis

Without the pumps at the WTP operating, the hydraulic model shows that some portions of the distribution system are unable to meet the fire flow requirements of Section 3.1.5.

With the pumps at the WTP operating, the hydraulic model shows the City can supply the fire flows listed in Section 3.1.5, however, in some cases, the City cannot supply the flows for the durations listed. This deficiency is a function of both supply and storage.

Supply

In accordance with Section 8.2.3 of the DOH *Water System Design Manual, December 2009,* the most important and largest capacity pump is assumed to be out of service. In this case, the most important and largest capacity pump is the Douglas Well at 1,300 gpm. Therefore, under these conditions, the system will only be supplied by the Shop Well at 870 gpm plus any additional wells that may be installed in the future.

Storage

The fire suppression storage is limited to the capacity of the City's clear well at the WTP, approximately 304,400 gallons. Once this storage is depleted, the increased pressure provided by the WTP pumps is no longer available. As previously stated, some areas of the distribution system are unable to meet the higher fire flow requirements without the WTP pumps. With another well source supplying the clear well, the WTP pumps will be able to operate for the full four hour fire flow period. The need for additional storage can be offset by additional wells.

Table 3-11 summarizes the available fire suppression.

Table 3-11, Fire Suppression System Analysis

WTP Flow			Available Volume (gal)	Available Duration (min)	Available Duration (hours)
In (gpm)	Out (gpm)	Net (gpm)			
870	2,800	-1,930	304,400	157.72	2.63
870	1,000	-130	304,400	2,341.54	39.03
870	2,000	-1,130	304,400	269.38	4.49
870	3,000	-2,130	304,400	142.91	2.38
870	3,404	-2534	304,400	120.11	2.00
870	2,561	-1691	304,400	180.06	3.00
870	2,139	-1269	304,400	239.82	4.00

The City has the ability to expand the clear well by modifying the existing, unused raw water storage facility. This would increase the available volume by approximately 150,000 gallons. This increases the City's ability to provide 3,000 gpm fire flow plus MDD demands from 2.38 hours to 3.55 hours, still slightly below the City fire flow requirements listed in Section 3.1.5.

3.4 SUMMARY OF SYSTEM DEFICIENCIES

The following sections provide a brief summary of system deficiencies. Capital improvements required to correct the deficiencies are identified and discussed further in Chapter 8.

3.4.1 Water Rights

With current conservation, the City's existing water rights are adequate for the projected 20 year planning period. See Table 2-18, of Chapter 2, Section 2.2.6. It is anticipated that additional water rights will be needed near the end of that period.

3.4.2 Water Quality

The City is in compliance with all water quality regulations and monitoring requirements. New well water will be required within the 20 year planning period, and it must meet the requirements listed in Section 3.3.1.

3.4.3 Source

The City's wells can produce adequate quantity of water to meet Maximum Day Demand until approximately 2032. At that time additional well and pump capacity will be required. However additional wells are required for backup purposes. See Section 3.3.1.

3.4.4 Storage

In general, the City will require additional storage for the 6 and 20 year planning periods. To meet their storage goals, approximately 3.3 million gallons of additional storage will be needed for the 20 year planning period. A detailed analysis of the City's storage capacity and future requirements can be found in the City's *Water Supply and Storage Alternative Analysis* in Appendix N.

3.4.5 Distribution System

The distribution system in general is in good condition. Some areas of the distribution system, including booster pump stations are aging and in need of repair or replacement. With few exceptions, the distribution system is able to provide a minimum of 40 psi throughout the City. The required fire flow can be provided throughout most of the City as well. Improvements to correct system fire flow deficiencies are identified in Table 3-12 and are shown on the water system map.

3.5 ANALYSIS OF DEFINED IMPROVEMENT PROJECTS

The table in this section lists the deficiencies to the existing system, based upon the *Water Supply and Storage Alternative Analysis* in Appendix N, and the hydraulic analysis in Appendix G. Each item in the table has a number referencing it to the location of the planned improvements as shown on the Water System Map. The Water System Map shows the location and size or type of improvement recommended. The improvements on the map are color coded to correspond with the anticipated time of annexation as described in the City's *Annexation Blueprint, Annexation Phasing Plan: 2013-2034*. See Appendix M.

Improvements shown in Table 3-12 are intended to represent improvements that must be made to meet fire flow requirements, improve system reliability, increase minimum operating pressures, or expand into short-term Urban Growth Areas (UGA) after annexation. Locations are shown on the Plan Reference Number on the Water System Map.

Table 3-12 lists deficiencies in the existing system.

Table 3-12, Existing System Deficiencies

Plan Ref. No.	Category	Deficiency
1	Pumping	Church Rd. Pump Station Improvements
2	Pumping	Thornton Rd. Pump Station Improvements
3	Source	Central City Well Treatment & Activation
4	Source	New City Shop Well
5	Distribution	Malloy Village to Sampson Rope
6	Distribution	Guinevere St. to Washington St.
7	Distribution	Washington St. between Main St. & Vista Dr.
8	Distribution	Nordic Way to Hovander Rd.
9	Source	Thornton Rd. Well Treatment and Activation
10	Distribution	Thornton Rd. under I-5
11	Distribution	Thornton Rd. from Malloy Ave. to BNSF
12	Source	Install Additional Well
13	Storage	Expand Clear Well
14	Source	Intertie

15	Distribution	Connecting Main St. to S. Church Rd.
16	Distribution	Ferndale Terrace Pressure Zone
17	Distribution	Along Slater Rd. & Rural Ave.
18	Distribution	Along Malloy Rd. **To be in Mid Pressure Zone*
19	Distribution	Slater Rd. UGA Transmission Main
20	Distribution	Along Malloy Ave. & Portal Way to Grandview Rd. (SR 548)
21	Distribution	Along Aldergrove Rd. & Trigg Rd. to Portal Way
22	Distribution	Along Church Rd. to Aldergrove Rd.
23	Storage	New Water Storage Reservoir
24	Distribution	Along Malloy Ave.
25	Distribution	From Argyle St. to Church Rd.
26	Distribution	From Thornton Rd. to Glenmore St.
27	Distribution	Along Thornton St. & Hatton Pl.
28	Distribution	Connecting Mountainview Rd. to Lakeridge Dr.
29	Distribution	Along Hendrickson Ave.
30	Distribution	Along Main St. and Mountainview Rd.
31	Distribution	Mountain Vista Park
32	Distribution	Along Riverside Dr.
33	Distribution	Near Samuel's Furniture
34	Distribution	Along Northwest Dr.
35	Distribution	Along Hovander Rd.
36	Distribution	East of Nordic Way
37	Distribution	Hempler Food Group to Nordic Way
38	Storage	New Water Storage Reservoir
39	Distribution	Along Byers Rd. & Pacific Pl.
40	Distribution	Along Labounty Rd.
41	Distribution	Between Lincoln Dr., Malloy Ave., & N. Beulah Ave.
42	Distribution	Along Sunrise St.
43	Distribution	Along Pacific Hwy.
44	Distribution	Near Graveline Rd.

CHAPTER 4
WATER USE EFFICIENCY PROGRAM AND WATER RESOURCE ANALYSIS

4.0 OBJECTIVE

The objective of this chapter is to develop a conservation program that will promote efficient water use, ensure adequate water rights are secured for existing and future needs, promote system reliability, and describe existing and proposed interties. Applicable state laws include RCW 90.03.005, .080, 383(3), and .400, RCW 43.20.230, and .235; RCW 43.70.310, RCW 43.27A.090(6), RCW 90.44.110, Chapter 90.46 RCW, RCW 90.54.020(2)(6), .050 and .180, as well as WAC 246-290-100 and Chapter 173-590 WAC.

4.1 WATER USE EFFICIENCY PROGRAM

4.1.1 Current Program

In 2008, the City established a water use efficiency goal of reducing peak month water consumption by 1 percent each year for the next 6 years (until 2014).

In 2014, the City modified that goal to reduce seasonal outdoor use by 1 to 2 percent each year for the next 6 years (until 2020). Every summer between June 15 and September 15 customers are asked to voluntarily reduce outdoor water use by restricting watering to every other day, with even-numbered addresses irrigating only on Tuesday, Thursday, and Saturday and odd-numbered addresses irrigating only on Wednesday, Friday, and Sunday. Recognized outdoor water use exceptions are:

- Watering outdoor potted plants and hanging baskets
- Watering newly planted lawns
- Watering flower and vegetable gardens
- Watering at golf courses and turf farms
- Properly operating drip irrigation systems

The City provided notice of this conservation program to its customers via the local newspapers, bill inserts, homeowner association newsletters, and the City's web page (www.cityofferndale.org). The City also made available, for free, upon request, to any Ferndale water customer a rain/watering gauge that measures the number of inches of water applied during irrigation.

4.1.2 Estimated Water Savings

Using the City's authorized consumption figures from the Water Use Efficiency Reports the reduction in consumption can be calculated and seen in the table below.

Table 4-1, Estimated Water Savings

Year	Reporting Period	[1]Authorized Consumption (gal)	Reduction (gal)	Reduction (%)
2009	12/01/2008 to 11/30/2009	341,881,826	--	--
2010	12/01/2009 to 11/30/2010	297,600,206	-44,281,620	-12.95
2011	11/30/2010 to 12/01/2011	260,283,804	-37,316,402	-12.54
2012	12/01/2011 to 11/30/2012	326,148,828	65,865,024	25.31
2013	12/01/2012 to 11/30/2013	341,934,388	15,785,560	4.84
2014	12/01/2013 to 11/30/2014	396,177,084	54,242,696	15.86

[1]Figures from Water Use Efficiency Annual Performance Reports

4.2 SOURCE AND SERVICE METERS

4.2.1 Source Meters

The City's main source of supply is groundwater from the wells located near the City Shop and at Douglas Rd. Each source is metered separately and is continuously monitored. The wells pump directly to the City's Water Treatment Plant where the water is metered before entering the treatment process.

Typically this meter data is collected daily but can be recompiled to other time periods such as monthly or weekly. The meters are inspected periodically and calibrated as necessary as part of the maintenance program for the City's Water Treatment Plant. (The meters are at the well house, before treatment.)

4.2.2 Service Meters

All service connections are metered. Older meters are replaced on a routine schedule. Compound meters are tested and serviced regularly.

4.3 WATER RIGHT EVALUATION

4.3.1 Water Right Self-Assessment

The City has water rights for four wells. A summary for the wells is shown below.

Table 4-2, City of Ferndale, Existing Water Rights

Right/Permit	Description	Quantity
GWC 3058	City Shop	870 gpm 440 ac-ft/yr
GWC 1513	Douglas Rd.	1,000 gpm 1,615 ac-ft/yr
G1-00720P	Douglas Rd.	1,000 gpm 1,614 ac-ft/yr[1]
GWC 7700	Central City	60 gpm 85 ac-ft/yr
Total	--	2,930 gpm 2,140 ac-ft/yr[1]

Source: Washington State Department of Ecology, Water Resources, August, 2015.
[1]The maximum annual volume (Q_a)

The City submitted several applications for change/transfer of water rights to the Department of Ecology (DOE)requesting that the point of diversion/withdrawal for all water rights be applied to multiple locations throughout the city limits. This request has been granted and the changes are shown in Appendix I.

Detailed water rights information including Water Rights Self-assessments forms for the City's existing status, 6 year forecast, and 20 year forecast can be found at the back of this chapter.

4.3.2 Water Rights, Current Water Usage, and Projected Needs

Generally demand follows the increases in the spring, peaks during the summer months, and then begins to drop as fall approaches. Average bi-monthly usage for the entire system is approximately 56 MG, peak bi-monthly use averages 71 MG. Due to the unseasonably hot and dry conditions, 2015, demand was higher than normal in during the spring months, then peaked notably higher than previous years. The figure below clearly shows the relationship between 2015 and the previous years. Average bi-monthly usage for the entire system for 2015 is approximately 60 MG, peak bi-monthly use was roughly 88 MG.

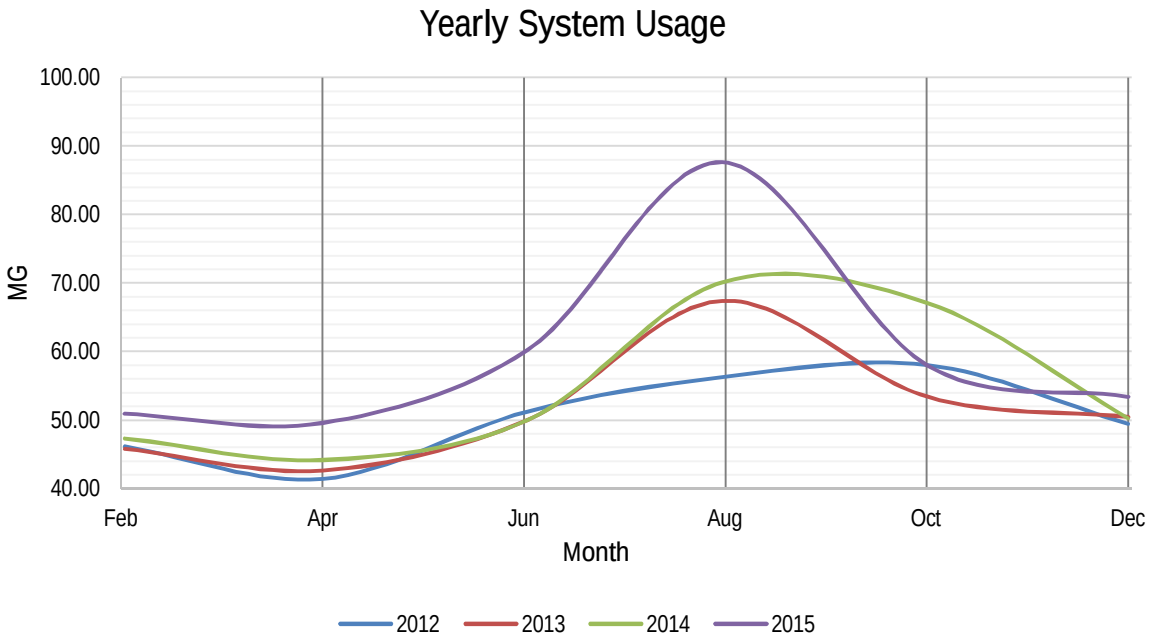


Figure 4-1, Yearly System Usage

Existing water rights can be seen above in Table 4-2. It is anticipated that the City will take advantage of reclaimed water for irrigation uses on some City parks and other public property within the 20 year planning period. Therefore, existing water rights are considered adequate for the 6 and 20 year planning periods (with conservation). See Table 4-3 below.

Table 4-3, Forecasted Water Demands

		ADD (MGD)		MDD (MGD)		PHD (GPM)		Annual (AC-FT/YR)	
Year	ERUs	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons
2013	6,286	1.08	1.08	1.91	1.91	2,194	2,194	1,205	1,205
2014	6,574	1.13	1.13	1.91	1.91	1,300	1,300	1,265	1,265
2015	6,611	1.21	1.21	2.07	2.07	2,366	2,366	1,356	1,356
2016	6,802	1.19	1.26	2.07	2.21	2,371	2,526	1,334	1,410
2017	6,998	1.22	1.29	2.13	2.27	2,438	2,596	1,372	1,451
2018	7,194	1.26	1.33	2.19	2.34	2,504	2,667	1,411	1,491
2019	7,390	1.29	1.37	2.25	2.40	2,571	2,738	1,449	1,532
2020	7,586	1.33	1.40	2.31	2.47	2,637	2,809	1,488	1,573
2021	7,908	1.38	1.46	2.41	2.57	2,746	2,925	1,551	1,639
2022	8,607	1.51	1.59	2.63	2.80	2,983	3,177	1,688	1,784
2036	10,770[1]	1.88	1.99	3.28	3.50	3,716	3,958	2,112	2,232

[1]By the year 2036 it is assumed that reclaimed water will make up approximately 50% of the irrigation ERUs (582 ERUs). The Demand figures above in Table 4-3account for this.

4.4 SOURCE OF SUPPLY ANALYSIS

Water source alternatives and emergency intertie alternatives are discussed extensively in the City's *Water Supply and Storage Alternative Analysis*. A copy of this report can be found in Appendix N.

4.4.1 Water Supply and Demand Characteristics

In general, 2015 was an unseasonably hot and dry year. Demand for the system as a whole was greater than previous years. This is illustrated above in Figure 4-1. Of the four customer classes the City serves, two of the four class demands were notable higher; Single-Family and Irrigation. This in turn caused an increase in system supply. Water supplied to the system is shown in Figure 4-2.

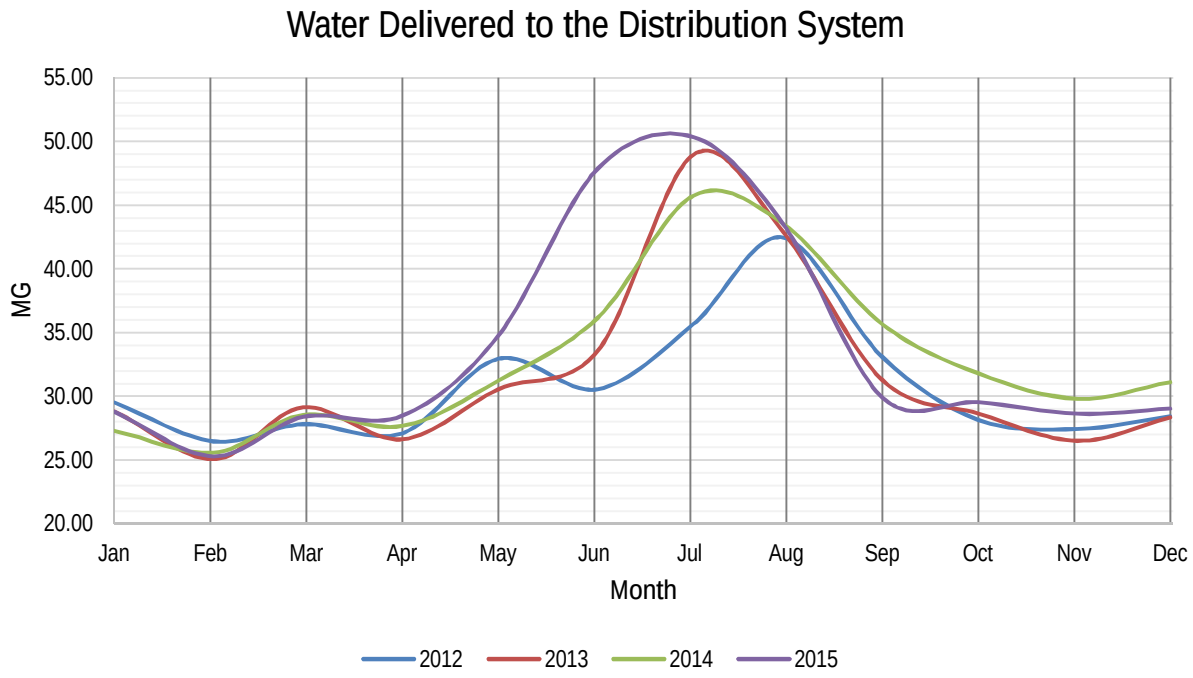


Figure 4-2, Water Delivered to the Distribution System, MG

A brief description of each customer class follows.

Single-Family Residences

Single-family use accounts for approximately 65% of the water sold by the City, and is the most seasonally variable use of the customer classes. Generally demand follows the increases in the spring, peaks during the summer months, and then begins to drop as fall approaches. Average bi-monthly use is roughly 35 MG, peak bi-monthly use averages 45 MG.

Multi-Family Residences

Multi-family use accounts for approximately 12% of the water sold by the City. Demand follows the typical seasonal peak, however the peaks are not as drastic as those seen in the single-family demands. Average bi-monthly use is more or less 6 MG, while the average peak bi-monthly use is slightly over 7MG.

Commercial/Industrial Connections

Commercial and Industrial use accounts for approximately 18% of the water sold by the City. Average bi-monthly use is just under 10 MG; the average peak bi-monthly use is slightly under 12 MG. Generally, use is consistent with a slight increase in use during the summer months.

Irrigation Connections

Irrigation use accounts for approximately 5% of the water sold by the City. Average bi-monthly use is just under 3 MG; the average peak bi-monthly use is slightly under 15 MG. Use is very minimal throughout the beginning of the year and begins to increase around April and peak in August.

The relationship between each of the customer classes for 2015 is shown in Figure 4-3.

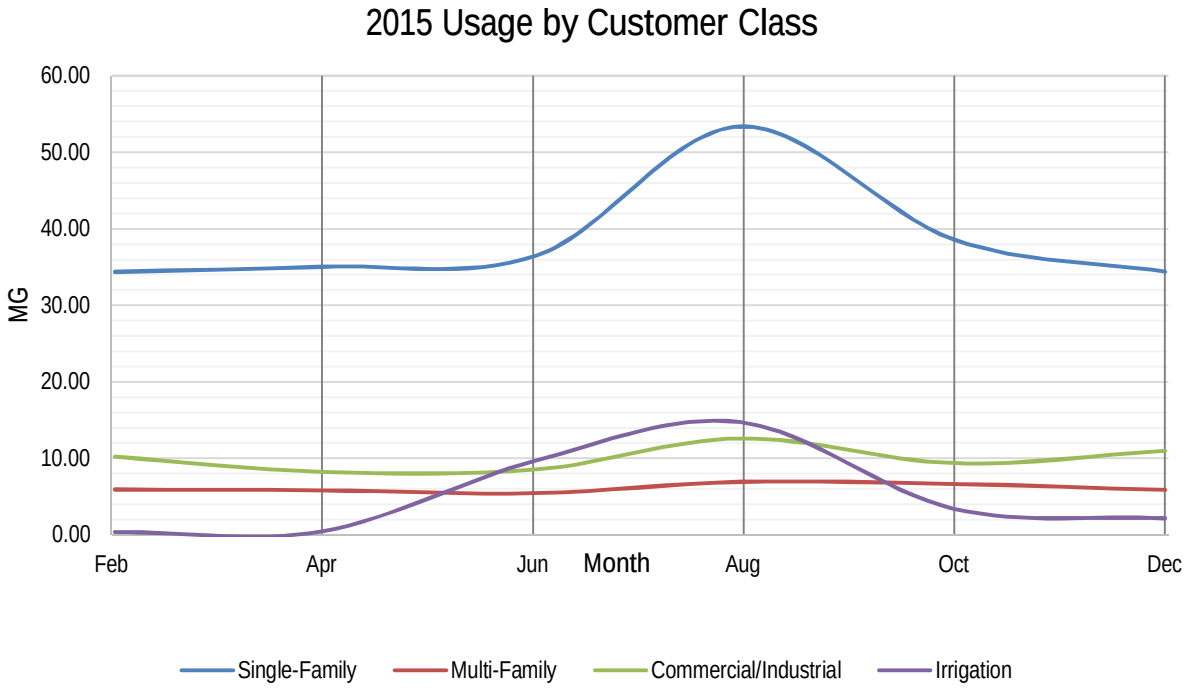


Figure 4-3, 2015 Usage by Customer Class

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Table 1

WATER SYSTEM PLAN
WATER RIGHTS SELF ASSESSMENT – EXISTING STATUS

PERMIT CERTIFICATE OR CLAIM #	NAME ON DOCUMENT	PRIORITY DATE (List oldest first)	SOURCE NAME/ NUMBER	ANY PORTION SUPPLEMENTAL? (If yes, explain in footnote)	EXISTING WATER RIGHTS		EXISTING CONSUMPTION		CURRENT WATER RIGHT STATUS (Excess/Deficiency)	
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Permits/ Certificates										
1. GWC 1513	Ferndale	5/9/1952	Douglas	No	1,000 gpm	1,615 af	1,000 gpm	1,062 af	0 gpm	553 af
2. GWC 3058	Ferndale	2/28/1955	Shop	No	870 gpm	440 af	870 gpm	278 af	0 gpm	162 af
3. GWC 7700	Central City	3/10/1970	Central City	No	60 gpm	85 af	0 gpm	0 af	60 gpm	85 af
4. G1-00720P	Ferndale	7/22/1971	Douglas	No	1,000 gpm	1,614 af	0 gpm	1,614 af	1,000 gpm	1,614 af
Claims 1.										
2.										
3.										
4.										
TOTAL	**********	*********	*********	**********	2,930 gpm	2,140 af*	1,870 gpm	1,340 af*	1,060 gpm	800 af*

INTERTIE NAME/ IDENTIFIER	NAME OF PURVEYOR PROVIDING WATER	EXISTING LIMITS ON INTERTIE USE		EXISTING CONSUMPTION THROUGH INTERTIE		CURRENT INTERTIE SUPPLY STATUS (Excess/Deficiency)	
		Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
1.							
2.							
3.							
4.							
TOTAL	**********						

PENDING WATER RIGHT APPLICATION (New/Change)	NAME ON APPLICATION	DATE SUBMITTED	ANY PORTION SUPPLEMENTAL? (If yes, explain in footnote)	PENDING WATER RIGHTS	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested
1					
2.					
3.					
4.					

. * Per Water Rights Certificates and Permits the maximum amount of withdrawal from all four water rights shall not exceed 2,140 AF per year.

Please return completed form to the Office of Drinking Water regional office checked below.

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Fax: (509) 329-2104

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Table 2

WATER SYSTEM PLAN
WATER RIGHTS SELF ASSESSMENT – 6 YEAR FORECAST

PERMIT CERTIFICATE OR CLAIM #	NAME ON DOCUMENT	PRIORITY DATE (List oldest first)	SOURCE NAME/ NUMBER	ANY PORTION SUPPLEMENTAL? (If yes, explain in footnote)	EXISTING WATER RIGHTS		FORECASTED WATER USE FROM SOURCES (6-year Demand)		FORECASTED WATER RIGHT STATUS (Excess/Deficiency)	
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Permits/ Certificates										
1. GWC 1513	Ferndale	5/9/1952	Douglas	No	1,000 gpm	1,615 af	1,000 gpm	600 af	0 gpm	1,015 af
2. GWC 3058	Ferndale	2/28/1955	Shop	No	870 gpm	440 af	870 gpm	403 af	0 gpm	37 af
3. GWC 7700	Central City	3/10/1970	Central City	No	60 gpm	85 af	60 gpm	85 af	0 gpm	0 af
4. G1-00720P	Ferndale	7/22/1971	Douglas	No	1,000 gpm	1,614 af	1,000 gpm	600af	0 gpm	1,014 af
Claims 1.										
2.										
3.										
4.										
TOTAL	**********	********	********	**********	2,930 gpm	2,140 af *	2,930 gpm	1,688 af	0 gpm	452 af *

INTERTIE NAME/ IDENTIFIER	NAME OF PURVEYOR PROVIDING WATER	EXISTING LIMITS ON INTERTIE USE		FORECASTED CONSUMPTION THROUGH INTERTIE		FORECASTED INTERTIE SUPPLY STATUS (Excess/Deficiency)	
		Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
1.							
2.							
3.							
4.							
TOTAL	**********						

PENDING WATER RIGHT APPLICATION (New/Change)	NAME ON APPLICATION	DATE SUBMITTED	ANY PORTION SUPPLEMENTAL? (If yes, explain in footnote)	PENDING WATER RIGHTS	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested
1.					
2.					
3.					
4.					

* Per Water Rights Certificates and Permits the maximum amount of withdrawal from all four water rights shall not exceed 2,140 AF per year.

To return form, please see reverse side.

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☐ Eastern Drinking Water
Department of Health
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Spokane Valley, WA 99216
Phone: (509) 329-2100
Fax: (509) 329-2104

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Table 3

WATER SYSTEM PLAN
WATER RIGHTS SELF ASSESSMENT – 20 YEAR FORECAST

PERMIT CERTIFICATE OR CLAIM #	NAME ON DOCUMENT	PRIORITY DATE (List oldest first)	SOURCE NAME/ NUMBER	ANY PORTION SUPPLEMENTAL? (If yes, explain in footnote)	EXISTING WATER RIGHTS		FORECASTED WATER USE FROM SOURCES (20-year Demand)		FORECASTED WATER RIGHT STATUS (Excess/Deficiency)	
					Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Permits/ Certificates										
1. GWC 1513	Ferndale	5/9/1952	Douglas	No	1,000 gpm	1,615 af	1,000 gpm	793 af	0 gpm	14 af*
2. GWC 3058	Ferndale	2/28/1955	Shop	No	870 gpm	440 af	870 gpm	440 af	0 gpm	0 af
3. GWC 7700	Central City	3/10/1970	Central City	No	60 gpm	85 af	60 gpm	85 af	0 gpm	0 af
4. G1-00720P	Ferndale	7/22/1971	Douglas	No	1,000 gpm	1,614 af	1000 gpm	794 af	0 gpm	14 af*
Claims 1.										
2.										
3.										
4.										
TOTAL	**********	********	********	**********	2,930 gpm	2,140 af *	2,930 gpm	2,112 af	0 gpm	28 af*

INTERTIE NAME/ IDENTIFIER	NAME OF PURVEYOR PROVIDING WATER	EXISTING LIMITS ON INTERTIE USE		FORECASTED CONSUMPTION THROUGH INTERTIE		FORECASTED INTERTIE SUPPLY STATUS (Excess/Deficiency)	
		Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
1.							
2.							
3.							
4.							
TOTAL	**********						

PENDING WATER RIGHT APPLICATION (New/Change)	NAME ON APPLICATION	DATE SUBMITTED	ANY PORTION SUPPLEMENTAL? (If yes, explain in footnote)	PENDING WATER RIGHTS	
				Maximum Instantaneous Flow Rate (Qi) Requested	Maximum Annual Volume (Qa) Requested
1					
2.					
3.					
4.					

* Per Water Rights Certificates and Permits the maximum amount of withdrawal from all four water rights shall not exceed 2,140 AF per year.

DOH Form 331-373 (Updated 08/10)

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CHAPTER 5
SOURCE WATER PROTECTION

5.0 OBJECTIVE

The objective of this chapter is to develop a program to protect, and if possible, improve, source waters used by public water systems. This is accomplished by identifying, monitoring, limiting and controlling (to the extent feasible), all facilities and activities within the watershed or zone of contribution which may adversely impact source water quality. Source water protection for Group A systems is required under WAC 246-290-135, -668 and -690.

5.1 WELLHEAD PROTECTION PROGRAM

The City of Ferndale has contracted with Wilson Engineering, LLC and Associated Earth Sciences, Inc. to develop a wellhead protection plan. The summary as prepared by the aforementioned firms is as follows:

> *"This report summarizes the results of the work done to characterize the aquifer utilized by the City of Ferndale water supply wells. It also investigates and discusses risks of contamination to the water supply wells by delineating 1, 5, and 10 year time of travel (TOT) boundaries and creating an inventory of existing and potential contaminant sources within those boundaries (the Wellhead Protection Area, or WPA). The potential and known contamination sources at or near the ground surface will not be seen in the aquifer for several decades because the Regional Aquifer is separated from surface sources by a thick layer of low permeability sediments. Other public and private groundwater wells that are directly connected to the Regional Aquifer present more immediate risks if contamination is introduced into a well casing. This report also discusses management strategies to minimize risk of contamination of the aquifer."*

The report goes on to provide a description of the supply wells, susceptibility assessment, wellhead protection area delineation, potential contamination sources inventory, management strategies, and a contingency plan. A full copy of the wellhead protection plan can be found in Appendix O.

CHAPTER 6
OPERATION AND MAINTENANCE PROGRAM

6.0 OBJECTIVE

The objective of the operation and maintenance program is to assure satisfactory management of water system operations in accordance with WAC 246-290-100, -300, -310, -320, -440, -480, and -490; WAC 246-292-020, -050 and -090.

6.1 INTRODUCTION

The Water Facilities Inventory Form (WFI) for the City's water system was updated on May 9, 2016. According to that document, the water system is classified as a "Group A Community" system. The System ID No. is 24850 M, Owner No. is 001896. A copy of the WFI is provided in Appendix B.

A draft Water Treatment Plant Operations and Maintenance Manual was prepared in 2012 by RH2 Engineering, Inc. after the WTP was refitted to treat groundwater rather than surface water. A copy of the manual is included in Appendix J.

6.2 WATER SYSTEM MANAGEMENT AND PERSONNEL

The City's Public Works Director is responsible for operations of the water system. Duties include general oversight of all activities, budget formulation, implementation of the improvement program, contact with the public/press, responding to complaints, and review/approval of billings. The Public Works Director is also responsible for responding to emergencies related to the water system and development/implementation of the cross-connection control program.

The Chief Water Treatment Plant Operator/Distribution Manager's main responsibility is to operate and maintain the water treatment plant so that Maximum Contaminant Levels (MCLs) and Maximum Residual Disinfectant Levels (MRDLs) are satisfied in accordance with WAC 246-290-310. As the water treatment plant operator, duties include preventative maintenance at the treatment plant and water quality monitoring. As the water distribution manager responsibilities include operating and maintaining the City's water system including reservoirs, pump stations, valves, and piping within public right-of-way or easements.

6.3 OPERATOR CERTIFICATION

6.3.1 Classification of Public Water System

Water Treatment Plant

WAC 246-292-040 classifies water treatment plans according to the point system in the ABC *Purification Plant Criteria* (October 2007) and can be seen in the table below.

Table 6-1, Water Treatment Plant Classification

Total Points Assigned	Water Treatment Plant Classification
Less than 31	Class 1
31 to 55	Class 2
56 to 75	Class 3
More than 75	Class 4

The Washington State Department of Health (DOH) provide a Purification Plant Criteria Worksheet. A copy of the filled out worksheet can be found at the end of this chapter. The City's WTP is Class 2.

Distribution System

WAC 246-292-040 classifies distribution systems according to the population served on the systems WFI form. The classifications can be seen in the following table.

Table 6-2, Water Treatment Plant Classification

Population Served	Distribution System Classification
Less than 251	Class S
251 to 1,500	Class 1
1,501 to 15,000	Class 2
15,001 to 50,000	Class 3
More than 50,000	Class 4

A 2016, WFI shows the City has a full-time residential population of 12,921. Therefore the City's distribution system is classified as Class 2.

Requirements

Based on the classification of the WTP and the distribution system, the City is required to have a least one certified operator in charge of the WTP with a minimum operator certification of WTPO 2, and one certified operator in charge of the distribution system with a minimum operator certification of WDM 2.

The City is also required to designate a cross-connection control specialist (CCS) to be in charge of a public water system's cross-connection control program, and have a backflow assembly tester (BAT) to ensure compliance with cross-connection requirements.

In summary, the City is required to have the following:

- Water Treatment Plant Operator, WTPO 2
- Water Distribution Manager, WDM 2
- Cross-Connection Control Specialist, CCS

The City is also required to have a designated Backflow Assembly Tester (BAT) available when periodically needed. This is contracted out to Ron Main as needed.

Current Staff and Certification

Operator Certifications and contact information for City Staff are provided below.

Table 6-3, Staff Certifications and Contract Information

Name	Title	Active Certifications	Contact Numbers
Kevin Renz	Public Works Director	--	W: (360) 685-2376 C: (360) 603-0348
Mike Olinger	Chief Water Plant Operator Distribution Manager	WTPO 3 WDM 2 CCS 1	W: (360) 384-4607 C: 360-815-1508
Jason Valley	Water Plant Operator	WTPO 3 WDM 2 CCS 1	W: (360) 384-4607
Dennis O'Shaughnessy	Water Plant Operator	WTPO 2 WDM 2 CCS 1	W: (360) 384-4607
Jesse Winder	Water Plant Operator	WTPO 2 WDM 1	W: (360) 384-4607

Note that the City does not have a certified BAT on staff nor does it have the necessary equipment to inspect and field test backflow prevention assemblies. This work is contracted to Rob Main of On-Site Backflow and Cross Connection Control Services in Bellingham.

The City supports training to ensure that operators comply with professional growth acceptable to DOH. Each certified operator accomplishes the following:

- Accumulates a minimum of three (3) continuing education units (CEUs) or college credits for training relevant to the operation, maintenance, or management of the water system and have an influence on water quality, water supply, or public health protection.
- Advances by examination in the Water Works Operator Certification Program to a level 2, 3, or 4 or achieve certification by examination as defined in the Water Works Operator Certification regulations.

6.4 SYSTEM OPERATION AND CONTROL

6.4.1 Identification of Major System Components

Major components to the existing water system are shown on the attached Water System Map. Major components include:

- The City's Wells
  - Shop Well
  - Douglass Rd. Well
  - Central City Well (not currently connected to the distribution system)
- The Water Treatment Plant
  - Greensand Filtration
  - Reverse Osmosis

    - The City generates a 0.8% sodium hypochlorite solution. This replaces the chlorine gas and related equipment that was associated with the treatment of surface water.
- Two (2) above ground storage reservoirs:
    - Reservoir No. 1 (Thornton) – Approx. 950,000 gallons
    - Reservoir No. 2 (Bakerview) – Approx. 1.7 million gallons
- Three (3) multiple pump booster pump stations
    - Thornton Rd. (adjacent to Tank No. 1)
    - Church Rd.
    - Bakerview (adjacent to Tank No. 2)
- Pressure reducing valves strategically located to maintain six (6) pressure zones
- Transmission and distribution piping including isolation valves and hydrants

6.4.2 Routine System Operation

Groundwater

The City has two wells. Both wells deliver water directly to the water treatment plant via a dedicated main. Both wells are connected directly to the distribution system as well, however the connections are normally closed.

- The Shop Well is located at the City's public works yard.
- The Douglas Well is located on City owned property along the south side of Douglas Rd., just west of the intersection of Douglas Rd. and Imhoff Rd.
- The well water does not exceed the MCLs for primary drinking water standards.
- The well water exceeds the MCL for manganese for secondary drinking water standards.
    - Note: Secondary contaminants are not health threatening and are associated with aesthetic, cosmetic, and technical effects.

Telemetry

The City's telemetry system, located at the water treatment plant, allows the operators to monitor and control operations, treatment functions at the City's plant, and pumps throughout the water system. If there is an emergency, the telemetry equipment initiates an alarm that alerts on-call City personnel.

Treatment

The City's water treatment plant has the capacity to treat 4.12 MGD. An overview of the treatment process follows:

- Influent from the City's wells flows to the plant where the raw water is split between two treatment processes.
    - Greensand Filter – The City uses two banks of greensand filters in a configuration of parallel groups of four to remove manganese. Small amounts of iron are also removed by the filters. Chlorine is added to the raw water prior to treatment.
    - Reverse Osmosis – The City uses two skids to remove hardness. Manganese is also removed through the reverse osmosis process. Chlorine is not added to the raw water prior to treatment. The City has a third skid in place without the membranes installed. This third
- Water from the reverse osmosis units is dosed with chlorine after treatment then blended with the effluent from the greensand filters to attain the desired residual.
- The treated water flows to the clear well from which it is pumped to the distribution system.
- The chlorine residual is monitored leaving the clear well and can be post-chlorinated if required.

Storage

The City maintains two (2) above ground storage reservoirs and an in ground clear well.

Reservoir 1 is a 950,000 gallon concrete tank situated east of the intersection of Vista Drive and Thornton Road. It has a diameter and height of 83 and 23.5 feet, respectively. It is filled by the pumps at the water treatment plant. The set point is 1.5 feet below full tank level.

Reservoir 2 is a 1.7 MG steel tank south and east of Thornton Road and Church Road. It is 85 feet in diameter and 41.5 feet tall. It is filled either from both the pump station at Reservoir 1 and the Church Road Pump Station (described in the next section). Similar to Reservoir 1, the set point is 1.5 feet below full tank level.

The clear well is an in ground concrete reservoir at the WTP, approximately 304,000 gallon capacity. It is 78 feet long and 57.33 feet wide. It is filled by the WTP after treatment. The bottom 5 feet are considered dead storage to avoid pump cavitation. Treatment of the well water, and therefore filling of the clear well will stop at approximately 14 feet above the floor of the clear well.

Pumps

The City's water system includes pumps at the water treatment plant and at the three (3) booster stations described below.

Water Treatment Plant

Treated water is delivered from the treatment plant to the distribution system by three (3) vertical turbine pumps; one rated for 3,250 gpm and a TDH of 250 feet, two rated for 1,600 gpm and a TDH of 250 feet. They operate depending on the water levels of reservoir 1.

Pump Station No. 1

Pump Station No. 1 is located adjacent to reservoir no. 1. The pump station contains two (2) vertical turbine pumps rated for 850 gpm and a TDH of 280 feet. Operations are controlled by the water level of reservoir no. 2.

Church Rd. Pump Station

The Church Rd. Pump Station is located in the northwest quadrant of the Mountain View Road and Church Road intersection. It contains two (2) vertical turbine pumps rated for 800 gpm at 356 feet TDH. The pump(s) operate depending on the water system elevations in reservoir no. 2 and only when the pump at the water treatment plant are running.

Bakerview Pump Station

The Bakerview Pump Station is located adjacent to reservoir no. 2. The pump station contains four (4) pumps rated for 1,373 gpm at 50 feet TDH. The pump station is controlled by the pressure in the Bakerview Pressure Zone. The lead pump is set to run continuously. If the lead pump cannot maintain the set point pressure, the lag and lag-lag pumps are sequentially activated to maintain pressure.

Transmission/Distribution System

The transmission/distribution system has evolved as the City has grown. Water mains range in size from less than 2 inches to 20 inches in diameter. Certain water mains will need to be replaced and/or upgraded to satisfy requirements associated with the water system as it expands to meet anticipated growth.

6.4.3 Preventative Maintenance

Filters – Inspected daily, backwashed automatically as controlled by loss of head gauges. Filters can be backwashed on specified time intervals or manually as well. Maintenance is performed in accordance with manufacturer's recommendations.

Sodium Hypochlorite – Sodium hypochlorite is generated onsite and storage in two 1,700 gallon hypochlorite storage tanks. Tank conditions and level are frequently monitored.

Feed Pumps – Inspected daily.

Distribution System – Isolation valves are inspected annually. Pressure Reducing Valves and meters are inspected as needed. The City replaces the older meters throughout the system on a regular schedule.

The transmission/distribution system is flushed, reservoirs are cleaned and pumps and motors serviced as needed. Service meters are replaced on a rotating schedule, meters on commercial and industrial services are checked for accuracy on a routine basis.

6.4.4 Equipment, Supplies, and Chemical Listing

Chemicals kept on hand at the treatment plant follow:

- Chlorine
- Sodium hypochlorite
- Caustic soda
- Media
- Anti-scalants
- Hypochlorous acid

Table 6-4, Risk Assessment Contact Numbers

Organization	Contact	Phone
Electrician	Riteway Electric	360- 733-8672
Electric Utility Company	Puget Sound Energy	888-225-5773
Gas Utility Company	Cascade Natural Gas	360-733-5980
Sewer Utility Company	City of Ferndale	360-384-4006
Telephone Utility Company	Verizon	800-483-2000
Plumber	City of Ferndale	360-384-4006
Pump Specialist	PumpTech	425-644-8501
Utilities Underground Locate Center	Call Before You Dig	360-424-5555
Soil Excavator/Backhoe Operator	City of Ferndale	360-384-4006
Equipment Rental (Generators)	Hertz Rental	360-354-1610
Equipment Rental (Chlorinators)	Jones Chemical	360-274-0104
Equipment Rental (Portable Fencing)	NA	

Equipment Repairman	City of Ferndale	360-384-4006
Radio/Telemetry Repair Service	L2 Systems	425-320-7632
Bottled Water Source	NA	
Bulk Water Hauler	NA	
Pump Supplier	Whitney Equipment	800-255-2580
Well Driller	Tacoma Pump and Drilling	1-888-374-5744
Pipe Supplier	HD Fowler	360-734-8400

6.5 COMPREHENSIVE MONITORING (REGULATORY COMPLIANCE) PLAN

The City of Ferndale is required by DOH to sample water quality at representative locations throughout the distribution system. Sampling parameters are established by federal rule that have been adopted by the State. These parameters are a function of the population served and the type of source(s) used. Monitoring requirements that apply to the City are shown below. The new Federal Ground Water Rule will require additional monitoring and testing. The City will comply with this rule when adopted by the State of Washington.

Table 6-5, Water Quality Monitoring Requirements

	Primary MCL (mg/L)	Secondary MCL (mg/L)	MRDL
Bacteriological			
Fecal Coliform			
E. coli			
Inorganic Chemical			
Antimony (Sb)	0.006		
Arsenic (As)	0.010		
Asbestos	7 million fibers/L longer than 10 microns		
Barium (Ba)	2.0		
Beryllium (Be)	0.004		
Cadmium (Cd)	0.005		
Chromium (Cr)	0.1		
Copper (Cu)	1.3		
Cyanide (HCN)	0.2		
Fluoride (F)	4.0		
Lead (Pb)	0.015		
Mercury (Hg)	0.002		
Nickel (Ni)	0.1		
Nitrate (as N)	10.0		
Nitrite (as N)	1.0		
Selenium (Se)	0.05		
Sodium (Na)	20.0		

Thallium (Tl)	0.002		
Chloride (Cl)		250.0	
Fluoride (F)		2.0	
Iron (Fe)		0.3	
Manganese(Mn)		0.05	
Silver (Ag)		0.1	
Sulfate (SO_4)		250.0	
Zinc (Zn)		5.0	
Physical Characteristics			
Color		15 Color Units	
Specific Conductivity		700 mmhos/cm	
Total Dissolved Solids (TDS)		500	
Disinfection Byproducts			
Total Trihalomethanes (TTHMs)	0.080		
Haloacetic Acids (five) (HAA5)	0.060		
Bromate	0.010		
Chlorite	1.0		
Disinfectants			
Chlorine			4.0 (as Cl_2)
Chloramines			4.0 (as Cl_2)
Chlorine Dioxide			0.8 (as ClO_2)
Radionuclides			
Radium – 226	Combined 5 pCi/L		
Radium – 228			
Gross Alpha Particle Activity	15 pCi/L		
Beta Particle and Photon Radioactivity	4 millirems per year		
Uranium	30 mg/L		
Organic Chemicals			
VOC	X		
SOC	X		

The City currently has one source of water supply; groundwater. The groundwater is pumped from two wells. In emergency conditions, the wells can pump directly into the distribution system. Additional sources of water supply, including emergency interties, are identified in the City's *Water Supply and Storage Alternative Analysis*.

The quality of the raw water from the wells is good. The raw water is in compliance with all primary maximum contaminant levels (MCL), but does exceed the secondary MCL for manganese. Although not a contaminant, the groundwater is also hard, which is an annoyance and an aesthetic issue for the public.

6.5.1 Coliform Monitoring Plan, Water Quality Monitoring and Ground Water Rule

Water quality monitoring requirements for the City of Ferndale's system are established in WAC 246-290-300. These requirements are expected to change when the new Ground Water Rule is adopted and enacted by the State.

Water quality samples are taken in accordance with the Coliform Monitoring Plan included in Appendix H. The City recently annexed the Central City Water Association. This entailed replacing the water mains and services, and tying them into the City's system. The Coliform Monitoring Plan was updated to include this area.

All other testing and monitoring is in accordance with DOH regulations.

6.6 EMERGENCY RESPONSE PROGRAM

The City has a general emergency response program (ERP), which identifies the City's procedures for emergency situations. The current plan identifies the logistics and notification procedures in the event of various types of emergencies. In response to the events of 9/11/01, the Federal government enacted the Public Health Security and Bio-Terrorism Preparedness and Response Act (HR 3448) requiring preparation of vulnerability assessments and preparation or update of ERP's, for public water systems serving populations greater than 3,300 people. A copy of the City's Emergency Response Plan is on file with the Ferndale Public Works Department.

Under emergency situations, all Public Works personnel are available for system operation and maintenance. A notification policy for City personnel is in place. Depending on the type or extent of the problem, the notification process includes emergency services and fire department personnel. An interlocal agreement between the Cities of Ferndale and Bellingham for equipment and emergency supplies is in place.

Other than the two wells, the City has no other supply in case of emergencies. As previously mentioned, additional sources of water supply, including emergency interties, are identified in the City's *Water Supply and Storage Alternative Analysis* in Appendix N. The City has budgeted the cost for an emergency intertie in 2018, (see Chapter 9) but has not yet identified which option it will go with.

6.6.1 Water System Personnel Emergency Call-up List

A contact list is shown in the table below.

Table 6-6, Emergency Contact List

Emergency Contacts	
Contact	Telephone No.
Emergency	911
City of Ferndale - Main Number (Voice message provides emergency contact number for after hours emergencies)	360-384-4302
City of Ferndale – Public Works (Voice message provides emergency contact number for after-hours emergencies)	360-384-4006
Kevin Renz, Public Works Director	360-685-2376 o 360-603-0348
Mike Olinger, Chief Water Plant Operator	360-815-1508
Washington State Department of Health (Location – City of Kent)	253-395-6750 or 877-481-4901
T.V. Stations (Seattle area) KIRO KOMO KING	 800-777-5476 800-477-5666 206-448-4521
Radio Station KGMI)	360-734-9790
Whatcom County Emergency Mgmt.	360-676-6681 or 360-714-3507
North Whatcom Fire & Rescue Services - Business	360-371-2533
Whatcom County Fire District 7 Business	360-384-0303

6.6.2 Notification Procedures

The procedure to notify the city (and public if necessary) under an emergency condition follows:

- Notify City personnel on the type and extent of the problem. If necessary, notify emergency services and the fire department.
- Contact City employees. Depending on the extent of damage to the water system, appropriate areas will be isolated through valves. Repairs will be made in the following order:
  - Wells and Pumps
  - Water Treatment Plant
  - Booster Pump Stations
  - Water Storage Facilities
  - Transmission lines;
  - Distribution lines; and
  - Subdivision and feeder lines to isolated areas

- The type of damage or contamination of the water system will require additional sampling to ensure the water quality is acceptable. If the water quality is not acceptable, the City Administrator will issue a "boil water" order through local media and emergency services to residents of the impacted area including a description of the communication process applicable to after hours, weekends and holidays to obtain status updates.

6.6.3 Vulnerability Assessment

A water system's vulnerability assessment identifies areas of the system, which are in danger of damage or failure during various types of emergency or threat scenarios. The assessment also evaluates alternative operating modes and provides additional emergency response procedures.

On June 12, 2002, the President of the United States signed the Public Health Security and Bioterrorism Preparedness and Response Act (PL. 107-188). Section 1433(a) of the act requires water systems that serve a population of more than 3,300 people to complete a Vulnerability Assessment (VA). These water purveyors must also certify to the US EPA that the VA has been completed, and submit a copy the EPA. In January 2003, the US EPA finalized guidance for preparation of a VA.

The size of the City of Ferndale's water system dictates that the City complete a vulnerability assessment. The City has completed the required Assessment and maintains the information on file at the Public Works Office. The Assessment contains information specific to City facilities, treatment techniques and personnel. This information is considered confidential and has been excluded from this plan. The City maintains the information in a separate document, which is kept secure by City staff.

6.6.4 Contingency Operational Plan

The City's water supply system is operated manually through the control of the City's wells. The distribution system is operated automatically via telemetry and radio communication. If operation of these systems is interrupted, the City staff can operate the distribution system manually. The staff members can control the well pumps manually in response to changes in reservoir levels, and adjustment can be made several times throughout the day as necessary. Emergency generators are integrated into the water treatment plant, both wells and the Bakerview Booster Station. A generator is planned for the Thornton Road Booster Pump Station and a manual transfer switch for the Church Road Booster Station. In addition the City has portable generators that can be used in emergencies, although they must be shared with other public works operations including the sewer system.

There are currently no other options for water to be delivered to the City customers other than the City's own wells. However, the potential exists for limited supply through one of several potential emergency interties, as discussed in the *Water Supply and Storage Analysis* report which can be found in Appendix N. Construction of an emergency intertie is budgeted in the Capital Improvement Program for the year 2017-2018.

In the event that the treatment plant is not operational, the City's wells are capable of pumping directly to the distribution system. While the water quality of the wells meets are primary MCL, the water is hard. This sudden change in water hardness when the treatment plant is bypassed is considered an annoyance and

an aesthetic issue for the public. Therefore, the public would be notified of the change in water quality as quickly as possible using the methods described in Section 6.5.2.
The City is also in the process of preparing a draft water shortage response plan that will identify different shortage stages and develop procedures to reduce use and obtain additional supply, based upon the severity of a water shortage situation.

6.7 SAFETY PROCEDURES

The City's Public Works Department has a Safety Committee that meets monthly. Safety procedures maintained by the City are:

- All employees are required to notify their supervisor immediately and fill out the appropriate form in the event of a work place injury.
- Material Safety Data Sheets for all chemicals are located at the WTP.
- The WTP Operator and all other personnel are tested in chlorine safety routinely. In addition, the names of the chlorine repair service and manufacturer are provided at appropriate locations in the plant.
- Appropriate clothing is specified when handling chemicals.
- All employees are trained in first-aid annually and CPR every two years. First-Aid equipment is maintained at the WTP and at City Hall.

6.8 SANITARY SURVEY

All deficiencies noted in the Sanitary Survey provided by DOH and dated May 20, 2015 have been addressed with the exception of the modification of the overflow at reservoir one. Construction to complete an air gap at the existing overflow are being implemented.

A copy of the Sanitary Survey can be found in Appendix P.

6.9 CROSS-CONNECTION CONTROL PROGRAM

The City's Cross Connection Control Program is included in Appendix E.

6.10 CUSTOMER COMPLAINT RESPONSE PROGRAM

The City's responds to customer complaints using the A*WWA Water Quality Complaint Investigator's Field Guide*. In addition, the City's offer the customer a site visit where the City' will examine and analyze the water. Two staff member conduct the site visits for quality control and safety. If necessary, once the site visit is complete and lab tests and observations are finished, the Chief Operator will follow up with a customer consultation.

6.11 RECORDKEEPING AND REPORTING

Sampling schedules are mandated by State regulations. Further information on monitoring requirements can be found in WAC 246-290-300.

DOH requires that a Group A water system keep records of operation and water quality. The specific requirements are found in WAC 246-290-480. These regulations stipulate that the results of water quality testing, operational reports, and other documents related to compliance with the State regulations must be available for inspection. In addition, this information must be submitted to the State.

6.12 O&M IMPROVEMENTS

The City has no actual O&M Deficiencies, but has scheduled several improvements in the next 6 years to improve reliability and upgrade existing facilities. These improvements can be found in Chapters 8 and 9.

6.13 REFERENCED PLANS AND DOCUMENTS

- Operations and Maintenance Manuals for the Douglas and Shop Wells, Booster Pump Stations and Groundwater Treatment Plant are kept in the Public Works Office and are available as needed. They are updated periodically as new equipment is added and as changes are made.

CHAPTER 7
DISTRIBUTION FACILITIES DESIGN AND CONSTRUCTION STANDARDS

7.0 OBJECTIVE

The objective of this chapter is to describe and provide guidance for the inclusion of water system distribution facilities design and construction standards to enable the water purveyor to utilize an alternative approval process.

7.1 INTRODUCTION

The City of Ferndale has adopted design and construction standards for their water system. This chapter describes those standards and the City's methods of assuring conformance. WAC 246-290-125 exempts the City from submittal requirements to the State Department of Health for review and approval of Project Reports per WAC 246-290-110, and construction documents per WAC 246-290-120 for new distribution mains and other distribution-related projects as defined in WAC 246-290-010 under certain conditions.

- The City has a current Water System Plan (WSP) approved by Washington State Department of Health (DOH).
- The City submits a request for such exemption with each Water System Plan or Amendment, identifying the types of projects to be exempted.
- The purveyor has procedures and standards for preparation, submittal, review and approval of Project Reports, contract plans and specifications, and construction administration/documentation in accordance with WAC 246-290-125 (3).

Exemption for the following project types shown in the Capital Improvement Section of this Water System Plan is requested:

- Distribution Mains
- Transmission Mains

7.2 PROJECT REVIEW PROCEDURES

The City requires approved Construction Plans, Specifications and under certain conditions a Project Report per WAC 246-290-110, for projects when water system additions, modifications or improvements are made to the City's system. Improvements in public right of way or recorded easements are normally required of an owner or developer as a condition to receive a building permit or as a condition to subdivide property. Improvements fall into two (2) categories:

1. Capital Improvement Projects (CIP) proposed by the City, in accordance with an approved Water System Plan/Capital Improvement Program. Typically the City retains the services of a Design Engineer to prepare the design or does the work internally.
2. Private developer projects for a specific improvement or subdivision of property. In this case, the developer (Applicant) normally retains an engineering firm to do the design. The City

reviews the developer's design and monitors construction, testing, and approval process defined in WAC 245-290-110, 120, and 125.

7.2.1 Basic Requirements

- A pre-design meeting shall be held with the City to determine scope.
- The Project Report, per WAC 246-290-110, when required, and related Construction Documents shall bear the seal, date and signature of a professional engineer licensed in the state of Washington.
- The Project Report, provides a description as to why a project is proposed and includes engineering design calculations demonstrating how the project will meet its objectives.
- Construction Documents (Plans and Specifications) provide detailed information as to how the project will meet the requirements and conditions set in the Project Report and/or approved Water System Plan.
- Once the Project Report and Construction Documents have been approved, a Design Review Report will be issued stating that the documentation has been reviewed and found to be in accordance with appropriate regulations and standard engineering practice.

7.2.2 Additional Requirements – Municipal Projects (Outside Design)

- At the pre-design meeting a Project Report may be requested by the City.
- The Design Engineer shall submit one set of stamped preliminary documents to the City. The level of completion shall normally be 90%, however the Design Engineer may submit at 40% completion, and may request periodic meetings to review design parameters. The preliminary documents will be reviewed by City staff or a consultant other than the Design Engineer. A minimum of two (2) weeks shall be allowed for this review.
- When the review is completed, the City will provide the Design Engineer one (1) set of documents, annotated to show questions, comments, and changes. A review conference may be scheduled depending on the nature and extent of the comments.
- Once appropriate action has been taken, the Design Engineer shall submit two (2) copies of the final sealed, signed, and dated documents and the originals to the City. Each set will be marked "Approved" and dated by the City. One copy will be returned to the Design Engineer. The other and the originals will be retained by the City.

7.2.3 Additional Requirements – Private Projects

- At the pre-design meeting a Project Report may be requested by the City.
- The Applicant shall submit three (3) sets of stamped preliminary documents to the City. The level of completion shall be 100%. A review will be performed by City staff or a consultant retained for this purpose. A minimum of two (2) weeks shall be allowed for this review.
- When the review is completed, the City will submit to the Applicant one (1) set of documents, annotated to show questions, comments and changes. A review conference may be scheduled depending on the nature and extent of the comments.
- Once appropriate action has been taken, the Applicant shall submit to the City two (2) sets of the final sealed, signed and dated documents and the originals. Each set will be marked as "Approved" and dated by the City. One copy will be returned to the Applicant, the other and the originals will be retained by the City.

7.3 WATER SYSTEM STANDARDS

The City of Ferndale Standards for Water Systems, Sec. 705. WATER DISTRIBUTION SYSTEMS, is currently under review. When they are completed they will be adopted by the City and become part of the Water System Plan. The following is a copy of the draft standards, as of December, 2016.

A. Water Distribution System Design Requirements. The City of Ferndale requires water distribution plan submittal for development projects when improvements are proposed within public right-of-way or in easements. Two sets of plans are to be submitted to the Public Works Department for review.

1. Minimum Size Water Mains. The water main· sizes for each individual project shall be determined by a professional engineer, but shall not be less than the minimums listed below.

(a) Residential Zones. The minimum size water main shall be 8 inches in diameter with an average gridded spacing not to exceed 1,500 feet. Pipes less than 8 inches in diameter may be allowed by the Public Works Director when future extension is not anticipated, such as in a cul-de-sac, provided the main does not serve a fire hydrant.

(b) Commercial, Industrial, and Institutional Zones. All water main construction and reconstruction shall be done pursuant to a design that, when fully implemented, will provide the fire flow requirements of the City of Ferndale's fire protection standards. When improvements increase the fire flow requirements, the Applicant shall upgrade the water system to support the changes.

The Applicant will install as a minimum, the size pipe as required by the City's Water System Plan. The minimum pressures allowed by the City at any time are 40 psi under instantaneous demand, or 20 psi under maximum instantaneous demand and fireflow combined.

(c) Supply Water Mains. Supply water mains shall be provided as specified by the Water System Plan. Where clear definition is not provided by the Water System Plan, the minimum size supply main shall be 12 inches in diameter and shall be spaced on approximately 3,000 foot centers. The actual size of the supply main shall be determined by its ability to deliver water based on the maximum day demand, plus designated fire flow.

2. Valve Spacing. Valves shall be placed on each main at a junction point (node) and shall be spaced along the water main at intervals not to exceed 500 feet for pipe sizes 10 inches in diameter and larger, and not to exceed 800 feet for pipe sizes less than 10 inches in diameter. Resilient seat gate valves shall be used on pipes 8 inches in diameter and smaller, and resilient seat butterfly valves used on pipes 10 inches in diameter and larger.

3. Fire Hydrant Spacing. Fire Hydrants shall be spaced as follows:

(a) No greater than 500 foot intervals along public streets or approved fire access routes for residential areas. Shorter intervals may be required by the Public Works Director,

(b) No greater than 300 foot intervals along public streets or approved fire access routes for all other areas. Shorter intervals may be required by the Public Works Director.

4. Fire Flow Rates. Supply water mains shall be provided as specified by the Water System Plan. All water main construction and reconstruction shall be done pursuant to a design that, when fully implemented, will provide the fire flow requirements of Whatcom County Fire District 7's fire protection standards.

   When any improvements which increase the fire flow requirements are made, the water system must be upgraded if necessary to support the changes.

5. Fire Main and Hydrant Standards. All fire hydrants and water mains serving hydrants will be publicly owned and maintained.

   (a) Access. A minimum 24 foot maintenance easement shall be granted to the city and recorded for any public water main on private property. See Section 505 for easement descriptions. Fire hydrants must be located within 5 feet of the required access. Water mains on private property serving building sprinkler systems will be privately owned and maintained as long as the main serves only one property and no hydrants are required. In this case, the following requirements apply:

      i. An approved detector check valve device must be installed:
      ii. No domestic or other water service allowed on fire main.
      iii. No requirement for construction standards imposed by Public Works.
      iv. No maintenance easement is necessary.

   (b) Materials and Installation. Fire hydrants and fire mains must conform to City of Ferndale Standard Detail W -1 and the following standards:

      i. Fire hydrants shall have two 2 1/2 inch ports and one 51/4 inch main valve opening. A 4 1/2 inch NST pumper nozzle and a 5 inch Storz port with cap and cable shall be supplied. Hydrants shall be M&H 929 hydrant.

      ii. Fire hydrants shall have the Storz port facing the required access and the base flange of the hydrant must not vary more than 1 foot in elevation from the grade level of the required access. The lowest stem shall be a minimum of 14 inches above the ground.

      iii. If, in the opinion of the Public Works Director, fire hydrants are vulnerable to vehicular damage, appropriate crash posts shall be provided. No obstructions shall exist within a 5 foot working area of each required access. Crash posts shall be 4 inch cement-filled pipe minimum 3 feet in height with 2 feet of piping below grade. Hydrant shutoff valves shall be located between 5 and 20 feet from the hydrant.

iv. Underground supplies to fire hydrants must be inspected. Such inspection shall include visual inspection of piping and hydrostatic pressure test of a minimum of 200 psi or 50 psi in excess of street main pressure, whichever is greater. A flow test· will be required when installation is complete.

v. Fire hydrant installation must comply with Standard Detail W-1

vi. Fire hydrants must be maintained in an operable condition at all times and must be repaired or replaced when defective. Hydrants shall be fully operable before construction commences above grade level.

B. Construction of Water Main Extension. The petitioner shall contract with a contractor licensed to perform the construction in the State of Washington to install a main extension as approved by the Department of Public Works.

The applicant shall grade all roads to the design subgrade elevation prior to the start of waterline construction and shall advise the City in writing of any changes which may be contemplated during construction. If the Applicant changes the sub grade elevation of the road after completion of the waterline extension, or any part thereof, the Applicant shall be responsible for all costs incurred for the water extension as a result of said change in subgrade elevation. This obligation shall remain in full force until City releases performance bond or bond of other description in connection with the Applicant's obligation for completion of the roads within the area.

The Department of Public Works shall inspect the installation of the water main to ensure compliance with the specifications. The charges for such inspection, including administrative and overhead charges, shall be withdrawn from the construction inspection fee deposited with the City Planning Director.

At such time as the Public Works Director determines the remaining funds are not adequate to provide necessary inspection for the project, the petitioner shall be notified and an estimate of additional inspection fees required will be provided.

The additional fees shall be deposited with the Community Development Director prior to the depletion of the funds on deposit. The City reserves the right to reject any installation not inspected and approved by the Department of Public Works. Any monies unexpended from the inspection fee upon completion of the project shall be returned to the petitioner.

Upon satisfactory completion of all required tests and acceptance of the main, extension, the Department of Public Works shall cause the extension to be connected to the City system. All costs incurred in the connection, including overhead and administrative charges, shall be paid by the petitioner. Any adjustment of the actual· cost of installation because of a variance between the estimate and the actual costs shall be refunded upon completion of the job to the petitioner or by payment by the petitioner to the City of any additional expense above the estimate.

When a main extension is to serve a new single-family residential area, individual services shall be installed by the developer to supply each proposed building site. These services shall be

installed to City standards. All fees and charges for installation of the services shall be paid at the time a building permit is obtained.

1. Energizing Main Extensions. No main extensions shall be energized other than for test purposes by duly authorized personnel until the main extension has been accepted by the City and all fees and charges have been paid. If energizing a main is necessary to restore service to existing customers, fire hydrants will not be activated until acceptance of the main extension.

2. Payment for Water Mains. Water mains placed in public rights-of-way or easements and connected to City mains may be paid for by:

    a. The party benefitting from the installation;
    b. The City;
    c. A local improvement district, as provided by law; or
    d. Latecomer Agreements. The City may, in accordance with state law, grant the party constructing a new water main the right to partial reimbursement from other abutting property owners benefitted by the improvement. Such reimbursement shall be administered by the City and shall be subject to reasonable overhead and administrative charges by the City.

C. Standards for Water Main Construction

(a) Pipe for Water Main. All pipe shall be of A WW A C151 and cement lining C104 and shall be ductile iron, standard thickness Class 50 push-on joints or M.J. joints. Ductile iron pipe joined using bolted flange joints shall be standard thickness Class 53. The pipe shall be of 150 psi working pressure, plus 100 psi surge pressure. No PVC or AC pipe will be allowed.

Pipe laying shall meet the requirements of Section 7-09 of the Washington State Department of Transportation Standard Specifications for Road, Bridge or Municipal construction. All pipe shall have minimum covering of 3.5 feet.

(b) Fittings. Material for fittings such as crosses, tees, bends, reducers and sleeves shall be ductile iron. Joints shall be M.J., flanged or push-on joints and shall conform to AWWA specifications C110 and C104.

(c) Concrete Thrust Blocking. Concrete blocking shall be as specified in City of Ferndale Standard Details W-2 through W-4, or as directed by the Project Engineer. Blocks shall be installed as specified in Section 7-09 of the Washington State Department of Transportation Standard Specifications for Road, Bridge or Municipal construction. No precast blocks are allowed. Thrust restraint systems in lieu of thrust blocks must be designed by a licensed professional engineer.

(d) Connection to Existing Water Mains. The Contractor must notify the Public Works Director of a proposed connection time at least four working days in advance.

(e) Hydrostatic Testing and Disinfection of Water Main. All hydrostatic testing and disinfection of water mains shall conform to the Washington State Department of Transportation Standard Specifications for Road, Bridge or Municipal Construction, current edition. Hydrostatic testing inspected by City.

(f) Water Service Transfers. Tap installations shall meet the requirements of the City of Ferndale Standard Details.

(g) Gate Valves. Gate valves shall be for lines 2 inches through 10 inches, and shall be installed in cast-iron valve boxes. Short-body valves suitable for a non-shock shut-off pressure of 130 psi resilient seat valves and suitable for direct burial are specified.

Gate valves shall be resilient seated iron-body, full-bronze mounted valves conforming to AWWA C509 or C515 and suitable for service with the type and class of pipe used.

All valves shall have nonrising stems and shall open counterclockwise and shall be equipped with a 2 inch operating nut. Valves will be flange or M.J. joints.

Valve markers shall be located outside of pavement section

(h) Butterfly Valves. Butterfly valves shall be for mains 10 inches and larger and be resilient seated and shall meet or exceed AWWA C504, Class 150B. Butterfly valves shall be suitable for direct burial. Shaft seals shall be standard 0-ring seals. The size of the butterfly valves shall be the same as the main on which they are located.

Valves shall be iron-body, full-bronze mounted, resilient-seat valves and suitable for service with the type and class of pipe used.

The valve operator shall be of the traveling-nut or worm-gear type, sealed, gasketed, and permanently lubricated for underground service. The valve operator shall be constructed to the standard of the valve manufacturer to withstand all anticipated operating torques and designed to resist submergence in groundwater.

(i) Blow-off Valves. Blow-off valves shall be supplied and installed at high points, line ends, or as required by the plans. Blow-off installation shall be in conformance with Standard Details W-9 or W-10.

D. Water Service Standards. Water service and sewer service connection fees shall be based on an Equivalent Residential Unit (ERU) basis. Attachment B as set forth in Ferndale Municipal Code 13.08 gives the basis for calculating single-family connections. City does not supply flushing water. City provides PRV to individual connection. All ¾, 1, 1 ½ and 2 inch water services must conform to the following standards and City of Ferndale Standard Detail W-5:

1. Water Service Installation Requirements

(a) Tapping with tapping clamp and saddle must use I.P. Threaded corporations. If the dry-tap method is used, the following minimum hole sizes shall be used:

1 7/8" for 2" service
1 7/16" for 1 1/2" service
1 5/16" for 1" service
11/16" for 3/4" service

Caution, care, and prudence is necessary in aligning the clamp and saddle to assure full flow capability.

(b) Corporation taps shall make as nearly as possible a 45 degree angle off the vertical center line of the main. No tap is to be made on the top of a water main.

(c) Type "K" copper shall be used on water services within the public right-of-way.

(d) Curb stops shall be located no closer than three (3) feet or farther than five (5) feet from the property line. Stop-and-waste type curb stops are not allowed.

(e) All underground fittings shall be flared within the public right-of-way, no sweat or compression connections are to be used. The use of teflon tape as a sealant is acceptable, but the use of pipe dope is not acceptable.

(f) The water service pipe shall have a minimum of 34 24 inch depth and a maximum of 38 inch depth, including under ditch sections. If a meter is required, there shall be 30 inches cover in the meter area.

All meters and meter installations .shall meet City of Ferndale Standard Detail W-5. If developer changes ground elevation after completion of water service installation, Developer is responsible for all costs incurred as a result of said charges.

(g) No service is to be covered until the City Inspector has inspected the initial installation. Note that all corporations must be in an ON position and all curb stops must be in. the OFF position.

(h) Service testing shall be done in conjunction with water main testing. Any air relief and flushing shall be the responsibility of the Applicant.

(i) An acceptance inspection will be made by the City upon completion of all project work. During the inspection, every service shall be turned on to its full capacity to check flow and guarantee that each service line has been flushed. In no case shall the acceptance inspection be made until all project work is complete. Damage incurred during other construction work on the project shall be corrected by the developer or his agent prior to acceptance by the city.

(j) The bond release inspection shall be made prior to the end of the 2 year maintenance bond period. Any problems noted at this time shall be corrected by the developer and/or bonding company prior to releasing the bond.

(k) Staking of lots and/or property lines to assure correct water service locations is the responsibility of the developer. Locations are to be as shown on the approved drawings. Errors due to failure to provide a property survey or due to changing lot locations during final plat approval shall be corrected by the developer at the time of such change or when the error is detected by the City.

(l) Tools, materials and work area shall be maintained in a sanitary condition at all times.

2. Water Service Meter Box Installation Requirements

(a) Cover of 34 to 38 inches shall be maintained from finished grade to the service pipe except where a variance is approved by the Department of Public Works. Note that the top of the box shall be flush with the finished grade and that this includes the expansion material when required.

(b) The Meter Setter or Curb Stop shall be located within the meter box.

i. Minimum clearance of 1 inch from inside surface.
ii. Maximum clearance of 2 inches from inside surface shall be maintained from the stop.
iii. Stops shall be within 3 to 5 feet from the property line within the public right-of-way or as approved by the City, except when this puts the stop in the sidewalk, in which case the stop will be located in the planting strip.

(c) Meter boxes shall conform to City of Ferndale Standard Details W-6 through W-8. P.V.C. boxes are not to be used.

(d) Location of Meter Boxes

i. If a meter box for a ¾ or 1 inch service is to be located within a sidewalk area, a meter box in accordance with Standard Plan XXX In any traffic areas a pyramid-type box with a framed lid must be used.
ii. An expansion material must be used around the lid section to enable removal for maintenance. The material shall be flush with the lid section to avoid any cracks or protrusions.
iii. As-builts shall show location of water service taps into main, location of meter/boxes with distances to the right-of-way or nearest property corners.

7.4 STANDARD DETAILS

Standard Details for the Water System are included in Appendix F.

7.5 CONSTRUCTION CERTIFICATION AND FOLLOW-UP PROCEDURES

Once the Project Report and Construction Documents have been approved and signed by the City, the Contractor (if a municipal project) or Applicant (if private development) shall request a preconstruction conference with the City before work can commence. Construction inspection shall be provided either by the City or a designated representative.

After completion of construction work, the Contractor/Applicant shall verify that all work and materials are in accordance with the City Standards and the approved construction drawings, before requesting a final inspection. The City will schedule the inspection and provide the Contractor/Applicant a list of deficiencies (punch list) to correct within 30 calendar days. When the punch list is completed, the Contractor/Applicant will notify the City.

After all deficiencies are corrected the Applicant will provide:

- Certified Original As-Built and one paper copy, showing all easements and recording numbers.
- 1 CD in AutoCad format, with plot style table.
- A copy of all required easements that have been recorded at the County Courthouse; and,
- The Deed of Conveyance (Bill of Sale) and itemized construction costs for all project improvements to be accepted by the City for maintenance.
- Certifications for completion of construction and testing in Accordance with WAC 246-290-125. Certifications shall be on Department of Health Forms.

Upon receipt of the above the City will accept the project and authorize the reduction of the financial security to 10% of the actual cost to protect the City against defects in materials and workmanship for two (2) years. At that time, the City will enable the extension to be connected to the overall system. Costs for the connection shall be paid by the City for municipal work or by the Applicant for private development.

Prior to two years following project acceptance, the City will conduct an end of maintenance period inspection and develop a list of deficiencies. The Contractor/Applicant will have 30 calendar days to correct the deficiencies. After all deficiencies are corrected, the final security will be released.

CHAPTER 8
IMPROVEMENT PROGRAM

8.0 OBJECTIVE

This chapter will develop an improvement program by incorporating the system needs identified in the previous chapters. All identified improvements will be analyzed and prioritized, leading to development of the improvement program schedule. WAC 246-290-100 requires that systems identify their planned improvements in the WSP. DOH has the legal authority to order specific improvements in certain health-threatening situations pursuant to WAC 246-290-050.

8.1 PRIORITIZING IMPROVEMENTS

8.1.1 Identification of System Improvements

System improvements are generally classified as follows:

- Source
- Treatment
- Pumping Facilities
- Storage Reservoirs
- Distribution System

8.1.2 Assessment of Alternatives

Source and Treatment

There are several alternatives available to the City for developing their source water supply. Each alternative is discussed in detail in the City's *Water Supply and Storage Alternative Analysis*. A copy of this report can be found in Appendix N. The analysis recommends drilling two new wells, one at the Douglas Road site and another at the Shop site, activate the Central City well and investigate the possibility of Aquifer Storage and Recovery. It also recommends installing a pump and connecting the Thornton well into the system.

Interties

There are several alternatives available to the City for developing new interties. Each alternative is discussed in detail in the City's *Water Supply and Storage Alternative Analysis*. A copy of this report can be found in Appendix N. The analysis recommends constructing an emergency intertie with the City of Bellingham near the Bellingham Marietta Storage Tank. Other potential emergency interties include a connection on Smith Road to the Deer Creek Water Association and to the Blaine/Birch Bay system north of the City.

Storage Reservoirs

There are several alternatives available to the City for developing new storage reservoirs. Each alternative is discussed in detail in the City's *Water Supply and Storage Alternative Analysis*. A copy of this report can be found in Appendix N. The analysis recommends pursuing acquisition of the City of Bellingham's

Marietta Tank. If that is not available a second tank can be built at the Bakerview Site. The Smith Road tank site should be kept available for future storage in the southerly part of the City.

Distribution System

The existing distribution system has many pipes that are undersized or in poor condition. Many of the undersized pipes supply fire hydrants, with no alternative but to be replaced. Others are in poor condition, including old asbestos cement (AC) pipes which are prone to leaks and breaks. Two areas in particular have water pipes that are in poor condition and are subject to problems from pressure spikes. These areas are in the Ferndale Terrace Area and the Deer Creek Area. There are alternatives to upgrading both of these areas.

Ferndale Terrace Area

This is a small area in the northwest part of the Main Pressure Zone located west of Vista Road that has old undersized AC water lines. The water lines are subject to breakage from pressure fluctuations. To minimize breaks, the Ferndale Terrace Pressure Zone was created. It is currently valved off from the Main Pressure Zone, and supplied with water from the Mid Pressure Zone through pressure reducing valves. This results in unsatisfactory fire flows in some areas. There are two alternatives.

Alternative A

high head supply pumps at the Water Treatment Plant we fitted with variable frequency drives to allow the Main Pressure Zone to operate under relatively constant pressure. This along with some piping and pressure reducing valve modifications would allow most of the Ferndale Terrace Pressure Zone to be eliminated and re-incorporated into the Main Pressure Zone. The normally closed valves could be opened and two new connections made to the Main Pressure Zone. One water line on Ferndale Terrace should also be replaced. This will provide better fire protection service through a looped system. The remaining AC lines may eventually need to be replaced, but it would no longer be a critical issue.

Alternative B

Replace all of the AC water lines in the Ferndale Terrace Zone with minimum 8 inch water mains. This would also allow the majority of the Ferndale Terrace Pressure Zone to be eliminated. This solution is costly, but may be necessary due to the age and condition of the water lines in the zone.

Alternative, B is recommended.

Deer Creek Area

This is a small subdivision located in the Axton Pressure Zone. This pressure zone is located outside of the Ferndale City Limits and Urban Growth Area. Pressure is reduced in this zone because pipes in the Deer Creek area are of poor quality and cannot withstand the pressure spikes from the high head pumps at the water Treatment Plant. Pressure in the Axton Zone needs to be increased in order to provide required pressure in outlying areas. Fire flow is not required in rural areas outside of Urban Growth Areas. There are three alternatives.

Alternative A

Replace the existing small water line on Deer Creek Drive with a 12 inch main that will also serve the proposed commercial area to the South and could be developer financed. Install two new pressure reducing valves on the Deer Creek subdivision and remove the existing pressure reducing valve on Axton Road. This will reduce the Axton Pressure Zone to include only the Deer Creek area.

Alternative B

Replace all of the water lines in the Deer Creek development and eliminate the Axton Pressure Zone entirely. This alternative is considered cost prohibitive.

Alternative C

This alternative would include either of the above alternatives plus tying the long dead end line on Axton Road to the long dead end on Smith Road with a new water line on Northwest Road. This alternative would solve many problems by looping two large areas that are currently served by dead end lines. Both water quality and reliability would be improved, particularly to the area of Smith Road and Northwest Avenue where a school, library and county offices are located. This alternative is not consistent with Ferndale's policy of no new water service into areas outside of the City Limits. Currently there are no plans to extend the Urban Growth Area out to Northwest Avenue.

Alternative, A is recommended.

8.2 IMPROVEMENT SCHEDULE

The Water System Plan Map lists deficiencies in the existing water system, and includes a general layout of improvements required to serve future development areas within the Urban Growth Areas, in accordance with the *Ferndale Urban Growth Areas – Water Availability* report in Appendix L. Existing deficiencies are classified as either City Responsibility or Developer Responsibility. City Responsibility consists of General Facilities projects that benefit the general public such as new sources, treatment plant improvements, replacing undersized transmission mains and older deteriorating water lines, increasing water storage capacity, interties, rate studies, and water system planning. Developer Responsibility consists of replacing undersized or inadequate facilities that benefit specific properties, such as increasing line size to provide fire flow to a specific development, building, or area. Other projects serving new Urban Growth Areas are generally new distribution system facilities financed and constructed by developers. The Water System Map shows the location of facilities required to serve the Urban Growth Areas. These facilities are a general guideline and must be analyzed and modified as required to accommodate future growth as it occurs. The schedule of improvements in Table 8.1 includes both the existing deficiencies, the improvements discussed in the alternatives section above, and improvements required to serve the Urban Growth Areas. There are other deficiencies and improvements that will be addressed during the life of this plan. When the City does major street improvements they often replace utilities that may be adequate to meet existing demands, but should be enlarged to meet City Standards or be replaced because of poor condition or age. Provisions for these type of improvements are included in the Capital Improvement Plan as Small Project Facility Replacements. Improvements are color coded in the Plan Reference Column. Numbers in green address existing deficiencies, numbers in yellow address mid-term UGA areas and numbers in red address long-term UGAs.

Table 8-1, Recommended Improvements

Plan Ref. No.	Category	Deficiency
1	Pumping	Church Rd. Pump Station Improvements
2	Pumping	Thornton Rd. Pump Station Improvements
3	Source	Central City Well Treatment & Activation
4	Source	New City Shop Well
5	Distribution	Malloy Village to Sampson Rope
6	Distribution	Guinevere St. to Washington St.
7	Distribution	Washington St. between Main St. & Vista Dr.
8	Distribution	Nordic Way to Hovander Rd.
9	Source	Thornton Rd. Well Pump and Treatment
10	Distribution	Thornton Rd. under I-5
11	Distribution	Thornton Rd. from Malloy Ave. to BNSF
12	Source	New Douglas Well
13	Storage	Expand Clear Well
14	Source	Emergency Intertie (3 Alternatives)
15	Distribution	Connecting Main St. to S. Church Rd.
16	Distribution	Ferndale Terrace Pressure Zone
17a	Distribution	Along Slater Rd. W. of Rural Ave.
17b	Distribution	Rural Ave. S. of Slater Road to City Limits
18	Distribution	Along Malloy Rd. **To be in Mid Pressure Zone*
19	Distribution	Slater Rd. UGA Transmission Main
20	Distribution	Along Malloy Ave. & Portal Way to Grandview Rd. (SR 548)
21	Distribution	Along Aldergrove Rd. & Trigg Rd. to Portal Way
22	Distribution	Along Church Rd. to Aldergrove Rd.
23	Storage	New Bakerview Storage Reservoir
24	Distribution	Along Malloy Ave.
25	Distribution	From Argyle St. to Church Rd.
26	Distribution	From Thornton Rd. to Glenmore St.
27	Distribution	Along Thornton St. & Hatton Pl.
28	Distribution	Connecting Mountainview Rd. to Lakeridge Dr.

29	Distribution	Along Hendrickson Ave.
30	Distribution	Along Main St. and Mountainview Rd.
31	Distribution	Mountain Vista Park
32	Distribution	Along Riverside Dr.
33	Distribution	Near Samuel's Furniture
34	Distribution	Along Northwest Dr.
35	Distribution	Along Hovander Rd.
36	Distribution	East of Nordic Way
37	Distribution	Hempler Food Group to Nordic Way
38	Storage	New Smith Rd. Storage Reservoir
39	Distribution	Along Byers Rd. & Pacific Pl.
40	Distribution	Along Labounty Rd.
41	Distribution	Between Lincoln Dr., Malloy Ave., & N. Beulah Ave.
42	Distribution	Along Sunrise St.
43	Distribution	Along Pacific Hwy.
44	Distribution	Near Graveline Rd.
45	Distribution	Along Delta Line Rd.
46	Distribution	Along Grandview Rd. to Vista Dr.
47	Distribution	Along Aldergrove Rd.
48	Distribution	Along Vista Dr.
49	Distribution	Connecting Vista Dr. to Malloy Ave.
50	Distribution	Along Grandview Rd. & I-5 Business Park
51	Distribution	Along Vista Dr. from Brown Rd. to Grandview Rd. (SR548)
52	Distribution	Along Enterprise Rd.
53	Distribution	Along Brown Rd.
54	Distribution	Along Vista Dr. from Aldergrove Rd. & Brown Rd.
55	Distribution	Along Hovander Rd. & W. Smith Rd.
56	Distribution	Deer Creek Upgrade

CHAPTER 9
FINANCIAL PROGRAM

9.0 OBJECTIVE

The objective of the financial program is to identify the total cost of providing water service, assure that the Capital Improvement schedule will be implemented, and assist in establishing adequate fees for service.

9.1 PAST AND PRESENT FINANCIAL STATUS

The City Water Program Fund No. 401 accounts for operations of the water utility, and includes revenues and expenditures, as shown on the attached 2016 Budget report. The report covers the past years from 2012 through 2015, and budgets for the year 2016. 2016 Capital Projects are shown on the attached map. In past years the revenue balances the expenditures. This is accomplished by developing annual budgets to cover maintenance and operations, and the capital improvements planned for that year. Income to cover the budgeted expenses is derived from water sales, connection fees, and other sources of funding covered in the next section. Income is also transferred to the Bond Redemption Fund No. 404 for annual debt service payments. This fund covers Water, Sewer and Storm Bonds. Specific transfers from the Water Fund are itemized. The Bond Reserve Fund No. 404 is maintained to cover bond reserve requirements of bond covenants. The required amount for Water, Sewer and Storm bond reserves is currently $1,482,300. Excess balances are transferred into and out of this fund as required.

Water rates are periodically modified by ordinance to keep up with the needs of the water utility, to cover bond redemption, and to maintain required reserves.

9.1.1 Available Revenue Sources

The two main sources of water system revenue are Water Sales and Capital Connection Fees. Other sources include miscellaneous fees for reconnection, meter reads, late fees, etc. Loans and grants from state and federal agencies, such as the Drinking Water State Revolving Fund, Public Works Trust Fund and State Health Department are utilized for specific capital improvements. Revenue bonds are also utilized by the City. Some projects can be financed by formation of local improvement districts, and other local facilities serving private developments are financed by developers. The City also has a latecomer's ordinance. Interfund loans are utilized and repaid as necessary to finance other capital improvements.

9.1.2 Allocation of Revenue Sources

The Improvement Program in Chapter 8 will be financed through several sources. As each project enters the planning phase, preliminary cost estimates will be prepared and method of funding determined. Projects that are developer driven will be financed primarily with developer funding, with the possibility of local participation for oversizing or construction of general facilities that will also benefit the public. Projects that are upgrades to correct existing deficiencies are Capital Improvements and will be financed by the City. Source and storage capital improvements, and emergency interties will generally be financed from connection fees, and state/federal loans and grants and bond issues. Table 9-1 lists Capital Improvement projects and other anticipated developer constructed projects. The Capital Improvement Projects are identified with a star adjacent to the Plan Reference Number. The table also gives a general allocation of

funding sources for each of the projects along with an estimated cost and the year when the project is anticipated to be constructed. The project number in the table is keyed to the location on the Water System Map. Project numbers in green represent deficiencies or improvements to serve near term UGAs. Numbers in yellow represent mid-term improvements and numbers in red represent long term improvements. Not all of these recommendations can be expected to be accomplished. For example there are several viable storage alternatives, and obviously not all of them will be constructed. The distribution improvements to serve future UGAs are primarily a guide to show the general location and sizing required for adequate service. The exact locations will be dependent upon actual growth patterns and conditions as they occur. The majority of the distribution system pipelines serving development within the UGAs will be financed with private developer funds, and will have limited impact on City finances.

Table 9-2 shows the projected Capital Improvements for the six and twenty year period, listed by category and year, and is used to develop the six and twenty year operating budget shown in Table 9-3.

Table 9-3 is based upon the City's six year operating budget for the water fund. Projections for years seven through twenty take into account growth and inflation. Two bond issues are anticipated, one within the six year period and one within the twenty year period. The budget includes bond redemption costs. The table shows that water fund revenues plus loans and bonds cover and exceed the expenses, capital improvement cost and bond redemption cost throughout the twenty year planning period.

Table 9-1, Recommended Improvements

RECOMMENDED IMPROVEMENTS							
#	Year	Category	Site Description	Length (FT)	Size (IN)	Estimated Cost	Funding Source
1*	2017	Pumping	Church Rd. Pump Sta. Improvements	--	--	$222,000	City
2*	2017	Pumping	Thornton Rd. Pump Sta. Improvements	--	--	$275,000	City
3*	2017	Source	Central City Well Treatment & Activation	--	--	$200,000	City
4*	2017	Source	New City Shop Well	--	--	$750,000	City
5*	2017	Distribution	Malloy Village to Sampson Rope	1,385 520	8 12	$100,000	City Share
6*	2017	Distribution	Guinevere St. to Washington St.	365	8	$75,000	City
7*	2016	Distribution	Washington St. between Main St. & Vista Dr.	1,780	12	$275,000	City
8*	2017	Distribution	Nordic Way to Hovander Rd.	1,000	12	$325,000	City
9*	2018	Source	Thornton Rd. Well Pump & Treatment	--	--	$700,000	City
10*	2018	Distribution	Thornton Rd. under I-5	525	12	$305,000	City
11*	2018	Distribution	Thornton Rd. from Malloy Ave. to BNSF	1,200	12	$325,000	City
12*	2019	Source	New Douglas Well	--	--	$785,000	City
13*	2019	Storage	Expand Clear Well	--	--	$300,000	City

14*	2019	Source	Emergency Intertie (3 Alternatives)	--	--	$1,000,000	City
15*	2020	Distribution	Connecting Main St. to S. Church Rd.	2,175	8	$230,000	City
16*	2021	Distribution	Ferndale Terrace Pressure Zone	9,600	8	$2,500,000	City
17a*	2021	Distribution	Slater Rd. W. of Rural Ave.	1,200	12	$95,000	City
17b	2021	Distribution	Rural Ave. S. of Slater Rd. to City Limits	1,000	12/16	$200,000	Private
18*	2022	Distribution	Along Malloy Rd. *To be in Mid Pressure Zone	2,525	15	$785,000	City
19*	2023	Distribution	Slater Rd. UGA Transmission Main	2,760	12	$350,000	City
20*	2024	Distribution	Along Malloy Ave. & Portal Way to Grandview Rd. (SR 548)	6,400	16	$750,000	City
21	2018-24	Distribution	Along Aldergrove Rd. & Trigg Rd. to Portal Way	2,675	12	$1,050,000	Private
22	2018-24	Distribution	Along Church Rd. to Aldergrove Rd.	3,350	12	$550,000	Private
23*	2018-24	Storage	New Bakerview Storage Reservoir	--	--	$3,000,000	City
24	2018-24	Distribution	Along Malloy Ave.	2,775	16	$380,000	Private
25	2018-24	Distribution	From Argyle St. to Church Rd.	3,250	12	$585,000	Private
26	2018-24	Distribution	From Thornton Rd. to Glenmore St.	1,650	12	$330,000	Private
27	2018-24	Distribution	Along Thornton St. & Hatton Pl.	1,500	8	$225,000	City
28	2018-24	Distribution	Connecting Mountainview Rd. to Lakeridge Dr.	3,300	8	$495,000	Private
29	2018-24	Distribution	Along Hendrickson Ave.	1,475	12	$221,300	Private
30	2018-24	Distribution	Along Main St. and Mountainview Rd.	4,100	12	$615,000	Private
31	2018-24	Distribution	Mountain Vista Park	750	12	$112,500	Private
32	2018-24	Distribution	Along Riverside Dr.	1,725	12	$260,000	Private
33	2018-24	Distribution	Near Samuel's Furniture	725	12	$110,000	Private
34	2018-24	Distribution	Along Northwest Dr.	4,500	8	$675,000	Private
35	2018-24	Distribution	Along Hovander Rd.	3,050	12	$460,000	Private
36	2018-24	Distribution	East of Nordic Way	775	12	$120,000	Private
37	2018-24	Distribution	Hempler Food Group to Nordic Way	500	12	$75,000	Private
38	2018-24	Storage	New Smith Rd. Storage Reservoir	--	--	$4,000,000	City
39	2018-24	Distribution	Along Byers Rd. & Pacific Pl.	950	12	$145,000	Private
40	2018-24	Distribution	Along Labounty Rd.	1,710	12	$400,000	Private
41	2018-24	Distribution	Between Lincoln Dr., Malloy Ave., & N. Beulah Ave.	1,600 665	12 8	$460,000	Private

42	2018-24	Distribution	Along Sunrise St.	650	8	$125,000	Private
43	2018-24	Distribution	Along Pacific Hwy.	3,025	12	$605,000	Private
44	2018-24	Distribution	Near Graveline Rd.	3,500	12	$475,000	Private
45	2024-36	Distribution	Along Delta Line Rd.	3,375	12	$510,000	Private
46	2024-36	Distribution	Along Grandview Rd. to Vista Dr.	2,200	12	$440,000	Private
47	2024-36	Distribution	Along Aldergrove Rd.	5,125	12	$770,000	Private
48	2024-36	Distribution	Along Vista Dr.	3,400	12	$680,000	Private
49	2024-36	Distribution	Connecting Vista Dr. to Malloy Ave.	2,700	12	$405,000	Private
50	2024-36	Distribution	Along Grandview Rd. & I-5 Business Park	3,200	12	$690,000	Private
51	2024-36	Distribution	Along Vista Dr. from Brown Rd. to Grandview Rd. (SR548)	2,800	12	$480,000	Private
52	2024-36	Distribution	Along Enterprise Rd.	4,500	12	$675,000	Private
53	2024-36	Distribution	Along Brown Rd.	4,575	12	$690,000	Private
54	2024-36	Distribution	Along Vista Dr. from Aldergrove Rd. & Brown Rd.	2,800	12	$420,000	Private
55	2024-36	Distribution	Along Hovander Rd. & W. Smith Rd.	3,600	12	$720,000	Private
56	2024-36	Distribution	Deer Creek Upgrade	800	12	$200,000	City

9.1.3 Program Justification

The source, intertie and storage projects in the next 6 years are required to provide for projected growth, and will require outside financing through state and federal loans and grants and/or bonding. As growth occurs connection fees and revenue from water sales will increase, and rates will be adjusted accordingly, providing revenue required to repay loans and bonds. Distribution projects that are developer driven will be paid for primarily by the developers, although some City participation may be required and is accounted for in the budget.

9.2 ASSESSMENT OF RATES

The City's rate structure is shown in Appendix B. It is an increasing block rate that gives low water users a lower commodity rate and larger users a higher rate. This structure promotes conservation, and benefits lower income users who use less water. Rates are adjusted periodically as required to meet operation and maintenance costs and to provide funding for loan repayment and bond redemption, and to maintain reserves. As new capital funding requirements occur, the rates are analyzed by the finance department to assure that they are adequate.

Figure 9-2, Capital Improvement Program

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
General																				
Planning, Water Supply and Facilities		$ 100,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 10,000	$ 145,000	$ 10,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 175,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000
Water Treatment Plant																				
Filter/Media Replacement											$ 1,500,000									
Expansion																				
Booster Stations																				
Church Road VFD & Switch Gear		$ 222,000																		
Thornton Road Generator & Switch Gear		$ 275,000																		
Source																				
Central City Well Treatment		$ 200,000																		
New City Shop Well		$ 750,000																		
Thornton Well Pump & Treatment			$ 700,000																	
New Douglas Well				$ 135,000	$ 650,000															
New Well and Pump (Location TBD)														$ 1,000,000						
Storage																				
Treatment Plant Clearwell Enlargement				$ 300,000																
Smith Road Tank and Booster Pump												$ 2,500,000	$ 1,500,000							
Recoat Bakerview Tank																			$ 250,000	
Equipment																				
Vehicle Replacement		$ 22,000				$ 40,000				$ 50,000				$ 50,000				$ 55,000		
Equipment			$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 10,000	$ 235,000	$ 10,000	$ 10,000	$ 10,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Water Distribution System																				
Small Projects		$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000
Malloy Village to Sampson Rope		$ 100,000																		
Guinevere To Washington		$ 75,000																		
Washington, Main to Vista		$ 275,000																		
Nordic Way to Hovander		$ 325,000																		
Thornton/I-5 Crossing			$ 630,000																	
Main to South Church					$ 230,000															
Ferndale Terrace Replacement						$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000										
Slater Road						$ 95,000														
Slater Road UGA Transmission Main								$ 350,000												
Replace and Upgrade Substandard Pipe								$ 300,000	$ 460,000	$ 250,000	$ 1,000,000	$ 25,000	$ 1,725,000	$ 1,015,000	$ 1,215,000	$ 715,000	$ 1,715,000	$ 1,660,000	$ 1,465,000	$ 1,715,000
Thornton and Malloy Pressure Zone Upgrade							$ 785,000													
Malloy Transmission Upgrade									$ 325,000	$ 425,000										
Emergency Intertie				$ 1,000,000																
Total	$ 3,715,000	$ 2,544,000	$ 1,545,000	$ 1,650,000	$ 1,095,000	$ 850,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 3,000,000	$ 2,800,000	$ 3,500,000	$ 2,500,000	$ 1,500,000	$ 1,000,000	$ 2,000,000	$ 2,000,000	$ 2,000,000	$ 2,000,000

Table 9-3, Six and Twenty Year Operating Budget

No.		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	REVENUES																				
2	Water Sales	$ 2,358,128	$ 2,429,343	$ 2,502,709	$ 2,578,291	$ 2,656,156	$ 2,763,464	$ 2,901,637	$ 3,046,719	$ 3,199,055	$ 3,359,008	$ 3,526,958	$ 3,703,306	$ 3,888,471	$ 4,082,895	$ 4,287,040	$ 4,501,392	$ 4,726,461	$ 4,962,784	$ 5,210,924	$ 5,471,470
3	Connection Fees and Service	$ 603,143	$ 633,662	$ 665,725	$ 699,411	$ 734,801	$ 771,982	$ 810,581	$ 851,110	$ 893,666	$ 938,349	$ 985,266	$ 1,034,530	$ 1,086,256	$ 1,140,569	$ 1,197,597	$ 1,257,477	$ 1,320,351	$ 1,386,369	$ 1,455,687	$ 1,528,472
4	Other Revenue	$ 724,589	$ 350,782	$ 350,978	$ 351,177	$ 351,380	$ 351,588	$ 369,167	$ 387,626	$ 407,007	$ 427,357	$ 448,725	$ 471,162	$ 494,720	$ 519,456	$ 545,428	$ 572,700	$ 601,335	$ 631,402	$ 662,972	$ 696,120
5	Loans and Bonds	$ 1,135,000	$ 5,000,000							$ 6,000,000											
6	Grants	$ 1,135,000																			
7	TOTAL REVENUES	$ 5,955,860	$ 8,413,787	$ 3,519,412	$ 3,628,879	$ 3,742,337	$ 3,887,034	$ 4,081,386	$ 4,285,455	$ 10,499,728	$ 4,724,714	$ 4,960,950	$ 5,208,997	$ 5,469,447	$ 5,742,920	$ 6,030,066	$ 6,331,569	$ 6,648,147	$ 6,980,555	$ 7,329,582	$ 7,696,061
8	EXPENSES																				
9	Operation & Maintenance (O&M)	$ 982,236	$ 1,011,603	$ 1,042,055	$ 1,073,317	$ 1,105,516	$ 1,138,681	$ 1,172,841	$ 1,208,027	$ 1,244,267	$ 1,281,595	$ 1,320,043	$ 1,359,645	$ 1,400,434	$ 1,442,447	$ 1,485,720	$ 1,530,292	$ 1,576,201	$ 1,623,487	$ 1,672,191	$ 1,722,357
10	General & Administrative Expenses	$ 851,994	$ 878,237	$ 905,335	$ 933,317	$ 962,214	$ 995,849	$ 1,025,724	$ 1,056,496	$ 1,088,191	$ 1,120,837	$ 1,154,462	$ 1,189,096	$ 1,224,769	$ 1,261,512	$ 1,299,357	$ 1,338,338	$ 1,378,488	$ 1,419,843	$ 1,462,438	$ 1,506,311
11	TOTAL EXPENSES	$ 1,834,230	$ 1,889,840	$ 1,947,390	$ 2,006,634	$ 2,067,730	$ 2,134,530	$ 2,198,566	$ 2,264,523	$ 2,332,459	$ 2,402,432	$ 2,474,505	$ 2,548,740	$ 2,625,203	$ 2,703,959	$ 2,785,078	$ 2,868,630	$ 2,954,689	$ 3,043,329	$ 3,134,629	$ 3,228,668
12	Annual Debt Payments - Loans/Bonds (Principal & Interest)	$ 489,225	$ 1,053,043	$ 1,243,736	$ 905,817	$ 906,317	$ 906,717	$ 906,717	$ 906,717	$ 906,717	$ 906,717	$ 906,717	$ 1,250,000	$ 1,250,000	$ 1,250,000	$ 1,250,000	$ 1,250,000	$ 1,250,000	$ 1,250,000	$ 1,250,000	$ 1,250,000
13	Total Outstanding Debt - Loans/Bonds (Principal & Interest)																				
14	Capital Improvement Program Expenditures																				
15	New CIP Facilities	$ 3,715,000	$ 2,544,000	$ 1,545,000	$ 1,650,000	$ 1,095,000	$ 850,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 1,500,000	$ 3,000,000	$ 2,800,000	$ 3,500,000	$ 2,500,000	$ 1,500,000	$ 1,000,000	$ 2,000,000	$ 2,000,000	$ 2,000,000	$ 2,000,000
16	Total Expenditures	$ 6,038,455	$ 5,486,883	$ 4,736,126	$ 4,562,451	$ 4,069,047	$ 3,891,247	$ 4,605,283	$ 4,671,240	$ 4,739,176	$ 4,809,149	$ 6,381,222	$ 6,598,740	$ 7,375,203	$ 6,453,959	$ 5,535,078	$ 5,118,630	$ 6,204,689	$ 6,293,329	$ 6,384,629	$ 6,478,668
17	Withdrawal/ Deposit From Existing Reserves	$ (82,595)	$ 2,926,904	$ (1,216,714)	$ (933,572)	$ (326,710)	$ (4,213)	$ (523,897)	$ (385,785)	$ 5,760,552	$ (84,435)	$ (1,420,272)	$ (1,389,743)	$ (1,905,755)	$ (711,039)	$ 494,988	$ 1,212,939	$ 443,459	$ 687,225	$ 944,953	$ 1,217,393
18	Operating Cash Reserve	$ 665,401	$ 3,592,305	$ 2,375,591	$ 1,442,019	$ 1,115,309	$ 1,111,096	$ 587,199	$ 201,414	$ 5,961,966	$ 5,877,531	$ 4,457,258	$ 3,067,515	$ 1,161,760	$ 450,721	$ 945,709	$ 2,158,648	$ 2,602,106	$ 3,289,331	$ 4,234,284	$ 5,451,678

City of Ferndale

Department: WATER FUND **Program Fund No.** 401

Director: Kevin Renz **Title:** Public Works Director

Program Mission/Vision Statement: The purpose of the Water Fund is to account for the operations of our water utility. The City of Ferndale in the past purchased water from the PUD, treated the water, and sold it to our citizens. Starting in 2012, the City started using well water. The departments within the Water Fund include administration, maintenance, and operations.

Revenues

#401 WATER	2012 Actual	2013 Actual	2014 Actual	2015 Actual	2016 Projected
Capital Connection Fees	$877,755	$632,612	$499,639	$629,234	$637,733
Water Sales	1,833,103	1,934,453	1,965,864	2,024,226	2,163,420
Investment/Interfund Loan Interest	2,744	3,422	2,551	487	0
Setup Fees	15,430	18,401	16,878	14,546	20,000
Setup Fees - New Meter Set	10,468	10,648	5,737	5,590	4,000
Late Fees	40,152	64,801	67,738	72,405	80,000
Reconnection Fees	23,595	27,901	35,895	32,924	35,000
Meter Charges	22,691	28,334	12,100	21,524	25,000
Meter Installation Charges - New Meter Set	20,349	20,123	18,525	11,724	11,000
Property Sale Final Meter Read Fee	8,453	12,800	10,920	15,396	15,000
Miscellaneous - Refund From PUD #1		200,000	0	0	0
Other Miscellaneous/Grants/Latecomers	4,953	6,457	86,118	52,752	0
Trans In Fr Bond Res #404 (Int)			884	1,857	0
Interfund Loan Repayment - 308 Main St. 3rd to Church Constr.	0	550,000	0	0	0
Interfund Loan From Sewer 402					500,000
2016 DOH Loan (Central City Water Assoc.)	0	0	0	0	2,270,000
Total Revenue	**$2,859,693**	**$3,509,952**	**$2,722,849**	**$2,882,665**	**$5,761,153**

EXPENDITURES

#401 WATER	2012 Actual	2013 Actual	2014 Actual	2015 Actual	2016 Budget
WATER ADMINISTRATION					
SALARIES	$113,783	$67,578	$80,793	$100,437	$137,515
BENEFITS	$43,101	$31,402	$31,659	$29,345	$71,025
SUPPLIES	$496	$702	$971	$1,235	$1,000
PROF SERVICES	16,134	36,160	37,862	29,588	50,000
POSTAGE	5,639	4,816	5,817	5,928	4,500
CELL PHONE	2,273	3,298	2,915	3,112	3,600
COPY MACHINE LEASES/MAINT	2,905	1,827	2,208	1,951	2,450
MISCELLANEOUS/TRAVEL/PUB NOTICE/ETC	8,436	3,623	5,708	296	3,750
B&O/EXCISE TAX	109,931	118,626	113,979	117,174	129,150
CITY OF FERNDALE UTILITY TAX			75,146	87,277	91,803
CENTRAL SERVICES	98,049	102,372	89,779	88,216	100,940
VEHICLE RENTAL 550	52,185	78,123	81,538	81,900	55,605
COMPUTER REP & REPL 510/ SOFTWARE	4,449	8,345	8,152	8,707	4,560
OTHER CHARGES & SERV	$300,001	$357,190	$423,104	$424,149	$446,358
TOTAL ADMINISTRATION	**$457,381**	**$456,872**	**$536,527**	**$555,166**	**$655,898**
SYSTEM MAINTENANCE					
SALARIES	$150,312	$185,868	$192,448	$176,096	$219,083
BENEFITS	$78,309	$101,681	$102,289	$98,322	$127,966
SUPPLIES	$62,206	$96,631	$89,807	$91,207	$93,500
PROFESSIONAL SERVICES	705	796	1,213	4,669	2,000
CONTRACT R & M	0	0	0	0	1,500
CELL PHONE/TRAVEL	152	546	80	17	400
MISCELLANEOUS	16,508	316	636	1,661	500
CERTIFICATIONS	434	762	946	505	1,500
OTHER CHARGES & SERVICES	$17,799	$2,420	$2,875	$6,852	$5,900
TOTAL SYSTEM MAINT	**$308,626**	**$386,600**	**$387,419**	**$372,477**	**$446,449**
PLANT OPERATIONS					
SALARIES	$115,970	$115,750	$134,194	$136,410	$150,768
BENEFITS	$50,414	$50,345	$61,002	$63,782	$67,469
SUPPLIES	$88,632	$80,847	$66,818	$145,967	$102,500
WATER PURCHASED FROM PUD	$21,859	$0	$0	$0	$0
TRAVEL	854	85	485	96	1,000
MISC & SAFETY TRAINING/EQUIPMENT	4,567	6,439	2,474	1,559	8,000
INTERGOVT-DEPT OF HEALTH	0	0	6,112	7,081	7,000
PHONE-COMMUNICATIONS	5,319	3,745	3,256	1,447	5,000
UTILITIES - PSE ELECTRICITY & NAT. GAS	131,452	126,390	124,810	136,818	139,050
UTILITIES - WATER/SEWER/STORM	1,097	894	219	220	0
PROFESSIONAL SERVICES	25,099	45,440	27,478	19,900	40,000
CONTRACT R & M	7,684	3,348	369	6,218	15,000
LAB TESTING	11,820	10,642	6,374	9,666	0
OTHER CHARGES & SERVICES	$209,751	$196,983	$171,577	$183,005	$215,050
TOTAL OPERATIONS	**$464,767**	**$443,925**	**$433,591**	**$529,164**	**$535,787**

#401 WATER	2012 Actual	2013 Actual	2014 Actual	2015 Actual	2016 Budget
CAPITAL OUTLAY					
TOUCHREAD METERS	$9,341	$0	$0	$0	$0
LONG TERM WATER PLANNING	0	32,150	268,869	68,040	0
WATER SYSTEM PLAN	0	0	0	35,198	
MAIN ST. CONSTR.	287,958	3,370	0	0	
VISTA DRIVE CONSTR.		265,311	0	0	
CHURCH ROAD CONSTR.			376,811	0	
LIBRARY CONSTR.			33,373	0	
POLICE STATION CONSTR.			14,438	0	
GROUNDWATER PROJECTS	509,150	134,981	790	0	
WATER SOFTENING STUDY/CONSTR.		169,495	2,086,155	79,230	
GUINEVERE WATER PROJECT		44,453	0	0	
HIGH SERVICE PUMPS		108,008	79,584	0	
PAINT WATER TANKS		39,920	0	0	
BASS STREET MAIN UPGRADE		13,812	33,431	0	
CENTRAL CITY WATER ASSOC. CONVERSION				12,847	
WELLHEAD PROTECTION PLAN				12,173	
RESERVOIR MIXERS				19,969	
MISC PROJECTS			12,566	14,268	
CAPITAL BUDGET - OTHER					3,715,000
TOTAL CAPITAL OUTLAY	**$806,449**	**$811,500**	**$2,906,017**	**$241,725**	**$3,715,000**
TRANSFERS/LATECOMERS/LOANS					
TRANS TO WATER SEWER REV BONDS FUND 403	$399,997	$396,144	$397,244	$397,044	$397,944
TRANS TO WATER SEWER REV BONDS RES FUND 404	(25,765)	0	0	0	
INTERFUND LOAN TO MAIN STREET CONSTR. FUND 308	400,000	0	0	0	
TRANS TO SEWER FUND 402					
TRANS TO UTIL LOAN SVC FUNDS 408/218	89,065	90,421	103,651	108,330	91,281
2011 REVENUE BONDS COSTS OF ISSUANCE					
LATECOMERS/BOND ISSUANCE	0	0	0	0	
TOTAL TRANSF/LATECOMERS/LOANS/BOND EXPENSES	**$863,297**	**$486,565**	**$500,895**	**$505,374**	**$489,225**
TOTAL EXPENDITURES	**$2,900,520**	**$2,585,462**	**$4,764,449**	**$2,203,906**	**$5,842,359**

CHAPTER 10
MISCELLANEOUS DOCUMENTS

10.0 OBJECTIVE

The objective of this chapter is to provide and present other supportive documents.

A list of adjacent water purveyors who were provided with the attached Notice of Public Hearing on the water system plan is included. The Draft Water System Plan is located on the City of Ferndale's Web Site.

Documentation on WSP compliance with the requirements of the State Environmental Policy Act (Chapter 43.21 RCW) is included in Appendix C.

Copies of Local Government Consistency Determination Forms are provided in Appendix D.

Notice of Public Hearings – Water and Wastewater Comprehensive Plans

Posted on May 19, 2016 by Susan Duncan

LEGAL NOTICE
City of Ferndale
NOTICE OF PUBLIC HEARING

Notice is hereby given that the Ferndale City Council will hold two public hearings on Monday, June 6, 2016 to consider the approval of the draft Water Comprehensive Plan and draft Wastewater Comprehensive Plan.
The hearings will be held at the City Hall Annex Building located at 5694 Second Avenue, beginning at 7:00 p.m. All interested persons are encouraged to attend and enter testimony, either written or oral.

Susan Duncan
City Clerk

Published May 25, 2016
Ferndale Record

The Draft Water System Plan may be viewed at the City Hall or online at
https://ferndale.civicweb.net/filepro/document/8768/Draft%20Comprehensive%20Water%20Plan.pdf

Ferndale Record

SERVING FERNDALE, BLAINE, CUSTER AND BIRCH BAY, WASHINGTON SINCE 1885

AFFIDAVIT OF PUBLICATION

LEGAL

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Susan Duncan
City Clerk
Published by Ferndale Record,
May 25, 2016.

STATE OF WASHINGTON.
COUNTY OF WHATCOM

C. Bovenkamp being first sworn on oath, deposes and says that she is the principal clerk of the FERNDALE RECORD, a weekly newspaper. That said newspaper is a legal newspaper and has been approved as a legal newspaper by order of the superior court in the county in which it is published and it is now and has been for more than six months prior to the date of publications hereinafter referred to, published in the English language continually as a weekly newspaper in Whatcom County, Washington, and it is now, and during all of said time was, printed in an office maintained at the aforesaid place of publication of said newspaper.

That the annexed is a true copy of a Public Hearing Notice re: Water Comp Plan & Wastewater Comp Plan as it was published in regular issues (and not in supplement form)

of said newspaper once each week for a period of One consecutive weeks, commencing on the

25th day of May 20 16, and ending on the

____ day of _____ 20 ___, both dates inclusive, and that such newspaper was regularly distributed to its subscribers during all of said period. That the full amount of the fee charged for the

foregoing publication is the sum of $ 49.50 which amount has been paid in full.

Subscribed and sworn to before me this 25th day of May 2016

M D Lewis

Notary Public in and for the State of Washington, residing in Lynden.

MICHAEL DAVID LEWIS
NOTARY PUBLIC
STATE OF WASHINGTON
COMMISSION EXPIRES JULY 20, 2016

Aldergrove Water Assoc.
Attn: Dave Olson
6951 Hannigan Rd. #2
Lynden, WA 98264

Baker View Water Assoc.
Attn: Scott Johnston
2652 Halverstick Rd
Lynden, WA 98264

Belfern West
Attn: Al Reinikka
5355 Bell West Dr
Bellingham, WA 98226

City of Bellingham-Water Division
Attn: Robert Johnson
2317 St. Clair Street
Bellingham, WA 98229-4011

Custer Water Association
Attn: Chester Haynes
PO Box 575
Custer, WA 98240

Double L Mobile Home Park
Attn: Ashley Wesselman
PO Box 1953
Ferndale, WA 98248

Fairfield MHP
Attn: Scott Johnston
2652 Halverstick Rd
Lynden, WA 98264

Ferndale Mobile Village
Attn: Susan Grady
2350 Douglas Rd No 27
Ferndale, WA 98248

Grandview Center Business Park
Attn: Mark Douglas
7056 Portal Way Site A-5
Ferndale, WA 98248

Grandview-Northgate Industrial Park
Attn: Fred Disch
1705 Trigg Rd
Ferndale, WA 98248

Malloy Rd Mobile Home Pk
Attn: Paul Hartvig
6485 Malloy Rd
Ferndale, WA 98248

Mountain View Water Association
Attn: Dave Olson
6951 Hannigan Rd. #2
Lynden, WA 98264

Northwest Water Association Inc.
Attn: Tim Brinkley
5168 Graveline Rd
Bellingham, WA 98226

Orchard Water Assoc
Attn: Connie Ellis
PO Box 563
Ferndale, WA 98248

River Rd Water Association
Attn: Judy Channel
PO Box 284
Ferndale, WA 98248

Thornton Water Association
Attn: Cleve Guessford
PO Box 1799
Ferndale, WA 98248

Zoller Water System
Attn: Fred Zoller
1800 Harris Ave
Bellingham, WA 98225

ORDINANCE #1952

AN ORDINANCE ADOPTING THE 2016 UPDATE TO THE FERNDALE COMPREHENSIVE PLAN

WHEREAS, the City of Ferndale is required to plan in accordance with the Washington State Growth Management Act (GMA); and

WHEREAS, the GMA requires that jurisdictions adopt and periodically update comprehensive plans; and

WHEREAS, Whatcom County and its respective cities are required to update their comprehensive plans by June 30, 2016; and

WHEREAS, for the purposes of the Comprehensive Plan a twenty-year planning period ending in 2036 is established; and

WHEREAS, the City of Ferndale has held over three dozen workshops, town halls, and other events; and

WHEREAS, the City's public process has been consistent with its Public Participation Plan (adopted January 2014); and

WHEREAS, Whatcom County has indicated that it projects that Ferndale will grow by 6,833 residents and add 4,000 jobs by 2036; and

WHEREAS, all required elements of the Ferndale Comprehensive Plan must be consistent with these projections; and

WHEREAS, the City has engaged several consultants and relied on City staff to complete the work within the Comprehensive Plan; and

WHEREAS, the Ferndale Planning Commission has focused on the 2016 update of the comprehensive plan for nearly two years; and

WHEREAS, the 2016 update features electronic readability, improved graphics, associated multi-media displays, a combined electronic capital facilities project map, and more; and

WHEREAS, the 2016 update seeks innovative ways to increase densities without reducing quality of life or the essential character of established neighborhoods; and

WHEREAS, the 2016 update seeks to establish capital facilities and transportation projects that are realistic and financially achievable; and

WHEREAS, the 2016 update responds to all requirements of the Growth Management Act and fulfill the requirements of the periodic update; and

WHEREAS, the City issued a Determination of Non-Significance on March 11, 2016, following a two-week comment period; and

WHEREAS, the 2016 update anticipates that the Whatcom County Council will approve the conversion of approximately 114 acres of land at the northeast intersection of Pacific Highway and Slater Road, from Urban Growth Area Reserve to Urban Growth Area. A land use designation of Commercial will be assigned to this area; and

WHEREAS, the Ferndale City Council formally adopted the City's Water and Sewer Plans on June 6th, 2016 following an open record public hearing; and

WHEREAS, the Ferndale Planning Commission held an open record public hearing on June 15, 2016; and

WHEREAS, the Ferndale City Council held an open record public hearing on June 20, 2016; and

WHEREAS, the Ferndale Planning Commission and City Council acknowledge that further formatting of the comprehensive plan may occur following adoption; and

WHEREAS, the City has docketed further updates to the Comprehensive Plan to be considered in late 2016; and

WHEREAS, such further updates may include an analysis of the City's future building needs, updates to the City's Annexation Phasing Plan, Parks, Recreation and Trails Master Plan, an expanded bicycle and pedestrian project list, potential clarification and modifications resulting from required reviews of Water and Sewer plans by State agencies, and associated other living documents adopted by reference; and

WHEREAS, the City anticipates that such modifications, though not required in order to complete the periodic update process, will be complete by December 31, 2016.

NOW THEREFORE, THE CITY COUNCIL OF THE CITY OF FERNDALE DO ORDAIN AS FOLLOWS:

Section 1: The 2016 Update to the Ferndale Comprehensive Plan is hereby adopted and can be viewed in its entirety at www.cityofferndale.org

Section 2: This ordinance shall become effective on the sixth day after publication.

PASSED by the Council of the City of Ferndale, Washington, on this 20thth day of June, 2016.

ATTEST:

Jon Mutcher, Mayor

Susan Duncan, City Clerk

Publication Date June 22, 2016 – Ferndale Record

Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - ALDERGROVE WATER ASSOC. - Water System Id - 01200

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Association
Type	Community	**Residential Population**	120	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	ALDERGROVE WATER ASSOC.	**Total Calculated Connections**	60	**System Inactive Date**	
Primary Contact	Dave Olson	**Total Approved Connections**	120	**SMA Name**	
Primary Contact Phone	(360) 354-7909	**Distribution Capacity (gallons)**	47,000	**SMA Number**	
Water System Mailing Address	6951 Hannigan Rd. #2 Lynden, WA 98264				

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Department of Health, Office of Drinking Water

Street Address:
243 Israel Road S.E. 2nd floor
Tumwater, WA 98501

Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

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Comments or questions regarding this Web site? Send email to Environmental Health Application Testing and Support or call 360-236-4593.

Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

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Individual System View - BAKER VIEW WATER ASSOC - Water System Id - 04050

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	Status	Active	Ownership Type	Private
Type	Community	Residential Population	40	Jurisdiction	WA DOH ODW
County	WHATCOM	NonResidential Population	0	System Effective Date	1/1/1970
Owner Name	BAKER VIEW WATER ASSOC	Total Calculated Connections	14	System Inactive Date	
Primary Contact	Scott Johnston	Total Approved Connections	Unapproved	SMA Name	
Primary Contact Phone	(360) 201-1797	Distribution Capacity (gallons)	11,600	SMA Number	
Water System Mailing Address	2652 Halverstick Rd Lynden, WA 98264-9529				

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Washington State Department of Health

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Individual System View - BELFERN WEST - Water System Id - 09899

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Association
Type	Community	**Residential Population**	60	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	11/1/1981
Owner Name	BELFERN WEST	**Total Calculated Connections**	24	**System Inactive Date**	
Primary Contact	AL REINIKKA	**Total Approved Connections**	25	**SMA Name**	
Primary Contact Phone	(360) 384-3959	**Distribution Capacity (gallons)**	0	**SMA Number**	
Water System Mailing Address	5355 BELL WEST DR BELLINGHAM, WA 98226				

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - BELLINGHAM-WATER DIVISION, CITY OF - Water System Id - 05600

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	City/Town
Type	Community	**Residential Population**	90,000	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	BELLINGHAM-WATER DIVISION, CITY OF	**Total Calculated Connections**	24,978	**System Inactive Date**	
Primary Contact	Robert Johnson	**Total Approved Connections**	Unspecified	**SMA Name**	
Primary Contact Phone	(360) 778-7735	**Distribution Capacity (gallons)**	29,375,000	**SMA Number**	
Water System Mailing Address	2317 St. Clair Street Bellingham, WA 98229-4011				

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Washington State Department of Health

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Office of Drinking Water

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Individual System View - Custer Water Association - Water System Id - 17050

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Private
Type	Community	**Residential Population**	365	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	Custer Water Association	**Total Calculated Connections**	235	**System Inactive Date**	
Primary Contact	Chester Haynes	**Total Approved Connections**	315	**SMA Name**	
Primary Contact Phone	(360) 366-3474	**Distribution Capacity (gallons)**	200,000	**SMA Number**	
Water System Mailing Address	PO Box 575 Custer, WA 98240				

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Department of Health, Office of Drinking Water

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243 Israel Road S.E. 2nd floor
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Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - DOUBLE L MOBILE HOME PARK - Water System Id - 19890

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Private
Type	Community	**Residential Population**	58	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	DOUBLE L MOBILE HOME PARK	**Total Calculated Connections**	25	**System Inactive Date**	
Primary Contact	Ashley Wesselman	**Total Approved Connections**	Unapproved	**SMA Name**	
Primary Contact Phone	(360) 384-4663 x212	**Distribution Capacity (gallons)**	10,000	**SMA Number**	
Water System Mailing Address	PO Box 1953 Ferndale, WA 98248				

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Department of Health, Office of Drinking Water

Street Address:
243 Israel Road S.E. 2nd floor
Tumwater, WA 98501

Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

Send inquiries about DOH and its programs to the Health Consumer Assistance Office
Comments or questions regarding this Web site? Send email to Environmental Health Application Testing and Support or call 360-236-4593.

Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - FAIRFIELD MHP - Water System Id - 02601

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Investor
Type	Community	**Residential Population**	66	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	4/1/1980
Owner Name	FAIRFIELD MHP	**Total Calculated Connections**	25	**System Inactive Date**	
Primary Contact	Scott Johnston	**Total Approved Connections**	25	**SMA Name**	
Primary Contact Phone	(360) 201-1797	**Distribution Capacity (gallons)**	4,400	**SMA Number**	
Water System Mailing Address	2652 Halverstick Rd Lynden, WA 98264-9529				

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Olympia, WA 98504-7822

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Washington State Department of Health

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Help

Individual System View - FERNDALE MOBILE VILLAGE - Water System Id - 24840

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Investor
Type	Community	**Residential Population**	85	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	FERNDALE MOBILE VILLAGE	**Total Calculated Connections**	54	**System Inactive Date**	
Primary Contact	Susan Grady	**Total Approved Connections**	55	**SMA Name**	NORTHWEST WATER WORKS LLC
Primary Contact Phone	(360) 384-1274	**Distribution Capacity (gallons)**	59,000	**SMA Number**	126
Water System Mailing Address	2350 Douglas Rd No 27 Ferndale, WA 98248				

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Department of Health, Office of Drinking Water

Street Address:
243 Israel Road S.E. 2nd floor
Tumwater, WA 98501

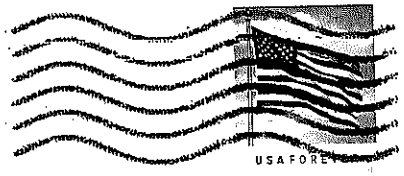
Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

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R&E Reichhardt & Ebe
ENGINEERING INC
P.O. Box 978 | 423 Front Street, Lynden WA 98264

SEATTLE WA 980
26 MAY 2016 PM 6 L



Hand delivered
6/3/16
CFK

Received
6/3/16

Grandview Center Business Park
Attn: Mark Douglas
7056 Portal Way Site A-5
Ferndale, WA 98248

NSN
MIXIE 980 SE 1 0105/31/16
RETURN TO SENDER
NO SUCH NUMBER
UNABLE TO FORWARD
BC: 98264097878 *2226-03943-26-41

Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - GRANDVIEW CENTER BUSINESS PARK WS - Water System Id - 03971N

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Inactive	**Ownership Type**	Association
Type	Non-Transient, Non-Community	**Residential Population**	2	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	43	**System Effective Date**	12/18/2002
Owner Name	GRANDVIEW CENTER BUSINESS PARK WS	**Total Calculated Connections**	20	**System Inactive Date**	6/10/2011
Primary Contact	Mark Douglas	**Total Approved Connections**	21	**SMA Name**	
Primary Contact Phone	(360) 734-2222	**Distribution Capacity (gallons)**	3,400	**SMA Number**	
Water System Mailing Address	7056 Portal Way Ste A-5 Ferndale, WA 98248				

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Tumwater, WA 98501

Mail:
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Olympia, WA 98504-7822

Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - GRANDVIEW-NORTHGATE INDUSTRIAL PARK - Water System Id - 00638

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Special District
Type	Non-Transient, Non-Community	**Residential Population**	0	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	350	**System Effective Date**	12/4/1995
Owner Name	GRANDVIEW-NORTHGATE INDUSTRIAL PARK	**Total Calculated Connections**	48	**System Inactive Date**	
Primary Contact	Fred Disch	**Total Approved Connections**	Unspecified	**SMA Name**	
Primary Contact Phone	(360) 384-4288 x24	**Distribution Capacity (gallons)**	30,000	**SMA Number**	
Water System Mailing Address	1705 Trigg Rd Ferndale, WA 98248				

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Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - MALLOY RD MOBILE HOME PK - Water System Id - 529030

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	B	**Status**	Inactive	**Ownership Type**	Investor
Type		**Residential Population**	18	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	11/1/1988
Owner Name	MALLOY RD MOBILE HOME PK	**Total Calculated Connections**	9	**System Inactive Date**	11/1/1988
Primary Contact	PAUL HARTVIG	**Total Approved Connections**	Undetermined	**SMA Name**	
Primary Contact Phone	(360) 384-4641	**Distribution Capacity (gallons)**	1,200	**SMA Number**	
Water System Mailing Address	6485 MALLOY RD FERNDALE, WA 98248				

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Department of Health, Office of Drinking Water

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Tumwater, WA 98501

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Olympia, WA 98504-7822

Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - MOUNTAIN VIEW WATER ASSOCIATION - Water System Id - 56900

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Association
Type	Community	**Residential Population**	186	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	MOUNTAIN VIEW WATER ASSOCIATION	**Total Calculated Connections**	75	**System Inactive Date**	
Primary Contact	Dave Olson	**Total Approved Connections**	95	**SMA Name**	
Primary Contact Phone	(360) 354-7909	**Distribution Capacity (gallons)**	34,000	**SMA Number**	
Water System Mailing Address	6951 Hannigan Rd. #2 Lyndon, WA 98264				

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Department of Health, Office of Drinking Water

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Tumwater, WA 98501

Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - NORTHWEST WATER ASSOCIATION, INC - Water System Id - 62000

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Association
Type	Community	**Residential Population**	400	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	NORTHWEST WATER ASSOCIATION, INC	**Total Calculated Connections**	146	**System Inactive Date**	
Primary Contact	Tim Brinkley	**Total Approved Connections**	260	**SMA Name**	
Primary Contact Phone	(360) 384-6489	**Distribution Capacity (gallons)**	130,000	**SMA Number**	
Water System Mailing Address	5168 GRAVELINE RD BELLINGHAM, WA 98226				

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Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - ORCHARD WATER ASSOC - Water System Id - 64150

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Association
Type	Community	**Residential Population**	153	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	ORCHARD WATER ASSOC	**Total Calculated Connections**	51	**System Inactive Date**	
Primary Contact	Connie Ellis	**Total Approved Connections**	59	**SMA Name**	
Primary Contact Phone	(360) 312-0114	**Distribution Capacity (gallons)**	18,000	**SMA Number**	
Water System Mailing Address	PO BOX 563 Ferndale, WA 98248				

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243 Israel Road S.E. 2nd floor
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Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - RIVER RD WATER ASSOCIATION - Water System Id - 72800

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Private
Type	Community	**Residential Population**	29	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	RIVER RD WATER ASSOCIATION	**Total Calculated Connections**	15	**System Inactive Date**	
Primary Contact	Judy Channel	**Total Approved Connections**	20	**SMA Name**	
Primary Contact Phone	(360) 305-4859	**Distribution Capacity (gallons)**	10,000	**SMA Number**	
Water System Mailing Address	PO Box 284 Ferndale, WA 98248				

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Department of Health, Office of Drinking Water

Street Address:
243 Israel Road S.E. 2nd floor
Tumwater, WA 98501

Mail:
PO BOX 47822
Olympia, WA 98504-7822

Phone: (360) 236-3100

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Comments or questions regarding this Web site? Send email to Environmental Health Application Testing and Support or call 360-236-4593.

Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - THORNTON WATER ASSOCIATION - Water System Id - 88050

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	A	**Status**	Active	**Ownership Type**	Private
Type	Community	**Residential Population**	55	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	1/1/1970
Owner Name	THORNTON WATER ASSOCIATION	**Total Calculated Connections**	18	**System Inactive Date**	
Primary Contact	Cleve Guessford	**Total Approved Connections**	26	**SMA Name**	
Primary Contact Phone	(360) 305-1918	**Distribution Capacity (gallons)**	11,000	**SMA Number**	
Water System Mailing Address	PO Box 1799 Ferndale, WA 98248				

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Department of Health, Office of Drinking Water

Street Address:
243 Israel Road S.E. 2nd floor
Tumwater, WA 98501

Mail:
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Olympia, WA 98504-7822

Phone: (360) 236-3100

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Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

Individual System View - ZOLLER WATER SYSTEM - Water System Id - 02741K

Compliance Actions | Operating Permits | Operators | Reports | Water Use Efficiency

General Information | Source Information | Samples | Exceedances | Water Quality Monitoring Schedule

Group	B	**Status**	Active	**Ownership Type**	Investor
Type		**Residential Population**	21	**Jurisdiction**	WA DOH ODW
County	WHATCOM	**NonResidential Population**	0	**System Effective Date**	11/8/1993
Owner Name	ZOLLER WATER SYSTEM	**Total Calculated Connections**	8	**System Inactive Date**	
Primary Contact	Fred Zoller	**Total Approved Connections**	Undetermined	**SMA Name**	
Primary Contact Phone	(360) 676-6292	**Distribution Capacity (gallons)**	0	**SMA Number**	
Water System Mailing Address	1800 Harris Ave Bellingham, WA 98225				

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243 Israel Road S.E. 2nd floor
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Mail:
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Olympia, WA 98504-7822

Phone: (360) 236-3100

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APPENDICES

A. AGENCY COMMENTS

B. WATER FACILITIES INVENTORY (WFI) FORM AND ORDINANCES

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

WATER FACILITIES INVENTORY (WFI) FORM

ONE FORM PER SYSTEM

Quarter: 1
Updated: 05/09/2016
Printed: 5/9/2016
WFI Printed For: On-Demand
Submission Reason: Pop/Connect Update

RETURN TO: Central Services - WFI, PO Box 47822, Olympia, WA, 98504-7822

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
24850 M	FERNDALE	WHATCOM	A	Comm

6. PRIMARY CONTACT NAME & MAILING ADDRESS

MICHAEL C. OLINGER [OPERATOR]
PO BOX 936
FERNDALE, WA 98248

7. OWNER NAME & MAILING ADDRESS — **8. OWNER NUMBER: 001896**

FERNDALE, CITY OF
JON MUTCHLER MAYOR
PO BOX 936
FERNDALE, WA 98248

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN
ADDRESS 2095 MAIN ST
CITY FERNDALE STATE WA ZIP 98248

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN
ADDRESS 2095 MAIN STR
CITY FERNDALE STATE WA ZIP 98248

9. 24 HOUR PRIMARY CONTACT INFORMATION

Primary Contact Daytime Phone: (360) 815-1508
Primary Contact Mobile/Cell Phone: (360) 815-1508
Primary Contact Evening Phone: (360) 815-1508
Fax: (360) 384-4017 E-mail: MikeOlinger@cityofferndale.org

10. OWNER CONTACT INFORMATION

Owner Daytime Phone: (360) 685-2350
Owner Mobile/Cell Phone: (360) 927-1881
Owner Evening Phone: (360) 384-9092
Fax: (360) 384-4017 E-mail: jonmutchler@cityofferndale.org

WAC 246-290-420(9) requires that water systems provide 24-hour contact information for emergencies.

11. SATELLITE MANAGEMENT AGENCY - SMA (check only one)

- [x] Not applicable (Skip to #12)
- [ ] Owned and Managed
- [ ] Managed Only
- [ ] Owned Only

SMA NAME: _____ SMA Number:

12. WATER SYSTEM CHARACTERISTICS (mark all that apply)

- [ ] Agricultural
- [x] Commercial / Business
- [x] Day Care
- [x] Food Service/Food Permit
- [ ] 1,000 or more person event for 2 or more days per year
- [x] Hospital/Clinic
- [x] Industrial
- [x] Licensed Residential Facility
- [x] Lodging
- [x] Recreational / RV Park
- [x] Residential
- [x] School
- [ ] Temporary Farm Worker
- [x] Other (church, fire station, etc.): _____

13. WATER SYSTEM OWNERSHIP (mark only one)

- [ ] Association
- [x] City / Town
- [ ] County
- [ ] Federal
- [ ] Investor
- [ ] Private
- [ ] Special District
- [ ] State

14. STORAGE CAPACITY (gallons)

2,750,000

15	16	17	18 SOURCE CATEGORY										19 USE			20	21 TREATMENT						22	23	24 SOURCE LOCATION			
Source Number	SOURCE NAME LIST UTILITY'S NAME FOR SOURCE AND WELL TAG ID NUMBER. Example: WELL #1 XYZ456 IF SOURCE IS PURCHASED OR INTERTIED, LIST SELLER'S NAME Example: SEATTLE	INTERTIE SYSTEM ID NUMBER	WELL	WELL FIELD	WELL IN A WELL FIELD	SPRING	SPRING FIELD	SPRING IN SPRINGFIELD	SEA WATER	SURFACE WATER	RANNEY / INF. GALLERY	OTHER	PERMANENT	SEASONAL	EMERGENCY	SOURCE METERED	NONE	CHLORINATION	FILTRATION	FLUORIDATION	IRRADIATION (UV)	OTHER	DEPTH TO FIRST OPEN INTERVAL IN FEET	CAPACITY (GALLONS PER MINUTE)	1/4, 1/4 SECTION	SECTION NUMBER	TOWNSHIP	RANGE
S02	Shop Well AFM090				X								X			Y		X	X			X	130	870	SE SW	19	39N	02E
S06	Douglas Well #1 BCB347				X								X			Y		X	X			X	146	1300	NW NE	30	39N	02E
S07	Shop & Douglas WF			X									X					X	X			X	130	2170			00N	00E

WATER FACILITIES INVENTORY (WFI) FORM - Continued

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
24850 M	FERNDALE	WHATCOM	A	Comm

	ACTIVE SERVICE CONNECTIONS	DOH USE ONLY! CALCULATED ACTIVE CONNECTIONS	DOH USE ONLY! APPROVED CONNECTIONS
25. SINGLE FAMILY RESIDENCES (How many of the following do you have?)		5301	Unspecified
A. Full Time Single Family Residences (Occupied 180 days or more per year)	4461		
B. Part Time Single Family Residences (Occupied less than 180 days per year)	0		
26. MULTI-FAMILY RESIDENTIAL BUILDINGS (How many of the following do you have?)			
A. Apartment Buildings, condos, duplexes, barracks, dorms	0		
B. Full Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied more than 180 days/year	840		
C. Part Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied less than 180 days/year	0		
27. NON-RESIDENTIAL CONNECTIONS (How many of the following do you have?)			
A. Recreational Services and/or Transient Accommodations (Campsites, RV sites, hotel/motel/overnight units)	0	0	
B. Institutional, Commercial/Business, School, Day Care, Industrial Services, etc.	335	335	
28. TOTAL SERVICE CONNECTIONS		5636	

29. FULL-TIME RESIDENTIAL POPULATION

A. How many residents are served by this system 180 or more days per year? 12921

30. PART-TIME RESIDENTIAL POPULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many part-time residents are present each month?												
B. How many days per month are they present?												

31. TEMPORARY & TRANSIENT USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many total visitors, attendees, travelers, campers, patients or customers have access to the water system each month?												
B. How many days per month is water accessible to the public?												

32. REGULAR NON-RESIDENTIAL USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. If you have schools, daycares, or businesses connected to your water system, how many students daycare children and/or employees are present each month?												
B. How many days per month are they present?												

33. ROUTINE COLIFORM SCHEDULE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
* Requirement is exception from WAC 246-290	15	15	15	15	15	15	15	15	15	15	15	15

34. NITRATE SCHEDULE	QUARTERLY	ANNUALLY	ONCE EVERY 3 YEARS
(One Sample per source by time period)			

35. Reason for Submitting WFI:

☐ Update - Change ☐ Update - No Change ☐ Inactivate ☐ Re-Activate ☐ Name Change ☐ New System ☐ Other _____

36. I certify that the information stated on this WFI form is correct to the best of my knowledge.

SIGNATURE: _____ **DATE:** _____

PRINT NAME: _____ **TITLE:** _____

WS ID	WS Name
24850	FERNDALE

Total WFI Printed: 1

ORDINANCE #1921

AN ORDINANCE OF THE CITY OF FERNDALE WASHINGTON, SETTING RATES AND FREQUENCY OF BILLINGS FOR WATER AND SEWER SERVICE AND REPEALING ALL PRIOR ORDINANCES IN CONFLICT HEREWITH.

WHEREAS, it is necessary to amend the City's billing rates and procedures relating to utility taxes in order to comply with new requirements set forth by the Washington State Auditor;

NOW THEREFORE, The City Council of the City of Ferndale do ordain as follows:

Ordinance 1801 is amended to read:

Section 1. The following rate schedule for water and sewer service is hereby adopted effective with bills mailed approximately December 31, ~~2013:~~ **2015.**

Section 1. A.

Water Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water) **A 9% utility tax is included in rates.**

1) **Single Family Residential/Residential Duplexes – Single Meter:**

Base fee	~~$13.44~~ **$14.81** Per Housing Unit
Consumption:	
1-25 units	~~$3.14~~ **$3.47**/unit
26-50 units	~~$3.47~~ **$3.84**/unit
51-150 units	~~$4.11~~ **$4.53**/unit
151+ units	~~$3.47~~ **$3.84**/unit

2) **Multiple Family Residential/Three or more units served through a Single Water Meter:**

Base fees	~~$13.44~~ **$14.81** Up to 1 inch Meter **or** ~~$42.06~~ **$46.44** Over 1 inch Meter
Consumption:	
1-25 units	~~$3.14~~ **$3.47**/unit
26-50 units	~~$3.47~~ **$3.84**/unit
51-150 units	~~$4.11~~ **$4.53**/unit
151+ units	~~$3.47~~ **$3.84**/unit

3) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**

Base fees	~~$13.44~~ **$14.81** Up to 1 inch Meter **or** ~~$42.06~~ **$46.44** Over 1 inch Meter
Consumption:	

1-25	units	~~$3.14~~ **$3.47**/unit
26-50	units	~~$3.47~~ **$3.84**/unit
51-150	units	~~$4.11~~ **$4.53**/unit
151+	units	~~$3.47~~ **$3.84**/unit

Shared Meters (Water):
Where more than one business or combination of one or more business and residential users have their water usage measured through a single meter, the invoice shall be charged to one designated user at the above rates.

Out-of-City Customers:
Customers outside the corporate limits of the City of Ferndale shall pay the rates shown in the above schedule, together with a surcharge of 50% to be applied to both the base fee and the use charge.

Section 1. B.

Water Service CPI Adjustment

An annual CPI adjustment for bi-monthly rates shall occur on June 30th annually as follows:

All rates increase (no decreases) by 50% of the Seattle CPI-W, change from April to April of the current year. **A 9% utility tax is included in rates.**

Section 1. C.

Sewer Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water used)

1) **Non-Metered/Residential Flat Rate**: ~~$ 86.15~~ **$97.57**

2) **Non-Metered/Commercial Flat Rate**: ~~$ 86.15~~ **$97.57**

3) Metered **Single Family Residential/Residential Duplexes – Single Meter**:

Base fee ~~**$23.16**~~ **$26.21**
Consumption:

1-25	units	~~$5.25~~ **$5.94**/unit
26-50	units	~~$5.84~~ **$6.62**/unit
51-150	units	~~$6.89~~ **$7.80**/unit
151+	units	~~$5.84~~ **$6.62**/unit

4) **Multiple Family Residential/Three or more units served through a Single Water Meter:**

Base fee ~~**$23.16**~~ **$26.21**
Consumption:

1-25	units	~~$5.25~~ **$5.94**/unit
26-50	units	~~$5.84~~ **$6.62**/unit
51-150	units	~~$6.89~~ **$7.80**/unit
151+	units	~~$5.84~~ **$6.62**/unit

5) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**

Base fee	~~**$23.16**~~ **$26.21**
Consumption:	
1-25 units	~~$5.25~~ **$5.94**/unit
26-50 units	~~$5.84~~ **$6.62**/unit
51-150 units	~~$6.89~~ **$7.80**/unit
151+ units	~~$5.84~~ **$6.62**/unit

Shared Meters (Sewer):
Where more than one business or combination of one or more business and residential users have their water usage measured through a single meter, the invoice shall be charged to one designated user at the above rates.

Commercial/Industrial Effluent:

Commercial/Industrial users contributing effluent which might be expected to impact the system to a greater degree than normal may be required to provide an industrial waste study from which an equitable rate may be established.

Out of City Customers:

Customers outside the corporate limits of the City of Ferndale shall pay the rates shown in the above schedule, together with a surcharge of 50% to be applied to both the base fee and use charge.

Summer Use:

When the use of water is such that a portion does not flow into the sewer system due to irrigation by single family residences and duplexes during the irrigation season, which is hereby defined as that billing period beginning approximately June 15 and ending approximately October 15, the maximum chargeable water entering the sewer system during a Bi-Monthly billing period shall be based upon the average for the previous four billing periods. The average may be based upon a lesser number of billing periods if reliable data is not available. If reliable data can not be obtained for at least two billing periods the average chargeable shall be the City-wide average.

Section 1. D.

Sewer Service CPI Adjustment

An annual CPI adjustment for bi-monthly rates shall occur on June 30th annually as follows:

All rates increase (no decreases) by 150% of the Seattle CPI-W, change from April to April of the current year.

Section 2. Repeal of Ordinances in conflict.

All Ordinances in conflict hereof are hereby repealed.

PASSED AND ENACTED by the City of Ferndale City Council meeting in regular session on the 2nd day of November, 2015.

ATTEST:

Gary S. Jensen, Mayor

Susan Duncan, City Clerk

11-3-15

Date

ORDINANCE #1801

AN ORDINANCE OF THE CITY OF FERNDALE WASHINGTON, SETTING RATES AND FREQUENCY OF BILLINGS FOR WATER AND SEWER SERVICE AND REPEALING ALL PRIOR ORDINANCES IN CONFLICT HEREWITH.

The City Council of the City of Ferndale do ordain as follows:

Ordinance 1599 is amended to read:

Section 1. The following rate schedule for water and sewer service is hereby adopted effective with bills mailed approximately December 31, 2010:

Section 1. A.

Water Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water)

1) **Single Family Residential/Residential Duplexes – Single Meter**:

Base fee	$12.78 Per Housing Unit
Consumption:	
1-25 units	$2.98/unit
26-50 units	$3.30/unit
51-150 units	$3.91/unit
151+ units	$3.30/unit

2) **Multiple Family Residential/Three or more units served through a Single Water Meter:**

Base fees	$12.78 Up to 1 inch Meter **or**
	$40.00 Over 1 inch Meter
Consumption:	
1-25 units	$2.98/unit
26-50 units	$3.30/unit
51-150 units	$3.91/unit
151+ units	$3.30/unit

3) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**

Base fees	$12.78 Up to 1 inch Meter **or**
	$40.00 Over 1 inch Meter
Consumption:	
1-25 units	$2.98/unit
26-50 units	$3.30/unit
51-150 units	$3.91/unit
151+ units	$3.30/unit

Shared Meters (Water):
Where more than one business or combination of one or more business and residential users have their water usage measured through a single meter, the invoice shall be charged to one designated user at the above rates.

For bills mailed June 30, 2011, the water and sewer charges, meter charges and flat rates for all customers will increase by 6.5%.

Out-of-City Customers:
Customers outside the corporate limits of the City of Ferndale shall pay the rates shown in the above schedule, together with a surcharge of 50% to be applied to both the base fee and the use charge.

Section 1. B.

Water Service CPI Adjustment

Bi-Monthly Rates to be effective for the water billing period for which bills will be sent approximately **June 30, 2012, and annually thereafter on June 30th:**

All rates increase (no decreases) by 100% of the Seattle CPI-W, change from April to April of the current year.

Section 1. C.

Sewer Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water used)

1) **Non-Metered/Residential Flat Rate**: $ 78.62

2) **Non-Metered/Commercial Flat Rate**: $ 78.62

3) Metered **Single Family Residential/Residential Duplexes – Single Meter**:

Base fee $21.14
Consumption:
1-25 units $4.79/unit
26-50 units $5.33/unit
51-150 units $6.28/unit
151+ units $5.33/unit

4) **Multiple Family Residential/Three or more units served through a Single Water Meter:**
Base fee $21.14
Consumption:
1-25 units $4.79/unit
26-50 units $5.33/unit
51-150 units $6.28/unit
151+ units $5.33/unit

5) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**
Base fee $21.14

Consumption:

1-25 units	$4.79/unit
26-50 units	$5.33/unit
51-150 units	$6.28/unit
151+ units	$5.33/unit

Shared Meters (Sewer):

Where more than one business or combination of one or more business and residential users have their water usage measured through a single meter, the invoice shall be charged to one designated user at the above rates.

For bills mailed June 30, 2011, the water and sewer charges, meter charges and flat rates for all customers will increase by 6.5%.

Commercial/Industrial Effluent:

Commercial/Industrial users contributing effluent which might be expected to impact the system to a greater degree than normal may be required to provide an industrial waste study from which an equitable rate may be established.

Out of City Customers:

Customers outside the corporate limits of the City of Ferndale shall pay the rates shown in the above schedule, together with a surcharge of 50% to be applied to both the base fee and use charge.

Summer Use:

When the use of water is such that a portion does not flow into the sewer system due to irrigation by single family residences and duplexes during the irrigation season, which is hereby defined as that billing period beginning approximately June 15 and ending approximately October 15, the maximum chargeable water entering the sewer system during a Bi-Monthly billing period shall be based upon the average for the previous four billing periods. The average may be based upon a lesser number of billing periods if reliable data is not available. If reliable data can not be obtained for at least two billing periods the average chargeable shall be the City-wide average.

Section 1. D.

Sewer Service CPI Adjustment

Bi-Monthly Rates to be effective for the sewer billing period for which bills will be sent approximately **June 30, 2012, and annually thereafter on June 30th:**

All rates increase (no decreases) by 100% of the Seattle CPI-W, change from April to April of the current year.

Section 2. Repeal of Ordinances in conflict.

~~All Ordinances in conflict hereof are hereby repealed.~~

Section 1. The following rate schedule for water and sewer service is hereby adopted effective with bills mailed approximately December 31, 2013:

Section 1. A.

Water Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water)

1) **Single Family Residential/Residential Duplexes – Single Meter:**

Base fee	$13.44 Per Housing Unit
Consumption:	
1-25 units	$3.14/unit
26-50 units	$3.47/unit
51-150 units	$4.11/unit
151+ units	$3.47/unit

2) **Multiple Family Residential/Three or more units served through a Single Water Meter:**

Base fees	$13.44 Up to 1 inch Meter **or** $42.06 Over 1 inch Meter
Consumption:	
1-25 units	$3.14/unit
26-50 units	$3.47/unit
51-150 units	$4.11/unit
151+ units	$3.47/unit

3) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**

Base fees	$13.44 Up to 1 inch Meter **or** $42.06 Over 1 inch Meter
Consumption:	
1-25 units	$3.14/unit
26-50 units	$3.47/unit
51-150 units	$4.11/unit
151+ units	$3.47/unit

Shared Meters (Water):
Where more than one business or combination of one or more business and residential users have their water usage measured through a single meter, the invoice shall be charged to one designated user at the above rates.

Out-of-City Customers:
Customers outside the corporate limits of the City of Ferndale shall pay the rates shown in the above schedule, together with a surcharge of 50% to be applied to both the base fee and the use charge.

Section 1. B.

Water Service CPI Adjustment

An annual CPI adjustment for bi-monthly rates shall occur on June 30th annually as follows:

All rates increase (no decreases) by 50% of the Seattle CPI-W, change from April to April of the current year.

Section 1. C.

Sewer Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water used)

1) **Non-Metered/Residential Flat Rate**: $ 86.15

2) **Non-Metered/Commercial Flat Rate**: $ 86.15

3) Metered **Single Family Residential/Residential Duplexes – Single Meter**:

Base fee	**$23.16**
Consumption:	
1-25 units	$5.25/unit
26-50 units	$5.84/unit
51-150 units	$6.89/unit
151+ units	$5.84/unit

4) **Multiple Family Residential/Three or more units served through a Single Water Meter:**

Base fee	**$23.16**
Consumption:	
1-25 units	$5.25/unit
26-50 units	$5.84/unit
51-150 units	$6.89/unit
151+ units	$5.84/unit

5) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**

Base fee	**$23.16**
Consumption:	
1-25 units	$5.25/unit
26-50 units	$5.84/unit
51-150 units	$6.89/unit
151+ units	$5.84/unit

Shared Meters (Sewer):
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Commercial/Industrial Effluent:

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Summer Use:

When the use of water is such that a portion does not flow into the sewer system due to irrigation by single family residences and duplexes during the irrigation season, which is hereby defined as that billing period beginning approximately June 15 and ending approximately October 15, the maximum chargeable water entering the sewer system during a Bi-Monthly billing period shall be based upon the average for the previous four billing periods. The average may be based upon a lesser number of billing periods if reliable data is not available. If reliable data can not be obtained for at least two billing periods the average chargeable shall be the City-wide average.

Section 1. D.

Sewer Service CPI Adjustment

An annual CPI adjustment for bi-monthly rates shall occur on June 30th annually as follows:

All rates increase (no decreases) by 150% of the Seattle CPI-W, change from April to April of the current year.

Section 2. Repeal of Ordinances in conflict.

All Ordinances in conflict hereof are hereby repealed.

PASSED AND ENACTED by the City of Ferndale City Council meeting in regular session on the 7th day of October, 2013.

ATTEST:

Gary S. Jensen, Mayor

Sam Taylor, CITY CLERK

ORDINANCE # 1764

AN ORDINANCE OF THE COUNCIL OF THE CITY OF FERNDALE, WASHINGTON, AMENDING THE CITY OF FERNDALE SCHEDULE OF SEWER AND WATER CONNECTION FEES, AMENDING CALCULATIONS FOR SPECIFIC LAND USES

WHEREAS, the City of Ferndale is authorized to charge water and sewer connection fees to development projects that connect to those City systems; and

WHEREAS, the Ferndale City Council adopted substantial updates to the City's Schedule of Sewer and Water Connection Fees in 2011; and

WHEREAS, the City Council directed staff to identify further periodic updates to the fee schedule in order to ensure continued accuracy; and

WHEREAS, the City has identified minor amendments to the fee schedule to add a new use-type: Health/Fitness Club, No Shower Facilities; and

WHEREAS, these amendments reflect a more accurate projection of actual water and sewer use for each land use.

NOW THEREFORE, the City Council of the City of Ferndale do ordain as follows:

Section 1. The City of Ferndale Schedule of Sewer and Water Connection Fees shall be amended to read as follows:

Sewer Current Equivalent Residential Unit Cost	$6,941

Equivalent Residential Unit = 210 Gallons Per Day

Water Current Equivalent Residential Unit Cost	$5,553

Adopted August 2012 — Revised January 2013

City of Ferndale
Schedule of Sewer and Water Connection Fees

Land Use Category			Equivalent Residential Units	Unit[1] (if means per 1000 square feet, unless otherwise noted)	Alternative	Adjustable Value # Units	Calculated Values Net ERU's	Sewer Connection Fee	Water Connection Fee
RESIDENTIAL									
Bed and Breakfast Establishments			1.000	Per Building plus .3 per guest room			0.00	$0.00	0
Multi Family			0.760	Dwelling Unit			0.00	$0.00	0
Residential Condominium/Townhouse			0.700	Dwelling Unit			0.00	$0.00	0
Mobile Home Park			0.700	Occupied Dwelling Unit			0.00	$0.00	0
Senior Adult Housing-Detached			1.000	Per Identities, plus .5 per bedroom			0.00	$0.00	0
Duplex			0.900	Dwelling Unit		0	0.00	$0.00	0
Studio apartment			0.400	Dwelling Unit			0.00	$0.00	0
RV Park			0.400	Per Trailer			0.00	$0.00	0
Convents			1.000	Per premise plus .25 per bedroom			0.00	$0.00	0
Senior Adult Housing-Attached			0.400	Occupied Dwelling Unit			0.00	$0.00	0
Congregate Care Facility (Nursing Homes)			0.310	Occupied Dwelling Unit			0.00	$0.00	0
Recreational Homes			0.260	Dwelling Unit			0.00	$0.00	0
Boarding Houses			1.000	per building plus .2 per apartment			0.00	$0.00	0
Single Family Dwellings			1.000	Unit			0.00	$0.00	0
INSTITUTIONAL									
Parks				Acre			0.00	$0.00	0
Golf Course				Acre			0.00	$0.00	0
Movie Theater			0.010	Per Seat			0.00	$0.00	0
Health/Fitness Club With Shower facilities			1.500	1,000 SF, pools, etc. calculated separately			0.00	$0.00	0
Health/Fitness Club, No Shower Facilities			0.700	1,000 sf, Pools, etc. calculated separately			0.00	$0.00	0
Library			0.200	1,000 sf GFA			0.00	$0.00	0
Hospital			1.000	Per Bed			0.00	$0.00	0
Boarding Schools			1.000	Per building plus .2 per bedroom			0.00	$0.00	0
Child Daycare			1.000	Per premises plus .05 per person			0.00	$0.00	0
Church with Kitchen			1.250	Per 200 members	.006 Per Seat		0.00	$0.00	0
Church - No Kitchen			0.006	Per Seat			0.00	$0.00	0
					.20 per stall/end trail pltr/24 hours				
Fire and Rescue Services			0.822	1,000 sf			0.00	$0.00	0
Hospitals			1.600	1,000 sf			0.00	$0.00	0
Indoor Tennis Courts			3.500	1,000 sf			0.00	$0.00	0
Research and Animal Hospitals			0.643	1,000 sf			0.00	$0.00	0
Public Institutions (other than hospitals)			0.750	1,000 sf			0.00	$0.00	0
Schools - Elementary			0.050	Per Student	1 ERU/classroom		0.00	$0.00	0
Schools - Junior High			0.040	Per Student	1 ERU/classroom		0.00	$0.00	0
Schools - Public High			0.075	Per Student	1 ERU/classroom		0.00	$0.00	0
Schools - Private			0.030	Per Student	1 ERU/classroom		0.00	$0.00	0
Public Swimming Pools (bathhouse seperate)			1.000	1000 sf			0.00	$0.00	0
Private Pools associated with private development			0.500	Per 10,000 gallons of pool volume			0.00	$0.00	0
Commercial and public pools			1.000	First 40,000 gallons of pool volume			0.00	$0.00	0
BUSINESS & COMMERCIAL							0.00	$0.00	0
Hotel (private baths)			0.250	Room[1]			0.00	$0.00	0
Motel			0.250	Room[1]			0.00	$0.00	0
Banquet Hall			1.800	1,000 sf GFA			0.00	$0.00	0
Resort Hotel			0.250	Per Room. Bar, restaurant, calculated separately			0.00	$0.00	0
Building Materials and Lumber Store			0.200	1,000 sf GFA			0.00	$0.00	0
Free-Standing Discount Superstore (with supermarket)			0.750	1,000 sf GFA			0.00	$0.00	0
Specialty Retail Center			0.200	1,000 sf GLA			0.00	$0.00	0
Free-Standing Discount Store			0.200	1,000 sf GFA			0.00	$0.00	0
Retail Other than Specifically Listed			0.200	1,000 sf GFA			0.00	$0.00	0
Fraternal Organizations (members only)			1.000	per hall			0.00	$0.00	0
Fraternal Organizations (members+rentals)			1.000	per hall - restaurant, bar calculated separately			0.00	$0.00	0
Hardware/Paint Store			0.200	1,000 sf GFA			0.00	$0.00	0
Nursery (Garden Center)			1.000	Per premises, plus .5 per employee			0.00	$0.00	0
Nursery (Wholesale)			1.000	premises, plus .5 per employee			0.00	$0.00	0
Print Shop			0.200	1000 sf of GLA			0.00	$0.00	0
Florist			0.500	1000 sf of GLA			0.00	$0.00	0
Shopping Center			0.200	1,000 sf GLA			0.00	$0.00	0
Factory Outlet Center			0.200	1,000 sf GFA			0.00	$0.00	0
Quality Restaurant			2.500	1,000 sf GFA			0.00	$0.00	0
High Turnover (Sit-Down) Restaurant			2.500	1,000 sf GFA			0.00	$0.00	0
Fast Food Restaurant			1.700	1,000 sf GFA			0.00	$0.00	0
Quick Lubrication Vehicle Shop			0.250	Servicing Position			0.00	$0.00	0
Automobile Care Center			0.600	first 1,000 sf, .3 per each additional 1000 square feet			0.00	$0.00	0
New Car Sales			0.400	1,000 sf GFA			0.00	$0.00	0
Automobile Parts Sales			0.200	1,000 sf GFA			0.00	$0.00	0
Gasoline/Service Station (Fueling Only)			0.500	Vehicle Fueling Position			0.00	$0.00	0
Gasoline/Service Station w/ Convenience Market			0.500	Vehicle Fueling Position, plus .2 per 1,000 sf			0.00	$0.00	0
Gasoline/Service Station w/ Convenience Market & Car Wash			0.500	Vehicle Fueling Position, plus .2 per 1,000 sf	Car Wash Calculated Separately		0.00	$0.00	0
Tire Store			0.200	1,000 sf GFA			0.00	$0.00	0
Tire Superstore			0.200	1,000 sf GFA			0.00	$0.00	0
Supermarket			0.700	1,000 sf GFA			0.00	$0.00	0
Convenience Market (No Gasoline)			0.500	1,000 sf GFA			0.00	$0.00	0
Discount Supermarket (no produce)			0.500	1,000 sf GFA			0.00	$0.00	0
Discount Club			0.200	1,000 sf GFA			0.00	$0.00	0
Home Improvement Superstore			0.200	1,000 sf GFA			0.00	$0.00	0
Electronic Superstore			0.200	1,000 sf GFA			0.00	$0.00	0
Toy/Children's Superstore			0.200	1,000 sf GFA			0.00	$0.00	0
Apparel Store			0.200	1,000 sf GFA			0.00	$0.00	0
Pharmacy/Drug Store			0.200	1,000 sf GFA			0.00	$0.00	0
Furniture Store			0.200	1,000 sf GFA			0.00	$0.00	0
Video Rental Store			0.200	1,000 sf GFA			0.00	$0.00	0
Bank and Office, except medical			0.500	1,000 sf GFA			0.00	$0.00	0
Pet Groomers			1.100	1,000 sf			0.00	$0.00	0
Veterinary Facility			2.000	Per Veterinarian	1.1 per 1,000 sf		0.00	$0.00	0
Barber shop			1.000	Per shop Plus .1 per chair after 2			0.00	$0.00	0
Bars (including bars within restaurants			4.000	1,000 sf GFA			0.00	$0.00	0
Bowling Alleys (w/out bars or lunch)			0.150	per alley			0.00	$0.00	0
Bowling Alleys (with bar and/or lunch)			0.600	per alley			0.00	$0.00	0
Pool Hall			0.100	per table			0.00	$0.00	0
Car Dealership			0.303	1,000 sf			0.00	$0.00	0
Car Wash			5.000	1,000 sf			0.00	$0.00	0
Car Wash - Self Service			1.250	Stall			0.00	$0.00	0
Department Stores with and Without Food Service			0.200	1,000 sf			0.00	$0.00	0
Laundry and/or Dry Cleaning (Staff Operated Machines)			2.700	1,000 sf			0.00	$0.00	0
Laundry (Coin Operated Machines)			8.700	1,000 sf			0.00	$0.00	0
Funeral Homes, viewing only			0.100	1,000 sf			0.00	$0.00	0
Funeral Homes, with crematorium and other services			1.000	1,000 sf			0.00	$0.00	0
Furniture Stores			0.100	1,000 sf			0.00	$0.00	0
Luxury Campsites			0.650	Per Campsite, exclusive of RV's			0.00	$0.00	0
Retail Stores (small, quick-service, convenience)			0.200	1,000 sf			0.00	$0.00	0
Supermarkets			0.519	1,000 sf			0.00	$0.00	0

Schedule of Sewer and Water Connection Fees

Land Use Category			Equivalent Residential Units	Unit* (sf means per 1000 square feet, unless otherwise noted)	Alternative	Adjustable Value # Units	Calculated Values Net ERU's	Sewer Connection Fee	Water Connection Fee
							0.00	$0.00	0
OFFICE							0.00	$0.00	0
General Office Building			0.400	*1,000 sf GFA*			0.00	$0.00	0
Corporate Headquarters Building			0.400	*1,000 sf GFA*			0.00	$0.00	0
Single Tenant Office Building			0.400	*1,000 sf GFA*			0.00	$0.00	0
Government Office, including City Hall, Court, etc.			0.400	*1,000 sf GFA*			0.00	$0.00	0
Post Office			1.000	*1,000 sf*			0.00	$0.00	0
Office Park			0.400	*1,000 sf GFA*			0.00	$0.00	0
Research and Development Center			0.600	*1,000 sf GFA*			0.00	$0.00	0
Business Park			0.400	*1,000 sf GFA*			0.00	$0.00	0
Dental Offices/ Dental Office Building			1.299	*1,000 sf*			0.00	$0.00	0
Doctor's Office			1.000	*Per premises plus .5 per exam*			0.00	$0.00	0
Medical Offices/ Medical Office Building			1.299	*1,000 sf*			0.00	$0.00	0
Medical Practitioners Metered Separately			0.000	*Per Practitioner*	*1 Per premises, plus .5 per exam room*		0.00	$0.00	0
Clinic			1.299	*1,000 sf*			0.00	$0.00	0
Newspaper Offices			0.000	*Per Employee*			0.00	$0.00	0
Office Buildings with Cafeteria			0.666	*1,000 sf*			0.00	$0.00	0
							0.00	$0.00	0
INDUSTRIAL**							0.00	$0.00	0
General Industrial (Light and Heavy), exclusive of wet process			0.500	*1,000 sf*			0.00	$0.00	0
Manufacturing (exclusive of industrial flow)			0.500	*1,000 sf*			0.00	$0.00	0
Mini-Warehouse (no individual restrooms)			1.000	*4 Plumbing Fixtures*	*.7 per unit*		0.00	$0.00	0
*Warehouse (Bulk Storage / Shelf)****			0.100	*10,000 sf*			0.00	$0.00	0
							0.00	$0.00	0
							0.00	$0.00	0
Truck Terminal			1.000	*4 Plumbing Fixtures*			0.00	$0.00	0
Park-and-Ride Lot with Bus Service			1.000	*4 Plumbing Fixtures*			0.00	$0.00	0

* Abbreviations include: GFA = Gross Floor Area, sf = square feet, and GLA = Gross Leasable Area.
** Consult with Public Works Director prior to applying ERU calculation for Industrial/ Manufacturing uses.
† Any accessory facilities such as laundry, dining, recreational area, residence, convention space, etc. shall be considered separately and in addition to living units, as per this ordinance.
*** Applies to warehouse structures that are intended primarily as either "shell buildings," prior to the identification of specific tenants, and/or as warehouse structures that are intended primarily for the long-term storage of goods and materials. Warehouse structures that are intended for the temporary storage of goods and materials as those goods and material transition from the supplier to the ultimate vendor, and which have permanent staff dedicated to the movement of said goods, shall require further consultation with the applicant.

These tables are based on the broad assumption that land uses will utilize an equivalent amount of water and sewer over the life of the project. At the discretion of the Public Works Director, the City may identify a separate ERU assumption for certain land uses that do not utilize water and sewer at an equivalent rate. These uses may include, but are not limited to, industrial/manufacturing uses and restaurant/dining uses, wherein water is utilized in the manufacture of products/ preparation of food and is not then disposed of through the City's sewer facility as waste.

CONNECTION FEE CALCULATION:

Net New Connection Fee (3)	X	$8,941 Per Equivalent Residential Unit = sewer ($5,563 = water)	=	Connection Fee per Unit of Development (4)

Section 6. Severability. If any section, sentence, clause or phrase of this ordinance should be held to be invalid or unconstitutional by a court of competent jurisdiction, such invalidity or unconstitutionality shall not affect the validity or constitutionality of any other section, sentence, clause or phrase of this ordinance.

Section 7. Effective Date. A summary of this Ordinance consisting of its title shall be published in the official newspaper of the City, and shall take effect and be in full force five (5) days after publication.

Passed by the Council of the City of Ferndale, Washington, on this 4th day of February, 2013.

ATTEST:

Gary S. Jensen, MAYOR

Sam Taylor, CITY CLERK

ORDINANCE # 1599

AN ORDINANCE OF THE CITY OF FERNDALE WASHINGTON, SETTING RATES AND FREQUENCY OF BILLINGS FOR WATER AND SEWER SERVICE AND REPEALING ALL PRIOR ORDINANCES IN CONFLICT HEREWITH.

The City Council of the City of Ferndale ordains as follows:

Section 1. The following rate schedule for water and sewer service is hereby adopted effective with bills mailed approximately December 31, 2010:

Section 1. A.

Water Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water)

1) **Single Family Residential/Residential Duplexes – Single Meter:**

Base fee	$12.78 Per Housing Unit
Consumption:	
1-25 units	$2.98/unit
26-50 units	$3.30/unit
51-150 units	$3.91/unit
151+ units	$3.30/unit

2) **Multiple Family Residential/Three or more units served through a Single Water Meter:**

Base fees	$12.78 Up to 1 inch Meter **or** $40.00 Over 1 inch Meter
Consumption:	
1-25 units	$2.98/unit
26-50 units	$3.30/unit
51-150 units	$3.91/unit
151+ units	$3.30/unit

3) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**

Base fees	$12.78 Up to 1 inch Meter **or** $40.00 Over 1 inch Meter
Consumption:	
1-25 units	$2.98/unit
26-50 units	$3.30/unit
51-150 units	$3.91/unit
151+ units	$3.30/unit

Shared Meters (Water):
Where more than one business or combination of one or more business and residential users have their water usage measured through a single meter, the invoice shall be charged to one designated user at the above rates.

For bills mailed June 30, 2011, the water and sewer charges, meter charges and flat rates for all customers will increase by 6.5%.

Out-of-City Customers:
Customers outside the corporate limits of the City of Ferndale shall pay the rates shown in the above schedule, together with a surcharge of 50% to be applied to both the base fee and the use charge.

Section 1. B.

Water Service CPI Adjustment

Bi-Monthly Rates to be effective for the water billing period for which bills will be sent approximately **June 30, 2012, and annually thereafter on June 30th:**

All rates increase (no decreases) by 100% of the Seattle CPI-W, change from April to April of the current year.

Section 1. C.

Sewer Service

Bi-Monthly Rates:
(1 unit = 100 cubic feet (748 gallons) of water used)

1) **Non-Metered/Residential Flat Rate**: $ 78.62

2) **Non-Metered/Commercial Flat Rate**: $ 78.62

3) Metered **Single Family Residential/Residential Duplexes – Single Meter**:

Base fee	**$21.14**
Consumption:	
1-25 units	$4.79/unit
26-50 units	$5.33/unit
51-150 units	$6.28/unit
151+ units	$5.33/unit

4) **Multiple Family Residential/Three or more units served through a Single Water Meter:**

Base fee	**$21.14**
Consumption:	
1-25 units	$4.79/unit
26-50 units	$5.33/unit
51-150 units	$6.28/unit
151+ units	$5.33/unit

5) **Commercial**/Non-Residential (Schools-Churches)/**Industrial – Single Meter:**

Base fee	**$21.14**
Consumption:	
1-25 units	$4.79/unit
26-50 units	$5.33/unit
51-150 units	$6.28/unit
151+ units	$5.33/unit

Shared Meters (Sewer):
Where more than one business or combination of one or more business and residential users have their water usage measured through a single meter, the invoice shall be charged to one designated user at the above rates.

For bills mailed June 30, 2011, the water and sewer charges, meter charges and flat rates for all customers will increase by 6.5%.

Commercial/Industrial Effluent:

Commercial/Industrial users contributing effluent which might be expected to impact the system to a greater degree than normal may be required to provide an industrial waste study from which an equitable rate may be established.

Out of City Customers:

Customers outside the corporate limits of the City of Ferndale shall pay the rates shown in the above schedule, together with a surcharge of 50% to be applied to both the base fee and use charge.

Summer Use:

When the use of water is such that a portion does not flow into the sewer system due to irrigation by single family residences and duplexes during the irrigation season, which is hereby defined as that billing period beginning approximately June 15 and ending approximately October 15, the maximum chargeable water entering the sewer system during a Bi-Monthly billing period shall be based upon the average for the previous four billing periods. The average may be based upon a lesser number of billing periods if reliable data is not available. If reliable data can not be obtained for at least two billing periods the average chargeable shall be the City-wide average.

Section 1. D.

Sewer Service CPI Adjustment

Bi-Monthly Rates to be effective for the sewer billing period for which bills will be sent approximately **June 30, 2012, and annually thereafter on June 30th:**

All rates increase (no decreases) by 100% of the Seattle CPI-W, change from April to April of the current year.

Section 2. Repeal of Ordinances in conflict.

All Ordinances in conflict hereof are hereby repealed.

PASSED AND ENACTED by the City of Ferndale City Council meeting in regular session on the 2nd day of August, 2010.

Paul Ingram, MAYOR PRO-TEM

ATTEST:

Linda Knutson, CITY CLERK

ORDINANCE NO. 1416

AN ORDINANCE ADOPTING CROSS-CONNECTION CONTROL REGULATIONS TO PROTECT THE CITY'S WATER SUPPLY SYSTEM AND REVISING AND AMENDING THE FERNDALE MUNICIPAL CODE

WHEREAS, Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies requires protection of the public drinking water supply from contamination due to cross-connections; and

WHEREAS, Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies requires that all cross-connections be eliminated or controlled; and

WHEREAS, Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies requires that the Water Purveyor develop and implement a cross-connection control program; and

WHEREAS, revisions to Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies have been adopted April 9, 1999; and

WHEREAS, the City of Ferndale has completed a thorough assessment of the current cross-connection control program, and has determined that the current cross-connection program must be updated to address revisions to Chapter 246-290 of the Washington Administrative Code Rules and Regulations; and

WHEREAS, the City of Ferndale establishes the following cross-connection control ordinance to protect the public drinking water system from the risk of contamination due to cross-connections;

NOW, THEREFORE, the City Council of the City of Ferndale hereby ordains the following:

Section 1: "Ferndale Municipal Code Sections 13.04.164, 13.04.162 and Ordinance 808, are hereby repealed and replaced by **Chapter 13.06 Cross-Connection Control Regulations**

Chapter 13.06 Cross-Connection Control Regulations

13.06.100 ABBREVIATIONS AND ACRONYMS

DOH - Washington State Department of Health
RCW - Revised Code of Washington (Laws of the State)
WAC - Washington State Administrative Code

13.06.110 DEFINITIONS

"Approved air gap" means a physical separation between the free flowing end of a potable water supply pipeline and the overflow rim of an open or non-pressurized receiving vessel. To be an air gap approved by the DOH, the separation must be at least:

- Twice the diameter of the supply piping measured vertically from the overflow rim of the receiving vessel, and in no case be less than one inch, when unaffected by vertical surfaces (sidewalls); and
- Three times the diameter of the supply piping, if the horizontal distance between the supply pipe and a vertical surface (sidewall) is less than or equal to three times the diameter of the supply pipe, or if the horizontal distance between the supply pipe and intersecting vertical surfaces (sidewalls) is less than or equal to four times the diameter of the supply pipe and in no case less than one and one half inches.

"Approved atmospheric vacuum breaker" means an atmospheric vacuum breaker of make, model, and size that is approved by the DOH. Atmospheric vacuum breakers that appear on the current approved backflow prevention assemblies list developed by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research, or that are listed, or approved by other nationally recognized testing agencies (such as the International Association of Plumbing and Mechanical Officials, American National Standards Institute, or Underwriter Laboratories) and acceptable to the local administrative authority are considered approved by the DOH.

"Approved backflow preventer" means an approved air gap, an approved backflow prevention assembly, or an approved atmospheric vacuum breaker, relied upon by the purveyor for the protection of the public water system. The requirements of WAC 246 290 490 do not apply to backflow preventers installed for other purposes.

"Approved backflow prevention assembly" means a reduced pressure backflow assembly, reduced pressure detector assembly, double check valve assembly, double check detector assembly, pressure vacuum breaker assembly, or spill resistant vacuum breaker assembly, of make, model, and size that is approved by the DOH. Assemblies that appear on the current approved backflow prevention assemblies list developed by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research, or other nationally recognized testing agencies and acceptable to the local administrative authority are considered approved by the DOH.

"Auxiliary water supply" means a water supply, other than the purveyor's water supply, on or available to the consumer's premises.

"Backflow" means the undesirable reversal of flow of water or other substances through a cross connection into the public water system or consumer's potable water system by means of backpressure or backsiphonage.

"Backpressure" means a pressure (caused by a pump, elevated tank or piping, boiler, or other means) on the consumer's side of the service connection that is greater than the pressure provided by the public water system and which may cause backflow.

"Backsiphonage" means backflow due to a reduction in system pressure in the purveyor's distribution system and/or the consumer's water system.

"Consumer" means any person receiving water from a point of delivery of the public water system. For purposes of cross connection control, "consumer" means the owner or operator of a premise receiving water from a point on delivery of the public water system.

"Consumer's water system", as used in WAC 246-290-490, means any potable and/or industrial water system that begins at a point of delivery from the public water system and is located on the consumer's premises. The consumer's water system includes all auxiliary sources of supply, storage, treatment, and distribution facilities, piping, plumbing, and fixtures under the control of the consumer.

"Contaminant" means a substance present in drinking water that may adversely affect the health of the consumer or the aesthetic qualities of the water.

"Cross-connection" means any actual or potential physical connection between a public water system or the consumer's water system and any source of non-potable liquid, solid, or gas that could contaminate the potable water supply by backflow.

"Cross-connection control program" means the administrative and technical procedures the water purveyor implements to protect the public water system from contamination via cross connections as required in WAC 246-290-490.

"Cross-connection control specialist" means a person holding a valid cross-connection control specialist certificate issued by DOH in accordance with chapter 246-292 WAC.

"Director" means Director of Public Works or duly authorized representative.

"DOH" means the Washington State Department of Health or health officer as identified in a joint plan of operation in accordance with WAC 246-290-030(1).

"High health cross-connection hazard" means a cross-connection that could impair the quality of potable water and create an actual public health hazard through poisoning or spread of disease by a contaminant source.

"Human consumption" means the use of water for drinking, bathing or showering, hand washing, food preparation, cooking, or oral hygiene.

"In-premise protection" means a method of protecting the health of consumers served by the consumer's potable water system, located within the property lines of the consumer's premise by the installation of an approved air gap or approved backflow prevention assembly at the point of hazard, which is generally a plumbing fixture.

"Local administrative authority" means the local official, board, department, or agency authorized to administer and enforce the provisions of the Uniform Plumbing Code as adopted under chapter 19.27 RCW.

"Low health cross-connection hazard" means a cross connection that could cause an impairment of the quality of potable water to a degree that does not create a hazard to the public health, but does adversely and unreasonably affect the aesthetic qualities of such potable waters.

"Point of delivery" means the point at which the consumer's water system connects to the public water system.

"Potable" means water suitable for human consumption.

"Premise" means a single building site, or single lot or aggregation of lots tied together by agreement for the purpose of obtaining a building permit or utility service.

"Premise isolation" means a method of protecting a public water system by installation of approved air gap or approved backflow prevention assembly at or near the service connection or alternative location acceptable to the purveyor to isolate the consumer's water system from the purveyor's distribution system.

"Public water system" means the water supply source, including all water treatment, storage, transmission and distribution facilities, to the point of delivery to the consumer.

"Purveyor" means the City of Ferndale, owner and operator of the public water system.

"Service connection" means the point of delivery from which potable water is provided to a single-family residence, or other residential or nonresidential population.

"State board of health" and **"board"** means the board created by RCW 43.20.030.

"Uniform Plumbing Code" means the code adopted under RCW 19.27.031(4) and amended under chapter 51 46 WAC. This code establishes statewide minimum plumbing standards applicable within the property lines of the consumer's premises.

"Used water" means water that has left the control of the purveyor.

13.06.120 APPLICABILITY

This Ordinance shall apply to all consumers with service connections to the purveyor's public water distribution system.

13.06.130 PURPOSE

1. Protect the public water system from contamination due to backflow through cross-connections; and

2. Eliminate or control cross-connections between the public water system and the consumer's water system.

13.06.140 RESPONSIBILITY

1. The consumer's responsibility for cross-connection control shall begin at the service connection.

2. Consumers shall be responsible for the:
i. Elimination of cross-connections when possible; or
ii. Control of cross-connections at the service connection (premise isolation); or
iii. Control of cross-connections, within the consumer's water system, by relying on in-premise protection when premise isolation is not required by WAC 246-290-490 and this method is approved by the Director.

3. Consumers are responsible for the installation, testing, inspection, repair, maintenance, and proper operation of approved backflow preventers required for the control of cross-connections between their premise and the public water system.

13.06.150 GENERAL REQUIREMENTS

1. The rules and regulations of the Washington State Department of Health as published in WAC 246-290-490 and hereby adopted by reference as they may be from time to time amended.

2. Consumers shall comply with the City's cross-connection control program policies and procedures as they may be from time to time amended.

3. An approved backflow preventer is required on all private fire lines, appropriate to the assessed degree of cross-connection health hazard, and shall incorporate a water meter for detecting water consumption. The approved backflow preventer shall be placed such that access for the City is provided to physically or electronically read the detecting meter.

4. Consumer shall permit periodic entry to their premise (in accordance with A new section or -------- or code here--------) by a cross-connection control specialist, for the determination of cross-connection health hazards and compliance with cross-connection control requirements.

13.06.160 ENFORCEMENT

1. In the event a consumer fails to comply with cross-connection control requirements, the Director shall have the authority to issue to the consumer a final order to achieve compliance with

this Ordinance, WAC 246-290-490 and or City cross-connection control policy and procedures, extent and time of the violation and the cross-connection control policy and procedures. The order shall include:

A. A description of the specific damage of the specific damage or potential damage that reasonably might occur;

B. A notice that the violation cease and desist and, in appropriate cases, the specific corrective actions to be taken;

C, That water service will be denied until corrective actions are completed or discontinued unless corrective actions are completed within a reasonable time to comply, depending on the circumstances.

D. The address, telephone number and contact person that the consumer may contact if a dispute exists as to the corrective action required;

E. That the consumer may request a hearing with the Hearings Examiner;

F. That the City will charge a shut-off and turn-on fee before service is resumed following discontinuance and/or impose civil penalties;

G. That the local administrative authority will be notified; and

H. That the service will not be shut off while a hearing is pending.

2. The local administrative official shall be notified prior to the City:

A. Denying water service; or

B. Discontinuing water service.

3. When an unprotected connection between the public water system and the consumer's water system constitutes an imminent threat of contamination to the City's public water system, water service may be shut off immediately without the notices provided above. In that case, notice of shut-off, corrective action, and appeal procedures and notice to the local administrative official shall be sent immediately upon such action being taken.

13.06.170 CIVIL PENALTY

1. In addition to any other remedy or sanction available, a consumer who fails to comply with a final order issued by the Director or Hearings Examiner pursuant to this chapter or who fails to conform to the terms of an approval issued, shall be subject to a civil penalty.

A. Amount of Penalty. The penalty shall be not less than $100.00 or exceed $5,000.00 for each violation. Each day of continued violation or repeated violation shall constitute a separate violation.

B. Aiding or Abetting. Any person who, through an act of commission, or omission, aids or abets in the violation shall be considered to have committed a violation for the purpose of the civil penalty.

C. Notice of Penalty. A civil penalty shall be imposed by the Director, by notice in writing, which shall be served either by certified mail with return receipt requested or by personal service, to the person incurring the same. The notice shall describe the violation, the date(s) of violation, and shall order the acts constituting the violation to cease and desist, and, in appropriate cases, require necessary corrective action within a specific time.

D. Appeal of Civil Penalty. Persons incurring a penalty imposed by the Director may appeal in writing within 10 days of the receipt of the notice of penalty to the Hearings Examiner. The Hearings Examiner shall hold a hearing to consider the appeal and may affirm, modify or reverse the penalty. Review of the Hearings Examiner's decision may be obtained by filing an action for a writ of certiorari with a court of competent jurisdiction within 10 days of the date of the decision.

2. Penalties imposed under this Section shall become due and payable 10 days after notice of the penalty is mailed or delivered, whichever occurs first, unless an appeal is filed. Whenever an appeal is made, penalties shall become due and payable after a final decision has been issued confirming all or part of the penalty. If the amount of a penalty owed is not paid within the time specified in this Section, the City may take actions necessary to recover such penalty.

3. Penalties shall be paid to the water fund.

13.06.180 OPERATING POLICIES

The Director shall promulgate and implement the City's policy on cross-connection control for the operation of the Cross-Connection Control Program. The Cross-Connection Control Program policy shall be enforced under the requirements of the City's Cross-Connection Control Ordinance.

PASSED by the Council of the City of Ferndale, Washington, on this 18th day of DECEMBER, 2006.

ATTEST:

Jerry Landcastle, Mayor

Linda Knutson, City Clerk

City of Ferndale
Ordinance #1344

AN ORDINANCE ADDING A NEW CODE SECTION DEALING WITH ANNEXATION

Whereas, the City of Ferndale is experiencing a high interest in annexations; and

Whereas, the process and procedures related to annexation into the City limits is not sufficiently detailed in City Code; and

Whereas, it is the desire of the City Council to specifically detail the desired process to be followed for such annexations; and

Whereas, the addition of a new code section dealing with annexation will clarify the City's desires regarding annexations, specify the process for annexation and aid those individuals wishing to be considered for annexation

Now therefore, the City Council of the City of Ferndale do hereby ordain as follows:

Section 1. A new code Chapter 13.38 is hereby adopted as follows:

13.38.010 Purpose and Planning Context

The Growth Management Act (GMA) requires that cities and counties cooperatively determine Urban Growth Areas (UGA). When added together, the UGA for Ferndale must be large enough to hold the urbanized growth which is expected to occur over the next 20 years. The primary purpose of this chapter is to establish a framework for phased growth within the City of Ferndale. The guidance contained herein is intended to ensure the efficient delivery of public services to new development as it occurs in a manner that is most beneficial to the citizens of the community.

UGA's are intended to achieve several important objectives. To the extent that annexation policies are used to support the goals and purposes of UGA's, they become an important component of the City's policies relative to the GMA. UGA's identify lands that will be developed for urban uses and land that will potentially become annexed into the city. This identification of developable lands provides knowledge to landowners and government agencies, allowing them to plan and invest in urban areas.

While some land within the UGA is either unsuited for urban development or has important resource values that will be protected, most of the area within the UGA will be developed for urban uses. The designation of UGA's also make the provision of public facilities easier by providing for contiguous and compact urban lands.

UGA's also protect rural areas, resource lands, and large areas of fish and wildlife habitats outside of the UGA boundaries. Property owners know they can invest in rural and natural resource uses on these lands without worrying about the encroachment of urban uses outside of the UGA boundary.

13.38.020 Annexation Goals

The following goals are intended to guide the annexation practices of the City of Ferndale:

1. Ensure that there are urban densities within the City's corporate limits.

2. Encourage urban growth within the city limits with gradual phasing outward from the urban core.

3. Ensure that adequate public services, facilities, and publicly-owned utilities are available or can be cost-effectively provided to proposed and existing development.

4. Supply a sufficient, safe, and suitable housing supply to meet the projected future housing needs for Ferndale over the next twenty years.

5. Reduce impacts from flooding, encourage efficient stormwater management, and ensure that the critical areas of Ferndale are protected and preserved.

6. Consider cost/benefit issues, when appropriate, for proposed annexations to determine annexation boundaries and timing.

7. Inform the public of all annexation proceedings, in full accordance with state law.

8. Consider citizens' concerns during the annexation process.

9. Extend public services and infrastructure consistent with the Comprehensive Plan and other planning documents.

10. Complete annexations following the guidance provided in the City/County Interlocal Agreement related to annexations.

13.38.030 Annexation - General

The City of Ferndale will consider annexation of contiguous properties within its UGA. Those properties whose physical location would promote "leap frog" annexation, resulting in noncontiguous city limits, will not be considered

Timing of annexation proposals will be determined based on what is most beneficial to the citizens of the community. Benefit to the community shall be determined through

cost/benefit calculations and other factors included in Section 13.38.020 and the City's Comprehensive Plan (Urban Growth Area/Annexation)

The City shall endeavor to apply consistent and appropriate zoning based on surrounding zoning densities, existing facilities, anticipated future facilities, neighboring resident's desires, and the City's desired direction for future development.

Newly annexed territory shall assume its equitable share of the City's bonded indebtedness.

13.38.040 Annexation – Unincorporated Islands

The City of Ferndale shall encourage annexation of unincorporated islands within its UGA. To the extent possible, the City shall not allow annexations that create new unincorporated islands or unincorporated areas substantially surrounded by annexed areas. The City shall consider annexations that lessen the size of existing unincorporated islands if it is not feasible to annex the entire island.

13.38.050 Annexation – Municipal Boundaries

To maintain efficient city service provision, Ferndale shall discourage annexations that would result in irregular city boundaries. Annexations shall include the largest practicable area contiguous to city limits that still result in logical city boundaries.

13.38.060 Annexation – Zoning

Ferndale shall only approve annexations that lie completely within the UGA and whose proposed zoning are consistent with the City's Comprehensive Plan. The land use designations specified in the Comprehensive Plan shall be used as guidance by the Planning Commission in determining the recommended zoning classification. The land use designations, as determined by the City Council through their acceptance of the annexation, shall remain on the annexed properties for at least five (5) years following annexation.

13.38.070 Extension of Services

Ferndale will only support extensions of public water, sewer, and/or storm drainage services within the UGA that are consistent with the City's Comprehensive Plan, Water Comprehensive Plan, Wastewater Comprehensive Plan, Chapter 13.36 of the Ferndale Municipal code, and other relevant documents. The City will only extend such services to areas outside of the established UGA when supported by the County-Wide Planning Policies.

Ferndale will consider the existing boundaries of special purpose districts when reviewing annexation proposals. Affected districts will be notified and provided the opportunity to comment on annexation proposals.

13.38.080 Annexation of Developed Properties

The City shall not support annexation of developed parcels unless they meet the following criteria:

1. Properties with existing, properly functioning septic tank drain field systems shall not be required to connect to city sewer until one of the following events occurs and at that time shall be required to connect:

    a. Upon determination by the County Health Department that the existing septic system cannot function properly and city sewer service is within 200 feet of the property.

    b. Upon determination by the County Health Department that the existing septic system must be expanded to accommodate the use and city sewer service is within 200 feet of the property.

    Failed septic systems (or systems deemed undersized for the use) shall not be repaired or replaced with another septic system.

13.38.090 Annexation Process

The following process assumes that the proponents of the annexation have chosen to utilize the "petition method" of annexation. To the extent that other methods of annexation exist and can be utilized, the process will vary. The annexation process also provides for the optional use of a Developers Agreement and Binding Site Plan – refer to Section 13.38.100.

1. Pre-"Notice Of Intent To Annex" Meeting with Planning Staff – Proponents, or their representatives, shall meet with the City Planning Staff to discuss the general annexation procedures, area-specific issues, recommended acreage size, logical boundaries of the annexation area, proponent's proposed zoning designations, and other areas of potential concern. Planning staff will provide interested parties with forms and procedural requirements relative to the proposed annexation.

2. Pre-"Notice Of Intent To Annex" Neighborhood Meeting. Proponents of an annexation shall complete the following at their own expense prior to submitting a Notice Of Intent To Annex document with the city:

    a. Obtain a list of all property owners within the proposed area of annexation and within 300 feet from the boundaries of the proposed area of annexation from the Whatcom County Assessor;

    b. Notify, via US mail, all property owners identified above of the neighborhood meeting at least 14 days prior to the date of the neighborhood meeting;

c. Advertise in a newspaper of general circulation at least 14 days prior, the time and place of the neighborhood meeting to discuss the proposed intent to annex.

d. Post a public notice of the neighborhood meeting at a few highly visible locations, as specified by the City, at least 14 days prior to the date of the meeting.

e. Provide notice to the Whatcom County Planning Department of the neighborhood meeting.

f. Provide an affidavit to the City verifying compliance with the required notification and public outreach contained in subsections a through e above.

3. Notice Of Intent To Annex. Once the above neighborhood meeting has been conducted, the proponents of annexation shall complete a Notice Of Intent To Annex on a form provided by the city. In addition to the requirement that the owners of not less than ten percent in value, according to the assessed valuation for general taxation of the property for which annexation is sought, have signed the Notice, the following shall be submitted to the City together with the Notice:

a. Confirmation that the required pre-notice neighborhood meeting has been conducted;

b. A complete list of property owners in the proposed annexation area;

c. A summary of the issues raised at the neighborhood meeting and the proponents responses;

d. A map depicting the proposed annexation area;

e. A legal description of the proposed annexation boundaries;

f. The payment of a Preliminary Annexation Processing fee totaling $500.00.

g. Copy of written notice to the Whatcom County Planning Department of the Notice of Intent to Annex.

4. City Council Consideration of the Notice of Intent to Annex. Within 30 days following the submission of the Notice of Intent to Annex and following a meeting in front of the Planning and Judicial Committee, the City Council will vote to accept or reject the Notice of Intent to Annex. If the Council votes to reject the Notice of Intent, the proponents shall be free to resubmit the Notice of Intent at any time following six (6) months from the date of rejection, following the procedures outlined herein and following the repayment of all

necessary fees. If the Council voted to accept the Notice of Intent, the proponents shall proceed with the steps outlined below.

5. Petition for Annexation. Following the acceptance by the City Council of the Notice of Intent to Annex, the petitioners shall complete a Petition for Annexation on a form provided by the City and pay an Annexation Processing Fee totaling $1,200.00. Concurrent with the proponents completion of the Petition for Annexation, City staff will complete, or caused to be completed, a technical review necessary to determine the fiscal impact of the annexation on the citizens of Ferndale. To complete this analysis, the following scale of fee deposits shall be payable:

   a. Annexation of up to 20 acres = $2,500.00 deposit fee

   b. Annexation of more than 20 acres to 100 acres = $4,500.00 deposit fee

   c. Annexation of more than 100 acres = $6,500.00 deposit fee

   The above fiscal impact analysis fees shall be in the form of a deposit. The actual cost of preparing the analysis shall be billed on a time and material basis with the City collecting additional funds if necessary and/or refunding unspent monies to the proponents upon the completion of the fiscal impact analysis.

6. Certificate of Petition Completeness. Following completion of the Petition for Annexation, payment of requisite fees, and submittal to the City, the City Clerk shall issue a Certificate of Completeness to the proponents. This Certificate of Completeness shall be issued by the City after the following steps are completed but in no case more than 30 days after the submission of the Petition.

   a. Confirmation with the County Assessor that the proponent-supplied list of property ownership is complete and accurate.

   b. Confirmation with the County Auditor that the proponent-supplied registered voter listing is complete and accurate.

   c. Confirmation that the Petition form is correct and that the requisite signatures have been obtained and fees paid.

7. City Technical Review & Analysis. Following the issuance of the Certificate of Petition Completeness, the City shall undertake, or cause to be undertaken, a review and analysis of the Petition and its conformance with the goals listed in Section 13.38.020 together with the fiscal impact analysis detailed in Section 13.38.090 (5). The City shall complete this review and analysis in a period not longer than 60 days from issuance of the Certificate of Petition Completeness. If the City is unable to complete the review and analysis within the time limits provided for in this section, it shall provide written notice of this fact to the project applicant. The notice shall include a

statement of reasons why the time limits have not been met and an estimated date for completion of the technical review and analysis.

8. Planning Commission Public Hearing. Following the completion of the technical review by the City and following the submission of the completed and deemed complete Petition for Annexation by the proponents, the City will schedule a public hearing in front of the Planning Commission to determine if the petition is to be forwarded to the City Council for consideration and if so, the preferred zoning for the area.

9. City Council Public Hearing. Within 30 days of the public hearing before the Planning Commission, the Council shall hold a public hearing and vote to accept or reject the Petition for Annexation. If the Council votes to reject the Petition for Annexation, the proponents shall be free to resubmit for annexation at a future date following the procedures outlined herein (see subsection 4) and following the repayment of all necessary fees. If the Council voted to accept the annexation, the proponents shall proceed with the steps outlined below.

10. Boundary Review Board (BRB) Review. Following the acceptance of the Petition for Annexation by the City Council and the payment of a $50.00 BRB fee by the annexation proponents, the City shall file a Notice of Intention containing required information (RCW 36.93.130 as amended) with the Boundary Review Board. The Notice of Intention process includes:

    a. The BRB Chief Clerk reviews the Notice of Intention to determine legal sufficiency and when deemed sufficient, assigns a filing date and file number. A 45-day review period begins on the date it is filed by the Chief Clerk.

    b. The Chief Clerk routes the Notice of Intention to agencies, municipalities, county departments, special purpose districts, and interested citizens for review and comment.

    c. The BRB Chair may waive the 45-day review period by written statement if the proposed action is an annexation under ten (10) acres and less than two million dollars in assessed valuation. The annexation then may proceed as proposed.

    d. If the 45-day review period elapses without the Board's jurisdiction being invoked, the proposed action is deemed approved.

11. City Council Annexation Ordinance. Within 30 days of approval by the BRB, the Ferndale City Council shall consider an ordinance annexing the property into the City. If approved, the property is annexed into the City.

13.38.100 Effective Date of Annexation

The annexation, together with any provisions for the assumption of indebtedness and any other special annexation requirements, takes effect on the date set in the annexation ordinance.

PASSED AND ENACTED by the City of Ferndale City Council meeting in regular session on the 22nd day of February, 2005.

Jerry Landcastle, Mayor

Linda Knutson, City Clerk

C. SEPA DETERMINATION OF NON-SIGNIFICANCE

Community Development Department
P.O. Box 936, 2095 Main Street, Ferndale, WA 98248 - (360) 685-2368

DETERMINATION OF NON-SIGNIFICANCE

Description of Proposal: **The proposal is a non-project action to update the City of Ferndale's existing comprehensive plan (adopted 1997, updated 2005, with additional annual amendments to certain elements) in accordance with Washington State requirements and in coordination with Whatcom County. One change to the Official Land Use Map is included, modifying the Land Use designation and zoning for approximately one acre of land at Legoe Avenue from Medium Density Residential to High Density Residential, rezoning the property to Residential Multi-Family.**

Overall, the Comprehensive Plan update plans for 6,833 new residents and 4,000 new employees within the City limits. The plan is intended to modify the existing plan by making it more visual, adding a companion multi-media presentation to each element, converting the document based on the expectation that it will be read primarily online or on a screen, adding breakout sections, infographics, hyperlinks and similar elements, and generally reducing the text within the document.

The City also plans to more closely link the various elements together to ensure that they refer to one another in terms of both referencing Growth Management Act requirements as well as enabling decision makers to easily consider multiple projects at one time through a consolidated master capital project map. In some cases, the City has studied growth in certain areas that may exceed the basic allocations provided by Whatcom County. The purpose of these modeling exercises is to ensure that capital projects can either be expanded over time, or are built with sufficient capacity to support projects that are more intensive than could be anticipated by the basic allocations.

The plan includes the conversion of approximately 100 acres at the northeast quadrant of Slater Road and Interstate Five from Urban Growth Area Reserve to Urban Growth Area in anticipation of rapid growth in this area – generally the result of planned development on lands controlled by the Lummi Nation as well as current development within the City of Bellingham at Bakerview Road. No additional UGA expansions are planned as part of the current update.

This strategy is intended to protect existing neighborhoods while allowing for (and describing) a variety of infill development approaches and a gradual increase in overall residential density. Subsequent changes to plan and codes will conform to and implement this Comprehensive Plan.

Proponent: City of Ferndale. Contact: Jori Burnett, Community Development Director

Location of Proposal: Citywide

Lead Agency: City of Ferndale

The lead agency has determined that the proposed project does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)(c). This decision was made after review of a completed environmental checklist and other information on file with the lead agency, as well as written comments received during the comment period. This information is available for review by the public upon request.

No mitigation measures were identified.

This DNS is issued under WAC 197-11-350. A 14-day comment period was provided beginning on February 24, 2016 and ending March 9, 2016. Notice of the intent to issue the MDNS was published, posted on the project site, and circulated to interested state and local agencies. No written comments were received during the comment period. No mitigation measures were modified from the original Intent to Issue DNS.

RESPONSIBLE OFFICIAL: Jori Burnett
P.O. Box 936
Ferndale, WA 98248
(360) 685-2367

Date: _March 11, 2016_ Signature: _____

D. CONSISTENCY DETERMINATION

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Local Government Consistency Determination Form

Water System Name: City of Ferndale Water System PWS ID: 24850M

Planning/Engineering Document Title: Water System Plan Plan Date: May 2016

Local Government with Jurisdiction Conducting Review: City of Ferndale Planning Department

Before the Department of Health (DOH) approves a planning or engineering submittal under Section 100 or Section 110, the local government must review the documentation the municipal water supplier provides to prove the submittal is consistent with local comprehensive plans, land use plans and development regulations (WAC 246-290-108). Submittals under Section 105 require a local consistency determination if the municipal water supplier requests a water right place-of-use expansion. The review must address the elements identified below as they relate to water service.

By signing this form, the local government reviewer confirms the document under review is consistent with applicable local plans and regulations. If the local government reviewer identifies an inconsistency, he or she should include the citation from the applicable comprehensive plan or development regulation and explain how to resolve the inconsistency, or confirm that the inconsistency is not applicable by marking N/A. See more instructions on reverse.

Local Government Consistency Statement	For use by water system: Identify the page(s) in submittal	For use by local government: Yes or Not Applicable
a) The water system service area is consistent with the adopted land use and zoning within the service area.	Chapter 1 Exhibit 2	
b) The growth projection used to forecast water demand is consistent with the adopted city or county's population growth projections. If a different growth projection is used, provide an explanation of the alternative growth projection and methodology.	Chapter 2 Table 2-15 Exhibit 4	
c) For cities and towns that provide water service: All water service area policies of the city or town described in the plan conform to all relevant utility service extension ordinances.	Chapter 1 Section 1.6	
d) Service area policies for new service connections conform to the adopted local plans and adopted development regulations of all cities and counties with jurisdiction over the service area.	Chapter 1 Section 1.6	
e) Other relevant elements related to water supply are addressed in the water system plan, if applicable. This may include Coordinated Water System Plans, Regional Wastewater Plans, Reclaimed Water Plans, Groundwater Management Area Plans, and the Capital Facilities Element of local comprehensive plans.		

I certify that the above statements are true to the best of my knowledge and that these specific elements are consistent with adopted local plans and development regulations.

Signature Date

Printed Name, Title, & Jurisdiction

Consistency Review Guidance

For Use by Local Governments and Municipal Water Suppliers

This checklist may be used to meet the requirements of WAC 246-290-108. When using an alternative format, it must describe all of the elements; 1a), b), c), d), and e), when they apply.

For water system plans (WSP), a consistency review is required for the service area and any additional areas where a municipal water supplier wants to expand its water right's place of use.

For small water system management programs, a consistency review is only required for areas where a municipal water supplier wants to expand its water right's place-of-use. If no water right place-of-use expansion is requested, a consistency review is not required.

For engineering documents, a consistency review is required for areas where a municipal water supplier wants to expand its water right's place-of-use (water system plan amendment is required). For noncommunity water systems, a consistency review is required when requesting a place-of-use expansion. All engineering documents must be submitted with a service area map (WAC 246-290-110(4)(b)(ii)).

A) Documenting Consistency: The planning or engineering document must include the following when applicable.

   a) A copy of the adopted land use/zoning map corresponding to the service area. The uses provided in the WSP should be consistent with the adopted land use/zoning map. Include any other portions of comprehensive plans or development regulations that relate to water supply planning.

   b) A copy of the growth projections that correspond to the service area. If the local population growth projections are not used, explain in detail why the chosen projections more accurately describe the expected growth rate. Explain how it is consistent with the adopted land use.

   c) Include water service area policies and show that they are consistent with the utility service extension ordinances within the city or town boundaries. *This applies to cities and towns only.*

   d) All service area policies for how new water service will be provided to new customers.

   e) Other relevant elements the Department of Health determines are related to water supply planning. See Local Government Consistency – Other Relevant Elements, Policy B.07, September 2009.

B) Documenting an Inconsistency: Please document the inconsistency, include the citation from the comprehensive plan or development regulation, and explain how to resolve the inconsistency.

C) Documenting a Lack of Local Review for Consistency: Where the local government with jurisdiction did not provide a consistency review, document efforts made and the amount of time provided to the local government for review. Please include: name of contact, date, and efforts made (letters, phone calls, and emails). To self-certify, please contact the DOH Planner.

The Department of Health is an equal opportunity agency. For persons with disabilities, this document is available on request in other formats. To submit a request, please call 1-800-525-0127 (TTY 1-800-833-6388).

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Local Government Consistency Determination Form

Water System Name: City of Ferndale Water System PWS ID: 24850M

Planning/Engineering Document Title: Water System Plan Plan Date: May 2016

Local Government with Jurisdiction Conducting Review: Whatcom County Planning Department

Before the Department of Health (DOH) approves a planning or engineering submittal under Section 100 or Section 110, the local government must review the documentation the municipal water supplier provides to prove the submittal is consistent with local comprehensive plans, land use plans and development regulations (WAC 246-290-108). Submittals under Section 105 require a local consistency determination if the municipal water supplier requests a water right place-of-use expansion. The review must address the elements identified below as they relate to water service.

By signing this form, the local government reviewer confirms the document under review is consistent with applicable local plans and regulations. If the local government reviewer identifies an inconsistency, he or she should include the citation from the applicable comprehensive plan or development regulation and explain how to resolve the inconsistency, or confirm that the inconsistency is not applicable by marking N/A. See more instructions on reverse.

Local Government Consistency Statement	For use by water system: Identify the page(s) in submittal	For use by local government: Yes or Not Applicable
a) The water system service area is consistent with the adopted land use and zoning within the service area.	Chapter 1 Exhibit 2	
b) The growth projection used to forecast water demand is consistent with the adopted city or county's population growth projections. If a different growth projection is used, provide an explanation of the alternative growth projection and methodology.	Chapter 2 Table 2-15 Exhibit 4	
c) For cities and towns that provide water service: All water service area policies of the city or town described in the plan conform to all relevant utility service extension ordinances.	Chapter 1 Section 1.6	
d) Service area policies for new service connections conform to the adopted local plans and adopted development regulations of all cities and counties with jurisdiction over the service area.	Chapter 1 Section 1.6	
e) Other relevant elements related to water supply are addressed in the water system plan, if applicable. This may include Coordinated Water System Plans, Regional Wastewater Plans, Reclaimed Water Plans, Groundwater Management Area Plans, and the Capital Facilities Element of local comprehensive plans.		

I certify that the above statements are true to the best of my knowledge and that these specific elements are consistent with adopted local plans and development regulations.

Signature Date

Printed Name, Title, & Jurisdiction

Consistency Review Guidance

For Use by Local Governments and Municipal Water Suppliers

This checklist may be used to meet the requirements of WAC 246-290-108. When using an alternative format, it must describe all of the elements; 1a), b), c), d), and e), when they apply.

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   a) A copy of the adopted land use/zoning map corresponding to the service area. The uses provided in the WSP should be consistent with the adopted land use/zoning map. Include any other portions of comprehensive plans or development regulations that relate to water supply planning.

   b) A copy of the growth projections that correspond to the service area. If the local population growth projections are not used, explain in detail why the chosen projections more accurately describe the expected growth rate. Explain how it is consistent with the adopted land use.

   c) Include water service area policies and show that they are consistent with the utility service extension ordinances within the city or town boundaries. *This applies to cities and towns only.*

   d) All service area policies for how new water service will be provided to new customers.

   e) Other relevant elements the Department of Health determines are related to water supply planning. See Local Government Consistency – Other Relevant Elements, Policy B.07, September 2009.

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C) Documenting a Lack of Local Review for Consistency: Where the local government with jurisdiction did not provide a consistency review, document efforts made and the amount of time provided to the local government for review. Please include: name of contact, date, and efforts made (letters, phone calls, and emails). To self-certify, please contact the DOH Planner.

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Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Local Government Consistency Determination Form

Water System Name: City of Ferndale Water System PWS ID: 24850M

Planning/Engineering Document Title: Water System Plan Plan Date: May 2016

Local Government with Jurisdiction Conducting Review: WRIA 1

Before the Department of Health (DOH) approves a planning or engineering submittal under Section 100 or Section 110, the local government must review the documentation the municipal water supplier provides to prove the submittal is consistent with local comprehensive plans, land use plans and development regulations (WAC 246-290-108). Submittals under Section 105 require a local consistency determination if the municipal water supplier requests a water right place-of-use expansion. The review must address the elements identified below as they relate to water service.

By signing this form, the local government reviewer confirms the document under review is consistent with applicable local plans and regulations. If the local government reviewer identifies an inconsistency, he or she should include the citation from the applicable comprehensive plan or development regulation and explain how to resolve the inconsistency, or confirm that the inconsistency is not applicable by marking N/A. See more instructions on reverse.

Local Government Consistency Statement	For use by water system: Identify the page(s) in submittal	For use by local government: Yes or Not Applicable
a) The water system service area is consistent with the adopted land use and zoning within the service area.	Chapter 1 Exhibit 2	
b) The growth projection used to forecast water demand is consistent with the adopted city or county's population growth projections. If a different growth projection is used, provide an explanation of the alternative growth projection and methodology.	Chapter 2 Table 2-15 Exhibit 4	
c) For cities and towns that provide water service: All water service area policies of the city or town described in the plan conform to all relevant utility service extension ordinances.	Chapter 1 Section 1.6	
d) Service area policies for new service connections conform to the adopted local plans and adopted development regulations of all cities and counties with jurisdiction over the service area.	Chapter 1 Section 1.6	
e) Other relevant elements related to water supply are addressed in the water system plan, if applicable. This may include Coordinated Water System Plans, Regional Wastewater Plans, Reclaimed Water Plans, Groundwater Management Area Plans, and the Capital Facilities Element of local comprehensive plans.		

I certify that the above statements are true to the best of my knowledge and that these specific elements are consistent with adopted local plans and development regulations.

Signature Date

Printed Name, Title, & Jurisdiction

Consistency Review Guidance

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A) Documenting Consistency: The planning or engineering document must include the following when applicable.

   a) A copy of the adopted land use/zoning map corresponding to the service area. The uses provided in the WSP should be consistent with the adopted land use/zoning map. Include any other portions of comprehensive plans or development regulations that relate to water supply planning.

   b) A copy of the growth projections that correspond to the service area. If the local population growth projections are not used, explain in detail why the chosen projections more accurately describe the expected growth rate. Explain how it is consistent with the adopted land use.

   c) Include water service area policies and show that they are consistent with the utility service extension ordinances within the city or town boundaries. *This applies to cities and towns only.*

   d) All service area policies for how new water service will be provided to new customers.

   e) Other relevant elements the Department of Health determines are related to water supply planning. See Local Government Consistency – Other Relevant Elements, Policy B.07, September 2009.

B) Documenting an Inconsistency: Please document the inconsistency, include the citation from the comprehensive plan or development regulation, and explain how to resolve the inconsistency.

C) Documenting a Lack of Local Review for Consistency: Where the local government with jurisdiction did not provide a consistency review, document efforts made and the amount of time provided to the local government for review. Please include: name of contact, date, and efforts made (letters, phone calls, and emails). To self-certify, please contact the DOH Planner.

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E. CROSS-CONNECTION CONTROL

ORDINANCE NO. 1416

AN ORDINANCE ADOPTING CROSS-CONNECTION CONTROL REGULATIONS TO PROTECT THE CITY'S WATER SUPPLY SYSTEM AND REVISING AND AMENDING THE FERNDALE MUNICIPAL CODE

WHEREAS, Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies requires protection of the public drinking water supply from contamination due to cross-connections; and

WHEREAS, Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies requires that all cross-connections be eliminated or controlled; and

WHEREAS, Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies requires that the Water Purveyor develop and implement a cross-connection control program; and

WHEREAS, revisions to Chapter 246-290 of the Washington Administrative Code Rules and Regulations governing public drinking water supplies have been adopted April 9, 1999; and

WHEREAS, the City of Ferndale has completed a thorough assessment of the current cross-connection control program, and has determined that the current cross-connection program must be updated to address revisions to Chapter 246-290 of the Washington Administrative Code Rules and Regulations; and

WHEREAS, the City of Ferndale establishes the following cross-connection control ordinance to protect the public drinking water system from the risk of contamination due to cross-connections;

NOW, THEREFORE, the City Council of the City of Ferndale hereby ordains the following:

Section 1: "Ferndale Municipal Code Sections 13.04.164, 13.04.162 and Ordinance 808, are hereby repealed and replaced by **Chapter 13.06 Cross-Connection Control Regulations**

Chapter 13.06 Cross-Connection Control Regulations

13.06.100 ABBREVIATIONS AND ACRONYMS

DOH - Washington State Department of Health
RCW - Revised Code of Washington (Laws of the State)
WAC - Washington State Administrative Code

13.06.110 DEFINITIONS

"Approved air gap" means a physical separation between the free flowing end of a potable water supply pipeline and the overflow rim of an open or non-pressurized receiving vessel. To be an air gap approved by the DOH, the separation must be at least:

- Twice the diameter of the supply piping measured vertically from the overflow rim of the receiving vessel, and in no case be less than one inch, when unaffected by vertical surfaces (sidewalls); and
- Three times the diameter of the supply piping, if the horizontal distance between the supply pipe and a vertical surface (sidewall) is less than or equal to three times the diameter of the supply pipe, or if the horizontal distance between the supply pipe and intersecting vertical surfaces (sidewalls) is less than or equal to four times the diameter of the supply pipe and in no case less than one and one half inches.

"Approved atmospheric vacuum breaker" means an atmospheric vacuum breaker of make, model, and size that is approved by the DOH. Atmospheric vacuum breakers that appear on the current approved backflow prevention assemblies list developed by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research, or that are listed, or approved by other nationally recognized testing agencies (such as the International Association of Plumbing and Mechanical Officials, American National Standards Institute, or Underwriter Laboratories) and acceptable to the local administrative authority are considered approved by the DOH.

"Approved backflow preventer" means an approved air gap, an approved backflow prevention assembly, or an approved atmospheric vacuum breaker, relied upon by the purveyor for the protection of the public water system. The requirements of WAC 246 290 490 do not apply to backflow preventers installed for other purposes.

"Approved backflow prevention assembly" means a reduced pressure backflow assembly, reduced pressure detector assembly, double check valve assembly, double check detector assembly, pressure vacuum breaker assembly, or spill resistant vacuum breaker assembly, of make, model, and size that is approved by the DOH. Assemblies that appear on the current approved backflow prevention assemblies list developed by the University of Southern California Foundation for Cross Connection Control and Hydraulic Research, or other nationally recognized testing agencies and acceptable to the local administrative authority are considered approved by the DOH.

"Auxiliary water supply" means a water supply, other than the purveyor's water supply, on or available to the consumer's premises.

"Backflow" means the undesirable reversal of flow of water or other substances through a cross connection into the public water system or consumer's potable water system by means of backpressure or backsiphonage.

"Backpressure" means a pressure (caused by a pump, elevated tank or piping, boiler, or other means) on the consumer's side of the service connection that is greater than the pressure provided by the public water system and which may cause backflow.

"Backsiphonage" means backflow due to a reduction in system pressure in the purveyor's distribution system and/or the consumer's water system.

"Consumer" means any person receiving water from a point of delivery of the public water system. For purposes of cross connection control, "consumer" means the owner or operator of a premise receiving water from a point on delivery of the public water system.

"Consumer's water system", as used in WAC 246-290-490, means any potable and/or industrial water system that begins at a point of delivery from the public water system and is located on the consumer's premises. The consumer's water system includes all auxiliary sources of supply, storage, treatment, and distribution facilities, piping, plumbing, and fixtures under the control of the consumer.

"Contaminant" means a substance present in drinking water that may adversely affect the health of the consumer or the aesthetic qualities of the water.

"Cross-connection" means any actual or potential physical connection between a public water system or the consumer's water system and any source of non-potable liquid, solid, or gas that could contaminate the potable water supply by backflow.

"Cross-connection control program" means the administrative and technical procedures the water purveyor implements to protect the public water system from contamination via cross connections as required in WAC 246-290-490.

"Cross-connection control specialist" means a person holding a valid cross-connection control specialist certificate issued by DOH in accordance with chapter 246-292 WAC.

"Director" means Director of Public Works or duly authorized representative.

"DOH" means the Washington State Department of Health or health officer as identified in a joint plan of operation in accordance with WAC 246-290-030(1).

"High health cross-connection hazard" means a cross-connection that could impair the quality of potable water and create an actual public health hazard through poisoning or spread of disease by a contaminant source.

"Human consumption" means the use of water for drinking, bathing or showering, hand washing, food preparation, cooking, or oral hygiene.

"In-premise protection" means a method of protecting the health of consumers served by the consumer's potable water system, located within the property lines of the consumer's premise by the installation of an approved air gap or approved backflow prevention assembly at the point of hazard, which is generally a plumbing fixture.

"Local administrative authority" means the local official, board, department, or agency authorized to administer and enforce the provisions of the Uniform Plumbing Code as adopted under chapter 19.27 RCW.

"Low health cross-connection hazard" means a cross connection that could cause an impairment of the quality of potable water to a degree that does not create a hazard to the public health, but does adversely and unreasonably affect the aesthetic qualities of such potable waters.

"Point of delivery" means the point at which the consumer's water system connects to the public water system.

"Potable" means water suitable for human consumption.

"Premise" means a single building site, or single lot or aggregation of lots tied together by agreement for the purpose of obtaining a building permit or utility service.

"Premise isolation" means a method of protecting a public water system by installation of approved air gap or approved backflow prevention assembly at or near the service connection or alternative location acceptable to the purveyor to isolate the consumer's water system from the purveyor's distribution system.

"Public water system" means the water supply source, including all water treatment, storage, transmission and distribution facilities, to the point of delivery to the consumer.

"Purveyor" means the City of Ferndale, owner and operator of the public water system.

"Service connection" means the point of delivery from which potable water is provided to a single-family residence, or other residential or nonresidential population.

"State board of health" and **"board"** means the board created by RCW 43.20.030.

"Uniform Plumbing Code" means the code adopted under RCW 19.27.031(4) and amended under chapter 51 46 WAC. This code establishes statewide minimum plumbing standards applicable within the property lines of the consumer's premises.

"Used water" means water that has left the control of the purveyor.

13.06.120 APPLICABILITY

This Ordinance shall apply to all consumers with service connections to the purveyor's public water distribution system.

13.06.130 PURPOSE

1. Protect the public water system from contamination due to backflow through cross-connections; and

2. Eliminate or control cross-connections between the public water system and the consumer's water system.

13.06.140 RESPONSIBILITY

1. The consumer's responsibility for cross-connection control shall begin at the service connection.

2. Consumers shall be responsible for the:
i. Elimination of cross-connections when possible; or
ii. Control of cross-connections at the service connection (premise isolation); or
iii. Control of cross-connections, within the consumer's water system, by relying on in-premise protection when premise isolation is not required by WAC 246-290-490 and this method is approved by the Director.

3. Consumers are responsible for the installation, testing, inspection, repair, maintenance, and proper operation of approved backflow preventers required for the control of cross-connections between their premise and the public water system.

13.06.150 GENERAL REQUIREMENTS

1. The rules and regulations of the Washington State Department of Health as published in WAC 246-290-490 and hereby adopted by reference as they may be from time to time amended.

2. Consumers shall comply with the City's cross-connection control program policies and procedures as they may be from time to time amended.

3. An approved backflow preventer is required on all private fire lines, appropriate to the assessed degree of cross-connection health hazard, and shall incorporate a water meter for detecting water consumption. The approved backflow preventer shall be placed such that access for the City is provided to physically or electronically read the detecting meter.

4. Consumer shall permit periodic entry to their premise (in accordance with A new section or -------- or code here--------) by a cross-connection control specialist, for the determination of cross-connection health hazards and compliance with cross-connection control requirements.

13.06.160 ENFORCEMENT

1. In the event a consumer fails to comply with cross-connection control requirements, the Director shall have the authority to issue to the consumer a final order to achieve compliance with

this Ordinance, WAC 246-290-490 and or City cross-connection control policy and procedures, extent and time of the violation and the cross-connection control policy and procedures. The order shall include:

A. A description of the specific damage of the specific damage or potential damage that reasonably might occur;

B. A notice that the violation cease and desist and, in appropriate cases, the specific corrective actions to be taken;

C, That water service will be denied until corrective actions are completed or discontinued unless corrective actions are completed within a reasonable time to comply, depending on the circumstances.

D. The address, telephone number and contact person that the consumer may contact if a dispute exists as to the corrective action required;

E. That the consumer may request a hearing with the Hearings Examiner;

F. That the City will charge a shut-off and turn-on fee before service is resumed following discontinuance and/or impose civil penalties;

G. That the local administrative authority will be notified; and

H. That the service will not be shut off while a hearing is pending.

2. The local administrative official shall be notified prior to the City:

A. Denying water service; or

B. Discontinuing water service.

3. When an unprotected connection between the public water system and the consumer's water system constitutes an imminent threat of contamination to the City's public water system, water service may be shut off immediately without the notices provided above. In that case, notice of shut-off, corrective action, and appeal procedures and notice to the local administrative official shall be sent immediately upon such action being taken.

13.06.170 CIVIL PENALTY

1. In addition to any other remedy or sanction available, a consumer who fails to comply with a final order issued by the Director or Hearings Examiner pursuant to this chapter or who fails to conform to the terms of an approval issued, shall be subject to a civil penalty.

A. Amount of Penalty. The penalty shall be not less than $100.00 or exceed $5,000.00 for each violation. Each day of continued violation or repeated violation shall constitute a separate violation.

B. Aiding or Abetting. Any person who, through an act of commission, or omission, aids or abets in the violation shall be considered to have committed a violation for the purpose of the civil penalty.

C. Notice of Penalty. A civil penalty shall be imposed by the Director, by notice in writing, which shall be served either by certified mail with return receipt requested or by personal service, to the person incurring the same. The notice shall describe the violation, the date(s) of violation, and shall order the acts constituting the violation to cease and desist, and, in appropriate cases, require necessary corrective action within a specific time.

D. Appeal of Civil Penalty. Persons incurring a penalty imposed by the Director may appeal in writing within 10 days of the receipt of the notice of penalty to the Hearings Examiner. The Hearings Examiner shall hold a hearing to consider the appeal and may affirm, modify or reverse the penalty. Review of the Hearings Examiner's decision may be obtained by filing an action for a writ of certiorari with a court of competent jurisdiction within 10 days of the date of the decision.

2. Penalties imposed under this Section shall become due and payable 10 days after notice of the penalty is mailed or delivered, whichever occurs first, unless an appeal is filed. Whenever an appeal is made, penalties shall become due and payable after a final decision has been issued confirming all or part of the penalty. If the amount of a penalty owed is not paid within the time specified in this Section, the City may take actions necessary to recover such penalty.

3. Penalties shall be paid to the water fund.

13.06.180 OPERATING POLICIES

The Director shall promulgate and implement the City's policy on cross-connection control for the operation of the Cross-Connection Control Program. The Cross-Connection Control Program policy shall be enforced under the requirements of the City's Cross-Connection Control Ordinance.

PASSED by the Council of the City of Ferndale, Washington, on this 18th day of DECEMBER, 2006.

ATTEST:

Jerry Landcastle, Mayor

Linda Knutson, City Clerk

The City of Ferndale
Cross-Connection Control Program
Policy and Procedures

October 25, 2006

TABLE OF CONTENTS

I. Purpose 3
II. Legal Requirements and References 3
III. Guidance Manuals 3
IV. Cross-Connection Control Responsibilities 3
V. Permits and Fees 5
VI. Plan Review of New and Modified Construction 6
VII. Unprotected High Health Hazard Cross-Connections 6
VIII. Requirements for Backflow Prevention device Type 6
IX. Installation Requirements for Backflow Prevention devices 7
X. Mobile Apparatus 9
XI. Inspecting Consumer Premises for Cross-Connection Hazards 9
XII. Testing and Inspection of Backflow Prevention device Installations 10
XIII. Notification Process for Corrective Actions 12
XIV. City Reporting Requirements to DOH 12
XV. City Public Education program 13
XVI. Training for City Staff 13
XVII. Definitions, Abbreviations, and Acronyms 13
XVIII. Appendices ..... **Error! Bookmark not defined.**

DOH regulations(WAC 246-290) 19
City Ordinance(----------) 19
City Procedures 19
Standard Plans and Specifications 19
Approved Backflow Prevention device List 19
Latest Annual Summary Report 19
Backflow Incident Reports 19
Sample Notification Letters 19
Copies of Public Education Materials 19
List of Backflow Assembly Testers 19

The City of Ferndale
Cross-Connection Control Program
POLICY AND PROCEDURES

I. PURPOSE

A. The City of Ferndale (City) establishes this policy to protect the public water system from the risk of contamination due to cross-connections.

II. LEGAL REQUIREMENTS AND REFERENCES

A. This policy is based on requirements of:

1. Washington State Department of Health Drinking Water Regulations (WAC 2246-290-490) and future amendments thereto;
2. State of Washington Uniform Plumbing Code (WAC 51-46) and Plumbing Code amendments (WAC 51-47) and future amendments thereto;
3. The City Cross-Connection Control Municipal Code (----------)and future amendments thereto; and
4. The City Uniform Plumbing Municipal Code (----------).

III. GUIDANCE MANUALS

A. The City uses the following references, as a minimum standard, to guide the operation of this program:

1. Most current edition of *Cross-Connection Control Manual, Accepted Procedure and Practice*, published by the Pacific Northwest Section of the American Water Works Association; and
2. Most current edition of *Manual of Cross-Connection Control*, published by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California.

IV. CROSS-CONNECTION CONTROL RESPONSIBILITIES

A. The City has the following responsibilities:

1. The City's responsibility for cross-connection control begins at the water supply source, includes all the public water treatment, storage and distribution facilities, and ends at the point of delivery to the consumer's water system;
2. The City enforces the rules and regulations of the Washington State Department of Health as published in WAC 246-290 and as they may be from time to time amended;

3. The City enforces the rules and regulations of the State of Washington as published in the Uniform Plumbing Code, and as they may be from time to time amended;
4. The City enforces the Ferndale Municipal Code (FMC ----------), which regulates cross connection control, as it may be from time to time amended;
5. The City may deny or discontinue water service to any consumer connected to the City's water system who fails to cooperate to eliminate or control cross-connections; and
6. The City has a right to access, at all reasonable times, all parts of the consumer's premises for the purpose of assessing the degree of hazard posed to the City's water system by the consumer's water system (FMC----------).

B. The City Public Works Director (Director), or duly authorized representative, has the following responsibilities:
1. The Director administers the City's cross-connection control program;
2. The Director, at his or her discretion, may approve, in writing, exceptions to the City's cross-connection control program policies and procedures;
3. The Director coordinates with the City Building Official on all on matters of cross-connection control within the corporate limits of the City of Ferndale; and
4. The Director coordinates with the Whatcom County Building Official (County Building Official) on all on matters of cross-connection control within the City water utility service area located outside the corporate limits of the City of Ferndale.

C. The City Building Official has the following responsibilities:
1. The City Building Official approves all cross-connection control policies and procedures within his or herjurisdiction; and
2. The City Building Official coordinates with the Director on all matters of cross-connection control within the corporate limits of the City of Ferndale.

D. The County Building Official has the following responsibilities:
1. The County Building Official approves all cross-connection control policies and procedures within his or her jurisdiction.
2. The County Building Official coordinates with the Director on all matters of cross-connection control within the City's water utility service area.

E. The City Cross-Connection Control Program Administrator (Program Administrator) has the following responsibilities:
1. The Program Administrator manages the day-to-day operation of the City's cross-connection control program;
2. The Program Administrator maintains current Washington State

certification as a cross-connection control specialist; and

3. The Program Administrator coordinates with the Director and City and County Building Officials on all matters of cross-connection control.

F. The City Cross-Connection Control Specialist(s) (Specialist(s)) have the following responsibilities:

1. The Specialist(s) reviews all new and remodel construction plans for cross-connection control;
2. The Specialist(s) maintains current Washington State certification as cross-connection control specialist; and
3. The Specialist(s) inspects premises and temporary uses to determine cross-connection health hazards and proper backflow prevention device installation.

G. The consumer has the following responsibilities:

1. The consumer's responsibility for cross-connection control begins downstream of the City service connection shutoff valve or water meter, generally located within the public right-of-way or utility easement in favor of the City of Ferndale;
2. The consumer eliminates or controls cross-connections between the consumer's water system and the City water system through the installation, annual testing and maintenance of approved backflow prevention devices;
3. The consumer provides information and pays all fees necessary for required City permits and approvals;
4. The consumer allows the City entry and access to their premises for the purpose of determining the degree of cross-connection health hazard existing in the consumer's premises and for the inspection of backflow prevention device installations; and
5. The consumer's failure to complete required backflow prevention device testing or to correct an existing cross-connection problem or potential risk will incur penalties as outlined within most current cross connection ordinance and carried out by the City. If a problem does cause harm to the City's public water system and/or other private parties connected to the City's public water system, the consumer will be solely liable for any and all such occurrences.

V. PERMITS AND FEES

A. The City provides occupancy and/or water service to new premises after the consumer has paid all appropriate fees and received all applicable and/or required permits and approvals;

B. The City may revoke and/or discontinue occupancy permits and/or water service

to premises being modified until the consumer has paid all appropriate fees and received all applicable and/or required permits and approvals;

C. The City incorporates the following permit fee schedules to recover City costs for cross-connection control plan review and inspections:

1. Plumbing permit fees;
2. Plan review fees;
3. UBC Building Code fees;
4. Permit, plan review and inspection fees;
5. Mechanical permit fees;
6. Water service connection fees; and
7. Installation permit fees.

VI. PLAN REVIEW OF NEW AND/OR MODIFIED CONSTRUCTION

A. The City Building Official and Director coordinate plan review for new and/or modified construction to assess degree of cross-connection health hazard, determine backflow prevention device requirements and applicable permits and appropriate fees; and

B. Civil design plans shall clearly show cross connection control devices for new development projects or revisions to existing buildings or infrastructure. All civil design plans shall display any cross-connection devices that are required for installation by the contractor. City staff may require the addition of backflow prevention devices to design plans as part of the review process.

VII. UNPROTECTED HIGH HEALTH HAZARD CROSS-CONNECTIONS

A. Within 24 hours of discovery, the City may deny or discontinue water service to any premises where an unprotected high health cross-connection hazard has been found to exist. The City will restore water service after the consumer has clearly demonstrated the elimination or has appropriately controlled the cross-connection; and

B. Within 24 hours of discovery, the City may deny or discontinue water service to any premises upon which an auxiliary water supply system exists and is used and/or operated such that an unprotected high health cross-connection hazard exists. The City will restore water service after the consumer has clearly demonstrated the elimination or has appropriately controlled the cross-connection.

VIII. REQUIREMENTS FOR BACKFLOW PREVENTION DEVICE TYPE

A. The City requires any backflow prevention device installed by the consumer must be an approved backflow prevention device; on the most current Wahington State Department Of Health approved backflow list.

B. The City specifies type of backflow prevention device required, based on the assessed degree of cross-connection health hazard;

C. The City requires, at minimum, an approved air gap (AG) or approved reduced pressure backflow assembly (RPBA) if a high health cross-connection hazard exists;

D. The City requires, at minimum, an approved double check valve assembly (DCVA) if a low health cross-connection hazard exists. The consumer may install higher levels of protection (i.e., an approved AG or approved RPBA) at their discretion;

E The City allows, at minimum, an approved pressure vacuum breaker assembly (PVBA) if a low health cross-connection hazard exists and there is no possibility of backpressure. The consumer may install a higher level of protection (i.e. an approved AG, approved RPBA, or an approved DCVA) at their discretion;

F. The City allows an approved atmospheric vacuum breaker (AVB) on landscape irrigation systems if a low health cross-connection hazard exists, and there is no possibility of backpressure. The consumer may install a higher level of protection (i.e. an approved AG, approved RPBA, or an approved DCVA) at their discretion;

G. The City requires an approved double check detector assembly (DCDA) on all private fire lines if a low health cross-connection hazard exists. The consumer shall install all DCDAs so the City has access to physically or electronically read the detecting meter;

H. The City requires an approved reduced pressure detector assembly (RPDA) on all private fire lines if a high health cross-connection hazard exists. The consumer shall install all RPDAs so the City has access to physically or electronically read the detecting meter;

I. The City requires an approved AG and/or approved RPBA at the service connection and located within an easement in favor of the City of Ferndale when the consumer, for security or propriety reasons, refuses or denies the City entry and access;

J. The City prohibits bypassing backflow prevention devices unless the bypass is protected with a backflow prevention device the same type as the backflow prevention device being bypassed;

K. The City requires an approved RPBA if any potable water system is to be directly plumbed and/or connected to a swimming pool, sauna, or hot tub; and

L. The City requires an AG or approved RPBA be installed upstream on the water supply connected to any and all aspirator type equipment capable of introducing any substance into the water line.

IX. INSTALLATION REQUIREMENTS FOR BACKFLOW PREVENTION DEVICES

A. The City requires approved backflow prevention device installations in accordance with the most recent edition of *Cross-Connection Control Manual, Accepted Procedure and Practice*, published by the Pacific Northwest Section of the American Water Works Association, and with this policy;

B. The City requires installation of approved backflow prevention devices at the service connection to meet premise isolation requirements. The City may approve an alternate location on a case-by-case basis;

C. The City may approve in-premises protection on a case-by-case basis. The City must approve all such in-premises protection;

D. The City requires approved backflow prevention devices be installed in locations that are accessible for testing, maintenance and inspection;

E. The City requires backflow prevention assemblies to be installed above ground unless prior written permission is obtained from the City, with the exception that approved DCVAs on landscape irrigation systems may be installed underground if installed as shown in the City's landscape irrigation installation standard drawing;

F. The City requires backflow prevention devices installed so that the centerline of the assembly is higher than five (5) feet above the floor or ground surface be provided with a permanently attached work platform to allow the backflow prevention device be inspected, tested and maintained;

G. The City requires backflow prevention devices be protected against freezing, flooding and mechanical damage;

H. The City requires backflow prevention devices be installed outside of any enclosure or area that could potentially fill with fumes which are or may become corrosive or toxic;

I. The City requires backflow prevention devices be installed where water spilt from the device during normal operation, inspection, testing or maintenance will not create a hazard or cause damage. The consumer must provide an adequate drainage system that can handle the discharge of water caused by any means;

J. The City requires RPBAs and DCVAs to be installed horizontally unless listed for other installation orientations in the most current edition of *Backflow Prevention Assemblies Approved for Installation in Washington State*, published by the Washington State Department of Health; and

K. The City allows installation of vacuum breakers as in-premises isolation in accordance with the most recent edition of *Cross Connection Control Manual, Accepted Procedure and Practice*, published by the Pacific Northwest Section of the American Water Works Association, with the following exception:

   1. Vacuum breakers shall not be installed where there is any chemical addition capability (e.g. dishwasher supply lines with automatic detergent dispensing, chemical feeders or aspirators).

X. MOBILE APPARATUS

A. Any mobile apparatus that uses the City's water system or water from any premises served by the City's water supply shall use an approved backflow prevention assembly or AG at the point of connection to the public water system and shall obtain a permit of such connection from the City. Such backflow prevention assemblies shall have been positively tested within the 12-month period prior to their temporary connection to the City's water system.

XI. INSPECTING CONSUMER PREMISES FOR CROSS-CONNECTION HAZARDS

A. The City assigns priorities to schedule inspections of existing consumer premises, with special emphasis placed on the type of premises listed in Table 9 of WAC 246-290-490 (4) (B), and future amendments thereto;

B. The City conducts joint inspections with a representative of the local administrative authority when necessary;

C. The City inspects premises prior to allowing the removal of any approved backflow prevention device that the consumer believes is no longer needed;

D. The City inspects consumer premises to assess the degree of cross-connection hazard to the City water system as described below:

1. The City shall inspect consumer premises prior to authorizing water service activation or issuing an occupancy permit;
2. The City shall conduct inspections of existing premises according to the following schedule and conditions:
   i. Within five years of the date of adoption of this policy, the City's goal is to inspect all known high health cross-connection hazard premises; and
   ii. Within seven years of the date of adoption of this policy, the City's goal is to inspect all known low health cross-connection hazard premises.
3. The City conducts re-inspections of consumer premises as follows:
   i. The City re-inspects consumer premises of the type listed in Table 9, WAC 246-290-490, and future revisions thereto, any time a building, plumbing or remodel permit is applied for; after a backflow incident; whenever water quality concerns arise; or at least every ten years from the date of the prior inspection; and
   ii. The City re-inspects other consumer premises any time a building, plumbing or remodel permit is applied for; after a backflow incident; whenever water quality concerns arise; or at least every ten years from the date of the prior inspection.
4. The City requires existing premises, without the required approved backflow prevention device, to be retrofitted within the following time frame:

i. Within 30 days of the City sending notice, all premises determined to be a high health cross-connection hazard shall have a backflow prevention device commensurate with the degree of hazard installed, tested and found to be functioning acceptably, as required by this policy;

ii. Within 90 days of the City sending notice, premises determined to be a low health cross-connection hazard shall have a backflow prevention device commensurate with the degree of hazard installed, tested and found to be functioning acceptably, as required by this policy;

iii. Within 10 days of the City sending notice, the consumer may submit a written request for a time extension to the requirements listed above, not to exceed 18 months, to comply with the backflow prevention device installation and/or testing requirements. The City may grant an extension of the time frame for installation and testing of the required backflow prevention devices in writing.

5. Temporary fire hydrant use shall comply with the following:

i. The City inspects equipment or processes, when a bulk water permit for temporary water service has been submitted, in order to establish the degree of cross-connection hazard posed by the requested use;

ii. The City requires an approved backflow prevention device appropriate for the degree of cross-connection health hazard;

iii. The consumer submits a completed backflow assembly test report form to the City prior to a bulk water permit is issued; and

iv. The consumer completes a bulk water permit application and pays all applicable fees.

XII. TESTING AND INSPECTION OF BACKFLOW PREVENTION DEVICE INSTALLATIONS

A. The City inspects all new backflow prevention device installations including AGs used in lieu of approved backflow prevention assemblies;

B. A Washington State Department of Health (DOH) certified cross-connection control specialist inspects all approved AVBs used as backflow prevention on landscape irrigation systems at the time of installation;

C. A DOH certified backflow assembly tester (BAT) inspects all replacement installations of approved backflow prevention devices, including AGs used in lieu of approved backflow prevention assemblies, as part of the required testing of the replacement installation. The City verifies that the backflow prevention device is of a type acceptable for the assessed degree of cross-connection health hazard;

D. The City requires approved backflow prevention assemblies be tested using

procedures acceptable to the DOH, such as those specified in the most current edition of *Manual of Cross-Connection Control*, published by the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California. The City accepts alternate backflow testing procedures in specific circumstances; however, only alternate procedures approved by the DOH may be used;

E. Washington State Department of Health requires certified BATs inspect all approved AG installations and test all approved backflow prevention assembly installations;

F. Consumers must have approved backflow prevention assemblies tested:

1. at the time of installation;
2. at least annually after installation;
3. after a backflow incident;
4. after an assembly is repaired or replaced; and/or
5. anytime an assembly is reinstalled or relocated.

G. The City inspects approved AGs, installed in lieu of approved backflow prevention assemblies, at the time of installation;

H. The consumer shall have approved AGs, installed in lieu of approved backflow assemblies, inspected:

1. at least annually after installation;
2. after an air gap is repaired;
3. after a backflow incident; and/or
4. any time the air gap is re-plumbed and/or relocated.

I. The consumer shall pay for all testing of approved backflow prevention assemblies and all inspections of approved AGs;

J. The consumer shall have approved AVBs used as backflow prevention on landscape irrigation systems inspected:

1. at the time of installation;
2. after a backflow incident; and/or
3. after repair, reinstallation, and/or relocation.

K. The City may require the consumer to have testing and inspection of approved backflow prevention devices performed more frequently than as specified within this policy, or City forces may field verify the test and inspection results;

L. The City maintains a list of BATs willing to test backflow assemblies in the City's water service area. The City does not set or control the fees charged by the BATs, nor does the City recommend any BAT on the list over other BATs;

M. Backflow assembly testers desiring to be on the City's list of BATs must submit the following to the City:

1. current copy of DOH backflow assembly certification;
2. current copy of test kit calibration or accuracy report. The test kits must be verified for accuracy or calibrated annually;
3. current proof of liability insurance;
4. current copy of Washington State business license;
5. City business license number;
6. current mailing address; and
7. current telephone number where the City can contact the BAT during regular working hours.

N. Backflow assembly testers complete and submit a City backflow assembly test report form for each backflow prevention device tested and/or inspected. The City will furnish backflow assembly test report forms upon request;

XIII. NOTIFICATION PROCESS FOR CORRECTIVE ACTIONS

A. The City issues the following notifications when a consumer does not meet the requirements outlined within this policy:

1. The City sends a notice to the consumer listing corrective actions needed to meet cross-connection requirements. The notice will reference a time schedule for compliance;
2. The City sends a second letter (via United States Postal Service, Certified Mail, Return Receipt Requested) notifying the consumer of corrective action needed and time schedule to meet cross connection requirements. The second letter will include a reminder to the consumer that the City may discontinue or deny water service for non-compliance. The City sends the local administrative authority a copy of the second letter, if applicable;
3. The City sends a final order (via Certified Mail, Return Receipt Requested) notifying the consumer of the City's intent to deny or discontinue water service on a specified date if compliance has not been achieved or other arrangements with the City have been made (code----------);
4. The consumer is subject to civil penalties for non-compliance with the final order (see code----------); and
5. Consumers may appeal the final order by requesting a hearing with the Hearings Examiner (see code----------).

XIV. CITY REPORTING REQUIREMENTS TO THE WASHINGTON STATE DEPARTMENT OF HEALTH

A. The City completes and submits an annual cross-connection control program summary report to DOH; and

B. The City completes a backflow incident report when a backflow occurrence is

discovered or reported to the City.

XV. CITY PUBLIC EDUCATION PROGRAM

A. The City maintains a cross-connection control program page on its website. The web page includes the City cross-connection control ordinance, the City of Ferndale Cross Connection Program Policy and Procedures, links to DOH regulations on cross-connection control, a list of approved backflow prevention devices, the list of City BATs, the most recent annual summary report submitted to DOH, City contact information, and links to other cross-connection web sites;

B. The City develops and/or obtains brochures and other information for consumers. Information will be located at public counters, sent to BATs, and included in the web page; and

C. The City provides public education and awareness using the utility bills and city web site.

XVI. TRAINING FOR CITY STAFF

A. The City facilitates employee training to maintain DOH certifications. Non-certified employees who have responsibility for design, inspection, operation and maintenance of the City water system receive periodic training through professional training opportunities and educational organizations, and/or through in-house or on-the-job training from currently certified employees.

XVII. ACRONYMS, ABBREVIATIONS AND DEFINITIONS

ACRONYMS AND ABBREVIATIONS:

AG	air gap
APWA	American Public Works Association
AVB	atmospheric vacuum breaker
AWWA	American Water Works Association
BAT	backflow assembly tester (for WAC 246-290-490)
CCS	cross-connection control specialist
CCR	consumer confidence report
DCDA	double check detector assembly
DCVA	double check valve assembly
DOH	Washington State Department of Health
IBC	International Building Code
NSF	National Sanitation Foundation
PVBA	pressure vacuum breaker assembly

RCW	Revised Code of Washington
RPBA	reduced pressure backflow assembly
RPDA	reduced pressure detector assembly
SDWA	Safe Drinking Water Act
SVBA	spill resistant vacuum breaker assembly
UL	Underwriters Laboratories, Inc.
UPC	Uniform Plumbing Code
WAC	Washington Administrative Code

DEFINITIONS:

Approved air gap - A physical separation between the free-flowing end of a potable water supply pipeline and the overflow rim of an open or nonpressurized receiving vessel. To be an approved air gap (i.e., approved by DOH) the separation must be at least:

- Twice the diameter of the supply piping measured vertically from the overflow rim of the receiving vessel, and in no case be less than one inch, when unaffected by vertical surfaces (sidewalls); and
- Three times the diameter of the supply piping, if the horizontal distance between the supply pipe and a vertical surface (sidewall) is less than or equal to three times the diameter of the supply pipe, or if the horizontal distance between the supply pipe and intersecting vertical surfaces (sidewalls) is less than or equal to four times the diameter of the supply pipe and in no case less than one and one-half inches.

Approved atmospheric vacuum breaker - An AVB of make, model, and size that is approved by DOH. AVBs that appear on the current approved backflow prevention assemblies list developed by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research or that are listed or approved by other nationally recognized testing agencies acceptable to the local administrative authority are considered approved by the DOH.

Approved backflow prevention device - An approved air gap, an approved backflow prevention assembly or an approved AVB. The terms *approved backflow prevention device*, *approved air gap*, or *approved backflow prevention assembly* refer only to those approved backflow prevention devices relied upon by the City for the protection of the public water system. The requirements of WAC 246-290-490 do not apply to backflow prevention devices installed for other purposes.

Approved backflow prevention assembly - An RPBA, RPDA, DCVA, DCDA, PVBA or SVBA of make, model, and size that is approved by DOH. Assemblies that appear on the current approved backflow prevention assemblies list developed by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research or other entity acceptable to DOH are considered approved by DOH.

Backflow - The undesirable reversal of flow of water or other substances through a cross-connection into the public water system or that portion of the consumer's water system providing potable water.

Backflow assembly tester - A person holding a valid BAT certificate issued in accordance with WAC 246-290-490.

Backpressure - A pressure, caused by a pump, elevated tank or piping, boiler, or other means, on the consumer's side of the service connection that is greater than the pressure provided by the public water system and which may cause backflow.

Backsiphonage - Backflow due to a reduction in system pressure in the City's distribution system and/or consumer's water system.

Change in fixtures - Any alteration of plumbing fixtures on a premises that would increase backflow hazards as identified on the Water Usage Questionnaire (Exhibit B). This is distinct from "Change in Use" in District Code 7.04.040, which implies a change in Equivalent Living Units (ELUs).

Consumer - Any person receiving water from a public water system from either the meter or the point where the service line connects with the public water system if no meter is present. For purposes of cross-connection control, *consumer* means the owner or operator of a water system connected to a public water system through a service connection.

Consumer's water system - (as used in WAC 246-290-490) means any potable and/or industrial water system that begins at the point of delivery from the public water system and is located on the consumer's premises. The consumer's water system includes all auxiliary sources of supply, storage, treatment, and distribution facilities, piping, plumbing, and fixtures under the control of the consumer.

Contaminant - A substance present in drinking water that may adversely affect the health of the consumer or the aesthetic qualities of the water.

Cross-connection - Any actual or potential connection or physical arrangement between a public water system or the consumer's water system and any source of non-potable liquid, solid, or gas that could contaminate the potable water supply by backflow. Bypass arrangements, jumper connections, removable sections, swivel or change-over devices, and other temporary, permanent or potential connections through which, or because of which, backflow could occur are considered to be cross-connections.

Cross-connection control program - The administrative and technical procedures the City implements to protect the public water system from contamination via cross-connections, as required in WAC 246-290-490.

Cross-connection control specialist - A person holding a valid CCS certificate issued in accordance with WAC 246-290-490.

Cross-connection control summary report - The annual report that describes the status of the purveyor's cross-connection control program.

Department - DOH or DOH health officer as identified in a joint plan of operation in

accordance with WAC 246-290-030(1).

Direct service connection - A service hookup to a property that is contiguous to a water distribution main and where additional distribution mains or extensions are not needed to provide service.

Distribution system - All piping components of a public water system that serve to convey water from transmission mains linked to source, storage and treatment facilities to the consumer, excluding individual services.

Domestic or other non-distribution system plumbing problem - Contamination of a system having more that one service connection with the contamination limited to the specific service connection from which the sample was taken.

Emergency - An unforeseen event that causes damage or disrupts normal operations and requires immediate action to protect public health and safety.

Flow-through fire protection system - A fire sprinkler system that:

- Is supplied only by the purveyor's water;
- Does not have a fire department pumper connection;
- Is constructed of approved potable water piping and materials to which sprinkler heads are attached; and
- Terminates at a connection to a toilet or other plumbing fixture to prevent the water from becoming stagnant.

Guideline - A DOH document assisting the purveyor in meeting a rule requirement.

Health officer - The Health Officer of the City, county, county health department, or an authorized representative.

High health cross-connection hazard - A cross-connection that could impair the quality of potable water and create an actual public health hazard through poisoning or spread of disease by sewage, industrial liquids or waste.

Human consumption - The use of water for drinking, bathing or showering, hand washing, food preparation, cooking, or oral hygiene.

In-premises protection - A method of protecting the health of consumers served by that portion of the consumer's water system providing potable water, by the installation of an approved air gap or backflow prevention assembly at the point of hazard within the property lines of the consumer's premises. The hazard is generally a plumbing fixture.

Local administrative authority - The local official, City, department or agency authorized to administer and enforce the provision of the Uniform Plumbing Code as adopted under RCW 19.27. This term refers to Whatcom County where the City serves within an unincorporated area.

Low health cross-connection hazard - A cross-connection that could cause an impairment of the quality of potable water to a degree that does not create a hazard to the public health, but does adversely and unreasonably affect the aesthetic qualities of such potable waters for domestic use.

Potable - Water suitable for drinking by the public.

Premises isolation - A method of protecting a public water system by installation of approved air gaps or approved backflow prevention assemblies at or near the service connection or alternative location acceptable to the purveyor to isolate the consumer's water system from the purveyor's distribution system.

Public water system - Defined and referenced under WAC 246-290-020. As used herein, public water system refers to the City's water system.

Purveyor - The City of Ferndale.

Resident - An individual living in a dwelling unit served by a public water system.

Secondary standards - Standards based on factors other than health effects.

Unapproved auxiliary water supply - A water supply (other than the purveyor's water supply) on or available to the consumer's premises that is either not approved for human consumption by the health agency having jurisdiction or is not otherwise acceptable to the purveyor.

Uniform Plumbing Code - The code adopted under RCW 19.27.031(4) and amended under WAC 51-46. This code establishes state-wide minimum plumbing standards applicable within the property lines of the consumer's premises.

Used water - Water which has left the control of the purveyor.

To be added.....

DOH regulations(WAC 246-290)

City Ordinance(----------)

City Procedures

Standard Plans and Specifications

Approved Backflow Prevention device List

Latest Annual Summary Report

Backflow Incident Reports

Sample Notification Letters

Copies of Public Education Materials

List of Backflow Assembly Testers

City of Ferndale

Water Use Questionnaire (Single Family Residential)

:te_____ ☐ New Water Service ☐ Existing Water Service ☐ Change In Use

Account # _____ Phone Number: (_____) _____

Name: _____

Service Address: _____

Mailing Address: _____

Legal Description: _____

Please indicate if your home has, or will have, any of the following:

.1	☐ Access Denied or Restricted Locations	15	☐ Irrigation System
.2	☐ Agricultural Facilities (Livestock)	.16	☐ Pet Cleaning Basins
3	☐ Air Condition System (Direct Connection)	.17	☐ Piers, Docks, or Marinas
4	☐ Aquarium (Direct Connection)	18	☐ Plumbing 30' Above Water Meter
5	☐ Below Ground Hose Connections (Box Hydrants, Etc.)	.19	☐ Premises with Other Water Supply Connected with Potable Water
6	☐ Booster Pumps	.20	☐ Recreational Vehicle Sewage Dump or Tank
7	☐ Decorative Ponds or Fountains	21	☐ Solar Water Heating System
8	☐ Dialysis Machine	22	☐ Swamp Cooler
9	☐ Fire Sprinkler System	23	☐ Trap Primers
10	☐ Greenhouse	24	☐ Tubs (Below The Rim Fill)
11	☐ Heat Exchangers	.25	☐ Used, Reclaimed, or Gray Water Systems
12	☐ Heat Pumps	26	☐ Vehicle Maintenance Shop (Degreasing Equipment, etc.)
13	☐ Hot Tub, Pool, or Spa	.27	☐ Waste Water Pump
14	☐ Hot Water Heating Boilers (Radiant Heating Systems)	28	☐ Water Treatment Equipment (e.g., Softener)

Please provide the information below for all products that will be mixed with water and or chemicals stored on your premises:
Exclude normal household chemicals that are not stored in abnormal quantities

Product / Chemical	Quantity On-site	Use

I hereby acknowledge that the questionnaire above is filled out to the best of my knowledge and will notify the District and the Local Administrative Authority if there is a change in use of my water service connection. I agree to install a backflow prevention device as required by the District and its cross connection control program, and to allow the District reasonable access to the property to inspect or test the device.

Signature (Owner/Representative) _____ Name (Please print) _____ Date _____

CITY USE BELOW

Based on a review of this Water Usage Questionnaire, the following has been identified:

Does a hazard exist? **Yes** **No**

HAZARD	HIGH			LOW			
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:

☐ In-premises protection allowed ☐ Premises isolation required at property line ☐ Premises isolation agreement

Meter Status ☐ Locked ☐ Unlocked

CCS Signature _____ Water Manager Signature _____

City of Ferndale

Water Use Questionnaire (Multi Unit / Commercial))

te _____ ☐ New Water Service ☐ Existing Water Service ☐ Change In Use

Account # _____ Phone Number: (_____) _____

Name: _____

Service Address: _____

Mailing Address: _____

Legal Description: _____

Please indicate if your home has, or will have, any of the following:

1	☐ Access Denied or Restricted Locations	31	☐ Hot Water Heating Boilers (Radiant Heating Systems)
2	☐ Agricultural Facilities (Livestock)	32	☐ Industrial Fluid Systems
3	☐ Air Condition System (Direct Connection)	33	☐ Irrigation System
4	☐ Aquarium (Direct Connection)	34	☐ Janitor or Service Sinks
5	☐ Auxiliary Water System or Supply	35	☐ Laboratories, or Laboratory Equipment
6	☐ Beverage Bottling and or Bottle washing Equipment	36	☐ Laundromats, or Laundry Equipment (Commercial)
7	☐ Beverage Dispenser	37	☐ Metal Plating Industries
8	☐ Blood Plasma Centers	38	☐ Mortuaries
9	☐ Booster Pumps	39	☐ Nursing Homes (Adult Care Facilities)
10	☐ Box Hydrants (Below Ground)	40	☐ Pet Cleaning Basins
11	☐ Car Wash / Vehicle Wash Rack	41	☐ Petroleum Processing (Storage, Refineries)
12	☐ Chemical Feed Systems (Chemical Cleaners, or Products)	42	☐ Photo Developing Sinks and Tanks
13	☐ Chemical Plant or Storage	43	☐ Piers, Docks, or Marinas
14	☐ Chlorinators	44	☐ Plumbing 30' Above Water Meter
15	☐ Commercial Ice Makers	45	☐ Premises with Other Water Supply Connected with Potable Water
16	☐ Cooling Towers	46	☐ Private Fire Hydrant
	☐ Decorative Ponds or Fountains	47	☐ Pump Prime Lines
	☐ Dental Clinics or Equipment	48	☐ Radioactive material processing plants or nuclear reactors
19	☐ Dialysis Machine	49	☐ Recreational Vehicle Sewage Dump or Tank
20	☐ Dry Cleaning or Cleaners	50	☐ Solar Water Heating System
21	☐ Dye Vats and Tanks	51	☐ Steam Generating Equipment
22	☐ Fermenting Tanks	52	☐ Swamp Cooler
23	☐ Fire Sprinkler System	53	☐ Trap Primers
24	☐ Food Processing Plants	54	☐ Tubs (Below The Rim Fill)
25	☐ Garbage Can Washers	55	☐ Used, Reclaimed, or Gray Water Systems
26	☐ Greenhouse	56	☐ Vehicle Maintenance Shop (Degreasing Equipment)
27	☐ Heat Exchangers	57	☐ Veterinary Clinics
28	☐ Heat Pumps	58	☐ Waste Water Pump or Pump Stations
29	☐ Hospital (Medical Clinics or Centers)	59	☐ Waste Water Treatment and Waster Water Pump Stations
30	☐ Hot Tub, Pool, or Spa	60	☐ Water Treatment Equipment (e.g., Softener)

Yes	No	
☐	☐	Are you aware of any existing backflow devices or backflow protection you have on your property?

Please provide the information below for all products that will be mixed with water and or chemicals stored on your premises:
Exclude normal household chemicals that are not stored in abnormal quantities:

Product / Chemical	Quantity On-site	Use

I hereby acknowledge that the questionnaire above is filled out to the best of my knowledge and will notify the District and the Local Administrative Authority if there is a change in use of my water service connection. I agree to install a backflow prevention device as required by the District and its cross connection control program, and to allow the District reasonable access to the property to inspect test the device

Signature (Owner/Representative) _____ Name (please print) _____ Date _____

City of Ferndale

Application for Water Service

ıte _____ ☐ New Water Service ☐ Existing Water Service ☐ Change In Use

Account # _____ Phone Number: (_____) _____

Name: _____

Service Address: _____

Mailing Address: _____

Legal Description: _____

Please indicate if your home has, or will have, any of the following:

1	☐ Access Denied or Restricted Locations	31	☐ Hot Water Heating Boilers (Radiant Heating Systems)
2	☐ Agricultural Facilities (Livestock)	32	☐ Industrial Fluid Systems
3	☐ Air Condition System (Direct Connection)	33	☐ Irrigation System
4	☐ Aquarium (Direct Connection)	34	☐ Janitor or Service Sinks
5	☐ Auxiliary Water System or Supply	35	☐ Laboratories, or Laboratory Equipment
6	☐ Beverage Bottling and or Bottle washing Equipment	36	☐ Laundromats, or Laundry Equipment (Commercial)
7	☐ Beverage Dispenser	37	☐ Metal Plating Industries
8	☐ Blood Plasma Centers	38	☐ Mortuaries
9	☐ Booster Pumps	39	☐ Nursing Homes (Adult Care Facilities)
10	☐ Box Hydrants (Below Ground)	40	☐ Pet Cleaning Basins
11	☐ Car Wash / Vehicle Wash Rack	41	☐ Petroleum Processing (Storage, Refineries)
12	☐ Chemical Feed Systems (Chemical Cleaners, or Products)	42	☐ Photo Developing Sinks and Tanks
13	☐ Chemical Plant or Storage	43	☐ Piers, Docks, or Marinas
14	☐ Chlorinators	44	☐ Plumbing 30' Above Water Meter
15	☐ Commercial Ice Makers	45	☐ Premises with Other Water Supply Connected with Potable Water
16	☐ Cooling Towers	46	☐ Private Fire Hydrant
	☐ Decorative Ponds or Fountains	47	☐ Pump Prime Lines
	☐ Dental Clinics or Equipment	48	☐ Radioactive material processing plants or nuclear reactors
19	☐ Dialysis Machine	49	☐ Recreational Vehicle Sewage Dump or Tank
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23	☐ Fire Sprinkler System	53	☐ Trap Primers
24	☐ Food Processing Plants	54	☐ Tubs (Below The Rim Fill)
25	☐ Garbage Can Washers	55	☐ Used, Reclaimed, or Gray Water Systems
26	☐ Greenhouse	56	☐ Vehicle Maintenance Shop (Degreasing Equipment)
27	☐ Heat Exchangers	57	☐ Veterinary Clinics
28	☐ Heat Pumps	58	☐ Waste Water Pump or Pump Stations
29	☐ Hospital (Medical Clinics or Centers)	59	☐ Waste Water Treatment and Waster Water Pump Stations
30	☐ Hot Tub, Pool, or Spa	60	☐ Water Treatment Equipment (e.g., Softener)

Yes	No	
☐	☐	Are you aware of any existing backflow devices or backflow protection you have on your property?

Please provide the information below for all products that will be mixed with water and or chemicals stored on your premises:
Exclude normal household chemicals that are not stored in abnormal quantities:

Product / Chemical	Quantity On-site	Use

I hereby acknowledge that the questionnaire above is filled out to the best of my knowledge and will notify the District and the Local Administrative Authority if there is a change in use of my water service connection. I agree to install a backflow prevention device as required by the District and its cross connection control program, and to allow the District reasonable access to the property to inspect test the device

Signature (Owner/Representative) _____ Name (please print) _____ Date _____

City of Ferndale

Application for Water Service

Date _____ ☐ New Water Service ☐ Existing Water Service ☐ Change In Use

Account # _____ Phone Number: (_____) _____

Name: _____

Service Address: _____

Mailing Address: _____

Legal Description: _____

Please indicate if your home has, or will have, any of the following:

.1	☐ Access Denied or Restricted Locations	15	☐ Irrigation System
.2	☐ Agricultural Facilities (Livestock)	.16	☐ Pet Cleaning Basins
3	☐ Air Condition System (Direct Connection)	.17	☐ Piers, Docks, or Marinas
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Signature (Owner/Representative) _____ Name (Please print) _____ Date _____

CITY USE BELOW

Based on a review of this Water Usage Questionnaire, the following has been identified:

Does a hazard exist? **Yes** **No**

HAZARD	HIGH			LOW			
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:
	AG	RPBA	RPDA	DCVA	DCDA	AVB	OTHER:

☐ In-premises protection allowed ☐ Premises isolation required at property line ☐ Premises isolation agreement

Meter Status ☐ Locked ☐ Unlocked

CCS Signature _____ Water Manager Signature _____

City of Ferndale

2095 Main Street
Ferndale, Washington 98248
P.O. Box 935
PHONE: (360) 384-4006
FAX: (360) 384-4017

DATE

CUSTOMER NAME
ADDRESS
Ferndale, WA 98230

Dear Customer:

Properly functioning drinking water systems are designed to prevent foreign substances from entering the water supply. Sometimes, however, contaminated materials can enter the private or public potable water system by flowing back in the wrong direction. When this occurs, it is called "backflow" and the source of the contamination is called a "cross-connection." Under regulations of the Washington State Department of Health (DOH), the District is implementing a Cross Connection Control Program intended to enhance protection of our drinking water.

As part of that program, we are asking our customers to review the "Water Usage Questionnaire" on the other side of this letter, indicating any fixtures and/or uses that may pose a cross-connection hazard. Please return the completed questionnaire in the enclosed self-addressed envelope to the District office no later than **<DATE>** If you have declared fixtures or uses that may pose a cross-connection hazard, a District Cross Connection Control Specialist will contact you to arrange for a mandatory on-site inspection of your property to determine what actions will be required to comply with DOH regulations.

DOH regulations for this program are found in Washington Administrative Code (WAC) 246-290-490. If you have any questions, please call me at 360-384-4607.

Sincerely,

Mike Olinger
Water Operations Manager
City of Ferndale

City of Ferndale

2095 Main Street
Ferndale, Washington 98248
P.O. Box 935
PHONE: (360) 384-4006
FAX: (360) 384-4017

DATE

Dear Customer:

Properly functioning drinking water systems are designed to prevent foreign substances from entering the water supply. Sometimes, however, contaminated materials can enter the private or public potable water system by flowing back in the wrong direction. When this occurs, it is called "backflow" and the source of the contamination is called a "cross-connection." Following regulations of the Washington State Department of Health (DOH), the City of Ferndale is implementing a Cross Connection Control Program intended to enhance protection of our drinking water and to comply with the DOH regulations found in Washington Administrative Code (WAC) 246-290-490.

As part of that program, we are asking our customers to review the "Water Usage Questionnaire" on the other side of this letter, indicating any fixtures and/or uses that may pose a cross-connection hazard. If you have fixtures or uses to declare, please return the completed questionnaire to the City of Ferndale no later than **<DATE>**. After reviewing the questionnaire, the Cities Cross Connection Control Specialist will contact you to arrange for a mandatory on-site inspection of your property to determine what actions will be required to comply with DOH regulations. Non-return of the questionnaire will be interpreted as a declaration that you have no problematic fixtures or uses on your property. Therefore, if you have no fixtures or uses to declare, you do not need to return the questionnaire.

DOH regulations for this program are found in Washington Administrative Code (WAC) 246-290-490. If you have any questions, please call me at 380-4607.

Sincerely,

Mike Olinger
Chief Water Treatment Operator
Cross Connection Control Specialist
City of Ferndale

(Back)

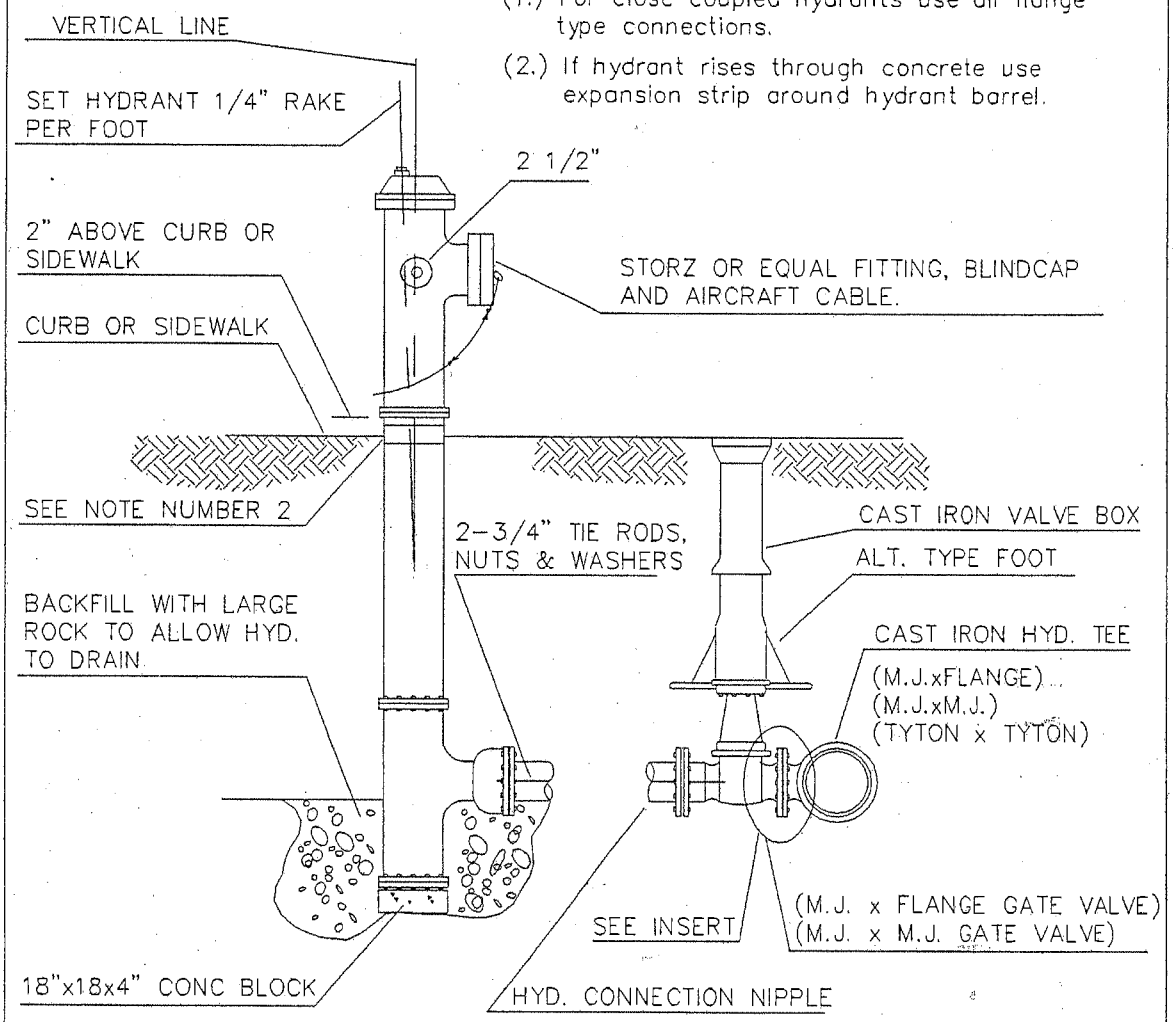
F. CONSTRUCTION STANDARDS

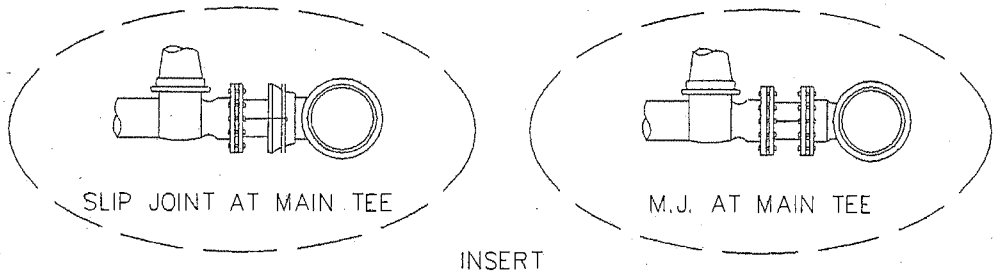
The City of Ferndale Standard Details are currently being updated. The details enclosed in this report are the most current, formally approved City of Ferndale Standard Details. The updated details, when complete and approved, shall supersede the enclosed details where applicable.

NOTES

(1.) For close coupled hydrants use all flange type connections.

(2.) If hydrant rises through concrete use expansion strip around hydrant barrel.



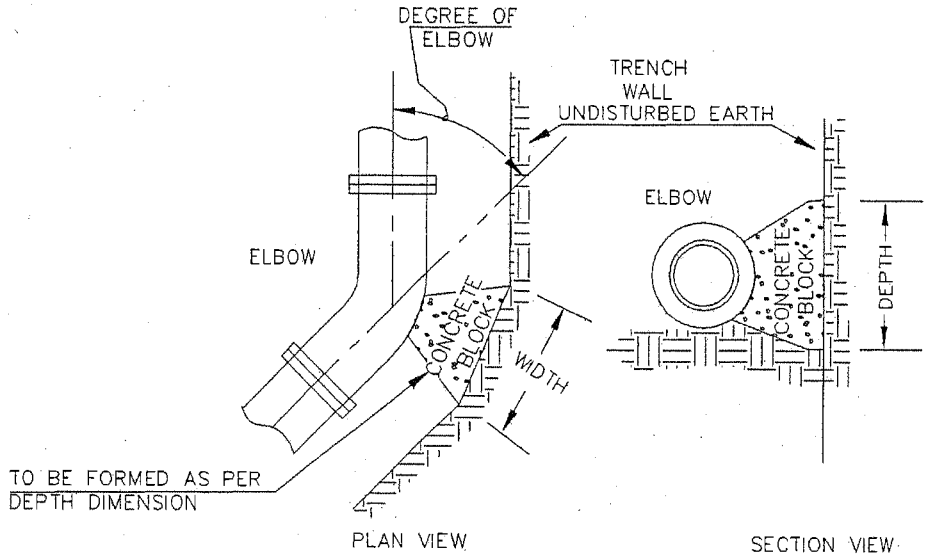


INSERT

NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE FIRE HYDRANT ASSEMBLY	DRAWING W-1

JUNE 1995



100 P.S.I. OPERATING PRESSURE

SIZE	11 1/4°		22 1/2°		45°		90°	
	W	D	W	D	W	D	W	D
6"	1'-0"	1'-0"	1'-0"	1'-0"	1'-6"	1'-6"	2'-3"	1'-6"
8"	1'-3"	1'-3"	1'-3"	1'-3"	1'-9"	1'-9"	3'-0"	2'-0"
10"	1'-9"	1'-6"	1'-9"	1'-6"	2'-3"	2'-3"	3'-6"	2'-6"
12"	2'-0"	1'-9"	2'-0"	1'-9"	2'-9"	2'-6"	4'-0"	3'-0"
16"	2'-9"	2'-3"	2'-9"	2'-3"	4'-0"	3'-0"	6'-3"	3'-6"
20"	3'-6"	2'-9"	3'-6"	2'-9"	4'-6"	4'-0"	8'-6"	4'-0"
24"	4'-6"	3'-0"	4'-6"	3'-0"	5'-6"	5'-0"	9'-9"	5'-0"

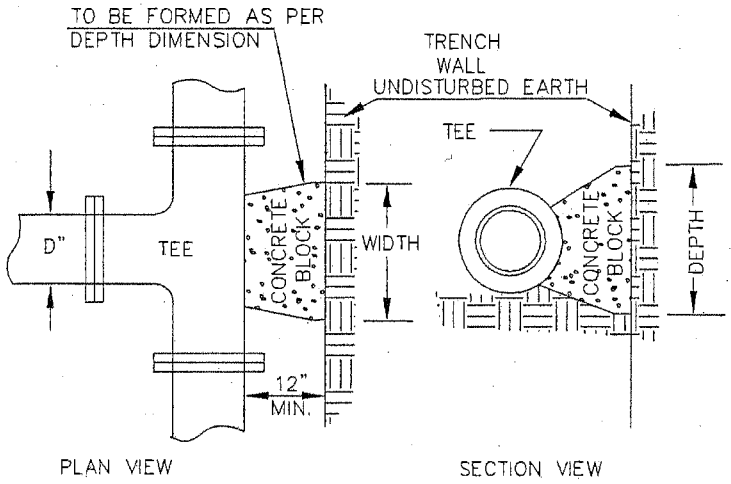
NOTE:
ALL ABOVE DIMENSIONS APPLY TO STABLE TRENCH WALLS, UNDER VARIBLE CONDITIONS SIZE OF THRUST BLOCK SHALL BE DETERMINED BY ENGINEER.

NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE THRUST BLOCKING ELBOWS	DRAWING W-2

JUNE 1995

2091WA2A/W-2



100 P.S.I.
OPERATING PRESSURE

SIZE	WIDTH	DEPTH
6"	1'-6"	1'-6"
8"	2'-0"	2'-0"
10"	2'-6"	2'-6"
12"	3'-0"	3'-0"
16"	4'-6"	3'-6"
20"	6'-0"	4'-0"
24"	7'-0"	5'-0"

NOTE:
ALL ABOVE DIMENSIONS APPLY TO STABLE TRENCH WALLS, UNDER VARIBLE CONDITIONS SIZE OF THRUST BLOCK SHALL BE DETERMINED BY ENGINEER.

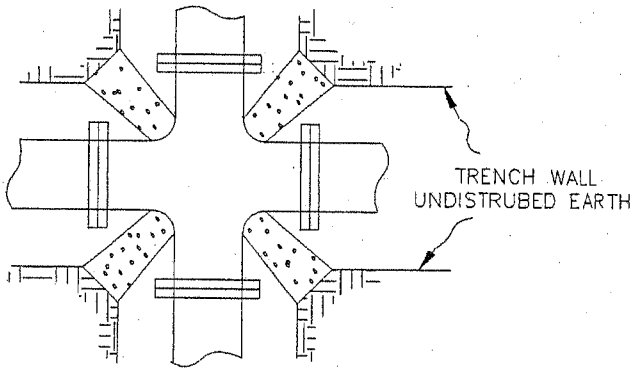
NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE THRUST BLOCKING TEES	DRAWING W-3

JUNE 1995

2091WA2A/W-3

TO BE FORMED AS PER
DEPTH DIMENSION



100 P.S.I.
OPERATING PRESSURE

SIZE	WIDTH	DEPTH
6"	1'-0"	1'-0"
8"	1'-3"	1'-3"
10"	1'-6"	1'-6"
12"	1'-9"	1'-9"
16"	2'-3"	2'-6"
20"	2'-6"	3'-6"
24"	3'-0"	4'-0"

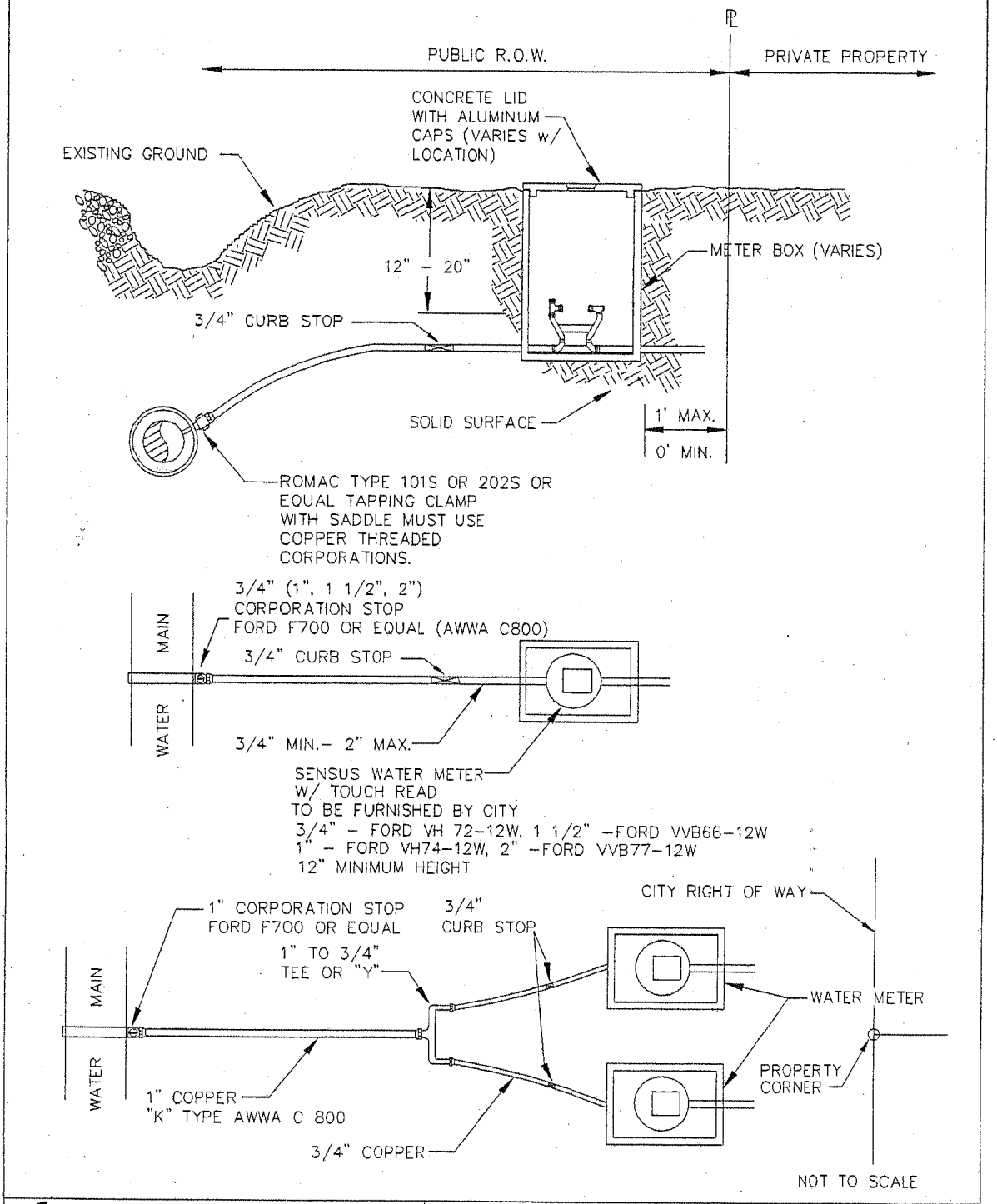
NOTE:
ALL ABOVE DIMENSIONS APPLY TO STABLE TRENCH WALLS, UNDER VARIBLE CONDITIONS SIZE OF THRUST BLOCK SHALL BE DETERMINED BY ENGINEER.

NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE THRUST BLOCKING 4-WAY INTERSECTION	DRAWING W-4

JUNE 1995

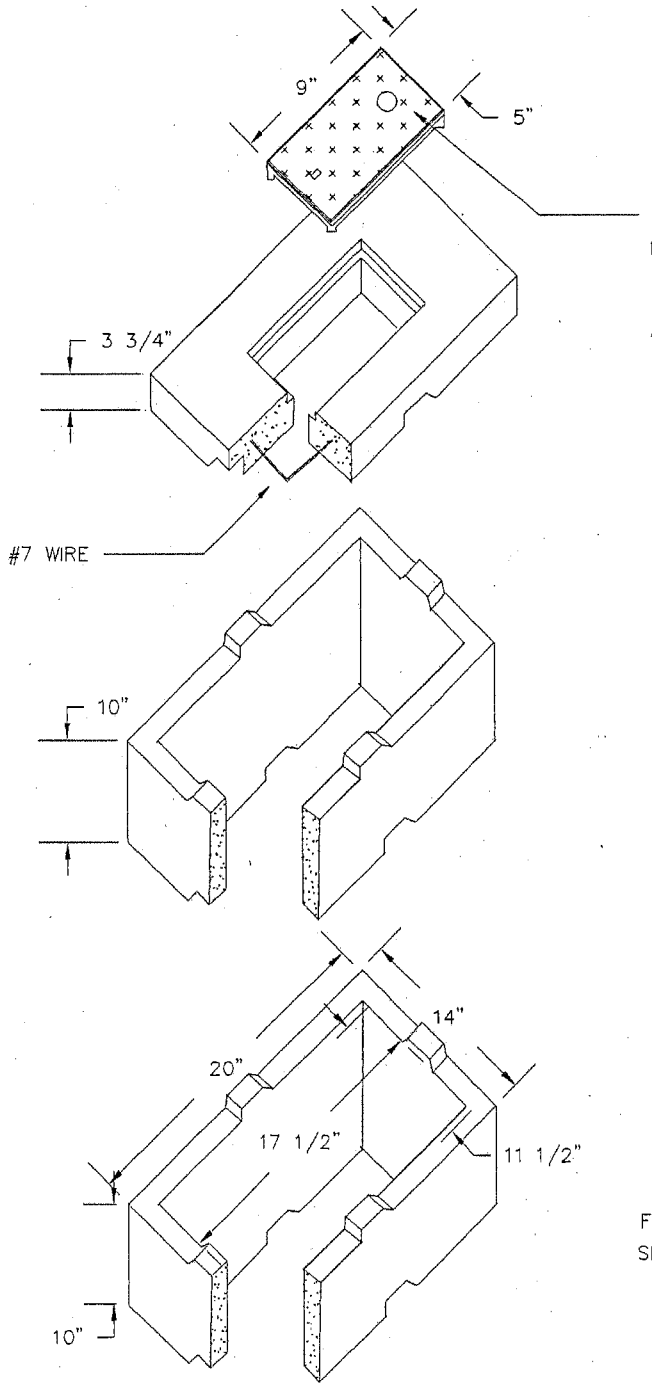
2091WA2A/W-4



APPROVED Public Works Director Date	CITY OF FERNDALE TYPICAL WATER SERVICE (3/4" TO 2")	DRAWING W-5

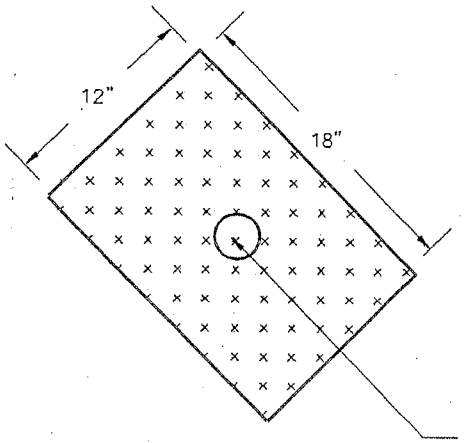
JUNE 1995

2091WA1A/W-5

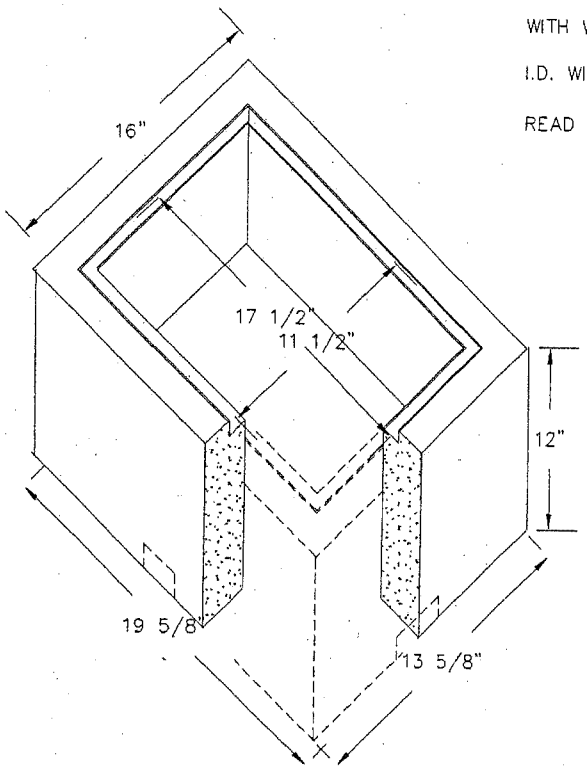


APPROVED	CITY OF FERNDALE	DRAWING
Public Works Director Date	NO. 1 METER BOX FOG TITE	W-6

JUNE 1995



3/8" STEEL TRAFFIC COVER WITH WELD "WATER" METER I.D. WITH 2" HOLE FOR TOUCH READ



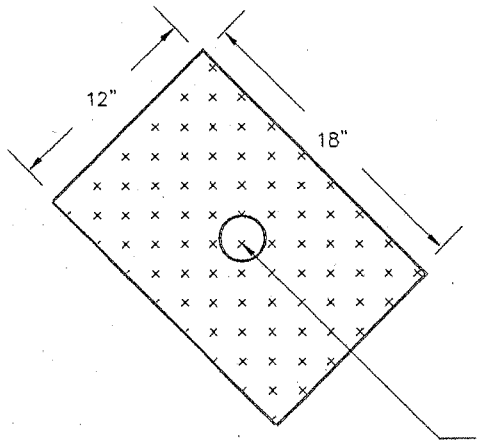
NOTE: FOR USE WITH 3/4" OR 1" SERVICE IN TRAFFIC AREA

NOT TO SCALE

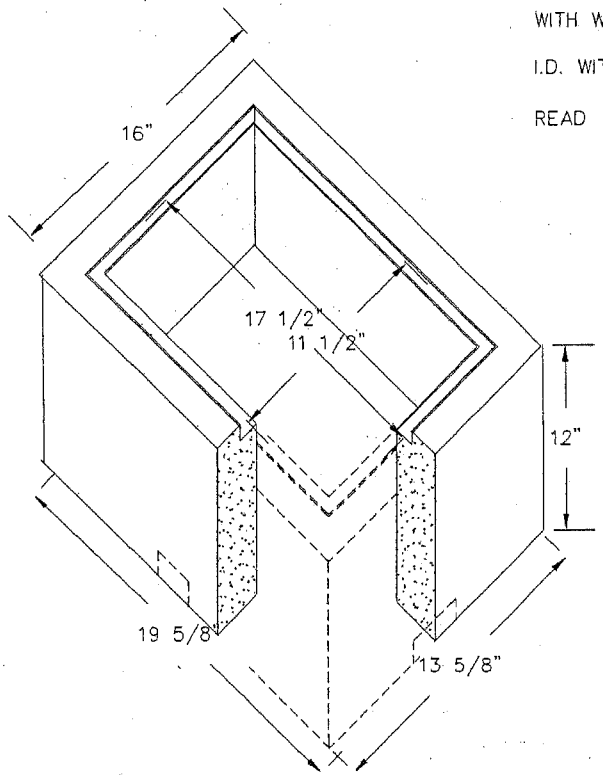
APPROVED John F Ealey Public Works Director Date	CITY OF FERNDALE 1 D METER BOX FOG TITE	DRAWING W-7

JUNE 1995

2091ST4A/R-7



3/8" STEEL TRAFFIC COVER WITH WELD "WATER" METER I.D. WITH 2" HOLE FOR TOUCH READ

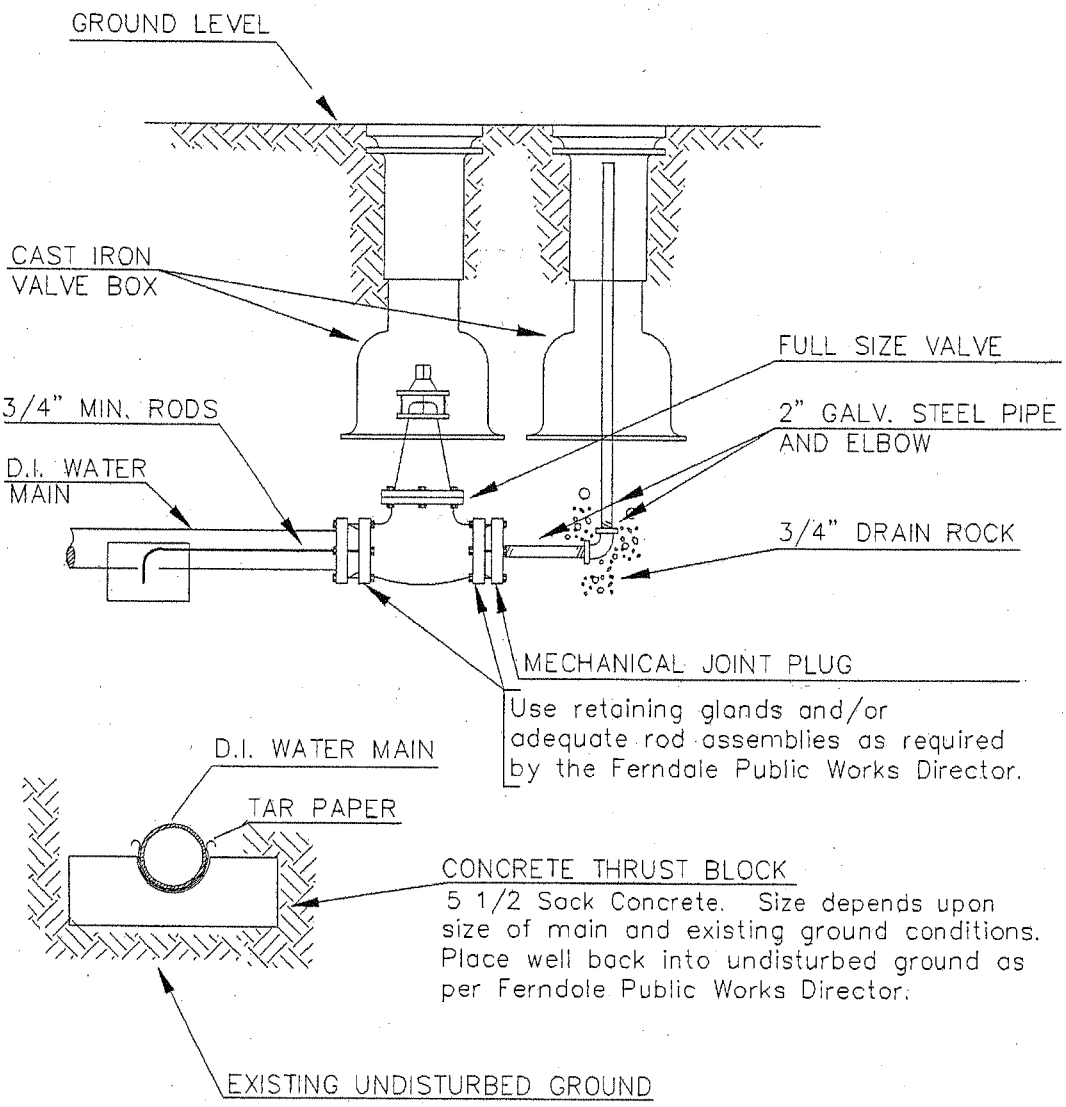


NOTE: FOR USE WITH 2" METER

NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE NO. 2 METER BOX FOG TITE	DRAWING W-8

JUNE 1995

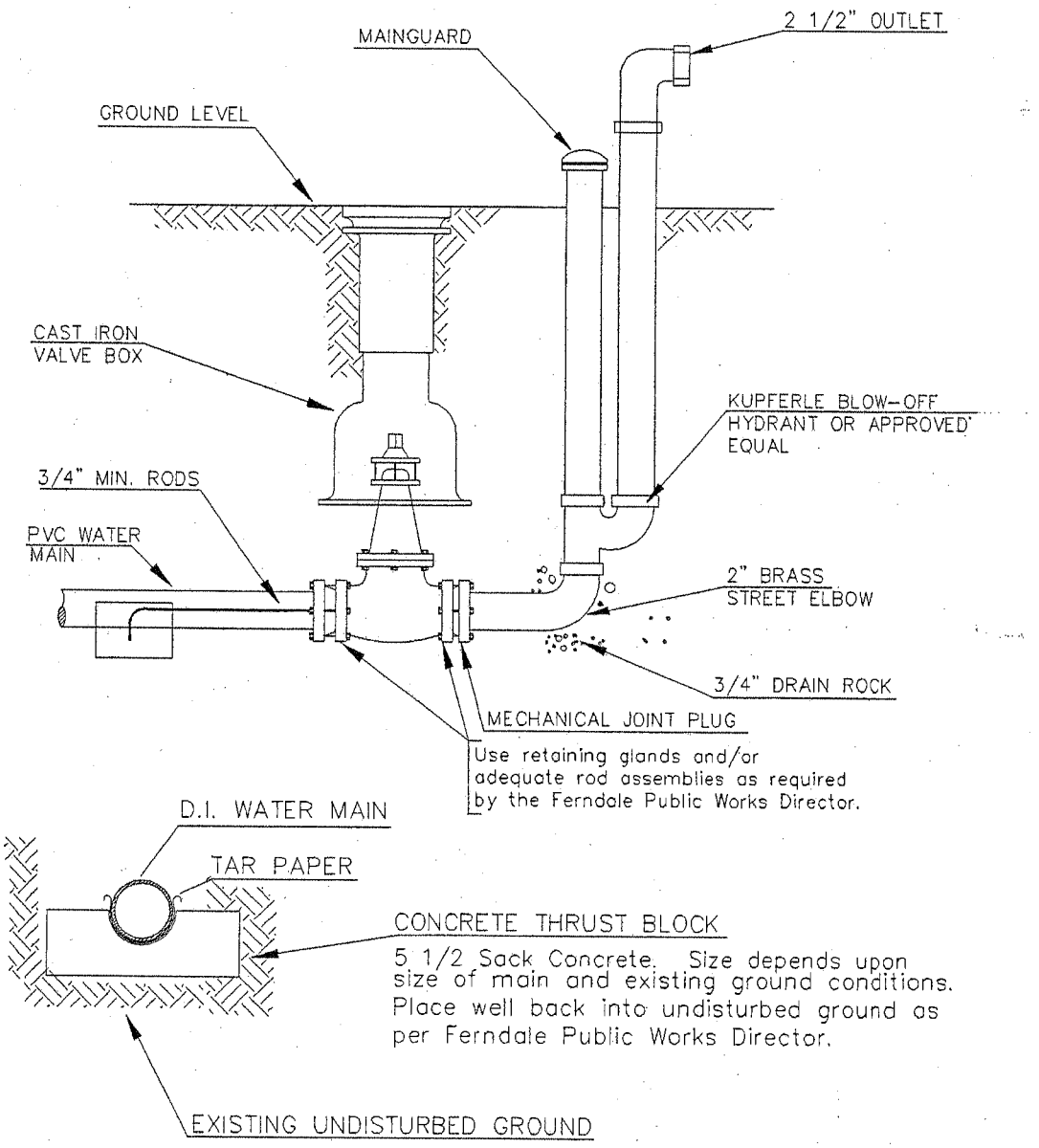


2" blow-off to be used where the main will extended in the future. For mains with no further extension, refer to 2" blowoff, non-extendable main.

NOT TO SCALE

APPROVED	CITY OF FERNDALE	DRAWING
Public Works Director Date	2" BLOW-OFF WATER MAIN EXTENSION	W-9

JUNE 1995



2" blow-off, non-extendable main to be used where mains will not be extended. For mains with future extension, refer to 2" blow-off.

NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE 2" BLOW-OFF NON-EXTENDABLE MAIN	DRAWING W-10

JUNE 1995

2091WA1A/W-10

JUNE 1995

APPROVED

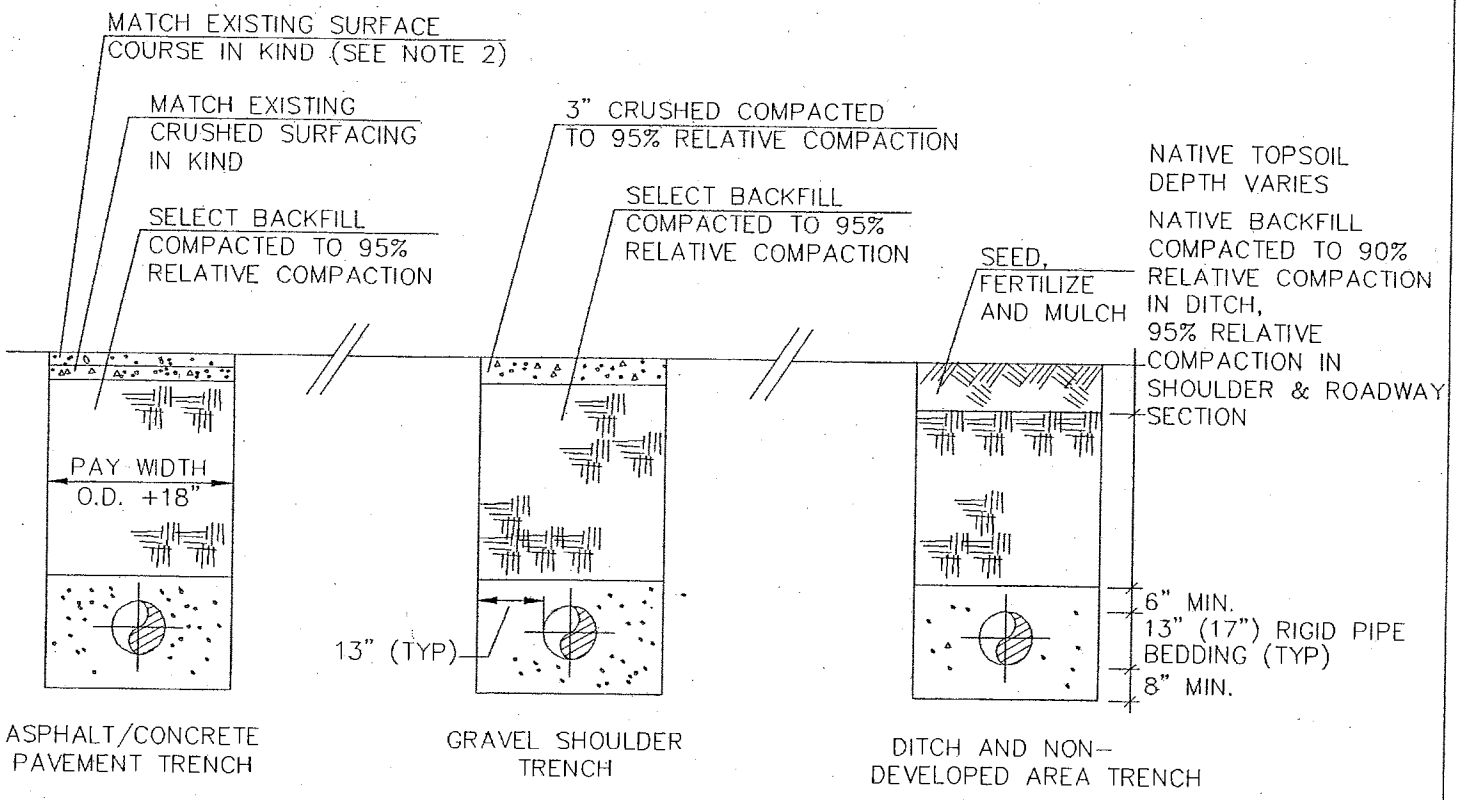
Public Works Director

Date

CITY OF FERNDALE

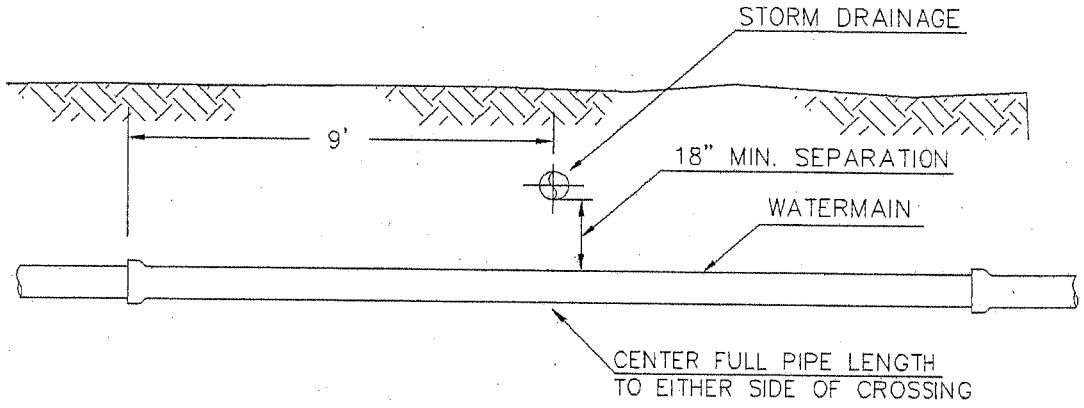
TRENCHING DETAIL

DRAWING W-11



NOTES:
1. NATIVE BACKFILL SHALL BE COMPACTED TO 90% RELATIVE COMPACTION.
2. SELECT BACKFILL/CRUSHED SURFACE COURSE SHALL BE COMPACTED TO 95% COMPACTION.
3. PAVEMENT SHALL BE SAW CUT, TACKED, AND COMPACTED TO 92% OF ABSOLUTE DENSITY.
4. P.C.C. REPLACEMENT SHALL BE 2" GREATER THAN EXISTING COURSE, 7" MINIMUM, 6.5 P.C.C. (HES – AIR ENTRAINED)
5. ALL TRENCH RESTORATION SHALL MEET CITY STANDARDS.

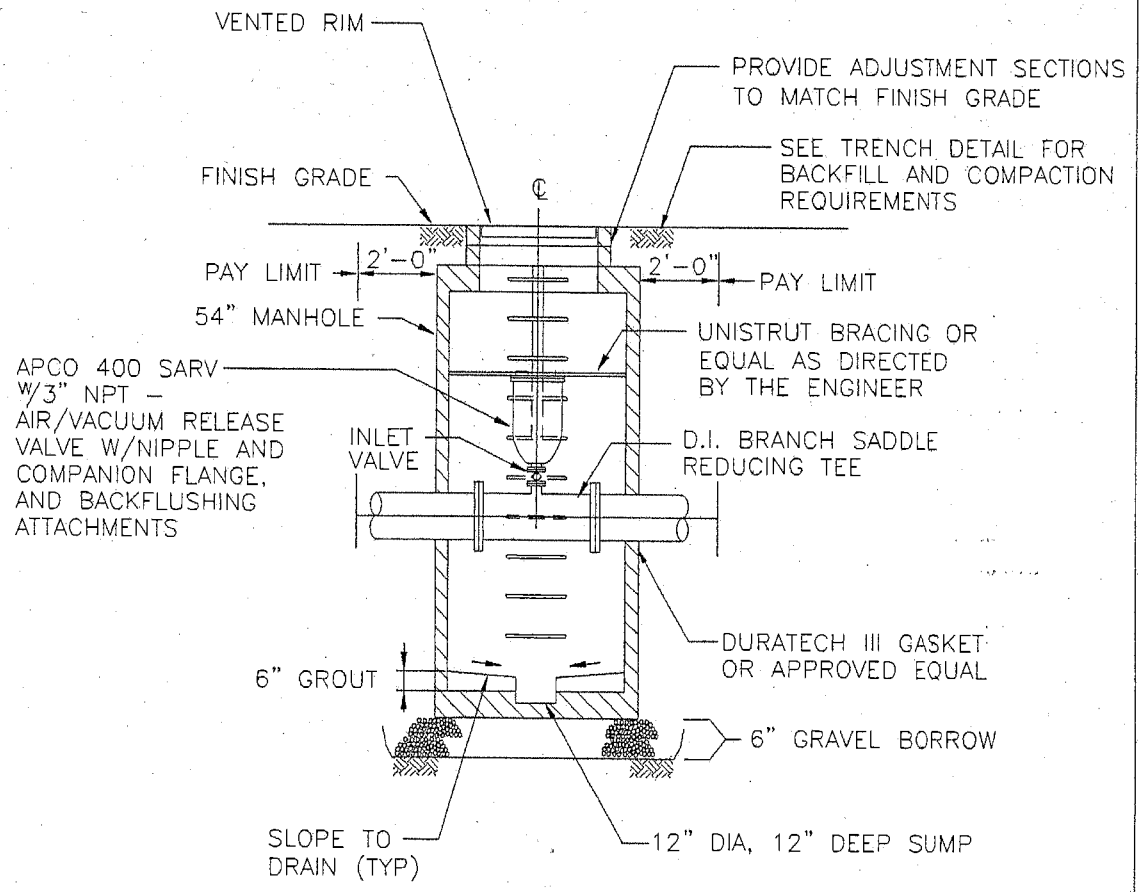
NOT TO SCALE



NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE WATER CROSSING DETAIL	DRAWING W-12

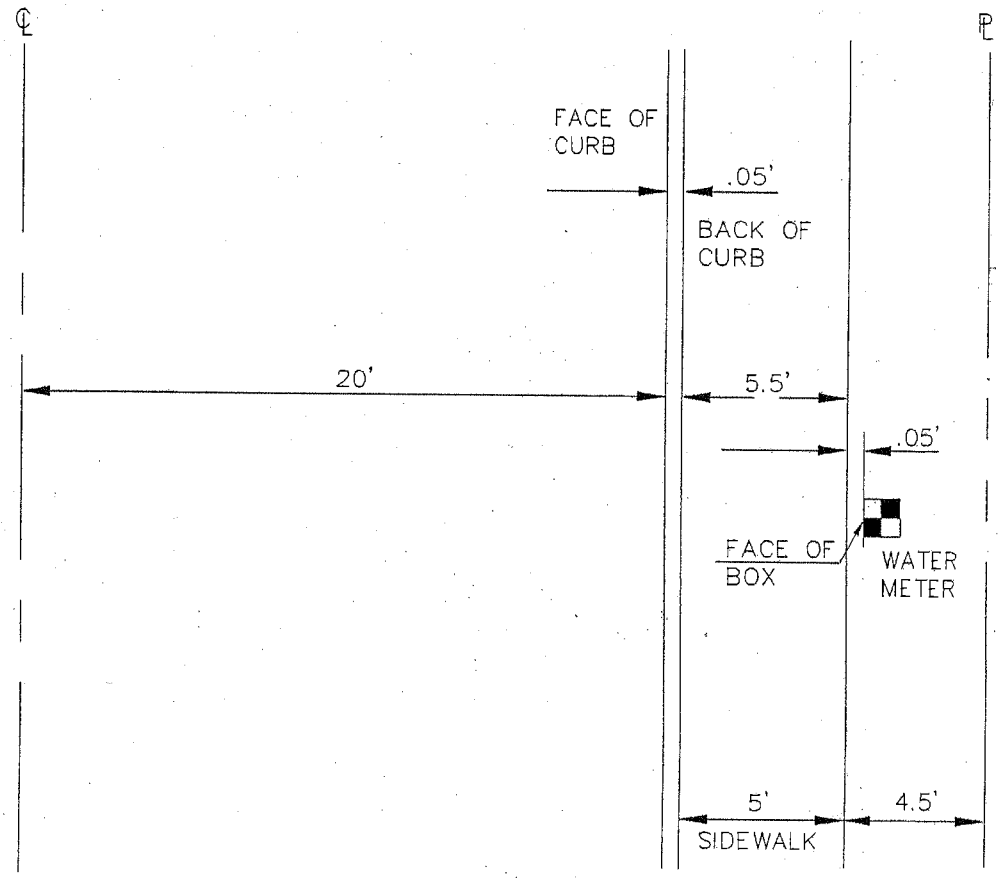
JUNE 1995



NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE AIR – VACUUM RELEASE VALVE ASSEMBLY	DRAWING W–13

JUNE 1995



NOT TO SCALE

APPROVED Public Works Director Date	CITY OF FERNDALE WATER METER LOCATION DETAIL	DRAWING W-14

JUNE 1995

G. HYDRAULIC ANALYSIS

HYDRAULIC ANALYSIS

1.0 OBJECTIVE

In accordance with Chapter 8 of the *DOH Water System Design Manual* the water system must evaluate two scenarios under steady-state conditions. These scenarios are as follows:

1. Peak Hour Demand. The water system must be able to provide PHD in each pressure zone and throughout the water system under conditions that deplete all equalizing storage volume and assume all sources are operating. The resulting pressures must be no less than 30 psi at all service connections throughout the distribution system.

2. Fire Suppression Events. The water system must be able to provide the highest demand fire suppression flows, such as commercial zones or industrial complexes (>1,000 gpm fire flows, for example), during MDD and under conditions that deplete designed fire suppression storage and equalizing storage. The resulting pressures must be no less than 20 psi at ground level and all points throughout the distribution system.

1.1 STORAGE COMPONENTS

1.1.1 Finished Water Clear Well

The Finished Water Clear Well at the City's Water Treatment Plant is essentially an underground concrete reservoir with a capacity of approximately 304,400 gallons. Water is pumped from the clear well to serve the Main Pressure Zone and the Axton Pressure Zone. The higher pressure zones may also utilize the clear well through the City's other storage tanks and pump stations.

Fire flow requirements for the City state that 3,000 gpm must be supplied to industrial and institutional areas for 4 hours. This is the highest fire flow requirement the City has, see Chapter 3. Assuming that the City's produces the maximum amount of finished water during a fire event the clear well can provide 3,000 gpm for a little more than 6 hours. However the DOH requires the largest source to be taken out of service while analyzing the water system during a fire event. Under these conditions the Douglas Well (1,300 gpm production) must be taken off line leaving the City to rely solely on the Shop Well (870 gm production). Producing 870 gpm of finished water during a fire event, the clear well can provide 3,000 gpm for only 2.38 hours. The clear well can however provide 2,000 gpm for almost 4.5 hours. Therefore the clear well can be relied upon to provide 2,000 gpm for 4 hours (480,000 gallons) during a fire event.

1.1.2 Storage Tank 1

Storage Tank 1 is a 950,000 gallon concrete tank serving the Main Pressure Zone and the Axton Pressure Zone. These two zones represent approximately 70% of the water system and corresponding ERU's. Below is a breakdown of the storage components for storage tank 1.

Storage Tank 1 is an 83 foot diameter tank with an overflow elevation 24 feet above the floor. There are approximately 40,471 gallons per foot of tank height.

Table 1-1, Storage Tank 1, Storage Components

Storage Component	Required Volume (gal)	Feet in Tank
OS	60,707	1.5
ES	0	0
SB	881,200	21.77
FSS	240,000	5.93
DS	0	0

Note: Volumes are based on 2015 PHD.

Using the figures in Table 1-1, the tank level would be at 22.5 feet (1.5 feet below the overflow) when all equalizing storage is depleted, and 16.57 (7.43 feet below the overflow) when fire suppression storage and equalizing storage is depleted.

It should be noted that the required fire suppression storage is 720,000 gallons (3,000 gallons for 4 hours) however a large portion of the City's clear well at the Water Treatment Plant can supplement the fire suppression storage. 480,000 gallons can be supplied by the clear well, therefore the fire storage requirement for storage tank 1 is only 240,000 gallons.

1.1.3 Storage Tank 2

Storage Tank 2 is a 1.7 million gallon steel tank serving all of the higher pressure zones, and supplementing Tank 1 and the lower pressure zones through pressure reducing valves. The higher Bakerview zone utilizes booster pumps drawing from Tank 2 to supply adequate pressure. Tank 2 serves approximately 30% of the water system and corresponding ERU's.

Storage Tank 2 is an 85 foot diameter tank with an overflow elevation 41.5 feet above the floor. There are approximately 42,445 gallons per foot of tank height.

Table 1-2, Storage Tank 2, Storage Components

Storage Component	Required Volume (gal)	Feet in Tank
OS	63,668	1.5
ES	0	0
SB	441,000	10.39
FSS	720,000	16.96
DS	0	0

Note: Volumes are based on 2015 PHD.

Using the figures in Table 1-2, the tank level would be at 40 feet (1.5 feet below the overflow) when all equalizing storage is depleted, and 23.04 (18.46 feet below the overflow) when fire suppression storage and equalizing storage is depleted.

1.2 PEAK HOUR DEMAND.

Below is a summary of system settings for the PHD scenario.

Table 1-3, System Settings

Location	Component	Setting
	Storage Tanks	
Thornton Rd.	Tank 1	232.5’
Bakerview	Tank 2	403.0’
	Pumps	
Water Treatment Plant	1	Operational
	2	Operational
	3	Operational
Pump Station No. 1	4	Operational
	5	Operational
Church Rd. Pump Station	6	Operational
	7	Operational
Bakerview Pump Station	8	Operational
	9	Operational
	10	Operational
	11	Operational
	PRVs	
S. Side Thornton Rd. (1.5”)	1	22 psi
S. Side Thornton Rd. (4”)	2	17 psi
Sunrise (3”)	3	22 psi
Snowden (6”)	4	38 psi
Axton (2”)	5	60 psi
Axton (8”)	6	55 psi
Vista (2”)	7	42 psi
Vista (6”_	8	37 psi
Augustine (8”)	9	43 psi
N. Side Thornton Rd. (3”)	10	31 psi
N. Side Thornton Rd. (8”)	11	26 psi
Pheasant (6”)	12	60 psi
Pine (6”)	13	47 psi
Westview (8”)	14	50 psi
Heather (6”)	15	57 psi
Church Rd. Pump Station (4”) *Pressure Relief Valve*	16	N/A
Church Rd. Pump Station (8”)	17	40 psi
Bakerview Pump Station (8”)	18	

1.3 FIRE SUPPRESSION

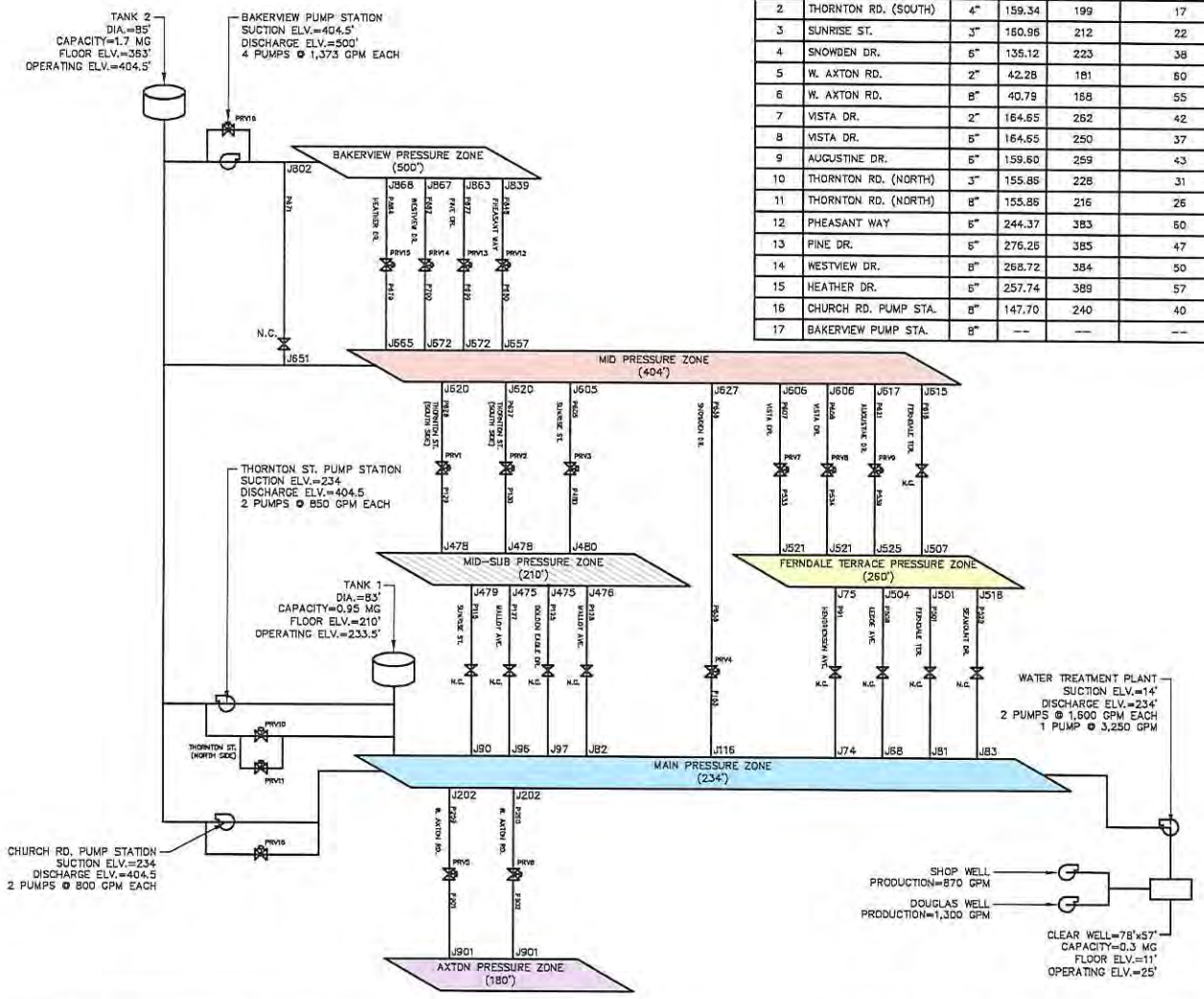
Below is a summary of system settings for the fire suppression scenario.

Table 1-4, System Settings

Location	Component	Setting
	Storage Tanks	
Thornton Rd.	Tank 1	226.57’
Bakerview	Tank 2	386.04’
	Pumps	
Water Treatment Plant	1	Operational
	2	Operational
	3	Operational
Pump Station No. 1	4	Operational
	5	Operational
Church Rd. Pump Station	6	Operational
	7	Operational
Bakerview Pump Station	8	Operational
	9	Operational
	10	Operational
	11	Operational
	PRVs	
S. Side Thornton Rd. (1.5”)	1	22 psi
S. Side Thornton Rd. (4”)	2	17 psi
Sunrise (3”)	3	22 psi
Snowden (6”)	4	38 psi
Axton (2”)	5	60 psi
Axton (8”)	6	55 psi
Vista (2”)	7	42 psi
Vista (6”_	8	37 psi
Augustine (8”)	9	43 psi
N. Side Thornton Rd. (3”)	10	31 psi
N. Side Thornton Rd. (8”)	11	26 psi
Pheasant (6”)	12	60 psi
Pine (6”)	13	47 psi
Westview (8”)	14	50 psi
Heather (6”)	15	57 psi
Church Rd. Pump Station (4”)	16	N/A

Pressure Relief Valve		
Church Rd. Pump Station (8”)	17	40 psi
Bakerview Pump Station (8”)	18	

PRV#	LOCATION	SIZE	ELV.	SETTING	
				HGL (FT)	PRESSURE (PSI)
1	THORNTON RD. (SOUTH)	1.5"	159.34	210	22
2	THORNTON RD. (SOUTH)	4"	159.34	199	17
3	SUNRISE ST.	3"	160.96	212	22
4	SNOWDEN DR.	6"	135.12	223	38
5	W. AXTON RD.	2"	42.28	181	60
6	W. AXTON RD.	8"	40.79	188	55
7	VISTA DR.	2"	164.65	262	42
8	VISTA DR.	6"	164.65	250	37
9	AUGUSTINE DR.	6"	159.60	259	43
10	THORNTON RD. (NORTH)	3"	155.86	228	31
11	THORNTON RD. (NORTH)	8"	155.86	216	26
12	PHEASANT WAY	6"	244.37	383	60
13	PINE DR.	6"	276.26	385	47
14	WESTVIEW DR.	8"	268.72	384	50
15	HEATHER DR.	6"	257.74	389	57
16	CHURCH RD. PUMP STA.	8"	147.70	240	40
17	BAKERVIEW PUMP STA.	8"	--	--	--



R&E Reichhardt & Ebe ENGINEERING INC

423 Front St, Lynden, WA 98264 (360) 354-3687

813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

EXHIBIT 5
CITY OF FERNDALE
PRESSURE ZONE SCHEMATIC

DATE: 10/17/16

ACO. PUMPS

BAKERVIEW Pump Station
4 EACH
Paco Express 6.0.0.70

Pump Performance Datasheet

Customer	:	Quote number	:
Customer reference	:	Pump size	: 4015-7/8 KP
Item number	:	Stages	: 1
Service	:	Based on curve number	: RC9917-2 Rev 0
Quantity of pumps	: 1	Date last saved	: 06 Aug 2007 1:57 PM

Operating Conditions

Flow, rated	: 1,373 USgpm
Head, rated (requested)	: 47.0 ft
Head, rated (actual)	: 47.1 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available, rated	: Ample
Frequency	: 60 Hz

Liquid

Liquid type	: Water
Additional liquid description	:
Solids diameter, max	: 0.00 in
Temperature, max	: 68.00 deg F
Fluid density, rated / max	: 0.998 / 0.998 SG
Viscosity, rated	: 1.00 cP
-	:

Performance

Pump speed, rated	: 1,749 rpm
Impeller diameter, rated	: 10.00 in
Impeller diameter, maximum	: 15.00 in
Impeller diameter, minimum	: 9.50 in
Efficiency	: 54.56 %
NPSH required / margin required	: 20.58 / 0.00 ft
Specific speed / Suction specific speed	: 866 / 4,630 US units
MCSF	: 208 USgpm
Head, maximum, rated diameter	: 107 ft
Head rise to shutoff	: 127.35 %
Flow, best eff. point (BEP)	: 823 USgpm
Flow ratio (rated / BEP)	: 166.75 %
Diameter ratio (rated / max)	: 66.67 %
Head ratio (rated dia / max dia)	: 22.69 %
Viscous coefficients (CQ / CH / CE)	: 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Material

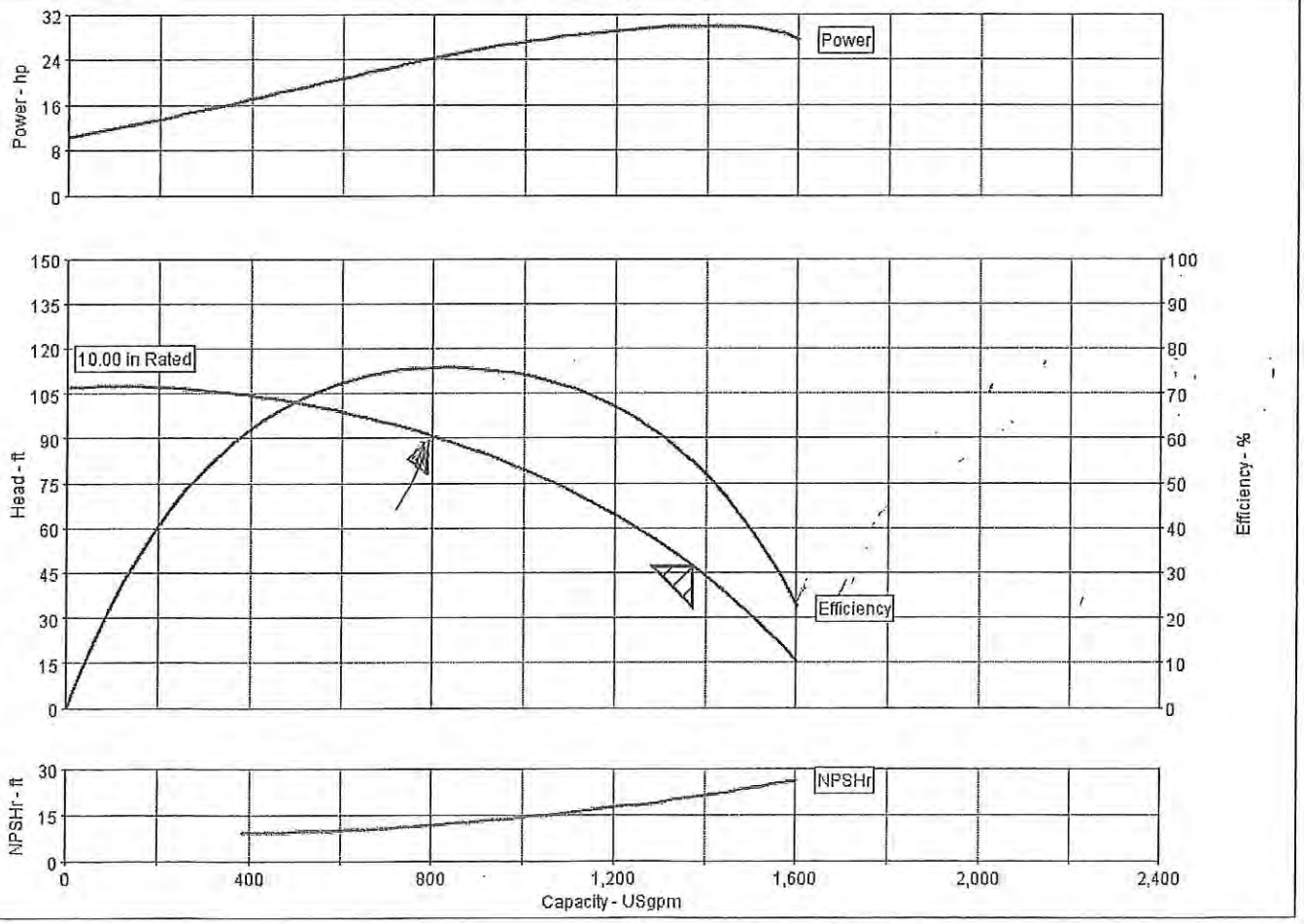
Material requested	: Auto
Material selected	: Cast iron

Pressure Data

Maximum working pressure	: 46.50 psi.g
Maximum allowable working pressure	: 250.0 psi.g
Maximum allowable suction pressure	: 250.0 psi.g
Hydrostatic test pressure	: 375.0 psi.g

Driver & Power Data

Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 16.3 hp
Power, rated	: 29.9 hp
Power, maximum, rated diameter	: 29.9 hp
Minimum recommended motor rating	: 30.0 hp / 22.4 kW



WATER TREATMENT PLANT
HIGH HEAD PUMPS - 2 EACH

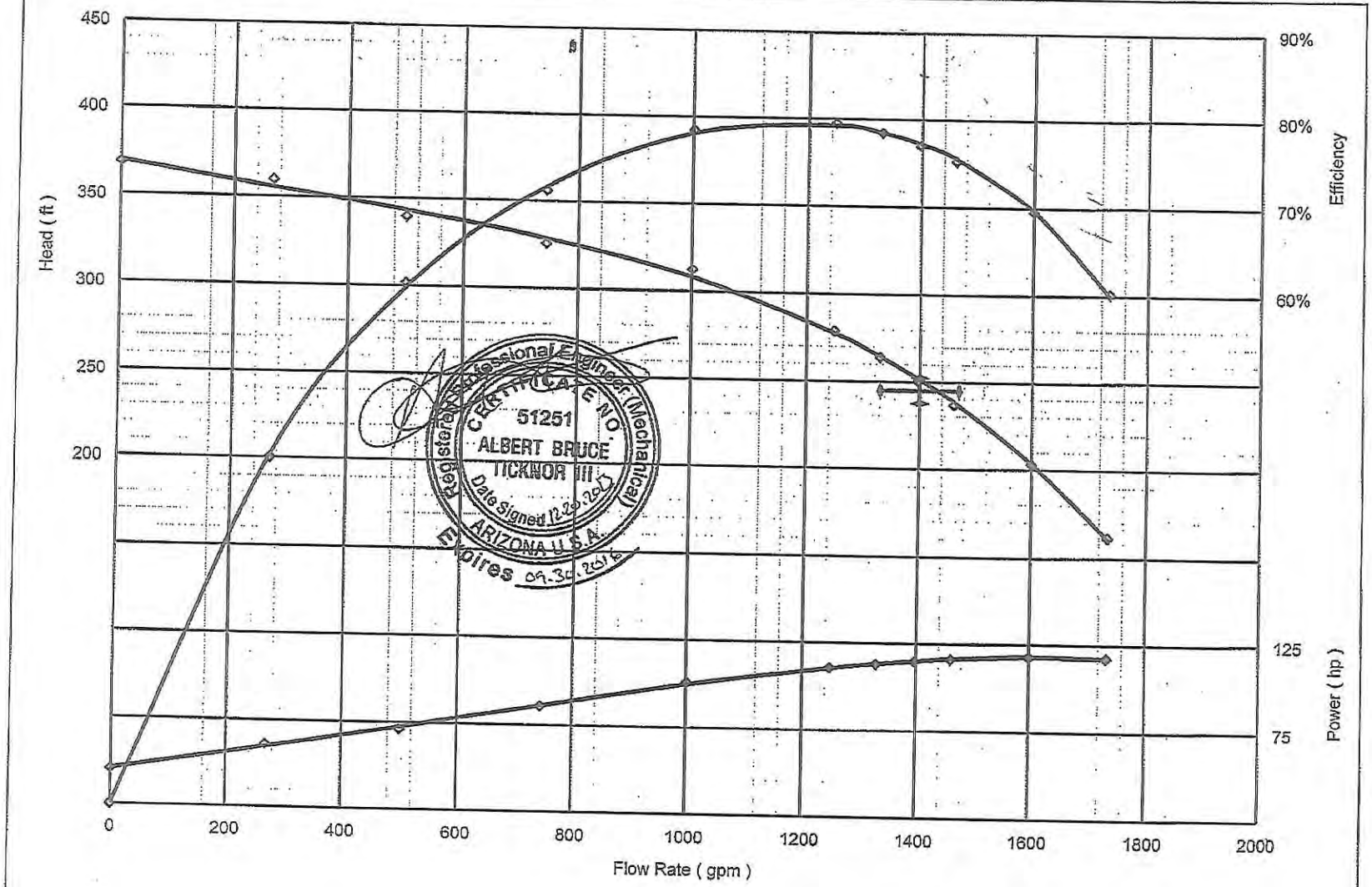
NATIONAL PUMP COMPANY
A GORMAN-RUPP COMPANY

7706 North 71st Ave. Glendale, AZ 85303

PERFORMANCE TEST REPORT

Test Information			
Test Number:	TST11753		
Customer Name:	CORRECT EQUIPMENT		
Project Name:	CITY OF FERNDALE		
S/N:	301435A-1	Tag #:	
Model:	Number STG:	Trim:	
E12HC	4	9.600	

Primary Design Condition	
Type	Bowl
Flow	1400 gpm
Head	245 ft
Rated Eff.	79.6 %
Speed	1770 rpm
Spec. Gr.	1.00



Registered Professional Engineer (Mechanical)
CERTIFICATE NO.
51251
ALBERT BRUCE
TICKNOR III
Date Signed 12-29-2014
ARIZONA U.S.A.
Expires 09-30-2016

FRQ-T02.2

WATER TREATMENT PLANT
HIGH HEAD PUMP - 1 EA

Customer :

Pumptech Inc.

12020 SE 32nd Street/Bellevue, WA 98005
Mike Dunn
Phone 425-644-8501
Fax 425-562-9213

Contact :
Phone : Fax :

Project :
Quote No. : US-2158-317 Page No : 1 Date : Friday, January 05, 2007

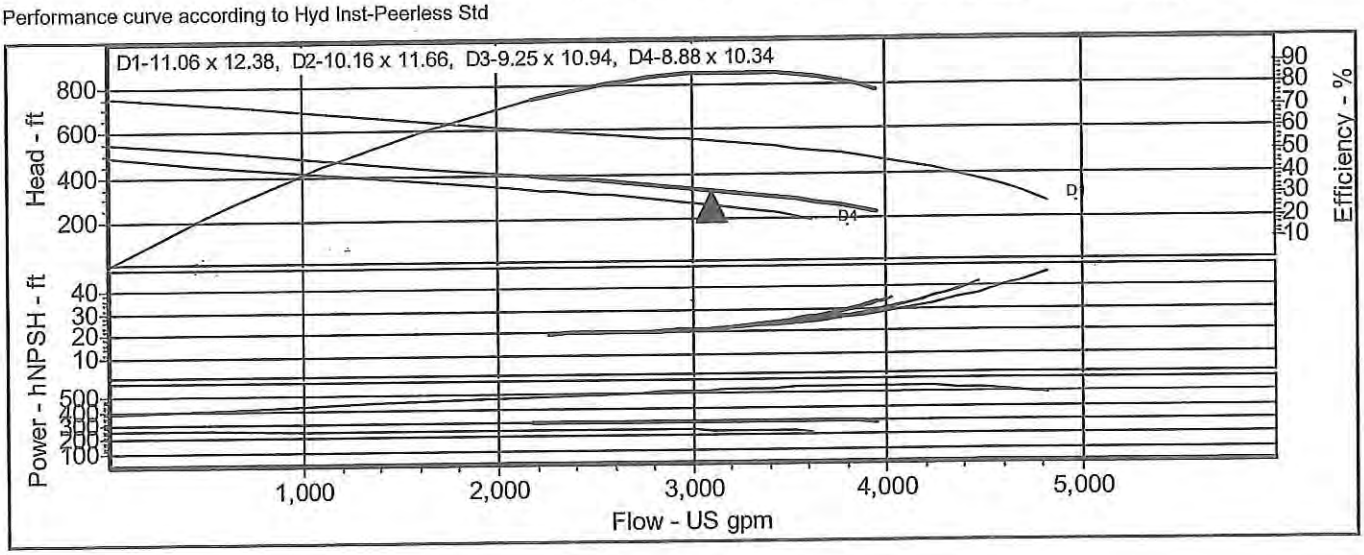
Pump Model: **Peerless Vertical - 16HXB 5 Stages**
Nom. Speed: **1770 RPM, 60 Hz Electric**
Market : **Vertical Turbine Pump**
Impeller No.: **4601399**
Material Spec. Group: **A - B: CIE; I: Brz = Standard**
Item : **1**
Your Ref. :

Fluid: **Water**
Temperature: **68** °F
Viscosity: **1.007** cSt
Sp. Gravity: **1.000** (base temp. 68 °F)

Stage No.	Trim Status	Imp. Dia. (inch) D2-in x D2-out
-----	Full	-----
-----	Full	11.06 x 12.38
1 - 5	Trimmed P	9.15 x 10.82

Flow rate Q:	3100	US gpm
Bowl Total Head:	320	ft
Bowl Efficiency:	85.8	%
Bowl Power Required:	299.93	hp
NPSH Required	21.324	ft

Performance curve according to Hyd Inst-Peerless Std



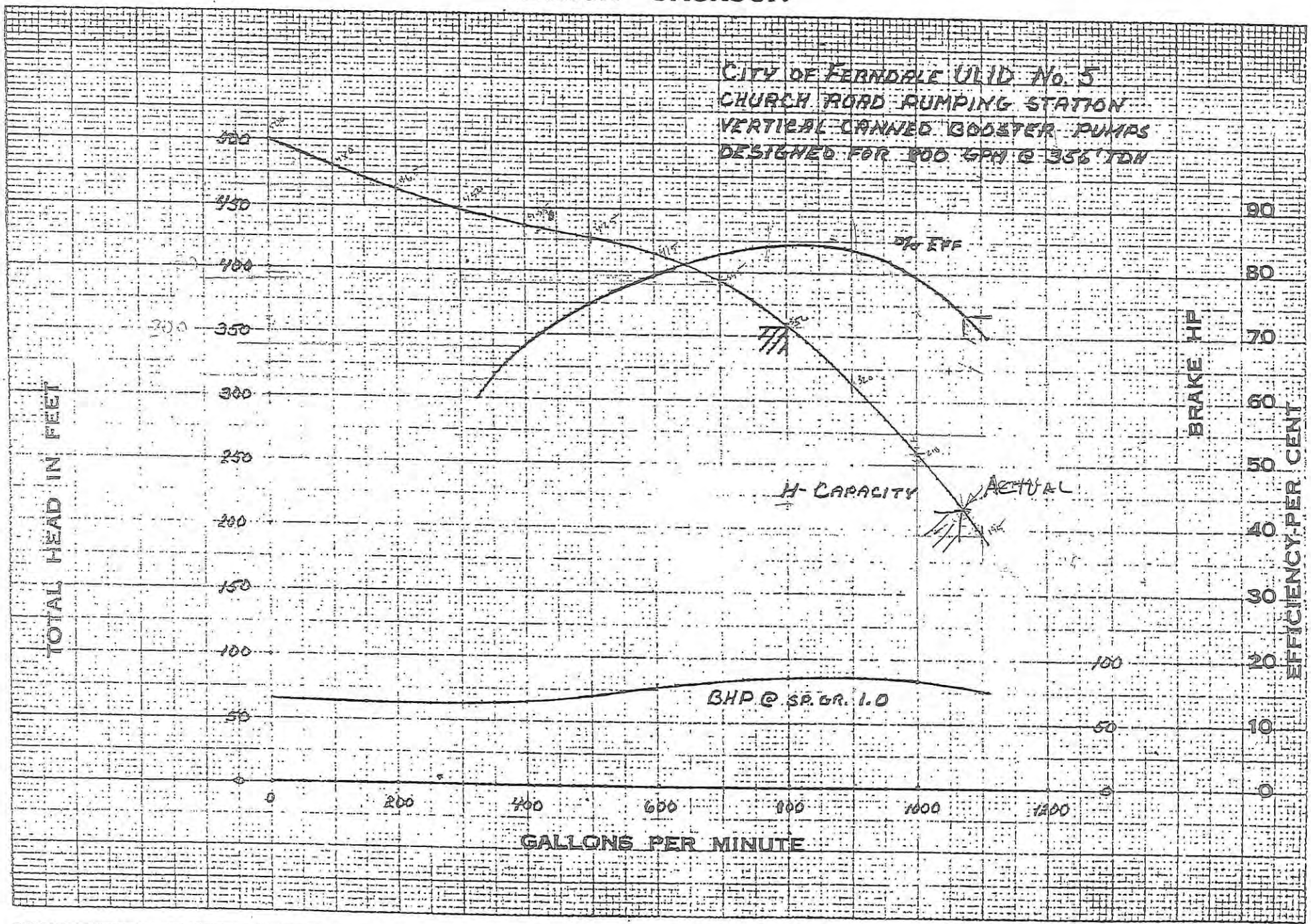
Comments

Refer to factory for all single point bowl performance guarantees. Pumps must be selected with Hydraulic Institute-Peerless Std. See Std Hydraulic Performance document in RAPID for testing tolerances & contractual guarantees.

Flow (US gpm)	Head (ft)	Efficiency (%)	Power Required (hp)	NPSH Required (ft)	Thrust (lb)
0.0	553.0	0.0	298.0		14006.69
493.7	517.5	21.8	296.2		12325.86
987.5	481.7	40.5	296.5		11034.36
1481.2	445.7	56.5	295.3		9958.44
1975.0	410.4	69.7	293.7		8906.81
2468.7	375.8	79.5	294.5	20.0	7745.43
2962.5	339.3	85.0	298.6	20.8	6399.76
3456.2	293.9	85.1	301.5	24.2	4834.94
3950.0	226.5	77.9	290.0	33.5	3062.88

CHURCH ROAD PUMP STA. - 2 PUMPS

BYRON JACKSON



PUMP SIZE AND TYPE	RPM	CUSTOMER NO.	IMPELLER NO.	BASED ON	DATE	BYRON JACKSON NUMBER
12GL - 7 STAGE	1770	EERKE'S CONTRACT	165414	3417	8 SEPT 80	PC 806-W-1367/68

741-S-0079

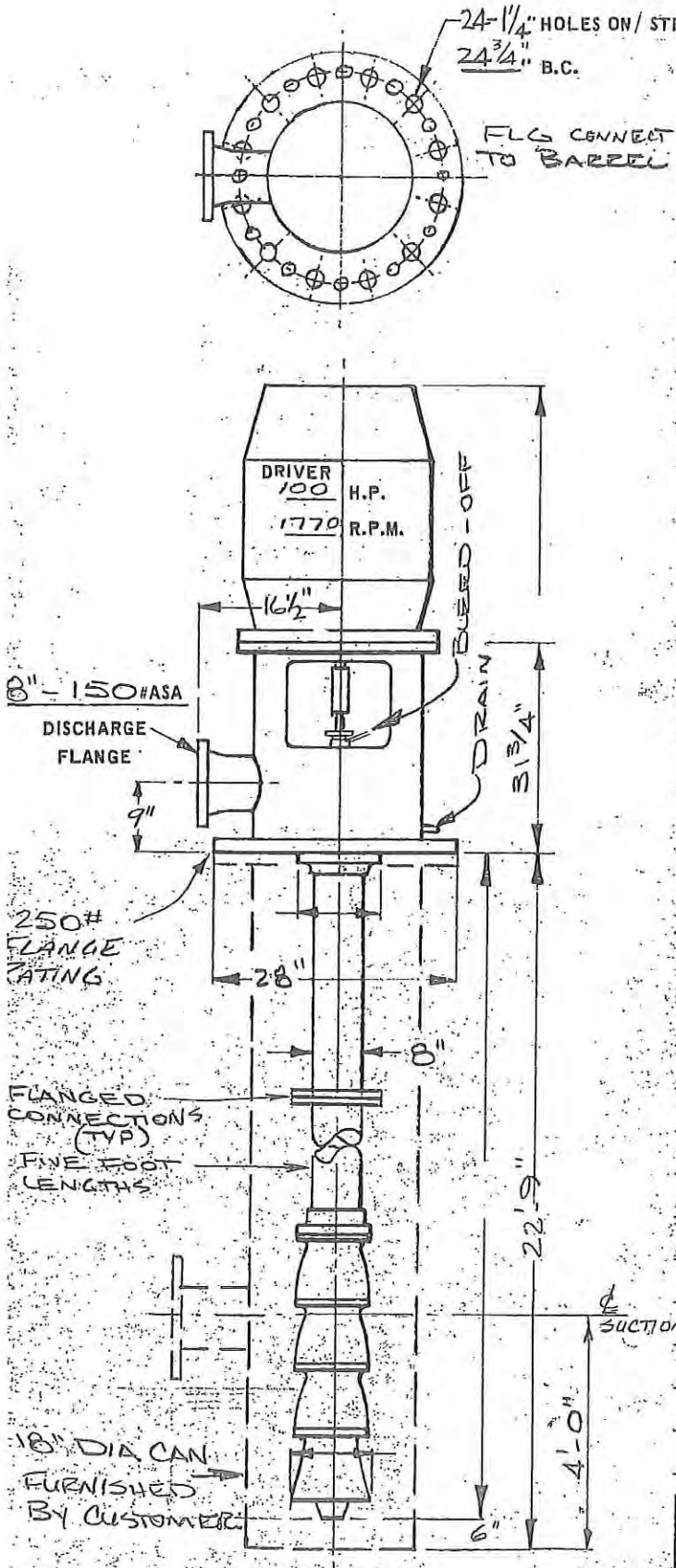
PUMP No. 1

BOOSTER STATION

Byron Jackson Pump Division
BORG-WARNER CORPORATION

OUTLINE DIMENSIONS

DATE 12-1-73



CUSTOMER: TOWN OF FERNDALE
BOOSTER STATION
DAWSON CONSTR. CO.

ITEM NO. 1 NO. OF UNITS: 1

DRIVER: 100HP, 1770 RPM, VHS/NRR 230/460 V/3/60 CLASS B INSULATION, DRIPPROOF WPI ENCLOSURE, 1.15 SF 40°C AMBIENT SCREENS, NON-HYGROSCOPIC INSULATION THERMOTECTORS EMBEDDED IN WINDINGS

PUMP TYPE: 12GM STAGES: 5
SELF LUBE, SEMI-OPEN BRONZE IMPELLERS

COLUMN: FLANGED 5' LENGTHS 8" DIA x 1½" SHAFT DOWSHED TO 1 7/16"

DISCHARGE HEAD: FABRICATED STEEL 8"-150# ASA FLANGE DISCH. 20" BD TWO-PIECE HEAD SHAFT; 250# FLG. ~~RATING BASE TO SUCTION CAN CONNECTION~~

COMMENTS:
DAWSON CONSTRUCTION CO. TO FURNISH SUCTION BARREL - PER SPEC.

CONFORMS IN ALL RESPECTS TO AWWA E-101

DO NOT USE FOR CONSTRUCTION UNLESS CERTIFIED

CERTIFIED CORRECT

DATE

P-885 6/68

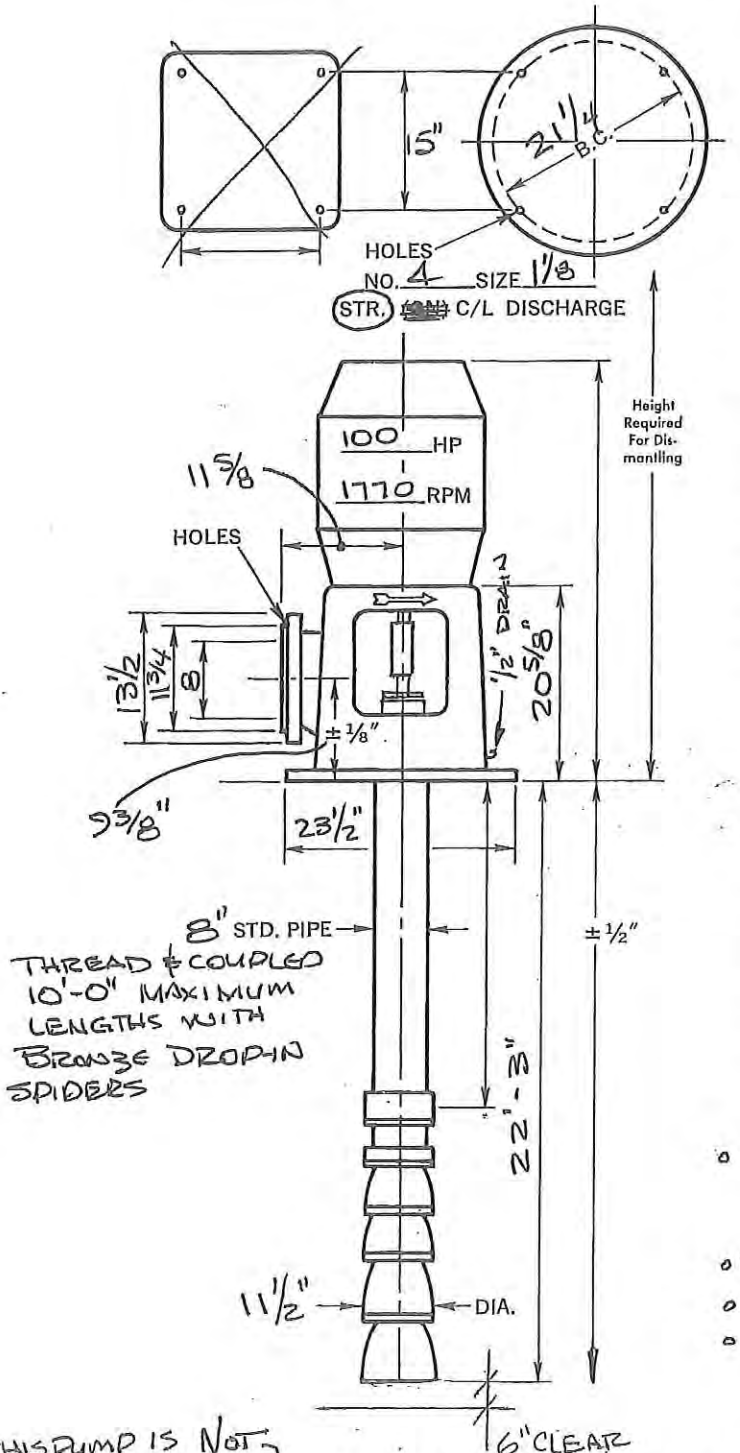
THORNTON BOOSTER STA PUMP 1

Byron Jackson Pump Division
BORG-WARNER CORPORATION

BORG WARNER®

SUMPMASTER PUMPS

MOTOR DRIVE OUTLINE



DATE 12-19-95

NAME OF CUSTOMER SEATTLE PUMP

PROPOSITION NO. —

ORDER NO. 94WS0044

PURCHASE ORDER NO. 14329

ITEM NO. —

NO. OF UNITS ONE

DRIVER: TYPE 100HP, VHS/NBR, 1.15SF

FRAME 404TP PHASE 3 CYCLES 60 VOLTS 460

MANUFACTURER U.S.E.M.

WINDING THERMOSTATS

ENCLOSURE WPI 40°C AMBIENT, SS SCREENS

DISCHARGE HEAD: TYPE & SIZE 8x16 1/2 GSR

RATING 8 125# ✓ ASA — NPT —

LUBRICATION SELF

SHAFT 1 7/16" C1045 W/STL. STL. SLEEVES

BOWLS: SIZE 12 TYPE GM STAGES 5

SUCTION PIPE NONE

STRAINER NONE

NOTES: ○ SUCTION BARREL BY OTHERS

○ HYDRAULICLY EQUAL TO PUMP SN 741-S-0079 850 GPM @ 300' TDH

○ PACKED STUFFING BOX

○ MOTOR IS FULL VOLTAGE START NEMA CODE G.

○ PUMP SHIPPED IN MAJOR COMPONENTS MUST BE FIELD ASSEMBLED.

THIS PUMP IS NOT DIMENSIONALLY INTERCHANGEABLE WITH PUMP SN 741-S-0079 EXCEPT IN MOST BOWL ASSY. ITEMS.

DO NO USE FOR CONSTRUCTION UNLESS VERIFIED

JOB NO. — PROP. NO. —

CERTIFIED CORRECT — DATE —

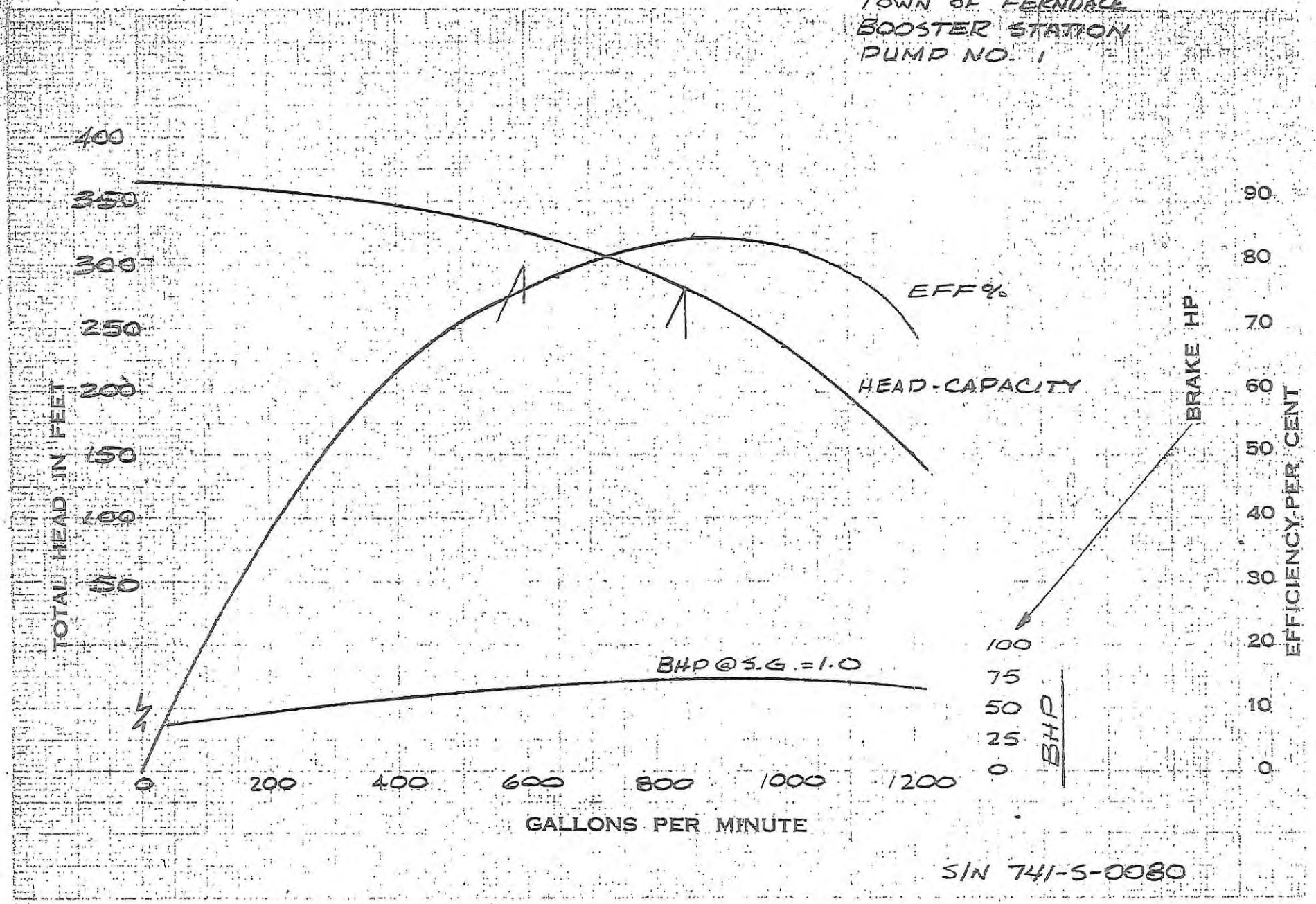
FORM P-591 5/69

THORNTON BOOSTER STA. PUMP 2

P200R

BYRON JACKSON

TOWN OF FERNDALE
BOOSTER STATION
PUMP NO. 1



S/N 741-S-0080

PUMP SIZE AND TYPE	RPM	CUSTOMER NO.	IMPELLER NO.	BASED ON	DATE	BYRON JACKSON NUMBER
12GM - 5 STAGE	1770	G. S.	750437	3416	6-13-74 12-11-73	PC 71640-1
			BRANCH NO. 61310	DATA BY DB	DRAWN BY DB	

THORNTON BOOSTER STA. PUMPS 1 & 2

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J1	32.27	Main	0.00	343.12	0.00	310.85	134.49	
J2	19.38	Main	0.00	321.94	0.00	302.56	130.90	
J3	19.35	Main	2.29	318.17	2.29	298.82	129.29	
J4	19.94	Main	2.29	313.36	2.29	293.42	126.95	
J5	21.91	Main	3.61	310.74	3.61	288.83	124.96	
J6	21.10	Main	5.37	307.76	5.37	286.66	124.02	
J7	29.30	Main	5.91	304.44	5.91	275.14	119.04	
J8	30.11	Main	6.44	302.17	6.44	272.06	117.71	
J9	17.45	Main	7.87	300.31	7.87	282.86	122.38	
J10	29.82	Main	6.37	299.08	6.37	269.26	116.50	
J11	36.36	Main	5.37	298.86	5.37	262.50	113.57	
J12	38.62	Main	2.15	298.72	2.15	260.10	112.53	
J13	42.33	Main	2.89	298.12	2.89	255.79	110.67	
J14	58.54	Main	5.01	298.09	5.01	239.55	103.64	
J15	60.59	Main	3.44	298.08	3.44	237.49	102.75	
J16	69.90	Main	18.18	298.07	18.18	228.17	98.72	
J17	87.08	Main	2.86	298.07	2.86	210.99	91.28	
J18	116.41	Main	0.36	298.07	0.36	181.66	78.60	
J19	131.75	Main	0.00	298.07	0.00	166.32	71.96	Church/Main Intersection
J20	140.58	Main	0.00	298.07	0.00	157.49	68.14	Chruch Rd. PS
J21	21.75	Main	4.34	310.90	4.34	289.15	125.10	
J22	20.89	Main	4.34	308.69	4.34	287.80	124.52	
J23	22.58	Main	11.38	304.65	11.38	282.07	122.04	
J24	18.16	Main	3.22	301.86	3.22	283.70	122.74	
J25	28.90	Main	15.32	298.07	15.32	269.17	116.46	
J26	25.23	Main	19.86	298.07	19.86	272.84	118.04	
J27	39.66	Main	6.98	298.09	6.98	258.43	111.81	
J28	33.05	Main	6.98	298.07	6.98	265.02	114.66	
J29	38.03	Main	4.29	298.07	4.29	260.04	112.51	
J30	32.39	Main	12.36	298.07	12.36	265.68	114.95	
J31	61.52	Main	4.87	298.09	4.87	236.57	102.35	
J32	62.76	Main	5.73	298.08	5.73	235.32	101.81	
J33	54.15	Main	3.15	298.07	3.15	243.92	105.53	
J34	48.63	Main	3.22	298.07	3.22	249.44	107.92	
J35	50.35	Main	0.36	298.06	0.36	247.71	107.17	
J36	48.20	Main	3.22	298.04	3.22	249.84	108.10	
J37	38.44	Main	8.05	298.08	8.05	259.64	112.33	
J38	36.58	Main	0.36	298.06	0.36	261.48	113.13	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J39	34.50	Main	1.07	298.06	1.07	263.56	114.03	
J40	32.09	Main	4.65	298.04	4.65	265.95	115.06	
J41	22.01	Main	2.51	298.04	2.51	276.03	119.43	
J42	18.26	Main	1.43	298.04	1.43	279.78	121.05	
J43	20.37	Main	3.58	298.04	3.58	277.67	120.13	
J44	20.20	Main	2.15	298.04	2.15	277.84	120.21	
J45	20.47	Main	4.65	298.04	4.65	277.57	120.09	
J46	24.44	Main	5.01	298.04	5.01	273.60	118.37	
J47	18.68	Main	4.65	298.04	4.65	279.36	120.87	
J48	56.67	Main	3.69	298.06	3.69	241.39	104.44	
J49	60.90	Main	0.36	298.06	0.36	237.16	102.61	
J50	50.37	Main	3.22	298.04	3.22	247.67	107.16	
J51	62.59	Main	2.51	298.04	2.51	235.45	101.87	
J52	51.25	Main	4.29	298.04	4.29	246.79	106.77	
J53	52.25	Main	6.80	298.04	6.80	245.79	106.34	
J54	61.11	Main	1.79	298.04	1.79	236.93	102.51	
J55	62.05	Main	1.72	298.07	1.72	236.02	102.11	
J56	68.20	Main	0.57	298.07	0.57	229.87	99.45	
J57	78.39	Main	0.00	298.07	0.00	219.68	95.04	
J58	76.25	Main	0.00	298.07	0.00	221.82	95.97	
J59	64.19	Main	0.00	298.07	0.00	233.88	101.19	
J60	61.94	Main	0.00	298.07	0.00	236.13	102.16	
J61	111.77	Main	11.56	298.07	11.56	186.30	80.60	
J62	46.47	Main	7.23	298.61	7.23	252.14	109.09	
J63	49.95	Main	3.61	297.81	3.61	247.86	107.24	
J64	50.80	Main	7.23	298.70	7.23	247.90	107.25	
J65	53.56	Main	1.15	297.89	1.15	244.33	105.71	
J66	49.27	Main	4.34	298.70	4.34	249.43	107.91	
J67	63.87	Main	6.30	297.44	6.30	233.57	101.06	
J68	84.49	Main	5.91	296.75	5.91	212.26	91.84	
J69	75.74	Main	4.83	296.32	4.83	220.58	95.43	
J70	63.74	Main	6.44	296.16	6.44	232.42	100.56	
J71	65.43	Main	1.72	296.28	1.72	230.85	99.88	
J72	58.83	Main	1.43	296.20	1.43	237.37	102.70	
J73	63.89	Main	0.57	298.09	0.57	234.20	101.33	
J74	72.02	Main	1.43	298.08	1.43	226.06	97.81	
J75	105.21	Main	2.15	256.49	2.15	151.28	65.45	
J76	27.96	Main	6.98	300.93	6.98	272.97	118.10	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J77	27.43	Main	10.13	299.81	10.13	272.38	117.85	
J78	28.01	Main	8.95	298.85	8.95	270.83	117.18	
J79	42.26	Main	3.72	296.52	3.72	254.26	110.01	
J80	48.12	Main	9.13	295.72	9.13	247.60	107.12	
J81	58.11	Main	1.61	294.63	1.61	236.52	102.33	
J82	108.98	Main	6.44	291.29	6.44	182.31	78.88	
J83	121.31	Main	4.29	290.23	4.29	168.92	73.08	
J84	26.93	Main	16.77	298.41	16.77	271.48	117.46	
J85	35.06	Main	4.34	297.46	4.34	262.40	113.53	
J86	34.93	Main	3.72	296.06	3.72	261.13	112.98	
J87	34.99	Main	2.58	295.02	2.58	260.03	112.50	
J88	40.39	Main	6.73	292.98	6.73	252.59	109.28	
J89	97.35	Main	7.52	288.34	7.52	190.99	82.63	
J90	124.43	Main	5.01	272.19	5.01	147.76	63.93	
J91	117.97	Main	5.01	262.63	5.01	144.66	62.59	
J92	121.23	Main	3.94	251.67	3.94	130.44	56.43	
J93	135.49	Main	0.00	248.47	0.00	112.98	48.88	
J94	161.06	Main	0.00	245.06	0.00	84.00	36.34	N. Thornton PRV Station
J95	223.00	Zone	0.00	232.55	0.00	9.55	4.13	Near Thornton Tank
J96	58.62	Main	2.15	294.63	2.15	236.01	102.11	
J97	39.84	Main	0.29	296.06	0.29	256.22	110.85	
J98	81.55	Main	2.51	289.02	2.51	207.47	89.76	
J99	75.89	Main	3.94	289.02	3.94	213.13	92.21	
J100	103.19	Main	5.01	262.63	5.01	159.44	68.98	
J101	82.36	Main	6.80	262.63	6.80	180.27	77.99	
J102	86.90	Main	2.15	251.67	2.15	164.77	71.29	
J103	62.06	Main	1.07	251.67	1.07	189.61	82.03	
J104	53.26	Main	0.54	251.67	0.54	198.41	85.84	
J105	48.83	Main	2.15	251.67	2.15	202.84	87.76	
J106	84.52	Main	3.58	251.67	3.58	167.15	72.32	
J107	61.07	Main	0.54	251.67	0.54	190.60	82.46	
J108	54.00	Main	0.00	251.67	0.00	197.67	85.52	
J109	56.30	Main	0.54	251.67	0.54	195.37	84.53	
J110	112.10	Main	6.08	251.56	6.08	139.46	60.34	
J111	119.12	Main	4.65	251.56	4.65	132.44	57.30	
J112	122.05	Main	3.58	251.56	3.58	129.50	56.03	
J113	117.79	Main	2.15	251.55	2.15	133.76	57.87	
J114	113.63	Main	1.07	251.55	1.07	137.92	59.67	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J115	108.44	Main	6.19	251.55	6.19	143.11	61.92	
J116	128.19	Main	7.52	250.31	7.52	122.12	52.83	
J117	101.27	Main	11.81	251.56	11.81	150.28	65.02	
J118	109.48	Main	7.27	251.55	7.27	142.07	61.47	
J119	85.70	Main	9.05	251.55	9.05	165.85	71.75	
J120	27.80	Main	4.29	299.81	4.29	272.01	117.68	
J121	33.04	Main	17.34	297.41	17.34	264.37	114.38	
J122	37.41	Main	11.56	296.20	11.56	258.79	111.96	
J123	35.90	Main	10.19	295.25	10.19	259.35	112.21	
J124	37.07	Main	3.61	294.67	3.61	257.60	111.45	
J125	39.23	Main	0.54	292.84	0.54	253.61	109.72	
J126	38.43	Main	0.54	292.89	0.54	254.46	110.09	
J127	38.78	Main	5.19	292.89	5.19	254.11	109.94	
J128	38.33	Main	0.54	292.89	0.54	254.56	110.14	
J129	25.92	Main	1.43	299.81	1.43	273.89	118.50	
J130	35.99	Main	0.72	297.42	0.72	261.43	113.11	
J131	27.43	Main	2.58	295.42	2.58	267.99	115.95	
J132	40.25	Main	1.72	295.01	1.72	254.76	110.22	
J133	36.33	Main	4.29	294.67	4.29	258.34	111.77	
J134	41.10	Main	3.44	294.65	3.44	253.55	109.70	
J135	37.93	Main	2.68	294.67	2.68	256.74	111.08	
J136	40.49	Main	17.72	293.10	17.72	252.61	109.29	
J137	24.41	Main	1.61	293.10	1.61	268.69	116.25	
J138	36.53	Main	4.29	292.97	4.29	256.44	110.95	
J139	37.48	Main	2.68	292.93	2.68	255.45	110.52	
J140	39.37	Main	2.68	292.89	2.68	253.52	109.69	
J141	47.08	Main	7.52	292.85	7.52	245.77	106.33	
J142	48.13	Main	2.68	292.84	2.68	244.71	105.87	
J143	49.78	Main	5.91	292.83	5.91	243.05	105.15	
J144	54.92	Main	1.61	292.81	1.61	237.89	102.92	
J145	57.97	Main	0.54	292.80	0.54	234.83	101.60	
J146	58.97	Main	2.68	292.80	2.68	233.83	101.17	
J147	66.87	Main	2.15	292.77	2.15	225.90	97.74	
J148	70.92	Main	0.72	292.77	0.72	221.85	95.99	
J149	35.87	Main	2.68	292.96	2.68	257.09	111.23	
J150	36.29	Main	1.61	292.96	1.61	256.66	111.05	
J151	36.59	Main	1.43	292.96	1.43	256.36	110.92	
J152	36.68	Main	3.76	292.96	3.76	256.27	110.88	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J153	37.16	Main	0.72	292.96	0.72	255.79	110.67	
J154	37.07	Main	2.15	292.93	2.15	255.86	110.70	
J155	47.68	Main	3.76	292.89	3.76	245.21	106.09	
J156	35.69	Main	2.86	292.89	2.86	257.20	111.28	
J157	35.57	Main	2.86	292.89	2.86	257.32	111.33	
J158	34.92	Main	9.66	292.83	9.66	257.91	111.59	
J159	39.12	Main	6.44	292.83	6.44	253.71	109.77	
J160	44.73	Main	2.15	292.84	2.15	248.11	107.34	
J161	47.70	Main	1.61	292.81	1.61	245.11	106.05	
J162	45.03	Main	1.43	292.81	1.43	247.78	107.20	
J163	51.58	Main	0.00	292.81	0.00	241.22	104.37	
J164	52.09	Main	0.54	292.81	0.54	240.72	104.15	
J165	51.45	Main	2.15	292.81	2.15	241.35	104.42	
J166	54.26	Main	3.22	292.80	3.22	238.54	103.21	
J167	59.81	Main	0.54	292.80	0.54	232.99	100.81	
J168	74.51	Main	2.51	292.77	2.51	218.26	94.43	
J169	73.78	Main	4.29	292.77	4.29	218.99	94.75	
J170	75.93	Main	7.52	292.77	7.52	216.84	93.82	
J171	64.94	Main	5.37	292.75	5.37	227.81	98.56	
J172	51.87	Main	0.00	292.75	0.00	240.88	104.22	
J173	59.86	Main	6.08	292.74	6.08	232.88	100.76	
J174	51.80	Main	5.01	292.74	5.01	240.94	104.24	
J175	55.50	Main	10.74	292.74	10.74	237.24	102.64	
J176	71.10	Main	2.51	292.77	2.51	221.67	95.91	
J177	69.77	Main	2.15	292.77	2.15	223.00	96.48	
J178	70.43	Main	4.65	292.77	4.65	222.34	96.20	
J179	72.51	Main	4.29	292.77	4.29	220.26	95.30	
J180	71.35	Main	3.58	292.77	3.58	221.42	95.80	
J181	22.42	Main	2.68	316.04	2.68	293.62	127.03	
J182	20.59	Main	1.45	313.21	1.45	292.62	126.60	
J183	20.14	Main	5.06	312.13	5.06	291.99	126.33	
J184	21.28	Main	14.53	311.84	14.53	290.56	125.71	
J185	27.44	Main	8.45	303.79	8.45	276.35	119.56	
J186	23.15	Main	4.12	316.04	4.12	292.89	126.72	
J187	23.71	Main	6.50	312.90	6.50	289.19	125.12	
J188	26.25	Main	8.52	301.22	8.52	274.97	118.97	
J189	30.41	Main	7.37	299.80	7.37	269.39	116.55	
J190	30.22	Main	14.28	299.25	14.28	269.03	116.40	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J191	33.09	Main	9.48	298.98	9.48	265.89	115.04	
J192	32.45	Main	6.62	298.45	6.62	266.00	115.08	
J193	32.79	Main	5.30	296.35	5.30	263.56	114.03	
J194	33.45	Main	14.60	295.70	14.60	262.25	113.46	
J195	33.14	Main	5.83	294.86	5.83	261.72	113.23	
J196	38.46	Main	1.61	293.51	1.61	255.05	110.35	
J197	30.22	Main	7.62	293.39	7.62	263.17	113.86	
J198	31.73	Main	3.69	293.26	3.69	261.53	113.15	
J199	32.35	Main	5.37	293.21	5.37	260.86	112.86	
J200	35.68	Main	6.08	293.12	6.08	257.44	111.38	
J201	38.93	Main	2.86	292.78	2.86	253.85	109.83	
J202	46.62	Main	0.00	292.65	0.00	246.03	106.44	
J203	35.44	Main	1.61	295.02	1.61	259.58	112.31	
J204	30.43	Main	0.00	301.22	0.00	270.79	117.16	
J205	32.33	Main	1.07	299.80	1.07	267.47	115.72	
J206	27.33	Main	0.54	299.80	0.54	272.47	117.89	
J207	30.59	Main	3.22	298.98	3.22	268.39	116.12	
J208	28.25	Main	5.19	298.98	5.19	270.73	117.13	
J209	33.50	Main	7.87	293.47	7.87	259.97	112.47	
J210	27.60	Main	7.80	293.39	7.80	265.79	114.99	
J211	26.35	Main	1.07	293.47	1.07	267.12	115.57	
J212	30.33	Main	15.14	293.46	15.14	263.13	113.84	
J213	31.87	Main	6.80	293.12	6.80	261.24	113.03	
J214	29.69	Main	0.54	293.26	0.54	263.57	114.03	
J215	31.27	Main	1.61	293.26	1.61	261.99	113.35	
J216	40.74	Main	6.80	292.77	6.80	252.03	109.04	
J217	47.40	Main	5.73	292.77	5.73	245.36	106.16	
J218	42.26	Main	4.65	292.76	4.65	250.50	108.38	
J219	42.55	Main	5.01	292.76	5.01	250.21	108.25	
J220	29.96	Main	0.54	301.04	0.54	271.08	117.28	
J221	38.81	Main	4.83	300.83	4.83	262.02	113.36	
J222	39.98	Main	0.00	300.74	0.00	260.76	112.82	
J223	41.58	Main	1.07	300.72	1.07	259.14	112.12	
J224	31.62	Main	0.00	300.71	0.00	269.09	116.42	
J225	18.72	Main	2.68	298.49	2.68	279.77	121.04	
J226	18.72	Main	1.07	297.11	1.07	278.39	120.45	
J227	23.06	Main	3.76	294.93	3.76	271.86	117.62	
J228	30.96	Main	5.30	299.07	5.30	268.11	116.00	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J229	32.81	Main	1.61	299.07	1.61	266.26	115.20	
J230	37.35	Main	27.13	298.95	27.13	261.60	113.18	
J231	38.40	Main	0.54	301.03	0.54	262.63	113.63	
J232	46.63	Main	0.54	301.03	0.54	254.40	110.07	
J233	16.63	Main	6.91	301.03	6.91	284.40	123.04	
J234	46.94	Main	0.54	301.03	0.54	254.09	109.93	
J235	44.29	Main	91.08	300.64	91.08	256.35	110.91	
J236	43.78	Main	6.98	300.64	6.98	256.86	111.13	
J237	41.81	Main	0.54	300.64	0.54	258.83	111.98	
J238	45.89	Main	4.22	300.72	4.22	254.83	110.25	
J239	51.49	Main	0.54	300.72	0.54	249.23	107.83	
J240	46.83	Main	0.54	300.72	0.54	253.89	109.85	
J241	41.66	Main	0.54	300.72	0.54	259.06	112.08	
J242	35.11	Main	0.00	296.25	0.00	261.14	112.98	
J243	37.09	Main	4.76	296.17	4.76	259.08	112.09	
J244	37.84	Main	1.07	296.17	1.07	258.33	111.77	
J245	39.87	Main	1.61	296.17	1.61	256.30	110.89	
J246	37.89	Main	4.47	296.17	4.47	258.28	111.75	
J247	35.42	Main	0.54	295.91	0.54	260.49	112.70	
J248	32.25	Main	2.15	295.66	2.15	263.41	113.97	
J249	43.58	Main	0.00	296.21	0.00	252.63	109.30	
J250	30.59	Main	2.15	295.42	2.15	264.83	114.58	
J251	20.08	Main	2.68	295.14	2.68	275.06	119.00	
J252	35.00	Main	1.07	294.85	1.07	259.85	112.42	
J253	26.43	Main	0.54	294.85	0.54	268.42	116.13	
J254	26.84	Main	4.65	294.85	4.65	268.01	115.95	
J255	73.42	Main	0.00	294.84	0.00	221.42	95.80	
J256	63.12	Main	12.35	294.86	12.35	231.74	100.26	
J257	55.08	Main	2.68	294.86	2.68	239.78	103.74	
J258	52.38	Main	2.86	294.82	2.86	242.44	104.89	
J259	51.10	Main	5.83	294.82	5.83	243.71	105.44	
J260	47.56	Main	2.68	294.81	2.68	247.25	106.97	
J261	38.43	Main	2.15	294.81	2.15	256.38	110.92	
J262	24.40	Main	0.54	294.85	0.54	270.45	117.01	
J263	47.52	Main	1.61	294.82	1.61	247.30	107.00	
J264	43.10	Main	1.61	294.82	1.61	251.72	108.91	
J265	40.99	Main	15.25	294.81	15.25	253.82	109.82	
J266	45.15	Main	1.61	294.81	1.61	249.66	108.02	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J267	46.14	Main	0.86	294.81	0.86	248.67	107.59	
J268	41.17	Main	8.70	294.81	8.70	253.64	109.74	
J269	41.52	Main	2.68	294.81	2.68	253.29	109.59	
J270	33.52	Main	17.82	294.81	17.82	261.29	113.05	
J271	25.11	Main	12.13	294.81	12.13	269.70	116.69	
J272	36.48	Main	7.44	294.81	7.44	258.33	111.77	
J273	36.90	Main	0.00	294.81	0.00	257.91	111.59	
J274	38.85	Main	0.00	294.81	0.00	255.96	110.74	
J275	35.46	Main	0.00	294.81	0.00	259.35	112.21	
J276	34.77	Main	0.00	294.81	0.00	260.04	112.51	
J277	42.95	Main	9.66	294.81	9.66	251.86	108.97	
J278	57.14	Main	10.74	294.81	10.74	237.67	102.83	
J279	57.01	Main	7.73	294.86	7.73	237.85	102.91	
J280	45.50	Main	0.57	294.86	0.57	249.36	107.89	
J281	67.89	Main	3.04	294.85	3.04	226.96	98.20	
J282	42.83	Main	4.22	294.81	4.22	251.98	109.02	
J283	59.21	Main	1.07	294.82	1.07	235.61	101.94	
J284	58.65	Main	6.98	294.83	6.98	236.17	102.18	
J285	59.32	Main	1.61	294.83	1.61	235.51	101.89	
J286	71.13	Main	2.15	294.85	2.15	223.71	96.79	
J287	72.23	Main	18.36	294.84	18.36	222.61	96.31	
J288	83.30	Main	8.34	294.84	8.34	211.53	91.52	
J289	91.52	Main	2.86	294.83	2.86	203.31	87.96	
J290	93.47	Main	8.95	294.83	8.95	201.36	87.12	
J291	96.02	Main	2.51	294.83	2.51	198.81	86.01	
J292	96.09	Main	7.98	294.83	7.98	198.74	85.98	
J293	55.35	Main	1.61	294.81	1.61	239.46	103.60	
J294	60.33	Main	4.76	294.82	4.76	234.49	101.45	
J295	58.90	Main	4.22	294.83	4.22	235.92	102.07	
J296	62.07	Main	0.54	294.83	0.54	232.75	100.70	
J297	61.42	Main	1.07	294.83	1.07	233.40	100.98	
J298	64.73	Main	1.07	294.83	1.07	230.09	99.55	
J299	64.41	Main	2.15	294.83	2.15	230.41	99.69	
J300	65.27	Main	4.29	294.83	4.29	229.56	99.32	
J301	67.70	Main	4.29	294.83	4.29	227.12	98.27	
J302	77.22	Main	6.08	294.84	6.08	217.62	94.15	
J303	74.35	Main	5.01	294.84	5.01	220.49	95.39	
J304	77.94	Main	5.73	294.84	5.73	216.90	93.84	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J305	79.29	Main	6.80	294.83	6.80	215.54	93.26	
J306	80.94	Main	4.29	294.83	4.29	213.89	92.54	
J307	83.03	Main	4.29	294.83	4.29	211.80	91.64	
J308	82.17	Main	3.94	294.83	3.94	212.66	92.01	
J309	83.59	Main	7.52	294.83	7.52	211.24	91.39	
J310	82.56	Main	3.94	294.83	3.94	212.27	91.84	
J311	84.36	Main	2.86	294.83	2.86	210.47	91.06	
J312	90.61	Main	8.23	294.83	8.23	204.22	88.36	
J313	91.27	Main	5.37	294.83	5.37	203.56	88.07	
J314	93.83	Main	2.15	294.83	2.15	201.00	86.96	
J315	93.89	Main	3.22	294.83	3.22	200.94	86.94	
J316	101.80	Main	2.86	294.83	2.86	193.03	83.51	
J317	100.38	Main	1.79	294.83	1.79	194.45	84.13	
J318	85.83	Main	1.07	294.83	1.07	208.99	90.42	
J319	81.72	Main	0.36	294.83	0.36	213.11	92.20	
J320	90.45	Main	0.00	294.83	0.00	204.38	88.42	
J321	80.11	Main	0.00	294.83	0.00	214.72	92.90	
J475	69.22	Mid-Sub	2.15	211.73	2.15	142.51	61.66	
J476	82.89	Mid-Sub	1.43	211.73	1.43	128.84	55.74	
J477	119.18	Mid-Sub	5.37	211.75	5.37	92.57	40.05	
J478	162.66	Mid-Sub	0.00	211.75	0.00	49.09	21.24	S. Thornton PRV Station
J479	126.29	Mid-Sub	2.51	211.75	2.51	85.46	36.98	
J480	146.22	Mid-Sub	3.76	211.77	3.76	65.54	28.36	Near Sunrise PRV
J501	63.63	Ferndale Terrace	5.48	256.77	5.48	193.14	83.56	
J502	77.68	Ferndale Terrace	2.51	256.75	2.51	179.07	77.48	
J503	84.37	Ferndale Terrace	3.58	256.69	3.58	172.32	74.55	
J504	95.37	Ferndale Terrace	7.16	256.59	7.16	161.22	69.75	
J505	103.19	Ferndale Terrace	3.58	256.51	3.58	153.32	66.33	
J506	115.70	Ferndale Terrace	3.58	256.49	3.58	140.79	60.91	
J507	97.88	Ferndale Terrace	6.08	256.71	6.08	158.83	68.72	
J508	115.27	Ferndale Terrace	3.94	256.70	3.94	141.43	61.19	
J509	95.37	Ferndale Terrace	8.59	256.59	8.59	161.22	69.75	
J510	106.92	Ferndale Terrace	7.87	256.53	7.87	149.61	64.73	
J511	109.30	Ferndale Terrace	5.37	256.51	5.37	147.21	63.69	
J512	133.37	Ferndale Terrace	5.01	256.79	5.01	123.42	53.40	
J513	128.79	Ferndale Terrace	8.59	256.57	8.59	127.78	55.28	
J514	138.21	Ferndale Terrace	8.95	256.52	8.95	118.31	51.19	
J515	135.66	Ferndale Terrace	3.94	256.62	3.94	120.96	52.33	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J516	134.67	Ferndale Terrace	2.51	257.34	2.51	122.67	53.07	
J517	136.08	Ferndale Terrace	6.80	257.34	6.80	121.26	52.46	
J518	121.93	Ferndale Terrace	3.58	257.05	3.58	135.12	58.46	
J519	112.00	Ferndale Terrace	3.58	257.04	3.58	145.04	62.75	
J520	146.91	Ferndale Terrace	1.43	255.84	1.43	108.93	47.13	
J521	173.18	Ferndale Terrace	0.00	250.17	0.00	76.99	33.31	Vista PRV Station
J522	150.51	Ferndale Terrace	2.86	258.43	2.86	107.92	46.69	
J523	136.49	Ferndale Terrace	6.08	257.78	6.08	121.29	52.48	
J524	149.84	Ferndale Terrace	7.87	257.78	7.87	107.94	46.70	
J525	154.75	Ferndale Terrace	5.37	258.99	5.37	104.24	45.10	
J526	127.35	Ferndale Terrace	3.22	256.49	3.22	129.14	55.87	
J601	223.00	Mid	0.00	401.58	0.00	178.58	77.26	
J602	161.06	Mid	0.00	401.58	0.00	240.52	104.06	
J603	230.27	Mid	2.51	401.58	2.51	171.31	74.12	
J604	227.13	Mid	10.13	401.45	10.13	174.32	75.42	
J605	181.11	Mid	7.87	401.30	7.87	220.19	95.27	
J606	173.18	Mid	0.00	401.24	0.00	228.06	98.67	
J607	188.64	Mid	5.37	401.41	5.37	212.77	92.06	
J608	206.79	Mid	4.65	401.45	4.65	194.66	84.22	
J609	214.80	Mid	3.94	401.57	3.94	186.77	80.81	
J610	213.56	Mid	4.65	401.64	4.65	188.08	81.37	
J611	233.76	Mid	2.15	401.66	2.15	167.90	72.64	
J612	175.32	Mid	9.41	401.60	9.41	226.28	97.90	
J613	162.17	Mid	5.37	401.65	5.37	239.48	103.61	
J614	144.31	Mid	6.44	401.70	6.44	257.39	111.36	
J615	121.82	Mid	5.73	401.78	5.73	279.96	121.13	
J616	183.87	Mid	5.01	401.43	5.01	217.56	94.13	
J617	171.45	Mid	5.37	401.42	5.37	229.97	99.50	
J618	213.96	Mid	4.29	401.51	4.29	187.55	81.14	
J619	192.26	Mid	5.73	401.49	5.73	209.23	90.52	
J620	162.66	Mid	0.00	401.49	0.00	238.83	103.33	
J621	217.04	Mid	5.73	401.49	5.73	184.45	79.80	
J622	237.54	Mid	2.86	401.58	2.86	164.04	70.97	
J623	237.84	Mid	4.65	401.57	4.65	163.73	70.84	
J624	225.83	Mid	3.58	401.56	3.58	175.73	76.03	
J625	206.81	Mid	2.86	401.56	2.86	194.75	84.26	
J626	203.79	Mid	2.15	401.56	2.15	197.77	85.57	
J627	192.68	Mid	9.31	401.57	9.31	208.89	90.38	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J628	182.96	Mid	8.59	401.57	8.59	218.61	94.58	
J629	222.36	Mid	7.52	401.56	7.52	179.20	77.53	
J630	202.16	Mid	7.16	401.56	7.16	199.40	86.27	
J631	179.55	Mid	6.80	401.56	6.80	222.01	96.05	
J632	195.52	Mid	6.08	401.56	6.08	206.04	89.14	
J633	211.62	Mid	2.51	401.56	2.51	189.94	82.18	
J634	233.41	Mid	4.29	401.59	4.29	168.17	72.76	
J635	243.84	Mid	5.37	401.58	5.37	157.74	68.25	
J636	242.64	Mid	6.44	401.58	6.44	158.94	68.77	
J637	244.89	Mid	5.37	401.58	5.37	156.69	67.79	
J638	232.54	Mid	7.16	401.62	7.16	169.08	73.15	
J639	221.98	Mid	4.65	401.56	4.65	179.58	77.70	
J640	210.06	Mid	2.86	401.56	2.86	191.50	82.85	
J641	216.91	Mid	5.37	401.57	5.37	184.66	79.89	
J642	227.39	Mid	2.86	401.58	2.86	174.19	75.36	
J643	236.57	Mid	5.37	401.59	5.37	165.02	71.40	
J644	238.08	Mid	1.79	401.58	1.79	163.50	70.74	
J645	228.22	Mid	5.73	401.58	5.73	173.36	75.00	
J646	227.21	Mid	3.58	401.61	3.58	174.40	75.46	
J647	253.60	Mid	12.53	401.76	12.53	148.15	64.10	
J648	267.41	Mid	3.58	401.81	3.58	134.40	58.15	
J649	277.58	Mid	4.29	401.92	4.29	124.34	53.80	
J650	306.91	Mid	2.51	402.08	2.51	95.17	41.18	
J651	355.05	Zone	0.00	402.56	0.00	47.51	20.56	Near Bakerview Tank
J652	254.13	Mid	7.87	401.77	7.87	147.64	63.88	
J653	363.00	Zone	0.00	403.00	0.00	40.00	17.30	Near Bakerview Tank
J654	249.88	Mid	6.08	401.80	6.08	151.92	65.73	
J655	262.90	Mid	8.23	401.83	8.23	138.93	60.11	
J656	251.88	Mid	6.44	401.77	6.44	149.89	64.85	
J657	244.54	Mid	4.65	401.78	4.65	157.24	68.03	
J658	246.58	Mid	2.51	401.77	2.51	155.19	67.14	
J659	228.15	Mid	8.23	401.77	8.23	173.62	75.12	
J660	222.38	Mid	5.37	401.77	5.37	179.39	77.61	
J661	239.73	Mid	0.00	401.77	0.00	162.04	70.11	
J662	229.02	Mid	4.65	401.77	4.65	172.75	74.74	
J663	252.31	Mid	5.73	401.72	5.73	149.41	64.64	
J664	239.24	Mid	5.73	401.63	5.73	162.39	70.26	
J665	201.20	Mid	5.73	401.59	5.73	200.39	86.70	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J666	234.62	Mid	5.01	401.65	5.01	167.03	72.27	
J667	235.30	Mid	2.86	401.64	2.86	166.34	71.97	
J668	240.96	Mid	5.73	401.64	5.73	160.68	69.52	
J669	198.42	Mid	1.79	401.57	1.79	203.15	87.89	
J670	210.57	Mid	5.73	401.57	5.73	191.00	82.64	
J671	192.94	Mid	5.37	401.57	5.37	208.63	90.26	
J672	260.40	Mid	5.37	401.78	5.37	141.38	61.17	
J673	322.71	Mid	0.36	402.04	0.36	79.33	34.32	
J674	287.00	Mid	0.00	402.00	0.00	115.00	49.75	
J675	243.98	Mid	0.00	401.99	0.00	158.01	68.36	
J676	205.35	Mid	7.98	401.99	7.98	196.64	85.08	
J677	176.00	Mid	0.00	401.99	0.00	225.99	97.77	
J678	169.99	Mid	1.07	401.99	1.07	232.00	100.37	
J679	214.22	Mid	0.00	401.96	0.00	187.74	81.23	
J680	185.40	Mid	0.00	401.95	0.00	216.55	93.69	
J681	164.64	Mid	0.00	401.97	0.00	237.33	102.68	
J682	225.14	Mid	0.00	401.98	0.00	176.84	76.51	
J683	130.47	Mid	0.00	401.86	0.00	271.39	117.42	
J684	222.62	Mid	0.72	401.99	0.72	179.37	77.60	
J801	363.00	Bakerview	0.00	509.45	0.00	146.45	63.36	
J802	358.45	Bakerview	1.07	509.41	1.07	150.96	65.31	
J803	327.34	Bakerview	4.76	509.41	4.76	182.07	78.77	
J804	290.02	Bakerview	0.00	509.41	0.00	219.39	94.92	
J805	309.29	Bakerview	0.00	509.41	0.00	200.12	86.58	
J806	301.48	Bakerview	0.00	509.41	0.00	207.93	89.96	
J807	303.65	Bakerview	0.00	509.41	0.00	205.76	89.02	
J808	337.85	Bakerview	0.00	509.41	0.00	171.56	74.22	
J809	322.03	Bakerview	0.00	509.41	0.00	187.38	81.07	
J810	319.66	Bakerview	0.00	509.41	0.00	189.75	82.09	
J811	312.46	Bakerview	0.00	509.41	0.00	196.95	85.21	
J812	308.02	Bakerview	0.00	509.41	0.00	201.39	87.13	
J813	358.49	Bakerview	5.37	509.41	5.37	150.92	65.29	
J814	328.72	Bakerview	9.41	509.35	9.41	180.63	78.15	
J815	318.12	Bakerview	1.79	509.34	1.79	191.22	82.73	
J816	305.16	Bakerview	4.29	509.32	4.29	204.16	88.33	
J817	304.22	Bakerview	7.87	509.32	7.87	205.10	88.74	
J818	303.97	Bakerview	3.94	509.32	3.94	205.35	88.84	
J819	301.60	Bakerview	1.43	509.32	1.43	207.72	89.87	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J820	299.10	Bakerview	6.55	509.32	6.55	210.22	90.95	
J821	300.08	Bakerview	2.15	509.32	2.15	209.24	90.53	
J822	301.67	Bakerview	1.43	509.32	1.43	207.65	89.84	
J823	341.31	Bakerview	5.01	509.34	5.01	168.03	72.70	
J824	341.41	Bakerview	10.38	509.31	10.38	167.90	72.64	
J825	353.93	Bakerview	7.98	509.30	7.98	155.37	67.22	
J826	358.94	Bakerview	12.88	509.29	12.88	150.35	65.05	
J827	366.15	Bakerview	7.87	509.29	7.87	143.14	61.93	
J828	361.56	Bakerview	5.01	509.29	5.01	147.73	63.92	
J829	358.48	Bakerview	9.66	509.29	9.66	150.81	65.25	
J830	346.94	Bakerview	12.88	509.29	12.88	162.35	70.24	
J831	363.06	Bakerview	5.73	509.30	5.73	146.24	63.27	
J832	324.28	Bakerview	3.94	509.34	3.94	185.06	80.07	
J833	325.05	Bakerview	2.51	509.33	2.51	184.28	79.73	
J834	322.36	Bakerview	0.72	509.32	0.72	186.96	80.89	
J835	323.97	Bakerview	0.00	509.32	0.00	185.35	80.19	
J836	320.02	Bakerview	0.00	509.34	0.00	189.32	81.91	
J837	308.68	Bakerview	2.86	509.32	2.86	200.64	86.81	
J838	279.53	Bakerview	2.15	509.32	2.15	229.79	99.42	
J839	275.10	Bakerview	3.22	509.32	3.22	234.21	101.33	
J840	283.30	Bakerview	2.15	509.32	2.15	226.01	97.79	
J841	346.43	Bakerview	12.88	509.36	12.88	162.93	70.49	
J842	310.57	Bakerview	2.15	509.32	2.15	198.75	85.99	
J843	321.08	Bakerview	3.22	509.31	3.22	188.23	81.44	
J844	333.94	Bakerview	3.94	509.31	3.94	175.37	75.88	
J845	313.30	Bakerview	8.23	509.30	8.23	196.00	84.80	
J846	309.40	Bakerview	6.08	509.30	6.08	199.90	86.49	
J847	300.76	Bakerview	6.80	509.30	6.80	208.54	90.22	
J848	338.06	Bakerview	4.65	509.32	4.65	171.26	74.09	
J849	341.83	Bakerview	5.01	509.32	5.01	167.49	72.47	
J850	343.65	Bakerview	7.16	509.33	7.16	165.68	71.68	
J851	339.99	Bakerview	2.51	509.32	2.51	169.33	73.26	
J852	335.98	Bakerview	2.51	509.32	2.51	173.34	74.99	
J853	342.45	Bakerview	6.80	509.30	6.80	166.85	72.19	
J854	344.26	Bakerview	3.94	509.31	3.94	165.05	71.41	
J855	329.65	Bakerview	4.65	509.30	4.65	179.65	77.73	
J856	326.58	Bakerview	5.73	509.30	5.73	182.72	79.05	
J857	313.24	Bakerview	3.58	509.30	3.58	196.06	84.82	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J858	324.21	Bakerview	3.94	509.30	3.94	185.09	80.08	
J859	310.22	Bakerview	6.08	509.29	6.08	199.07	86.13	
J860	287.66	Bakerview	4.29	509.29	4.29	221.63	95.89	
J861	253.10	Mid	0.00	509.30	0.00	256.20	110.84	
J862	211.79	Mid	0.00	509.30	0.00	297.51	128.72	
J863	295.65	Bakerview	1.79	509.32	1.79	213.66	92.44	
J864	297.28	Bakerview	5.01	509.32	5.01	212.03	91.74	
J865	311.44	Bakerview	1.79	509.31	1.79	197.87	85.61	
J866	299.84	Bakerview	5.37	509.31	5.37	209.46	90.63	
J867	273.99	Bakerview	6.08	509.30	6.08	235.31	101.81	
J868	265.92	Bakerview	6.08	509.30	6.08	243.38	105.30	
J869	289.47	Bakerview	7.16	509.30	7.16	219.83	95.11	
J870	305.77	Bakerview	0.00	509.30	0.00	203.53	88.06	
J871	320.81	Bakerview	0.00	509.30	0.00	188.49	81.55	
J872	258.48	Bakerview	6.44	509.30	6.44	250.82	108.52	
J873	305.54	Bakerview	0.00	509.41	0.00	203.87	88.20	
J874	306.04	Bakerview	0.00	509.41	0.00	203.37	87.99	
J901	46.62	Axton	5.73	167.91	5.73	121.29	52.48	
J902	51.40	Axton	4.65	167.70	4.65	116.30	50.32	
J903	56.65	Axton	4.29	167.59	4.29	110.94	48.00	
J904	60.69	Axton	4.65	167.57	4.65	106.88	46.24	
J905	66.68	Axton	1.79	167.57	1.79	100.89	43.65	
J906	51.17	Axton	11.09	167.67	11.09	116.50	50.40	
J907	52.82	Axton	10.74	167.63	10.74	114.81	49.67	
J908	56.16	Axton	7.16	167.61	7.16	111.45	48.22	
J909	58.70	Axton	8.59	167.60	8.59	108.90	47.12	
J910	66.14	Axton	2.86	167.57	2.86	101.43	43.88	
J911	52.68	Axton	2.86	167.56	2.86	114.88	49.70	
J912	48.21	Axton	5.01	167.51	5.01	119.30	51.62	
J913	56.51	Axton	3.94	167.54	3.94	111.03	48.04	
J914	52.65	Axton	8.23	167.45	8.23	114.80	49.67	
J915	46.03	Axton	6.08	167.35	6.08	121.32	52.49	
J916	41.76	Axton	6.44	167.21	6.44	125.45	54.27	
J917	45.63	Axton	0.00	167.21	0.00	121.58	52.60	
J918	52.11	Axton	5.73	167.16	5.73	115.05	49.77	
J919	47.40	Axton	5.37	167.14	5.37	119.74	51.81	
J920	62.74	Axton	5.37	167.13	5.37	104.39	45.17	
J921	46.22	Axton	7.16	167.13	7.16	120.91	52.31	

Scenario: 2015 PHD
Steady State Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J922	65.53	Axton	2.51	167.34	2.51	101.81	44.05	
J923	61.34	Axton	2.86	167.34	2.86	106.00	45.86	
J924	49.03	Axton	2.86	167.34	2.86	118.31	51.19	
J925	6.98	Axton	2.15	167.34	2.15	160.36	69.38	
J926	61.54	Axton	2.15	167.34	2.15	105.80	45.78	
J927	61.36	Axton	2.15	167.34	2.15	105.98	45.85	

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P1	1,904.00	18.0	Ductile Iron	100.0	false	Open	4,966.41	6.26	343.12	321.94	21.18	11.12	J1	J2	Open
P2	339.00	18.0	Ductile Iron	100.0	false	Open	4,966.41	6.26	321.94	318.17	3.77	11.12	J2	J3	Open
P3	475.00	18.0	Ductile Iron	100.0	false	Open	4,720.76	5.95	318.17	313.36	4.81	10.13	J3	J4	Open
P4	336.00	18.0	Ductile Iron	100.0	false	Open	4,097.63	5.17	313.36	310.74	2.62	7.79	J4	J5	Open
P5	332.00	18.0	Ductile Iron	100.0	false	Open	4,426.23	5.58	310.74	307.76	2.98	8.99	J5	J6	Open
P6	370.00	18.0	Ductile Iron	100.0	false	Open	4,420.86	5.57	307.76	304.44	3.32	8.97	J6	J7	Open
P7	361.00	12.0	Ductile Iron	120.0	false	Open	1,507.65	4.28	304.44	302.17	2.27	6.29	J7	J8	Open
P8	644.00	12.0	Ductile Iron	120.0	false	Open	990.97	2.81	302.17	300.31	1.86	2.89	J8	J9	Open
P9	547.00	12.0	Ductile Iron	120.0	false	Open	865.63	2.46	300.31	299.08	1.23	2.25	J9	J10	Open
P10	171.00	12.0	Ductile Iron	120.0	false	Open	633.76	1.80	299.08	298.86	0.22	1.26	J10	J11	Open
P11	181.00	12.0	Ductile Iron	120.0	false	Open	499.08	1.42	298.86	298.72	0.15	0.81	J11	J12	Open
P12	740.00	12.0	Ductile Iron	120.0	false	Open	496.93	1.41	298.72	298.12	0.60	0.81	J12	J13	Open
P13	482.00	12.0	Ductile Iron	120.0	false	Open	124.76	0.35	298.12	298.09	0.03	0.06	J13	J14	Open
P14	782.00	12.0	Ductile Iron	120.0	false	Open	58.06	0.16	298.09	298.08	0.01	0.02	J14	J15	Open
P15	813.00	12.0	Ductile Iron	120.0	false	Open	47.32	0.13	298.08	298.07	0.01	0.01	J15	J16	Open
P16	471.00	12.0	Ductile Iron	120.0	false	Open	26.85	0.08	298.07	298.07	0.00	0.00	J16	J17	Open
P17	619.00	12.0	Ductile Iron	120.0	false	Open	11.92	0.03	298.07	298.07	0.00	0.00	J17	J18	Open
P18	374.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	298.07	298.07	0.00	0.00	J18	J19	Open
P19	143.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	298.07	298.07	0.00	0.00	J19	J20	Open
P20	361.00	6.0	Ductile Iron	120.0	false	Open	254.27	2.89	313.36	310.90	2.46	6.81	J4	J21	Open
P21	361.00	4.0	Ductile Iron	120.0	false	Open	79.51	2.03	310.74	308.69	2.06	5.70	J5	J22	Open
P22	336.00	6.0	Ductile Iron	120.0	false	Open	249.93	2.84	310.90	308.69	2.22	6.60	J21	J22	Open
P23	376.00	6.0	Ductile Iron	120.0	false	Open	325.10	3.69	308.69	304.65	4.04	10.74	J22	J23	Open
P24	326.00	4.0	Ductile Iron	120.0	false	Open	92.86	2.37	304.65	302.17	2.48	7.60	J23	J8	Open
P25	531.00	6.0	Ductile Iron	120.0	false	Open	220.87	2.51	304.65	301.86	2.79	5.25	J23	J24	Open
P26	304.00	6.0	Ductile Iron	120.0	false	Open	217.65	2.47	301.86	300.31	1.55	5.11	J24	J9	Open
P27	589.00	8.0	Ductile Iron	120.0	false	Open	50.04	0.32	298.12	298.07	0.05	0.08	J13	J25	Open
P28	652.00	8.0	Ductile Iron	120.0	false	Open	12.13	0.08	298.07	298.07	0.00	0.01	J25	J26	Open
P29	1,340.00	6.0	Ductile Iron	120.0	false	Open	-8.77	0.10	298.07	298.09	0.02	0.01	J26	J27	Open
P30	686.00	6.0	Ductile Iron	120.0	false	Open	-18.01	0.20	298.09	298.12	0.03	0.05	J27	J13	Open
P31	485.00	8.0	Ductile Iron	120.0	false	Open	1.04	0.01	298.07	298.07	0.00	0.00	J26	J28	Open
P32	317.00	8.0	Ductile Iron	120.0	false	Open	2.08	0.01	298.07	298.07	0.00	0.00	J28	J29	Open
P33	462.00	6.0	Ductile Iron	120.0	false	Open	-2.21	0.03	298.07	298.07	0.00	0.00	J29	J30	Open
P34	147.00	8.0	Ductile Iron	120.0	false	Open	-8.02	0.05	298.07	298.07	0.00	0.00	J28	J30	Open
P35	186.00	8.0	Ductile Iron	120.0	false	Open	-22.59	0.14	298.07	298.07	0.00	0.02	J30	J25	Open
P36	300.00	12.0	Ductile Iron	120.0	false	Open	61.12	0.17	298.09	298.09	0.00	0.02	J14	J31	Open
P37	510.00	12.0	Ductile Iron	120.0	false	Open	58.50	0.17	298.09	298.08	0.01	0.02	J31	J32	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P38	374.00	12.0	Ductile Iron	120.0	false	Open	50.60	0.14	298.08	298.07	0.00	0.01	J32	J33	Open
P39	662.00	12.0	Ductile Iron	120.0	false	Open	47.45	0.13	298.07	298.07	0.01	0.01	J33	J34	Open
P40	545.00	12.0	Ductile Iron	120.0	false	Open	44.23	0.13	298.07	298.06	0.00	0.01	J34	J35	Open
P41	1,563.00	12.0	Ductile Iron	120.0	false	Open	50.46	0.14	298.06	298.04	0.02	0.01	J35	J36	Open
P42	356.00	12.0	Ductile Iron	120.0	false	Open	28.63	0.08	298.04	298.04	0.00	0.00	J36	J40	Open
P43	884.00	12.0	Ductile Iron	120.0	false	Open	14.42	0.04	298.04	298.04	0.00	0.00	J40	J41	Open
P44	294.00	12.0	Ductile Iron	120.0	false	Open	11.91	0.03	298.04	298.04	0.00	0.00	J41	J42	Open
P45	278.00	6.0	Ductile Iron	120.0	false	Open	2.26	0.03	298.09	298.09	0.00	0.00	J27	J31	Open
P46	273.00	8.0	Ductile Iron	120.0	false	Open	8.05	0.05	298.08	298.08	0.00	0.00	J32	J37	Open
P47	222.00	8.0	Ductile Iron	120.0	false	Open	1.43	0.01	298.06	298.06	0.00	0.00	J35	J38	Open
P48	181.00	8.0	Ductile Iron	120.0	false	Open	1.07	0.01	298.06	298.06	0.00	0.00	J38	J39	Open
P49	842.00	8.0	Ductile Iron	120.0	false	Open	9.56	0.06	298.04	298.04	0.00	0.00	J40	J43	Open
P50	221.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	298.04	298.04	0.00	0.00	J43	J44	Open
P51	370.00	8.0	Ductile Iron	120.0	false	Open	3.83	0.02	298.04	298.04	0.00	0.00	J43	J45	Open
P52	433.00	8.0	Ductile Iron	120.0	false	Open	5.01	0.03	298.04	298.04	0.00	0.00	J45	J46	Open
P53	768.00	8.0	Ductile Iron	120.0	false	Open	-5.83	0.04	298.04	298.04	0.00	0.00	J45	J47	Open
P54	236.00	8.0	Ductile Iron	120.0	false	Open	-10.48	0.07	298.04	298.04	0.00	0.00	J47	J42	Open
P55	629.00	8.0	Ductile Iron	120.0	false	Open	-5.87	0.04	298.08	298.08	0.00	0.00	J32	J15	Open
P56	471.00	8.0	Ductile Iron	120.0	false	Open	-8.02	0.05	298.06	298.06	0.00	0.00	J35	J48	Open
P57	400.00	8.0	Ductile Iron	120.0	false	Open	0.36	0.00	298.06	298.06	0.00	0.00	J48	J49	Open
P58	309.00	12.0	Ductile Iron	120.0	false	Open	18.61	0.05	298.04	298.04	0.00	0.00	J36	J50	Open
P59	748.00	12.0	Ductile Iron	120.0	false	Open	2.51	0.01	298.04	298.04	0.00	0.00	J50	J51	Open
P60	289.00	8.0	Ductile Iron	120.0	false	Open	12.88	0.08	298.04	298.04	0.00	0.01	J50	J52	Open
P61	490.00	8.0	Ductile Iron	120.0	false	Open	6.80	0.04	298.04	298.04	0.00	0.00	J52	J53	Open
P62	725.00	8.0	Ductile Iron	120.0	false	Open	1.79	0.01	298.04	298.04	0.00	0.00	J52	J54	Open
P63	306.00	8.0	Ductile Iron	120.0	false	Open	1.09	0.01	298.07	298.07	0.00	0.00	J16	J55	Open
P64	397.00	8.0	Ductile Iron	120.0	false	Open	-0.63	0.00	298.07	298.07	0.00	0.00	J55	J56	Open
P65	131.00	8.0	Ductile Iron	120.0	false	Open	-1.20	0.01	298.07	298.07	0.00	0.00	J56	J16	Open
P66	106.00	8.0	Ductile Iron	120.0	false	Open	12.07	0.08	298.07	298.07	0.00	0.01	J17	J57	Open
P67	105.00	8.0	Ductile Iron	120.0	false	Open	-6.04	0.04	298.07	298.07	0.00	0.00	J58	J57	Open
P68	305.00	8.0	Ductile Iron	120.0	false	Open	-6.04	0.04	298.07	298.07	0.00	0.00	J60	J58	Open
P69	305.00	8.0	Ductile Iron	120.0	false	Open	6.04	0.04	298.07	298.07	0.00	0.00	J57	J59	Open
P70	105.00	8.0	Ductile Iron	120.0	false	Open	6.04	0.04	298.07	298.07	0.00	0.00	J59	J60	Open
P71	756.00	8.0	Ductile Iron	120.0	false	Open	12.07	0.08	298.07	298.06	0.00	0.01	J60	J48	Open
P72	230.00	8.0	Ductile Iron	120.0	false	Open	11.56	0.07	298.07	298.07	0.00	0.01	J18	J61	Open
P73	349.00	8.0	Ductile Iron	120.0	false	Open	225.50	1.44	299.08	298.61	0.47	1.34	J10	J62	Open
P74	401.00	8.0	Ductile Iron	120.0	false	Open	280.27	1.79	298.61	297.81	0.81	2.01	J62	J63	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P75	349.00	8.0	Ductile Iron	120.0	false	Open	129.31	0.83	298.86	298.70	0.17	0.48	J11	J64	Open
P76	365.00	4.0	Asbestos Cement	140.0	false	Open	55.74	1.42	298.70	297.89	0.81	2.22	J64	J65	Open
P77	171.00	6.0	Ductile Iron	120.0	false	Open	-62.00	0.70	298.61	298.70	0.09	0.50	J62	J64	Open
P78	181.00	6.0	Ductile Iron	120.0	false	Open	4.34	0.05	298.70	298.70	0.00	0.00	J64	J66	Open
P79	1,208.00	8.0	Asbestos Cement	140.0	false	Open	92.67	0.59	298.12	297.89	0.23	0.19	J13	J65	Open
P80	176.00	8.0	Asbestos Cement	140.0	false	Open	147.26	0.94	297.89	297.81	0.08	0.46	J65	J63	Open
P81	585.00	8.0	Ductile Iron	120.0	false	Open	208.56	1.33	298.12	297.44	0.68	1.16	J13	J67	Open
P82	627.00	8.0	Ductile Iron	120.0	false	Open	202.26	1.29	297.44	296.75	0.69	1.10	J67	J68	Open
P83	418.00	8.0	Ductile Iron	120.0	false	Open	196.35	1.25	296.75	296.32	0.43	1.04	J68	J69	Open
P84	414.00	8.0	Ductile Iron	120.0	false	Open	112.92	0.72	296.32	296.16	0.15	0.37	J69	J70	Open
P85	493.00	8.0	Ductile Iron	120.0	false	Open	181.93	1.16	296.16	295.72	0.44	0.90	J70	J80	Open
P86	222.00	8.0	Ductile Iron	120.0	false	Open	78.60	0.50	296.32	296.28	0.04	0.19	J69	J71	Open
P87	400.00	8.0	Ductile Iron	120.0	false	Open	76.88	0.49	296.28	296.20	0.07	0.18	J71	J72	Open
P88	220.00	8.0	Ductile Iron	120.0	false	Open	75.45	0.48	296.20	296.16	0.04	0.18	J72	J70	Open
P89	335.00	8.0	Ductile Iron	120.0	false	Open	0.57	0.00	298.09	298.09	0.00	0.00	J14	J73	Open
P90	731.00	8.0	Ductile Iron	120.0	false	Open	1.43	0.01	298.08	298.08	0.00	0.00	J15	J74	Open
P91	729.00	8.0	Ductile Iron	120.0	false	Closed	0.00	0.00	298.08	256.49	0.00	0.00	J74	J75	Closed
P92	332.00	12.0	Ductile Iron	120.0	false	Open	1,996.68	5.66	304.44	300.93	3.51	10.58	J7	J76	Open
P93	333.00	4.0	Ductile Iron	120.0	false	Open	110.84	2.83	304.44	300.93	3.51	10.55	J7	J76	Open
P94	362.00	12.0	Ductile Iron	120.0	false	Open	1,026.04	2.91	300.93	299.81	1.12	3.08	J76	J77	Open
P95	284.00	8.0	Ductile Iron	120.0	false	Open	603.10	3.85	302.17	299.81	2.36	8.30	J8	J77	Open
P96	624.00	12.0	Ductile Iron	120.0	false	Open	708.42	2.01	299.81	298.85	0.97	1.55	J77	J78	Open
P97	524.00	8.0	Ductile Iron	120.0	false	Open	335.12	2.14	300.31	298.85	1.47	2.80	J9	J78	Open
P98	743.00	12.0	Ductile Iron	120.0	false	Open	1,034.59	2.93	298.85	296.52	2.33	3.13	J78	J79	Open
P99	396.00	8.0	Asbestos Cement	140.0	false	Open	423.92	2.71	297.81	296.52	1.29	3.25	J63	J79	Open
P100	384.00	10.0	Ductile Iron	120.0	false	Open	513.98	2.10	296.52	295.72	0.80	2.08	J79	J80	Open
P101	306.00	10.0	Ductile Iron	120.0	false	Open	686.78	2.81	295.72	294.63	1.09	3.56	J80	J81	Open
P102	947.00	10.0	Ductile Iron	120.0	false	Open	683.02	2.79	294.63	291.29	3.34	3.53	J81	J82	Open
P103	305.00	10.0	Ductile Iron	120.0	false	Open	676.58	2.76	291.29	290.23	1.06	3.47	J82	J83	Open
P104	569.00	12.0	Ductile Iron	120.0	false	Open	910.59	2.58	299.81	298.41	1.41	2.47	J77	J84	Open
P105	396.00	12.0	Ductile Iron	120.0	false	Open	893.82	2.54	298.41	297.46	0.95	2.39	J84	J85	Open
P106	534.00	10.0	Cast iron	100.0	false	Open	485.02	1.98	297.46	296.06	1.40	2.62	J85	J86	Open
P107	369.00	14.0	Ductile Iron	120.0	false	Open	-940.81	1.96	296.06	296.52	0.46	1.24	J86	J79	Open
P108	485.00	6.0	Asbestos Cement	140.0	false	Open	252.14	2.86	297.46	295.02	2.44	5.04	J85	J203	Open
P109	336.00	8.0	Ductile Iron	120.0	false	Open	-16.21	0.10	295.02	295.02	0.00	0.01	J203	J87	Open
P110	1,112.00	8.0	Ductile Iron	120.0	false	Open	266.74	1.70	295.02	292.98	2.04	1.83	J203	J88	Open
P111	391.00	14.0	Ductile Iron	120.0	false	Open	1,421.82	2.96	296.06	295.02	1.04	2.66	J86	J87	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P112	786.00	14.0	Ductile Iron	120.0	false	Open	1,403.03	2.92	295.02	292.98	2.04	2.60	J87	J88	Open
P113	1,303.00	14.0	Ductile Iron	120.0	false	Open	1,663.04	3.47	292.98	288.34	4.64	3.56	J88	J89	Open
P114	1,153.00	14.0	Ductile Iron	120.0	false	Open	3,485.26	7.26	288.34	272.19	16.15	14.01	J89	J90	Open
P115	37.00	4.0	Ductile Iron	120.0	false	Closed	0.00	0.00	211.75	272.19	0.00	0.00	J479	J90	Close
P116	684.00	14.0	Ductile Iron	120.0	false	Open	3,480.25	7.25	272.19	262.63	9.56	13.97	J90	J91	Open
P117	792.00	14.0	Ductile Iron	120.0	false	Open	3,463.43	7.22	262.63	251.67	10.97	13.85	J91	J92	Open
P118	265.00	14.0	Ductile Iron	120.0	false	Open	3,216.84	6.70	251.67	248.47	3.20	12.08	J92	J93	Open
P119	256.00	14.0	Ductile Iron	120.0	false	Open	3,389.55	7.06	248.47	245.06	3.41	13.30	J93	J94	Open
P120	8.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	245.06	245.06	0.00	0.00	PRV1	J94	Open
P121	7.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	245.06	245.06	0.00	0.00	PRV1	J94	Open
P122	940.00	14.0	Ductile Iron	120.0	false	Open	-3,389.56	7.06	232.55	245.06	12.51	13.30	J95	J94	Open
P123	23.00	20.0	Ductile Iron	120.0	false	Open	3,389.56	3.46	232.55	232.50	0.05	2.34	J95	T1	Open
P124	1,149.00	4.0	Asbestos Cement	140.0	false	Open	0.29	0.01	296.06	296.06	0.00	0.00	J86	J97	Open
P125	629.00	4.0	Asbestos Cement	140.0	false	Closed	0.00	0.00	296.06	211.73	0.00	0.00	J97	J475	Close
P126	314.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	294.63	294.63	0.00	0.00	J81	J96	Open
P127	207.00	4.0	Asbestos Cement	140.0	false	Closed	0.00	0.00	294.63	211.73	0.00	0.00	J96	J475	Close
P128	391.00	4.0	Ductile Iron	120.0	false	Closed	0.00	0.00	291.29	211.73	0.00	0.00	J82	J476	Close
P129	67.00	1.5	Ductile Iron	120.0	false	Open	0.00	0.00	211.75	211.75	0.00	0.00	PRV1	J478	Open
P130	67.00	4.0	Ductile Iron	120.0	false	Open	-0.00	0.00	211.75	211.75	0.00	0.00	J478	PRV2	Open
P131	552.00	10.0	Ductile Iron	120.0	false	Open	672.29	2.75	290.23	288.34	1.89	3.42	J83	J89	Open
P132	235.00	12.0	Asbestos Cement	140.0	false	Open	-1,157.45	3.28	288.34	289.02	0.68	2.90	J89	J98	Open
P133	1,303.00	12.0	Asbestos Cement	140.0	false	Open	-1,163.90	3.30	289.02	292.84	3.81	2.93	J98	J125	Open
P134	240.00	8.0	Ductile Iron	120.0	false	Open	3.94	0.03	289.02	289.02	0.00	0.00	J98	J99	Open
P135	306.00	10.0	Ductile Iron	120.0	false	Open	11.81	0.05	262.63	262.63	0.00	0.00	J91	J100	Open
P136	450.00	8.0	Ductile Iron	120.0	false	Open	6.80	0.04	262.63	262.63	0.00	0.00	J100	J101	Open
P137	519.00	10.0	Asbestos Cement	140.0	false	Open	10.57	0.04	251.67	251.67	0.00	0.00	J92	J102	Open
P138	403.00	10.0	Asbestos Cement	140.0	false	Open	4.84	0.02	251.67	251.67	0.00	0.00	J102	J103	Open
P139	271.00	10.0	Asbestos Cement	140.0	false	Open	2.64	0.01	251.67	251.67	0.00	0.00	J103	J104	Open
P140	288.00	14.0	PVC	150.0	false	Open	2.15	0.00	251.67	251.67	0.00	0.00	J104	J105	Open
P141	272.00	8.0	Asbestos Cement	140.0	false	Open	3.58	0.02	251.67	251.67	0.00	0.00	J102	J106	Open
P142	275.00	8.0	Ductile Iron	120.0	false	Open	1.13	0.01	251.67	251.67	0.00	0.00	J103	J107	Open
P143	1,207.00	12.0	Ductile Iron	120.0	false	Open	0.59	0.00	251.67	251.67	0.00	0.00	J107	J109	Open
P144	340.00	8.0	Ductile Iron	120.0	false	Open	-0.05	0.00	251.67	251.67	0.00	0.00	J104	J108	Open
P145	164.00	12.0	Ductile Iron	120.0	false	Open	-0.05	0.00	251.67	251.67	0.00	0.00	J108	J109	Open
P146	544.00	12.0	Ductile Iron	120.0	false	Open	232.09	0.66	251.67	251.56	0.11	0.20	J92	J110	Open
P147	323.00	12.0	Ductile Iron	120.0	false	Open	45.77	0.13	251.56	251.56	0.00	0.01	J110	J111	Open
P148	285.00	12.0	Ductile Iron	120.0	false	Open	29.80	0.08	251.56	251.56	0.00	0.00	J111	J112	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P149	829.00	12.0	Ductile Iron	120.0	false	Open	25.73	0.07	251.56	251.55	0.00	0.00	J112	J113	Open
P150	339.00	12.0	Ductile Iron	120.0	false	Open	7.26	0.02	251.55	251.55	0.00	0.00	J113	J114	Open
P151	204.00	12.0	Ductile Iron	120.0	false	Open	5.11	0.01	251.55	251.55	0.00	0.00	J114	J115	Open
P152	553.00	6.0	Ductile Iron	120.0	false	Open	-172.72	1.96	248.47	250.31	1.84	3.33	J93	J116	Open
P153	144.00	6.0	Ductile Iron	120.0	false	Open	0.00	0.00	250.31	250.31	0.00	0.00	PRV4	J116	Open
P154	348.00	6.0	Ductile Iron	120.0	false	Open	-180.24	2.05	250.31	251.56	1.25	3.60	J116	J110	Open
P155	710.00	10.0	Ductile Iron	120.0	false	Open	11.32	0.05	251.56	251.56	0.00	0.00	J111	J117	Open
P156	750.00	8.0	Ductile Iron	120.0	false	Open	-0.49	0.00	251.56	251.56	0.00	0.00	J117	J112	Open
P157	491.00	8.0	Ductile Iron	120.0	false	Open	16.32	0.10	251.55	251.55	0.01	0.01	J113	J118	Open
P158	525.00	8.0	Ductile Iron	120.0	false	Open	9.05	0.06	251.55	251.55	0.00	0.00	J118	J119	Open
P159	504.00	8.0	Ductile Iron	120.0	false	Open	1.08	0.01	251.55	251.55	0.00	0.00	J114	J115	Open
P160	334.00	12.0	Ductile Iron	120.0	false	Open	1,074.50	3.05	300.93	299.81	1.12	3.36	J76	J120	Open
P161	838.00	12.0	Ductile Iron	130.0	false	Open	1,068.78	3.03	299.81	297.41	2.40	2.87	J120	J121	Open
P162	339.00	12.0	Ductile Iron	130.0	false	Open	1,203.04	3.41	297.41	296.20	1.21	3.57	J121	J122	Open
P163	329.00	12.0	Ductile Iron	130.0	false	Open	1,069.13	3.03	296.20	295.25	0.94	2.87	J122	J123	Open
P164	269.00	12.0	Ductile Iron	130.0	false	Open	918.05	2.60	295.25	294.67	0.58	2.16	J123	J124	Open
P165	896.00	12.0	Ductile Iron	130.0	false	Open	890.95	2.53	294.67	292.84	1.83	2.05	J124	J125	Open
P166	235.00	12.0	Ductile Iron	130.0	false	Open	-273.50	0.78	292.84	292.89	0.05	0.23	J125	J126	Open
P167	531.00	12.0	Ductile Iron	130.0	false	Open	-0.54	0.00	292.89	292.89	0.00	0.00	J128	J126	Open
P168	323.00	8.0	Ductile Iron	120.0	false	Open	1.43	0.01	299.81	299.81	0.00	0.00	J120	J129	Open
P169	182.00	10.0	Ductile Iron	120.0	false	Open	152.33	0.62	297.46	297.42	0.04	0.22	J85	J130	Open
P170	182.00	12.0	Ductile Iron	120.0	false	Open	151.61	0.43	297.42	297.41	0.02	0.09	J130	J121	Open
P171	585.00	6.0	Asbestos Cement	140.0	false	Open	122.35	1.39	296.20	295.42	0.77	1.32	J122	J131	Open
P172	584.00	8.0	Asbestos Cement	140.0	false	Open	140.89	0.90	295.25	295.01	0.25	0.42	J123	J132	Open
P173	196.00	8.0	Asbestos Cement	140.0	false	Open	23.49	0.15	294.67	294.67	0.00	0.02	J124	J133	Open
P174	388.00	6.0	Asbestos Cement	140.0	false	Open	16.52	0.19	294.67	294.65	0.01	0.03	J133	J134	Open
P175	840.00	8.0	Asbestos Cement	140.0	false	Open	2.68	0.02	294.67	294.67	0.00	0.00	J133	J135	Open
P176	329.00	6.0	Asbestos Cement	140.0	false	Open	119.77	1.36	295.42	295.01	0.42	1.27	J131	J132	Open
P177	269.00	8.0	Asbestos Cement	140.0	false	Open	258.95	1.65	295.01	294.65	0.35	1.30	J132	J134	Open
P178	1,091.00	8.0	Asbestos Cement	140.0	false	Open	272.03	1.74	294.65	293.10	1.56	1.43	J134	J136	Open
P179	158.00	6.0	Ductile Iron	120.0	false	Open	5.19	0.06	292.89	292.89	0.00	0.01	J126	J127	Open
P180	984.00	12.0	Asbestos Cement	140.0	false	Open	-279.77	0.79	292.89	293.10	0.21	0.21	J126	J136	Open
P181	857.00	12.0	Asbestos Cement	140.0	false	Open	-25.46	0.07	293.10	293.10	0.00	0.00	J136	J137	Open
P182	1,950.00	12.0	Ductile Iron	130.0	false	Open	141.73	0.40	293.10	292.97	0.13	0.07	J137	J138	Open
P183	676.00	12.0	Ductile Iron	130.0	false	Open	127.24	0.36	292.97	292.93	0.04	0.06	J138	J139	Open
P184	672.00	12.0	Ductile Iron	130.0	false	Open	122.41	0.35	292.93	292.89	0.03	0.05	J139	J140	Open
P185	1,054.00	12.0	Ductile Iron	130.0	false	Open	110.25	0.31	292.89	292.85	0.05	0.04	J140	J141	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P186	452.00	12.0	Ductile Iron	130.0	false	Open	81.05	0.23	292.85	292.84	0.01	0.02	J141	J142	Open
P187	452.00	12.0	Ductile Iron	130.0	false	Open	76.22	0.22	292.84	292.83	0.01	0.02	J142	J143	Open
P188	677.00	12.0	Ductile Iron	130.0	false	Open	75.89	0.22	292.83	292.81	0.01	0.02	J143	J144	Open
P189	621.00	12.0	Ductile Iron	130.0	false	Open	60.65	0.17	292.81	292.80	0.01	0.01	J144	J145	Open
P190	469.00	12.0	Ductile Iron	130.0	false	Open	64.25	0.18	292.80	292.80	0.01	0.02	J145	J146	Open
P191	1,538.00	12.0	Ductile Iron	130.0	false	Open	61.57	0.17	292.80	292.77	0.02	0.01	J146	J147	Open
P192	856.00	12.0	Ductile Iron	130.0	false	Open	17.90	0.05	292.77	292.77	0.00	0.00	J147	J148	Open
P193	567.00	6.0	Ductile Iron	120.0	false	Open	10.20	0.12	292.97	292.96	0.01	0.02	J138	J149	Open
P194	230.00	6.0	Ductile Iron	120.0	false	Open	3.76	0.04	292.96	292.96	0.00	0.00	J149	J150	Open
P195	172.00	6.0	Ductile Iron	120.0	false	Open	1.43	0.02	292.96	292.96	0.00	0.00	J150	J151	Open
P196	263.00	6.0	Ductile Iron	120.0	false	Open	3.76	0.04	292.96	292.96	0.00	0.00	J149	J152	Open
P197	330.00	6.0	Ductile Iron	120.0	false	Open	0.72	0.01	292.96	292.96	0.00	0.00	J150	J153	Open
P198	260.00	12.0	Ductile Iron	120.0	false	Open	2.15	0.01	292.93	292.93	0.00	0.00	J139	J154	Open
P199	639.00	10.0	Asbestos Cement	140.0	false	Open	3.76	0.02	292.89	292.89	0.00	0.00	J140	J155	Open
P200	687.00	8.0	Ductile Iron	120.0	false	Open	5.72	0.04	292.89	292.89	0.00	0.00	J140	J156	Open
P201	687.00	8.0	Ductile Iron	120.0	false	Open	2.86	0.02	292.89	292.89	0.00	0.00	J156	J157	Open
P202	869.00	8.0	Ductile Iron	120.0	false	Open	21.68	0.14	292.85	292.83	0.02	0.02	J141	J158	Open
P203	684.00	8.0	Ductile Iron	120.0	false	Open	12.02	0.08	292.83	292.83	0.00	0.01	J158	J159	Open
P204	970.00	8.0	Ductile Iron	120.0	false	Open	5.58	0.04	292.83	292.83	0.00	0.00	J159	J143	Open
P205	350.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	292.84	292.84	0.00	0.00	J142	J160	Open
P206	735.00	8.0	Ductile Iron	120.0	false	Open	13.63	0.09	292.81	292.81	0.01	0.01	J144	J161	Open
P207	688.00	8.0	Ductile Iron	120.0	false	Open	1.43	0.01	292.81	292.81	0.00	0.00	J161	J162	Open
P208	629.00	8.0	Ductile Iron	120.0	false	Open	-4.68	0.03	292.80	292.81	0.00	0.00	J145	J163	Open
P209	482.00	8.0	Ductile Iron	120.0	false	Open	-8.64	0.06	292.81	292.81	0.00	0.00	J163	J164	Open
P210	483.00	4.0	Ductile Iron	120.0	false	Open	1.40	0.04	292.81	292.81	0.00	0.00	J164	J165	Open
P211	688.00	4.0	Ductile Iron	120.0	false	Open	0.41	0.01	292.81	292.80	0.00	0.00	J165	J166	Open
P212	617.00	8.0	Ductile Iron	120.0	false	Open	-2.81	0.02	292.80	292.81	0.00	0.00	J166	J163	Open
P213	206.00	8.0	Ductile Iron	120.0	false	Open	1.16	0.01	292.81	292.81	0.00	0.00	J163	J165	Open
P214	241.00	8.0	Ductile Iron	120.0	false	Open	10.59	0.07	292.81	292.81	0.00	0.00	J161	J164	Open
P215	505.00	8.0	Ductile Iron	120.0	false	Open	0.54	0.00	292.80	292.80	0.00	0.00	J145	J167	Open
P216	482.00	8.0	Ductile Iron	120.0	false	Open	14.32	0.09	292.77	292.77	0.00	0.01	J147	J168	Open
P217	329.00	8.0	Ductile Iron	120.0	false	Open	6.13	0.04	292.77	292.77	0.00	0.00	J168	J169	Open
P218	802.00	8.0	Ductile Iron	120.0	false	Open	1.84	0.01	292.77	292.77	0.00	0.00	J169	J170	Open
P219	479.00	8.0	Ductile Iron	120.0	false	Open	-5.68	0.04	292.77	292.77	0.00	0.00	J170	J168	Open
P220	894.00	8.0	Ductile Iron	120.0	false	Open	27.20	0.17	292.77	292.75	0.02	0.03	J147	J171	Open
P221	1,539.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	292.75	292.75	0.00	0.00	J171	J172	Open
P222	553.00	8.0	Ductile Iron	120.0	false	Open	21.83	0.14	292.75	292.74	0.01	0.02	J171	J173	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P223	994.00	8.0	Ductile Iron	120.0	false	Open	5.01	0.03	292.74	292.74	0.00	0.00	J173	J174	Open
P224	216.00	8.0	Ductile Iron	120.0	false	Open	10.74	0.07	292.74	292.74	0.00	0.00	J173	J175	Open
P225	176.00	8.0	Ductile Iron	120.0	false	Open	17.18	0.11	292.77	292.77	0.00	0.01	J148	J176	Open
P226	433.00	8.0	Ductile Iron	120.0	false	Open	6.69	0.04	292.77	292.77	0.00	0.00	J176	J177	Open
P227	133.00	8.0	Ductile Iron	120.0	false	Open	4.57	0.03	292.77	292.77	0.00	0.00	J177	J178	Open
P228	891.00	8.0	Ductile Iron	120.0	false	Open	-0.03	0.00	292.77	292.77	0.00	0.00	J178	J179	Open
P229	144.00	8.0	Ductile Iron	120.0	false	Open	-4.37	0.03	292.77	292.77	0.00	0.00	J179	J180	Open
P230	312.00	8.0	Ductile Iron	120.0	false	Open	-7.98	0.05	292.77	292.77	0.00	0.00	J180	J176	Open
P231	419.00	8.0	Ductile Iron	120.0	false	Open	-0.03	0.00	292.77	292.77	0.00	0.00	J177	J180	Open
P232	424.00	8.0	Ductile Iron	120.0	false	Open	-0.05	0.00	292.77	292.77	0.00	0.00	J178	J179	Open
P233	340.00	6.0	Ductile Iron	120.0	false	Open	243.36	2.76	318.17	316.04	2.14	6.28	J3	J181	Open
P234	475.00	6.0	Ductile Iron	120.0	false	Open	236.56	2.68	316.04	313.21	2.83	5.96	J181	J182	Open
P235	336.00	8.0	Ductile Iron	120.0	false	Open	360.95	2.30	313.21	312.13	1.08	3.21	J182	J183	Open
P236	332.00	8.0	Ductile Iron	120.0	false	Open	178.40	1.14	312.13	311.84	0.29	0.87	J183	J184	Open
P237	370.00	4.0	Ductile Iron	120.0	false	Open	163.87	4.18	311.84	303.79	8.05	21.76	J184	J185	Open
P238	339.00	12.0	Ductile Iron	120.0	false	Open	366.57	1.04	313.36	313.21	0.16	0.46	J4	J182	Open
P239	338.00	8.0	Ductile Iron	120.0	false	Open	-411.72	2.63	310.74	312.13	1.38	4.10	J5	J183	Open
P240	201.00	6.0	Ductile Iron	120.0	false	Open	4.12	0.05	316.04	316.04	0.00	0.00	J181	J186	Open
P241	201.00	8.0	Ductile Iron	120.0	false	Open	240.73	1.54	313.21	312.90	0.30	1.52	J182	J187	Open
P242	537.00	8.0	Ductile Iron	120.0	false	Open	234.23	1.50	312.90	312.13	0.77	1.44	J187	J183	Open
P243	336.00	12.0	Ductile Iron	120.0	false	Open	799.78	2.27	304.44	303.79	0.65	1.94	J7	J185	Open
P244	952.00	12.0	Ductile Iron	120.0	false	Open	955.20	2.71	303.79	301.22	2.57	2.70	J185	J188	Open
P245	767.00	12.0	Ductile Iron	120.0	false	Open	778.41	2.21	301.22	299.80	1.42	1.85	J188	J189	Open
P246	305.00	12.0	Ductile Iron	120.0	false	Open	769.43	2.18	299.80	299.25	0.55	1.81	J189	J190	Open
P247	184.00	12.0	Ductile Iron	110.0	false	Open	628.71	1.78	299.25	298.98	0.27	1.46	J190	J191	Open
P248	504.00	12.0	Ductile Iron	120.0	false	Open	574.79	1.63	298.98	298.45	0.53	1.05	J191	J192	Open
P249	574.00	10.0	Ductile Iron	120.0	false	Open	696.60	2.85	298.45	296.35	2.10	3.66	J192	J193	Open
P250	297.00	10.0	Ductile Iron	120.0	false	Open	528.92	2.16	296.35	295.70	0.65	2.20	J193	J194	Open
P251	558.00	10.0	Ductile Iron	120.0	false	Open	431.05	1.76	295.70	294.86	0.84	1.50	J194	J195	Open
P252	1,071.00	10.0	Ductile Iron	120.0	false	Open	391.46	1.60	294.86	293.51	1.35	1.26	J195	J196	Open
P253	506.00	10.0	Asbestos Cement	140.0	false	Open	189.18	0.77	293.51	293.39	0.12	0.25	J196	J197	Open
P254	552.00	10.0	Asbestos Cement	140.0	false	Open	181.56	0.74	293.39	293.26	0.13	0.23	J197	J198	Open
P255	250.00	10.0	Asbestos Cement	140.0	false	Open	175.72	0.72	293.26	293.21	0.05	0.21	J198	J199	Open
P256	438.00	10.0	Asbestos Cement	140.0	false	Open	170.35	0.70	293.21	293.12	0.09	0.20	J199	J200	Open
P257	1,948.00	10.0	Asbestos Cement	140.0	false	Open	157.47	0.64	293.12	292.78	0.34	0.18	J200	J201	Open
P258	1,029.00	10.0	Asbestos Cement	140.0	false	Open	132.42	0.54	292.78	292.65	0.13	0.13	J201	J202	Open
P259	67.00	2.0	Ductile Iron	120.0	false	Open	86.45	8.83	292.65	279.60	13.05	194.80	J202	PRV5	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P260	67.00	10.0	Ductile Iron	120.0	false	Open	45.96	0.19	292.65	292.65	0.00	0.02	J202	PRV6	Open
P261	150.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	301.22	301.22	0.00	0.00	J188	J204	Open
P262	192.00	8.0	Ductile Iron	120.0	false	Open	1.61	0.01	299.80	299.80	0.00	0.00	J189	J205	Open
P263	482.00	8.0	Ductile Iron	120.0	false	Open	0.54	0.00	299.80	299.80	0.00	0.00	J205	J206	Open
P264	1,026.00	8.0	Ductile Iron	120.0	false	Open	8.41	0.05	298.98	298.98	0.00	0.00	J191	J207	Open
P265	700.00	8.0	Asbestos Cement	140.0	false	Open	5.19	0.03	298.98	298.98	0.00	0.00	J207	J208	Open
P266	299.00	12.0	Ductile Iron	120.0	false	Open	200.68	0.57	293.51	293.47	0.04	0.15	J196	J209	Open
P267	663.00	12.0	Ductile Iron	120.0	false	Open	176.60	0.50	293.47	293.39	0.08	0.12	J209	J210	Open
P268	2,654.00	12.0	Ductile Iron	120.0	false	Open	168.80	0.48	293.39	293.10	0.29	0.11	J210	J137	Open
P269	1,047.00	12.0	Ductile Iron	120.0	false	Open	1.07	0.00	293.47	293.47	0.00	0.00	J209	J211	Open
P270	640.00	8.0	Ductile Iron	120.0	false	Open	15.14	0.10	293.47	293.46	0.01	0.01	J209	J212	Open
P271	478.00	6.0	Asbestos Cement	140.0	false	Open	6.80	0.08	293.12	293.12	0.00	0.01	J200	J213	Open
P272	277.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	293.26	293.26	0.00	0.00	J198	J214	Open
P273	455.00	6.0	Ductile Iron	120.0	false	Open	1.61	0.02	293.26	293.26	0.00	0.00	J214	J215	Open
P274	467.00	8.0	Ductile Iron	120.0	false	Open	22.19	0.14	292.78	292.77	0.01	0.02	J201	J216	Open
P275	387.00	8.0	Ductile Iron	120.0	false	Open	15.39	0.10	292.77	292.77	0.00	0.01	J216	J217	Open
P276	560.00	8.0	Ductile Iron	120.0	false	Open	9.66	0.06	292.77	292.76	0.00	0.00	J217	J218	Open
P277	402.00	8.0	Ductile Iron	120.0	false	Open	5.01	0.03	292.76	292.76	0.00	0.00	J218	J219	Open
P278	390.00	8.0	Ductile Iron	120.0	false	Open	126.44	0.81	299.25	299.07	0.18	0.46	J190	J228	Open
P279	270.00	8.0	Ductile Iron	120.0	false	Open	1.61	0.01	299.07	299.07	0.00	0.00	J228	J229	Open
P280	278.00	8.0	Ductile Iron	120.0	false	Open	119.53	0.76	299.07	298.95	0.12	0.41	J228	J230	Open
P281	569.00	8.0	Ductile Iron	120.0	false	Open	36.03	0.23	298.98	298.95	0.03	0.04	J191	J230	Open
P282	1,068.00	8.0	Ductile Iron	120.0	false	Open	128.44	0.82	298.95	298.45	0.51	0.47	J230	J192	Open
P283	402.00	10.0	Ductile Iron	120.0	false	Open	162.38	0.66	296.35	296.25	0.10	0.25	J193	J242	Open
P284	502.00	10.0	Ductile Iron	120.0	false	Open	125.96	0.51	296.25	296.17	0.08	0.15	J242	J243	Open
P285	439.00	10.0	Ductile Iron	120.0	false	Open	7.15	0.03	296.17	296.17	0.00	0.00	J243	J244	Open
P286	346.00	10.0	Ductile Iron	120.0	false	Open	6.08	0.02	296.17	296.17	0.00	0.00	J244	J245	Open
P287	361.00	8.0	Ductile Iron	120.0	false	Open	4.47	0.03	296.17	296.17	0.00	0.00	J245	J246	Open
P288	693.00	10.0	Ductile Iron	120.0	false	Open	168.27	0.69	301.22	301.04	0.18	0.26	J188	J220	Open
P289	859.00	10.0	Ductile Iron	120.0	false	Open	159.20	0.65	301.04	300.83	0.20	0.24	J220	J221	Open
P290	398.00	10.0	Ductile Iron	120.0	false	Open	154.37	0.63	300.83	300.74	0.09	0.22	J221	J222	Open
P291	587.00	10.0	Ductile Iron	120.0	false	Open	55.77	0.23	300.74	300.72	0.02	0.03	J222	J223	Open
P292	514.00	10.0	Ductile Iron	120.0	false	Open	48.86	0.20	300.72	300.71	0.01	0.03	J223	J224	Open
P293	1,277.00	4.0	Asbestos Cement	140.0	false	Open	48.86	1.25	300.71	298.49	2.22	1.74	J224	J225	Open
P294	880.00	4.0	Asbestos Cement	140.0	false	Open	46.18	1.18	298.49	297.11	1.38	1.57	J225	J226	Open
P295	1,456.00	4.0	Asbestos Cement	140.0	false	Open	45.11	1.15	297.11	294.93	2.18	1.50	J226	J227	Open
P296	1,307.00	8.0	Ductile Iron	120.0	false	Open	8.53	0.05	301.04	301.03	0.00	0.00	J220	J231	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P297	440.00	8.0	Ductile Iron	120.0	false	Open	7.99	0.05	301.03	301.03	0.00	0.00	J231	J232	Open
P298	1,818.00	8.0	Ductile Iron	120.0	false	Open	6.91	0.04	301.03	301.03	0.00	0.00	J232	J233	Open
P299	643.00	8.0	Ductile Iron	120.0	false	Open	0.54	0.00	301.03	301.03	0.00	0.00	J232	J234	Open
P300	355.00	8.0	Ductile Iron	120.0	false	Open	98.60	0.63	300.74	300.64	0.10	0.29	J222	J235	Open
P301	159.00	8.0	Ductile Iron	120.0	false	Open	6.98	0.04	300.64	300.64	0.00	0.00	J235	J236	Open
P302	177.00	8.0	Ductile Iron	120.0	false	Open	0.54	0.00	300.64	300.64	0.00	0.00	J235	J237	Open
P303	554.00	10.0	Ductile Iron	120.0	false	Open	5.84	0.02	300.72	300.72	0.00	0.00	J223	J238	Open
P304	330.00	10.0	Ductile Iron	120.0	false	Open	1.08	0.00	300.72	300.72	0.00	0.00	J238	J239	Open
P305	179.00	8.0	Ductile Iron	120.0	false	Open	0.54	0.00	300.72	300.72	0.00	0.00	J239	J240	Open
P306	271.00	8.0	Ductile Iron	120.0	false	Open	0.54	0.00	300.72	300.72	0.00	0.00	J238	J241	Open
P307	1,116.00	12.0	Ductile Iron	120.0	false	Open	83.27	0.24	295.70	295.66	0.03	0.03	J194	J248	Open
P308	1,266.00	12.0	Ductile Iron	120.0	false	Open	231.05	0.66	295.66	295.42	0.25	0.19	J248	J250	Open
P309	1,453.00	12.0	Ductile Iron	120.0	false	Open	228.90	0.65	295.42	295.14	0.28	0.19	J250	J251	Open
P310	970.00	12.0	Ductile Iron	110.0	false	Open	226.22	0.64	295.14	294.93	0.21	0.22	J251	J227	Open
P311	843.00	8.0	Ductile Iron	120.0	false	Open	36.41	0.23	296.25	296.21	0.04	0.05	J242	J249	Open
P312	843.00	8.0	Ductile Iron	120.0	false	Open	36.41	0.23	296.21	296.17	0.04	0.05	J249	J243	Open
P313	412.00	8.0	Ductile Iron	120.0	false	Open	150.47	0.96	296.17	295.91	0.26	0.63	J243	J247	Open
P314	392.00	8.0	Ductile Iron	120.0	false	Open	149.93	0.96	295.91	295.66	0.25	0.63	J247	J248	Open
P315	1,693.00	12.0	Asbestos Cement	140.0	false	Open	33.76	0.10	294.86	294.85	0.01	0.00	J195	J252	Open
P316	1,278.00	12.0	Asbestos Cement	140.0	false	Open	32.69	0.09	294.85	294.85	0.01	0.00	J252	J253	Open
P317	1,766.00	12.0	Asbestos Cement	140.0	false	Open	27.50	0.08	294.85	294.84	0.01	0.00	J253	J255	Open
P318	403.00	8.0	Ductile Iron	130.0	false	Open	4.65	0.03	294.85	294.85	0.00	0.00	J253	J254	Open
P319	1,749.00	16.0	Ductile Iron	120.0	false	Open	196.95	0.31	294.93	294.86	0.06	0.04	J227	J256	Open
P320	1,819.00	12.0	Ductile Iron	120.0	false	Open	10.93	0.03	294.86	294.86	0.00	0.00	J256	J257	Open
P321	712.00	4.0	Asbestos Cement	140.0	false	Open	8.25	0.21	294.86	294.82	0.05	0.06	J257	J258	Open
P322	639.00	8.0	Ductile Iron	120.0	false	Open	5.39	0.03	294.82	294.82	0.00	0.00	J258	J259	Open
P323	816.00	12.0	Ductile Iron	120.0	false	Open	11.42	0.03	294.82	294.81	0.00	0.00	J259	J260	Open
P324	816.00	10.0	Ductile Iron	120.0	false	Open	8.74	0.04	294.81	294.81	0.00	0.00	J260	J261	Open
P325	3,273.00	12.0	Ductile Iron	120.0	false	Open	70.62	0.20	294.93	294.85	0.07	0.02	J227	J262	Open
P326	1,566.00	12.0	Ductile Iron	120.0	false	Open	70.08	0.20	294.85	294.82	0.03	0.02	J262	J263	Open
P327	831.00	12.0	Ductile Iron	120.0	false	Open	30.52	0.09	294.82	294.82	0.00	0.00	J263	J264	Open
P328	798.00	12.0	Ductile Iron	120.0	false	Open	28.91	0.08	294.82	294.81	0.00	0.00	J264	J265	Open
P329	359.00	10.0	Ductile Iron	120.0	false	Open	37.95	0.16	294.82	294.82	0.01	0.02	J263	J259	Open
P330	669.00	12.0	Ductile Iron	120.0	false	Open	26.09	0.07	294.82	294.81	0.00	0.00	J259	J266	Open
P331	439.00	12.0	Ductile Iron	120.0	false	Open	14.79	0.04	294.81	294.81	0.00	0.00	J266	J267	Open
P332	410.00	12.0	Ductile Iron	120.0	false	Open	3.19	0.01	294.81	294.81	0.00	0.00	J267	J268	Open
P333	420.00	12.0	Ductile Iron	120.0	false	Open	-10.12	0.03	294.81	294.81	0.00	0.00	J268	J269	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P334	969.00	10.0	Ductile Iron	120.0	false	Open	9.69	0.04	294.81	294.81	0.00	0.00	J266	J270	Open
P335	668.00	10.0	Ductile Iron	120.0	false	Open	-8.13	0.03	294.81	294.81	0.00	0.00	J270	J271	Open
P336	377.00	8.0	Ductile Iron	120.0	false	Open	4.61	0.03	294.81	294.81	0.00	0.00	J268	J272	Open
P337	571.00	8.0	Ductile Iron	120.0	false	Open	-2.83	0.02	294.81	294.81	0.00	0.00	J272	J273	Open
P338	200.00	8.0	Ductile Iron	120.0	false	Open	-2.83	0.02	294.81	294.81	0.00	0.00	J273	J274	Open
P339	356.00	12.0	Ductile Iron	120.0	false	Open	12.49	0.04	294.81	294.81	0.00	0.00	J269	J274	Open
P340	264.00	12.0	Ductile Iron	120.0	false	Open	9.66	0.03	294.81	294.81	0.00	0.00	J274	J275	Open
P341	461.00	12.0	Ductile Iron	120.0	false	Open	9.66	0.03	294.81	294.81	0.00	0.00	J275	J276	Open
P342	713.00	12.0	Ductile Iron	120.0	false	Open	9.66	0.03	294.81	294.81	0.00	0.00	J276	J277	Open
P343	358.00	12.0	Ductile Iron	120.0	false	Open	13.66	0.04	294.81	294.81	0.00	0.00	J265	J261	Open
P344	670.00	12.0	Ductile Iron	120.0	false	Open	20.26	0.06	294.81	294.81	0.00	0.00	J261	J271	Open
P345	435.00	12.0	Ductile Iron	120.0	false	Open	10.74	0.03	294.81	294.81	0.00	0.00	J267	J278	Open
P346	237.00	8.0	Ductile Iron	120.0	false	Open	8.30	0.05	294.86	294.86	0.00	0.00	J256	J279	Open
P347	918.00	8.0	Ductile Iron	120.0	false	Open	0.28	0.00	294.86	294.86	0.00	0.00	J279	J280	Open
P348	918.00	8.0	Ductile Iron	120.0	false	Open	-0.28	0.00	294.86	294.86	0.00	0.00	J280	J279	Open
P349	440.00	16.0	Ductile Iron	120.0	false	Open	165.37	0.26	294.86	294.85	0.01	0.03	J256	J281	Open
P350	504.00	12.0	Ductile Iron	120.0	false	Open	-25.29	0.07	294.81	294.81	0.00	0.00	J269	J282	Open
P351	1,385.00	12.0	Ductile Iron	120.0	false	Open	-31.12	0.09	294.81	294.82	0.01	0.00	J282	J283	Open
P352	751.00	12.0	Ductile Iron	120.0	false	Open	-36.95	0.10	294.82	294.83	0.00	0.01	J283	J284	Open
P353	405.00	12.0	Ductile Iron	120.0	false	Open	-49.17	0.14	294.83	294.83	0.00	0.01	J284	J285	Open
P354	1,227.00	12.0	Ductile Iron	120.0	false	Open	-63.17	0.18	294.83	294.85	0.02	0.02	J285	J281	Open
P355	655.00	16.0	Ductile Iron	120.0	false	Open	99.16	0.16	294.85	294.85	0.01	0.01	J281	J286	Open
P356	567.00	16.0	Ductile Iron	120.0	false	Open	97.01	0.15	294.85	294.84	0.01	0.01	J286	J287	Open
P357	1,000.00	16.0	Ductile Iron	120.0	false	Open	65.02	0.10	294.84	294.84	0.00	0.00	J287	J288	Open
P358	928.00	16.0	Ductile Iron	120.0	false	Open	47.35	0.08	294.84	294.83	0.00	0.00	J288	J289	Open
P359	1,234.00	12.0	Ductile Iron	120.0	false	Open	28.74	0.08	294.83	294.83	0.01	0.00	J289	J290	Open
P360	695.00	12.0	Ductile Iron	120.0	false	Open	19.79	0.06	294.83	294.83	0.00	0.00	J290	J291	Open
P361	475.00	12.0	Ductile Iron	120.0	false	Open	17.28	0.05	294.83	294.83	0.00	0.00	J291	J292	Open
P362	526.00	12.0	Ductile Iron	120.0	false	Open	1.61	0.00	294.81	294.81	0.00	0.00	J282	J293	Open
P363	257.00	12.0	Ductile Iron	120.0	false	Open	4.76	0.01	294.82	294.82	0.00	0.00	J283	J294	Open
P364	400.00	10.0	Ductile Iron	120.0	false	Open	5.24	0.02	294.83	294.83	0.00	0.00	J284	J295	Open
P365	379.00	10.0	Ductile Iron	120.0	false	Open	4.83	0.02	294.83	294.83	0.00	0.00	J295	J296	Open
P366	283.00	10.0	Ductile Iron	120.0	false	Open	4.29	0.02	294.83	294.83	0.00	0.00	J296	J297	Open
P367	431.00	8.0	Ductile Iron	120.0	false	Open	1.07	0.01	294.83	294.83	0.00	0.00	J297	J298	Open
P368	227.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	294.83	294.83	0.00	0.00	J297	J299	Open
P369	689.00	8.0	Ductile Iron	120.0	false	Open	12.39	0.08	294.83	294.83	0.00	0.01	J285	J300	Open
P370	216.00	8.0	Ductile Iron	120.0	false	Open	4.29	0.03	294.83	294.83	0.00	0.00	J300	J301	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P371	531.00	8.0	Ductile Iron	120.0	false	Open	-3.81	0.02	294.83	294.83	0.00	0.00	J295	J300	Open
P372	521.00	12.0	Ductile Iron	120.0	false	Open	27.50	0.08	294.84	294.84	0.00	0.00	J255	J302	Open
P373	203.00	12.0	Ductile Iron	120.0	false	Open	-2.89	0.01	294.84	294.84	0.00	0.00	J302	J303	Open
P374	509.00	12.0	Ductile Iron	120.0	false	Open	-13.63	0.04	294.84	294.84	0.00	0.00	J303	J287	Open
P375	314.00	8.0	Ductile Iron	120.0	false	Open	5.73	0.04	294.84	294.84	0.00	0.00	J303	J304	Open
P376	240.00	8.0	Ductile Iron	120.0	false	Open	24.31	0.16	294.84	294.83	0.01	0.02	J302	J305	Open
P377	266.00	8.0	Ductile Iron	120.0	false	Open	9.69	0.06	294.83	294.83	0.00	0.00	J305	J306	Open
P378	643.00	8.0	Ductile Iron	120.0	false	Open	5.40	0.03	294.83	294.83	0.00	0.00	J306	J307	Open
P379	641.00	8.0	Ductile Iron	120.0	false	Open	7.82	0.05	294.83	294.83	0.00	0.00	J305	J308	Open
P380	288.00	8.0	Ductile Iron	120.0	false	Open	3.88	0.02	294.83	294.83	0.00	0.00	J308	J307	Open
P381	213.00	8.0	Ductile Iron	120.0	false	Open	4.99	0.03	294.83	294.83	0.00	0.00	J307	J309	Open
P382	528.00	8.0	Ductile Iron	120.0	false	Open	-5.39	0.03	294.83	294.83	0.00	0.00	J309	J310	Open
P383	226.00	8.0	Ductile Iron	120.0	false	Open	2.86	0.02	294.83	294.83	0.00	0.00	J309	J311	Open
P384	711.00	8.0	Ductile Iron	120.0	false	Open	-9.33	0.06	294.83	294.84	0.00	0.00	J310	J288	Open
P385	467.00	8.0	Ductile Iron	120.0	false	Open	15.75	0.10	294.83	294.83	0.00	0.01	J289	J312	Open
P386	285.00	8.0	Ductile Iron	120.0	false	Open	7.52	0.05	294.83	294.83	0.00	0.00	J312	J313	Open
P387	938.00	8.0	Ductile Iron	120.0	false	Open	1.05	0.01	294.83	294.83	0.00	0.00	J313	J314	Open
P388	857.00	8.0	Ductile Iron	120.0	false	Open	1.10	0.01	294.83	294.83	0.00	0.00	J313	J314	Open
P389	215.00	12.0	Ductile Iron	120.0	false	Open	3.22	0.01	294.83	294.83	0.00	0.00	J292	J315	Open
P390	857.00	12.0	Ductile Iron	120.0	false	Open	4.65	0.01	294.83	294.83	0.00	0.00	J292	J316	Open
P391	515.00	8.0	Ductile Iron	120.0	false	Open	1.79	0.01	294.83	294.83	0.00	0.00	J316	J317	Open
P392	702.00	12.0	Ductile Iron	120.0	false	Open	1.43	0.00	294.83	294.83	0.00	0.00	J292	J318	Open
P393	750.00	12.0	Ductile Iron	120.0	false	Open	0.36	0.00	294.83	294.83	0.00	0.00	J318	J319	Open
P394	1,039.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	294.83	294.83	0.00	0.00	J318	J320	Open
P395	1,631.00	12.0	Ductile Iron	120.0	false	Open	0.00	0.00	294.83	294.83	0.00	0.00	J319	J321	Open
P475	1,915.00	4.0	Asbestos Cement	140.0	false	Open	-0.00	0.00	211.75	211.75	0.00	0.00	J479	J478	Open
P476	499.00	4.0	Asbestos Cement	140.0	false	Open	-3.60	0.09	211.75	211.75	0.01	0.01	J477	J479	Open
P477	934.00	4.0	Asbestos Cement	140.0	false	Open	-3.58	0.09	211.73	211.75	0.01	0.01	J476	J477	Open
P478	481.00	4.0	Asbestos Cement	140.0	false	Open	-2.15	0.05	211.73	211.73	0.00	0.01	J475	J476	Open
P479	330.00	4.0	Asbestos Cement	140.0	false	Open	6.11	0.16	211.77	211.75	0.01	0.04	J480	J479	Open
P480	220.00	4.0	Asbestos Cement	140.0	false	Open	-15.22	0.39	211.77	211.81	0.04	0.20	J480	PRV3	Open
P481	663.00	4.0	Asbestos Cement	140.0	false	Open	-5.35	0.14	211.75	211.77	0.02	0.03	J477	J480	Open
P501	75.00	8.0	Ductile Iron	120.0	false	Closed	0.00	0.00	294.63	256.77	0.00	0.00	J81	J501	Closed
P502	358.00	8.0	Ductile Iron	120.0	false	Open	39.71	0.25	256.77	256.75	0.02	0.05	J501	J502	Open
P503	399.00	4.0	Ductile Iron	120.0	false	Open	11.76	0.30	256.75	256.69	0.06	0.16	J502	J503	Open
P504	517.00	4.0	Ductile Iron	120.0	false	Open	12.69	0.32	256.69	256.59	0.10	0.18	J503	J504	Open
P505	987.00	4.0	Ductile Iron	120.0	false	Open	8.29	0.21	256.59	256.51	0.09	0.09	J504	J505	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P506	163.00	4.0	Ductile Iron	120.0	false	Open	8.95	0.23	256.51	256.49	0.02	0.10	J505	J75	Open
P507	315.00	8.0	Ductile Iron	120.0	false	Open	6.80	0.04	256.49	256.49	0.00	0.00	J75	J506	Open
P508	306.00	4.0	Ductile Iron	120.0	false	Closed	0.00	0.00	256.59	296.75	0.00	0.00	J504	J68	Close
P509	412.00	6.0	Ductile Iron	120.0	false	Open	25.44	0.29	256.75	256.71	0.04	0.09	J502	J507	Open
P510	269.00	6.0	Ductile Iron	120.0	false	Open	19.36	0.22	256.71	256.70	0.02	0.06	J507	J508	Open
P511	391.00	4.0	Ductile Iron	120.0	false	Open	-4.51	0.12	256.69	256.70	0.01	0.03	J503	J508	Open
P512	753.00	4.0	Ductile Iron	120.0	false	Open	10.91	0.28	256.70	256.59	0.10	0.14	J508	J509	Open
P513	652.00	4.0	Ductile Iron	120.0	false	Open	8.86	0.23	256.59	256.53	0.06	0.10	J509	J510	Open
P514	248.00	4.0	Ductile Iron	120.0	false	Open	7.32	0.19	256.53	256.51	0.02	0.07	J510	J511	Open
P515	206.00	4.0	Ductile Iron	120.0	false	Open	-2.76	0.07	256.59	256.59	0.00	0.01	J504	J509	Open
P516	230.00	4.0	Ductile Iron	120.0	false	Open	-4.24	0.11	256.51	256.51	0.01	0.02	J505	J511	Open
P517	836.00	4.0	Ductile Iron	120.0	false	Open	-14.35	0.37	256.59	256.79	0.20	0.23	J509	J512	Open
P518	729.00	4.0	Ductile Iron	120.0	false	Open	5.05	0.13	256.59	256.57	0.02	0.03	J509	J513	Open
P519	756.00	4.0	Ductile Iron	120.0	false	Open	-6.32	0.16	256.53	256.57	0.04	0.05	J510	J513	Open
P520	720.00	4.0	Ductile Iron	120.0	false	Open	-2.30	0.06	256.51	256.52	0.01	0.01	J511	J514	Open
P521	677.00	4.0	Ductile Iron	120.0	false	Open	-11.25	0.29	256.52	256.62	0.10	0.15	J514	J515	Open
P522	438.00	4.0	Ductile Iron	120.0	false	Open	-9.87	0.25	256.57	256.62	0.05	0.12	J513	J515	Open
P523	252.00	4.0	Ductile Iron	120.0	false	Open	-25.05	0.64	256.62	256.79	0.17	0.67	J515	J512	Open
P524	286.00	4.0	Ductile Iron	120.0	false	Open	-44.41	1.13	256.79	257.34	0.55	1.92	J512	J516	Open
P525	644.00	8.0	Ductile Iron	120.0	false	Open	542.26	3.46	257.34	257.05	0.29	0.44	J516	J518	Open
P526	200.00	8.0	Ductile Iron	120.0	false	Open	6.80	0.04	257.34	257.34	0.00	0.00	J516	J517	Open
P527	963.00	6.0	Ductile Iron	120.0	false	Open	-45.19	0.51	256.77	257.04	0.27	0.28	J501	J519	Open
P528	251.00	8.0	Asbestos Cement	140.0	false	Open	-48.77	0.31	257.04	257.05	0.01	0.06	J519	J518	Open
P529	60.00	6.0	Ductile Iron	120.0	false	Closed	0.00	0.00	257.05	290.23	0.00	0.00	J518	J83	Close
P530	589.00	8.0	Ductile Iron	120.0	false	Open	489.91	3.13	257.05	255.84	1.22	2.06	J518	J520	Open
P531	339.00	8.0	Ductile Iron	120.0	false	Open	-2,104.24	13.43	255.84	258.43	2.60	7.66	J520	J522	Open
P532	413.00	8.0	Asbestos Cement	140.0	false	Open	2,592.73	16.55	255.84	250.17	5.67	13.72	J520	J521	Open
P533	67.00	2.0	Ductile Iron	120.0	false	Open	88.92	9.08	261.73	250.17	11.56	172.49	PRV7	J521	Open
P534	67.00	8.0	Ductile Iron	120.0	false	Open	-2,681.65	17.12	250.17	250.17	0.00	0.00	PRV8	J521	Open
P535	353.00	8.0	Ductile Iron	120.0	false	Open	609.93	3.89	258.43	257.78	0.66	1.86	J522	J523	Open
P536	730.00	8.0	Ductile Iron	120.0	false	Open	7.87	0.05	257.78	257.78	0.00	0.00	J523	J524	Open
P537	312.00	8.0	Ductile Iron	120.0	false	Open	-595.98	3.80	257.34	257.78	0.44	1.41	J516	J523	Open
P538	445.00	8.0	Ductile Iron	120.0	false	Open	-2,717.03	17.34	258.43	258.99	0.55	1.24	J522	J525	Open
P539	253.00	8.0	Ductile Iron	120.0	false	Open	2,722.40	17.38	258.99	258.99	0.00	0.00	PRV9	J525	Open
P540	332.00	6.0	Ductile Iron	120.0	false	Open	3.22	0.04	256.49	256.49	0.00	0.00	J506	J526	Open
P541	10.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.58	401.58	0.00	0.00	J602	PRV1	Open
P542	7.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.58	401.58	0.00	0.00	J602	PRV1	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P601	399.00	14.0	Ductile Iron	120.0	false	Open	-17.90	0.04	401.58	401.58	0.00	0.00	J601	J603	Open
P602	759.00	14.0	Ductile Iron	120.0	false	Open	17.90	0.04	401.58	401.58	0.00	0.00	J601	J602	Open
P603	678.00	8.0	Asbestos Cement	140.0	false	Open	-94.33	0.60	401.45	401.58	0.14	0.20	J604	J603	Open
P604	900.00	8.0	Asbestos Cement	140.0	false	Open	-84.20	0.54	401.30	401.45	0.15	0.16	J605	J604	Open
P605	430.00	4.0	Asbestos Cement	140.0	false	Open	15.22	0.39	401.30	401.21	0.09	0.20	J605	PRV3	Open
P606	169.00	8.0	Asbestos Cement	140.0	false	Open	129.67	0.83	401.30	401.24	0.06	0.36	J605	J606	Open
P607	67.00	2.0	Ductile Iron	120.0	false	Open	129.67	13.24	401.24	373.59	27.65	412.73	J606	PRV7	Open
P608	67.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.24	401.24	0.00	0.00	J606	PRV8	Open
P609	744.00	8.0	Ductile Iron	120.0	false	Open	68.56	0.44	401.41	401.30	0.11	0.15	J607	J605	Open
P610	489.00	8.0	Ductile Iron	120.0	false	Open	50.97	0.33	401.45	401.41	0.04	0.08	J608	J607	Open
P611	492.00	8.0	Ductile Iron	120.0	false	Open	88.96	0.57	401.57	401.45	0.12	0.24	J609	J608	Open
P612	1,027.00	8.0	Ductile Iron	120.0	false	Open	-45.49	0.29	401.57	401.64	0.07	0.07	J609	J610	Open
P613	549.00	8.0	Ductile Iron	120.0	false	Open	-35.72	0.23	401.64	401.66	0.02	0.04	J610	J611	Open
P614	576.00	8.0	Ductile Iron	120.0	false	Open	41.71	0.27	401.60	401.57	0.03	0.06	J612	J609	Open
P615	525.00	8.0	Ductile Iron	120.0	false	Open	51.12	0.33	401.65	401.60	0.05	0.09	J613	J612	Open
P616	485.00	8.0	Ductile Iron	120.0	false	Open	56.48	0.36	401.70	401.65	0.05	0.10	J614	J613	Open
P617	658.00	8.0	Ductile Iron	120.0	false	Open	62.92	0.40	401.78	401.70	0.08	0.13	J615	J614	Open
P618	329.00	8.0	Ductile Iron	120.0	false	Closed	0.00	0.00	256.49	401.78	0.00	0.00	J506	J615	Closed
P619	546.00	8.0	Ductile Iron	120.0	false	Open	33.34	0.21	401.45	401.43	0.02	0.03	J608	J616	Open
P620	703.00	8.0	Ductile Iron	120.0	false	Open	28.33	0.18	401.43	401.42	0.02	0.02	J616	J617	Open
P621	147.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.42	401.42	0.00	0.00	J617	PRV9	Open
P622	308.00	8.0	Ductile Iron	120.0	false	Open	22.96	0.15	401.42	401.41	0.00	0.01	J617	J607	Open
P623	354.00	4.0	Asbestos Cement	140.0	false	Open	15.75	0.40	401.58	401.51	0.08	0.21	J603	J618	Open
P624	315.00	4.0	Asbestos Cement	140.0	false	Open	7.06	0.18	401.51	401.49	0.02	0.05	J618	J619	Open
P625	263.00	4.0	Asbestos Cement	140.0	false	Open	0.00	0.00	401.49	401.49	0.00	0.00	J619	J620	Open
P626	67.00	1.5	Ductile Iron	120.0	false	Open	0.00	0.00	401.49	401.49	0.00	0.00	J620	PRV1	Open
P627	67.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.49	401.49	0.00	0.00	J620	PRV2	Open
P628	822.00	4.0	Asbestos Cement	140.0	false	Open	4.40	0.11	401.51	401.49	0.02	0.02	J618	J621	Open
P629	612.00	4.0	Asbestos Cement	140.0	false	Open	-1.33	0.03	401.49	401.49	0.00	0.00	J621	J619	Open
P630	489.00	10.0	Ductile Iron	120.0	false	Open	37.26	0.15	401.58	401.58	0.01	0.02	J603	J622	Open
P631	402.00	10.0	Ductile Iron	120.0	false	Open	44.93	0.18	401.58	401.57	0.01	0.02	J622	J623	Open
P632	690.00	10.0	Ductile Iron	120.0	false	Open	17.41	0.07	401.57	401.56	0.00	0.00	J623	J624	Open
P633	390.00	10.0	Ductile Iron	120.0	false	Open	4.60	0.02	401.56	401.56	0.00	0.00	J624	J625	Open
P634	315.00	10.0	Ductile Iron	120.0	false	Open	-0.88	0.00	401.56	401.56	0.00	0.00	J625	J626	Open
P635	726.00	8.0	Ductile Iron	120.0	false	Open	17.90	0.11	401.58	401.57	0.01	0.01	J602	J627	Open
P636	1,030.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.57	401.57	0.00	0.00	J627	PRV4	Open
P637	411.00	8.0	Ductile Iron	120.0	false	Open	8.59	0.05	401.57	401.57	0.00	0.00	J627	J628	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P638	393.00	8.0	Ductile Iron	120.0	false	Open	13.35	0.09	401.57	401.56	0.00	0.01	J623	J629	Open
P639	696.00	8.0	Ductile Iron	120.0	false	Open	5.83	0.04	401.56	401.56	0.00	0.00	J629	J630	Open
P640	523.00	8.0	Ductile Iron	120.0	false	Open	4.98	0.03	401.56	401.56	0.00	0.00	J630	J631	Open
P641	945.00	8.0	Ductile Iron	120.0	false	Open	-1.82	0.01	401.56	401.56	0.00	0.00	J631	J632	Open
P642	407.00	8.0	Ductile Iron	120.0	false	Open	-7.90	0.05	401.56	401.56	0.00	0.00	J632	J633	Open
P643	840.00	8.0	Ductile Iron	120.0	false	Open	-9.52	0.06	401.56	401.57	0.00	0.00	J633	J623	Open
P644	215.00	8.0	Ductile Iron	120.0	false	Open	7.20	0.05	401.56	401.56	0.00	0.00	J624	J633	Open
P645	375.00	8.0	Ductile Iron	120.0	false	Open	6.31	0.04	401.56	401.56	0.00	0.00	J633	J630	Open
P646	489.00	6.0	Ductile Iron	120.0	false	Open	-10.53	0.12	401.58	401.59	0.01	0.02	J622	J634	Open
P647	669.00	6.0	Ductile Iron	120.0	false	Open	5.07	0.06	401.59	401.58	0.00	0.00	J634	J635	Open
P648	592.00	6.0	Ductile Iron	120.0	false	Open	5.49	0.06	401.59	401.58	0.00	0.01	J634	J636	Open
P649	348.00	6.0	Ductile Iron	120.0	false	Open	-0.95	0.01	401.58	401.58	0.00	0.00	J636	J635	Open
P650	464.00	6.0	Ductile Iron	120.0	false	Open	-1.25	0.01	401.58	401.58	0.00	0.00	J635	J637	Open
P651	735.00	6.0	Ductile Iron	120.0	false	Open	-17.58	0.20	401.58	401.62	0.04	0.05	J637	J638	Open
P652	205.00	6.0	Ductile Iron	120.0	false	Open	-40.79	0.46	401.62	401.66	0.05	0.23	J638	J611	Open
P653	316.00	6.0	Ductile Iron	120.0	false	Open	2.62	0.03	401.56	401.56	0.00	0.00	J625	J639	Open
P654	650.00	6.0	Ductile Iron	120.0	false	Open	-2.03	0.02	401.56	401.56	0.00	0.00	J639	J624	Open
P655	342.00	6.0	Ductile Iron	120.0	false	Open	-3.03	0.03	401.56	401.56	0.00	0.00	J626	J640	Open
P656	371.00	6.0	Ductile Iron	120.0	false	Open	-5.89	0.07	401.56	401.57	0.00	0.01	J640	J641	Open
P657	447.00	6.0	Ductile Iron	120.0	false	Open	-11.26	0.13	401.57	401.58	0.01	0.02	J641	J642	Open
P658	279.00	6.0	Ductile Iron	120.0	false	Open	-10.96	0.12	401.58	401.58	0.01	0.02	J642	J637	Open
P659	601.00	6.0	Ductile Iron	120.0	false	Open	16.05	0.18	401.62	401.59	0.02	0.04	J638	J643	Open
P660	575.00	6.0	Ductile Iron	120.0	false	Open	10.68	0.12	401.59	401.58	0.01	0.02	J643	J644	Open
P661	357.00	6.0	Ductile Iron	120.0	false	Open	8.89	0.10	401.58	401.58	0.00	0.01	J644	J645	Open
P662	333.00	6.0	Ductile Iron	120.0	false	Open	3.16	0.04	401.58	401.58	0.00	0.00	J645	J642	Open
P663	610.00	14.0	Ductile Iron	120.0	false	Open	-167.76	0.35	401.58	401.61	0.03	0.05	J603	J646	Open
P664	729.00	14.0	Ductile Iron	120.0	false	Open	-196.72	0.41	401.61	401.66	0.05	0.07	J646	J611	Open
P665	312.00	6.0	Ductile Iron	120.0	false	Open	25.38	0.29	401.61	401.59	0.03	0.10	J646	J634	Open
P666	714.00	14.0	Ductile Iron	120.0	false	Open	-275.37	0.57	401.66	401.76	0.09	0.13	J611	J647	Open
P667	364.00	14.0	Ductile Iron	120.0	false	Open	-300.49	0.63	401.76	401.81	0.05	0.15	J647	J648	Open
P668	563.00	14.0	Ductile Iron	120.0	false	Open	-351.58	0.73	401.81	401.92	0.11	0.20	J648	J649	Open
P669	578.00	14.0	Ductile Iron	120.0	false	Open	-418.97	0.87	401.92	402.08	0.16	0.28	J649	J650	Open
P670	1,243.00	14.0	Ductile Iron	120.0	false	Open	-500.27	1.04	402.08	402.56	0.48	0.38	J650	J651	Open
P671	106.00	14.0	Ductile Iron	120.0	false	Closed	0.00	0.00	402.56	509.41	0.00	0.00	J651	J802	Closed
P672	1,141.00	14.0	Ductile Iron	120.0	false	Open	-500.27	1.04	402.56	403.00	0.44	0.38	J651	T2	Open
P673	89.00	18.0	Ductile Iron	120.0	true	Open	288.88	0.36	403.00	403.00	0.00	0.04	T2	J653	Open
P674	927.00	6.0	Ductile Iron	120.0	false	Open	-9.07	0.10	401.76	401.77	0.01	0.01	J647	J652	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P675	341.00	6.0	Ductile Iron	120.0	false	Open	-23.38	0.27	401.77	401.80	0.03	0.08	J652	J654	Open
P676	298.00	8.0	Ductile Iron	120.0	false	Open	-54.87	0.35	401.80	401.83	0.03	0.10	J654	J655	Open
P677	763.00	8.0	Ductile Iron	120.0	false	Open	63.10	0.40	401.92	401.83	0.10	0.13	J649	J655	Open
P678	293.00	6.0	Ductile Iron	120.0	false	Open	6.44	0.07	401.77	401.77	0.00	0.01	J652	J656	Open
P679	829.00	8.0	Ductile Iron	120.0	false	Open	25.41	0.16	401.80	401.78	0.02	0.02	J654	J657	Open
P680	106.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	401.78	401.78	0.00	0.00	J657	PRV1	Open
P681	400.00	8.0	Ductile Iron	120.0	false	Open	20.76	0.13	401.78	401.77	0.01	0.02	J657	J658	Open
P682	303.00	8.0	Ductile Iron	120.0	false	Open	18.25	0.12	401.77	401.77	0.00	0.01	J658	J659	Open
P683	638.00	8.0	Ductile Iron	120.0	false	Open	5.37	0.03	401.77	401.77	0.00	0.00	J659	J660	Open
P684	537.00	12.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.77	401.77	0.00	0.00	J660	J661	Open
P685	411.00	8.0	Ductile Iron	120.0	false	Open	4.65	0.03	401.77	401.77	0.00	0.00	J659	J662	Open
P686	524.00	6.0	Ductile Iron	120.0	false	Open	21.66	0.25	401.76	401.72	0.04	0.07	J647	J663	Open
P687	639.00	6.0	Ductile Iron	120.0	false	Open	30.05	0.34	401.72	401.63	0.08	0.13	J663	J664	Open
P688	519.00	6.0	Ductile Iron	120.0	false	Open	24.32	0.28	401.63	401.59	0.05	0.09	J664	J665	Open
P689	599.00	6.0	Ductile Iron	120.0	false	Open	28.02	0.32	401.72	401.65	0.07	0.11	J663	J666	Open
P690	344.00	8.0	Ductile Iron	120.0	false	Open	23.01	0.15	401.65	401.64	0.01	0.02	J666	J667	Open
P691	249.00	6.0	Ductile Iron	120.0	false	Open	5.73	0.07	401.64	401.64	0.00	0.01	J667	J668	Open
P692	298.00	8.0	Ductile Iron	120.0	false	Open	14.42	0.09	401.64	401.64	0.00	0.01	J667	J610	Open
P693	332.00	6.0	Ductile Iron	120.0	false	Open	18.60	0.21	401.59	401.57	0.02	0.05	J665	J669	Open
P694	320.00	6.0	Ductile Iron	120.0	false	Open	5.71	0.06	401.57	401.57	0.00	0.01	J669	J609	Open
P695	271.00	8.0	Ductile Iron	120.0	false	Open	5.73	0.04	401.57	401.57	0.00	0.00	J669	J670	Open
P696	231.00	8.0	Ductile Iron	120.0	false	Open	5.37	0.03	401.57	401.57	0.00	0.00	J669	J671	Open
P697	604.00	6.0	Ductile Iron	120.0	false	Open	-0.00	0.00	401.59	401.59	0.00	0.00	J665	PRV1	Open
P698	237.00	6.0	Ductile Iron	120.0	false	Open	-42.14	0.48	401.72	401.78	0.06	0.24	J663	J672	Open
P699	555.00	6.0	Ductile Iron	120.0	false	Open	-0.00	0.00	401.78	401.78	0.00	0.00	J672	PRV1	Open
P700	484.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	401.78	401.78	0.00	0.00	J672	PRV1	Open
P701	452.00	8.0	Ductile Iron	120.0	false	Open	-47.51	0.30	401.78	401.81	0.03	0.08	J672	J648	Open
P702	1,575.00	12.0	Ductile Iron	120.0	false	Open	-78.79	0.22	402.04	402.08	0.04	0.03	J673	J650	Open
P703	1,701.00	12.0	Ductile Iron	120.0	false	Open	-78.43	0.22	402.00	402.04	0.04	0.03	J674	J673	Open
P704	608.00	12.0	Ductile Iron	120.0	false	Open	-51.05	0.14	401.99	402.00	0.01	0.01	J675	J674	Open
P705	393.00	12.0	Ductile Iron	120.0	false	Open	-9.77	0.03	401.99	401.99	0.00	0.00	J676	J675	Open
P706	520.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	401.99	401.99	0.00	0.00	J677	J676	Open
P707	400.00	8.0	Ductile Iron	120.0	false	Open	1.07	0.01	401.99	401.99	0.00	0.00	J676	J678	Open
P708	344.00	8.0	Ductile Iron	120.0	false	Open	0.72	0.00	401.99	401.99	0.00	0.00	J676	J684	Open
P709	520.00	8.0	Ductile Iron	130.0	false	Open	41.27	0.26	401.99	401.96	0.03	0.05	J675	J679	Open
P710	281.00	8.0	Ductile Iron	130.0	false	Open	41.27	0.26	401.96	401.95	0.01	0.05	J679	J680	Open
P711	740.00	8.0	Ductile Iron	130.0	false	Open	-27.38	0.17	401.95	401.97	0.02	0.02	J680	J681	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P712	488.00	8.0	Ductile Iron	130.0	false	Open	-27.38	0.17	401.97	401.98	0.01	0.02	J681	J682	Open
P713	795.00	8.0	Ductile Iron	130.0	false	Open	-27.38	0.17	401.98	402.00	0.02	0.02	J682	J674	Open
P714	692.00	8.0	Ductile Iron	130.0	false	Open	68.66	0.44	401.95	401.86	0.09	0.13	J680	J683	Open
P715	615.00	8.0	Ductile Iron	130.0	false	Open	68.66	0.44	401.86	401.78	0.08	0.13	J683	J615	Open
P801	642.00	16.0	Ductile Iron	120.0	false	Open	288.88	0.46	509.45	509.41	0.05	0.07	J801	J802	Open
P802	1,305.00	14.0	Ductile Iron	120.0	false	Open	4.76	0.01	509.41	509.41	0.00	0.00	J802	J803	Open
P803	685.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J803	J804	Open
P804	833.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J804	J805	Open
P805	458.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J805	J806	Open
P806	864.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J806	J807	Open
P807	849.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J807	J808	Open
P808	476.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J808	J809	Open
P809	271.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J805	J873	Open
P810	179.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J806	J874	Open
P811	506.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J807	J810	Open
P812	984.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J810	J808	Open
P813	337.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J809	J811	Open
P814	224.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.41	509.41	0.00	0.00	J809	J812	Open
P815	356.00	10.0	Ductile Iron	120.0	false	Open	5.37	0.02	509.41	509.41	0.00	0.00	J802	J813	Open
P816	677.00	10.0	Ductile Iron	120.0	false	Open	92.55	0.38	509.41	509.35	0.06	0.09	J802	J814	Open
P817	287.00	10.0	Ductile Iron	120.0	false	Open	62.40	0.25	509.35	509.34	0.01	0.04	J814	J815	Open
P818	394.00	10.0	Ductile Iron	120.0	false	Open	64.77	0.26	509.34	509.32	0.02	0.04	J815	J816	Open
P819	337.00	12.0	Ductile Iron	120.0	false	Open	29.73	0.08	509.32	509.32	0.00	0.00	J816	J817	Open
P820	263.00	12.0	Ductile Iron	120.0	false	Open	19.00	0.05	509.32	509.32	0.00	0.00	J817	J818	Open
P821	243.00	12.0	Ductile Iron	120.0	false	Open	12.12	0.03	509.32	509.32	0.00	0.00	J818	J819	Open
P822	343.00	12.0	Ductile Iron	120.0	false	Open	21.10	0.06	509.32	509.32	0.00	0.00	J819	J820	Open
P823	335.00	12.0	Ductile Iron	120.0	false	Open	8.95	0.03	509.32	509.32	0.00	0.00	J820	J821	Open
P824	374.00	12.0	Ductile Iron	120.0	false	Open	3.58	0.01	509.32	509.32	0.00	0.00	J821	J822	Open
P825	650.00	8.0	Ductile Iron	120.0	false	Open	56.95	0.36	509.41	509.34	0.07	0.11	J802	J823	Open
P826	836.00	10.0	Ductile Iron	120.0	false	Open	51.94	0.21	509.34	509.31	0.02	0.03	J823	J824	Open
P827	1,031.00	12.0	Ductile Iron	120.0	false	Open	62.01	0.18	509.31	509.30	0.02	0.02	J824	J825	Open
P828	544.00	12.0	Ductile Iron	120.0	false	Open	36.01	0.10	509.30	509.29	0.00	0.01	J825	J826	Open
P829	558.00	12.0	Ductile Iron	120.0	false	Open	23.13	0.07	509.29	509.29	0.00	0.00	J826	J827	Open
P830	524.00	12.0	Ductile Iron	120.0	false	Open	15.26	0.04	509.29	509.29	0.00	0.00	J827	J828	Open
P831	530.00	12.0	Ductile Iron	120.0	false	Open	10.25	0.03	509.29	509.29	0.00	0.00	J828	J829	Open
P832	877.00	8.0	Ductile Iron	120.0	false	Open	0.59	0.00	509.29	509.29	0.00	0.00	J829	J830	Open
P833	967.00	8.0	Ductile Iron	120.0	false	Open	-12.29	0.08	509.29	509.30	0.01	0.01	J830	J825	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P834	470.00	8.0	Ductile Iron	120.0	false	Open	5.73	0.04	509.30	509.30	0.00	0.00	J825	J831	Open
P835	258.00	8.0	Ductile Iron	120.0	false	Open	35.79	0.23	509.35	509.34	0.01	0.04	J814	J832	Open
P836	311.00	8.0	Ductile Iron	120.0	false	Open	27.70	0.18	509.34	509.33	0.01	0.03	J832	J833	Open
P837	406.00	8.0	Ductile Iron	120.0	false	Open	25.19	0.16	509.33	509.32	0.01	0.02	J833	J834	Open
P838	545.00	8.0	Ductile Iron	120.0	false	Open	10.41	0.07	509.32	509.32	0.00	0.00	J834	J819	Open
P839	431.00	8.0	Ductile Iron	120.0	false	Open	14.06	0.09	509.32	509.32	0.00	0.01	J834	J835	Open
P840	664.00	12.0	Ductile Iron	120.0	false	Open	-20.44	0.06	509.31	509.32	0.00	0.00	J824	J835	Open
P841	545.00	12.0	Ductile Iron	120.0	false	Open	-6.39	0.02	509.32	509.32	0.00	0.00	J835	J820	Open
P842	288.00	8.0	Ductile Iron	120.0	false	Open	4.16	0.03	509.34	509.34	0.00	0.00	J832	J836	Open
P843	413.00	8.0	Ductile Iron	120.0	false	Open	4.16	0.03	509.34	509.34	0.00	0.00	J836	J815	Open
P844	220.00	8.0	Ductile Iron	120.0	false	Open	2.86	0.02	509.32	509.32	0.00	0.00	J817	J837	Open
P845	521.00	6.0	Ductile Iron	120.0	false	Open	2.94	0.03	509.32	509.32	0.00	0.00	J818	J838	Open
P846	502.00	6.0	Ductile Iron	120.0	false	Open	0.79	0.01	509.32	509.32	0.00	0.00	J838	J820	Open
P847	395.00	8.0	Ductile Iron	120.0	false	Open	3.22	0.02	509.32	509.32	0.00	0.00	J821	J839	Open
P848	375.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	509.32	509.32	0.00	0.00	J839	PRV1	Open
P849	416.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	509.32	509.32	0.00	0.00	J822	J840	Open
P850	763.00	12.0	Ductile Iron	120.0	false	Open	128.18	0.36	509.41	509.36	0.05	0.07	J802	J841	Open
P851	705.00	12.0	Ductile Iron	120.0	false	Open	-100.24	0.28	509.33	509.36	0.03	0.04	J850	J841	Open
P852	1,004.00	8.0	Ductile Iron	120.0	false	Open	15.06	0.10	509.36	509.35	0.01	0.01	J841	J814	Open
P853	236.00	10.0	Ductile Iron	120.0	false	Open	30.75	0.13	509.32	509.32	0.00	0.01	J816	J842	Open
P854	528.00	10.0	Ductile Iron	120.0	false	Open	21.80	0.09	509.32	509.31	0.00	0.01	J842	J843	Open
P855	406.00	10.0	Ductile Iron	120.0	false	Open	-2.14	0.01	509.31	509.31	0.00	0.00	J843	J844	Open
P856	671.00	10.0	Ductile Iron	120.0	false	Open	38.70	0.16	509.31	509.30	0.01	0.02	J844	J845	Open
P857	657.00	10.0	Ductile Iron	120.0	false	Open	21.24	0.09	509.30	509.30	0.00	0.01	J845	J846	Open
P858	427.00	10.0	Ductile Iron	120.0	false	Open	17.17	0.07	509.30	509.30	0.00	0.00	J846	J847	Open
P859	374.00	12.0	Ductile Iron	120.0	false	Open	-44.77	0.13	509.31	509.32	0.00	0.01	J844	J848	Open
P860	310.00	12.0	Ductile Iron	120.0	false	Open	-54.44	0.15	509.32	509.32	0.00	0.01	J848	J849	Open
P861	482.00	12.0	Ductile Iron	120.0	false	Open	-59.45	0.17	509.32	509.33	0.01	0.02	J849	J850	Open
P862	190.00	8.0	Ductile Iron	120.0	false	Open	2.51	0.02	509.32	509.32	0.00	0.00	J848	J851	Open
P863	385.00	8.0	Ductile Iron	120.0	false	Open	2.51	0.02	509.32	509.32	0.00	0.00	J848	J852	Open
P864	862.00	8.0	Ductile Iron	120.0	false	Open	-2.97	0.02	509.30	509.30	0.00	0.00	J845	J853	Open
P865	333.00	8.0	Ductile Iron	120.0	false	Open	-29.68	0.19	509.30	509.31	0.01	0.03	J853	J854	Open
P866	405.00	8.0	Ductile Iron	120.0	false	Open	-33.62	0.21	509.31	509.33	0.02	0.04	J854	J850	Open
P867	229.00	8.0	Ductile Iron	120.0	false	Open	19.91	0.13	509.30	509.30	0.00	0.02	J853	J855	Open
P868	396.00	8.0	Ductile Iron	120.0	false	Open	9.31	0.06	509.30	509.30	0.00	0.00	J855	J856	Open
P869	351.00	8.0	Ductile Iron	120.0	false	Open	3.58	0.02	509.30	509.30	0.00	0.00	J856	J857	Open
P870	374.00	8.0	Ductile Iron	120.0	false	Open	5.95	0.04	509.30	509.30	0.00	0.00	J855	J858	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P871	417.00	8.0	Ductile Iron	120.0	false	Open	2.01	0.01	509.30	509.30	0.00	0.00	J858	J846	Open
P872	624.00	8.0	Ductile Iron	120.0	false	Open	10.37	0.07	509.30	509.29	0.00	0.00	J847	J859	Open
P873	459.00	8.0	Ductile Iron	120.0	false	Open	4.29	0.03	509.29	509.29	0.00	0.00	J859	J860	Open
P874	711.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.30	509.30	0.00	0.00	J847	J861	Open
P875	489.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.30	509.30	0.00	0.00	J861	J862	Open
P876	281.00	8.0	Ductile Iron	120.0	false	Open	6.80	0.04	509.32	509.32	0.00	0.00	J842	J863	Open
P877	377.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	509.32	509.32	0.00	0.00	J863	PRV1	Open
P878	140.00	8.0	Ductile Iron	120.0	false	Open	5.01	0.03	509.32	509.32	0.00	0.00	J863	J864	Open
P879	249.00	8.0	Ductile Iron	120.0	false	Open	20.72	0.13	509.31	509.31	0.00	0.02	J843	J865	Open
P880	248.00	8.0	Ductile Iron	120.0	false	Open	18.93	0.12	509.31	509.31	0.00	0.01	J865	J866	Open
P881	576.00	8.0	Ductile Iron	120.0	false	Open	13.56	0.09	509.31	509.30	0.00	0.01	J866	J867	Open
P882	95.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	509.30	509.30	0.00	0.00	J867	PRV1	Open
P883	498.00	8.0	Ductile Iron	120.0	false	Open	7.48	0.05	509.30	509.30	0.00	0.00	J867	J868	Open
P884	111.00	6.0	Ductile Iron	120.0	false	Open	0.00	0.00	509.30	509.30	0.00	0.00	J868	PRV1	Open
P885	518.00	8.0	Ductile Iron	120.0	false	Open	0.45	0.00	509.30	509.30	0.00	0.00	J868	J869	Open
P886	641.00	8.0	Ductile Iron	120.0	false	Open	-6.71	0.04	509.30	509.30	0.00	0.00	J869	J845	Open
P887	754.00	8.0	Ductile Iron	120.0	false	Open	6.44	0.04	509.30	509.30	0.00	0.00	J868	J872	Open
P888	682.00	8.0	Ductile Iron	130.0	false	Open	5.49	0.04	509.30	509.30	0.00	0.00	J870	J868	Open
P889	389.00	8.0	Ductile Iron	130.0	false	Open	5.49	0.04	509.30	509.30	0.00	0.00	J845	J870	Open
P890	332.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	509.30	509.30	0.00	0.00	J870	J871	Open
P901	67.00	2.0	Ductile Iron	120.0	false	Open	86.45	8.83	180.96	167.91	13.05	194.80	PRV5	J901	Open
P902	66.00	8.0	Ductile Iron	120.0	false	Open	45.96	0.29	167.91	167.91	0.00	0.07	PRV6	J901	Open
P903	1,421.00	8.0	Asbestos Cement	140.0	false	Open	80.08	0.51	167.91	167.70	0.21	0.15	J901	J902	Open
P904	842.00	8.0	Asbestos Cement	140.0	false	Open	75.43	0.48	167.70	167.59	0.11	0.13	J902	J903	Open
P905	795.00	10.0	Asbestos Cement	140.0	false	Open	45.54	0.19	167.59	167.57	0.01	0.02	J903	J904	Open
P906	522.00	10.0	Asbestos Cement	140.0	false	Open	1.79	0.01	167.57	167.57	0.00	0.00	J904	J905	Open
P907	1,086.00	6.0	Asbestos Cement	140.0	false	Open	46.61	0.53	167.91	167.67	0.24	0.22	J901	J906	Open
P908	305.00	6.0	Asbestos Cement	140.0	false	Open	35.52	0.40	167.67	167.63	0.04	0.13	J906	J907	Open
P909	624.00	6.0	Asbestos Cement	140.0	false	Open	14.99	0.17	167.63	167.61	0.02	0.03	J907	J908	Open
P910	312.00	6.0	Asbestos Cement	140.0	false	Open	17.62	0.20	167.61	167.60	0.01	0.04	J908	J909	Open
P911	1,276.00	6.0	Asbestos Cement	140.0	false	Open	9.03	0.10	167.60	167.59	0.01	0.01	J909	J903	Open
P912	1,372.00	6.0	Asbestos Cement	140.0	false	Open	9.79	0.11	167.63	167.61	0.02	0.01	J907	J908	Open
P913	277.00	8.0	Ductile Iron	120.0	false	Open	2.86	0.02	167.57	167.57	0.00	0.00	J904	J910	Open
P914	682.00	8.0	Ductile Iron	120.0	false	Open	34.63	0.22	167.59	167.56	0.03	0.04	J903	J911	Open
P915	1,313.00	8.0	Ductile Iron	120.0	false	Open	31.77	0.20	167.56	167.51	0.05	0.04	J911	J912	Open
P916	808.00	8.0	Ductile Iron	120.0	false	Open	-32.30	0.21	167.51	167.54	0.03	0.04	J912	J913	Open
P917	696.00	8.0	Ductile Iron	120.0	false	Open	-36.24	0.23	167.54	167.57	0.03	0.05	J913	J904	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P918	516.00	8.0	Ductile Iron	120.0	false	Open	59.06	0.38	167.51	167.45	0.06	0.11	J912	J914	Open
P919	1,145.00	8.0	Ductile Iron	120.0	false	Open	50.83	0.32	167.45	167.35	0.10	0.09	J914	J915	Open
P920	1,136.00	6.0	Ductile Iron	120.0	false	Open	30.07	0.34	167.35	167.21	0.15	0.13	J915	J916	Open
P921	805.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	167.21	167.21	0.00	0.00	J916	J917	Open
P922	610.00	6.0	Ductile Iron	120.0	false	Open	23.63	0.27	167.21	167.16	0.05	0.08	J916	J918	Open
P923	340.00	6.0	Ductile Iron	120.0	false	Open	17.90	0.20	167.16	167.14	0.02	0.05	J918	J919	Open
P924	878.00	6.0	Ductile Iron	120.0	false	Open	5.37	0.06	167.14	167.13	0.00	0.01	J919	J920	Open
P925	450.00	6.0	Ductile Iron	120.0	false	Open	7.16	0.08	167.14	167.13	0.00	0.01	J919	J921	Open
P926	1,336.00	8.0	Ductile Iron	120.0	false	Open	14.68	0.09	167.35	167.34	0.01	0.01	J915	J922	Open
P927	940.00	8.0	Ductile Iron	120.0	false	Open	7.87	0.05	167.34	167.34	0.00	0.00	J922	J923	Open
P928	498.00	8.0	Ductile Iron	120.0	false	Open	2.86	0.02	167.34	167.34	0.00	0.00	J923	J924	Open
P929	183.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	167.34	167.34	0.00	0.00	J923	J925	Open
P930	592.00	8.0	Ductile Iron	120.0	false	Open	4.30	0.03	167.34	167.34	0.00	0.00	J922	J926	Open
P931	445.00	8.0	Ductile Iron	120.0	false	Open	2.15	0.01	167.34	167.34	0.00	0.00	J926	J927	Open
P1001	10.00	12.0	Ductile Iron	120.0	false	Open	926.55	2.63	24.77	24.74	0.03	2.55	CLEA	PMP1	Open
P1002	10.00	12.0	Ductile Iron	120.0	true	Open	926.55	2.63	343.15	343.12	0.03	2.55	PMP1	J1	Open
P1003	10.00	12.0	Ductile Iron	120.0	false	Open	926.55	2.63	24.77	24.74	0.03	2.55	CLEA	PMP2	Open
P1004	10.00	12.0	Ductile Iron	120.0	true	Open	926.55	2.63	343.15	343.12	0.03	2.55	PMP2	J1	Open
P1005	10.00	12.0	Ductile Iron	120.0	false	Open	3,113.31	8.83	24.77	24.53	0.24	24.08	CLEA	PMP3	Open
P1006	10.00	12.0	Ductile Iron	130.0	true	Open	3,113.31	8.83	343.33	343.12	0.21	20.76	PMP3	J1	Open
P1007	24.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	232.55	232.55	0.00	0.00	J95	PMP4	Open
P1008	11.00	8.0	Ductile Iron	120.0	true	Open	-0.00	0.00	401.58	401.58	0.00	0.00	PMP4	J601	Open
P1009	20.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	232.55	232.55	0.00	0.00	J95	PMP5	Open
P1010	11.00	8.0	Ductile Iron	120.0	true	Open	-0.00	0.00	401.58	401.58	0.00	0.00	PMP5	J601	Open
P1011	1.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	298.07	298.07	0.00	0.00	J20	PMP6	Open
P1012	1.00	8.0	Ductile Iron	120.0	true	Open	0.00	0.00	401.99	401.99	0.00	0.00	PMP6	J677	Open
P1013	1.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	298.07	298.07	0.00	0.00	J20	PMP7	Open
P1014	1.00	8.0	Ductile Iron	120.0	true	Open	0.00	0.00	401.99	401.99	0.00	0.00	PMP7	J677	Open
P1015	1.00	4.0	Ductile Iron	120.0	false	Open	-0.00	0.00	401.99	401.99	0.00	0.00	PRV1	J677	Open
P1016	1.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	298.07	298.07	0.00	0.00	PRV1	J20	Open
P1017	186.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	401.99	401.99	0.00	0.00	J677	PRV1	Open
P1018	1.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	298.07	298.07	0.00	0.00	PRV1	J20	Open
P1019	1.00	8.0	Ductile Iron	120.0	false	Open	72.22	0.46	403.00	403.00	0.00	0.18	J653	PMP8	Open
P1020	1.00	6.0	Ductile Iron	120.0	true	Open	72.22	0.82	509.45	509.45	0.00	0.67	PMP8	J801	Open
P1021	1.00	8.0	Ductile Iron	120.0	false	Open	72.22	0.46	403.00	403.00	0.00	0.18	J653	PMP9	Open
P1022	1.00	6.0	Ductile Iron	120.0	true	Open	72.22	0.82	509.45	509.45	0.00	0.67	PMP9	J801	Open
P1023	1.00	8.0	Ductile Iron	120.0	false	Open	72.22	0.46	403.00	403.00	0.00	0.18	J653	PMP1	Open

Scenario: 2015 PHD
Steady State Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P1024	1.00	6.0	Ductile Iron	120.0	true	Open	72.22	0.82	509.45	509.45	0.00	0.67	PMP1	J801	Open
P1025	1.00	8.0	Ductile Iron	120.0	false	Open	72.22	0.46	403.00	403.00	0.00	0.18	J653	PMP1	Open
P1026	1.00	6.0	Ductile Iron	120.0	true	Open	72.22	0.82	509.45	509.45	0.00	0.67	PMP1	J801	Open
P1027	94.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	403.00	403.00	0.00	0.00	J653	PRV1	Open
P1028	334.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	509.45	509.45	0.00	0.00	PRV1	J801	Open
P1044	1.00	18.0	Ductile Iron	130.0	false	Open	870.00	1.10	300.00	300.00	0.00	0.27	R5	FCV2	Open
P1045	1.00	18.0	Ductile Iron	130.0	true	Open	870.00	1.10	24.77	24.77	0.00	0.27	FCV2	CLEA	Open

Scenario: 2015 PHD
Steady State Analysis
Pump Report

Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)	Calculated Water Power (Hp)	Notes
PMP1	32.27	On	24.74	343.15	926.55	318.40	74.48	WTP
PMP2	32.27	On	24.74	343.15	926.55	318.40	74.48	WTP
PMP3	28.77	On	24.53	343.33	3,113.31	318.80	250.59	WTP
PMP4	223.00	Off	232.55	401.58	0.00	0.00	0.00	Thornton Rd.
PMP5	223.00	Off	232.55	401.58	0.00	0.00	0.00	Thornton Rd.
PMP6	147.70	Off	298.07	401.99	0.00	0.00	0.00	Church Rd.
PMP7	147.70	Off	298.07	401.99	0.00	0.00	0.00	Church Rd.
PMP8	363.00	On	403.00	509.45	72.22	106.46	1.94	Bakerview
PMP9	363.00	On	403.00	509.45	72.22	106.46	1.94	Bakerview
PMP10	363.00	On	403.00	509.45	72.22	106.46	1.94	Bakerview
PMP11	363.00	On	403.00	509.45	72.22	106.46	1.94	Bakerview

Scenario: 2015 PHD
Steady State Analysis
Tank Report

Label	Zone	Base Elevation (ft)	Minimum Elevation (ft)	Maximum Elevation (ft)	Initial Level (ft)	Initial HGL (ft)	Inactive Volume (gal)	Tank Diameter (ft)	Inflow (gpm)	Current Status	Calculated Hydraulic Grade (ft)	Calculated Percent Full (%)
T1	Main	210.00	210.00	235.00	22.50	232.50	0.00	79.83	3,389.56	Filling	232.50	90.0
T2	Bakerview	363.00	363.00	405.00	40.00	403.00	0.00	85.00	-789.15	Draining	403.00	95.2
CLEAR WEL	Main	10.77	15.77	26.77	14.00	24.77	0.00	N/A	4,096.41	Draining	24.77	81.8

Scenario: 2015 PHD
Steady State Analysis
Valve Report

Label	Elevation (ft)	Diameter (in)	Initial HGL (ft)	Initial Pressure (psi)	Minor Loss Coefficient	Control Status	Discharge (gpm)	From HGL (ft)	To HGL (ft)	Headloss (ft)	From Pressure (psi)	To Pressure (psi)
FCV2	23.77	18.0			0.00	Throttling	870.00	300.00	24.77	275.23	119.51	0.43
PRV1	159.34	1.5	210.17	22.00	5.80	Closed	0.00	401.49	211.75	0.00	104.77	22.68
PRV2	159.34	4.0	198.62	17.00	5.80	Closed	0.00	401.49	211.75	0.00	104.77	22.68
PRV3	160.96	3.0	211.79	22.00	6.00	Throttling	15.22	401.21	211.81	189.41	103.95	22.00
PRV4	135.12	6.0	222.92	38.00	5.70	Closed	0.00	401.57	250.31	0.00	115.28	49.84
PRV5	42.28	2.0	180.91	60.00	5.60	Throttling	86.45	279.60	180.96	98.64	102.68	60.00
PRV6	40.79	8.0	167.87	55.00	6.10	Throttling	45.96	292.65	167.91	124.73	108.97	55.00
PRV7	164.65	2.0	261.69	42.00	5.60	Throttling	129.67	373.59	261.73	111.86	90.40	42.00
PRV8	164.65	6.0	250.14	37.00	5.70	Throttling	0.00	401.24	250.17	151.07	102.36	37.00
PRV9	159.60	8.0	258.95	43.00	6.10	Throttling	0.00	401.42	258.99	142.43	104.62	43.00
PRV10	155.86	3.0	227.49	31.00	6.00	Closed	0.00	401.58	245.06	0.00	106.31	38.59
PRV11	155.86	8.0	215.93	26.00	6.10	Closed	0.00	401.58	245.06	0.00	106.31	38.59
PRV12	244.37	6.0	383.00	60.00	5.70	Closed	0.00	509.32	401.78	0.00	114.63	68.10
PRV13	276.26	6.0	384.85	47.00	5.70	Closed	0.00	509.32	401.78	0.00	100.83	54.30
PRV14	268.72	8.0	384.24	50.00	6.10	Closed	0.00	509.30	401.78	0.00	104.09	57.57
PRV15	257.74	6.0	389.44	57.00	5.70	Closed	0.00	509.30	401.59	0.00	108.84	62.24
PRV16	147.83	4.0	218.88	30.75	5.80	Closed	0.00	401.99	298.07	0.00	109.96	65.00
PRV17	147.70	8.0	240.12	40.00	6.10	Closed	0.00	401.99	298.07	0.00	110.02	65.06
PRV18	363.00	8.0	363.00	0.00	6.10	Closed	0.00	403.00	509.45	0.00	17.30	63.36

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J1	Main	true	1,000.00	10,000.00	1,000.00	10,000.00	20.00	74.45	20.00	27.91	J94	N/A	PMP1
J2	Main	true	2,000.00	10,000.00	2,000.00	10,000.00	20.00	77.68	20.00	27.60	J94	N/A	PMP1
J3	Main	true	2,000.00	10,000.00	2,001.40	10,001.40	20.00	77.55	20.00	27.56	J94	N/A	PMP1
J4	Main	true	3,000.00	10,000.00	3,001.40	10,001.40	20.00	77.22	20.00	27.52	J94	N/A	PMP1
J5	Main	true	3,000.00	10,000.00	3,002.20	10,002.20	20.00	76.10	20.00	27.49	J94	N/A	PMP1
J6	Main	true	3,000.00	10,000.00	3,003.26	10,003.26	20.00	76.29	20.00	27.46	J94	N/A	PMP1
J7	Main	true	3,000.00	10,000.00	3,003.58	10,003.58	20.00	73.00	20.00	27.43	J94	N/A	PMP1
J8	Main	true	3,000.00	10,000.00	3,003.91	10,003.91	20.00	66.44	20.00	27.44	J94	N/A	PMP1
J9	Main	true	3,000.00	10,000.00	3,004.78	10,004.78	20.00	67.32	20.00	27.51	J94	N/A	PMP1
J10	Main	true	3,000.00	10,000.00	3,003.87	10,003.87	20.00	57.13	20.00	27.71	J94	N/A	PMP1
J11	Main	true	3,000.00	10,000.00	3,003.26	10,003.26	20.00	52.68	20.00	27.78	J94	N/A	PMP1
J12	Main	true	3,000.00	10,000.00	3,001.30	10,001.30	20.00	48.72	20.00	27.83	J94	N/A	PMP1
J13	Main	true	1,000.00	10,000.00	1,001.76	10,001.76	20.00	44.74	20.00	27.99	J94	N/A	PMP1
J14	Main	true	2,000.00	9,910.69	2,003.05	9,913.74	20.00	26.84	20.00	20.00	J20	N/A	PMP1
J15	Main	true	2,000.00	8,995.77	2,002.08	8,997.86	20.00	25.49	20.00	20.00	J20	N/A	PMP1
J16	Main	true	2,000.00	8,102.61	2,011.05	8,113.66	20.00	26.92	20.00	20.00	J20	N/A	PMP1
J17	Main	true	1,000.00	7,578.53	1,001.73	7,580.27	20.00	28.20	20.00	20.01	J20	N/A	PMP1
J18	Main	true	1,000.00	6,836.56	1,000.22	6,836.77	20.00	23.65	20.00	20.01	J20	N/A	PMP1
J19	Main	true	1,000.00	6,481.77	1,000.00	6,481.77	20.00	21.93	20.00	20.00	J20	N/A	PMP1
J20	Main	true	500.00	7,231.85	500.00	7,231.85	5.00	5.00	5.00	10.56	J19	N/A	PMP1
J21	Main	true	2,000.00	4,353.22	2,002.64	4,355.86	20.00	20.00	20.00	29.34	J94	N/A	PMP1
J22	Main	true	2,000.00	4,401.85	2,002.64	4,404.49	20.00	20.01	20.00	29.32	J94	N/A	PMP1
J23	Main	true	3,000.00	4,299.54	3,006.92	4,306.46	20.00	20.01	20.00	29.36	J94	N/A	PMP1
J24	Main	true	3,000.00	4,398.32	3,001.96	4,400.28	20.00	20.03	20.00	29.33	J94	N/A	PMP1
J25	Main	true	1,000.00	4,770.07	1,009.31	4,779.38	20.00	23.28	20.00	20.00	J29	N/A	PMP1
J26	Main	true	1,000.00	4,478.95	1,012.07	4,491.02	20.00	20.00	20.00	25.39	J29	N/A	PMP1
J27	Main	true	1,000.00	5,148.89	1,004.24	5,153.13	20.00	20.00	20.00	29.71	J94	N/A	PMP1
J28	Main	true	1,000.00	4,257.04	1,004.24	4,261.28	20.00	21.40	20.00	20.00	J29	N/A	PMP1
J29	Main	true	1,000.00	3,693.74	1,002.61	3,696.35	20.00	20.02	20.00	30.36	J94	N/A	PMP1
J30	Main	true	1,000.00	4,376.46	1,007.50	4,383.96	20.00	20.86	20.00	20.00	J29	N/A	PMP1
J31	Main	true	2,000.00	9,631.50	2,002.96	9,634.46	20.00	20.00	20.00	21.02	J20	N/A	PMP1
J32	Main	true	2,000.00	8,729.11	2,003.48	8,732.59	20.00	20.00	20.00	23.46	J51	N/A	PMP1
J33	Main	true	2,000.00	8,049.00	2,001.91	8,050.91	20.00	20.09	20.00	20.00	J51	N/A	PMP1
J34	Main	true	1,000.00	7,077.24	1,001.96	7,079.20	20.00	24.00	20.00	20.00	J51	N/A	PMP1
J35	Main	true	3,000.00	6,553.37	3,000.22	6,553.59	20.00	25.30	20.00	20.00	J51	N/A	PMP1
J36	Main	true	1,000.00	4,435.67	1,001.96	4,437.63	20.00	26.24	20.00	20.01	J51	N/A	PMP1
J37	Main	true	1,000.00	5,130.46	1,004.90	5,135.36	20.00	20.00	20.00	30.08	J94	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J38	Main	true	3,000.00	4,843.73	3,000.22	4,843.95	20.00	20.00	20.00	20.90	J39	N/A	PMP1
J39	Main	true	3,000.00	4,025.70	3,000.66	4,026.36	20.00	20.00	20.00	30.68	J94	N/A	PMP1
J40	Main	true	1,000.00	4,435.63	1,002.82	4,438.46	20.00	26.01	20.00	20.01	J51	N/A	PMP1
J41	Main	true	1,000.00	4,370.10	1,001.52	4,371.62	20.00	20.00	20.00	21.67	J51	N/A	PMP1
J42	Main	true	1,000.00	4,325.01	1,000.87	4,325.89	20.00	20.00	20.00	21.40	J47	N/A	PMP1
J43	Main	true	1,000.00	3,660.56	1,002.18	3,662.74	20.00	20.00	20.00	20.07	J44	N/A	PMP1
J44	Main	true	1,000.00	3,195.92	1,001.30	3,197.22	20.00	20.00	20.00	30.94	J94	N/A	PMP1
J45	Main	true	1,000.00	3,561.04	1,002.82	3,563.86	20.00	21.72	20.00	20.00	J46	N/A	PMP1
J46	Main	true	1,000.00	2,812.12	1,003.05	2,815.17	20.00	20.00	20.00	31.04	J94	N/A	PMP1
J47	Main	true	1,000.00	3,963.85	1,002.82	3,966.68	20.00	20.00	20.00	26.96	J46	N/A	PMP1
J48	Main	true	1,000.00	5,467.75	1,002.24	5,469.99	20.00	21.83	20.00	20.00	J49	N/A	PMP1
J49	Main	true	1,000.00	3,422.69	1,000.22	3,422.91	20.00	20.00	20.00	30.98	J94	N/A	PMP1
J50	Main	true	1,000.00	4,207.94	1,001.96	4,209.90	20.00	25.30	20.00	20.01	J51	N/A	PMP1
J51	Main	true	1,000.00	3,770.56	1,001.52	3,772.08	20.00	20.00	20.00	30.77	J94	N/A	PMP1
J52	Main	true	1,000.00	3,246.33	1,002.61	3,248.94	20.00	24.29	20.00	20.03	J54	N/A	PMP1
J53	Main	true	1,000.00	2,550.50	1,004.13	2,554.63	20.00	20.00	20.00	31.10	J94	N/A	PMP1
J54	Main	true	1,000.00	2,267.84	1,001.09	2,268.93	20.00	20.01	20.00	31.29	J94	N/A	PMP1
J55	Main	true	2,000.00	6,575.40	2,001.05	6,576.45	20.00	20.02	20.00	29.65	J94	N/A	PMP1
J56	Main	true	2,000.00	7,023.24	2,000.35	7,023.59	20.00	20.00	20.00	29.27	J94	N/A	PMP1
J57	Main	true	2,000.00	7,061.77	2,000.00	7,061.77	20.00	20.00	20.00	21.50	J58	N/A	PMP1
J58	Main	true	2,000.00	6,430.23	2,000.00	6,430.23	20.00	20.01	20.00	29.84	J94	N/A	PMP1
J59	Main	true	1,000.00	6,444.80	1,000.00	6,444.80	20.00	20.00	20.00	29.81	J94	N/A	PMP1
J60	Main	true	1,000.00	6,679.25	1,000.00	6,679.25	20.00	20.00	20.00	23.96	J59	N/A	PMP1
J61	Main	true	1,000.00	4,369.62	1,007.02	4,376.64	20.00	20.00	20.00	31.57	J94	N/A	PMP1
J62	Main	true	1,000.00	9,548.77	1,004.39	9,553.16	20.00	20.00	20.00	27.89	J94	N/A	PMP1
J63	Main	true	2,000.00	10,000.00	2,002.20	10,002.20	20.00	23.33	20.00	27.57	J94	N/A	PMP1
J64	Main	true	1,000.00	7,671.08	1,004.39	7,675.48	20.00	20.00	20.00	20.66	J66	N/A	PMP1
J65	Main	true	2,000.00	8,549.05	2,000.70	8,549.75	20.00	20.00	20.00	28.18	J94	N/A	PMP1
J66	Main	true	1,000.00	3,093.88	1,002.64	3,096.52	20.00	20.00	20.00	30.12	J94	N/A	PMP1
J67	Main	true	2,000.00	5,276.55	2,003.83	5,280.38	20.00	20.00	20.00	29.07	J94	N/A	PMP1
J68	Main	true	1,000.00	4,379.71	1,003.58	4,383.30	20.00	20.00	20.00	29.34	J94	N/A	PMP1
J69	Main	true	1,000.00	4,828.25	1,002.94	4,831.18	20.00	20.00	20.00	27.27	J71	N/A	PMP1
J70	Main	true	1,000.00	5,343.86	1,003.91	5,347.77	20.00	20.58	20.00	20.00	J69	N/A	PMP1
J71	Main	true	2,000.00	4,579.38	2,001.05	4,580.43	20.00	20.00	20.00	28.81	J69	N/A	PMP1
J72	Main	true	2,000.00	4,750.86	2,000.87	4,751.73	20.00	20.00	20.00	27.22	J71	N/A	PMP1
J73	Main	true	2,000.00	4,516.39	2,000.35	4,516.74	20.00	20.00	20.00	30.27	J94	N/A	PMP1
J74	Main	false	3,000.00	2,997.78	3,000.87	2,998.65	20.00	20.00	20.00	31.06	J94	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J75	Main	false	1,000.00	562.20	1,001.30	563.51	20.00	20.00	20.00	35.12	J94	N/A	PMP1
J76	Main	true	3,000.00	10,000.00	3,004.24	10,004.24	20.00	69.46	20.00	27.36	J94	N/A	PMP1
J77	Main	true	3,000.00	10,000.00	3,006.15	10,006.15	20.00	69.24	20.00	27.33	J94	N/A	PMP1
J78	Main	true	3,000.00	10,000.00	3,005.44	10,005.44	20.00	62.12	20.00	27.33	J94	N/A	PMP1
J79	Main	true	2,000.00	10,000.00	2,002.26	10,002.26	20.00	61.50	20.00	27.27	J94	N/A	PMP1
J80	Main	true	2,000.00	10,000.00	2,005.54	10,005.54	20.00	30.49	20.00	25.48	J83	N/A	PMP1
J81	Main	true	1,000.00	8,905.90	1,000.98	8,906.88	20.00	20.22	20.00	20.00	J96	N/A	PMP1
J82	Main	true	1,000.00	6,537.75	1,003.91	6,541.66	20.00	20.00	20.00	25.22	J83	N/A	PMP1
J83	Main	true	1,000.00	6,537.63	1,002.61	6,540.24	20.00	20.00	20.00	28.22	J94	N/A	PMP1
J84	Main	true	3,000.00	10,000.00	3,010.18	10,010.18	20.00	58.90	20.00	27.27	J94	N/A	PMP1
J85	Main	true	3,000.00	10,000.00	3,002.64	10,002.64	20.00	59.99	20.00	27.24	J94	N/A	PMP1
J86	Main	true	3,000.00	10,000.00	3,002.26	10,002.26	20.00	63.68	20.00	27.20	J94	N/A	PMP1
J87	Main	true	3,000.00	10,000.00	3,001.57	10,001.57	20.00	60.31	20.00	27.12	J94	N/A	PMP1
J88	Main	true	3,000.00	10,000.00	3,004.09	10,004.09	20.00	55.00	20.00	26.99	J94	N/A	PMP1
J89	Main	true	1,000.00	10,000.00	1,004.57	10,004.57	20.00	38.47	20.00	26.41	J94	N/A	PMP1
J90	Main	true	1,000.00	10,000.00	1,003.05	10,003.05	20.00	22.31	20.00	24.29	J94	N/A	PMP1
J91	Main	true	1,000.00	10,000.00	1,003.05	10,003.05	20.00	28.04	20.00	23.74	J94	N/A	PMP1
J92	Main	true	1,000.00	10,000.00	1,002.39	10,002.39	20.00	35.12	20.00	23.71	J94	N/A	PMP1
J93	Main	true	1,000.00	10,000.00	1,000.00	10,000.00	20.00	31.64	20.00	23.67	J94	N/A	PMP1
J94	Main	true	1,000.00	10,000.00	1,000.00	10,000.00	20.00	23.55	20.00	36.76	J93	N/A	PMP1
J95	Zone	false	500.00	0.00	500.00	0.00	5.00	1.57	5.00	9.97	J653	N/A	PMP1
J96	Main	true	1,000.00	4,354.41	1,001.30	4,355.71	20.00	20.02	20.00	28.83	J94	N/A	PMP1
J97	Main	true	0.01	595.46	0.18	595.63	20.00	20.00	20.00	34.02	J94	N/A	PMP1
J98	Main	true	1,000.00	10,000.00	1,001.52	10,001.52	20.00	38.49	20.00	26.59	J94	N/A	PMP1
J99	Main	true	1,000.00	5,010.93	1,002.39	5,013.32	20.00	20.00	20.00	28.43	J94	N/A	PMP1
J100	Main	true	1,000.00	6,447.53	1,003.05	6,450.58	20.00	20.00	20.00	27.53	J94	N/A	PMP1
J101	Main	true	1,000.00	3,206.96	1,004.13	3,211.09	20.00	20.00	20.00	29.01	J94	N/A	PMP1
J102	Main	true	1,000.00	6,455.69	1,001.30	6,457.00	20.00	20.01	20.00	21.04	J106	N/A	PMP1
J103	Main	true	3,000.00	5,493.13	3,000.66	5,493.79	20.00	20.00	20.00	20.43	J107	N/A	PMP1
J104	Main	true	3,000.00	5,217.40	3,000.33	5,217.72	20.00	20.01	20.00	21.93	J105	N/A	PMP1
J105	Main	true	3,000.00	5,192.69	3,001.30	5,193.99	20.00	20.01	20.00	20.51	J104	N/A	PMP1
J106	Main	true	1,000.00	4,072.40	1,002.18	4,074.58	20.00	20.00	20.00	28.45	J94	N/A	PMP1
J107	Main	true	3,000.00	4,534.02	3,000.33	4,534.35	20.00	20.00	20.00	26.61	J109	N/A	PMP1
J108	Main	true	3,000.00	4,581.57	3,000.00	4,581.57	20.00	20.09	20.00	20.00	J109	N/A	PMP1
J109	Main	true	3,000.00	4,538.20	3,000.33	4,538.53	20.00	20.00	20.00	21.96	J108	N/A	PMP1
J110	Main	true	1,000.00	7,695.92	1,003.70	7,699.62	20.00	24.31	20.00	20.00	J112	N/A	PMP1
J111	Main	true	1,000.00	5,876.88	1,002.82	5,879.71	20.00	21.27	20.00	20.01	J112	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J112	Main	true	1,000.00	5,159.92	1,002.18	5,162.10	20.00	20.00	20.00	21.84	J113	N/A	PMP1
J113	Main	true	1,000.00	3,834.87	1,001.30	3,836.17	20.00	20.00	20.00	21.80	J114	N/A	PMP1
J114	Main	true	1,000.00	3,617.86	1,000.66	3,618.51	20.00	20.01	20.00	22.26	J115	N/A	PMP1
J115	Main	true	1,000.00	3,618.66	1,003.76	3,622.41	20.00	20.27	20.00	20.00	J114	N/A	PMP1
J116	Main	true	1,000.00	4,330.28	1,004.57	4,334.84	20.00	20.01	20.00	29.66	J94	N/A	PMP1
J117	Main	true	1,000.00	4,706.04	1,007.18	4,713.22	20.00	20.00	20.00	27.85	J112	N/A	PMP1
J118	Main	true	1,000.00	2,337.68	1,004.41	2,342.09	20.00	20.00	20.00	29.89	J94	N/A	PMP1
J119	Main	true	1,000.00	2,045.98	1,005.50	2,051.48	20.00	20.00	20.00	27.92	J118	N/A	PMP1
J120	Main	true	3,000.00	10,000.00	3,002.61	10,002.61	20.00	59.62	20.00	27.31	J94	N/A	PMP1
J121	Main	true	3,000.00	10,000.00	3,010.53	10,010.53	20.00	59.06	20.00	27.24	J94	N/A	PMP1
J122	Main	true	3,000.00	10,000.00	3,007.02	10,007.02	20.00	49.35	20.00	27.21	J94	N/A	PMP1
J123	Main	true	3,000.00	10,000.00	3,006.19	10,006.19	20.00	45.88	20.00	27.19	J94	N/A	PMP1
J124	Main	true	3,000.00	10,000.00	3,002.20	10,002.20	20.00	42.60	20.00	27.17	J94	N/A	PMP1
J125	Main	true	3,000.00	10,000.00	3,000.33	10,000.33	20.00	44.57	20.00	27.08	J94	N/A	PMP1
J126	Main	true	3,000.00	10,000.00	3,000.33	10,000.33	20.00	36.41	20.00	26.88	J170	N/A	PMP1
J127	Main	true	3,000.00	3,589.82	3,003.15	3,592.97	20.00	20.00	20.00	29.36	J94	N/A	PMP1
J128	Main	true	3,000.00	8,537.59	3,000.33	8,537.92	20.00	20.00	20.00	27.63	J94	N/A	PMP1
J129	Main	true	2,000.00	5,289.60	2,000.87	5,290.48	20.00	20.00	20.00	28.69	J94	N/A	PMP1
J130	Main	true	3,000.00	10,000.00	3,000.44	10,000.44	20.00	55.86	20.00	27.24	J94	N/A	PMP1
J131	Main	true	2,000.00	4,787.84	2,001.57	4,789.41	20.00	20.00	20.00	28.69	J94	N/A	PMP1
J132	Main	true	2,000.00	8,326.11	2,001.05	8,327.16	20.00	20.00	20.00	27.79	J94	N/A	PMP1
J133	Main	true	3,000.00	8,213.34	3,002.61	8,215.94	20.00	20.69	20.00	20.00	J135	N/A	PMP1
J134	Main	true	2,000.00	8,149.00	2,002.08	8,151.09	20.00	20.00	20.00	27.86	J94	N/A	PMP1
J135	Main	true	3,000.00	3,455.15	3,001.63	3,456.79	20.00	20.00	20.00	29.54	J94	N/A	PMP1
J136	Main	true	3,000.00	8,756.81	3,010.76	8,767.57	20.00	33.54	20.00	20.00	J170	N/A	PMP1
J137	Main	true	3,000.00	7,157.94	3,000.98	7,158.91	20.00	42.36	20.00	20.01	J170	N/A	PMP1
J138	Main	true	3,000.00	4,223.17	3,002.61	4,225.78	20.00	37.09	20.00	20.01	J170	N/A	PMP1
J139	Main	true	3,000.00	3,846.41	3,001.63	3,848.04	20.00	36.68	20.00	20.01	J170	N/A	PMP1
J140	Main	true	3,000.00	3,562.38	3,001.63	3,564.01	20.00	35.84	20.00	20.00	J170	N/A	PMP1
J141	Main	true	3,000.00	3,225.08	3,004.57	3,229.64	20.00	32.50	20.00	20.00	J170	N/A	PMP1
J142	Main	true	3,000.00	3,131.55	3,001.63	3,133.18	20.00	31.98	20.00	20.00	J170	N/A	PMP1
J143	Main	true	3,000.00	3,057.69	3,003.58	3,061.27	20.00	31.33	20.00	20.00	J170	N/A	PMP1
J144	Main	false	3,000.00	2,910.19	3,000.98	2,911.17	20.00	29.10	20.00	20.01	J170	N/A	PMP1
J145	Main	false	3,000.00	2,820.71	3,000.33	2,821.04	20.00	27.78	20.00	20.01	J170	N/A	PMP1
J146	Main	false	3,000.00	2,738.40	3,001.63	2,740.03	20.00	27.35	20.00	20.01	J170	N/A	PMP1
J147	Main	false	3,000.00	2,511.60	3,001.30	2,512.90	20.00	23.92	20.00	20.00	J170	N/A	PMP1
J148	Main	true	1,000.00	2,438.50	1,000.43	2,438.93	20.00	20.69	20.00	20.00	J179	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J149	Main	false	2,000.00	1,869.65	2,001.63	1,871.28	20.00	20.56	20.00	20.00	J153	N/A	PMP1
J150	Main	false	2,000.00	1,610.08	2,000.98	1,611.05	20.00	20.43	20.00	20.05	J153	N/A	PMP1
J151	Main	false	2,000.00	1,475.89	2,000.87	1,476.76	20.00	20.05	20.00	32.45	J94	N/A	PMP1
J152	Main	false	2,000.00	1,583.19	2,002.28	1,585.47	20.00	20.03	20.00	32.27	J94	N/A	PMP1
J153	Main	false	2,000.00	1,374.74	2,000.43	1,375.17	20.00	20.00	20.00	32.62	J94	N/A	PMP1
J154	Main	true	3,000.00	3,846.89	3,001.30	3,848.20	20.00	32.83	20.00	20.00	J170	N/A	PMP1
J155	Main	true	3,000.00	3,477.13	3,002.28	3,479.41	20.00	20.00	20.00	22.70	J170	N/A	PMP1
J156	Main	false	3,000.00	2,757.73	3,001.73	2,759.46	20.00	20.01	20.00	20.06	J157	N/A	PMP1
J157	Main	true	2,000.00	2,217.46	2,001.73	2,219.20	20.00	20.02	20.00	31.25	J94	N/A	PMP1
J158	Main	true	2,000.00	3,046.82	2,005.87	3,052.69	20.00	20.00	20.00	24.74	J170	N/A	PMP1
J159	Main	true	2,000.00	2,975.18	2,003.91	2,979.09	20.00	20.00	20.00	26.17	J170	N/A	PMP1
J160	Main	false	3,000.00	2,875.56	3,001.30	2,876.87	20.00	20.00	20.00	29.25	J170	N/A	PMP1
J161	Main	false	3,000.00	2,802.78	3,000.98	2,803.75	20.00	20.01	20.00	21.12	J164	N/A	PMP1
J162	Main	true	1,000.00	2,228.93	1,000.87	2,229.80	20.00	20.01	20.00	31.24	J94	N/A	PMP1
J163	Main	false	3,000.00	2,750.47	3,000.00	2,750.47	20.00	21.16	20.00	20.00	J166	N/A	PMP1
J164	Main	false	3,000.00	2,744.07	3,000.33	2,744.40	20.00	20.01	20.00	24.81	J166	N/A	PMP1
J165	Main	false	3,000.00	2,618.81	3,001.30	2,620.12	20.00	20.00	20.00	26.50	J166	N/A	PMP1
J166	Main	false	3,000.00	2,309.40	3,001.96	2,311.36	20.00	20.00	20.00	31.11	J94	N/A	PMP1
J167	Main	false	3,000.00	2,404.53	3,000.33	2,404.86	20.00	20.00	20.00	30.97	J94	N/A	PMP1
J168	Main	true	1,000.00	2,116.08	1,001.52	2,117.60	20.00	20.61	20.00	20.00	J170	N/A	PMP1
J169	Main	true	1,000.00	2,037.02	1,002.61	2,039.63	20.00	20.01	20.00	22.49	J170	N/A	PMP1
J170	Main	true	1,000.00	2,002.86	1,004.57	2,007.43	20.00	20.01	20.00	25.52	J169	N/A	PMP1
J171	Main	true	1,000.00	1,962.42	1,003.26	1,965.69	20.00	20.00	20.00	22.20	J173	N/A	PMP1
J172	Main	true	1,000.00	1,548.36	1,000.00	1,548.36	20.00	20.00	20.00	32.33	J94	N/A	PMP1
J173	Main	true	1,000.00	1,770.42	1,003.70	1,774.12	20.00	20.00	20.00	21.89	J175	N/A	PMP1
J174	Main	true	1,000.00	1,544.29	1,003.05	1,547.34	20.00	20.00	20.00	32.34	J94	N/A	PMP1
J175	Main	true	1,000.00	1,724.44	1,006.52	1,730.96	20.00	20.00	20.00	23.58	J173	N/A	PMP1
J176	Main	true	1,000.00	2,285.90	1,001.52	2,287.41	20.00	20.61	20.00	20.00	J179	N/A	PMP1
J177	Main	true	1,000.00	2,212.92	1,001.30	2,214.22	20.00	20.30	20.00	20.00	J179	N/A	PMP1
J178	Main	true	1,000.00	2,187.89	1,002.82	2,190.71	20.00	20.01	20.00	20.34	J179	N/A	PMP1
J179	Main	true	1,000.00	2,172.04	1,002.61	2,174.65	20.00	20.01	20.00	22.11	J178	N/A	PMP1
J180	Main	true	1,000.00	2,207.89	1,002.18	2,210.07	20.00	20.19	20.00	20.00	J179	N/A	PMP1
J181	Main	true	1,000.00	4,752.52	1,001.63	4,754.15	20.00	20.32	20.00	20.00	J186	N/A	PMP1
J182	Main	true	3,000.00	10,000.00	3,000.88	10,000.88	20.00	61.68	20.00	27.52	J94	N/A	PMP1
J183	Main	true	3,000.00	10,000.00	3,003.07	10,003.07	20.00	40.28	20.00	27.51	J94	N/A	PMP1
J184	Main	true	3,000.00	5,818.15	3,008.83	5,826.97	20.00	20.00	20.00	28.72	J94	N/A	PMP1
J185	Main	true	3,000.00	10,000.00	3,005.13	10,005.13	20.00	51.92	20.00	25.23	J316	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J186	Main	true	1,000.00	2,914.30	1,002.50	2,916.81	20.00	20.02	20.00	30.75	J94	N/A	PMP1
J187	Main	true	2,000.00	9,208.71	2,003.95	9,212.66	20.00	20.00	20.00	27.82	J94	N/A	PMP1
J188	Main	true	3,000.00	7,330.25	3,005.17	7,335.42	20.00	43.48	20.00	20.00	J316	N/A	PMP1
J189	Main	true	3,000.00	6,266.93	3,004.48	6,271.40	20.00	41.00	20.00	20.00	J316	N/A	PMP1
J190	Main	true	3,000.00	5,967.48	3,008.67	5,976.15	20.00	41.65	20.00	20.01	J316	N/A	PMP1
J191	Main	true	3,000.00	5,839.25	3,005.76	5,845.01	20.00	40.34	20.00	20.00	J316	N/A	PMP1
J192	Main	true	3,000.00	5,574.62	3,004.02	5,578.64	20.00	41.97	20.00	20.00	J316	N/A	PMP1
J193	Main	true	3,000.00	4,815.54	3,003.21	4,818.75	20.00	46.60	20.00	20.00	J316	N/A	PMP1
J194	Main	true	3,000.00	4,657.92	3,008.87	4,666.79	20.00	47.27	20.00	20.01	J316	N/A	PMP1
J195	Main	true	3,000.00	4,601.74	3,003.54	4,605.28	20.00	46.97	20.00	20.01	J316	N/A	PMP1
J196	Main	true	3,000.00	5,574.48	3,000.98	5,575.45	20.00	26.49	20.00	20.00	J316	N/A	PMP1
J197	Main	true	3,000.00	4,600.57	3,004.63	4,605.20	20.00	27.55	20.00	20.01	J217	N/A	PMP1
J198	Main	true	3,000.00	3,920.02	3,002.24	3,922.26	20.00	26.86	20.00	20.00	J217	N/A	PMP1
J199	Main	true	1,000.00	3,711.38	1,003.26	3,714.64	20.00	26.60	20.00	20.01	J217	N/A	PMP1
J200	Main	true	1,000.00	3,416.79	1,003.70	3,420.49	20.00	25.14	20.00	20.00	J217	N/A	PMP1
J201	Main	true	1,000.00	2,635.44	1,001.73	2,637.17	20.00	23.67	20.00	20.00	J217	N/A	PMP1
J202	Main	true	1,000.00	2,394.89	1,000.00	2,394.89	20.00	20.02	20.00	31.06	J94	N/A	PMP1
J203	Main	true	3,000.00	8,989.42	3,000.98	8,990.39	20.00	20.00	20.00	27.50	J94	N/A	PMP1
J204	Main	true	3,000.00	5,943.73	3,000.00	5,943.73	20.00	20.00	20.00	28.59	J94	N/A	PMP1
J205	Main	true	3,000.00	5,115.73	3,000.66	5,116.39	20.00	20.00	20.00	22.16	J206	N/A	PMP1
J206	Main	true	3,000.00	3,406.56	3,000.33	3,406.89	20.00	20.00	20.00	29.76	J94	N/A	PMP1
J207	Main	false	3,000.00	2,832.67	3,001.96	2,834.63	20.00	20.01	20.00	21.02	J208	N/A	PMP1
J208	Main	false	3,000.00	2,397.29	3,003.15	2,400.44	20.00	20.00	20.00	31.16	J94	N/A	PMP1
J209	Main	true	3,000.00	5,721.55	3,004.78	5,726.34	20.00	26.84	20.00	20.00	J316	N/A	PMP1
J210	Main	true	3,000.00	6,101.47	3,004.74	6,106.21	20.00	25.51	20.00	20.00	J316	N/A	PMP1
J211	Main	true	3,000.00	4,908.66	3,000.66	4,909.31	20.00	20.01	20.00	28.72	J94	N/A	PMP1
J212	Main	true	3,000.00	3,259.17	3,009.20	3,268.37	20.00	20.02	20.00	29.86	J94	N/A	PMP1
J213	Main	true	1,000.00	2,098.26	1,004.13	2,102.39	20.00	20.00	20.00	31.50	J94	N/A	PMP1
J214	Main	true	3,000.00	3,389.30	3,000.33	3,389.63	20.00	20.68	20.00	20.00	J215	N/A	PMP1
J215	Main	false	3,000.00	1,909.47	3,000.98	1,910.44	20.00	20.00	20.00	31.79	J94	N/A	PMP1
J216	Main	true	1,000.00	2,253.38	1,004.13	2,257.50	20.00	22.88	20.00	20.00	J217	N/A	PMP1
J217	Main	true	1,000.00	2,038.45	1,003.48	2,041.93	20.00	20.01	20.00	22.10	J219	N/A	PMP1
J218	Main	true	1,000.00	1,839.33	1,002.82	1,842.16	20.00	20.15	20.00	20.02	J219	N/A	PMP1
J219	Main	true	1,000.00	1,715.83	1,003.05	1,718.88	20.00	20.00	20.00	30.17	J218	N/A	PMP1
J220	Main	true	3,000.00	4,939.57	3,000.33	4,939.90	20.00	29.11	20.00	20.00	J239	N/A	PMP1
J221	Main	true	3,000.00	3,725.38	3,002.94	3,728.31	20.00	25.32	20.00	20.01	J239	N/A	PMP1
J222	Main	true	3,000.00	3,434.85	3,000.00	3,434.85	20.00	24.86	20.00	20.01	J239	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J223	Main	true	3,000.00	3,126.61	3,000.66	3,127.27	20.00	24.29	20.00	20.00	J239	N/A	PMP1
J224	Main	true	3,000.00	3,095.52	3,000.00	3,095.52	20.00	20.00	20.00	22.26	J239	N/A	PMP1
J225	Main	false	3,000.00	988.42	3,001.63	990.05	20.00	20.00	20.00	33.38	J94	N/A	PMP1
J226	Main	false	3,000.00	972.27	3,000.66	972.93	20.00	20.00	20.00	33.40	J94	N/A	PMP1
J227	Main	true	3,000.00	3,670.83	3,002.28	3,673.11	20.00	51.91	20.00	20.00	J316	N/A	PMP1
J228	Main	true	3,000.00	5,582.95	3,003.21	5,586.16	20.00	20.80	20.00	20.00	J229	N/A	PMP1
J229	Main	true	3,000.00	4,029.66	3,000.98	4,030.64	20.00	20.00	20.00	29.14	J94	N/A	PMP1
J230	Main	true	3,000.00	5,737.51	3,016.48	5,753.99	20.00	20.00	20.00	21.45	J316	N/A	PMP1
J231	Main	false	3,000.00	2,344.04	3,000.33	2,344.36	20.00	23.70	20.00	20.00	J234	N/A	PMP1
J232	Main	false	3,000.00	2,088.90	3,000.33	2,089.23	20.00	20.16	20.00	20.02	J234	N/A	PMP1
J233	Main	false	3,000.00	1,655.30	3,004.20	1,659.50	20.00	20.00	20.00	32.31	J94	N/A	PMP1
J234	Main	false	3,000.00	1,831.71	3,000.33	1,832.04	20.00	20.00	20.00	32.04	J94	N/A	PMP1
J235	Main	false	3,000.00	2,887.19	3,055.33	2,942.52	20.00	20.00	20.00	20.22	J236	N/A	PMP1
J236	Main	false	3,000.00	2,709.09	3,004.24	2,713.33	20.00	20.02	20.00	29.06	J235	N/A	PMP1
J237	Main	false	3,000.00	2,706.13	3,000.33	2,706.46	20.00	20.02	20.00	29.20	J235	N/A	PMP1
J238	Main	false	3,000.00	2,855.71	3,002.57	2,858.27	20.00	22.42	20.00	20.00	J239	N/A	PMP1
J239	Main	false	3,000.00	2,724.89	3,000.33	2,725.22	20.00	20.02	20.00	22.04	J240	N/A	PMP1
J240	Main	false	3,000.00	2,581.56	3,000.33	2,581.89	20.00	20.00	20.00	27.49	J239	N/A	PMP1
J241	Main	false	3,000.00	2,637.83	3,000.33	2,638.16	20.00	20.03	20.00	30.75	J239	N/A	PMP1
J242	Main	true	1,000.00	4,745.62	1,000.00	4,745.62	20.00	34.77	20.00	20.00	J316	N/A	PMP1
J243	Main	true	3,000.00	4,714.64	3,002.90	4,717.53	20.00	28.91	20.00	20.00	J316	N/A	PMP1
J244	Main	true	3,000.00	4,200.23	3,000.66	4,200.88	20.00	20.88	20.00	20.00	J245	N/A	PMP1
J245	Main	true	3,000.00	3,786.47	3,000.98	3,787.45	20.00	20.00	20.00	20.86	J246	N/A	PMP1
J246	Main	true	3,000.00	3,069.21	3,002.72	3,071.93	20.00	20.00	20.00	30.17	J94	N/A	PMP1
J247	Main	true	3,000.00	4,612.09	3,000.33	4,612.42	20.00	26.21	20.00	20.00	J316	N/A	PMP1
J248	Main	true	3,000.00	4,431.76	3,001.30	4,433.06	20.00	45.58	20.00	20.00	J316	N/A	PMP1
J249	Main	true	3,000.00	3,949.60	3,000.00	3,949.60	20.00	20.00	20.00	29.11	J94	N/A	PMP1
J250	Main	true	3,000.00	4,086.16	3,001.30	4,087.47	20.00	44.28	20.00	20.00	J316	N/A	PMP1
J251	Main	true	3,000.00	3,831.22	3,001.63	3,832.85	20.00	50.19	20.00	20.00	J316	N/A	PMP1
J252	Main	true	3,000.00	4,155.89	3,000.66	4,156.54	20.00	43.12	20.00	20.00	J316	N/A	PMP1
J253	Main	true	1,000.00	3,935.22	1,000.33	3,935.55	20.00	47.08	20.00	20.00	J316	N/A	PMP1
J254	Main	true	1,000.00	3,626.48	1,002.82	3,629.30	20.00	20.00	20.00	26.96	J316	N/A	PMP1
J255	Main	true	1,000.00	3,716.04	1,000.00	3,716.04	20.00	29.15	20.00	20.02	J316	N/A	PMP1
J256	Main	true	3,000.00	3,626.61	3,007.50	3,634.12	20.00	35.26	20.00	20.01	J316	N/A	PMP1
J257	Main	true	3,000.00	3,571.33	3,001.63	3,572.96	20.00	20.00	20.00	21.43	J316	N/A	PMP1
J258	Main	false	3,000.00	2,874.81	3,001.73	2,876.54	20.00	20.01	20.00	30.45	J94	N/A	PMP1
J259	Main	true	3,000.00	3,646.64	3,003.54	3,650.19	20.00	22.07	20.00	20.00	J316	N/A	PMP1

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J260	Main	true	3,000.00	3,628.63	3,001.63	3,630.26	20.00	20.00	20.00	20.46	J316	N/A	PMP1
J261	Main	true	3,000.00	3,646.68	3,001.30	3,647.98	20.00	23.78	20.00	20.00	J316	N/A	PMP1
J262	Main	true	3,000.00	3,648.11	3,000.33	3,648.43	20.00	35.29	20.00	20.01	J316	N/A	PMP1
J263	Main	true	3,000.00	3,647.07	3,000.98	3,648.05	20.00	23.94	20.00	20.01	J316	N/A	PMP1
J264	Main	true	3,000.00	3,646.94	3,000.98	3,647.91	20.00	21.97	20.00	20.00	J316	N/A	PMP1
J265	Main	true	3,000.00	3,646.83	3,009.26	3,656.09	20.00	22.17	20.00	20.00	J316	N/A	PMP1
J266	Main	true	3,000.00	3,646.17	3,000.98	3,647.14	20.00	24.76	20.00	20.00	J316	N/A	PMP1
J267	Main	true	3,000.00	3,628.49	3,000.52	3,629.02	20.00	24.77	20.00	20.01	J278	N/A	PMP1
J268	Main	true	3,000.00	3,644.53	3,005.29	3,649.81	20.00	26.39	20.00	20.00	J316	N/A	PMP1
J269	Main	true	3,000.00	3,643.83	3,001.63	3,645.46	20.00	26.43	20.00	20.00	J316	N/A	PMP1
J270	Main	true	3,000.00	3,646.65	3,010.83	3,657.48	20.00	20.90	20.00	20.00	J316	N/A	PMP1
J271	Main	true	3,000.00	3,646.77	3,007.37	3,654.14	20.00	26.62	20.00	20.00	J316	N/A	PMP1
J272	Main	true	3,000.00	3,506.02	3,004.53	3,510.55	20.00	20.00	20.00	23.50	J316	N/A	PMP1
J273	Main	true	3,000.00	3,566.91	3,000.00	3,566.91	20.00	20.00	20.00	21.96	J316	N/A	PMP1
J274	Main	true	3,000.00	3,643.74	3,000.00	3,643.74	20.00	24.22	20.00	20.01	J316	N/A	PMP1
J275	Main	true	3,000.00	3,611.65	3,000.00	3,611.65	20.00	23.24	20.00	20.00	J277	N/A	PMP1
J276	Main	true	3,000.00	3,458.85	3,000.00	3,458.85	20.00	23.54	20.00	20.00	J277	N/A	PMP1
J277	Main	true	3,000.00	3,257.34	3,005.87	3,263.21	20.00	20.02	20.00	29.66	J316	N/A	PMP1
J278	Main	true	3,000.00	3,469.80	3,006.52	3,476.32	20.00	20.00	20.00	24.44	J316	N/A	PMP1
J279	Main	true	3,000.00	3,475.14	3,004.70	3,479.84	20.00	20.00	20.00	23.87	J316	N/A	PMP1
J280	Main	true	3,000.00	3,094.09	3,000.35	3,094.44	20.00	20.00	20.00	30.13	J94	N/A	PMP1
J281	Main	true	3,000.00	3,613.31	3,001.85	3,615.16	20.00	33.62	20.00	20.02	J316	N/A	PMP1
J282	Main	true	3,000.00	3,642.46	3,002.57	3,645.02	20.00	26.47	20.00	20.00	J316	N/A	PMP1
J283	Main	true	3,000.00	3,637.26	3,000.66	3,637.91	20.00	22.87	20.00	20.00	J316	N/A	PMP1
J284	Main	true	3,000.00	3,633.27	3,004.24	3,637.51	20.00	26.29	20.00	20.00	J316	N/A	PMP1
J285	Main	true	3,000.00	3,631.18	3,000.98	3,632.15	20.00	27.59	20.00	20.00	J316	N/A	PMP1
J286	Main	true	3,000.00	3,590.16	3,001.30	3,591.47	20.00	32.76	20.00	20.01	J316	N/A	PMP1
J287	Main	true	3,000.00	3,569.78	3,011.16	3,580.94	20.00	32.79	20.00	20.02	J316	N/A	PMP1
J288	Main	true	3,000.00	3,480.40	3,005.07	3,485.47	20.00	28.01	20.00	20.00	J316	N/A	PMP1
J289	Main	true	500.00	3,376.32	501.73	3,378.05	20.00	24.46	20.00	20.01	J316	N/A	PMP1
J290	Main	true	500.00	2,949.86	505.44	2,955.30	20.00	23.61	20.00	20.00	J316	N/A	PMP1
J291	Main	true	500.00	2,772.83	501.52	2,774.35	20.00	22.52	20.00	20.02	J316	N/A	PMP1
J292	Main	true	500.00	2,668.70	504.85	2,673.55	20.00	22.47	20.00	20.00	J316	N/A	PMP1
J293	Main	true	3,000.00	3,478.79	3,000.98	3,479.76	20.00	20.00	20.00	24.15	J316	N/A	PMP1
J294	Main	true	3,000.00	3,603.26	3,002.90	3,606.15	20.00	20.00	20.00	20.87	J316	N/A	PMP1
J295	Main	true	3,000.00	3,528.58	3,002.57	3,531.15	20.00	22.52	20.00	20.00	J298	N/A	PMP1
J296	Main	true	3,000.00	3,228.71	3,000.33	3,229.03	20.00	21.15	20.00	20.00	J298	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J297	Main	true	3,000.00	3,050.24	3,000.66	3,050.89	20.00	21.43	20.00	20.00	J298	N/A	PMP1
J298	Main	false	3,000.00	2,504.27	3,000.66	2,504.93	20.00	20.00	20.00	30.96	J94	N/A	PMP1
J299	Main	false	3,000.00	2,725.76	3,001.30	2,727.06	20.00	20.03	20.00	30.65	J94	N/A	PMP1
J300	Main	true	3,000.00	3,255.62	3,002.61	3,258.22	20.00	21.05	20.00	20.00	J301	N/A	PMP1
J301	Main	false	3,000.00	2,875.81	3,002.61	2,878.42	20.00	20.01	20.00	30.44	J94	N/A	PMP1
J302	Main	true	1,000.00	3,640.14	1,003.70	3,643.84	20.00	28.95	20.00	20.00	J316	N/A	PMP1
J303	Main	true	1,000.00	3,617.82	1,003.05	3,620.87	20.00	30.39	20.00	20.00	J316	N/A	PMP1
J304	Main	true	1,000.00	3,067.42	1,003.48	3,070.90	20.00	20.00	20.00	30.17	J94	N/A	PMP1
J305	Main	true	1,000.00	3,473.99	1,004.13	3,478.11	20.00	20.16	20.00	20.00	J306	N/A	PMP1
J306	Main	true	1,000.00	3,197.74	1,002.61	3,200.35	20.00	20.00	20.00	27.18	J307	N/A	PMP1
J307	Main	true	1,000.00	3,227.63	1,002.61	3,230.24	20.00	20.00	20.00	21.95	J311	N/A	PMP1
J308	Main	true	1,000.00	3,128.18	1,002.39	3,130.57	20.00	20.00	20.00	26.67	J307	N/A	PMP1
J309	Main	true	1,000.00	3,128.46	1,004.57	3,133.03	20.00	20.33	20.00	20.00	J311	N/A	PMP1
J310	Main	true	1,000.00	3,141.73	1,002.39	3,144.13	20.00	20.00	20.00	27.74	J311	N/A	PMP1
J311	Main	true	1,000.00	2,740.91	1,001.73	2,742.64	20.00	20.00	20.00	30.63	J94	N/A	PMP1
J312	Main	true	500.00	2,573.53	505.00	2,578.53	20.00	21.39	20.00	20.00	J314	N/A	PMP1
J313	Main	true	500.00	2,278.00	503.26	2,281.27	20.00	21.11	20.00	20.00	J314	N/A	PMP1
J314	Main	true	500.00	2,090.73	501.30	2,092.04	20.00	20.00	20.00	30.04	J313	N/A	PMP1
J315	Main	false	3,000.00	2,668.72	3,001.96	2,670.68	20.00	21.74	20.00	20.00	J316	N/A	PMP1
J316	Main	true	500.00	2,508.06	501.73	2,509.79	20.00	20.00	20.00	20.62	J317	N/A	PMP1
J317	Main	true	500.00	2,059.61	501.09	2,060.70	20.00	20.00	20.00	31.61	J94	N/A	PMP1
J318	Main	false	3,000.00	2,654.55	3,000.66	2,655.21	20.00	22.00	20.00	20.00	J320	N/A	PMP1
J319	Main	true	500.00	2,609.68	500.22	2,609.89	20.00	20.00	20.00	20.70	J321	N/A	PMP1
J320	Main	true	500.00	1,859.15	500.00	1,859.15	20.00	20.00	20.00	31.92	J94	N/A	PMP1
J321	Main	true	500.00	2,389.17	500.00	2,389.17	20.00	20.00	20.00	29.71	J319	N/A	PMP1
J475	Mid-S	true	0.01	133.64	1.31	134.94	20.00	52.60	20.00	20.00	J478	N/A	PMP1
J476	Mid-S	true	0.01	133.59	0.88	134.46	20.00	49.07	20.00	20.00	J478	N/A	PMP1
J477	Mid-S	true	0.01	133.52	3.27	136.79	20.00	38.03	20.00	20.00	J478	N/A	PMP1
J478	Mid-S	false	1,000.00	51.32	1,000.00	51.32	20.00	20.01	20.00	28.21	J480	N/A	PMP1
J479	Mid-S	true	0.01	118.26	1.53	119.78	20.00	35.65	20.00	20.01	J478	N/A	PMP1
J480	Mid-S	false	1,000.00	155.34	1,002.28	157.62	20.00	27.01	20.00	20.00	J478	N/A	PMP1
J501	Fernc	true	1,000.00	1,353.37	1,003.33	1,356.69	20.00	39.95	20.00	20.00	J508	N/A	PMP1
J502	Fernc	true	1,000.00	1,309.27	1,001.52	1,310.79	20.00	34.38	20.00	20.00	J508	N/A	PMP1
J503	Fernc	true	1,000.00	1,167.14	1,002.18	1,169.32	20.00	20.00	20.00	20.93	J514	N/A	PMP1
J504	Fernc	false	1,000.00	966.58	1,004.35	970.93	20.00	24.25	20.00	20.00	J526	N/A	PMP1
J505	Fernc	false	1,000.00	618.53	1,002.18	620.70	20.00	30.46	20.00	20.00	J526	N/A	PMP1
J506	Fernc	false	1,000.00	488.13	1,002.18	490.30	20.00	25.04	20.00	20.00	J526	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J507	Fernc	true	1,000.00	1,176.10	1,003.70	1,179.80	20.00	25.44	20.00	20.00	J508	N/A	PMP1
J508	Fernc	true	1,000.00	1,111.48	1,002.39	1,113.88	20.00	20.00	20.00	25.55	J514	N/A	PMP1
J509	Fernc	false	1,000.00	949.97	1,005.22	955.19	20.00	32.65	20.00	20.00	J514	N/A	PMP1
J510	Fernc	false	1,000.00	811.36	1,004.78	816.14	20.00	21.71	20.00	20.00	J514	N/A	PMP1
J511	Fernc	false	1,000.00	727.81	1,003.26	731.08	20.00	24.62	20.00	20.00	J526	N/A	PMP1
J512	Fernc	false	1,000.00	955.77	1,003.05	958.82	20.00	20.00	20.00	22.54	J515	N/A	PMP1
J513	Fernc	false	1,000.00	725.80	1,005.22	731.02	20.00	20.01	20.00	27.19	J514	N/A	PMP1
J514	Fernc	false	1,000.00	524.63	1,005.44	530.07	20.00	20.00	20.00	34.94	J521	N/A	PMP1
J515	Fernc	false	1,000.00	746.82	1,002.39	749.21	20.00	20.05	20.00	22.93	J514	N/A	PMP1
J516	Fernc	true	1,000.00	3,230.65	1,001.52	3,232.17	20.00	20.61	20.00	20.00	J517	N/A	PMP1
J517	Fernc	true	1,000.00	2,566.14	1,004.13	2,570.26	20.00	20.00	20.00	30.46	J524	N/A	PMP1
J518	Fernc	true	1,000.00	3,429.42	1,002.18	3,431.60	20.00	23.53	20.00	20.00	J514	N/A	PMP1
J519	Fernc	true	1,000.00	3,016.62	1,002.18	3,018.80	20.00	23.59	20.00	20.00	J514	N/A	PMP1
J520	Fernc	true	1,000.00	3,878.19	1,000.87	3,879.06	20.00	20.45	20.00	20.00	J521	N/A	PMP1
J521	Fernc	true	1,000.00	3,506.70	1,000.00	3,506.70	20.00	20.00	20.00	35.52	J520	N/A	PMP1
J522	Fernc	true	1,000.00	3,846.82	1,001.73	3,848.55	20.00	20.00	20.00	21.21	J524	N/A	PMP1
J523	Fernc	true	1,000.00	3,146.97	1,003.70	3,150.66	20.00	25.78	20.00	20.00	J524	N/A	PMP1
J524	Fernc	true	1,000.00	1,652.98	1,004.78	1,657.77	20.00	20.00	20.00	33.01	J521	N/A	PMP1
J525	Fernc	true	1,000.00	3,943.69	1,003.26	3,946.95	20.00	20.00	20.00	30.49	J522	N/A	PMP1
J526	Fernc	false	1,000.00	464.86	1,001.96	466.82	20.00	20.06	20.00	28.11	J506	N/A	PMP1
J601	Mid	true	1,000.00	5,007.17	1,000.00	5,007.17	20.00	38.92	20.00	20.00	J673	N/A	PMP1
J602	Mid	true	1,000.00	5,007.17	1,000.00	5,007.17	20.00	56.68	20.00	20.00	J673	N/A	PMP1
J603	Mid	true	3,000.00	5,007.17	3,001.52	5,008.69	20.00	40.52	20.00	20.00	J673	N/A	PMP1
J604	Mid	true	3,000.00	4,164.89	3,006.15	4,171.04	20.00	20.00	20.00	21.84	J673	N/A	PMP1
J605	Mid	true	1,000.00	4,338.20	1,004.78	4,342.99	20.00	20.00	20.00	21.23	J673	N/A	PMP1
J606	Mid	true	1,000.00	3,928.07	1,000.00	3,928.07	20.00	20.00	20.00	22.17	J673	N/A	PMP1
J607	Mid	true	1,000.00	4,381.47	1,003.26	4,384.73	20.00	20.00	20.00	20.85	J673	N/A	PMP1
J608	Mid	true	1,000.00	4,298.46	1,002.82	4,301.28	20.00	20.00	20.00	20.94	J673	N/A	PMP1
J609	Mid	true	1,000.00	4,526.89	1,002.39	4,529.28	20.00	36.00	20.00	20.00	J673	N/A	PMP1
J610	Mid	true	1,000.00	5,019.70	1,002.82	5,022.53	20.00	33.83	20.00	20.00	J673	N/A	PMP1
J611	Mid	true	1,000.00	5,027.92	1,001.30	5,029.23	20.00	48.21	20.00	20.00	J673	N/A	PMP1
J612	Mid	true	1,000.00	3,737.72	1,005.72	3,743.44	20.00	40.25	20.00	20.00	J673	N/A	PMP1
J613	Mid	true	1,000.00	3,339.36	1,003.26	3,342.63	20.00	45.24	20.00	20.00	J673	N/A	PMP1
J614	Mid	true	1,000.00	3,067.86	1,003.91	3,071.78	20.00	56.36	20.00	20.00	J673	N/A	PMP1
J615	Mid	true	1,000.00	2,768.86	1,003.48	2,772.34	20.00	74.32	20.00	20.00	J673	N/A	PMP1
J616	Mid	true	1,000.00	3,820.22	1,003.05	3,823.27	20.00	20.00	20.00	22.11	J673	N/A	PMP1
J617	Mid	true	1,000.00	4,134.45	1,003.26	4,137.72	20.00	20.00	20.00	21.42	J673	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J618	Mid	false	1,000.00	827.78	1,002.61	830.39	20.00	21.41	20.00	20.07	J621	N/A	PMP1
J619	Mid	false	1,000.00	731.54	1,003.48	735.02	20.00	23.07	20.00	20.05	J621	N/A	PMP1
J620	Mid	false	1,000.00	667.86	1,000.00	667.86	20.00	20.00	20.00	26.78	J673	N/A	PMP1
J621	Mid	false	1,000.00	628.11	1,003.48	631.60	20.00	20.00	20.00	26.82	J673	N/A	PMP1
J622	Mid	true	1,000.00	5,009.97	1,001.73	5,011.71	20.00	22.35	20.00	20.00	J673	N/A	PMP1
J623	Mid	true	1,000.00	4,277.91	1,002.82	4,280.73	20.00	20.00	20.00	21.72	J673	N/A	PMP1
J624	Mid	true	1,000.00	4,176.33	1,002.18	4,178.50	20.00	20.00	20.00	21.94	J673	N/A	PMP1
J625	Mid	true	1,000.00	4,061.96	1,001.73	4,063.70	20.00	23.91	20.00	20.00	J639	N/A	PMP1
J626	Mid	true	1,000.00	4,011.39	1,001.30	4,012.70	20.00	20.00	20.00	22.29	J673	N/A	PMP1
J627	Mid	true	1,000.00	2,900.77	1,005.66	2,906.43	20.00	20.01	20.00	24.22	J628	N/A	PMP1
J628	Mid	true	1,000.00	2,472.68	1,005.22	2,477.90	20.00	20.01	20.00	24.99	J673	N/A	PMP1
J629	Mid	true	1,000.00	3,692.89	1,004.57	3,697.45	20.00	20.00	20.00	22.93	J673	N/A	PMP1
J630	Mid	true	1,000.00	4,105.06	1,004.35	4,109.41	20.00	20.00	20.00	22.09	J673	N/A	PMP1
J631	Mid	true	1,000.00	3,785.87	1,004.13	3,789.99	20.00	20.00	20.00	22.75	J673	N/A	PMP1
J632	Mid	true	1,000.00	3,717.03	1,003.70	3,720.73	20.00	20.00	20.00	22.89	J673	N/A	PMP1
J633	Mid	true	1,000.00	4,300.42	1,001.52	4,301.94	20.00	20.00	20.00	20.21	J623	N/A	PMP1
J634	Mid	true	1,000.00	3,917.92	1,002.61	3,920.53	20.00	20.00	20.00	20.53	J636	N/A	PMP1
J635	Mid	true	1,000.00	2,821.93	1,003.26	2,825.20	20.00	20.00	20.00	24.48	J673	N/A	PMP1
J636	Mid	true	1,000.00	2,339.43	1,003.91	2,343.34	20.00	20.01	20.00	25.18	J673	N/A	PMP1
J637	Mid	true	1,000.00	2,942.54	1,003.26	2,945.80	20.00	20.00	20.00	24.29	J673	N/A	PMP1
J638	Mid	true	1,000.00	3,611.07	1,004.35	3,615.43	20.00	20.00	20.00	23.11	J673	N/A	PMP1
J639	Mid	true	1,000.00	2,679.95	1,002.82	2,682.77	20.00	20.01	20.00	24.69	J673	N/A	PMP1
J640	Mid	true	1,000.00	2,769.34	1,001.73	2,771.07	20.00	20.02	20.00	24.56	J673	N/A	PMP1
J641	Mid	true	1,000.00	2,536.17	1,003.26	2,539.43	20.00	20.01	20.00	24.91	J673	N/A	PMP1
J642	Mid	true	1,000.00	2,928.72	1,001.73	2,930.45	20.00	20.00	20.00	24.31	J673	N/A	PMP1
J643	Mid	true	1,000.00	1,992.52	1,003.26	1,995.79	20.00	20.00	20.00	25.62	J673	N/A	PMP1
J644	Mid	true	1,000.00	1,904.87	1,001.09	1,905.96	20.00	20.00	20.00	25.72	J673	N/A	PMP1
J645	Mid	true	1,000.00	2,207.99	1,003.48	2,211.47	20.00	20.01	20.00	23.89	J644	N/A	PMP1
J646	Mid	true	3,000.00	5,014.00	3,002.18	5,016.18	20.00	45.43	20.00	20.00	J673	N/A	PMP1
J647	Mid	true	1,000.00	5,033.08	1,007.61	5,040.68	20.00	44.43	20.00	20.00	J673	N/A	PMP1
J648	Mid	true	1,000.00	4,963.91	1,002.18	4,966.09	20.00	40.40	20.00	20.00	J673	N/A	PMP1
J649	Mid	true	1,000.00	4,681.41	1,002.61	4,684.02	20.00	37.74	20.00	20.00	J673	N/A	PMP1
J650	Mid	true	1,000.00	4,289.39	1,001.52	4,290.91	20.00	26.76	20.00	20.00	J673	N/A	PMP1
J651	Zone	false	1,000.00	0.00	1,000.00	0.00	20.00	13.40	20.00	1.57	J95	N/A	PMP1
J652	Mid	true	1,000.00	2,568.27	1,004.78	2,573.06	20.00	20.01	20.00	20.99	J656	N/A	PMP1
J653	Zone	false	500.00	0.00	500.00	0.00	5.00	9.97	5.00	1.57	J95	N/A	PMP1
J654	Mid	true	1,000.00	4,658.76	1,003.70	4,662.45	20.00	20.00	20.00	23.40	J673	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J655	Mid	true	1,000.00	4,306.07	1,005.00	4,311.07	20.00	20.00	20.00	23.58	J673	N/A	PMP1
J656	Mid	true	1,000.00	1,512.73	1,003.91	1,516.64	20.00	20.03	20.00	26.46	J673	N/A	PMP1
J657	Mid	true	1,000.00	4,151.81	1,002.82	4,154.63	20.00	20.88	20.00	20.00	J658	N/A	PMP1
J658	Mid	true	1,000.00	2,936.20	1,001.52	2,937.72	20.00	20.00	20.00	22.96	J661	N/A	PMP1
J659	Mid	true	1,000.00	2,539.77	1,005.00	2,544.77	20.00	25.01	20.00	20.00	J661	N/A	PMP1
J660	Mid	true	1,000.00	1,884.27	1,003.26	1,887.54	20.00	27.51	20.00	20.00	J661	N/A	PMP1
J661	Mid	true	1,000.00	1,832.85	1,000.00	1,832.85	20.00	20.00	20.00	27.01	J673	N/A	PMP1
J662	Mid	true	1,000.00	2,191.72	1,002.82	2,194.54	20.00	20.00	20.00	26.96	J673	N/A	PMP1
J663	Mid	true	1,000.00	4,939.62	1,003.48	4,943.10	20.00	20.00	20.00	21.72	J673	N/A	PMP1
J664	Mid	true	1,000.00	2,574.93	1,003.48	2,578.41	20.00	20.00	20.00	25.56	J673	N/A	PMP1
J665	Mid	true	1,000.00	4,235.00	1,003.48	4,238.48	20.00	20.00	20.00	24.10	J673	N/A	PMP1
J666	Mid	true	1,000.00	3,638.52	1,003.05	3,641.57	20.00	20.00	20.00	23.37	J673	N/A	PMP1
J667	Mid	true	1,000.00	4,025.12	1,001.73	4,026.85	20.00	22.45	20.00	20.00	J668	N/A	PMP1
J668	Mid	true	1,000.00	1,925.12	1,003.48	1,928.60	20.00	20.00	20.00	25.74	J673	N/A	PMP1
J669	Mid	true	1,000.00	3,617.76	1,001.09	3,618.85	20.00	25.26	20.00	20.00	J670	N/A	PMP1
J670	Mid	true	1,000.00	2,920.16	1,003.48	2,923.64	20.00	20.01	20.00	24.76	J673	N/A	PMP1
J671	Mid	true	1,000.00	3,215.90	1,003.26	3,219.17	20.00	20.01	20.00	24.36	J673	N/A	PMP1
J672	Mid	true	1,000.00	6,756.74	1,003.26	6,760.01	20.00	25.36	20.00	20.00	J673	N/A	PMP1
J673	Mid	true	1,000.00	2,014.86	1,000.22	2,015.08	20.00	20.00	20.00	32.08	J650	N/A	PMP1
J674	Mid	true	1,000.00	2,156.00	1,000.00	2,156.00	20.00	29.96	20.00	20.00	J673	N/A	PMP1
J675	Mid	true	1,000.00	2,173.43	1,000.00	2,173.43	20.00	46.65	20.00	20.00	J673	N/A	PMP1
J676	Mid	true	1,000.00	2,173.44	1,004.85	2,178.29	20.00	61.24	20.00	20.00	J673	N/A	PMP1
J677	Mid	true	1,000.00	2,173.43	1,000.00	2,173.43	20.00	71.16	20.00	20.00	J673	N/A	PMP1
J678	Mid	true	1,000.00	2,173.37	1,000.66	2,174.02	20.00	61.10	20.00	20.00	J673	N/A	PMP1
J679	Mid	true	1,000.00	2,249.89	1,000.00	2,249.89	20.00	55.11	20.00	20.00	J673	N/A	PMP1
J680	Mid	true	1,000.00	2,303.47	1,000.00	2,303.47	20.00	67.23	20.00	20.00	J673	N/A	PMP1
J681	Mid	true	1,000.00	2,228.50	1,000.00	2,228.50	20.00	72.17	20.00	20.00	J673	N/A	PMP1
J682	Mid	true	1,000.00	2,197.36	1,000.00	2,197.36	20.00	47.08	20.00	20.00	J673	N/A	PMP1
J683	Mid	true	1,000.00	2,552.35	1,000.00	2,552.35	20.00	79.35	20.00	20.00	J673	N/A	PMP1
J684	Mid	true	1,000.00	2,173.44	1,000.43	2,173.87	20.00	40.49	20.00	20.00	J673	N/A	PMP1
J801	Baker	true	1,000.00	5,685.40	1,000.00	5,685.40	20.00	21.46	20.00	20.01	J827	N/A	PMP1
J802	Baker	true	1,000.00	5,374.87	1,000.66	5,375.53	20.00	23.39	20.00	20.00	J827	N/A	PMP1
J803	Baker	true	3,000.00	5,112.91	3,002.90	5,115.81	20.00	24.55	20.00	20.00	J808	N/A	PMP1
J804	Baker	true	1,000.00	4,461.89	1,000.00	4,461.89	20.00	40.70	20.00	20.00	J808	N/A	PMP1
J805	Baker	true	1,000.00	3,880.83	1,000.00	3,880.83	20.00	32.36	20.00	20.01	J808	N/A	PMP1
J806	Baker	true	1,000.00	3,646.62	1,000.00	3,646.62	20.00	35.74	20.00	20.00	J808	N/A	PMP1
J807	Baker	true	1,000.00	3,269.67	1,000.00	3,269.67	20.00	34.80	20.00	20.00	J808	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J808	Baker	true	1,000.00	3,092.79	1,000.00	3,092.79	20.00	20.00	20.00	26.84	J809	N/A	PMP1
J809	Baker	true	1,000.00	3,092.57	1,000.00	3,092.57	20.00	22.63	20.00	20.01	J808	N/A	PMP1
J810	Baker	true	1,000.00	3,256.03	1,000.00	3,256.03	20.00	24.85	20.00	20.00	J808	N/A	PMP1
J811	Baker	true	1,000.00	2,738.76	1,000.00	2,738.76	20.00	20.00	20.00	29.60	J808	N/A	PMP1
J812	Baker	true	1,000.00	2,946.69	1,000.00	2,946.69	20.00	20.00	20.00	24.06	J808	N/A	PMP1
J813	Baker	true	1,000.00	4,349.23	1,003.26	4,352.49	20.00	20.00	20.00	33.40	J827	N/A	PMP1
J814	Baker	true	1,000.00	4,884.73	1,005.72	4,890.45	20.00	32.54	20.00	20.00	J827	N/A	PMP1
J815	Baker	true	1,000.00	4,790.79	1,001.09	4,791.88	20.00	35.77	20.00	20.00	J827	N/A	PMP1
J816	Baker	true	1,000.00	4,696.83	1,002.61	4,699.44	20.00	42.40	20.00	20.01	J827	N/A	PMP1
J817	Baker	true	1,000.00	4,598.53	1,004.78	4,603.31	20.00	42.72	20.00	20.00	J827	N/A	PMP1
J818	Baker	true	1,000.00	4,526.76	1,002.39	4,529.15	20.00	43.27	20.00	20.00	J827	N/A	PMP1
J819	Baker	true	3,000.00	4,475.85	3,000.87	4,476.72	20.00	44.67	20.00	20.00	J827	N/A	PMP1
J820	Baker	true	3,000.00	4,402.76	3,003.98	4,406.74	20.00	45.91	20.00	20.00	J827	N/A	PMP1
J821	Baker	true	1,000.00	4,402.69	1,001.30	4,403.99	20.00	38.84	20.00	20.00	J827	N/A	PMP1
J822	Baker	true	1,000.00	4,402.70	1,000.87	4,403.58	20.00	30.74	20.00	20.00	J827	N/A	PMP1
J823	Baker	true	1,000.00	4,333.01	1,003.05	4,336.06	20.00	20.00	20.00	20.35	J827	N/A	PMP1
J824	Baker	true	1,000.00	3,978.27	1,006.30	3,984.57	20.00	30.71	20.00	20.01	J827	N/A	PMP1
J825	Baker	true	1,000.00	3,206.56	1,004.85	3,211.40	20.00	25.29	20.00	20.00	J827	N/A	PMP1
J826	Baker	true	1,000.00	3,004.36	1,007.83	3,012.19	20.00	22.98	20.00	20.00	J827	N/A	PMP1
J827	Baker	true	1,000.00	2,860.66	1,004.78	2,865.44	20.00	20.00	20.00	22.22	J828	N/A	PMP1
J828	Baker	true	1,000.00	2,849.68	1,003.05	2,852.73	20.00	20.00	20.00	20.83	J827	N/A	PMP1
J829	Baker	true	1,000.00	2,825.91	1,005.87	2,831.78	20.00	20.01	20.00	21.25	J828	N/A	PMP1
J830	Baker	true	1,000.00	2,722.75	1,007.83	2,730.58	20.00	20.00	20.00	26.77	J827	N/A	PMP1
J831	Baker	true	1,000.00	2,220.01	1,003.48	2,223.49	20.00	20.00	20.00	37.58	J827	N/A	PMP1
J832	Baker	true	1,000.00	4,783.34	1,002.39	4,785.73	20.00	26.38	20.00	20.00	J827	N/A	PMP1
J833	Baker	true	1,000.00	4,556.62	1,001.52	4,558.14	20.00	20.00	20.00	22.05	J827	N/A	PMP1
J834	Baker	true	3,000.00	4,507.93	3,000.43	4,508.36	20.00	28.32	20.00	20.00	J827	N/A	PMP1
J835	Baker	true	3,000.00	4,252.92	3,000.00	4,252.92	20.00	36.92	20.00	20.00	J827	N/A	PMP1
J836	Baker	true	1,000.00	4,765.47	1,000.00	4,765.47	20.00	20.00	20.00	20.30	J827	N/A	PMP1
J837	Baker	true	1,000.00	4,147.41	1,001.73	4,149.14	20.00	20.00	20.00	26.63	J827	N/A	PMP1
J838	Baker	true	1,000.00	3,392.05	1,001.30	3,393.35	20.00	20.00	20.00	34.59	J827	N/A	PMP1
J839	Baker	true	1,000.00	3,741.66	1,001.96	3,743.62	20.00	20.00	20.00	29.56	J827	N/A	PMP1
J840	Baker	true	1,000.00	3,456.13	1,001.30	3,457.43	20.00	20.00	20.00	33.06	J827	N/A	PMP1
J841	Baker	true	1,000.00	5,141.61	1,007.83	5,149.44	20.00	22.25	20.00	20.00	J827	N/A	PMP1
J842	Baker	true	1,000.00	4,780.58	1,001.30	4,781.88	20.00	34.74	20.00	20.00	J827	N/A	PMP1
J843	Baker	true	1,000.00	5,009.08	1,001.96	5,011.05	20.00	24.52	20.00	20.00	J827	N/A	PMP1
J844	Baker	true	1,000.00	5,022.24	1,002.39	5,024.64	20.00	20.44	20.00	20.00	J853	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

Label	Zone	Satisfies Fire Flow Constraints?	Needed Fire Flow (gpm)	Available Fire Flow (gpm)	Total Flow Needed (gpm)	Total Flow Available (gpm)	Residual Pressure (psi)	Calculated Residual Pressure (psi)	Minimum Zone Pressure (psi)	Calculated Minimum Zone Pressure (psi)	Minimum Zone Junction	Minimum System Pressure (psi)	Minimum System Junction
J845	Baker	true	1,000.00	4,644.53	1,005.00	4,649.53	20.00	28.51	20.00	20.00	J853	N/A	PMP1
J846	Baker	true	1,000.00	4,248.96	1,003.70	4,252.66	20.00	20.36	20.00	20.00	J859	N/A	PMP1
J847	Baker	true	1,000.00	3,658.24	1,004.13	3,662.36	20.00	24.09	20.00	20.00	J859	N/A	PMP1
J848	Baker	true	1,000.00	4,766.02	1,002.82	4,768.84	20.00	20.84	20.00	20.00	J851	N/A	PMP1
J849	Baker	true	1,000.00	4,764.71	1,003.05	4,767.76	20.00	20.00	20.00	22.06	J851	N/A	PMP1
J850	Baker	true	1,000.00	4,900.17	1,004.35	4,904.52	20.00	20.01	20.00	20.33	J854	N/A	PMP1
J851	Baker	true	1,000.00	3,647.56	1,001.52	3,649.08	20.00	20.00	20.00	36.83	J827	N/A	PMP1
J852	Baker	true	1,000.00	1,856.17	1,001.52	1,857.69	20.00	49.35	20.00	50.20	J827	N/A	PMP1
J853	Baker	true	1,000.00	3,883.60	1,004.13	3,887.72	20.00	20.00	20.00	27.46	J854	N/A	PMP1
J854	Baker	true	1,000.00	3,877.62	1,002.39	3,880.01	20.00	20.00	20.00	28.00	J853	N/A	PMP1
J855	Baker	true	1,000.00	3,791.20	1,002.82	3,794.02	20.00	20.00	20.00	21.33	J856	N/A	PMP1
J856	Baker	true	1,000.00	2,749.52	1,003.48	2,753.00	20.00	20.00	20.00	25.77	J857	N/A	PMP1
J857	Baker	true	1,000.00	2,425.51	1,002.18	2,427.68	20.00	20.00	20.00	30.86	J856	N/A	PMP1
J858	Baker	true	1,000.00	3,737.55	1,002.39	3,739.94	20.00	20.00	20.00	28.19	J855	N/A	PMP1
J859	Baker	true	1,000.00	2,458.95	1,003.70	2,462.64	20.00	20.02	20.00	29.78	J860	N/A	PMP1
J860	Baker	true	1,000.00	2,248.53	1,002.61	2,251.13	20.00	20.02	20.00	29.17	J859	N/A	PMP1
J861	Mid	true	1,000.00	2,988.69	1,000.00	2,988.69	20.00	20.00	20.00	27.38	J673	N/A	PMP1
J862	Mid	true	1,000.00	2,820.01	1,000.00	2,820.01	20.00	20.00	20.00	27.38	J673	N/A	PMP1
J863	Baker	true	1,000.00	4,007.22	1,001.09	4,008.31	20.00	20.71	20.00	20.00	J864	N/A	PMP1
J864	Baker	true	1,000.00	3,547.60	1,003.05	3,550.65	20.00	20.00	20.00	34.12	J863	N/A	PMP1
J865	Baker	true	1,000.00	4,404.23	1,001.09	4,405.32	20.00	20.00	20.00	27.64	J827	N/A	PMP1
J866	Baker	false	1,000.00	53.71	1,003.26	56.98	20.00	83.10	20.00	54.55	J827	N/A	PMP1
J867	Baker	true	1,000.00	4,478.68	1,003.70	4,482.38	20.00	20.02	20.00	28.03	J853	N/A	PMP1
J868	Baker	true	1,000.00	4,685.03	1,003.70	4,688.72	20.00	29.46	20.00	20.00	J871	N/A	PMP1
J869	Baker	true	1,000.00	4,341.45	1,004.35	4,345.80	20.00	20.00	20.00	26.95	J853	N/A	PMP1
J870	Baker	false	1,000.00	138.18	1,000.00	138.18	20.00	80.30	20.00	54.46	J827	N/A	PMP1
J871	Baker	true	1,000.00	3,039.01	1,000.00	3,039.01	20.00	20.01	20.00	41.65	J827	N/A	PMP1
J872	Baker	true	1,000.00	2,909.11	1,003.91	2,913.02	20.00	20.01	20.00	42.63	J827	N/A	PMP1
J873	Baker	true	1,000.00	3,522.12	1,000.00	3,522.12	20.00	20.01	20.00	28.08	J808	N/A	PMP1
J874	Baker	true	1,000.00	3,590.76	1,000.00	3,590.76	20.00	20.01	20.00	21.34	J808	N/A	PMP1
J901	Axton	true	500.00	2,061.75	503.48	2,065.23	20.00	28.79	20.00	20.05	J905	N/A	PMP1
J902	Axton	true	500.00	1,768.94	502.82	1,771.76	20.00	25.76	20.00	20.00	J905	N/A	PMP1
J903	Axton	true	500.00	1,620.00	502.61	1,622.61	20.00	24.34	20.00	20.00	J905	N/A	PMP1
J904	Axton	true	500.00	1,508.65	502.82	1,511.47	20.00	22.59	20.00	20.00	J905	N/A	PMP1
J905	Axton	true	500.00	1,424.04	501.09	1,425.13	20.00	20.00	20.00	22.57	J910	N/A	PMP1
J906	Axton	true	500.00	1,545.83	506.74	1,552.58	20.00	20.00	20.00	22.34	J907	N/A	PMP1
J907	Axton	true	500.00	1,446.99	506.52	1,453.51	20.00	20.00	20.00	21.32	J908	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Fire Flow Report

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J908	Axtor	true	500.00	1,376.32	504.35	1,380.67	20.00	20.00	20.00	22.66	J909	N/A	PMP1
J909	Axtor	true	500.00	1,336.27	505.22	1,341.49	20.00	20.00	20.00	25.16	J908	N/A	PMP1
J910	Axtor	true	500.00	1,352.51	501.73	1,354.25	20.00	20.00	20.00	24.22	J905	N/A	PMP1
J911	Axtor	true	500.00	1,479.41	501.73	1,481.14	20.00	22.94	20.00	20.00	J922	N/A	PMP1
J912	Axtor	true	500.00	1,304.57	503.05	1,307.62	20.00	27.52	20.00	20.00	J922	N/A	PMP1
J913	Axtor	true	500.00	1,420.77	502.39	1,423.16	20.00	22.02	20.00	20.00	J922	N/A	PMP1
J914	Axtor	true	500.00	1,109.14	505.00	1,114.14	20.00	25.59	20.00	20.00	J922	N/A	PMP1
J915	Axtor	true	500.00	866.45	503.70	870.14	20.00	28.44	20.00	20.00	J922	N/A	PMP1
J916	Axtor	true	500.00	545.71	503.91	549.62	20.00	29.09	20.00	20.00	J920	N/A	PMP1
J917	Axtor	true	500.00	545.72	500.00	545.72	20.00	25.01	20.00	20.00	J920	N/A	PMP1
J918	Axtor	false	500.00	469.51	503.48	472.99	20.00	24.60	20.00	20.00	J920	N/A	PMP1
J919	Axtor	false	500.00	438.57	503.26	441.83	20.00	26.64	20.00	20.00	J920	N/A	PMP1
J920	Axtor	false	500.00	381.08	503.26	384.35	20.00	20.00	20.00	32.20	J919	N/A	PMP1
J921	Axtor	false	500.00	438.58	504.35	442.93	20.00	23.44	20.00	20.00	J920	N/A	PMP1
J922	Axtor	true	500.00	718.73	501.52	720.25	20.00	20.01	20.00	21.73	J926	N/A	PMP1
J923	Axtor	true	500.00	677.23	501.73	678.97	20.00	20.00	20.00	22.43	J922	N/A	PMP1
J924	Axtor	true	500.00	677.30	501.73	679.04	20.00	23.10	20.00	20.00	J923	N/A	PMP1
J925	Axtor	true	500.00	677.24	501.30	678.55	20.00	42.71	20.00	20.00	J923	N/A	PMP1
J926	Axtor	true	500.00	700.22	501.30	701.53	20.00	20.01	20.00	20.08	J927	N/A	PMP1
J927	Axtor	true	500.00	671.31	501.30	672.61	20.00	20.00	20.00	21.88	J926	N/A	PMP1

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J1	32.27	Main	0.00	348.78	0.00	316.51	136.94	
J2	19.38	Main	0.00	329.08	0.00	309.70	133.99	
J3	19.35	Main	1.40	325.57	1.40	306.22	132.49	
J4	19.94	Main	1.40	321.09	1.40	301.15	130.29	
J5	21.91	Main	2.20	318.65	2.20	296.73	128.38	
J6	21.10	Main	3.26	315.85	3.26	294.75	127.52	
J7	29.30	Main	3.58	312.74	3.58	283.44	122.63	
J8	30.11	Main	3.91	310.49	3.91	280.38	121.31	
J9	17.45	Main	4.78	308.67	4.78	291.22	126.00	
J10	29.82	Main	3.87	307.51	3.87	277.69	120.14	
J11	36.36	Main	3.26	307.31	3.26	270.95	117.23	
J12	38.62	Main	1.30	307.18	1.30	268.56	116.19	
J13	42.33	Main	1.76	306.65	1.76	264.32	114.36	
J14	58.54	Main	3.05	306.64	3.05	248.10	107.34	
J15	60.59	Main	2.08	306.63	2.08	246.04	106.45	
J16	69.90	Main	11.05	306.63	11.05	236.73	102.42	
J17	87.08	Main	1.73	306.63	1.73	219.55	94.99	
J18	116.41	Main	0.22	306.63	0.22	190.22	82.30	
J19	131.75	Main	0.00	306.63	0.00	174.88	75.66	Church/Main Intersection
J20	140.58	Main	0.00	306.63	0.00	166.05	71.84	Chruch Rd. PS
J21	21.75	Main	2.64	318.81	2.64	297.05	128.52	
J22	20.89	Main	2.64	316.72	2.64	295.83	127.99	
J23	22.58	Main	6.92	312.90	6.92	290.32	125.61	
J24	18.16	Main	1.96	310.19	1.96	292.03	126.35	
J25	28.90	Main	9.31	306.63	9.31	277.73	120.16	
J26	25.23	Main	12.07	306.63	12.07	281.40	121.75	
J27	39.66	Main	4.24	306.63	4.24	266.97	115.51	
J28	33.05	Main	4.24	306.63	4.24	273.58	118.36	
J29	38.03	Main	2.61	306.63	2.61	268.60	116.21	
J30	32.39	Main	7.50	306.63	7.50	274.24	118.65	
J31	61.52	Main	2.96	306.63	2.96	245.11	106.05	
J32	62.76	Main	3.48	306.63	3.48	243.87	105.51	
J33	54.15	Main	1.91	306.63	1.91	252.48	109.24	
J34	48.63	Main	1.96	306.63	1.96	258.00	111.62	
J35	50.35	Main	0.22	306.63	0.22	256.27	110.88	
J36	48.20	Main	1.96	306.62	1.96	258.42	111.80	
J37	38.44	Main	4.90	306.63	4.90	268.19	116.03	
J38	36.58	Main	0.22	306.63	0.22	270.04	116.84	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J39	34.50	Main	0.66	306.63	0.66	272.12	117.74	
J40	32.09	Main	2.82	306.62	2.82	274.53	118.77	
J41	22.01	Main	1.52	306.62	1.52	284.61	123.14	
J42	18.26	Main	0.87	306.62	0.87	288.36	124.76	
J43	20.37	Main	2.18	306.62	2.18	286.25	123.84	
J44	20.20	Main	1.30	306.62	1.30	286.42	123.92	
J45	20.47	Main	2.82	306.62	2.82	286.15	123.80	
J46	24.44	Main	3.05	306.62	3.05	282.17	122.08	
J47	18.68	Main	2.82	306.62	2.82	287.94	124.58	
J48	56.67	Main	2.24	306.63	2.24	249.95	108.14	
J49	60.90	Main	0.22	306.63	0.22	245.72	106.31	
J50	50.37	Main	1.96	306.62	1.96	256.25	110.87	
J51	62.59	Main	1.52	306.62	1.52	244.03	105.58	
J52	51.25	Main	2.61	306.62	2.61	255.37	110.48	
J53	52.25	Main	4.13	306.62	4.13	254.37	110.05	
J54	61.11	Main	1.09	306.62	1.09	245.51	106.22	
J55	62.05	Main	1.05	306.63	1.05	244.58	105.82	
J56	68.20	Main	0.35	306.63	0.35	238.43	103.16	
J57	78.39	Main	0.00	306.63	0.00	228.24	98.75	
J58	76.25	Main	0.00	306.63	0.00	230.38	99.67	
J59	64.19	Main	0.00	306.63	0.00	242.44	104.89	
J60	61.94	Main	0.00	306.63	0.00	244.69	105.86	
J61	111.77	Main	7.02	306.63	7.02	194.86	84.31	
J62	46.47	Main	4.39	307.03	4.39	260.55	112.73	
J63	49.95	Main	2.20	306.15	2.20	256.20	110.84	
J64	50.80	Main	4.39	307.13	4.39	256.33	110.90	
J65	53.56	Main	0.70	306.26	0.70	252.70	109.33	
J66	49.27	Main	2.64	307.13	2.64	257.86	111.56	
J67	63.87	Main	3.83	305.86	3.83	241.99	104.70	
J68	84.49	Main	3.58	305.04	3.58	220.54	95.42	
J69	75.74	Main	2.94	304.50	2.94	228.76	98.97	
J70	63.74	Main	3.91	304.31	3.91	240.57	104.08	
J71	65.43	Main	1.05	304.45	1.05	239.02	103.41	
J72	58.83	Main	0.87	304.36	0.87	245.53	106.23	
J73	63.89	Main	0.35	306.64	0.35	242.75	105.02	
J74	72.02	Main	0.87	306.63	0.87	234.61	101.51	
J75	105.21	Main	1.30	258.65	1.30	153.43	66.38	
J76	27.96	Main	4.24	309.21	4.24	281.25	121.68	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J77	27.43	Main	6.15	308.08	6.15	280.65	121.42	
J78	28.01	Main	5.44	307.07	5.44	279.06	120.73	
J79	42.26	Main	2.26	304.59	2.26	262.33	113.50	
J80	48.12	Main	5.54	303.73	5.54	255.61	110.59	
J81	58.11	Main	0.98	302.48	0.98	244.37	105.73	
J82	108.98	Main	3.91	298.64	3.91	189.66	82.06	
J83	121.31	Main	2.61	297.41	2.61	176.10	76.19	
J84	26.93	Main	10.18	306.66	10.18	279.73	121.03	
J85	35.06	Main	2.64	305.70	2.64	270.64	117.09	
J86	34.93	Main	2.26	304.07	2.26	269.14	116.44	
J87	34.99	Main	1.57	302.88	1.57	267.89	115.90	
J88	40.39	Main	4.09	300.54	4.09	260.15	112.55	
J89	97.35	Main	4.57	295.21	4.57	197.86	85.60	
J90	124.43	Main	3.05	275.54	3.05	151.11	65.38	
J91	117.97	Main	3.05	263.89	3.05	145.92	63.13	
J92	121.23	Main	2.39	250.46	2.39	129.23	55.91	
J93	135.49	Main	0.00	246.48	0.00	110.99	48.02	
J94	161.06	Main	0.00	242.23	0.00	81.17	35.12	N. Thornton PRV Station
J95	223.00	Zone	0.00	226.64	0.00	3.64	1.57	Near Thornton Tank
J96	58.62	Main	1.30	302.48	1.30	243.86	105.51	
J97	39.84	Main	0.17	304.07	0.17	264.23	114.32	
J98	81.55	Main	1.52	296.12	1.52	214.57	92.83	
J99	75.89	Main	2.39	296.12	2.39	220.23	95.28	
J100	103.19	Main	3.05	263.89	3.05	160.70	69.53	
J101	82.36	Main	4.13	263.89	4.13	181.53	78.54	
J102	86.90	Main	1.30	250.46	1.30	163.56	70.77	
J103	62.06	Main	0.66	250.46	0.66	188.40	81.51	
J104	53.26	Main	0.33	250.46	0.33	197.20	85.32	
J105	48.83	Main	1.30	250.46	1.30	201.63	87.24	
J106	84.52	Main	2.18	250.46	2.18	165.94	71.79	
J107	61.07	Main	0.33	250.46	0.33	189.39	81.94	
J108	54.00	Main	0.00	250.46	0.00	196.46	85.00	
J109	56.30	Main	0.33	250.46	0.33	194.16	84.00	
J110	112.10	Main	3.70	250.35	3.70	138.25	59.82	
J111	119.12	Main	2.82	250.35	2.82	131.23	56.78	
J112	122.05	Main	2.18	250.35	2.18	128.30	55.51	
J113	117.79	Main	1.30	250.35	1.30	132.56	57.35	
J114	113.63	Main	0.66	250.35	0.66	136.72	59.15	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J115	108.44	Main	3.76	250.35	3.76	141.91	61.40	
J116	128.19	Main	4.57	248.82	4.57	120.63	52.19	
J117	101.27	Main	7.18	250.35	7.18	149.08	64.50	
J118	109.48	Main	4.41	250.35	4.41	140.87	60.95	
J119	85.70	Main	5.50	250.35	5.50	164.65	71.24	
J120	27.80	Main	2.61	308.09	2.61	280.29	121.27	
J121	33.04	Main	10.53	305.67	10.53	272.63	117.96	
J122	37.41	Main	7.02	304.54	7.02	267.13	115.57	
J123	35.90	Main	6.19	303.64	6.19	267.74	115.84	
J124	37.07	Main	2.20	303.09	2.20	266.02	115.09	
J125	39.23	Main	0.33	301.22	0.33	261.98	113.35	
J126	38.43	Main	0.33	301.36	0.33	262.93	113.76	
J127	38.78	Main	3.15	301.36	3.15	262.58	113.60	
J128	38.33	Main	0.33	301.36	0.33	263.03	113.80	
J129	25.92	Main	0.87	308.09	0.87	282.17	122.08	
J130	35.99	Main	0.44	305.68	0.44	269.69	116.68	
J131	27.43	Main	1.57	303.82	1.57	276.39	119.58	
J132	40.25	Main	1.05	303.42	1.05	263.17	113.86	
J133	36.33	Main	2.61	303.09	2.61	266.76	115.41	
J134	41.10	Main	2.08	303.09	2.08	261.99	113.35	
J135	37.93	Main	1.63	303.09	1.63	265.16	114.72	
J136	40.49	Main	10.76	301.88	10.76	261.39	113.09	
J137	24.41	Main	0.98	302.01	0.98	277.60	120.11	
J138	36.53	Main	2.61	301.96	2.61	265.43	114.84	
J139	37.48	Main	1.63	301.95	1.63	264.47	114.42	
J140	39.37	Main	1.63	301.93	1.63	262.56	113.60	
J141	47.08	Main	4.57	301.92	4.57	254.83	110.25	
J142	48.13	Main	1.63	301.91	1.63	253.78	109.80	
J143	49.78	Main	3.58	301.91	3.58	252.13	109.08	
J144	54.92	Main	0.98	301.90	0.98	246.98	106.86	
J145	57.97	Main	0.33	301.90	0.33	243.93	105.54	
J146	58.97	Main	1.63	301.89	1.63	242.92	105.10	
J147	66.87	Main	1.30	301.89	1.30	235.02	101.68	
J148	70.92	Main	0.43	301.89	0.43	230.96	99.93	
J149	35.87	Main	1.63	301.96	1.63	266.09	115.12	
J150	36.29	Main	0.98	301.96	0.98	265.67	114.94	
J151	36.59	Main	0.87	301.96	0.87	265.37	114.81	
J152	36.68	Main	2.28	301.96	2.28	265.28	114.77	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J153	37.16	Main	0.43	301.96	0.43	264.80	114.57	
J154	37.07	Main	1.30	301.95	1.30	264.88	114.60	
J155	47.68	Main	2.28	301.93	2.28	254.25	110.00	
J156	35.69	Main	1.73	301.93	1.73	266.24	115.19	
J157	35.57	Main	1.73	301.93	1.73	266.36	115.24	
J158	34.92	Main	5.87	301.91	5.87	266.99	115.51	
J159	39.12	Main	3.91	301.91	3.91	262.79	113.70	
J160	44.73	Main	1.30	301.91	1.30	257.18	111.27	
J161	47.70	Main	0.98	301.90	0.98	254.20	109.98	
J162	45.03	Main	0.87	301.90	0.87	256.87	111.13	
J163	51.58	Main	0.00	301.90	0.00	250.32	108.30	
J164	52.09	Main	0.33	301.90	0.33	249.81	108.08	
J165	51.45	Main	1.30	301.90	1.30	250.45	108.36	
J166	54.26	Main	1.96	301.90	1.96	247.64	107.14	
J167	59.81	Main	0.33	301.90	0.33	242.09	104.74	
J168	74.51	Main	1.52	301.88	1.52	227.37	98.37	
J169	73.78	Main	2.61	301.88	2.61	228.10	98.69	
J170	75.93	Main	4.57	301.88	4.57	225.95	97.76	
J171	64.94	Main	3.26	301.88	3.26	236.94	102.51	
J172	51.87	Main	0.00	301.88	0.00	250.01	108.17	
J173	59.86	Main	3.70	301.87	3.70	242.01	104.71	
J174	51.80	Main	3.05	301.87	3.05	250.07	108.19	
J175	55.50	Main	6.52	301.87	6.52	246.37	106.59	
J176	71.10	Main	1.52	301.88	1.52	230.78	99.85	
J177	69.77	Main	1.30	301.88	1.30	232.11	100.42	
J178	70.43	Main	2.82	301.88	2.82	231.45	100.14	
J179	72.51	Main	2.61	301.88	2.61	229.37	99.24	
J180	71.35	Main	2.18	301.88	2.18	230.53	99.74	
J181	22.42	Main	1.63	323.61	1.63	301.19	130.31	
J182	20.59	Main	0.88	320.95	0.88	300.36	129.95	
J183	20.14	Main	3.07	319.96	3.07	299.82	129.72	
J184	21.28	Main	8.83	319.71	8.83	298.43	129.12	
J185	27.44	Main	5.13	312.29	5.13	284.85	123.24	
J186	23.15	Main	2.50	323.61	2.50	300.46	129.99	
J187	23.71	Main	3.95	320.68	3.95	296.97	128.48	
J188	26.25	Main	5.17	310.43	5.17	284.18	122.95	
J189	30.41	Main	4.48	309.32	4.48	278.91	120.67	
J190	30.22	Main	8.67	308.89	8.67	278.67	120.57	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J191	33.09	Main	5.76	308.68	5.76	275.59	119.23	
J192	32.45	Main	4.02	308.24	4.02	275.79	119.32	
J193	32.79	Main	3.21	306.49	3.21	273.70	118.42	
J194	33.45	Main	8.87	305.93	8.87	272.48	117.89	
J195	33.14	Main	3.54	305.17	3.54	272.03	117.70	
J196	38.46	Main	0.98	303.36	0.98	264.90	114.61	
J197	30.22	Main	4.63	303.31	4.63	273.09	118.15	
J198	31.73	Main	2.24	303.26	2.24	271.53	117.48	
J199	32.35	Main	3.26	303.24	3.26	270.89	117.20	
J200	35.68	Main	3.70	303.20	3.70	267.52	115.74	
J201	38.93	Main	1.73	303.07	1.73	264.14	114.28	
J202	46.62	Main	0.00	303.01	0.00	256.39	110.93	
J203	35.44	Main	0.98	302.88	0.98	267.44	115.71	
J204	30.43	Main	0.00	310.43	0.00	280.00	121.14	
J205	32.33	Main	0.66	309.32	0.66	276.99	119.84	
J206	27.33	Main	0.33	309.32	0.33	281.99	122.01	
J207	30.59	Main	1.96	308.67	1.96	278.08	120.31	
J208	28.25	Main	3.15	308.67	3.15	280.42	121.33	
J209	33.50	Main	4.78	303.24	4.78	269.73	116.70	
J210	27.60	Main	4.74	302.99	4.74	275.39	119.15	
J211	26.35	Main	0.66	303.24	0.66	276.88	119.79	
J212	30.33	Main	9.20	303.23	9.20	272.90	118.07	
J213	31.87	Main	4.13	303.20	4.13	271.33	117.39	
J214	29.69	Main	0.33	303.26	0.33	273.57	118.36	
J215	31.27	Main	0.98	303.26	0.98	271.99	117.68	
J216	40.74	Main	4.13	303.06	4.13	262.32	113.49	
J217	47.40	Main	3.48	303.06	3.48	255.66	110.61	
J218	42.26	Main	2.82	303.06	2.82	260.80	112.84	
J219	42.55	Main	3.05	303.06	3.05	260.51	112.71	
J220	29.96	Main	0.33	310.34	0.33	280.38	121.31	
J221	38.81	Main	2.94	310.24	2.94	271.42	117.43	
J222	39.98	Main	0.00	310.19	0.00	270.21	116.91	
J223	41.58	Main	0.66	310.17	0.66	268.59	116.21	
J224	31.62	Main	0.00	310.16	0.00	278.54	120.51	
J225	18.72	Main	1.63	308.36	1.63	289.64	125.31	
J226	18.72	Main	0.66	307.20	0.66	288.48	124.81	
J227	23.06	Main	2.28	305.34	2.28	282.27	122.13	
J228	30.96	Main	3.21	308.75	3.21	277.79	120.19	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J229	32.81	Main	0.98	308.75	0.98	275.94	119.39	
J230	37.35	Main	16.48	308.66	16.48	271.31	117.38	
J231	38.40	Main	0.33	310.34	0.33	271.94	117.65	
J232	46.63	Main	0.33	310.34	0.33	263.71	114.09	
J233	16.63	Main	4.20	310.34	4.20	293.71	127.07	
J234	46.94	Main	0.33	310.34	0.33	263.40	113.96	
J235	44.29	Main	55.33	310.15	55.33	265.86	115.02	
J236	43.78	Main	4.24	310.15	4.24	266.37	115.24	
J237	41.81	Main	0.33	310.15	0.33	268.34	116.10	
J238	45.89	Main	2.57	310.17	2.57	264.28	114.34	
J239	51.49	Main	0.33	310.17	0.33	258.68	111.92	
J240	46.83	Main	0.33	310.17	0.33	263.34	113.94	
J241	41.66	Main	0.33	310.17	0.33	268.51	116.17	
J242	35.11	Main	0.00	306.41	0.00	271.30	117.38	
J243	37.09	Main	2.89	306.34	2.89	269.25	116.49	
J244	37.84	Main	0.66	306.34	0.66	268.50	116.17	
J245	39.87	Main	0.98	306.34	0.98	266.47	115.29	
J246	37.89	Main	2.72	306.34	2.72	268.45	116.15	
J247	35.42	Main	0.33	306.12	0.33	270.70	117.12	
J248	32.25	Main	1.30	305.91	1.30	273.66	118.40	
J249	43.58	Main	0.00	306.38	0.00	262.80	113.70	
J250	30.59	Main	1.30	305.72	1.30	275.13	119.04	
J251	20.08	Main	1.63	305.50	1.63	285.42	123.49	
J252	35.00	Main	0.66	305.19	0.66	270.19	116.90	
J253	26.43	Main	0.33	305.20	0.33	278.77	120.61	
J254	26.84	Main	2.82	305.20	2.82	278.36	120.43	
J255	73.42	Main	0.00	305.22	0.00	231.80	100.29	
J256	63.12	Main	7.50	305.28	7.50	242.16	104.77	
J257	55.08	Main	1.63	305.28	1.63	250.20	108.25	
J258	52.38	Main	1.73	305.27	1.73	252.89	109.41	
J259	51.10	Main	3.54	305.27	3.54	254.17	109.97	
J260	47.56	Main	1.63	305.27	1.63	257.71	111.50	
J261	38.43	Main	1.30	305.27	1.30	266.84	115.45	
J262	24.40	Main	0.33	305.29	0.33	280.89	121.53	
J263	47.52	Main	0.98	305.27	0.98	257.75	111.52	
J264	43.10	Main	0.98	305.27	0.98	262.17	113.43	
J265	40.99	Main	9.26	305.27	9.26	264.28	114.34	
J266	45.15	Main	0.98	305.26	0.98	260.11	112.54	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J267	46.14	Main	0.52	305.26	0.52	259.12	112.11	
J268	41.17	Main	5.29	305.26	5.29	264.09	114.26	
J269	41.52	Main	1.63	305.26	1.63	263.74	114.11	
J270	33.52	Main	10.83	305.26	10.83	271.74	117.57	
J271	25.11	Main	7.37	305.26	7.37	280.15	121.21	
J272	36.48	Main	4.53	305.26	4.53	268.78	116.29	
J273	36.90	Main	0.00	305.26	0.00	268.36	116.11	
J274	38.85	Main	0.00	305.26	0.00	266.41	115.26	
J275	35.46	Main	0.00	305.26	0.00	269.80	116.73	
J276	34.77	Main	0.00	305.26	0.00	270.49	117.03	
J277	42.95	Main	5.87	305.26	5.87	262.31	113.49	
J278	57.14	Main	6.52	305.26	6.52	248.12	107.35	
J279	57.01	Main	4.70	305.28	4.70	248.27	107.41	
J280	45.50	Main	0.35	305.28	0.35	259.78	112.39	
J281	67.89	Main	1.85	305.27	1.85	237.38	102.70	
J282	42.83	Main	2.57	305.26	2.57	262.43	113.54	
J283	59.21	Main	0.66	305.26	0.66	246.05	106.46	
J284	58.65	Main	4.24	305.26	4.24	246.61	106.70	
J285	59.32	Main	0.98	305.26	0.98	245.94	106.41	
J286	71.13	Main	1.30	305.26	1.30	234.13	101.30	
J287	72.23	Main	11.16	305.25	11.16	233.02	100.82	
J288	83.30	Main	5.07	305.24	5.07	221.94	96.02	
J289	91.52	Main	1.73	305.24	1.73	213.72	92.47	
J290	93.47	Main	5.44	305.24	5.44	211.77	91.62	
J291	96.02	Main	1.52	305.24	1.52	209.22	90.52	
J292	96.09	Main	4.85	305.24	4.85	209.15	90.49	
J293	55.35	Main	0.98	305.26	0.98	249.91	108.13	
J294	60.33	Main	2.89	305.26	2.89	244.93	105.97	
J295	58.90	Main	2.57	305.26	2.57	246.36	106.59	
J296	62.07	Main	0.33	305.26	0.33	243.19	105.22	
J297	61.42	Main	0.66	305.26	0.66	243.84	105.50	
J298	64.73	Main	0.66	305.26	0.66	240.53	104.07	
J299	64.41	Main	1.30	305.26	1.30	240.85	104.21	
J300	65.27	Main	2.61	305.26	2.61	239.99	103.83	
J301	67.70	Main	2.61	305.26	2.61	237.56	102.78	
J302	77.22	Main	3.70	305.23	3.70	228.01	98.65	
J303	74.35	Main	3.05	305.24	3.05	230.89	99.89	
J304	77.94	Main	3.48	305.24	3.48	227.30	98.34	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J305	79.29	Main	4.13	305.23	4.13	225.94	97.75	
J306	80.94	Main	2.61	305.23	2.61	224.29	97.04	
J307	83.03	Main	2.61	305.23	2.61	222.20	96.14	
J308	82.17	Main	2.39	305.23	2.39	223.06	96.51	
J309	83.59	Main	4.57	305.23	4.57	221.64	95.89	
J310	82.56	Main	2.39	305.24	2.39	222.68	96.34	
J311	84.36	Main	1.73	305.23	1.73	220.87	95.56	
J312	90.61	Main	5.00	305.24	5.00	214.63	92.86	
J313	91.27	Main	3.26	305.24	3.26	213.97	92.58	
J314	93.83	Main	1.30	305.24	1.30	211.41	91.47	
J315	93.89	Main	1.96	305.24	1.96	211.35	91.44	
J316	101.80	Main	1.73	305.24	1.73	203.44	88.02	
J317	100.38	Main	1.09	305.24	1.09	204.86	88.63	
J318	85.83	Main	0.66	305.24	0.66	219.41	94.93	
J319	81.72	Main	0.22	305.24	0.22	223.52	96.71	
J320	90.45	Main	0.00	305.24	0.00	214.79	92.93	
J321	80.11	Main	0.00	305.24	0.00	225.13	97.40	
J475	69.22	Mid-Sub	1.30	211.78	1.30	142.56	61.68	
J476	82.89	Mid-Sub	0.87	211.78	0.87	128.89	55.76	
J477	119.18	Mid-Sub	3.26	211.78	3.26	92.60	40.07	
J478	162.66	Mid-Sub	0.00	211.79	0.00	49.13	21.25	S. Thornton PRV Station
J479	126.29	Mid-Sub	1.52	211.79	1.52	85.50	36.99	
J480	146.22	Mid-Sub	2.28	211.79	2.28	65.57	28.37	Near Sunrise PRV
J501	63.63	Ferndale Terrace	3.33	258.79	3.33	195.16	84.44	
J502	77.68	Ferndale Terrace	1.52	258.78	1.52	181.10	78.35	
J503	84.37	Ferndale Terrace	2.18	258.75	2.18	174.37	75.44	
J504	95.37	Ferndale Terrace	4.35	258.69	4.35	163.32	70.66	
J505	103.19	Ferndale Terrace	2.18	258.65	2.18	155.46	67.26	
J506	115.70	Ferndale Terrace	2.18	258.65	2.18	142.94	61.85	
J507	97.88	Ferndale Terrace	3.70	258.76	3.70	160.88	69.60	
J508	115.27	Ferndale Terrace	2.39	258.75	2.39	143.48	62.08	
J509	95.37	Ferndale Terrace	5.21	258.69	5.21	163.32	70.66	
J510	106.92	Ferndale Terrace	4.78	258.66	4.78	151.74	65.65	
J511	109.30	Ferndale Terrace	3.26	258.65	3.26	149.35	64.62	
J512	133.37	Ferndale Terrace	3.05	258.75	3.05	125.38	54.24	
J513	128.79	Ferndale Terrace	5.21	258.68	5.21	129.88	56.19	
J514	138.21	Ferndale Terrace	5.44	258.65	5.44	120.44	52.11	
J515	135.66	Ferndale Terrace	2.39	258.69	2.39	123.03	53.23	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J516	134.67	Ferndale Terrace	1.52	258.92	1.52	124.25	53.76	
J517	136.08	Ferndale Terrace	4.13	258.92	4.13	122.84	53.15	
J518	121.93	Ferndale Terrace	2.18	258.92	2.18	136.99	59.27	
J519	112.00	Ferndale Terrace	2.18	258.92	2.18	146.92	63.56	
J520	146.91	Ferndale Terrace	0.87	258.95	0.87	112.04	48.47	
J521	173.18	Ferndale Terrace	0.00	258.96	0.00	85.78	37.11	Vista PRV Station
J522	150.51	Ferndale Terrace	1.73	258.95	1.73	108.44	46.92	
J523	136.49	Ferndale Terrace	3.70	258.93	3.70	122.44	52.98	
J524	149.84	Ferndale Terrace	4.78	258.93	4.78	109.09	47.20	
J525	154.75	Ferndale Terrace	3.26	258.97	3.26	104.22	45.09	
J526	127.35	Ferndale Terrace	1.96	258.64	1.96	131.29	56.80	
J601	223.00	Mid	0.00	385.93	0.00	162.93	70.49	
J602	161.06	Mid	0.00	385.93	0.00	224.87	97.29	
J603	230.27	Mid	1.52	385.93	1.52	155.66	67.35	
J604	227.13	Mid	6.15	385.90	6.15	158.77	68.69	
J605	181.11	Mid	4.78	385.87	4.78	204.76	88.59	
J606	173.18	Mid	0.00	385.87	0.00	212.69	92.02	
J607	188.64	Mid	3.26	385.88	3.26	197.24	85.34	
J608	206.79	Mid	2.82	385.91	2.82	179.12	77.50	
J609	214.80	Mid	2.39	385.99	2.39	171.19	74.06	
J610	213.56	Mid	2.82	385.97	2.82	172.41	74.59	
J611	233.76	Mid	1.30	385.95	1.30	152.19	65.85	
J612	175.32	Mid	5.72	385.98	5.72	210.66	91.14	
J613	162.17	Mid	3.26	385.98	3.26	223.81	96.83	
J614	144.31	Mid	3.91	385.98	3.91	241.67	104.56	
J615	121.82	Mid	3.48	385.98	3.48	264.16	114.29	
J616	183.87	Mid	3.05	385.89	3.05	202.02	87.41	
J617	171.45	Mid	3.26	385.88	3.26	214.43	92.77	
J618	213.96	Mid	2.61	385.90	2.61	171.94	74.39	
J619	192.26	Mid	3.48	385.89	3.48	193.63	83.78	
J620	162.66	Mid	0.00	385.89	0.00	223.23	96.58	
J621	217.04	Mid	3.48	385.89	3.48	168.85	73.05	
J622	237.54	Mid	1.73	385.92	1.73	148.38	64.20	
J623	237.84	Mid	2.82	385.92	2.82	148.08	64.07	
J624	225.83	Mid	2.18	385.92	2.18	160.09	69.26	
J625	206.81	Mid	1.73	385.92	1.73	179.11	77.49	
J626	203.79	Mid	1.30	385.92	1.30	182.13	78.80	
J627	192.68	Mid	5.66	385.92	5.66	193.24	83.61	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J628	182.96	Mid	5.21	385.92	5.21	202.96	87.81	
J629	222.36	Mid	4.57	385.92	4.57	163.56	70.76	
J630	202.16	Mid	4.35	385.92	4.35	183.76	79.50	
J631	179.55	Mid	4.13	385.92	4.13	206.37	89.29	
J632	195.52	Mid	3.70	385.92	3.70	190.40	82.38	
J633	211.62	Mid	1.52	385.92	1.52	174.30	75.41	
J634	233.41	Mid	2.61	385.93	2.61	152.52	65.99	
J635	243.84	Mid	3.26	385.93	3.26	142.08	61.47	
J636	242.64	Mid	3.91	385.93	3.91	143.28	61.99	
J637	244.89	Mid	3.26	385.93	3.26	141.03	61.02	
J638	232.54	Mid	4.35	385.94	4.35	153.40	66.37	
J639	221.98	Mid	2.82	385.92	2.82	163.94	70.93	
J640	210.06	Mid	1.73	385.92	1.73	175.86	76.09	
J641	216.91	Mid	3.26	385.92	3.26	169.01	73.12	
J642	227.39	Mid	1.73	385.92	1.73	158.53	68.59	
J643	236.57	Mid	3.26	385.93	3.26	149.36	64.62	
J644	238.08	Mid	1.09	385.92	1.09	147.84	63.97	
J645	228.22	Mid	3.48	385.92	3.48	157.70	68.23	
J646	227.21	Mid	2.18	385.94	2.18	158.73	68.67	
J647	253.60	Mid	7.61	385.97	7.61	132.37	57.27	
J648	267.41	Mid	2.18	385.97	2.18	118.56	51.30	
J649	277.58	Mid	2.61	385.98	2.61	108.40	46.90	
J650	306.91	Mid	1.52	385.99	1.52	79.08	34.21	
J651	355.05	Zone	0.00	386.01	0.00	30.96	13.40	Near Bakerview Tank
J652	254.13	Mid	4.78	385.96	4.78	131.83	57.03	
J653	363.00	Zone	0.00	386.03	0.00	23.03	9.97	Near Bakerview Tank
J654	249.88	Mid	3.70	385.96	3.70	136.08	58.87	
J655	262.90	Mid	5.00	385.96	5.00	123.06	53.24	
J656	251.88	Mid	3.91	385.96	3.91	134.07	58.01	
J657	244.54	Mid	2.82	385.95	2.82	141.41	61.18	
J658	246.58	Mid	1.52	385.95	1.52	139.37	60.30	
J659	228.15	Mid	5.00	385.94	5.00	157.79	68.27	
J660	222.38	Mid	3.26	385.94	3.26	163.56	70.77	
J661	239.73	Mid	0.00	385.94	0.00	146.21	63.26	
J662	229.02	Mid	2.82	385.94	2.82	156.92	67.89	
J663	252.31	Mid	3.48	386.01	3.48	133.70	57.85	
J664	239.24	Mid	3.48	386.49	3.48	147.25	63.71	
J665	201.20	Mid	3.48	386.92	3.48	185.71	80.35	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J666	234.62	Mid	3.05	385.98	3.05	151.36	65.48	
J667	235.30	Mid	1.73	385.97	1.73	150.67	65.19	
J668	240.96	Mid	3.48	385.97	3.48	145.01	62.74	
J669	198.42	Mid	1.09	386.41	1.09	187.99	81.33	
J670	210.57	Mid	3.48	386.41	3.48	175.84	76.08	
J671	192.94	Mid	3.26	386.41	3.26	193.47	83.71	
J672	260.40	Mid	3.26	385.98	3.26	125.58	54.33	
J673	322.71	Mid	0.22	385.99	0.22	63.28	27.38	
J674	287.00	Mid	0.00	385.99	0.00	98.99	42.83	
J675	243.98	Mid	0.00	385.98	0.00	142.00	61.44	
J676	205.35	Mid	4.85	385.98	4.85	180.63	78.15	
J677	176.00	Mid	0.00	385.98	0.00	209.98	90.85	
J678	169.99	Mid	0.66	385.98	0.66	215.99	93.45	
J679	214.22	Mid	0.00	385.98	0.00	171.76	74.31	
J680	185.40	Mid	0.00	385.98	0.00	200.58	86.78	
J681	164.64	Mid	0.00	385.98	0.00	221.34	95.77	
J682	225.14	Mid	0.00	385.98	0.00	160.84	69.59	
J683	130.47	Mid	0.00	385.98	0.00	255.51	110.55	
J684	222.62	Mid	0.43	385.98	0.43	163.36	70.68	
J801	363.00	Bakerview	0.00	492.57	0.00	129.57	56.06	
J802	358.45	Bakerview	0.66	492.49	0.66	134.04	57.99	
J803	327.34	Bakerview	2.89	492.49	2.89	165.15	71.45	
J804	290.02	Bakerview	0.00	492.49	0.00	202.47	87.60	
J805	309.29	Bakerview	0.00	492.49	0.00	183.20	79.26	
J806	301.48	Bakerview	0.00	492.49	0.00	191.01	82.64	
J807	303.65	Bakerview	0.00	492.49	0.00	188.84	81.70	
J808	337.85	Bakerview	0.00	492.49	0.00	154.64	66.91	
J809	322.03	Bakerview	0.00	492.49	0.00	170.46	73.75	
J810	319.66	Bakerview	0.00	492.49	0.00	172.83	74.78	
J811	312.46	Bakerview	0.00	492.49	0.00	180.03	77.89	
J812	308.02	Bakerview	0.00	492.49	0.00	184.47	79.81	
J813	358.49	Bakerview	3.26	492.49	3.26	134.00	57.98	
J814	328.72	Bakerview	5.72	492.40	5.72	163.68	70.82	
J815	318.12	Bakerview	1.09	492.38	1.09	174.26	75.39	
J816	305.16	Bakerview	2.61	492.36	2.61	187.19	80.99	
J817	304.22	Bakerview	4.78	492.36	4.78	188.14	81.40	
J818	303.97	Bakerview	2.39	492.36	2.39	188.39	81.51	
J819	301.60	Bakerview	0.87	492.36	0.87	190.76	82.53	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J820	299.10	Bakerview	3.98	492.36	3.98	193.26	83.61	
J821	300.08	Bakerview	1.30	492.36	1.30	192.28	83.19	
J822	301.67	Bakerview	0.87	492.36	0.87	190.69	82.50	
J823	341.31	Bakerview	3.05	492.40	3.05	151.09	65.37	
J824	341.41	Bakerview	6.30	492.36	6.30	150.95	65.31	
J825	353.93	Bakerview	4.85	492.36	4.85	138.43	59.89	
J826	358.94	Bakerview	7.83	492.36	7.83	133.41	57.72	
J827	366.15	Bakerview	4.78	492.35	4.78	126.20	54.60	
J828	361.56	Bakerview	3.05	492.35	3.05	130.79	56.59	
J829	358.48	Bakerview	5.87	492.35	5.87	133.87	57.92	
J830	346.94	Bakerview	7.83	492.35	7.83	145.41	62.91	
J831	363.06	Bakerview	3.48	492.36	3.48	129.30	55.94	
J832	324.28	Bakerview	2.39	492.38	2.39	168.10	72.73	
J833	325.05	Bakerview	1.52	492.38	1.52	167.32	72.39	
J834	322.36	Bakerview	0.43	492.36	0.43	170.00	73.55	
J835	323.97	Bakerview	0.00	492.36	0.00	168.39	72.85	
J836	320.02	Bakerview	0.00	492.38	0.00	172.36	74.57	
J837	308.68	Bakerview	1.73	492.36	1.73	183.68	79.47	
J838	279.53	Bakerview	1.30	492.36	1.30	212.83	92.08	
J839	275.10	Bakerview	1.96	492.36	1.96	217.26	94.00	
J840	283.30	Bakerview	1.30	492.36	1.30	209.06	90.45	
J841	346.43	Bakerview	7.83	492.40	7.83	145.97	63.15	
J842	310.57	Bakerview	1.30	492.33	1.30	181.76	78.64	
J843	321.08	Bakerview	1.96	492.28	1.96	171.20	74.07	
J844	333.94	Bakerview	2.39	492.27	2.39	158.33	68.50	
J845	313.30	Bakerview	5.00	492.19	5.00	178.89	77.40	
J846	309.40	Bakerview	3.70	492.19	3.70	182.79	79.09	
J847	300.76	Bakerview	4.13	492.19	4.13	191.43	82.82	
J848	338.06	Bakerview	2.82	492.29	2.82	154.23	66.73	
J849	341.83	Bakerview	3.05	492.30	3.05	150.47	65.10	
J850	343.65	Bakerview	4.35	492.32	4.35	148.67	64.32	
J851	339.99	Bakerview	1.52	492.29	1.52	152.30	65.89	
J852	335.98	Bakerview	1.52	492.29	1.52	156.31	67.63	
J853	342.45	Bakerview	4.13	492.22	4.13	149.77	64.80	
J854	344.26	Bakerview	2.39	492.26	2.39	148.00	64.03	
J855	329.65	Bakerview	2.82	492.21	2.82	162.56	70.33	
J856	326.58	Bakerview	3.48	492.21	3.48	165.63	71.66	
J857	313.24	Bakerview	2.18	492.21	2.18	178.97	77.43	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J858	324.21	Bakerview	2.39	492.20	2.39	167.99	72.68	
J859	310.22	Bakerview	3.70	492.19	3.70	181.97	78.73	
J860	287.66	Bakerview	2.61	492.19	2.61	204.53	88.49	
J861	253.10	Mid	0.00	492.19	0.00	239.09	103.44	
J862	211.79	Mid	0.00	492.19	0.00	280.40	121.32	
J863	295.65	Bakerview	1.09	492.33	1.09	196.68	85.09	
J864	297.28	Bakerview	3.05	492.33	3.05	195.05	84.39	
J865	311.44	Bakerview	1.09	492.23	1.09	180.79	78.22	
J866	299.84	Bakerview	3.26	492.19	3.26	192.35	83.22	
J867	273.99	Bakerview	3.70	492.10	3.70	218.11	94.37	
J868	265.92	Bakerview	3.70	492.03	3.70	226.11	97.83	
J869	289.47	Bakerview	4.35	492.10	4.35	202.63	87.67	
J870	305.77	Bakerview	0.00	492.13	0.00	186.36	80.63	
J871	320.81	Bakerview	0.00	492.13	0.00	171.32	74.12	
J872	258.48	Bakerview	3.91	492.03	3.91	233.55	101.05	
J873	305.54	Bakerview	0.00	492.49	0.00	186.95	80.89	
J874	306.04	Bakerview	0.00	492.49	0.00	186.45	80.67	
J901	46.62	Axton	3.48	169.54	3.48	122.92	53.18	
J902	51.40	Axton	2.82	169.46	2.82	118.06	51.08	
J903	56.65	Axton	2.61	169.41	2.61	112.76	48.79	
J904	60.69	Axton	2.82	169.41	2.82	108.72	47.04	
J905	66.68	Axton	1.09	169.41	1.09	102.73	44.45	
J906	51.17	Axton	6.74	169.45	6.74	118.28	51.17	
J907	52.82	Axton	6.52	169.43	6.52	116.61	50.45	
J908	56.16	Axton	4.35	169.42	4.35	113.26	49.00	
J909	58.70	Axton	5.21	169.42	5.21	110.72	47.90	
J910	66.14	Axton	1.73	169.41	1.73	103.27	44.68	
J911	52.68	Axton	1.73	169.40	1.73	116.72	50.50	
J912	48.21	Axton	3.05	169.38	3.05	121.17	52.43	
J913	56.51	Axton	2.39	169.40	2.39	112.89	48.84	
J914	52.65	Axton	5.00	169.36	5.00	116.71	50.50	
J915	46.03	Axton	3.70	169.32	3.70	123.29	53.34	
J916	41.76	Axton	3.91	169.26	3.91	127.50	55.16	
J917	45.63	Axton	0.00	169.26	0.00	123.63	53.49	
J918	52.11	Axton	3.48	169.24	3.48	117.13	50.68	
J919	47.40	Axton	3.26	169.24	3.26	121.84	52.71	
J920	62.74	Axton	3.26	169.23	3.26	106.49	46.07	
J921	46.22	Axton	4.35	169.23	4.35	123.01	53.22	

Scenario: 2015 MDD
Fire Flow Analysis
Junction Report

Label	Elevation (ft)	Zone	Demand (Calculated) (gpm)	Calculated Hydraulic Grade (ft)	Base Flow (gpm)	Pressure Head (ft)	Pressure (psi)	Notes
J922	65.53	Axton	1.52	169.32	1.52	103.79	44.90	
J923	61.34	Axton	1.73	169.32	1.73	107.98	46.72	
J924	49.03	Axton	1.73	169.32	1.73	120.29	52.04	
J925	6.98	Axton	1.30	169.32	1.30	162.34	70.24	
J926	61.54	Axton	1.30	169.32	1.30	107.78	46.63	
J927	61.36	Axton	1.30	169.32	1.30	107.96	46.71	

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P1	1,904.00	18.0	Ductile Iron	100.0	false	Open	4,776.28	6.02	348.78	329.08	19.70	10.35	J1	J2	Open
P2	339.00	18.0	Ductile Iron	100.0	false	Open	4,776.28	6.02	329.08	325.57	3.51	10.35	J2	J3	Open
P3	475.00	18.0	Ductile Iron	100.0	false	Open	4,542.26	5.73	325.57	321.09	4.48	9.43	J3	J4	Open
P4	336.00	18.0	Ductile Iron	100.0	false	Open	3,950.76	4.98	321.09	318.65	2.45	7.28	J4	J5	Open
P5	332.00	18.0	Ductile Iron	100.0	false	Open	4,272.58	5.39	318.65	315.85	2.79	8.42	J5	J6	Open
P6	370.00	18.0	Ductile Iron	100.0	false	Open	4,269.31	5.38	315.85	312.74	3.11	8.41	J6	J7	Open
P7	361.00	12.0	Ductile Iron	120.0	false	Open	1,501.51	4.26	312.74	310.49	2.25	6.24	J7	J8	Open
P8	644.00	12.0	Ductile Iron	120.0	false	Open	978.94	2.78	310.49	308.67	1.82	2.83	J8	J9	Open
P9	547.00	12.0	Ductile Iron	120.0	false	Open	838.18	2.38	308.67	307.51	1.16	2.12	J9	J10	Open
P10	171.00	12.0	Ductile Iron	120.0	false	Open	605.33	1.72	307.51	307.31	0.20	1.16	J10	J11	Open
P11	181.00	12.0	Ductile Iron	120.0	false	Open	467.93	1.33	307.31	307.18	0.13	0.72	J11	J12	Open
P12	740.00	12.0	Ductile Iron	120.0	false	Open	466.63	1.32	307.18	306.65	0.53	0.72	J12	J13	Open
P13	482.00	12.0	Ductile Iron	120.0	false	Open	75.80	0.22	306.65	306.64	0.01	0.02	J13	J14	Open
P14	782.00	12.0	Ductile Iron	120.0	false	Open	35.27	0.10	306.64	306.63	0.00	0.01	J14	J15	Open
P15	813.00	12.0	Ductile Iron	120.0	false	Open	28.74	0.08	306.63	306.63	0.00	0.00	J15	J16	Open
P16	471.00	12.0	Ductile Iron	120.0	false	Open	16.30	0.05	306.63	306.63	0.00	0.00	J16	J17	Open
P17	619.00	12.0	Ductile Iron	120.0	false	Open	7.24	0.02	306.63	306.63	0.00	0.00	J17	J18	Open
P18	374.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	306.63	306.63	0.00	0.00	J18	J19	Open
P19	143.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	306.63	306.63	0.00	0.00	J19	J20	Open
P20	361.00	6.0	Ductile Iron	120.0	false	Open	244.42	2.77	321.09	318.81	2.29	6.33	J4	J21	Open
P21	361.00	4.0	Ductile Iron	120.0	false	Open	76.66	1.96	318.65	316.72	1.92	5.33	J5	J22	Open
P22	336.00	6.0	Ductile Iron	120.0	false	Open	241.78	2.74	318.81	316.72	2.08	6.20	J21	J22	Open
P23	376.00	6.0	Ductile Iron	120.0	false	Open	315.80	3.58	316.72	312.90	3.83	10.17	J22	J23	Open
P24	326.00	4.0	Ductile Iron	120.0	false	Open	91.48	2.34	312.90	310.49	2.41	7.39	J23	J8	Open
P25	531.00	6.0	Ductile Iron	120.0	false	Open	217.40	2.47	312.90	310.19	2.71	5.10	J23	J24	Open
P26	304.00	6.0	Ductile Iron	120.0	false	Open	215.44	2.44	310.19	308.67	1.52	5.01	J24	J9	Open
P27	589.00	8.0	Ductile Iron	120.0	false	Open	30.40	0.19	306.65	306.63	0.02	0.03	J13	J25	Open
P28	652.00	8.0	Ductile Iron	120.0	false	Open	7.37	0.05	306.63	306.63	0.00	0.00	J25	J26	Open
P29	1,340.00	6.0	Ductile Iron	120.0	false	Open	-5.33	0.06	306.63	306.63	0.01	0.01	J26	J27	Open
P30	686.00	6.0	Ductile Iron	120.0	false	Open	-10.94	0.12	306.63	306.65	0.01	0.02	J27	J13	Open
P31	485.00	8.0	Ductile Iron	120.0	false	Open	0.63	0.00	306.63	306.63	0.00	0.00	J26	J28	Open
P32	317.00	8.0	Ductile Iron	120.0	false	Open	1.26	0.01	306.63	306.63	0.00	0.00	J28	J29	Open
P33	462.00	6.0	Ductile Iron	120.0	false	Open	-1.35	0.02	306.63	306.63	0.00	0.00	J29	J30	Open
P34	147.00	8.0	Ductile Iron	120.0	false	Open	-4.87	0.03	306.63	306.63	0.00	0.00	J28	J30	Open
P35	186.00	8.0	Ductile Iron	120.0	false	Open	-13.72	0.09	306.63	306.63	0.00	0.01	J30	J25	Open
P36	300.00	12.0	Ductile Iron	120.0	false	Open	37.13	0.11	306.64	306.63	0.00	0.01	J14	J31	Open
P37	510.00	12.0	Ductile Iron	120.0	false	Open	35.54	0.10	306.63	306.63	0.00	0.01	J31	J32	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P38	374.00	12.0	Ductile Iron	120.0	false	Open	30.73	0.09	306.63	306.63	0.00	0.00	J32	J33	Open
P39	662.00	12.0	Ductile Iron	120.0	false	Open	28.82	0.08	306.63	306.63	0.00	0.00	J33	J34	Open
P40	545.00	12.0	Ductile Iron	120.0	false	Open	26.86	0.08	306.63	306.63	0.00	0.00	J34	J35	Open
P41	1,563.00	12.0	Ductile Iron	120.0	false	Open	30.65	0.09	306.63	306.62	0.01	0.00	J35	J36	Open
P42	356.00	12.0	Ductile Iron	120.0	false	Open	17.39	0.05	306.62	306.62	0.00	0.00	J36	J40	Open
P43	884.00	12.0	Ductile Iron	120.0	false	Open	8.76	0.02	306.62	306.62	0.00	0.00	J40	J41	Open
P44	294.00	12.0	Ductile Iron	120.0	false	Open	7.24	0.02	306.62	306.62	0.00	0.00	J41	J42	Open
P45	278.00	6.0	Ductile Iron	120.0	false	Open	1.37	0.02	306.63	306.63	0.00	0.00	J27	J31	Open
P46	273.00	8.0	Ductile Iron	120.0	false	Open	4.90	0.03	306.63	306.63	0.00	0.00	J32	J37	Open
P47	222.00	8.0	Ductile Iron	120.0	false	Open	0.87	0.01	306.63	306.63	0.00	0.00	J35	J38	Open
P48	181.00	8.0	Ductile Iron	120.0	false	Open	0.66	0.00	306.63	306.63	0.00	0.00	J38	J39	Open
P49	842.00	8.0	Ductile Iron	120.0	false	Open	5.81	0.04	306.62	306.62	0.00	0.00	J40	J43	Open
P50	221.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	306.62	306.62	0.00	0.00	J43	J44	Open
P51	370.00	8.0	Ductile Iron	120.0	false	Open	2.33	0.01	306.62	306.62	0.00	0.00	J43	J45	Open
P52	433.00	8.0	Ductile Iron	120.0	false	Open	3.05	0.02	306.62	306.62	0.00	0.00	J45	J46	Open
P53	768.00	8.0	Ductile Iron	120.0	false	Open	-3.54	0.02	306.62	306.62	0.00	0.00	J45	J47	Open
P54	236.00	8.0	Ductile Iron	120.0	false	Open	-6.37	0.04	306.62	306.62	0.00	0.00	J47	J42	Open
P55	629.00	8.0	Ductile Iron	120.0	false	Open	-3.57	0.02	306.63	306.63	0.00	0.00	J32	J15	Open
P56	471.00	8.0	Ductile Iron	120.0	false	Open	-4.88	0.03	306.63	306.63	0.00	0.00	J35	J48	Open
P57	400.00	8.0	Ductile Iron	120.0	false	Open	0.22	0.00	306.63	306.63	0.00	0.00	J48	J49	Open
P58	309.00	12.0	Ductile Iron	120.0	false	Open	11.30	0.03	306.62	306.62	0.00	0.00	J36	J50	Open
P59	748.00	12.0	Ductile Iron	120.0	false	Open	1.52	0.00	306.62	306.62	0.00	0.00	J50	J51	Open
P60	289.00	8.0	Ductile Iron	120.0	false	Open	7.82	0.05	306.62	306.62	0.00	0.00	J50	J52	Open
P61	490.00	8.0	Ductile Iron	120.0	false	Open	4.13	0.03	306.62	306.62	0.00	0.00	J52	J53	Open
P62	725.00	8.0	Ductile Iron	120.0	false	Open	1.09	0.01	306.62	306.62	0.00	0.00	J52	J54	Open
P63	306.00	8.0	Ductile Iron	120.0	false	Open	0.66	0.00	306.63	306.63	0.00	0.00	J16	J55	Open
P64	397.00	8.0	Ductile Iron	120.0	false	Open	-0.39	0.00	306.63	306.63	0.00	0.00	J55	J56	Open
P65	131.00	8.0	Ductile Iron	120.0	false	Open	-0.74	0.00	306.63	306.63	0.00	0.00	J56	J16	Open
P66	106.00	8.0	Ductile Iron	120.0	false	Open	7.33	0.05	306.63	306.63	0.00	0.00	J17	J57	Open
P67	105.00	8.0	Ductile Iron	120.0	false	Open	-3.67	0.02	306.63	306.63	0.00	0.00	J58	J57	Open
P68	305.00	8.0	Ductile Iron	120.0	false	Open	-3.67	0.02	306.63	306.63	0.00	0.00	J60	J58	Open
P69	305.00	8.0	Ductile Iron	120.0	false	Open	3.67	0.02	306.63	306.63	0.00	0.00	J57	J59	Open
P70	105.00	8.0	Ductile Iron	120.0	false	Open	3.67	0.02	306.63	306.63	0.00	0.00	J59	J60	Open
P71	756.00	8.0	Ductile Iron	120.0	false	Open	7.33	0.05	306.63	306.63	0.00	0.00	J60	J48	Open
P72	230.00	8.0	Ductile Iron	120.0	false	Open	7.02	0.04	306.63	306.63	0.00	0.00	J18	J61	Open
P73	349.00	8.0	Ductile Iron	120.0	false	Open	228.98	1.46	307.51	307.03	0.48	1.38	J10	J62	Open
P74	401.00	8.0	Ductile Iron	120.0	false	Open	293.81	1.88	307.03	306.15	0.88	2.19	J62	J63	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P75	349.00	8.0	Ductile Iron	120.0	false	Open	134.14	0.86	307.31	307.13	0.18	0.51	J11	J64	Open
P76	365.00	4.0	Asbestos Cement	140.0	false	Open	57.87	1.48	307.13	306.26	0.87	2.38	J64	J65	Open
P77	171.00	6.0	Ductile Iron	120.0	false	Open	-69.23	0.79	307.03	307.13	0.10	0.61	J62	J64	Open
P78	181.00	6.0	Ductile Iron	120.0	false	Open	2.64	0.03	307.13	307.13	0.00	0.00	J64	J66	Open
P79	1,208.00	8.0	Asbestos Cement	140.0	false	Open	121.35	0.77	306.65	306.26	0.39	0.32	J13	J65	Open
P80	176.00	8.0	Asbestos Cement	140.0	false	Open	178.52	1.14	306.26	306.15	0.12	0.65	J65	J63	Open
P81	585.00	8.0	Ductile Iron	120.0	false	Open	226.38	1.44	306.65	305.86	0.79	1.35	J13	J67	Open
P82	627.00	8.0	Ductile Iron	120.0	false	Open	222.55	1.42	305.86	305.04	0.82	1.31	J67	J68	Open
P83	418.00	8.0	Ductile Iron	120.0	false	Open	218.97	1.40	305.04	304.50	0.53	1.27	J68	J69	Open
P84	414.00	8.0	Ductile Iron	120.0	false	Open	127.88	0.82	304.50	304.31	0.19	0.47	J69	J70	Open
P85	493.00	8.0	Ductile Iron	120.0	false	Open	210.20	1.34	304.31	303.73	0.58	1.18	J70	J80	Open
P86	222.00	8.0	Ductile Iron	120.0	false	Open	88.16	0.56	304.50	304.45	0.05	0.24	J69	J71	Open
P87	400.00	8.0	Ductile Iron	120.0	false	Open	87.11	0.56	304.45	304.36	0.09	0.23	J71	J72	Open
P88	220.00	8.0	Ductile Iron	120.0	false	Open	86.24	0.55	304.36	304.31	0.05	0.23	J72	J70	Open
P89	335.00	8.0	Ductile Iron	120.0	false	Open	0.35	0.00	306.64	306.64	0.00	0.00	J14	J73	Open
P90	731.00	8.0	Ductile Iron	120.0	false	Open	0.87	0.01	306.63	306.63	0.00	0.00	J15	J74	Open
P91	729.00	8.0	Ductile Iron	120.0	false	Closed	0.00	0.00	306.63	258.65	0.00	0.00	J74	J75	Closed
P92	332.00	12.0	Ductile Iron	120.0	false	Open	2,002.16	5.68	312.74	309.21	3.53	10.63	J7	J76	Open
P93	333.00	4.0	Ductile Iron	120.0	false	Open	111.15	2.84	312.74	309.21	3.53	10.60	J7	J76	Open
P94	362.00	12.0	Ductile Iron	120.0	false	Open	1,034.05	2.93	309.21	308.08	1.13	3.13	J76	J77	Open
P95	284.00	8.0	Ductile Iron	120.0	false	Open	610.13	3.89	310.49	308.08	2.41	8.48	J8	J77	Open
P96	624.00	12.0	Ductile Iron	120.0	false	Open	724.79	2.06	308.08	307.07	1.01	1.62	J77	J78	Open
P97	524.00	8.0	Ductile Iron	120.0	false	Open	351.41	2.24	308.67	307.07	1.60	3.05	J9	J78	Open
P98	743.00	12.0	Ductile Iron	120.0	false	Open	1,070.77	3.04	307.07	304.59	2.48	3.34	J78	J79	Open
P99	396.00	8.0	Asbestos Cement	140.0	false	Open	470.14	3.00	306.15	304.59	1.56	3.94	J63	J79	Open
P100	384.00	10.0	Ductile Iron	120.0	false	Open	534.42	2.18	304.59	303.73	0.86	2.24	J79	J80	Open
P101	306.00	10.0	Ductile Iron	120.0	false	Open	739.08	3.02	303.73	302.48	1.25	4.08	J80	J81	Open
P102	947.00	10.0	Ductile Iron	120.0	false	Open	736.80	3.01	302.48	298.64	3.84	4.06	J81	J82	Open
P103	305.00	10.0	Ductile Iron	120.0	false	Open	732.89	2.99	298.64	297.41	1.23	4.02	J82	J83	Open
P104	569.00	12.0	Ductile Iron	120.0	false	Open	913.25	2.59	308.08	306.66	1.41	2.48	J77	J84	Open
P105	396.00	12.0	Ductile Iron	120.0	false	Open	903.06	2.56	306.66	305.70	0.96	2.43	J84	J85	Open
P106	534.00	10.0	Cast iron	100.0	false	Open	526.13	2.15	305.70	304.07	1.63	3.05	J85	J86	Open
P107	369.00	14.0	Ductile Iron	120.0	false	Open	-1,004.23	2.09	304.07	304.59	0.52	1.40	J86	J79	Open
P108	485.00	6.0	Asbestos Cement	140.0	false	Open	272.39	3.09	305.70	302.88	2.82	5.82	J85	J203	Open
P109	336.00	8.0	Ductile Iron	120.0	false	Open	-15.81	0.10	302.88	302.88	0.00	0.01	J203	J87	Open
P110	1,112.00	8.0	Ductile Iron	120.0	false	Open	287.23	1.83	302.88	300.54	2.34	2.10	J203	J88	Open
P111	391.00	14.0	Ductile Iron	120.0	false	Open	1,527.93	3.18	304.07	302.88	1.19	3.04	J86	J87	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P112	786.00	14.0	Ductile Iron	120.0	false	Open	1,510.55	3.15	302.88	300.54	2.34	2.98	J87	J88	Open
P113	1,303.00	14.0	Ductile Iron	120.0	false	Open	1,793.69	3.74	300.54	295.21	5.33	4.09	J88	J89	Open
P114	1,153.00	14.0	Ductile Iron	120.0	false	Open	3,876.38	8.08	295.21	275.54	19.67	17.06	J89	J90	Open
P115	37.00	4.0	Ductile Iron	120.0	false	Closed	0.00	0.00	211.79	275.54	0.00	0.00	J479	J90	Close
P116	684.00	14.0	Ductile Iron	120.0	false	Open	3,873.33	8.07	275.54	263.89	11.65	17.03	J90	J91	Open
P117	792.00	14.0	Ductile Iron	120.0	false	Open	3,863.11	8.05	263.89	250.46	13.43	16.95	J91	J92	Open
P118	265.00	14.0	Ductile Iron	120.0	false	Open	3,621.53	7.55	250.46	246.48	3.99	15.04	J92	J93	Open
P119	256.00	14.0	Ductile Iron	120.0	false	Open	3,818.22	7.96	246.48	242.23	4.25	16.59	J93	J94	Open
P120	8.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	242.23	242.23	0.00	0.00	PRV1	J94	Open
P121	7.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	242.23	242.23	0.00	0.00	PRV1	J94	Open
P122	940.00	14.0	Ductile Iron	120.0	false	Open	-3,818.22	7.96	226.64	242.23	15.59	16.59	J95	J94	Open
P123	23.00	20.0	Ductile Iron	120.0	false	Open	3,818.22	3.90	226.64	226.57	0.07	2.92	J95	T1	Open
P124	1,149.00	4.0	Asbestos Cement	140.0	false	Open	0.17	0.00	304.07	304.07	0.00	0.00	J86	J97	Open
P125	629.00	4.0	Asbestos Cement	140.0	false	Closed	0.00	0.00	304.07	211.78	0.00	0.00	J97	J475	Close
P126	314.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	302.48	302.48	0.00	0.00	J81	J96	Open
P127	207.00	4.0	Asbestos Cement	140.0	false	Closed	0.00	0.00	302.48	211.78	0.00	0.00	J96	J475	Close
P128	391.00	4.0	Ductile Iron	120.0	false	Closed	0.00	0.00	298.64	211.78	0.00	0.00	J82	J476	Close
P129	67.00	1.5	Ductile Iron	120.0	false	Open	0.00	0.00	211.79	211.79	0.00	0.00	PRV1	J478	Open
P130	67.00	4.0	Ductile Iron	120.0	false	Open	-0.00	0.00	211.79	211.79	0.00	0.00	J478	PRV2	Open
P131	552.00	10.0	Ductile Iron	120.0	false	Open	730.28	2.98	297.41	295.21	2.20	3.99	J83	J89	Open
P132	235.00	12.0	Asbestos Cement	140.0	false	Open	-1,356.98	3.85	295.21	296.12	0.91	3.89	J89	J98	Open
P133	1,303.00	12.0	Asbestos Cement	140.0	false	Open	-1,360.89	3.86	296.12	301.22	5.09	3.91	J98	J125	Open
P134	240.00	8.0	Ductile Iron	120.0	false	Open	2.39	0.02	296.12	296.12	0.00	0.00	J98	J99	Open
P135	306.00	10.0	Ductile Iron	120.0	false	Open	7.18	0.03	263.89	263.89	0.00	0.00	J91	J100	Open
P136	450.00	8.0	Ductile Iron	120.0	false	Open	4.13	0.03	263.89	263.89	0.00	0.00	J100	J101	Open
P137	519.00	10.0	Asbestos Cement	140.0	false	Open	6.43	0.03	250.46	250.46	0.00	0.00	J92	J102	Open
P138	403.00	10.0	Asbestos Cement	140.0	false	Open	2.95	0.01	250.46	250.46	0.00	0.00	J102	J103	Open
P139	271.00	10.0	Asbestos Cement	140.0	false	Open	1.60	0.01	250.46	250.46	0.00	0.00	J103	J104	Open
P140	288.00	14.0	PVC	150.0	false	Open	1.30	0.00	250.46	250.46	0.00	0.00	J104	J105	Open
P141	272.00	8.0	Asbestos Cement	140.0	false	Open	2.18	0.01	250.46	250.46	0.00	0.00	J102	J106	Open
P142	275.00	8.0	Ductile Iron	120.0	false	Open	0.69	0.00	250.46	250.46	0.00	0.00	J103	J107	Open
P143	1,207.00	12.0	Ductile Iron	120.0	false	Open	0.36	0.00	250.46	250.46	0.00	0.00	J107	J109	Open
P144	340.00	8.0	Ductile Iron	120.0	false	Open	-0.03	0.00	250.46	250.46	0.00	0.00	J104	J108	Open
P145	164.00	12.0	Ductile Iron	120.0	false	Open	-0.03	0.00	250.46	250.46	0.00	0.00	J108	J109	Open
P146	544.00	12.0	Ductile Iron	120.0	false	Open	232.76	0.66	250.46	250.35	0.11	0.20	J92	J110	Open
P147	323.00	12.0	Ductile Iron	120.0	false	Open	27.81	0.08	250.35	250.35	0.00	0.00	J110	J111	Open
P148	285.00	12.0	Ductile Iron	120.0	false	Open	18.11	0.05	250.35	250.35	0.00	0.00	J111	J112	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P149	829.00	12.0	Ductile Iron	120.0	false	Open	15.63	0.04	250.35	250.35	0.00	0.00	J112	J113	Open
P150	339.00	12.0	Ductile Iron	120.0	false	Open	4.41	0.01	250.35	250.35	0.00	0.00	J113	J114	Open
P151	204.00	12.0	Ductile Iron	120.0	false	Open	3.10	0.01	250.35	250.35	0.00	0.00	J114	J115	Open
P152	553.00	6.0	Ductile Iron	120.0	false	Open	-196.69	2.23	246.48	248.82	2.34	4.23	J93	J116	Open
P153	144.00	6.0	Ductile Iron	120.0	false	Open	0.00	0.00	248.82	248.82	0.00	0.00	PRV4	J116	Open
P154	348.00	6.0	Ductile Iron	120.0	false	Open	-201.26	2.28	248.82	250.35	1.54	4.42	J116	J110	Open
P155	710.00	10.0	Ductile Iron	120.0	false	Open	6.88	0.03	250.35	250.35	0.00	0.00	J111	J117	Open
P156	750.00	8.0	Ductile Iron	120.0	false	Open	-0.29	0.00	250.35	250.35	0.00	0.00	J117	J112	Open
P157	491.00	8.0	Ductile Iron	120.0	false	Open	9.92	0.06	250.35	250.35	0.00	0.00	J113	J118	Open
P158	525.00	8.0	Ductile Iron	120.0	false	Open	5.50	0.04	250.35	250.35	0.00	0.00	J118	J119	Open
P159	504.00	8.0	Ductile Iron	120.0	false	Open	0.66	0.00	250.35	250.35	0.00	0.00	J114	J115	Open
P160	334.00	12.0	Ductile Iron	120.0	false	Open	1,075.02	3.05	309.21	308.09	1.12	3.36	J76	J120	Open
P161	838.00	12.0	Ductile Iron	130.0	false	Open	1,071.54	3.04	308.09	305.67	2.41	2.88	J120	J121	Open
P162	339.00	12.0	Ductile Iron	130.0	false	Open	1,162.46	3.30	305.67	304.54	1.14	3.35	J121	J122	Open
P163	329.00	12.0	Ductile Iron	130.0	false	Open	1,037.51	2.94	304.54	303.64	0.89	2.71	J122	J123	Open
P164	269.00	12.0	Ductile Iron	130.0	false	Open	897.20	2.55	303.64	303.09	0.56	2.07	J123	J124	Open
P165	896.00	12.0	Ductile Iron	130.0	false	Open	900.82	2.56	303.09	301.22	1.87	2.09	J124	J125	Open
P166	235.00	12.0	Ductile Iron	130.0	false	Open	-460.40	1.31	301.22	301.36	0.14	0.60	J125	J126	Open
P167	531.00	12.0	Ductile Iron	130.0	false	Open	-0.33	0.00	301.36	301.36	0.00	0.00	J128	J126	Open
P168	323.00	8.0	Ductile Iron	120.0	false	Open	0.87	0.01	308.09	308.09	0.00	0.00	J120	J129	Open
P169	182.00	10.0	Ductile Iron	120.0	false	Open	101.90	0.42	305.70	305.68	0.02	0.10	J85	J130	Open
P170	182.00	12.0	Ductile Iron	120.0	false	Open	101.46	0.29	305.68	305.67	0.01	0.04	J130	J121	Open
P171	585.00	6.0	Asbestos Cement	140.0	false	Open	117.94	1.34	304.54	303.82	0.72	1.23	J122	J131	Open
P172	584.00	8.0	Asbestos Cement	140.0	false	Open	134.11	0.86	303.64	303.42	0.23	0.39	J123	J132	Open
P173	196.00	8.0	Asbestos Cement	140.0	false	Open	-5.81	0.04	303.09	303.09	0.00	0.00	J124	J133	Open
P174	388.00	6.0	Asbestos Cement	140.0	false	Open	-10.05	0.11	303.09	303.09	0.01	0.01	J133	J134	Open
P175	840.00	8.0	Asbestos Cement	140.0	false	Open	1.63	0.01	303.09	303.09	0.00	0.00	J133	J135	Open
P176	329.00	6.0	Asbestos Cement	140.0	false	Open	116.37	1.32	303.82	303.42	0.40	1.20	J131	J132	Open
P177	269.00	8.0	Asbestos Cement	140.0	false	Open	249.43	1.59	303.42	303.09	0.33	1.22	J132	J134	Open
P178	1,091.00	8.0	Asbestos Cement	140.0	false	Open	237.29	1.51	303.09	301.88	1.21	1.11	J134	J136	Open
P179	158.00	6.0	Ductile Iron	120.0	false	Open	3.15	0.04	301.36	301.36	0.00	0.00	J126	J127	Open
P180	984.00	12.0	Asbestos Cement	140.0	false	Open	-464.21	1.32	301.36	301.88	0.52	0.53	J126	J136	Open
P181	857.00	12.0	Asbestos Cement	140.0	false	Open	-237.67	0.67	301.88	302.01	0.13	0.15	J136	J137	Open
P182	1,950.00	12.0	Ductile Iron	130.0	false	Open	86.08	0.24	302.01	301.96	0.05	0.03	J137	J138	Open
P183	676.00	12.0	Ductile Iron	130.0	false	Open	77.28	0.22	301.96	301.95	0.01	0.02	J138	J139	Open
P184	672.00	12.0	Ductile Iron	130.0	false	Open	74.34	0.21	301.95	301.93	0.01	0.02	J139	J140	Open
P185	1,054.00	12.0	Ductile Iron	130.0	false	Open	66.96	0.19	301.93	301.92	0.02	0.02	J140	J141	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P186	452.00	12.0	Ductile Iron	130.0	false	Open	49.23	0.14	301.92	301.91	0.00	0.01	J141	J142	Open
P187	452.00	12.0	Ductile Iron	130.0	false	Open	46.29	0.13	301.91	301.91	0.00	0.01	J142	J143	Open
P188	677.00	12.0	Ductile Iron	130.0	false	Open	46.09	0.13	301.91	301.90	0.01	0.01	J143	J144	Open
P189	621.00	12.0	Ductile Iron	130.0	false	Open	36.84	0.10	301.90	301.90	0.00	0.01	J144	J145	Open
P190	469.00	12.0	Ductile Iron	130.0	false	Open	39.02	0.11	301.90	301.89	0.00	0.01	J145	J146	Open
P191	1,538.00	12.0	Ductile Iron	130.0	false	Open	37.39	0.11	301.89	301.89	0.01	0.01	J146	J147	Open
P192	856.00	12.0	Ductile Iron	130.0	false	Open	10.86	0.03	301.89	301.89	0.00	0.00	J147	J148	Open
P193	567.00	6.0	Ductile Iron	120.0	false	Open	6.19	0.07	301.96	301.96	0.00	0.01	J138	J149	Open
P194	230.00	6.0	Ductile Iron	120.0	false	Open	2.28	0.03	301.96	301.96	0.00	0.00	J149	J150	Open
P195	172.00	6.0	Ductile Iron	120.0	false	Open	0.87	0.01	301.96	301.96	0.00	0.00	J150	J151	Open
P196	263.00	6.0	Ductile Iron	120.0	false	Open	2.28	0.03	301.96	301.96	0.00	0.00	J149	J152	Open
P197	330.00	6.0	Ductile Iron	120.0	false	Open	0.43	0.00	301.96	301.96	0.00	0.00	J150	J153	Open
P198	260.00	12.0	Ductile Iron	120.0	false	Open	1.30	0.00	301.95	301.95	0.00	0.00	J139	J154	Open
P199	639.00	10.0	Asbestos Cement	140.0	false	Open	2.28	0.01	301.93	301.93	0.00	0.00	J140	J155	Open
P200	687.00	8.0	Ductile Iron	120.0	false	Open	3.47	0.02	301.93	301.93	0.00	0.00	J140	J156	Open
P201	687.00	8.0	Ductile Iron	120.0	false	Open	1.73	0.01	301.93	301.93	0.00	0.00	J156	J157	Open
P202	869.00	8.0	Ductile Iron	120.0	false	Open	13.17	0.08	301.92	301.91	0.01	0.01	J141	J158	Open
P203	684.00	8.0	Ductile Iron	120.0	false	Open	7.30	0.05	301.91	301.91	0.00	0.00	J158	J159	Open
P204	970.00	8.0	Ductile Iron	120.0	false	Open	3.39	0.02	301.91	301.91	0.00	0.00	J159	J143	Open
P205	350.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	301.91	301.91	0.00	0.00	J142	J160	Open
P206	735.00	8.0	Ductile Iron	120.0	false	Open	8.28	0.05	301.90	301.90	0.00	0.00	J144	J161	Open
P207	688.00	8.0	Ductile Iron	120.0	false	Open	0.87	0.01	301.90	301.90	0.00	0.00	J161	J162	Open
P208	629.00	8.0	Ductile Iron	120.0	false	Open	-2.84	0.02	301.90	301.90	0.00	0.00	J145	J163	Open
P209	482.00	8.0	Ductile Iron	120.0	false	Open	-5.25	0.03	301.90	301.90	0.00	0.00	J163	J164	Open
P210	483.00	4.0	Ductile Iron	120.0	false	Open	0.85	0.02	301.90	301.90	0.00	0.00	J164	J165	Open
P211	688.00	4.0	Ductile Iron	120.0	false	Open	0.25	0.01	301.90	301.90	0.00	0.00	J165	J166	Open
P212	617.00	8.0	Ductile Iron	120.0	false	Open	-1.71	0.01	301.90	301.90	0.00	0.00	J166	J163	Open
P213	206.00	8.0	Ductile Iron	120.0	false	Open	0.70	0.00	301.90	301.90	0.00	0.00	J163	J165	Open
P214	241.00	8.0	Ductile Iron	120.0	false	Open	6.43	0.04	301.90	301.90	0.00	0.00	J161	J164	Open
P215	505.00	8.0	Ductile Iron	120.0	false	Open	0.33	0.00	301.90	301.90	0.00	0.00	J145	J167	Open
P216	482.00	8.0	Ductile Iron	120.0	false	Open	8.70	0.06	301.89	301.88	0.00	0.00	J147	J168	Open
P217	329.00	8.0	Ductile Iron	120.0	false	Open	3.73	0.02	301.88	301.88	0.00	0.00	J168	J169	Open
P218	802.00	8.0	Ductile Iron	120.0	false	Open	1.12	0.01	301.88	301.88	0.00	0.00	J169	J170	Open
P219	479.00	8.0	Ductile Iron	120.0	false	Open	-3.45	0.02	301.88	301.88	0.00	0.00	J170	J168	Open
P220	894.00	8.0	Ductile Iron	120.0	false	Open	16.53	0.11	301.89	301.88	0.01	0.01	J147	J171	Open
P221	1,539.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	301.88	301.88	0.00	0.00	J171	J172	Open
P222	553.00	8.0	Ductile Iron	120.0	false	Open	13.26	0.08	301.88	301.87	0.00	0.01	J171	J173	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P223	994.00	8.0	Ductile Iron	120.0	false	Open	3.05	0.02	301.87	301.87	0.00	0.00	J173	J174	Open
P224	216.00	8.0	Ductile Iron	120.0	false	Open	6.52	0.04	301.87	301.87	0.00	0.00	J173	J175	Open
P225	176.00	8.0	Ductile Iron	120.0	false	Open	10.43	0.07	301.89	301.88	0.00	0.00	J148	J176	Open
P226	433.00	8.0	Ductile Iron	120.0	false	Open	4.06	0.03	301.88	301.88	0.00	0.00	J176	J177	Open
P227	133.00	8.0	Ductile Iron	120.0	false	Open	2.77	0.02	301.88	301.88	0.00	0.00	J177	J178	Open
P228	891.00	8.0	Ductile Iron	120.0	false	Open	-0.02	0.00	301.88	301.88	0.00	0.00	J178	J179	Open
P229	144.00	8.0	Ductile Iron	120.0	false	Open	-2.66	0.02	301.88	301.88	0.00	0.00	J179	J180	Open
P230	312.00	8.0	Ductile Iron	120.0	false	Open	-4.85	0.03	301.88	301.88	0.00	0.00	J180	J176	Open
P231	419.00	8.0	Ductile Iron	120.0	false	Open	-0.02	0.00	301.88	301.88	0.00	0.00	J177	J180	Open
P232	424.00	8.0	Ductile Iron	120.0	false	Open	-0.03	0.00	301.88	301.88	0.00	0.00	J178	J179	Open
P233	340.00	6.0	Ductile Iron	120.0	false	Open	232.63	2.64	325.57	323.61	1.96	5.78	J3	J181	Open
P234	475.00	6.0	Ductile Iron	120.0	false	Open	228.49	2.59	323.61	320.95	2.65	5.59	J181	J182	Open
P235	336.00	8.0	Ductile Iron	120.0	false	Open	344.90	2.20	320.95	319.96	0.99	2.95	J182	J183	Open
P236	332.00	8.0	Ductile Iron	120.0	false	Open	165.59	1.06	319.96	319.71	0.25	0.76	J183	J184	Open
P237	370.00	4.0	Ductile Iron	120.0	false	Open	156.77	4.00	319.71	312.29	7.42	20.04	J184	J185	Open
P238	339.00	12.0	Ductile Iron	120.0	false	Open	345.68	0.98	321.09	320.95	0.14	0.41	J4	J182	Open
P239	338.00	8.0	Ductile Iron	120.0	false	Open	-400.67	2.56	318.65	319.96	1.32	3.89	J5	J183	Open
P240	201.00	6.0	Ductile Iron	120.0	false	Open	2.50	0.03	323.61	323.61	0.00	0.00	J181	J186	Open
P241	201.00	8.0	Ductile Iron	120.0	false	Open	228.39	1.46	320.95	320.68	0.28	1.37	J182	J187	Open
P242	537.00	8.0	Ductile Iron	120.0	false	Open	224.43	1.43	320.68	319.96	0.71	1.33	J187	J183	Open
P243	336.00	12.0	Ductile Iron	120.0	false	Open	650.91	1.85	312.74	312.29	0.45	1.33	J7	J185	Open
P244	952.00	12.0	Ductile Iron	120.0	false	Open	802.55	2.28	312.29	310.43	1.86	1.96	J185	J188	Open
P245	767.00	12.0	Ductile Iron	120.0	false	Open	681.12	1.93	310.43	309.32	1.11	1.44	J188	J189	Open
P246	305.00	12.0	Ductile Iron	120.0	false	Open	675.66	1.92	309.32	308.89	0.43	1.42	J189	J190	Open
P247	184.00	12.0	Ductile Iron	110.0	false	Open	557.01	1.58	308.89	308.68	0.21	1.17	J190	J191	Open
P248	504.00	12.0	Ductile Iron	120.0	false	Open	518.70	1.47	308.68	308.24	0.44	0.87	J191	J192	Open
P249	574.00	10.0	Ductile Iron	120.0	false	Open	631.43	2.58	308.24	306.49	1.75	3.05	J192	J193	Open
P250	297.00	10.0	Ductile Iron	120.0	false	Open	483.47	1.97	306.49	305.93	0.55	1.86	J193	J194	Open
P251	558.00	10.0	Ductile Iron	120.0	false	Open	408.80	1.67	305.93	305.17	0.76	1.36	J194	J195	Open
P252	1,071.00	10.0	Ductile Iron	120.0	false	Open	459.99	1.88	305.17	303.36	1.82	1.70	J195	J196	Open
P253	506.00	10.0	Asbestos Cement	140.0	false	Open	114.90	0.47	303.36	303.31	0.05	0.10	J196	J197	Open
P254	552.00	10.0	Asbestos Cement	140.0	false	Open	110.27	0.45	303.31	303.26	0.05	0.09	J197	J198	Open
P255	250.00	10.0	Asbestos Cement	140.0	false	Open	106.73	0.44	303.26	303.24	0.02	0.09	J198	J199	Open
P256	438.00	10.0	Asbestos Cement	140.0	false	Open	103.47	0.42	303.24	303.20	0.04	0.08	J199	J200	Open
P257	1,948.00	10.0	Asbestos Cement	140.0	false	Open	95.65	0.39	303.20	303.07	0.14	0.07	J200	J201	Open
P258	1,029.00	10.0	Asbestos Cement	140.0	false	Open	80.43	0.33	303.07	303.01	0.05	0.05	J201	J202	Open
P259	67.00	2.0	Ductile Iron	120.0	false	Open	80.43	8.21	303.01	291.60	11.42	170.41	J202	PRV5	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P260	67.00	10.0	Ductile Iron	120.0	false	Open	0.00	0.00	303.01	303.01	0.00	0.00	J202	PRV6	Open
P261	150.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	310.43	310.43	0.00	0.00	J188	J204	Open
P262	192.00	8.0	Ductile Iron	120.0	false	Open	0.99	0.01	309.32	309.32	0.00	0.00	J189	J205	Open
P263	482.00	8.0	Ductile Iron	120.0	false	Open	0.33	0.00	309.32	309.32	0.00	0.00	J205	J206	Open
P264	1,026.00	8.0	Ductile Iron	120.0	false	Open	5.11	0.03	308.68	308.67	0.00	0.00	J191	J207	Open
P265	700.00	8.0	Asbestos Cement	140.0	false	Open	3.15	0.02	308.67	308.67	0.00	0.00	J207	J208	Open
P266	299.00	12.0	Ductile Iron	120.0	false	Open	344.11	0.98	303.36	303.24	0.12	0.41	J196	J209	Open
P267	663.00	12.0	Ductile Iron	120.0	false	Open	329.47	0.93	303.24	302.99	0.25	0.38	J209	J210	Open
P268	2,654.00	12.0	Ductile Iron	120.0	false	Open	324.73	0.92	302.99	302.01	0.97	0.37	J210	J137	Open
P269	1,047.00	12.0	Ductile Iron	120.0	false	Open	0.66	0.00	303.24	303.24	0.00	0.00	J209	J211	Open
P270	640.00	8.0	Ductile Iron	120.0	false	Open	9.20	0.06	303.24	303.23	0.00	0.00	J209	J212	Open
P271	478.00	6.0	Asbestos Cement	140.0	false	Open	4.13	0.05	303.20	303.20	0.00	0.00	J200	J213	Open
P272	277.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	303.26	303.26	0.00	0.00	J198	J214	Open
P273	455.00	6.0	Ductile Iron	120.0	false	Open	0.98	0.01	303.26	303.26	0.00	0.00	J214	J215	Open
P274	467.00	8.0	Ductile Iron	120.0	false	Open	13.48	0.09	303.07	303.06	0.00	0.01	J201	J216	Open
P275	387.00	8.0	Ductile Iron	120.0	false	Open	9.35	0.06	303.06	303.06	0.00	0.00	J216	J217	Open
P276	560.00	8.0	Ductile Iron	120.0	false	Open	5.87	0.04	303.06	303.06	0.00	0.00	J217	J218	Open
P277	402.00	8.0	Ductile Iron	120.0	false	Open	3.05	0.02	303.06	303.06	0.00	0.00	J218	J219	Open
P278	390.00	8.0	Ductile Iron	120.0	false	Open	109.98	0.70	308.89	308.75	0.14	0.36	J190	J228	Open
P279	270.00	8.0	Ductile Iron	120.0	false	Open	0.98	0.01	308.75	308.75	0.00	0.00	J228	J229	Open
P280	278.00	8.0	Ductile Iron	120.0	false	Open	105.79	0.68	308.75	308.66	0.09	0.33	J228	J230	Open
P281	569.00	8.0	Ductile Iron	120.0	false	Open	27.44	0.18	308.68	308.66	0.02	0.03	J191	J230	Open
P282	1,068.00	8.0	Ductile Iron	120.0	false	Open	116.75	0.75	308.66	308.24	0.42	0.40	J230	J192	Open
P283	402.00	10.0	Ductile Iron	120.0	false	Open	144.74	0.59	306.49	306.41	0.08	0.20	J193	J242	Open
P284	502.00	10.0	Ductile Iron	120.0	false	Open	112.28	0.46	306.41	306.34	0.06	0.12	J242	J243	Open
P285	439.00	10.0	Ductile Iron	120.0	false	Open	4.35	0.02	306.34	306.34	0.00	0.00	J243	J244	Open
P286	346.00	10.0	Ductile Iron	120.0	false	Open	3.70	0.02	306.34	306.34	0.00	0.00	J244	J245	Open
P287	361.00	8.0	Ductile Iron	120.0	false	Open	2.72	0.02	306.34	306.34	0.00	0.00	J245	J246	Open
P288	693.00	10.0	Ductile Iron	120.0	false	Open	116.25	0.47	310.43	310.34	0.09	0.13	J188	J220	Open
P289	859.00	10.0	Ductile Iron	120.0	false	Open	110.74	0.45	310.34	310.24	0.10	0.12	J220	J221	Open
P290	398.00	10.0	Ductile Iron	120.0	false	Open	107.80	0.44	310.24	310.19	0.05	0.12	J221	J222	Open
P291	587.00	10.0	Ductile Iron	120.0	false	Open	47.90	0.20	310.19	310.17	0.02	0.03	J222	J223	Open
P292	514.00	10.0	Ductile Iron	120.0	false	Open	43.69	0.18	310.17	310.16	0.01	0.02	J223	J224	Open
P293	1,277.00	4.0	Asbestos Cement	140.0	false	Open	43.69	1.12	310.16	308.36	1.81	1.41	J224	J225	Open
P294	880.00	4.0	Asbestos Cement	140.0	false	Open	42.06	1.07	308.36	307.20	1.16	1.32	J225	J226	Open
P295	1,456.00	4.0	Asbestos Cement	140.0	false	Open	41.40	1.06	307.20	305.34	1.86	1.28	J226	J227	Open
P296	1,307.00	8.0	Ductile Iron	120.0	false	Open	5.18	0.03	310.34	310.34	0.00	0.00	J220	J231	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P297	440.00	8.0	Ductile Iron	120.0	false	Open	4.86	0.03	310.34	310.34	0.00	0.00	J231	J232	Open
P298	1,818.00	8.0	Ductile Iron	120.0	false	Open	4.20	0.03	310.34	310.34	0.00	0.00	J232	J233	Open
P299	643.00	8.0	Ductile Iron	120.0	false	Open	0.33	0.00	310.34	310.34	0.00	0.00	J232	J234	Open
P300	355.00	8.0	Ductile Iron	120.0	false	Open	59.90	0.38	310.19	310.15	0.04	0.12	J222	J235	Open
P301	159.00	8.0	Ductile Iron	120.0	false	Open	4.24	0.03	310.15	310.15	0.00	0.00	J235	J236	Open
P302	177.00	8.0	Ductile Iron	120.0	false	Open	0.33	0.00	310.15	310.15	0.00	0.00	J235	J237	Open
P303	554.00	10.0	Ductile Iron	120.0	false	Open	3.55	0.01	310.17	310.17	0.00	0.00	J223	J238	Open
P304	330.00	10.0	Ductile Iron	120.0	false	Open	0.66	0.00	310.17	310.17	0.00	0.00	J238	J239	Open
P305	179.00	8.0	Ductile Iron	120.0	false	Open	0.33	0.00	310.17	310.17	0.00	0.00	J239	J240	Open
P306	271.00	8.0	Ductile Iron	120.0	false	Open	0.33	0.00	310.17	310.17	0.00	0.00	J238	J241	Open
P307	1,116.00	12.0	Ductile Iron	120.0	false	Open	65.81	0.19	305.93	305.91	0.02	0.02	J194	J248	Open
P308	1,266.00	12.0	Ductile Iron	120.0	false	Open	201.67	0.57	305.91	305.72	0.19	0.15	J248	J250	Open
P309	1,453.00	12.0	Ductile Iron	120.0	false	Open	200.36	0.57	305.72	305.50	0.22	0.15	J250	J251	Open
P310	970.00	12.0	Ductile Iron	110.0	false	Open	198.73	0.56	305.50	305.34	0.17	0.17	J251	J227	Open
P311	843.00	8.0	Ductile Iron	120.0	false	Open	32.46	0.21	306.41	306.38	0.03	0.04	J242	J249	Open
P312	843.00	8.0	Ductile Iron	120.0	false	Open	32.46	0.21	306.38	306.34	0.03	0.04	J249	J243	Open
P313	412.00	8.0	Ductile Iron	120.0	false	Open	137.49	0.88	306.34	306.12	0.22	0.54	J243	J247	Open
P314	392.00	8.0	Ductile Iron	120.0	false	Open	137.17	0.88	306.12	305.91	0.21	0.53	J247	J248	Open
P315	1,693.00	12.0	Asbestos Cement	140.0	false	Open	-54.73	0.16	305.17	305.19	0.02	0.01	J195	J252	Open
P316	1,278.00	12.0	Asbestos Cement	140.0	false	Open	-55.39	0.16	305.19	305.20	0.01	0.01	J252	J253	Open
P317	1,766.00	12.0	Asbestos Cement	140.0	false	Open	-58.54	0.17	305.20	305.22	0.02	0.01	J253	J255	Open
P318	403.00	8.0	Ductile Iron	130.0	false	Open	2.82	0.02	305.20	305.20	0.00	0.00	J253	J254	Open
P319	1,749.00	16.0	Ductile Iron	120.0	false	Open	183.17	0.29	305.34	305.28	0.05	0.03	J227	J256	Open
P320	1,819.00	12.0	Ductile Iron	120.0	false	Open	5.97	0.02	305.28	305.28	0.00	0.00	J256	J257	Open
P321	712.00	4.0	Asbestos Cement	140.0	false	Open	4.34	0.11	305.28	305.27	0.01	0.02	J257	J258	Open
P322	639.00	8.0	Ductile Iron	120.0	false	Open	2.60	0.02	305.27	305.27	0.00	0.00	J258	J259	Open
P323	816.00	12.0	Ductile Iron	120.0	false	Open	6.11	0.02	305.27	305.27	0.00	0.00	J259	J260	Open
P324	816.00	10.0	Ductile Iron	120.0	false	Open	4.47	0.02	305.27	305.27	0.00	0.00	J260	J261	Open
P325	3,273.00	12.0	Ductile Iron	120.0	false	Open	54.69	0.16	305.34	305.29	0.04	0.01	J227	J262	Open
P326	1,566.00	12.0	Ductile Iron	120.0	false	Open	54.36	0.15	305.29	305.27	0.02	0.01	J262	J263	Open
P327	831.00	12.0	Ductile Iron	120.0	false	Open	22.74	0.06	305.27	305.27	0.00	0.00	J263	J264	Open
P328	798.00	12.0	Ductile Iron	120.0	false	Open	21.77	0.06	305.27	305.27	0.00	0.00	J264	J265	Open
P329	359.00	10.0	Ductile Iron	120.0	false	Open	30.64	0.13	305.27	305.27	0.00	0.01	J263	J259	Open
P330	669.00	12.0	Ductile Iron	120.0	false	Open	23.60	0.07	305.27	305.26	0.00	0.00	J259	J266	Open
P331	439.00	12.0	Ductile Iron	120.0	false	Open	20.10	0.06	305.26	305.26	0.00	0.00	J266	J267	Open
P332	410.00	12.0	Ductile Iron	120.0	false	Open	13.06	0.04	305.26	305.26	0.00	0.00	J267	J268	Open
P333	420.00	12.0	Ductile Iron	120.0	false	Open	4.36	0.01	305.26	305.26	0.00	0.00	J268	J269	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P334	969.00	10.0	Ductile Iron	120.0	false	Open	2.53	0.01	305.26	305.26	0.00	0.00	J266	J270	Open
P335	668.00	10.0	Ductile Iron	120.0	false	Open	-8.30	0.03	305.26	305.26	0.00	0.00	J270	J271	Open
P336	377.00	8.0	Ductile Iron	120.0	false	Open	3.41	0.02	305.26	305.26	0.00	0.00	J268	J272	Open
P337	571.00	8.0	Ductile Iron	120.0	false	Open	-1.12	0.01	305.26	305.26	0.00	0.00	J272	J273	Open
P338	200.00	8.0	Ductile Iron	120.0	false	Open	-1.12	0.01	305.26	305.26	0.00	0.00	J273	J274	Open
P339	356.00	12.0	Ductile Iron	120.0	false	Open	6.99	0.02	305.26	305.26	0.00	0.00	J269	J274	Open
P340	264.00	12.0	Ductile Iron	120.0	false	Open	5.87	0.02	305.26	305.26	0.00	0.00	J274	J275	Open
P341	461.00	12.0	Ductile Iron	120.0	false	Open	5.87	0.02	305.26	305.26	0.00	0.00	J275	J276	Open
P342	713.00	12.0	Ductile Iron	120.0	false	Open	5.87	0.02	305.26	305.26	0.00	0.00	J276	J277	Open
P343	358.00	12.0	Ductile Iron	120.0	false	Open	12.51	0.04	305.27	305.27	0.00	0.00	J265	J261	Open
P344	670.00	12.0	Ductile Iron	120.0	false	Open	15.68	0.04	305.27	305.26	0.00	0.00	J261	J271	Open
P345	435.00	12.0	Ductile Iron	120.0	false	Open	6.52	0.02	305.26	305.26	0.00	0.00	J267	J278	Open
P346	237.00	8.0	Ductile Iron	120.0	false	Open	5.05	0.03	305.28	305.28	0.00	0.00	J256	J279	Open
P347	918.00	8.0	Ductile Iron	120.0	false	Open	0.17	0.00	305.28	305.28	0.00	0.00	J279	J280	Open
P348	918.00	8.0	Ductile Iron	120.0	false	Open	-0.17	0.00	305.28	305.28	0.00	0.00	J280	J279	Open
P349	440.00	16.0	Ductile Iron	120.0	false	Open	164.64	0.26	305.28	305.27	0.01	0.03	J256	J281	Open
P350	504.00	12.0	Ductile Iron	120.0	false	Open	-4.26	0.01	305.26	305.26	0.00	0.00	J269	J282	Open
P351	1,385.00	12.0	Ductile Iron	120.0	false	Open	-7.80	0.02	305.26	305.26	0.00	0.00	J282	J283	Open
P352	751.00	12.0	Ductile Iron	120.0	false	Open	-11.36	0.03	305.26	305.26	0.00	0.00	J283	J284	Open
P353	405.00	12.0	Ductile Iron	120.0	false	Open	-20.56	0.06	305.26	305.26	0.00	0.00	J284	J285	Open
P354	1,227.00	12.0	Ductile Iron	120.0	false	Open	-27.30	0.08	305.26	305.27	0.00	0.00	J285	J281	Open
P355	655.00	16.0	Ductile Iron	120.0	false	Open	135.50	0.22	305.27	305.26	0.01	0.02	J281	J286	Open
P356	567.00	16.0	Ductile Iron	120.0	false	Open	134.19	0.21	305.26	305.25	0.01	0.02	J286	J287	Open
P357	1,000.00	16.0	Ductile Iron	120.0	false	Open	50.54	0.08	305.25	305.24	0.00	0.00	J287	J288	Open
P358	928.00	16.0	Ductile Iron	120.0	false	Open	28.77	0.05	305.24	305.24	0.00	0.00	J288	J289	Open
P359	1,234.00	12.0	Ductile Iron	120.0	false	Open	17.46	0.05	305.24	305.24	0.00	0.00	J289	J290	Open
P360	695.00	12.0	Ductile Iron	120.0	false	Open	12.02	0.03	305.24	305.24	0.00	0.00	J290	J291	Open
P361	475.00	12.0	Ductile Iron	120.0	false	Open	10.50	0.03	305.24	305.24	0.00	0.00	J291	J292	Open
P362	526.00	12.0	Ductile Iron	120.0	false	Open	0.98	0.00	305.26	305.26	0.00	0.00	J282	J293	Open
P363	257.00	12.0	Ductile Iron	120.0	false	Open	2.89	0.01	305.26	305.26	0.00	0.00	J283	J294	Open
P364	400.00	10.0	Ductile Iron	120.0	false	Open	4.97	0.02	305.26	305.26	0.00	0.00	J284	J295	Open
P365	379.00	10.0	Ductile Iron	120.0	false	Open	2.95	0.01	305.26	305.26	0.00	0.00	J295	J296	Open
P366	283.00	10.0	Ductile Iron	120.0	false	Open	2.62	0.01	305.26	305.26	0.00	0.00	J296	J297	Open
P367	431.00	8.0	Ductile Iron	120.0	false	Open	0.66	0.00	305.26	305.26	0.00	0.00	J297	J298	Open
P368	227.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	305.26	305.26	0.00	0.00	J297	J299	Open
P369	689.00	8.0	Ductile Iron	120.0	false	Open	5.76	0.04	305.26	305.26	0.00	0.00	J285	J300	Open
P370	216.00	8.0	Ductile Iron	120.0	false	Open	2.61	0.02	305.26	305.26	0.00	0.00	J300	J301	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P371	531.00	8.0	Ductile Iron	120.0	false	Open	-0.55	0.00	305.26	305.26	0.00	0.00	J295	J300	Open
P372	521.00	12.0	Ductile Iron	120.0	false	Open	-58.54	0.17	305.22	305.23	0.01	0.02	J255	J302	Open
P373	203.00	12.0	Ductile Iron	120.0	false	Open	-65.96	0.19	305.23	305.24	0.00	0.02	J302	J303	Open
P374	509.00	12.0	Ductile Iron	120.0	false	Open	-72.49	0.21	305.24	305.25	0.01	0.02	J303	J287	Open
P375	314.00	8.0	Ductile Iron	120.0	false	Open	3.48	0.02	305.24	305.24	0.00	0.00	J303	J304	Open
P376	240.00	8.0	Ductile Iron	120.0	false	Open	3.72	0.02	305.23	305.23	0.00	0.00	J302	J305	Open
P377	266.00	8.0	Ductile Iron	120.0	false	Open	0.37	0.00	305.23	305.23	0.00	0.00	J305	J306	Open
P378	643.00	8.0	Ductile Iron	120.0	false	Open	-2.24	0.01	305.23	305.23	0.00	0.00	J306	J307	Open
P379	641.00	8.0	Ductile Iron	120.0	false	Open	-0.77	0.00	305.23	305.23	0.00	0.00	J305	J308	Open
P380	288.00	8.0	Ductile Iron	120.0	false	Open	-3.16	0.02	305.23	305.23	0.00	0.00	J308	J307	Open
P381	213.00	8.0	Ductile Iron	120.0	false	Open	-8.01	0.05	305.23	305.23	0.00	0.00	J307	J309	Open
P382	528.00	8.0	Ductile Iron	120.0	false	Open	-14.32	0.09	305.23	305.24	0.00	0.01	J309	J310	Open
P383	226.00	8.0	Ductile Iron	120.0	false	Open	1.73	0.01	305.23	305.23	0.00	0.00	J309	J311	Open
P384	711.00	8.0	Ductile Iron	120.0	false	Open	-16.71	0.11	305.24	305.24	0.01	0.01	J310	J288	Open
P385	467.00	8.0	Ductile Iron	120.0	false	Open	9.57	0.06	305.24	305.24	0.00	0.00	J289	J312	Open
P386	285.00	8.0	Ductile Iron	120.0	false	Open	4.57	0.03	305.24	305.24	0.00	0.00	J312	J313	Open
P387	938.00	8.0	Ductile Iron	120.0	false	Open	0.64	0.00	305.24	305.24	0.00	0.00	J313	J314	Open
P388	857.00	8.0	Ductile Iron	120.0	false	Open	0.67	0.00	305.24	305.24	0.00	0.00	J313	J314	Open
P389	215.00	12.0	Ductile Iron	120.0	false	Open	1.96	0.01	305.24	305.24	0.00	0.00	J292	J315	Open
P390	857.00	12.0	Ductile Iron	120.0	false	Open	2.82	0.01	305.24	305.24	0.00	0.00	J292	J316	Open
P391	515.00	8.0	Ductile Iron	120.0	false	Open	1.09	0.01	305.24	305.24	0.00	0.00	J316	J317	Open
P392	702.00	12.0	Ductile Iron	120.0	false	Open	0.87	0.00	305.24	305.24	0.00	0.00	J292	J318	Open
P393	750.00	12.0	Ductile Iron	120.0	false	Open	0.22	0.00	305.24	305.24	0.00	0.00	J318	J319	Open
P394	1,039.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	305.24	305.24	0.00	0.00	J318	J320	Open
P395	1,631.00	12.0	Ductile Iron	120.0	false	Open	0.00	0.00	305.24	305.24	0.00	0.00	J319	J321	Open
P475	1,915.00	4.0	Asbestos Cement	140.0	false	Open	-0.00	0.00	211.79	211.79	0.00	0.00	J479	J478	Open
P476	499.00	4.0	Asbestos Cement	140.0	false	Open	-2.19	0.06	211.78	211.79	0.00	0.01	J477	J479	Open
P477	934.00	4.0	Asbestos Cement	140.0	false	Open	-2.18	0.06	211.78	211.78	0.01	0.01	J476	J477	Open
P478	481.00	4.0	Asbestos Cement	140.0	false	Open	-1.30	0.03	211.78	211.78	0.00	0.00	J475	J476	Open
P479	330.00	4.0	Asbestos Cement	140.0	false	Open	3.71	0.09	211.79	211.79	0.00	0.01	J480	J479	Open
P480	220.00	4.0	Asbestos Cement	140.0	false	Open	-9.24	0.24	211.79	211.81	0.02	0.08	J480	PRV3	Open
P481	663.00	4.0	Asbestos Cement	140.0	false	Open	-3.25	0.08	211.78	211.79	0.01	0.01	J477	J480	Open
P501	75.00	8.0	Ductile Iron	120.0	false	Closed	0.00	0.00	302.48	258.79	0.00	0.00	J81	J501	Closed
P502	358.00	8.0	Ductile Iron	120.0	false	Open	27.08	0.17	258.79	258.78	0.01	0.03	J501	J502	Open
P503	399.00	4.0	Ductile Iron	120.0	false	Open	8.18	0.21	258.78	258.75	0.03	0.08	J502	J503	Open
P504	517.00	4.0	Ductile Iron	120.0	false	Open	9.28	0.24	258.75	258.69	0.06	0.11	J503	J504	Open
P505	987.00	4.0	Ductile Iron	120.0	false	Open	5.36	0.14	258.69	258.65	0.04	0.04	J504	J505	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P506	163.00	4.0	Ductile Iron	120.0	false	Open	5.44	0.14	258.65	258.65	0.01	0.04	J505	J75	Open
P507	315.00	8.0	Ductile Iron	120.0	false	Open	4.14	0.03	258.65	258.65	0.00	0.00	J75	J506	Open
P508	306.00	4.0	Ductile Iron	120.0	false	Closed	0.00	0.00	258.69	305.04	0.00	0.00	J504	J68	Close
P509	412.00	6.0	Ductile Iron	120.0	false	Open	17.38	0.20	258.78	258.76	0.02	0.05	J502	J507	Open
P510	269.00	6.0	Ductile Iron	120.0	false	Open	13.68	0.16	258.76	258.75	0.01	0.03	J507	J508	Open
P511	391.00	4.0	Ductile Iron	120.0	false	Open	-3.28	0.08	258.75	258.75	0.01	0.02	J503	J508	Open
P512	753.00	4.0	Ductile Iron	120.0	false	Open	8.01	0.20	258.75	258.69	0.06	0.08	J508	J509	Open
P513	652.00	4.0	Ductile Iron	120.0	false	Open	5.79	0.15	258.69	258.66	0.03	0.04	J509	J510	Open
P514	248.00	4.0	Ductile Iron	120.0	false	Open	4.63	0.12	258.66	258.65	0.01	0.03	J510	J511	Open
P515	206.00	4.0	Ductile Iron	120.0	false	Open	-0.43	0.01	258.69	258.69	0.00	0.00	J504	J509	Open
P516	230.00	4.0	Ductile Iron	120.0	false	Open	-2.26	0.06	258.65	258.65	0.00	0.01	J505	J511	Open
P517	836.00	4.0	Ductile Iron	120.0	false	Open	-7.22	0.18	258.69	258.75	0.06	0.07	J509	J512	Open
P518	729.00	4.0	Ductile Iron	120.0	false	Open	3.80	0.10	258.69	258.68	0.01	0.02	J509	J513	Open
P519	756.00	4.0	Ductile Iron	120.0	false	Open	-3.63	0.09	258.66	258.68	0.01	0.02	J510	J513	Open
P520	720.00	4.0	Ductile Iron	120.0	false	Open	-0.89	0.02	258.65	258.65	0.00	0.00	J511	J514	Open
P521	677.00	4.0	Ductile Iron	120.0	false	Open	-6.33	0.16	258.65	258.69	0.04	0.05	J514	J515	Open
P522	438.00	4.0	Ductile Iron	120.0	false	Open	-5.04	0.13	258.68	258.69	0.02	0.03	J513	J515	Open
P523	252.00	4.0	Ductile Iron	120.0	false	Open	-13.76	0.35	258.69	258.75	0.06	0.22	J515	J512	Open
P524	286.00	4.0	Ductile Iron	120.0	false	Open	-24.03	0.61	258.75	258.92	0.18	0.62	J512	J516	Open
P525	644.00	8.0	Ductile Iron	120.0	false	Open	-0.95	0.01	258.92	258.92	0.00	0.00	J516	J518	Open
P526	200.00	8.0	Ductile Iron	120.0	false	Open	4.13	0.03	258.92	258.92	0.00	0.00	J516	J517	Open
P527	963.00	6.0	Ductile Iron	120.0	false	Open	-30.41	0.35	258.79	258.92	0.13	0.13	J501	J519	Open
P528	251.00	8.0	Asbestos Cement	140.0	false	Open	-32.58	0.21	258.92	258.92	0.01	0.03	J519	J518	Open
P529	60.00	6.0	Ductile Iron	120.0	false	Closed	0.00	0.00	258.92	297.41	0.00	0.00	J518	J83	Close
P530	589.00	8.0	Ductile Iron	120.0	false	Open	-35.71	0.23	258.92	258.95	0.03	0.04	J518	J520	Open
P531	339.00	8.0	Ductile Iron	120.0	false	Open	0.79	0.01	258.95	258.95	0.00	0.00	J520	J522	Open
P532	413.00	8.0	Asbestos Cement	140.0	false	Open	-37.37	0.24	258.95	258.96	0.01	0.04	J520	J521	Open
P533	67.00	2.0	Ductile Iron	120.0	false	Open	37.37	3.82	261.73	258.96	2.76	41.20	PRV7	J521	Open
P534	67.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	258.96	258.96	0.00	0.00	PRV8	J521	Open
P535	353.00	8.0	Ductile Iron	120.0	false	Open	37.21	0.24	258.95	258.93	0.02	0.05	J522	J523	Open
P536	730.00	8.0	Ductile Iron	120.0	false	Open	4.78	0.03	258.93	258.93	0.00	0.00	J523	J524	Open
P537	312.00	8.0	Ductile Iron	120.0	false	Open	-28.73	0.18	258.92	258.93	0.01	0.03	J516	J523	Open
P538	445.00	8.0	Ductile Iron	120.0	false	Open	-38.15	0.24	258.95	258.97	0.02	0.05	J522	J525	Open
P539	253.00	8.0	Ductile Iron	120.0	false	Open	41.42	0.26	258.99	258.97	0.01	0.06	PRV9	J525	Open
P540	332.00	6.0	Ductile Iron	120.0	false	Open	1.96	0.02	258.65	258.64	0.00	0.00	J506	J526	Open
P541	10.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.93	385.93	0.00	0.00	J602	PRV1	Open
P542	7.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.93	385.93	0.00	0.00	J602	PRV1	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P601	399.00	14.0	Ductile Iron	120.0	false	Open	-10.88	0.02	385.93	385.93	0.00	0.00	J601	J603	Open
P602	759.00	14.0	Ductile Iron	120.0	false	Open	10.87	0.02	385.93	385.93	0.00	0.00	J601	J602	Open
P603	678.00	8.0	Asbestos Cement	140.0	false	Open	-40.20	0.26	385.90	385.93	0.03	0.04	J604	J603	Open
P604	900.00	8.0	Asbestos Cement	140.0	false	Open	-34.05	0.22	385.87	385.90	0.03	0.03	J605	J604	Open
P605	430.00	4.0	Asbestos Cement	140.0	false	Open	9.24	0.24	385.87	385.84	0.03	0.08	J605	PRV3	Open
P606	169.00	8.0	Asbestos Cement	140.0	false	Open	37.37	0.24	385.87	385.87	0.01	0.04	J605	J606	Open
P607	67.00	2.0	Ductile Iron	120.0	false	Open	37.37	3.82	385.87	383.11	2.76	41.20	J606	PRV7	Open
P608	67.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.87	385.87	0.00	0.00	J606	PRV8	Open
P609	744.00	8.0	Ductile Iron	120.0	false	Open	17.34	0.11	385.88	385.87	0.01	0.01	J607	J605	Open
P610	489.00	8.0	Ductile Iron	120.0	false	Open	40.27	0.26	385.91	385.88	0.03	0.06	J608	J607	Open
P611	492.00	8.0	Ductile Iron	120.0	false	Open	71.16	0.45	385.99	385.91	0.08	0.16	J609	J608	Open
P612	1,027.00	8.0	Ductile Iron	120.0	false	Open	20.61	0.13	385.99	385.97	0.02	0.02	J609	J610	Open
P613	549.00	8.0	Ductile Iron	120.0	false	Open	29.66	0.19	385.97	385.95	0.02	0.03	J610	J611	Open
P614	576.00	8.0	Ductile Iron	120.0	false	Open	-11.01	0.07	385.98	385.99	0.00	0.00	J612	J609	Open
P615	525.00	8.0	Ductile Iron	120.0	false	Open	-5.29	0.03	385.98	385.98	0.00	0.00	J613	J612	Open
P616	485.00	8.0	Ductile Iron	120.0	false	Open	-2.03	0.01	385.98	385.98	0.00	0.00	J614	J613	Open
P617	658.00	8.0	Ductile Iron	120.0	false	Open	1.88	0.01	385.98	385.98	0.00	0.00	J615	J614	Open
P618	329.00	8.0	Ductile Iron	120.0	false	Closed	0.00	0.00	258.65	385.98	0.00	0.00	J506	J615	Closed
P619	546.00	8.0	Ductile Iron	120.0	false	Open	28.06	0.18	385.91	385.89	0.02	0.03	J608	J616	Open
P620	703.00	8.0	Ductile Iron	120.0	false	Open	25.01	0.16	385.89	385.88	0.02	0.02	J616	J617	Open
P621	147.00	8.0	Ductile Iron	120.0	false	Open	41.42	0.26	385.88	385.87	0.01	0.06	J617	PRV9	Open
P622	308.00	8.0	Ductile Iron	120.0	false	Open	-19.67	0.13	385.88	385.88	0.00	0.01	J617	J607	Open
P623	354.00	4.0	Asbestos Cement	140.0	false	Open	9.57	0.24	385.93	385.90	0.03	0.08	J603	J618	Open
P624	315.00	4.0	Asbestos Cement	140.0	false	Open	4.29	0.11	385.90	385.89	0.01	0.02	J618	J619	Open
P625	263.00	4.0	Asbestos Cement	140.0	false	Open	0.00	0.00	385.89	385.89	0.00	0.00	J619	J620	Open
P626	67.00	1.5	Ductile Iron	120.0	false	Open	0.00	0.00	385.89	385.89	0.00	0.00	J620	PRV1	Open
P627	67.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.89	385.89	0.00	0.00	J620	PRV2	Open
P628	822.00	4.0	Asbestos Cement	140.0	false	Open	2.67	0.07	385.90	385.89	0.01	0.01	J618	J621	Open
P629	612.00	4.0	Asbestos Cement	140.0	false	Open	-0.81	0.02	385.89	385.89	0.00	0.00	J621	J619	Open
P630	489.00	10.0	Ductile Iron	120.0	false	Open	25.09	0.10	385.93	385.92	0.00	0.01	J603	J622	Open
P631	402.00	10.0	Ductile Iron	120.0	false	Open	28.18	0.12	385.92	385.92	0.00	0.01	J622	J623	Open
P632	690.00	10.0	Ductile Iron	120.0	false	Open	11.13	0.05	385.92	385.92	0.00	0.00	J623	J624	Open
P633	390.00	10.0	Ductile Iron	120.0	false	Open	3.62	0.01	385.92	385.92	0.00	0.00	J624	J625	Open
P634	315.00	10.0	Ductile Iron	120.0	false	Open	0.36	0.00	385.92	385.92	0.00	0.00	J625	J626	Open
P635	726.00	8.0	Ductile Iron	120.0	false	Open	10.87	0.07	385.93	385.92	0.00	0.00	J602	J627	Open
P636	1,030.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.92	385.92	0.00	0.00	J627	PRV4	Open
P637	411.00	8.0	Ductile Iron	120.0	false	Open	5.21	0.03	385.92	385.92	0.00	0.00	J627	J628	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P638	393.00	8.0	Ductile Iron	120.0	false	Open	8.25	0.05	385.92	385.92	0.00	0.00	J623	J629	Open
P639	696.00	8.0	Ductile Iron	120.0	false	Open	3.68	0.02	385.92	385.92	0.00	0.00	J629	J630	Open
P640	523.00	8.0	Ductile Iron	120.0	false	Open	3.05	0.02	385.92	385.92	0.00	0.00	J630	J631	Open
P641	945.00	8.0	Ductile Iron	120.0	false	Open	-1.07	0.01	385.92	385.92	0.00	0.00	J631	J632	Open
P642	407.00	8.0	Ductile Iron	120.0	false	Open	-4.77	0.03	385.92	385.92	0.00	0.00	J632	J633	Open
P643	840.00	8.0	Ductile Iron	120.0	false	Open	-5.98	0.04	385.92	385.92	0.00	0.00	J633	J623	Open
P644	215.00	8.0	Ductile Iron	120.0	false	Open	4.04	0.03	385.92	385.92	0.00	0.00	J624	J633	Open
P645	375.00	8.0	Ductile Iron	120.0	false	Open	3.73	0.02	385.92	385.92	0.00	0.00	J633	J630	Open
P646	489.00	6.0	Ductile Iron	120.0	false	Open	-4.82	0.05	385.92	385.93	0.00	0.00	J622	J634	Open
P647	669.00	6.0	Ductile Iron	120.0	false	Open	3.53	0.04	385.93	385.93	0.00	0.00	J634	J635	Open
P648	592.00	6.0	Ductile Iron	120.0	false	Open	3.77	0.04	385.93	385.93	0.00	0.00	J634	J636	Open
P649	348.00	6.0	Ductile Iron	120.0	false	Open	-0.14	0.00	385.93	385.93	0.00	0.00	J636	J635	Open
P650	464.00	6.0	Ductile Iron	120.0	false	Open	0.13	0.00	385.93	385.93	0.00	0.00	J635	J637	Open
P651	735.00	6.0	Ductile Iron	120.0	false	Open	-9.59	0.11	385.93	385.94	0.01	0.02	J637	J638	Open
P652	205.00	6.0	Ductile Iron	120.0	false	Open	-23.00	0.26	385.94	385.95	0.02	0.08	J638	J611	Open
P653	316.00	6.0	Ductile Iron	120.0	false	Open	1.53	0.02	385.92	385.92	0.00	0.00	J625	J639	Open
P654	650.00	6.0	Ductile Iron	120.0	false	Open	-1.29	0.01	385.92	385.92	0.00	0.00	J639	J624	Open
P655	342.00	6.0	Ductile Iron	120.0	false	Open	-0.95	0.01	385.92	385.92	0.00	0.00	J626	J640	Open
P656	371.00	6.0	Ductile Iron	120.0	false	Open	-2.68	0.03	385.92	385.92	0.00	0.00	J640	J641	Open
P657	447.00	6.0	Ductile Iron	120.0	false	Open	-5.95	0.07	385.92	385.92	0.00	0.01	J641	J642	Open
P658	279.00	6.0	Ductile Iron	120.0	false	Open	-6.46	0.07	385.92	385.93	0.00	0.01	J642	J637	Open
P659	601.00	6.0	Ductile Iron	120.0	false	Open	9.06	0.10	385.94	385.93	0.01	0.01	J638	J643	Open
P660	575.00	6.0	Ductile Iron	120.0	false	Open	5.79	0.07	385.93	385.92	0.00	0.01	J643	J644	Open
P661	357.00	6.0	Ductile Iron	120.0	false	Open	4.70	0.05	385.92	385.92	0.00	0.00	J644	J645	Open
P662	333.00	6.0	Ductile Iron	120.0	false	Open	1.22	0.01	385.92	385.92	0.00	0.00	J645	J642	Open
P663	610.00	14.0	Ductile Iron	120.0	false	Open	-87.25	0.18	385.93	385.94	0.01	0.02	J603	J646	Open
P664	729.00	14.0	Ductile Iron	120.0	false	Open	-104.17	0.22	385.94	385.95	0.02	0.02	J646	J611	Open
P665	312.00	6.0	Ductile Iron	120.0	false	Open	14.74	0.17	385.94	385.93	0.01	0.03	J646	J634	Open
P666	714.00	14.0	Ductile Iron	120.0	false	Open	-98.81	0.21	385.95	385.97	0.01	0.02	J611	J647	Open
P667	364.00	14.0	Ductile Iron	120.0	false	Open	-90.10	0.19	385.97	385.97	0.01	0.02	J647	J648	Open
P668	563.00	14.0	Ductile Iron	120.0	false	Open	-66.26	0.14	385.97	385.98	0.01	0.01	J648	J649	Open
P669	578.00	14.0	Ductile Iron	120.0	false	Open	-93.62	0.20	385.98	385.99	0.01	0.02	J649	J650	Open
P670	1,243.00	14.0	Ductile Iron	120.0	false	Open	-106.66	0.22	385.99	386.01	0.03	0.02	J650	J651	Open
P671	106.00	14.0	Ductile Iron	120.0	false	Closed	0.00	0.00	386.01	492.49	0.00	0.00	J651	J802	Closed
P672	1,141.00	14.0	Ductile Iron	120.0	false	Open	-106.66	0.22	386.01	386.04	0.03	0.02	J651	T2	Open
P673	89.00	18.0	Ductile Iron	120.0	true	Open	372.79	0.47	386.04	386.03	0.01	0.07	T2	J653	Open
P674	927.00	6.0	Ductile Iron	120.0	false	Open	8.06	0.09	385.97	385.96	0.01	0.01	J647	J652	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P675	341.00	6.0	Ductile Iron	120.0	false	Open	-0.63	0.01	385.96	385.96	0.00	0.00	J652	J654	Open
P676	298.00	8.0	Ductile Iron	120.0	false	Open	-19.76	0.13	385.96	385.96	0.00	0.01	J654	J655	Open
P677	763.00	8.0	Ductile Iron	120.0	false	Open	24.75	0.16	385.98	385.96	0.02	0.02	J649	J655	Open
P678	293.00	6.0	Ductile Iron	120.0	false	Open	3.91	0.04	385.96	385.96	0.00	0.00	J652	J656	Open
P679	829.00	8.0	Ductile Iron	120.0	false	Open	15.43	0.10	385.96	385.95	0.01	0.01	J654	J657	Open
P680	106.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	385.95	385.95	0.00	0.00	J657	PRV1	Open
P681	400.00	8.0	Ductile Iron	120.0	false	Open	12.61	0.08	385.95	385.95	0.00	0.01	J657	J658	Open
P682	303.00	8.0	Ductile Iron	120.0	false	Open	11.09	0.07	385.95	385.94	0.00	0.01	J658	J659	Open
P683	638.00	8.0	Ductile Iron	120.0	false	Open	3.26	0.02	385.94	385.94	0.00	0.00	J659	J660	Open
P684	537.00	12.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.94	385.94	0.00	0.00	J660	J661	Open
P685	411.00	8.0	Ductile Iron	120.0	false	Open	2.82	0.02	385.94	385.94	0.00	0.00	J659	J662	Open
P686	524.00	6.0	Ductile Iron	120.0	false	Open	-24.39	0.28	385.97	386.01	0.05	0.09	J647	J663	Open
P687	639.00	6.0	Ductile Iron	120.0	false	Open	-77.28	0.88	386.01	386.49	0.48	0.75	J663	J664	Open
P688	519.00	6.0	Ductile Iron	120.0	false	Open	-80.76	0.92	386.49	386.92	0.42	0.81	J664	J665	Open
P689	599.00	6.0	Ductile Iron	120.0	false	Open	20.14	0.23	386.01	385.98	0.04	0.06	J663	J666	Open
P690	344.00	8.0	Ductile Iron	120.0	false	Open	17.09	0.11	385.98	385.97	0.00	0.01	J666	J667	Open
P691	249.00	6.0	Ductile Iron	120.0	false	Open	3.48	0.04	385.97	385.97	0.00	0.00	J667	J668	Open
P692	298.00	8.0	Ductile Iron	120.0	false	Open	11.87	0.08	385.97	385.97	0.00	0.01	J667	J610	Open
P693	332.00	6.0	Ductile Iron	120.0	false	Open	113.00	1.28	386.92	386.41	0.50	1.52	J665	J669	Open
P694	320.00	6.0	Ductile Iron	120.0	false	Open	105.17	1.19	386.41	385.99	0.42	1.33	J669	J609	Open
P695	271.00	8.0	Ductile Iron	120.0	false	Open	3.48	0.02	386.41	386.41	0.00	0.00	J669	J670	Open
P696	231.00	8.0	Ductile Iron	120.0	false	Open	3.26	0.02	386.41	386.41	0.00	0.00	J669	J671	Open
P697	604.00	6.0	Ductile Iron	120.0	false	Open	-197.24	2.24	386.92	389.49	2.57	4.26	J665	PRV1	Open
P698	237.00	6.0	Ductile Iron	120.0	false	Open	29.28	0.33	386.01	385.98	0.03	0.12	J663	J672	Open
P699	555.00	6.0	Ductile Iron	120.0	false	Open	-0.00	0.00	385.98	385.98	0.00	0.00	J672	PRV1	Open
P700	484.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	385.98	385.98	0.00	0.00	J672	PRV1	Open
P701	452.00	8.0	Ductile Iron	120.0	false	Open	26.01	0.17	385.98	385.97	0.01	0.02	J672	J648	Open
P702	1,575.00	12.0	Ductile Iron	120.0	false	Open	-11.52	0.03	385.99	385.99	0.00	0.00	J673	J650	Open
P703	1,701.00	12.0	Ductile Iron	120.0	false	Open	-11.30	0.03	385.99	385.99	0.00	0.00	J674	J673	Open
P704	608.00	12.0	Ductile Iron	120.0	false	Open	-8.79	0.02	385.98	385.99	0.00	0.00	J675	J674	Open
P705	393.00	12.0	Ductile Iron	120.0	false	Open	-5.94	0.02	385.98	385.98	0.00	0.00	J676	J675	Open
P706	520.00	12.0	Ductile Iron	120.0	false	Open	-0.00	0.00	385.98	385.98	0.00	0.00	J677	J676	Open
P707	400.00	8.0	Ductile Iron	120.0	false	Open	0.66	0.00	385.98	385.98	0.00	0.00	J676	J678	Open
P708	344.00	8.0	Ductile Iron	120.0	false	Open	0.43	0.00	385.98	385.98	0.00	0.00	J676	J684	Open
P709	520.00	8.0	Ductile Iron	130.0	false	Open	2.86	0.02	385.98	385.98	0.00	0.00	J675	J679	Open
P710	281.00	8.0	Ductile Iron	130.0	false	Open	2.86	0.02	385.98	385.98	0.00	0.00	J679	J680	Open
P711	740.00	8.0	Ductile Iron	130.0	false	Open	-2.51	0.02	385.98	385.98	0.00	0.00	J680	J681	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P712	488.00	8.0	Ductile Iron	130.0	false	Open	-2.51	0.02	385.98	385.98	0.00	0.00	J681	J682	Open
P713	795.00	8.0	Ductile Iron	130.0	false	Open	-2.51	0.02	385.98	385.99	0.00	0.00	J682	J674	Open
P714	692.00	8.0	Ductile Iron	130.0	false	Open	5.36	0.03	385.98	385.98	0.00	0.00	J680	J683	Open
P715	615.00	8.0	Ductile Iron	130.0	false	Open	5.36	0.03	385.98	385.98	0.00	0.00	J683	J615	Open
P801	642.00	16.0	Ductile Iron	120.0	false	Open	372.79	0.59	492.57	492.49	0.07	0.12	J801	J802	Open
P802	1,305.00	14.0	Ductile Iron	120.0	false	Open	2.89	0.01	492.49	492.49	0.00	0.00	J802	J803	Open
P803	685.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J803	J804	Open
P804	833.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J804	J805	Open
P805	458.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J805	J806	Open
P806	864.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J806	J807	Open
P807	849.00	12.0	Ductile Iron	130.0	false	Open	-0.00	0.00	492.49	492.49	0.00	0.00	J807	J808	Open
P808	476.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J808	J809	Open
P809	271.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J805	J873	Open
P810	179.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J806	J874	Open
P811	506.00	12.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J807	J810	Open
P812	984.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J810	J808	Open
P813	337.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J809	J811	Open
P814	224.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.49	492.49	0.00	0.00	J809	J812	Open
P815	356.00	10.0	Ductile Iron	120.0	false	Open	3.26	0.01	492.49	492.49	0.00	0.00	J802	J813	Open
P816	677.00	10.0	Ductile Iron	120.0	false	Open	118.93	0.49	492.49	492.40	0.09	0.14	J802	J814	Open
P817	287.00	10.0	Ductile Iron	120.0	false	Open	73.65	0.30	492.40	492.38	0.02	0.06	J814	J815	Open
P818	394.00	10.0	Ductile Iron	120.0	false	Open	81.33	0.33	492.38	492.36	0.03	0.07	J815	J816	Open
P819	337.00	12.0	Ductile Iron	120.0	false	Open	-26.24	0.07	492.36	492.36	0.00	0.00	J816	J817	Open
P820	263.00	12.0	Ductile Iron	120.0	false	Open	-32.76	0.09	492.36	492.36	0.00	0.01	J817	J818	Open
P821	243.00	12.0	Ductile Iron	120.0	false	Open	-32.86	0.09	492.36	492.36	0.00	0.01	J818	J819	Open
P822	343.00	12.0	Ductile Iron	120.0	false	Open	-17.93	0.05	492.36	492.36	0.00	0.00	J819	J820	Open
P823	335.00	12.0	Ductile Iron	120.0	false	Open	5.44	0.02	492.36	492.36	0.00	0.00	J820	J821	Open
P824	374.00	12.0	Ductile Iron	120.0	false	Open	2.18	0.01	492.36	492.36	0.00	0.00	J821	J822	Open
P825	650.00	8.0	Ductile Iron	120.0	false	Open	66.95	0.43	492.49	492.40	0.09	0.14	J802	J823	Open
P826	836.00	10.0	Ductile Iron	120.0	false	Open	63.91	0.26	492.40	492.36	0.04	0.04	J823	J824	Open
P827	1,031.00	12.0	Ductile Iron	120.0	false	Open	37.70	0.11	492.36	492.36	0.01	0.01	J824	J825	Open
P828	544.00	12.0	Ductile Iron	120.0	false	Open	21.90	0.06	492.36	492.36	0.00	0.00	J825	J826	Open
P829	558.00	12.0	Ductile Iron	120.0	false	Open	14.06	0.04	492.36	492.35	0.00	0.00	J826	J827	Open
P830	524.00	12.0	Ductile Iron	120.0	false	Open	9.28	0.03	492.35	492.35	0.00	0.00	J827	J828	Open
P831	530.00	12.0	Ductile Iron	120.0	false	Open	6.23	0.02	492.35	492.35	0.00	0.00	J828	J829	Open
P832	877.00	8.0	Ductile Iron	120.0	false	Open	0.36	0.00	492.35	492.35	0.00	0.00	J829	J830	Open
P833	967.00	8.0	Ductile Iron	120.0	false	Open	-7.47	0.05	492.35	492.36	0.00	0.00	J830	J825	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P834	470.00	8.0	Ductile Iron	120.0	false	Open	3.48	0.02	492.36	492.36	0.00	0.00	J825	J831	Open
P835	258.00	8.0	Ductile Iron	120.0	false	Open	39.96	0.26	492.40	492.38	0.01	0.05	J814	J832	Open
P836	311.00	8.0	Ductile Iron	120.0	false	Open	28.80	0.18	492.38	492.38	0.01	0.03	J832	J833	Open
P837	406.00	8.0	Ductile Iron	120.0	false	Open	27.28	0.17	492.38	492.36	0.01	0.03	J833	J834	Open
P838	545.00	8.0	Ductile Iron	120.0	false	Open	15.80	0.10	492.36	492.36	0.01	0.01	J834	J819	Open
P839	431.00	8.0	Ductile Iron	120.0	false	Open	11.05	0.07	492.36	492.36	0.00	0.01	J834	J835	Open
P840	664.00	12.0	Ductile Iron	120.0	false	Open	19.91	0.06	492.36	492.36	0.00	0.00	J824	J835	Open
P841	545.00	12.0	Ductile Iron	120.0	false	Open	30.95	0.09	492.36	492.36	0.00	0.00	J835	J820	Open
P842	288.00	8.0	Ductile Iron	120.0	false	Open	8.77	0.06	492.38	492.38	0.00	0.00	J832	J836	Open
P843	413.00	8.0	Ductile Iron	120.0	false	Open	8.77	0.06	492.38	492.38	0.00	0.00	J836	J815	Open
P844	220.00	8.0	Ductile Iron	120.0	false	Open	1.73	0.01	492.36	492.36	0.00	0.00	J817	J837	Open
P845	521.00	6.0	Ductile Iron	120.0	false	Open	-2.30	0.03	492.36	492.36	0.00	0.00	J818	J838	Open
P846	502.00	6.0	Ductile Iron	120.0	false	Open	-3.60	0.04	492.36	492.36	0.00	0.00	J838	J820	Open
P847	395.00	8.0	Ductile Iron	120.0	false	Open	1.96	0.01	492.36	492.36	0.00	0.00	J821	J839	Open
P848	375.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	492.36	492.36	0.00	0.00	J839	PRV1	Open
P849	416.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	492.36	492.36	0.00	0.00	J822	J840	Open
P850	763.00	12.0	Ductile Iron	120.0	false	Open	180.09	0.51	492.49	492.40	0.09	0.12	J802	J841	Open
P851	705.00	12.0	Ductile Iron	120.0	false	Open	-171.86	0.49	492.32	492.40	0.08	0.11	J850	J841	Open
P852	1,004.00	8.0	Ductile Iron	120.0	false	Open	0.39	0.00	492.40	492.40	0.00	0.00	J841	J814	Open
P853	236.00	10.0	Ductile Iron	120.0	false	Open	104.97	0.43	492.36	492.33	0.03	0.11	J816	J842	Open
P854	528.00	10.0	Ductile Iron	120.0	false	Open	99.52	0.41	492.33	492.28	0.05	0.10	J842	J843	Open
P855	406.00	10.0	Ductile Iron	120.0	false	Open	22.79	0.09	492.28	492.27	0.00	0.01	J843	J844	Open
P856	671.00	10.0	Ductile Iron	120.0	false	Open	111.54	0.46	492.27	492.19	0.08	0.12	J844	J845	Open
P857	657.00	10.0	Ductile Iron	120.0	false	Open	-7.71	0.03	492.19	492.19	0.00	0.00	J845	J846	Open
P858	427.00	10.0	Ductile Iron	120.0	false	Open	10.43	0.04	492.19	492.19	0.00	0.00	J846	J847	Open
P859	374.00	12.0	Ductile Iron	120.0	false	Open	-91.14	0.26	492.27	492.29	0.01	0.03	J844	J848	Open
P860	310.00	12.0	Ductile Iron	120.0	false	Open	-97.01	0.28	492.29	492.30	0.01	0.04	J848	J849	Open
P861	482.00	12.0	Ductile Iron	120.0	false	Open	-100.06	0.28	492.30	492.32	0.02	0.04	J849	J850	Open
P862	190.00	8.0	Ductile Iron	120.0	false	Open	1.52	0.01	492.29	492.29	0.00	0.00	J848	J851	Open
P863	385.00	8.0	Ductile Iron	120.0	false	Open	1.52	0.01	492.29	492.29	0.00	0.00	J848	J852	Open
P864	862.00	8.0	Ductile Iron	120.0	false	Open	-28.23	0.18	492.19	492.22	0.02	0.03	J845	J853	Open
P865	333.00	8.0	Ductile Iron	120.0	false	Open	-65.06	0.42	492.22	492.26	0.04	0.13	J853	J854	Open
P866	405.00	8.0	Ductile Iron	120.0	false	Open	-67.45	0.43	492.26	492.32	0.06	0.14	J854	J850	Open
P867	229.00	8.0	Ductile Iron	120.0	false	Open	32.71	0.21	492.22	492.21	0.01	0.04	J853	J855	Open
P868	396.00	8.0	Ductile Iron	120.0	false	Open	5.66	0.04	492.21	492.21	0.00	0.00	J855	J856	Open
P869	351.00	8.0	Ductile Iron	120.0	false	Open	2.18	0.01	492.21	492.21	0.00	0.00	J856	J857	Open
P870	374.00	8.0	Ductile Iron	120.0	false	Open	24.23	0.15	492.21	492.20	0.01	0.02	J855	J858	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P871	417.00	8.0	Ductile Iron	120.0	false	Open	21.84	0.14	492.20	492.19	0.01	0.02	J858	J846	Open
P872	624.00	8.0	Ductile Iron	120.0	false	Open	6.30	0.04	492.19	492.19	0.00	0.00	J847	J859	Open
P873	459.00	8.0	Ductile Iron	120.0	false	Open	2.61	0.02	492.19	492.19	0.00	0.00	J859	J860	Open
P874	711.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.19	492.19	0.00	0.00	J847	J861	Open
P875	489.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.19	492.19	0.00	0.00	J861	J862	Open
P876	281.00	8.0	Ductile Iron	120.0	false	Open	4.14	0.03	492.33	492.33	0.00	0.00	J842	J863	Open
P877	377.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	492.33	492.33	0.00	0.00	J863	PRV1	Open
P878	140.00	8.0	Ductile Iron	120.0	false	Open	3.05	0.02	492.33	492.33	0.00	0.00	J863	J864	Open
P879	249.00	8.0	Ductile Iron	120.0	false	Open	74.77	0.48	492.28	492.23	0.04	0.17	J843	J865	Open
P880	248.00	8.0	Ductile Iron	120.0	false	Open	73.68	0.47	492.23	492.19	0.04	0.17	J865	J866	Open
P881	576.00	8.0	Ductile Iron	120.0	false	Open	70.42	0.45	492.19	492.10	0.09	0.16	J866	J867	Open
P882	95.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	492.10	492.10	0.00	0.00	J867	PRV1	Open
P883	498.00	8.0	Ductile Iron	120.0	false	Open	66.72	0.43	492.10	492.03	0.07	0.14	J867	J868	Open
P884	111.00	6.0	Ductile Iron	120.0	false	Open	197.24	2.24	492.03	491.56	0.47	4.26	J868	PRV1	Open
P885	518.00	8.0	Ductile Iron	120.0	false	Open	-63.54	0.41	492.03	492.10	0.07	0.13	J868	J869	Open
P886	641.00	8.0	Ductile Iron	120.0	false	Open	-67.89	0.43	492.10	492.19	0.09	0.15	J869	J845	Open
P887	754.00	8.0	Ductile Iron	120.0	false	Open	3.91	0.02	492.03	492.03	0.00	0.00	J868	J872	Open
P888	682.00	8.0	Ductile Iron	130.0	false	Open	74.59	0.48	492.13	492.03	0.10	0.15	J870	J868	Open
P889	389.00	8.0	Ductile Iron	130.0	false	Open	74.59	0.48	492.19	492.13	0.06	0.15	J845	J870	Open
P890	332.00	8.0	Ductile Iron	130.0	false	Open	0.00	0.00	492.13	492.13	0.00	0.00	J870	J871	Open
P901	67.00	2.0	Ductile Iron	120.0	false	Open	80.43	8.21	180.96	169.54	11.42	170.42	PRV5	J901	Open
P902	66.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	169.54	169.54	0.00	0.00	PRV6	J901	Open
P903	1,421.00	8.0	Asbestos Cement	140.0	false	Open	48.64	0.31	169.54	169.46	0.08	0.06	J901	J902	Open
P904	842.00	8.0	Asbestos Cement	140.0	false	Open	45.82	0.29	169.46	169.41	0.04	0.05	J902	J903	Open
P905	795.00	10.0	Asbestos Cement	140.0	false	Open	27.66	0.11	169.41	169.41	0.01	0.01	J903	J904	Open
P906	522.00	10.0	Asbestos Cement	140.0	false	Open	1.09	0.00	169.41	169.41	0.00	0.00	J904	J905	Open
P907	1,086.00	6.0	Asbestos Cement	140.0	false	Open	28.31	0.32	169.54	169.45	0.10	0.09	J901	J906	Open
P908	305.00	6.0	Asbestos Cement	140.0	false	Open	21.57	0.24	169.45	169.43	0.02	0.05	J906	J907	Open
P909	624.00	6.0	Asbestos Cement	140.0	false	Open	9.10	0.10	169.43	169.42	0.01	0.01	J907	J908	Open
P910	312.00	6.0	Asbestos Cement	140.0	false	Open	10.70	0.12	169.42	169.42	0.00	0.01	J908	J909	Open
P911	1,276.00	6.0	Asbestos Cement	140.0	false	Open	5.48	0.06	169.42	169.41	0.01	0.00	J909	J903	Open
P912	1,372.00	6.0	Asbestos Cement	140.0	false	Open	5.95	0.07	169.43	169.42	0.01	0.00	J907	J908	Open
P913	277.00	8.0	Ductile Iron	120.0	false	Open	1.73	0.01	169.41	169.41	0.00	0.00	J904	J910	Open
P914	682.00	8.0	Ductile Iron	120.0	false	Open	21.03	0.13	169.41	169.40	0.01	0.02	J903	J911	Open
P915	1,313.00	8.0	Ductile Iron	120.0	false	Open	19.30	0.12	169.40	169.38	0.02	0.01	J911	J912	Open
P916	808.00	8.0	Ductile Iron	120.0	false	Open	-19.62	0.13	169.38	169.40	0.01	0.01	J912	J913	Open
P917	696.00	8.0	Ductile Iron	120.0	false	Open	-22.01	0.14	169.40	169.41	0.01	0.02	J913	J904	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P918	516.00	8.0	Ductile Iron	120.0	false	Open	35.87	0.23	169.38	169.36	0.02	0.04	J912	J914	Open
P919	1,145.00	8.0	Ductile Iron	120.0	false	Open	30.87	0.20	169.36	169.32	0.04	0.03	J914	J915	Open
P920	1,136.00	6.0	Ductile Iron	120.0	false	Open	18.27	0.21	169.32	169.26	0.06	0.05	J915	J916	Open
P921	805.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	169.26	169.26	0.00	0.00	J916	J917	Open
P922	610.00	6.0	Ductile Iron	120.0	false	Open	14.36	0.16	169.26	169.24	0.02	0.03	J916	J918	Open
P923	340.00	6.0	Ductile Iron	120.0	false	Open	10.88	0.12	169.24	169.24	0.01	0.02	J918	J919	Open
P924	878.00	6.0	Ductile Iron	120.0	false	Open	3.26	0.04	169.24	169.23	0.00	0.00	J919	J920	Open
P925	450.00	6.0	Ductile Iron	120.0	false	Open	4.35	0.05	169.24	169.23	0.00	0.00	J919	J921	Open
P926	1,336.00	8.0	Ductile Iron	120.0	false	Open	8.90	0.06	169.32	169.32	0.00	0.00	J915	J922	Open
P927	940.00	8.0	Ductile Iron	120.0	false	Open	4.77	0.03	169.32	169.32	0.00	0.00	J922	J923	Open
P928	498.00	8.0	Ductile Iron	120.0	false	Open	1.73	0.01	169.32	169.32	0.00	0.00	J923	J924	Open
P929	183.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	169.32	169.32	0.00	0.00	J923	J925	Open
P930	592.00	8.0	Ductile Iron	120.0	false	Open	2.61	0.02	169.32	169.32	0.00	0.00	J922	J926	Open
P931	445.00	8.0	Ductile Iron	120.0	false	Open	1.30	0.01	169.32	169.32	0.00	0.00	J926	J927	Open
P1001	10.00	12.0	Ductile Iron	120.0	false	Open	810.85	2.30	24.77	24.75	0.02	1.99	CLEA	PMP1	Open
P1002	10.00	12.0	Ductile Iron	120.0	true	Open	810.85	2.30	348.80	348.78	0.02	1.99	PMP1	J1	Open
P1003	10.00	12.0	Ductile Iron	120.0	false	Open	810.85	2.30	24.77	24.75	0.02	1.99	CLEA	PMP2	Open
P1004	10.00	12.0	Ductile Iron	120.0	true	Open	810.85	2.30	348.80	348.78	0.02	1.99	PMP2	J1	Open
P1005	10.00	12.0	Ductile Iron	120.0	false	Open	3,154.59	8.95	24.77	24.52	0.25	24.68	CLEA	PMP3	Open
P1006	10.00	12.0	Ductile Iron	130.0	true	Open	3,154.59	8.95	348.99	348.78	0.21	21.28	PMP3	J1	Open
P1007	24.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	226.64	226.64	0.00	0.00	J95	PMP4	Open
P1008	11.00	8.0	Ductile Iron	120.0	true	Open	-0.00	0.00	385.93	385.93	0.00	0.00	PMP4	J601	Open
P1009	20.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	226.64	226.64	0.00	0.00	J95	PMP5	Open
P1010	11.00	8.0	Ductile Iron	120.0	true	Open	-0.00	0.00	385.93	385.93	0.00	0.00	PMP5	J601	Open
P1011	1.00	12.0	Ductile Iron	120.0	false	Open	0.00	0.00	306.63	306.63	0.00	0.00	J20	PMP6	Open
P1012	1.00	8.0	Ductile Iron	120.0	true	Open	-0.00	0.00	385.98	385.98	0.00	0.00	PMP6	J677	Open
P1013	1.00	12.0	Ductile Iron	120.0	false	Open	0.00	0.00	306.63	306.63	0.00	0.00	J20	PMP7	Open
P1014	1.00	8.0	Ductile Iron	120.0	true	Open	-0.00	0.00	385.98	385.98	0.00	0.00	PMP7	J677	Open
P1015	1.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.98	385.98	0.00	0.00	PRV1	J677	Open
P1016	1.00	4.0	Ductile Iron	120.0	false	Open	0.00	0.00	306.63	306.63	0.00	0.00	PRV1	J20	Open
P1017	186.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	385.98	385.98	0.00	0.00	J677	PRV1	Open
P1018	1.00	8.0	Ductile Iron	120.0	false	Open	0.00	0.00	306.63	306.63	0.00	0.00	PRV1	J20	Open
P1019	1.00	8.0	Ductile Iron	120.0	false	Open	93.20	0.59	386.03	386.03	0.00	0.27	J653	PMP8	Open
P1020	1.00	6.0	Ductile Iron	120.0	true	Open	93.20	1.06	492.57	492.57	0.00	1.07	PMP8	J801	Open
P1021	1.00	8.0	Ductile Iron	120.0	false	Open	93.20	0.59	386.03	386.03	0.00	0.27	J653	PMP9	Open
P1022	1.00	6.0	Ductile Iron	120.0	true	Open	93.20	1.06	492.57	492.57	0.00	1.07	PMP9	J801	Open
P1023	1.00	8.0	Ductile Iron	120.0	false	Open	93.20	0.59	386.03	386.03	0.00	0.27	J653	PMP1	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pipe Report

Label	Length (ft)	Diameter (in)	Material	Hazen-Williams C	Check Valve?	Control Status	Discharge (gpm)	Velocity (ft/s)	Upstream Structure Hydraulic Grade (ft)	Downstream Structure Hydraulic Grade (ft)	Pressure Pipe Headloss (ft)	Headloss Gradient (ft/1000ft)	Start Node	Stop Node	Initial Status
P1024	1.00	6.0	Ductile Iron	120.0	true	Open	93.20	1.06	492.57	492.57	0.00	1.07	PMP1	J801	Open
P1025	1.00	8.0	Ductile Iron	120.0	false	Open	93.20	0.59	386.03	386.03	0.00	0.27	J653	PMP1	Open
P1026	1.00	6.0	Ductile Iron	120.0	true	Open	93.20	1.06	492.57	492.57	0.00	1.07	PMP1	J801	Open
P1027	94.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	386.03	386.03	0.00	0.00	J653	PRV1	Open
P1028	334.00	8.0	Ductile Iron	120.0	false	Open	-0.00	0.00	492.57	492.57	0.00	0.00	PRV1	J801	Open
P1044	1.00	18.0	Ductile Iron	130.0	false	Open	870.00	1.10	300.00	300.00	0.00	0.27	R5	FCV2	Open
P1045	1.00	18.0	Ductile Iron	130.0	true	Open	870.00	1.10	24.77	24.77	0.00	0.27	FCV2	CLEA	Open

Scenario: 2015 MDD
Fire Flow Analysis
Pump Report

Label	Elevation (ft)	Control Status	Intake Pump Grade (ft)	Discharge Pump Grade (ft)	Discharge (gpm)	Pump Head (ft)	Calculated Water Power (Hp)	Notes
PMP1	32.27	On	24.75	348.80	810.85	324.05	66.34	WTP
PMP2	32.27	On	24.75	348.80	810.85	324.05	66.34	WTP
PMP3	28.77	On	24.52	348.99	3,154.59	324.47	258.42	WTP
PMP4	223.00	Off	226.64	385.93	0.00	0.00	0.00	Thornton Rd.
PMP5	223.00	Off	226.64	385.93	0.00	0.00	0.00	Thornton Rd.
PMP6	147.70	Off	306.63	385.98	0.00	0.00	0.00	Church Rd.
PMP7	147.70	Off	306.63	385.98	0.00	0.00	0.00	Church Rd.
PMP8	363.00	On	386.03	492.57	93.20	106.53	2.51	Bakerview
PMP9	363.00	On	386.03	492.57	93.20	106.53	2.51	Bakerview
PMP10	363.00	On	386.03	492.57	93.20	106.53	2.51	Bakerview
PMP11	363.00	On	386.03	492.57	93.20	106.53	2.51	Bakerview

Scenario: 2015 MDD
Fire Flow Analysis
Tank Report

Label	Zone	Base Elevation (ft)	Minimum Elevation (ft)	Maximum Elevation (ft)	Initial Level (ft)	Initial HGL (ft)	Inactive Volume (gal)	Tank Diameter (ft)	Inflow (gpm)	Current Status	Calculated Hydraulic Grade (ft)	Calculated Percent Full (%)
T1	Main	210.00	210.00	235.00	16.57	226.57	0.00	79.83	3,818.22	Filling	226.57	66.3
T2	Bakerview	363.00	363.00	405.00	23.04	386.04	0.00	85.00	-479.45	Draining	386.04	54.9
CLEAR WEL	Main	10.77	15.77	26.77	14.00	24.77	0.00	N/A	3,906.28	Draining	24.77	81.8

Scenario: 2015 MDD
Fire Flow Analysis
Valve Report

Label	Elevation (ft)	Diameter (in)	Initial HGL (ft)	Initial Pressure (psi)	Minor Loss Coefficient	Control Status	Discharge (gpm)	From HGL (ft)	To HGL (ft)	Headloss (ft)	From Pressure (psi)	To Pressure (psi)
FCV2	23.77	18.0			0.00	Throttling	870.00	300.00	24.77	275.23	119.51	0.43
PRV1	159.34	1.5	210.17	22.00	5.80	Closed	0.00	385.89	211.79	0.00	98.02	22.69
PRV2	159.34	4.0	198.62	17.00	5.80	Closed	0.00	385.89	211.79	0.00	98.02	22.69
PRV3	160.96	3.0	211.79	22.00	6.00	Throttling	9.24	385.84	211.81	174.03	97.29	22.00
PRV4	135.12	6.0	222.92	38.00	5.70	Closed	0.00	385.92	248.82	0.00	108.51	49.19
PRV5	42.28	2.0	180.91	60.00	5.60	Throttling	80.43	291.60	180.96	110.64	107.87	60.00
PRV6	40.79	8.0	167.87	55.00	6.10	Closed	0.00	303.01	169.54	0.00	113.45	55.70
PRV7	164.65	2.0	261.69	42.00	5.60	Throttling	37.37	383.11	261.73	121.38	94.52	42.00
PRV8	164.65	6.0	250.14	37.00	5.70	Closed	0.00	385.87	258.96	0.00	95.71	40.81
PRV9	159.60	8.0	258.95	43.00	6.10	Throttling	41.42	385.87	258.99	126.88	97.90	43.00
PRV10	155.86	3.0	227.49	31.00	6.00	Closed	0.00	385.93	242.23	0.00	99.54	37.37
PRV11	155.86	8.0	215.93	26.00	6.10	Closed	0.00	385.93	242.23	0.00	99.54	37.37
PRV12	244.37	6.0	383.00	60.00	5.70	Closed	0.00	492.36	385.95	0.00	107.29	61.25
PRV13	276.26	6.0	384.85	47.00	5.70	Closed	0.00	492.33	385.98	0.00	93.48	47.47
PRV14	268.72	8.0	384.24	50.00	6.10	Closed	0.00	492.10	385.98	0.00	96.65	50.73
PRV15	257.74	6.0	389.44	57.00	5.70	Throttling	197.24	491.56	389.49	102.07	101.16	57.00
PRV16	147.83	4.0	218.88	30.75	5.80	Closed	0.00	385.98	306.63	0.00	103.04	68.70
PRV17	147.70	8.0	240.12	40.00	6.10	Closed	0.00	385.98	306.63	0.00	103.09	68.76
PRV18	363.00	8.0	363.00	0.00	6.10	Closed	0.00	386.03	492.57	0.00	9.97	56.06

H. WATER QUALITY

Water Quality Monitoring Schedule

System: FERNDALE **PWS ID: 24850 M** **Region: NORTHWEST**
Contact: Michael C Olinger **Group: A - Comm** **County: WHATCOM**

NOTE: To receive credit for compliance samples, you must fill out laboratory and sample paperwork completely, send your samples to a laboratory accredited by Washington State to conduct the analyses, AND ensure the results are submitted to DOH Office of Drinking Water. There is often a lag time between when you collect your sample, when we credit your system with meeting the monitoring requirement, and when we generate the new monitoring requirement.

Coliform Monitoring Requirements

	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017
Coliform Monitoring Population	12921	12921	12921	12921	12921	12921	12921	12921	12921	12921	12921	12921
Number of Routine Samples Required	15	15	15	15	15	15	15	15	15	15	15	15

- Collect samples from representative points throughout the distribution system.
- Collect required repeat samples following an unsatisfactory sample. In addition, collect a sample from each operating groundwater source.
- For systems that chlorinate, record chlorine residual (measured when the coliform sample is collected) on the coliform lab slip.

Chemical Monitoring Requirements

Distribution Monitoring

Test Panel/Analyte	*# Samples Required*	*Compliance Period*	*Frequency*	*Last Sample Date*	*Next Sample Due*
Lead and Copper	30	Jan 2016 - Dec 2018	standard - 3 year	07/15/2015	Jul 2018
Asbestos	1	Jan 2011 - Dec 2019	standard - 9 year	03/24/2015	
Total Trihalomethane (THM)	2	Jan 2016 - Dec 2016	reduced - 1 year	02/23/2016	
Halo-Acetic Acids (HAA5)	2	Jan 2016 - Dec 2016	reduced - 1 year	02/23/2016	

Water Quality Monitoring Schedule

Notes on Distribution System Chemical Monitoring

For *Lead and Copper*:
- Collect samples from the COLD WATER side of a KITCHEN or BATHROOM faucet that is used daily.
- Before sampling, make sure the water has sat unused in the pipes for at least 6 hours, but no more than 12 hours (e.g. overnight).
- If you are sampling from a faucet that has hot water, make sure cold water is the last water to run through the faucet before it sits overnight.
- If your sampling frequency is annual or every 3 years, collect samples between June 1 and September 30.

For *Asbestos:* Collect the sample from one of your routine coliform sampling sites in an area of your distribution system that has asbestos concrete pipe.

For *Disinfection Byproducts (HAA5 and THM):* Collect the samples at the locations identified in your Disinfection Byproducts (DBP) monitoring plan.

Source Monitoring

- Collect 'source' chemical monitoring samples from a tap after all treatment (if any), but before entering the distribution system.
- Washington State grants monitoring waivers for various test panels /analytes. Please note that we may require some monitoring as a condition of some waivers. We have granted complete waivers for dioxin, endothal, glyphosate, diquat, and insecticides.

Source S07 *Shop & Douglas WF* *Well Field* *Use - Permanent* *Susceptility -*

Test Panel/Analyte	*# Samples Required*	*Compliance Period*	*Frequency*	*Last Sample Date*	*Next Sample Due*
Nitrate	1	Jan 2016 - Dec 2016	standard - 1 year		***Aug 2016***
Complete Inorganic (IOC)	1	Jan 2014 - Dec 2016	standard - 3 year		
Volatile Organics (VOC)	1	Jan 2014 - Dec 2016	standard - 3 year	07/12/2012	***Jul 2016***
Herbicides	1	Jan 2014 - Dec 2016	standard - 3 year	03/22/2007	***Jul 2016***
Pesticides	1	Jan 2014 - Dec 2016	standard - 3 year	03/22/2007	***Jul 2016***
Soil Fumigants	1	Jan 2014 - Dec 2016	standard - 3 year		***May 2016***
Soil Fumigants	1	Jan 2014 - Dec 2016	standard - 3 year		***Aug 2016***

Water Quality Monitoring Schedule

Other Information

Other Reporting Schedules	Due Date
Submit Consumer Confidence Report (CCR) to customers and ODW (Community systems only):	07/01/2016
Submit CCR certification form to ODW (Community systems only):	10/01/2016
Submit Water Use Efficiency report online to ODW (Community and other municipal water systems only):	07/01/2016
Send notices of lead and copper sample results to the customers sampled:	10 days after you receive the laboratory results
Submit Certification of customer notification of lead and copper results to ODW:	60 days after you notify customers

Special Notes

None

Northwest Regional Water Quality Monitoring Contacts

For questions regarding chemical monitoring:	Steve Hulsman: (253) 395-6777 or Steve.Hulsman@doh.wa.gov
For questions regarding DBPs:	Steve Hulsman: (253) 395-6777 or Steve.Hulsman@doh.wa.gov
For questions regarding coliform bacteria and microbial issues:	Carol Stuckey or Ingrid Salmon: (253) 395-6775: or carol.stuckey@doh.wa.gov or ingrid.salmon@doh.wa.gov

Additional Notes

The information on this monitoring schedule is valid as of the date in the upper left corner on the first page. However, the information may change with subsequent updates in our water quality monitoring database as we receive new data or revise monitoring schedules. There is often a lag time between when you collect your sample and when we credit your system with meeting the monitoring requirement.

We have not designed this monitoring schedule to display all compliance requirements. The purpose of this schedule is to assist water systems with planning for most water quality monitoring, and to allow systems to compare their records with DOH ODW records. Please be aware that this monitoring schedule does not include constituents that require a special monitoring frequency, such as monitoring affiliated with treatment.

Any inaccuracies on this schedule will not relieve the water system owner and operator of the requirement to comply with applicable regulations.

If you have any questions about your monitoring requirements, please contact the regional office staff listed above.

Burlington, WA	*Corporate Laboratory (a)*	1620 S Walnut St	Burlington, WA 98233	**800.755.9295** • 360.757.1400
Bellingham, WA	*Microbiology (b)*	805 Orchard Dr Ste 4	Bellingham, WA 98225	360.715.1212
Portland, OR	*Microbiology/Chemistry (c)*	9150 SW Pioneer Ct Ste W	Wilsonville, OR 97070	503.682.7802
Corvallis, OR	*Microbiology (d)*	540 SW Third Street	Corvallis, OR 97333	541.753.4946

FL NELAP E871040

INORGANIC COMPOUNDS (IOC) REPORT

Client Name: City of Ferndale
PO BOX 936
Ferndale, WA 98248

System Name: FERNDALE
System ID Number: 24850M
DOH Source Number: 96 - Blended Sample
Multiple Sources: 0206
Sample Type: A - After treatment
Sample Purpose: C - Compliance
Sample Location: 5846 Azalea
County: Whatcom

Reference Number: 15-05348
Project: 1st Qtr THM/HAAs

Sample Number:
Lab Number: 119-12248
Collect Date: 3/24/15 09:50
Date Received: 3/24/15
Report Date: 4/7/15
Sampled By: Jason Valley
Sampler Phone: 360-384-4607
Approved by: fm
Authorized by:

Patrick Miller, MS
QA Officer

DOH#	ANALYTES	**RESULTS**	UNITS	SRL	Trigger	MCL	Analyst	METHOD	Lab	Analyzed	COMMENT
0	*ASBESTOS	**ND**	MFL>10um	0.19			ty	100.2		03/31/15	Analyzed by EMSL

NOTES:

SRL (State Reporting Level): indicates the minimum reporting level required by the Washington Department of Health (DOH).
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; Federal Action Levels are 0.015 mg/L for Lead and 1.3 mg/L for Copper. Sodium has a recommended limit of 20 mg/L. A blank MCL value indicates a level is not currently established.
Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the Specified Reporting Limit (SRL).
An * in front of the parameter name indicates it is not NELAP accredited but it is accredited through WSDOH or USEPA Region 10.

These test results meet all the requirements of NELAC, unless otherwise stated in writing, and relate only to these samples.
If you have any questions concerning this report contact Patrick Miller, MS, QA Officer, at the toll-free phone number above.

FORM: IOC_ST

Burlington, WA	*Corporate Laboratory (a)*	1620 S Walnut St	Burlington, WA 98233	**800.755.9295** • 360.757.1400
Bellingham, WA	*Microbiology (b)*	805 Orchard Dr Ste 4	Bellingham, WA 98225	360.715.1212
Portland, OR	*Microbiology/Chemistry (c)*	9150 SW Pioneer Ct Ste W	Wilsonville, OR 97070	503.682.7802
Corvallis, OR	*Microbiology (d)*	540 SW Third Street	Corvallis, OR 97333	541.753.4946

FL NELAP E871040

INORGANIC COMPOUNDS (IOC) REPORT

Client Name: City of Ferndale
PO BOX 936
Ferndale, WA 98248

System Name: FERNDALE
System ID Number: 24850
DOH Source Number: 96 - Blended Sample
Multiple Sources: 0206
Sample Type: A - After treatment
Sample Purpose: C - Compliance
Sample Location: 5405 Ferndale Rd.
County: Whatcom

Reference Number: 15-02205
Project: IOC 2015

Sample Number: 5405 Ferndale Rd., WTP
Lab Number: 046-05161
Collect Date: 2/4/15 12:30
Date Received: 2/4/15
Report Date: 2/18/15
Sampled By: Jason Valley
Sampler Phone: 360-384-4607
Approved by: bj,mvp,sps
Authorized by:

Patrick Miller, MS
QA Officer

DOH#	ANALYTES	RESULTS	UNITS	SRL	Trigger	MCL	Analyst	METHOD	Lab	Analyzed	COMMENT
	EPA Regulated										
4	ARSENIC	**0.002**	mg/L	0.001	0.010	0.010	mvp	200.8	a	02/16/15	
5	BARIUM	**0.039**	mg/L	0.001	2	2	mvp	200.8	a	02/16/15	
6	CADMIUM	**ND**	mg/L	0.001	0.005	0.005	mvp	200.8	a	02/16/15	
7	CHROMIUM	**ND**	mg/L	0.001	0.1	0.1	mvp	200.8	a	02/16/15	
11	MERCURY	**ND**	mg/L	0.0002	0.002	0.002	mmh	245.1	a	02/12/15	
12	SELENIUM	**ND**	mg/L	0.002	0.05	0.05	mvp	200.8	a	02/16/15	
110	BERYLLIUM	**ND**	mg/L	0.001	0.004	0.004	mvp	200.8	a	02/16/15	
112	ANTIMONY	**ND**	mg/L	0.001	0.006	0.006	mvp	200.8	a	02/16/15	
113	THALLIUM	**ND**	mg/L	0.001	0.002	0.002	mvp	200.8	a	02/16/15	
116	CYANIDE, AVAILABLE	**ND**	mg/L	0.010	0.2	0.2	sps	OIA-1677-DW	a	02/10/15	
19	FLUORIDE	**0.11**	mg/L	0.1	2	4	srf	300.0	a	02/05/15	
114	NITRITE-N	**ND**	mg/L	0.1	0.5	1	srf	300.0	a	02/05/15 01:21	
20	NITRATE-N	**ND**	mg/L	0.1	5	10	srf	300.0	a	02/05/15 01:21	
161	TOTAL NITRATE/NITRITE	**ND**	mg/L	0.1	5	10	srf	300.0	a	02/05/15 01:21	
	EPA Regulated (Secondary)										
8	IRON	**ND**	mg/L	0.100	0.3	0.3	bj	200.7	a	02/16/15	
10	MANGANESE	**ND**	mg/L	0.001	0.05	0.05	mvp	200.8	a	02/16/15	
13	SILVER	**ND**	mg/L	0.010	0.05	0.05	mvp	200.8	a	02/16/15	
21	CHLORIDE	**91**	mg/L	0.1	250	250	srf	300.0	a	02/05/15	
22	SULFATE	**12**	mg/L	0.2	250	250	srf	300.0	a	02/05/15	
24	ZINC	**ND**	mg/L	0.005	5	5	mvp	200.8	a	02/16/15	
14	SODIUM	**77.4**	mg/L	5.0			bj	200.7	a	02/16/15	
15	HARDNESS as Calcium Carbonate	**91.9**	mg/L	10			bj	200.7	a	02/16/15	
16	ELECTRICAL CONDUCTIVITY	**557**	uS/cm	10	700	700	srf	SM2510 B	a	02/05/15	
17	TURBIDITY	**0.31**	NTU	0.10	1.0	1.0	srf	180.1	a	02/05/15 12:46	
18	COLOR	**ND**	Color Units	5	15	15	srf	SM2120 B	a	02/05/15 12:58	pH:7
111	NICKEL	**ND**	mg/L	0.005	0.1	0.1	mvp	200.8	a	02/16/15	
	State Unregulated										
9	LEAD	**ND**	mg/L	0.001		0.015	mvp	200.8	a	02/16/15	
23	COPPER	**0.015**	mg/L	0.005		1.3	mvp	200.8	a	02/16/15	

NOTES:

SRL (State Reporting Level): indicates the minimum reporting level required by the Washington Department of Health (DOH).
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; Federal Action Levels are 0.015 mg/L for Lead and 1.3 mg/L for Copper. Sodium has a recommended limit of 20 mg/L. A blank MCL value indicates a level is not currently established.
Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the Specified Reporting Limit (SRL).
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If you have any questions concerning this report contact Patrick Miller, MS, QA Officer, at the toll-free phone number above.

FORM: IOC_ST

Disinfection Byproducts Results

Sample Date	Sample Location	THM Results ug/L	HAA5 Results ug/L
10/21/2014	1050 Shaw Road	39.5	4.9
1/13/2015	1050 Shaw Road	28.0	5.6
3/24/2015	1050 Shaw Road	31.1	5.7
3/24/2015	5831 Second St.	17.8	4.2
3/24/2015	5727 Church Rd.	22.2	4.9
3/24/2015	5640 Riverside	21.5	4.6
4/28/2015	1050 Shaw Road	33.1	5.6
4/28/2015	5831 Second St.	15.7	3.7
4/28/2015	5727 Church Rd.	17.3	3.8
4/28/2015	5640 Riverside	20.3	4.6
7/28/2015	1050 Shaw Road	44.8	7.9
7/28/2015	5831 Second St.	17.3	4.9
7/28/2015	5727 Church Rd.	21.6	3.9
7/28/2015	5640 Riverside	26.6	4.8
Running Annual Average:		**25.5**	**4.9**

Sample Date	Sample Location	TOC Results mg/L
10/7/2014	Raw WTP 5405	0.70
11/12/2014	Raw WTP 5405	0.65
12/2/2014	Raw WTP 5405	0.61
1/6/2015	Raw WTP 5405	0.63
2/3/2015	Raw WTP 5405	0.71
3/3/2015	Raw WTP 5405	0.72
4/14/2015	Raw WTP 5405	0.65
5/12/2015	Raw WTP 5405	0.65
6/2/2015	Raw WTP 5405	0.70
7/7/2015	Raw WTP 5405	0.65
	Raw WTP 5405	
	Raw WTP 5405	
Running Annual Average:		**0.67**

CITY OF FERNDALE PROVIDES Exceptional water for you!

A Word From Our Mayor

In Ferndale we're proud of the safe, clean water used by our community. Our water treatment staff works hard ensuring the drinking water supply meets or exceeds every state and federal standard. In late 2014 a water filtration system will reduce the water hardness. The system will bring the hardness level down to what was experienced when Nooksack River water was purchased. Thank you for your patience during this transition!

Gary S. Jensen,

Mayor, City of Ferndale

Where Does Our Water Come From?

The City of Ferndale's water source is a system of two ground water wells. The two wells tap into a thick layer of coarse sand and gravel within the source aquifer. The aquifer is recharged by precipitation that falls on the upland and the lowlands within several miles of the City's wells. The ground water is pumped to the City's Water Treatment Plant on Ferndale Road where it is pretreated with chlorine (a disinfectant to protect against microbial contaminants) and filtered using a gravity system to remove manganese.

The City has implemented a voluntary watering schedule affective June 1st through September 15th. Residents with odd numbered street addresses are asked to water only on Wednesdays, Fridays and Sundays. Residents with even numbered street addresses water only on Tuesdays, Thursdays and Saturdays. Mondays are non-watering days to allow the City's reservoirs to recharge after the weekend. For more information visit www.Cityofferndale.org or contact the City at 360-384-4302.

Watering Exemptions:

The Voluntary Watering Schedule does not apply to the following situations:

- Drip irrigation systems or handheld watering
- Watering of flower and vegetable gardens
- Watering of outdoor potted plants and hanging baskets
- Watering newly planted lawns

VOLUNTARY WATERING SCHEDULE: JUNE 1 – SEPTEMBER 15

Addresses ending in EVEN numbers

0 2 4 6 8

water: **Tuesdays, Thursdays and Saturdays**

Addresses ending in ODD numbers

1 3 5 7 9

water: **Wednesday, Friday and Sunday**

MONDAY is a non-watering day for ALL Ferndale water customers!

WHATCOM WATER ALLIANCE Partner

The City of Ferndale is a partner of the Whatcom Water Alliance, a regional water conservation group. The Alliance shares a passion in providing clean and safe water to protect your health, planet and quality of life.

WATER'S WORTH IT

We must all work together to keep our water clean and healthy. To do that, we each need to learn to value water. To learn more, visit www.watersworthit.org. WATER'S WORTH IT™ is a trademark of the Water Environment Federation.

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City of Ferndale
P.O. Box 936, Ferndale, WA 98248

Your Comments Are Welcomed!

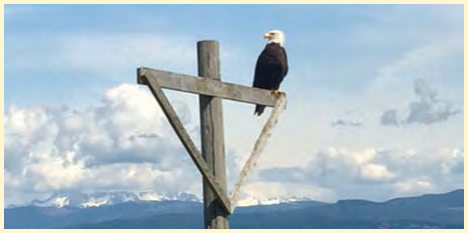
The Ferndale City Council meets the first and third Mondays of every month at the City Hall Annex Building located at 5694 2nd Avenue, Ferndale, starting at 6:00 p.m. Public comment is taken at the beginning of each meeting. For more information, please call City Hall at (360) 384-4302.

CITY OF FERNDALE

Water Quality

REPORT 2013





WHY PROVIDE A

Water Quality Report?

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

- Microbial contaminants, such as viruses and bacteria, which may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- Inorganic contaminants, such as salts and metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming.
- Pesticides and herbicides, which may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.
- Organic chemical contaminants, including synthetic and volatile organic chemicals, which are byproducts of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.
- Radioactive contaminants, which can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of certain contaminants in water provided by public water systems. Food and Drug Administration regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

WATER QUALITY RESULTS FOR 2013

PWS# 24850M

The City of Ferndale routinely monitors for substances in our drinking water according to Federal and State laws. We're proud that the drinking water we provide to our customers meets or exceeds all Federal and State requirements. These are the results of our monitoring for the period of January 1st to December 31st, 2013, except for copper and lead, which we monitor less than once per year, in accordance with our monitoring requirements.

Substance (units)	Level Detected	MCL	MCLG	Likely Source
REGULATED AT THE CONSUMER TAP				
Chlorine (residual) (ppm)*	Range detected: 0.6 - 1.5 ppm Average: 0.9 ppm	4.0 ppm (MRDLG)	4.0 ppm (MRDL)	Water additive used to control microbes.
Copper* (ppm)* (tested 2012)	90th Percentile Copper = .055 ppm Range Detected = 0-0.194 ppm Copper action level = 1.3 ppm	Action Level 1.3 ppm	1.3 ppm	Corrosion of household plumbing systems; erosion of natural deposits.
Lead* (tested 2012)	90th percentile Lead = .002 ppm Range Detected = 0-0.016ppm Lead action level = 0.015 ppm	Action Level 0.015 ppm	0	Corrosion of household plumbing systems; erosion of natural deposits.
Total Coliform	Not Detected (132 samples collected, 0 positive samples)	0	0	Naturally present in the environment.
Nitrate (ppm)*	Annual Sample: Not Detected	10 ppm	0	Runoff from fertilizer use; Leaking from septic tanks, sewage; Erosion of natural deposits
HaloaceticAcids (HAA) (ppb) *	HAA(5) Range Detected 7.6 - 13.5 ppb Average: 10.2 ppb	60 ppb	Not Applicable	By-product of drinking water disinfection.
Total Trihalomethanes (ppb)*	THM Range Detected: 66.2 - 72.1 ppb Average: 69.7 ppb	80 ppb	Not Applicable	By-product of drinking water disinfection.
RAW WATER (Before Treatment)				
Total Organic Carbon	Range Detected: 0.47 - 4.10 ppm Average: 1.35 ppm	Not Applicable	Not Applicable	Naturally present in the environment.

***Key to abbreviations used in chart: UNIT DESCRIPTIONS: ppm** (Parts per Million), **ppb** (Parts per Billion), **mg/L** (Milligrams per Liter)

MCLG Maximum Contaminant Level Goal: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

MCL Maximum Contaminant Level: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

MRDLG Maximum Residual Disinfectant Level Goal. The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

MRDL Maximum Residual Disinfectant Level. The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of mivcrobial contaminants (e.g. chlorine, chloramines, chlorine dioxide).

TT Treatment Technique: A required process intended to reduce the level of a contaminant in drinking water.

AL Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

NTU Turbidity: Turbidity is a measure of the water's cloudiness. It is monitored because it provides a good indicator of the filtration system's effectiveness. Turbidity is measured in NTU's nephelometric turbidity units.

ND Not detected

EPA Environmental Protection Agency

CDC Center for Disease Control & Prevention

City of Ferndale Water Treatment Plant, Phone (360) 384-4607, www.cityofferndale.org, Mike Olinger • Chief Treatment Plant Operator

MESSAGE FROM THE

Environmental Protection Agency (EPA)

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. We are responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your drinking water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

For more information on tap water quality, please visit www.drinktap.org



CITY OF FERNDALE PROVIDES Exceptional water for you!

A WORD FROM OUR MAYOR

The City finished its long journey toward finalizing its new well water supply system in 2014. The final phase of switching from Nooksack River water to our own groundwater source has been completed. A new Reverse Osmosis system was the final installation piece after we experienced unexpected hardness levels not found when we did the test pumping for this new system. We are pleased to say this new filtration system has reduced the hardness levels to near what we experienced when we purchased river water. It is a pleasure to have our citizens notice this difference and offer compliments on taste.

Gary S. Jensen,

Mayor, City of Ferndale

The City has implemented a voluntary watering schedule affective June 1st through September 15th. Residents with odd numbered street addresses are asked to water only on Wednesdays, Fridays and Sundays. Residents with even numbered street addresses water only on Tuesdays, Thursdays and Saturdays. Mondays are non-watering days to allow the City's reservoirs to recharge after the weekend. For more information visit www.Cityofferndale.org or contact the City at 360-384-4302.

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City of Ferndale
P.O. Box 936, Ferndale, WA 98248

Your Comments Are Welcomed!

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CITY OF FERNDALE

Water Quality

REPORT 2014



We are pleased to say this new Reverse Osmosis system has reduced the hardness levels. It has also drastically reduced our use of chlorine required to treat the water to ensure quality and safety.

CITY OF FERNDALE WASHINGTON

The City of Ferndale's water source is a system of two ground water wells. The two wells tap into a thick layer of coarse sand and gravel within the source aquifer. The aquifer is recharged by precipitation that falls on the upland and the lowlands within several miles of the City's wells. The ground water is treated at the City's Water Treatment Plant where it is softened and chlorinated (to protect against microbial contaminants).

WHY PROVIDE A

Water Quality Report?

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Substance (units)	Level Detected	MCL	MCLG	Likely Source
REGULATED AT THE CONSUMER TAP				
Chlorine (residual) (ppm)*	Range detected: 0.4 - 1.0 ppm Average: 0.7 ppm	4.0 ppm (MRDLG)	4.0 ppm (MRDL)	Water additive used to control microbes.
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Nitrate (ppm)*	Annual Sample: Not Detected	10 ppm	0	Runoff from fertilizer use; Leaking from septic tanks, sewage; Erosion of natural deposits
HaloaceticAcids (HAA) (ppb) *	HAA(5) Range Detected 4.9 - 12.1 ppb Average: 10.2 ppb	60 ppb	Not Applicable	By-product of drinking water disinfection.
Total Trihalomethanes (ppb)*	THM Range Detected: 39.5 - 77.0ppb Average: 63.2 ppb	80 ppb	Not Applicable	By-product of drinking water disinfection.
RAW WATER (Before Treatment)				
Total Organic Carbon	Range Detected: 0.50 - 1.52 Average: 0.71 ppm	Not Applicable	Not Applicable	Naturally present in the environment.

***Key to abbreviations used in chart: UNIT DESCRIPTIONS: ppm** (Parts per Million), **ppb** (Parts per Billion), **mg/L** (Milligrams per Liter)

MCLG Maximum Contaminant Level Goal: The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety.

MCL Maximum Contaminant Level: The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

MRDLG Maximum Residual Disinfectant Level Goal. The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

MRDL Maximum Residual Disinfectant Level. The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of mivcrobial contaminants (e.g. chlorine, chloramines, chlorine dioxide).

TT Treatment Technique: A required process intended to reduce the level of a contaminant in drinking water.

AL Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow.

NTU Turbidity: Turbidity is a measure of the water's cloudiness. It is monitored because it provides a good indicator of the filtration system's effectiveness. Turbidity is measured in NTU's nephelometric turbidity units.

ND Not detected

EPA Environmental Protection Agency

CDC Center for Disease Control & Prevention

City of Ferndale Water Treatment Plant, Phone (360) 384-4607, www.cityofferndale.org, Mike Olinger • Chief Treatment Plant Operator

MESSAGE FROM THE

Environmental Protection Agency (EPA)

Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the EPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. EPA/CDC guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. We are responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your drinking water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.



For more information on tap water quality, please visit www.drinktap.org

CITY OF FERNDALE
PUBLIC WORKS DEPARTMENT

COLIFORM MONITORING PLAN

September 10, 2015

Mike Olinger
Chief Operator
City of Ferndale
P.O. Box 936
2095 Main Street
Ferndale, WA 98248
(360) 384-4607

CITY OF FERNDALE
COLIFORM MONITORING PLAN

A. SYSTEM INFORMATION

Ferndale
System ID # 24850
Whatcom County

SOURCES

1. DOH Source No. 02
   a. Source Name – Shop Well
   b. Source Type - Well
   c. Source Use – Permanent
2. DOH Source No. 06
   a. Source Name – Douglas Well
   b. Source Type - Well
   c. Source Use – Permanent

STORAGE

1. Reservoir No. 1 – 1 MG concrete tank
2. Reservoir No. 2 – 1.7 MG steel tank

TREATMENT

The City of Ferndale obtains water from its two wells. The well water is pumped to the water treatment plant for treatment. Water is treated using manganese greensand and reverse osmosis. Sodium Hypochlorite is generated on site and is used for disinfection. The finished water is then pumped into the City distribution system and storage tanks.

PUMP STATIONS

There are four pump stations. Their locations are:

1. WTP - the water treatment plant
2. Pump Station No.1 - Adjacent to Reservoir No. 1, north of Thornton Road, east of Vista Drive.
3. Church Road Pump Station - It is located in the northwest quadrant of the Church Road/Mountain View Road intersection.
4. Bakerview Pump Station No. 2 – Adjacent to Reservoir No.1, located south of Thornton Rd. between Della Drive and Pacific Heights Drive.

PRESSURE ZONES

There are currently five pressure zones. The zones are maintained with pumps, pressure reducing valves, and isolation valves.

TOTAL POPULATION SERVED

Active Residential Population = 12,290

TOTAL NUMBER OF SERVICE CONNECTIONS

Total Number of Service Connections = 5,099

B. SAMPLING INFORMATION

ROUTINE SAMPLING REQUIRED BY REGULATION

DOH requirement for population of 12,290 is 10 samples per month.

ROUTINE & REPEAT SAMPLE SITE ADDRESSES

11 routine samples represent all areas served. The addresses underlined below are the routine sample sites. The 11 sample site groups, which include repeat same sites, are attached as a separate exhibit.

PRESSURE ZONE 1 (BAKERVIEW ZONE)

Group 1

1A. 6225 Argyle St. – Residence
1B. 6234 Argyle St. – Test Station
1C. 6238 Argyle St. – Residence

PRESSURE ZONE 2 (MID ZONE)

Group 2

2A. 5936 Artist Dr. – Residence
2B. 5937 Artist Dr. – Test Station
2C. 5939 Artist Dr. – Residence

PRESSURE ZONE 3 (MAIN ZONE) & PRESSURE ZONE 4 (FERNDALE TERRACE ZONE)

Note: Pressure Zone 4 is served through PRVs by Pressure Zone 3

GROUP 3

3A. 5803 Church Rd. – Residence
3B. 5727 Church Rd. – Test Station
3C. 5695 Meadow View Ct. – Residence

GROUP 4

4A. 2305 Douglas Rd. – Residence
4B. 2341 Douglas Rd.– Well House
4C. 2373 Douglas Rd. – Residence

GROUP 5

5A. 5636 Riverside Dr. – Business
5B. 5640 Riverside Dr. – Test Station
5C. 5657 Riverside Dr. – Business

GROUP 6

6A. 5828 Second St. – Residence
6B. 5831 Second St. – Test Station
6C. 5864 Second St. – Business

GROUP 7

7A. 6150 N Beulah Ave.– Residence
7B. 6152 N Beulah Ave. – Test Station
7C. 6154 N Beulah Ave. – Residence

GROUP 8

8A. 6460 Portal Manor Dr. Residence
8B. 6458 Portal Manor Dr. Test Station
8C. 6454 Portal Manor Dr. Residence

GROUP 9

9A. 4999 Labounty Pl. – Business
9B. 4950 Labounty Pl. – Test Station
9C. 5030 Labounty Dr.– Residence

GROUP 10

10A. 1131 W Smith Rd – Residence
10B. 1137 W Smith Rd – Test Station
10C. 1145 W Smith Rd – Residence

PRESSURE ZONE 5 (AXTON ZONE)

GROUP 11

11A. 5797 Northwest Rd – Residence
11B. 5800 Northwest Rd – Test Station
11C. 5805 Northwest Rd – Residence

C. ROTATION

Samples are taken on a monthly schedule. The weekly sampling rotation schedule can be seen below.

	Week 1	Week 2	Week 3	Week 4
Group	1, 2, 7,10	3, 4, 5,11	6, 8, 9	Reserve

A monthly rotation cycle is not needed as every site will be sampled once a month.

Repeat sample sites are located upstream and downstream from each routine sample site.

D. MONTH FOLLOWING UNSTISFACTORY SAMPLE

Regulations require a minimum of 10 routine samples in the month following an unsatisfactory routine sample. This requirement will be met since 11 routine samples are already taken each month.

Prepared on:
September 10, 2015

Prepared By: Mike Olinger

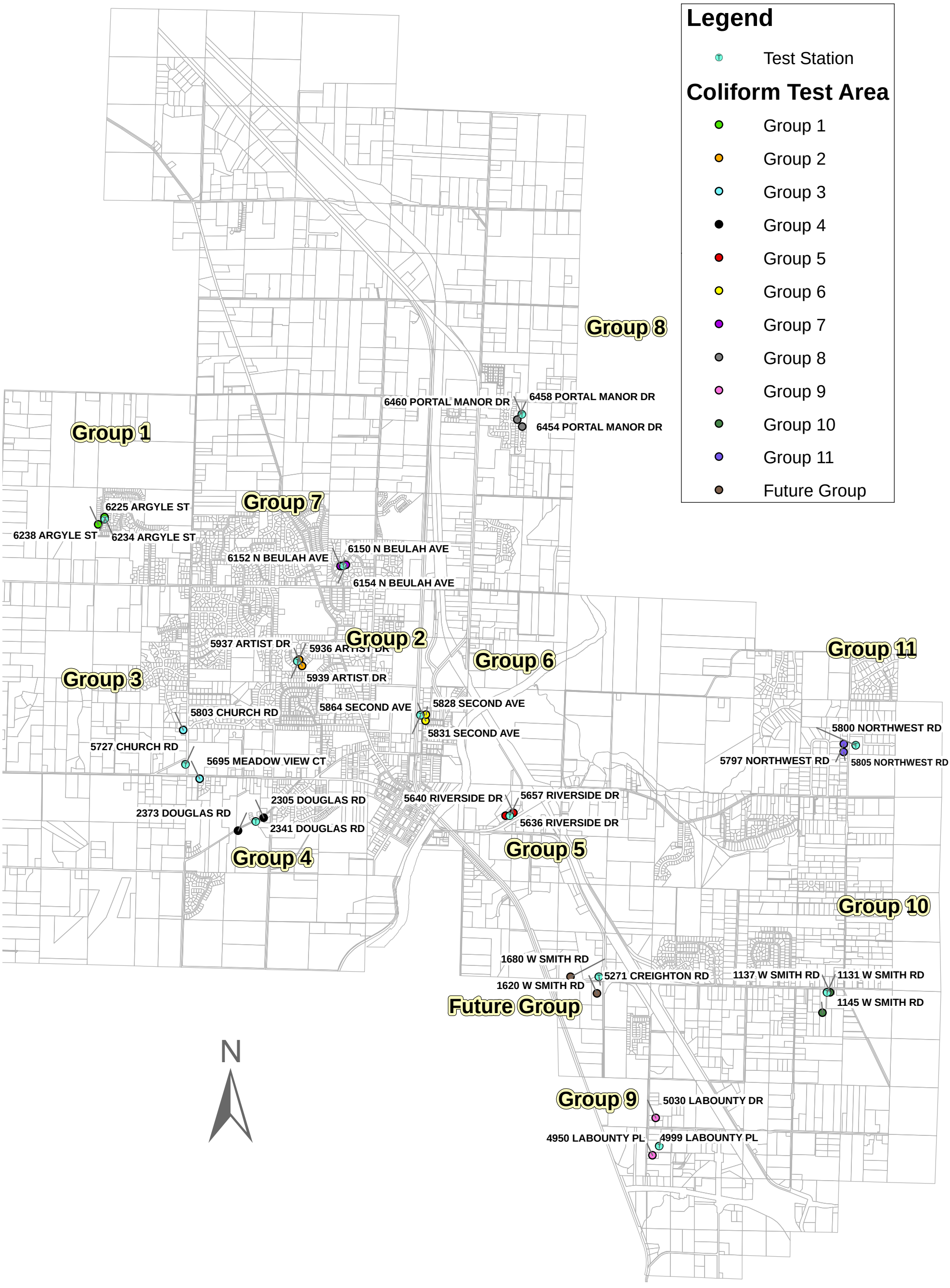
Mike Olinger on 9/10/15

E. MAP

See attached map

F. SAMPLE PROCEDURS

NOTE:
The City of Ferndale has adopted Coliform Sampling Procedure DOH PUB #331-225.This procedure is followed and in addition to the procedure the water is ran for a minimum of five minutes and only after the temperature and chlorine residual have stabilized, sample is taken.



City of Ferndale

Coliform Monitoring Sample Locations 2015

2,100 1,050 0 2,100 Feet

DISCLAIMER: USE OF THIS MAP IMPLIES THE USER'S AGREEMENT WITH THE FOLLOWING STATEMENT:

The City of Ferndale disclaims any warranty of merchantability or warranty of fitness of this map for any particular purpose, either express or implied. No representation or warranty is made concerning the accuracy, currency, completeness or quality of data depicted on this map. Any user of this map assumes all responsibility for use thereof, and further agrees to hold the City of Ferndale harmless from and against any damage, loss, or liability arising from any use of this map.

I. WATER RIGHTS

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Ave SE • Bellevue, WA 98008-5452 • 425-649-7000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

August 26, 2016

City of Ferndale
Recieved on:
SEP 02 2016
By:
Public Works
Department

Mike Olinger
City of Ferndale
2095 Main Street
PO Box 936
Ferndale, WA 98248

Re: Water Right Change Application No. CG1-00720P@1, CG1-*03899C, CG1-*02509C@1 and CG1-*10690C

Dear Sir or Madam:

Enclosed is a copy of the Department of Ecology's *Report of Examination for Change*. This report contains our decision regarding your application.

A copy of this *Report of Examination for Change* has been sent to the protestant(s).

Your application has been approved.

You must meet the provisions of your change authorization before we will issue a final Superseding Certificate.

Our information indicates your system has been completed. We are enclosing a *Proof of Appropriation of Water form* which is to be filed when the water has actually been put to full beneficial use. This form will need to include your County Assessor's Parcel Number and must be notarized.

If you cannot put the water to full beneficial use by **January 1, 2021:**

- You may submit the Proof of Appropriation for a lesser quantity, or
- You must contact this office to apply for an extension.

YOUR RIGHT TO APPEAL

You have a right to appeal this decision to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this decision. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).
To appeal you must do the following within 30 days of the date of receipt of this decision:

- File your appeal and a copy of this decision with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this decision on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey WA 98503 **Pollution Control Hearings Board** 1111 Israel Rd SW Ste 301 Tumwater WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia WA 98504-0903

For additional information visit the Environmental Hearings Office Website:
http://www.eho.wa.gov

To find laws and agency rules visit the Washington State Legislature Website:
http://www.leg.wa.gov/CodeReviser

If you have any questions, please contact Buck Smith at 425-649-7147.

Sincerely,

Tom Buroker
Section Manager
Water Resources Program

TB/mc
CG1-00720P@1, CG1-*03899C, CG1-*02509C@1 and CG1-*10690C

Enclosures: Report of Examination for Change
Your Right To Be Heard

By certified mail: 9171 9690 0935 0106 9655 90

VR File NR CG1-*02509C@1
WR Doc ID 6360536

DEPARTMENT OF ECOLOGY
State of Washington

State of Washington
Protested
Report of Examination for Water Right Change

Changed/added points of withdrawal

PRIORITY DATE	WATER RIGHT NUMBER
May 9, 1952	CG1-*02509C@1

MAILING ADDRESS	SITE ADDRESS (IF DIFFERENT)
City of Ferndale 2095 Main Street, PO Box 936 Ferndale, WA 98248	2341 Douglas Road Ferndale, WA 98248

Total Quantity Authorized for Withdrawal

WITHDRAWAL RATE	UNITS	ANNUAL QUANTITY (AF/YR)
1,000	GPM	1,615

The total annual quantity available under all four rights involved in the City's package of change requests: CG1-*02509C@1 (GWC 1513), CG1-00720P@1 (G1-00729P), CG1-*03899C (GWC 3058), CG1-*10690C (GWC 7700); shall not exceed 2,140 af/yr with a maximum withdrawal rate (Qi) of 2,930 gpm.

Purpose

	WITHDRAWAL RATE			ANNUAL QUANTITY (AF/YR)		
PURPOSE	ADDITIVE	NON-ADDITIVE	UNITS	ADDITIVE	NON-ADDITIVE	PERIOD OF USE (mm/dd)
Municipal	1,000		GPM	1,615		01/01-12/31

IRRIGATED ACRES		PUBLIC WATER SYSTEM INFORMATION	
ADDITIVE	NON-ADDITIVE	WATER SYSTEM ID	CONNECTIONS
		24850 M	5,099

Source Location

COUNTY	WATERBODY	TRIBUTARY TO	WATER RESOURCE INVENTORY AREA
Whatcom	Regional Aquifer		1 - Nooksack

SOURCE FACILITY/DEVICE	PARCEL	WELL TAG	TWN	RNG	SEC	QQ Q	LATITUDE	LONGITUDE
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8447	-122.6088
PW-3 (Thornton Road Well)	390124392440	BHX510	39N	1E	24	NW NE	48.8605	-122.6226

PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[1]	See area outlined on Figure 1 (Attached)						-	-

Datum: NAD83/WGS84

[1] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Place of Use (See Attached Map)

LEGAL DESCRIPTION OF AUTHORIZED PLACE OF USE

The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.

Proposed Works

The City of Ferndale has four existing wells (designated as the Shop, Douglas Road, Thornton Road, and Central City Wells). Additional future wells (Figure 1) in the Regional Aquifer may be incorporated into the City's existing water system as part of this consolidation project.

Development Schedule

BEGIN PROJECT	COMPLETE PROJECT	PUT WATER TO FULL USE
Begun	December 31, 2031	December 31, 2036

Measurement of Water Use

How often must water use be measured?	Daily
How often must water use data be reported to Ecology?	Annually
What volume should be reported?	Total Annual Volume for each well
What rate should be reported?	Annual Peak Rate of Withdrawal (gpm) for each well

Provisions

No Impairment of Existing Rights

This authorization to make use of public waters of the state is subject to existing rights, including any existing rights held by the United States for the benefit of tribes under treaty or settlement. If impairment does occur, the City will be required to diminish or cease pumping, or mitigate for this impairment.

Same Source Requirement

Any new wells installed under this change authorization shall be completed within the Regional Aquifer (i.e., the same source of water as the City's four existing wells). The City must file with the Department of Ecology a Showing of Compliance with RCW 90.44.100(3) prior to the use of any new wells.

Wells, Well Logs and Well Construction Standards
All wells constructed in the state must meet the construction requirements of WAC 173-160 titled "Minimum Standards for the Construction and Maintenance of Wells" and RCW 18.104 titled "Water Well Construction". Any well which is unusable, abandoned, or whose use has been permanently discontinued, or which is in such disrepair that its continued use is impractical or is an environmental, safety or public health hazard must be decommissioned.

Flowing wells must be constructed and equipped with valves to ensure that the flow of water can be completely stopped when not in use. Likewise, the well must be continuously maintained to prevent the waste of water through leaky casings, pipes, fittings, valves, or pumps -- either above or below land surface.

All wells must be tagged with a Department of Ecology unique well identification number. If you have an existing well and it does not have a tag, please contact the well-drilling coordinator at the Department of Ecology Northwest Regional Office. This tag must remain attached to the well. If you are required to submit water measuring reports, reference this tag number.

Installation and maintenance of an access port as described in WAC 173-160- 291(3) is required.

Measurements, Monitoring, Metering and Reporting
An approved measuring device must be installed and maintained for each of the sources identified by this water right in accordance with the rule "Requirements for Measuring and Reporting Water Use", WAC 173-173.

Department of Ecology personnel, upon presentation of proper credentials, must have access at reasonable times, to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.

WAC 173-173 describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition the Department of Ecology for modifications to some of the requirements.

Water Level Measurements
In order to maintain a sustainable supply of water, pumping must be managed so that static water levels do not progressively decline from year to year. Static water level is defined as the water level in a well when no pumping is occurring and the water level has fully recovered from previous pumping. Static water levels must be measured and recorded twice a year (April and October), using a consistent methodology. Data for the previous year must be submitted by January 31 to the Department of Ecology.

Static water level data must be submitted in digital format and must include the following elements:

Unique Well ID Number
Measurement date and time
Measurement method (air line, electric tape, pressure transducer, etc.)
Measurement accuracy (to nearest foot, tenth of foot, etc.)
Description of the measuring point (top of casing, sounding tube, etc.)

Measuring point elevation above or below land surface to the nearest 0.1 foot
Land surface elevation at the well head to the nearest foot.
Static water level below measuring point to the nearest 0.1 foot.

Department of Health Requirements
Prior to any new construction or alterations of a public water supply system, the State Board of Health rules require public water supply owners to obtain written approval from the Office of Drinking Water of the Washington State Department of Health. Please contact the Office of Drinking Water at Northwest Drinking Water Operations, 20435 72nd Avenue S, Suite 200, K17-12, Kent, WA 98032-2358, (253) 396-6750, prior to beginning (or modifying) your project.

Easement and Right-of-Way
Issuance of a water right change authorization by this department does not convey a right of access to, or other right to use, land which the applicant does not legally possess. Obtaining such a right is a private matter between applicant and owner of that land.

Water Use Efficiency
Use of water under this authorization will be contingent upon the water right holder's maintenance of efficient water delivery systems and use of up-to-date water conservation practices consistent with established regulation requirements and facility capabilities.

Schedule and Inspections
Department of Ecology personnel, upon presentation of proper credentials, will have access at reasonable times, to the project location, and to inspect at reasonable times, records of water use, wells, measuring devices and associated distribution systems for compliance with water law.

Findings of Facts
Upon reviewing the investigator's report, I find all facts, relevant and material to the subject application, have been thoroughly investigated and that the subject certificate (Ground Water Certificate No. 1513 ("GWC 1513")) is in good standing and is eligible for change. Furthermore, I find the change of water right as recommended is from the same body of public groundwater, and will not be detrimental to existing rights or the public interest.

Therefore, I ORDER the change to consolidate the multiple points of withdrawal requested in Change Application No. CG1-*02509C@1, be approved, subject to existing rights and the provisions specified above.

Your Right To Appeal

You have a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of the Order.

File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

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- Please send a copy of your appeal to:

  Tom Buroker, Section Manager
  Water Resources Program
  Northwest Regional Office
  3190 – 160th Avenue SE
  Bellevue, WA 98008

Signed at Bellevue, Washington, this 26th day of August 2016.

Tom Buroker, Section Manager

For additional information visit the Environmental Hearings Office Website: http://www.eho.wa.gov. To find laws and agency rules visit the Washington State Legislature Website: http://www1.leg.wa.gov/CodeReviser.

INVESTIGATOR'S REPORT
Water Right Control Number CG1-*02509C@1
City of Ferndale

BACKGROUND

This report serves as the written findings of fact concerning Water Right Application Number CG1-*02509C@1.

On November 19, 2014, the City of Ferndale (City) filed four Applications for Change with the Washington State Department of Ecology (Ecology) to consolidate withdrawal locations for all of the City's sources for four water rights and allow flexibility among three existing points of withdrawal and additional future points of withdrawal. The additional points of withdrawal will be determined based on test wells to evaluate locations with appropriate water quality and production capabilities to meet the City's needs. The four applications are:

Table 1. Change Applications Filed by the City of Ferndale

Change Application	Source	Water Right	Type	Priority Date
CG1-*02509C@1	PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952
CG1-*03899C	PW-1 Shop Well	GWC 3058	Certificate	2/28/1955
CG1-00720P@1	PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971
CG1-*10690C	PW-4 Central City Well	GWC 7700	Certificate	3/10/1970

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

The City's water system currently serves a residential population of approximately 12,920 people with approximately 6,611 equivalent residential units (ERUs). The City's water system consists of water withdrawal, conveyance, storage, and treatment facilities. The place of use is consistent with the 2010 update to the 2006 City of Ferndale Water System Plan, which is within the designated City water service area (Reichhardt & EBE Engineering Inc. 2010).

Existing and requested water right attributes for the specific water right addressed by this Report of Examination (ROE) are as follows:

EXISTING Water Right Attributes

Water Right Owner:	City of Ferndale
Priority Date:	May 9, 1952
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer		1 - Nooksack

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	1,000	GPM	1,615	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8605	-122.6226

Datum: NAD83/WGS84

WRIA = Water Resource Inventory Area; GPM = Gallons per Minute; Ac-ft/yr = Acre-feet per year; Twp = Township; Rng = Range; Sec. = Section; QQ Q = Quarter-quarter of a section

REQUESTED Water Right Attributes

Applicant Name:	**City of Ferndale**
Date of Application:	November 19, 2014
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer[1]		1 - Nooksack

[1] Also referred to as Deep Confined Aquifer

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	1,000	GPM	1,615	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
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PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[2]	See area outlined on Figure 1 (Attached)							

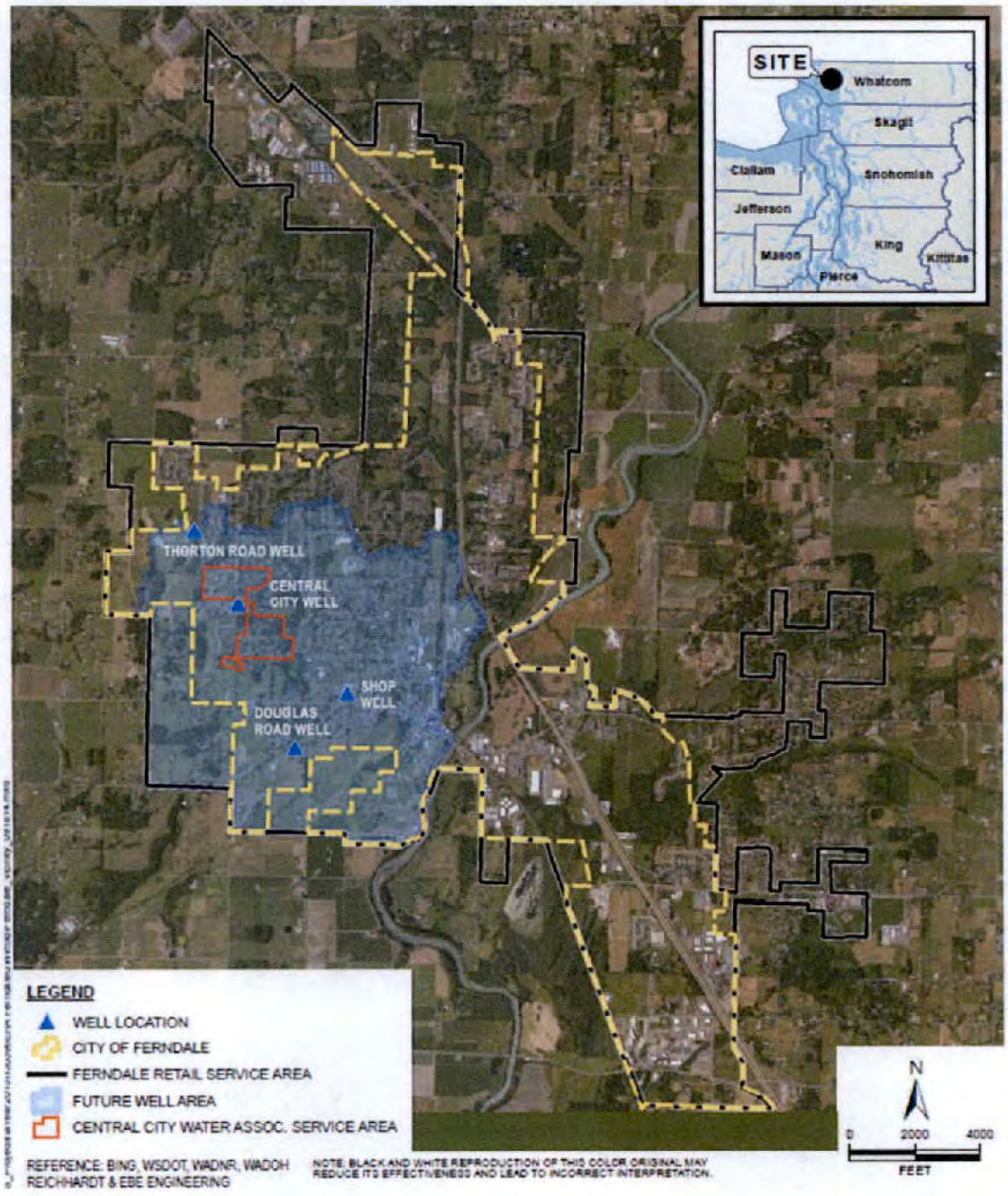
Datum: NAD83/WGS84

[2] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N½ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Cost Reimbursement

This application is being processed under a cost reimbursement agreement between the applicant the Department of Ecology. This report has been prepared by Aspect Consulting, LLC (Aspect) and reviewed by Ecology.

Figure 1. City of Ferndale Well Locations and Vicinity (source: AESI, 2013, modified by AESI in 2015)



Legal Requirements for Requested Change

Public Notice

RCW 90.03.280 requires that notice of a water right application be published once a week, for two consecutive weeks, in a newspaper of general circulation in the county or counties where the water is to be stored, diverted and used. Notice of this application was published in the Ferndale Record on February 11, 2015 and February 18, 2015.

Protest

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows.

Consultation with the Department of Fish and Wildlife

The Department must give notice to the Department of Fish and Wildlife (WDFW) of applications to divert, withdraw, or store water. Notice was provided to WDFW on January 14, 2016, of the four change applications filed by the City.

On January 29, 2016, Steve Boessow of WDFW responded in a letter to Ecology that:

> *"...based on impacts to fish and/or wildlife and the habitat they rely on, and pursuant to Chapter 77.57.020 RCW, WDFW does not oppose the issuance of these applications. These change applications do not increase the quantity of water allowed under any of the 4 water rights. Consolidation of wells is unlikely to impact fish."*

State Environmental Policy Act (SEPA)

A water right application is subject to a SEPA threshold determination (i.e., an evaluation whether there are likely to be significant adverse environmental impacts) if any one of the following conditions are met:

- It is a surface water right application for more than 1 cubic foot per second, unless that project is for agricultural irrigation, in which case the threshold is increased to 50 cubic feet per second, so long as that irrigation project will not receive public subsidies;
- It is a groundwater right application for more than 2,250 gallons per minute;
- It is an application that, in combination with other water right applications for the same project, collectively exceed the amounts above;
- It is a part of a larger proposal that is subject to SEPA for other reasons (e.g., the need to obtain other permits that are not exempt from SEPA);
- It is part of a series of exempt actions that, together, trigger the need to do a threshold determination, as defined under WAC 197-11-305.

This project is not categorically exempt from SEPA, because the four change applications associated with the project total more than 2,250 gallons per minute in additive instantaneous quantity. The total instantaneous quantity associated with the combined change applications is 2930 gallons per minute (gpm).

The City prepared a SEPA checklist and notice was posted in the Ferndale Record on February 10, 2016. No public comments were received during the public comment period, and a Determination of Non-Significance (DNS) was issued.

Water Resources Statutes and Case Law

RCW 90.03.380(1) states that a water right that has been put to beneficial use may be changed. The point of diversion, place of use, and purpose of use may be changed if it would not result in harm or injury to other water rights. The Washington Supreme Court has held that Ecology, when processing an application for change to a water right, is required to make a tentative determination of extent and validity of the claim or right. This is necessary to establish whether the claim or right is eligible for change. *R.D. Merrill v. PCHB* and *Okanogan Wilderness League v. Town of Twisp.*

RCW 90.03.386(3) requires a municipal water supplier to apply cost-effective water conservation measures as part of its water system planning. The water supplier must also evaluate the effects of delaying the use of inchoate water rights before it may increase use of those inchoate rights. RCW 90.03.320 requires Ecology to consider the public water supplier's use of conserved water when establishing a surface or ground water right construction schedule. The City's conservation program is outlined in Chapter 4 of the current water system plan (Reichhardt & EBE Engineering Inc. 2010).

RCW 90.03.386(2) states that a municipal water supplier may change its service area through the water system plan approval process. As long as the municipal water supplier is in compliance with the approved plan, the place of use for the water right is the service area of the plan.

RCW 90.44.100 allows Ecology to amend a ground water permit to: (1) allow the user to construct a replacement or additional well at a new location outside of the location of the original well, or to (2) change the manner or place of use of the water, if:

- The additional or replacement well taps the same body of public ground water as the original well. RCW 90.44.100(2)(a),
- Where a replacement well is approved, the user must discontinue use of the original well and properly decommission the original well. RCW 90.44.100(2)(b),
- Where an additional well is constructed, the user may continue to use the original well, but the combined total withdrawal from all wells shall not enlarge the right conveyed by the original permit or certificate. RCW 90.44.100(2)(c),
- Other existing rights shall not be impaired. RCW 90.44.100(2)(d).

When changing or adding points of withdrawal to groundwater rights (RCW 90.44.100), or when consolidating exempt wells with an existing permit or certificate (RCW 90.44.105), the wells must draw from the *same body of public groundwater*. Indicators that wells tap the *same body of public groundwater* include:

(a) Hydraulic connectivity.
(b) Common recharge (catchment) area.
(c) Common flow regime.
(d) Geologic materials that allow for storage and flow, with recognizable boundaries or effective barriers to flow.

INVESTIGATION

In consideration of this application, Aspect reviewed available documents pertaining to the application's site conditions, existing well installations, and the potential effect of the proposed change on existing water right holders and established minimum instream flows. This review included information submitted by the applicant, including well construction and testing reports, water system plan, and water level data, along with pertinent Ecology records, including well logs and water rights records. The review also included reports from multiple investigations characterizing the hydrogeology of the Ferndale area and Mountain View Upland.

A site visit was performed on July 21, 2015. Carl Einberger of Aspect met with City representative Mike Olinger to discuss the application, visit existing well locations and the area proposed as future withdrawal points, and to discuss the City's current water system operations.

Using the available information in the Ecology file record, existing reports, the site visit, and communications with the City, Aspect evaluated potential effects of the proposed consolidation of withdrawal locations for the four water rights involved in the package of change applications. The City's water rights are discussed in more detail in the following section.

Existing Water Rights

The following table summarizes the City's existing water rights. The subject of this report is Groundwater Certificate (GWC) 1513, however all of these water rights have change applications being processed together, and all are discussed in this report.

Table 2. City of Ferndale's Water Rights Portfolio

Source	Water Right	Type	Priority Date	Qi in gpm	Qa in ac-ft/yr	
					Additive	Non-Additive
PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952	1000	1615	-
PW-1 Shop Well	GWC 3058	Certificate	2/28/1955	870	440[1]	-
PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971	1000	-	1614[1]
PW-4 Central City Well	GWC 7700	Certificate	3/10/1970	60	85	-
			Total	2930	2140	1614

[1]There is some confusion in the water right record as to the total annual quantity allowed to be withdrawn under all City of Ferndale water rights. As a result, Reports of Examination prepared for changes to GWC 1513 and G1-00720P in 2004 tentatively determined that the City of Ferndale should be allowed under its then existing water rights to withdraw up to a combined 2,055 acre-feet per year from all three of its then existing water rights and permits. The Superseding Permit issued in 2004 for G1-00720P noted that the total annual quantity from GWC 1513, GWC 3058, and G1-00720 shall not exceed 2,055 acre-feet per year. In 2014, the City of Ferndale acquired GWC 7700, giving the City a total combined annual quantity from the four water rights of 2,140 acre-feet per year. A recent review of files as part of this investigation suggests the interpretation noted in Table 2 is the intent of the original water right approvals.

Table 3 summarizes the nomenclature historically applied to these water rights:

Table 3. Water right and change references numbers

Source	Original Designation	Previous Change Reference #'s	Current Change Reference #'s
PW-2 Douglas Road Well	GWC 1513	G1-*02509C	CG1-*02509C@1
PW-1 Shop Well	GWC 3058	G1-*03899C	CG1-*03899C
PW-2 Douglas Road Well	G1-00720P	-	CG1-00720P@1
PW-4 Central City Well	GWC 7700	-	CG1-*10690C

The Thornton Creek Well, PW-3, did not have any water rights associated with it as of the time of submittal of this change application, but is a requested point of withdrawal under this consolidation project and change request.

History of Water Use

The City has a complicated water supply history dating back to the early 1950s. All four of the water rights that have change applications filed for points of withdrawal consolidation are discussed in this summary.

A synopsis of key historical information includes:

- The City obtained two water rights in the early 1950s: GWC 1513 with a priority date of 5/9/52 (the subject of this ROE) and GWC 3058 with a priority date of 2/28/55. Both of these rights were certificated in the 1950s.

- The above water rights and associated wells near the City shop provided the main source of water for the City until 1975 (Reichhardt & EBE Engineering Inc. 2010).

- In 1971, the City obtained a permit for an additional water right at the City shop (G1-00720P).

- In 1974 the City entered into an agreement with Whatcom County Public Utilities District No. 1 (PUD 1) to provide water from the Nooksack River. It appears this was done to address water quality concerns in the existing wells. A water treatment plant was constructed in 1975 to switch to potable treated water from the Nooksack River. The well now known as the City Shop Well (PW-1) remained connected and used and relied on as an emergency and back-up water source; however, use of the well as a main source of water temporarily ceased.

- In early 1994, the City relocated one well (not the existing Shop Well) from the City shop area to the Douglas Road site to allow construction of a library near the shop location. This well (PW-2) was drilled but was not connected to the system (Reichhardt & EBE Engineering Inc. 2010) at that time. The City of Ferndale filed change applications for GWC 1513 and G1-00720P in 1992 for this relocation. GWC 3058 remained associated with a second well at the City Shop Well.

- In 2003, Ecology prepared a Hydrogeologic Report (Ecology, 2003) and ROEs supporting the above changes were completed in 2004. The change to G1-00720P was approved in a Superseding Permit on June 8, 2004. The change to GWC 1513 was approved by Ecology in a Superseding Certificate issued on February 25, 2005.

- Several years ago, the City began evaluating the possibility of switching off PUD water and returning to the City's back-up groundwater sources as the City's primary source of water. This switch had been encouraged by the Washington State Department of Health (DOH) for several years. The City also wanted to gain more control over costs of water delivery and treatment options for the water system (Associated Earth Sciences, Inc., 2013). This switch occurred on December 14, 2012.

- Soon after switching to the City's production wells as the primary source of water, the City encountered water quality changes from the both the Shop Well and the Douglas Road Well, with unanticipated increases in hardness and chloride. In response to this, the City installed a nanofiltration (reverse osmosis) treatment system to improve the quality of water delivered to its customers (Associated Earth Sciences, Inc., 2013).

- Records provided by the City indicate the City's two active wells (Douglas Well and the Shop Well), have had increasing production annually in the period from 2012 to 2015. In 2014, the Douglas and Shop Wells produced approximately 775 ac-ft/yr and 485 ac-ft/yr, respectively. In 2015, the Douglas and Shop Wells produced approximately 1,062 ac-ft/yr and 277 ac-ft/yr, respectively. Based on the change applications described above, the City currently exercises GWC 1513 and a portion of G1-00720P from the Douglas Well and exercises GWC 3058 from the Shop Well. Annual quantities associated with each of these wells and their corresponding water rights are set forth in Table 5 below. See also Table 2 describing the City's water rights portfolio, including authorized annual quantities.

- In 2014, the City acquired a water right (GWC 7700) from the Central City Water Association (CCWA). The CCWA water right was originally certificated for community domestic supply (and municipal as a matter of law) and is authorized for 60 gpm and 85 ac-ft/yr. While the water right has been inactive since the acquisition, as part of this consolidation request the City intends to reactivate beneficial use of this water right. A review of records filed with DOH from 2009 to 2014 indicates that this water right was actively used prior to acquisition for 15 or more connections. In 2014, Ecology issued an amended certificate to the City for GWC 7700 conforming its purpose of use to municipal supply for the authorized 60 gpm and 85 ac-ft/yr.

City-Wide Growth and Diligence

As set forth in Table 5 below, the City's water use records show that it has exercised in full the quantities authorized under GWC 3058 (authorizing 440 ac-ft/yr) from the Shop Well, and has exercised up to 1,062 ac-ft/yr out of the total authorized under GWC 1513 (authorizing 1,615 ac-ft/yr) and G1-00720P (providing supplemental non-additive annual quantities) from the Douglas Well, leaving approximately 553 ac-ft/yr of municipal inchoate water under GWC 1513 and G1-00720P. The City has and continues to exercise good faith and diligence in development of this inchoate portion of its water rights.

In a letter dated June 3, 2016, Joseph A. Rehberger of Cascadia Law Group, on behalf of the City of Ferndale, provided the following information on City-wide growth and diligence in growing into the inchoate portions of GWC 1513, G1-00729P, and GWC 3058. Mr. Rehberger's letter included a number of attachments which are now on file with Ecology.

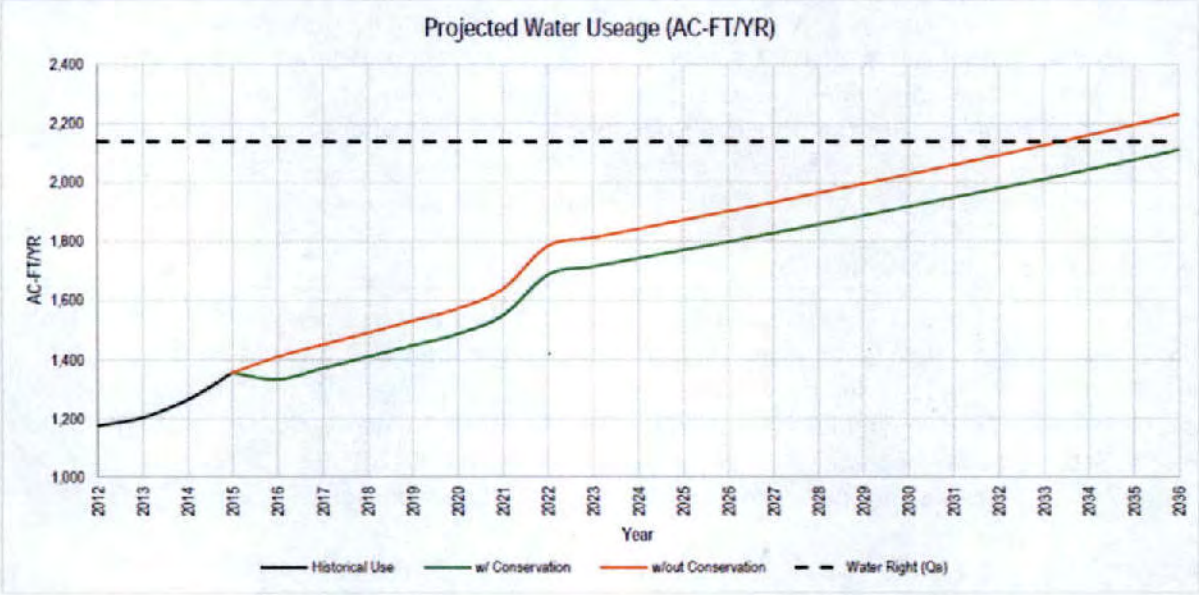
The City of Ferndale has been a growing community within Whatcom County for decades. That growth is expected to continue. The following table and graph from the City's *2016 Water System Plan, City of Ferndale* (Working Draft May 2016) describe the City's population growth from 1980 through 2015 and projected water usage through 2036 (see table and graph below).

Table 4.

Year	Population
1980	3,855
1990	5,398
2000	8,758
2010	11,415
2013	11,831
2014	12,710
2015	12,920

Source: Washington State Office of Financial Management
City of Ferndale, May 2016

Figure 2.



The following table shows the City's water use trends and increased use associated with current growth (units are in thousand gallons).

Table 5.

Month	2012		2013		2014		2015	
	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well
January	0	0	20,044	9,753	11,653	16,424	12,963	18,146
February	0	0	17,448	8,455	10,976	15,379	10,602	16,742
March	9,888	13,274	20,843	10,267	12,239	17,100	11,528	19,158
April	9,880	17,152	18,390	8,920	11,746	16,578	11,623	19,257
May	13,088	21,028	19,020	12,270	13,465	18,693	13,083	24,416
June	12,566	19,298	20,113	14,273	15,998	21,443	13,993	36,822
July	16,377	19,930	22,057	27,815	14,842	32,414	9,520	44,060
August	23,287	20,150	16,437	27,333	14,306	30,416	6,115	40,504
September	25,066	9,249	11,860	20,049	12,239	24,548	80	32,429
October	22,132	7,189	11,586	17,614	13,072	20,778	398	31,921
November	18,546	9,897	10,827	16,307	13,531	18,588	112	31,265
December	19,158	10,209	12,149	17,039	13,965	19,637	471	31,286
Total	169,988	147,376	200,774	190,095	158,032	251,998	90,488	346,006
Combined Total	317,364		390,869		410,030		436,494	

The City's Annexation History Map (on file with Ecology), shows the City's progressive annexation and growth of its municipal boundaries from the 1940s through present. The City's current urban growth area (UGA) and future growth and annexation phasing plan through 2034 are described in the City of Ferndale *Annexation Blueprint, Annexation Phasing Plan: 2013-2034* (also on file with Ecology).

The City is in the process of updating its Water System Plan (*2016 Water System Plan, City of Ferndale).* The City's May 2016 working draft estimates a City-wide population growth rate of approximately 2.32%, increasing from a population of 12,920 in 2015 to 20,072 in 2036.

Table 6.

Year	District								Total Pop.
	1	2	3	4	5	6	7	8	
2013	269	333	759	1,403	7,311	1,036	508	212	11,831
2014	282	352	817	1,518	7,831	1,131	548	231	12,710
2015	283	354	829	1,555	7,936	1,165	560	238	12,920
2016	283	357	847	1,600	8,079	1,208	574	246	13,194
2017	283	360	865	1,646	8,224	1,252	589	255	13,474
2018	284	363	883	1,693	8,371	1,298	604	264	13,760
2019	284	366	902	1,741	8,521	1,346	619	273	14,052
2020	284	369	921	1,790	8,673	1,395	635	283	14,350
2021	285	372	940	1,840	8,827	1,445	651	294	14,654
2022	285	375	960	1,892	8,984	1,498	667	304	14,965
2036	290	417	1,278	2,776	11,455	2,431	937	488	20,072
Growth Rate	0.33%	0.98%	2.29%	3.01%	1.97%	3.78%	2.70%	3.69%	2.32%

This corresponds to a projected increase in ERUs from 6,611 in 2015 to an estimated 11,352 ERUs in 2036.

Table 7.

Year	ERUs				Total
	Single-Family	Multi-Family	Commercial / Industrial	Irrigation	
2013	4,071	682	1,008	525	6,286
2014	4,169	689	1,149	567	6,574
2015	4,286	689	997	639	6,611
2016	4,365	704	1,074	659	6,802
2017	4,446	719	1,153	680	6,998
2018	4,529	733	1,232	700	7,194
2019	4,614	748	1,307	721	7,390
2020	4,701	763	1,380	742	7,586
2021	4,790	778	1,578	762	7,908
2022	4,881	793	2,150	783	8,607
2036	6,420	1,046	2,722	1,164	11,352

Using these projections, the City is expected to be at or in excess of its current water rights (2,140 af/yr) by 2036.

Table 8.

			ADD (MGD)		MDD (MGD)		PHD (GPM)		Annual (AC-FT/YR)	
Year	Total Population	ERUs	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons
2013	11,831	6,286	1.08	1.08	1.91	1.91	2,194	2,194	1,205	1,205
2014	12,710	6,574	1.13	1.13	1.91	1.91	1,300	1,300	1,265	1,265
2015	12,920	6,611	1.21	1.21	2.07	2.07	2,366	2,366	1,356	1,356
2016	13,194	6,802	1.19	1.26	2.07	2.21	2,371	2,526	1,334	1,410
2017	13,474	6,998	1.22	1.29	2.13	2.27	2,438	2,596	1,372	1,451
2018	13,760	7,194	1.26	1.33	2.19	2.34	2,504	2,667	1,411	1,491
2019	14,052	7,390	1.29	1.37	2.25	2.40	2,571	2,738	1,449	1,532
2020	14,350	7,586	1.33	1.40	2.31	2.47	2,637	2,809	1,488	1,573
2021	14,654	7,908	1.38	1.46	2.41	2.57	2,746	2,925	1,551	1,639
2022	14,965	8,607	1.51	1.59	2.63	2.80	2,983	3,177	1,688	1,784
2036	20,072	10,770[1]	1.88	1.99	3.28	3.50	3,716	3,958	2,112	2,232

Based on the information provided by the City and upon Ecology's review, it is tentatively determined that the subject water right is in good standing and is eligible for change. This is a municipal water supply water right that is not subject to relinquishment. The full certificated instantaneous rate (1000 gpm) has been perfected through beneficial use. The full annual quantity is not yet fully perfected through actual beneficial use. However, the City is a growing system, in good-standing, with a State Department of Health green operating permit. Their demand analysis indicates the City can easily grow into their full annual allocation. Therefore, the full certificated annual quantity of 1615 ac-ft/yr shall be eligible for change.

Proposed Use

The only change proposed for GWC 1513 is to allow the authorized quantities to be used with flexibility at any of the City's current points of withdrawal, and at possible new points of withdrawal within the area outlined on Figure 1. The goal is to allow the City the opportunity to tailor water withdrawals to water needs throughout the City's service area. In addition, the City is interested in finding potential new points of withdrawal that may have improved water quality compared to the current source wells.

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

Investigation of New Points of Withdrawal

The City has engaged Wilson Engineering and AESI to assist with identifying potential locations for new wells and with drilling test wells. A hydrogeologic evaluation in support of this goal was completed in 2013 that proposed drilling and testing of a new well at a location near the northwest corner of the City limits. This was designated as the "Thornton Road Well" location (AESI, 2013).

AESI considered the Thornton Road location to be promising from both a water quantity and quality standpoint. In addition, AESI recognized that the Thornton Road location was in the same surface water drainage basin as the existing Douglas Road, Shop, and Central City Wells, supporting the ability to withdraw from the same source of groundwater as these wells, thus aiding the addition of this location as a point of withdrawal. AESI noted that the nearby Thornton Road Water Association well has lower concentrations of sodium, chloride, conductivity, TDS, and manganese than the City's production wells.

In 2014, a test well was drilled under AESI's supervision at the Thornton Road Well location to 450 feet of depth. AESI concluded that the well could achieve a long-term yield of approximately 350 to 375 gpm. Test pumping of the well for 24 hours at 315 gpm did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well. Elevated water quality for manganese, conductivity, color, and total dissolved solids were noted, indicating that the water would require treatment to meet DOH standards for public water supply. No decision on future use of this well by the City has been made at this time, and additional locations within the proposed 'future well area' outlined on Figure 1 may be investigated for potential production well drilling and construction.

Other Rights Appurtenant to the Place of Use

As part of this investigation, Aspect obtained water right records from Ecology's database for the area proposed for potential future wells identified in Figure 1, including a ½ mile buffer outside of this area. Note that this area also includes the City's existing points of withdrawal.

Thirteen certificated groundwater rights were identified, with the majority of these being for domestic use. The largest of these were two domestic and stockwater rights owned by F. Imhoff, with each authorized for an instantaneous withdrawal (Qi) of 50 gpm and annual quantity (Qa) of 80 ac-ft/yr. These are located approximately ½ mile southeast of the City's Douglas Well. A review of the associated well log indicates a completion depth of 195 feet, likely within the Regional Aquifer.

In addition, there are 68 claims, all for groundwater use, within the search area. It is expected that many of the water rights found in this review are not being exercised, given the availability of public water supply from the City's system in much of the search area.

Hydrologic/Hydrogeologic Evaluation

The portions of the City of Ferndale area of interest for this investigation are located west of the Nooksack River near River Mile 6 (Figure 1), in the Fraser-Whatcom basin (additional incorporated areas of the City are located east of the Nooksack River). The western portion of the City water service area is within the Mountain View Upland, with elevations up to 360 feet near the Thornton Road Well. Areas closer to the river are lower in elevation and are part of the Nooksack River valley, with elevations as low 20 feet.

The Fraser-Whatcom basin was subject to repeated glaciation during the Pleistocene Epoch, and several hundred feet of glacial and interglacial sediments are present in the area, with bedrock found at considerable depth. The deepest well in the project area was drilled to a depth of 440 feet and did not encounter bedrock (AESI, 2013).

Overview of Groundwater Occurrence

Groundwater in the Ferndale area is found in discontinuous perched groundwater aquifers and in a single Regional Aquifer that appears to be composed of predominantly pre-Vashon deposits. Aspect (2009) conducted a study of the Mountain View Upland, which extends from the western upland portions of the City of Ferndale west to the Strait of Georgia. Seven hydrostratigraphic units were delineated:

> *The upper fine-grained unit (F1/F2) consists predominantly of glacial marine drift and potentially Sumas and Vashon age till. Shallow perched groundwater occurs above the F1 unit and within coarse-grained lenses interbedded with the F1 unit. A coarse-grained unit (C2) underlies the F1 unit and appears to be correlative with Vashon advance outwash (Mountain View Sand and Gravel). The C2 unit is generally unsaturated. Deeper units, interpreted as the Cherry Point silt and other pre-Vashon, fine-grained deposits, are found beneath the C2 units and form a lower aquitard (F3).* ***The regional aquifer in the study area is present predominantly in the coarse-grained C3 unit that is thought to be correlative with the pre-Fraser deposits, and in more permeable portions of the F3 unit (typically silty sands), as indicated by several productive wells completed within these zones.***

A review of well logs for the City's existing four wells and stratigraphic cross sections (Aspect, 2009) suggests that they are completed in the same source of water, the Regional Aquifer (see Table 9).

Table 9. Existing City Wells and Interpreted Aquifer		
Source	**Completion Depth (feet)**	**Interpreted Aquifer**
Douglas Road Well	152	Regional Aquifer
Shop Well	160	Regional Aquifer
Central City Well	290	Regional Aquifer
Thornton Road Well	450	Regional Aquifer

Groundwater Flow in the Regional Aquifer

Aspect (2009) also evaluated groundwater flow directions in the Regional Aquifer in the Mountain View Upland. Based on a review of these data, mapped for both March and October of 2008, groundwater flows in the southeastern portion of the Mountain View Upland near Ferndale generally trend southeast toward the Nooksack River. All of the area of interest for this investigation appears to be in the same source of water, with the Regional Aquifer flowing toward the Nooksack River. In addition to being consistent with Aspect's previous interpretation, this is also consistent with Ecology's previous interpretation in the hydrogeologic report for changes to the City's GWC 1515 and G1-00720P water rights (Ecology, 2003).

Key Aquifer Test Data and Potential Impairment

Ecology (2003) reviewed pumping tests conducted in 1994 on the Douglas Road Well. A step test and a 26-hour constant rate pumping test were conducted by GeoEngineers, with a well approximately 2200 feet away used as a monitoring well. This well had very limited drawdown observed during the test (0.33 feet). GeoEngineers (1994) also conducted an additional impairment analysis. This suggested that a nearby well (at Ferndale Mobile Village), would have experienced approximately 13 feet of drawdown from the 26-hour pumping test. Ecology concluded that no impairment would occur at this well, given the 120 feet of available drawdown.

As noted previously, the test well drilled into the Regional Aquifer in 2014 at the Thornton Road well location did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well, during a 24 hour pump test.

In general, based on a review of selected well logs, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1).

Impairment Considerations

Impairment of Minimum Instream Flow Water Rights

The term "instream flow" is used to identify a specific stream flow (typically measured in cubic feet per second, or cfs) at a specific location for a defined time, and typically following seasonal variations. Instream flows are usually defined as the stream flows needed to protect and preserve instream

resources and values, such as fish, wildlife and recreation. Instream flows are most often described and established in a formal legal document, typically an adopted state rule.

Once established, a minimum flow constitutes an appropriation with a priority date as of the effective date of the rule establishing the minimum flow (RCW 90.03.345). Thus, a minimum flow set by rule is an existing right which may not be impaired (RCW 90.03.345; RCW 90.44.030).

Minimum instream flows were established for the Nooksack River Water Resource Inventory Area (WRIA 1) by WAC 173-501 in 1985. None of the four water rights involved with this project are junior to the instream flow rule, and as such, they are not subject to curtailment when instream flows are not met. No additional impacts to instream flows are expected to result from authorization of this change request, given that there is no enlargement of the water right through this consolidation process. WDFW has concurred with this opinion, as noted in their January 29, 2016, letter to Ecology.

Impairment, Qualifying Ground Water Withdrawal Facilities, and Well Interference
There are three concepts that are important when considering whether a withdrawal of water from a well would impair another existing water right. The concepts are defined as follows:

1. Impairment is an adverse impact on the physical availability of water for a beneficial use that is entitled to protection (i.e., water rights that are both senior and junior in priority to the right the applicant seeks to change).

2. Qualifying ground water withdrawal facilities are defined as those wells which in the opinion of the Department are adequately constructed. An adequately constructed well is one that (a) is constructed in compliance with well construction requirements; (b) fully penetrates the saturated thickness of an aquifer or withdraws water from a reasonable and feasible pumping lift (WAC 173-150); (c) the withdrawal facilities must be able to accommodate a reasonable variation in seasonal pumping water levels; and (d) the withdrawal facilities including pumping facilities must be properly sized to the ability of the aquifer to produce water.

3. Well interference may occur when several wells penetrate and withdraw ground water from the same aquifer. Each pumping well creates a drawdown cone. When several wells pump from the same aquifer, well density, aquifer characteristics, and pumping demand may result in individual drawdown cones that intersect and form a composite drawdown cone. At any point in an aquifer, the composite drawdown caused by pumping wells will be greatly influenced by the transmissivity (T) of the aquifer. In aquifers with high Ts, composite drawdown will generally be much less than in aquifers with similar properties but with low Ts. Transmissivity is related to hydraulic conductivity (K) and the saturated thickness (b) of an aquifer by the relationship T=Kb.

   An aquifer's hydraulic conductivity (K) is derived from the physical properties of both the fluid and geologic materials that form an aquifer. Once formed, an aquifer's saturated thickness (b) becomes important in evaluating its transmissivity. For regions of similar K in an aquifer, a large saturated thickness will result in a much higher T than a small saturated thickness. As a result, regions of similar K in an aquifer with a large saturated thickness will experience less composite drawdown or well interference than with a small saturated thickness.

   Some conditions, however, will increase or steepen composite drawdown in an aquifer. For instance, where characteristics (such as very fine, clay-rich, or poorly sorted sediments) of an

unconfined aquifer cause significant drawdown relative to the saturated thickness, the composite drawdown will increase as saturated thickness is reduced and T becomes smaller. Additionally, in regions where negative or no-flow boundaries occur, such as near the edges of a valley fill aquifer where it is bounded by bedrock, composite drawdown will be steeper than in the central part (generally the greatest thickness region) of the aquifer. Consequently, it is commonly understood that the greatest composite drawdown or well interference is more likely to occur in regions of low transmissivities, thin saturated thicknesses and near negative or no-flow boundaries than in regions of high transmissivities, large saturated thicknesses, and away from negative or no-flow boundaries.

As noted in the review of pump test information and well log review noted previously, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1). No impairment issues are anticipated based on approval of the consolidation project and this associated change request.

Public Interest Considerations

No potential for detriment to the public interest was identified during the investigation of this water right change application.

Consideration of Protests and Comments

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows. However, this is a change application and not an application for new (consumptive) water use. Because the quantities of water involved will remain unchanged, there will be no increase in consumptive use, and each of the sources will pump from the same body of public water, therefore no additional or new impacts are associated with the change being recommended for approval. A provision has been added that specifically identifies that this right is subject to senior water rights.

CONCLUSIONS

The full quantities (Qi and Qa) of water allocated under the subject certificate are eligible to be changed.

Tentative determination

Groundwater Certificate 1513 is in good standing with the Department of Ecology and is therefore eligible for change. In accordance with RCW 90.14.140(2)(d), rights for municipal supply purposes are not subject to relinquishment.

Potential for Enlargement

No potential for enlargement of the existing water right exists, provided the City does not withdraw more than a total of 1000 gpm and 1615 ac-ft/yr (additive) under this water right at the existing and potential new points of withdrawal.

Same Source Considerations

All of the existing points of withdrawal considered under this change are within the same source of water, the Regional Aquifer. In addition, all of the existing City wells and the area proposed for future new wells are all within the same surface water drainage basin (Schell) as delineated by Whatcom County. Provided any new points of withdrawal are limited to the area proposed in Figure 1 and the wells are completed in the Deep Aquifer, they can be considered to also be within the same source of water.

Potential for Impairment of Existing Rights

The change requested will not impair existing rights.

Potential for Detriment to the Public Interest

The change requested will not be detrimental to the public interest.

RECOMMENDATIONS

Based on the above investigation and conclusions, I recommend this request for change be approved in the amounts and within the limitations listed below and subject to the provisions listed above.

Purpose of Use and Authorized Quantities

The amount of water recommended is a maximum limit and the water user may only use that amount of water within the specified limit that is reasonable and beneficial:

Q_i = 1,000 gpm
Q_a = 1,615 acre-feet per year (additive)
For Municipal Use

Points of Withdrawal

See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by AESI to support the City's water right change.

The City's existing wells also are located within this area as illustrated by Figure 1.

Place of Use

The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.



Carl M. Einberger

Carl Einberger, LG, LHG, License #1100

August 26, 2016
Date



J. R. "BUCK" SMITH

8/26/16

Reviewed Buck Smith, LG, LHG, License #1479 Date

If you need this publication in an alternate format, please call Water Resources Program at (360) 407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Selected References

Aspect Consulting, 2009. Aquifer Study of the Mountain View Upland – Lummi River Area, Whatcom County and Lummi Nation, Washington. March 2009.

Associated Earth Sciences, Inc. (AESI), 2013. City of Ferndale Hydrogeologic Evaluation, Whatcom County, Washington. December 2013.

AESI, 2014. Installation and Testing of the Thornton Road Well, Ferndale Washington. December 2014.

GeoEngineers, Inc., 2004. Installation and Testing of Production Well No. 3 Ferndale, Washington. April 1994.

Reichhardt & EBE Engineering Inc. 2010, City of Ferndale 2006 Water System Plan. Updated 2010.

Washington Department of Ecology, 2003. Hydrogeologic Report for Change to GWC 1513 and G1-00720P (City of Ferndale). November 2003.

WR File NR CG1-00720P@1
WR Doc ID 6360527

DEPARTMENT OF ECOLOGY
State of Washington

State of Washington
Protested
Report of Examination for Water Right Change

Changed/added points of withdrawal

PRIORITY DATE	WATER RIGHT NUMBER
July 22, 1971	CG1-00720P@1

MAILING ADDRESS	SITE ADDRESS (IF DIFFERENT)
City of Ferndale 2095 Main Street, PO Box 936 Ferndale, WA 98248	2341 Douglas Road Ferndale, WA 98248

Total Quantity Authorized for Withdrawal

WITHDRAWAL RATE	UNITS	ANNUAL QUANTITY (AF/YR)
1,000	GPM	1,614*

*This quantity is non-additive to CG1-*02509C@1 (GWC 1513) and CG1-*03899C (GWC 3058). The total annual quantity (Qa) available under all three rights shall not exceed 2,055 af/yr with a maximum instantaneous withdrawal rate (Qi) of 2,870 gpm. With the recent addition of CG1-*10690C (GWC 7700), the total annual quantity of the City's water right portfolio is 2,140 af/yr with a maximum Qi of 2,930 gpm.

Purpose

PURPOSE	WITHDRAWAL RATE ADDITIVE	WITHDRAWAL RATE NON-ADDITIVE	UNITS	ANNUAL QUANTITY (AF/YR) ADDITIVE	ANNUAL QUANTITY (AF/YR) NON-ADDITIVE	PERIOD OF USE (mm/dd)
Municipal	1,000		GPM		1,614	01/01-12/31

IRRIGATED ACRES ADDITIVE	IRRIGATED ACRES NON-ADDITIVE	PUBLIC WATER SYSTEM INFORMATION WATER SYSTEM ID	PUBLIC WATER SYSTEM INFORMATION CONNECTIONS
		24850 M	5,099

Source Location

COUNTY	WATERBODY	TRIBUTARY TO	WATER RESOURCE INVENTORY AREA
Whatcom	Regional Aquifer		1 - Nooksack

SOURCE FACILITY/DEVICE	PARCEL	WELL TAG	TWN	RNG	SEC	QQ Q	LATITUDE	LONGITUDE
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8447	-122.6088
PW-3 (Thornton Road Well)	390124392440	BHX510	39N	1E	24	NW NE	48.8605	-122.6226

PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[1]	See area outlined on Figure 1 (Attached)						-	-

Datum: NAD83/WGS84

[1] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Place of Use (See Attached Map)

LEGAL DESCRIPTION OF AUTHORIZED PLACE OF USE

The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.

Proposed Works

The City of Ferndale has four existing wells (designated as the Shop, Douglas Road, Thornton Road, and Central City Wells). Additional future wells (Figure 1) in the Regional Aquifer may be incorporated into the City's existing water system as part of this consolidation project.

Development Schedule

BEGIN PROJECT	COMPLETE PROJECT	PUT WATER TO FULL USE
Begun	December 31, 2031	December 31, 2036

Measurement of Water Use

How often must water use be measured?	Daily
How often must water use data be reported to Ecology?	Annually
What volume should be reported?	Total Annual Volume for each well
What rate should be reported?	Annual Peak Rate of Withdrawal (gpm) for each well

Provisions

No Impairment of Existing Rights

This authorization to make use of public waters of the state is subject to existing rights, including any existing rights held by the United States for the benefit of tribes under treaty or settlement. If impairment does occur, the City will be required to diminish or cease pumping, or mitigate for this impairment.

Same Source Requirement

Any new wells installed under this change authorization shall be completed within the Regional Aquifer (i.e., the same source of water as the City's four existing wells). The City must file with the Department of Ecology a Showing of Compliance with RCW 90.44.100(3) prior to the use of any new wells.

Wells, Well Logs and Well Construction Standards
All wells constructed in the state must meet the construction requirements of WAC 173-160 titled "Minimum Standards for the Construction and Maintenance of Wells" and RCW 18.104 titled "Water Well Construction". Any well which is unusable, abandoned, or whose use has been permanently discontinued, or which is in such disrepair that its continued use is impractical or is an environmental, safety or public health hazard must be decommissioned.

Flowing wells must be constructed and equipped with valves to ensure that the flow of water can be completely stopped when not in use. Likewise, the well must be continuously maintained to prevent the waste of water through leaky casings, pipes, fittings, valves, or pumps -- either above or below land surface.

All wells must be tagged with a Department of Ecology unique well identification number. If you have an existing well and it does not have a tag, please contact the well-drilling coordinator at the Department of Ecology Northwest Regional Office. This tag must remain attached to the well. If you are required to submit water measuring reports, reference this tag number.

Installation and maintenance of an access port as described in WAC 173-160- 291(3) is required.

Measurements, Monitoring, Metering and Reporting
An approved measuring device must be installed and maintained for each of the sources identified by this water right in accordance with the rule "Requirements for Measuring and Reporting Water Use", WAC 173-173.

Department of Ecology personnel, upon presentation of proper credentials, must have access at reasonable times, to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.

WAC 173-173 describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition the Department of Ecology for modifications to some of the requirements.

Water Level Measurements
In order to maintain a sustainable supply of water, pumping must be managed so that static water levels do not progressively decline from year to year. Static water level is defined as the water level in a well when no pumping is occurring and the water level has fully recovered from previous pumping. Static water levels must be measured and recorded twice a year (April and October), using a consistent methodology. Data for the previous year must be submitted by January 31 to the Department of Ecology.

Static water level data must be submitted in digital format and must include the following elements:

Unique Well ID Number
Measurement date and time
Measurement method (air line, electric tape, pressure transducer, etc.)
Measurement accuracy (to nearest foot, tenth of foot, etc.)
Description of the measuring point (top of casing, sounding tube, etc.)
Measuring point elevation above or below land surface to the nearest 0.1 foot

Land surface elevation at the well head to the nearest foot.
Static water level below measuring point to the nearest 0.1 foot.

Department of Health Requirements
Prior to any new construction or alterations of a public water supply system, the State Board of Health rules require public water supply owners to obtain written approval from the Office of Drinking Water of the Washington State Department of Health. Please contact the Office of Drinking Water at Northwest Drinking Water Operations, 20435 72nd Avenue S, Suite 200, K17-12, Kent, WA 98032-2358, (253) 396-6750, prior to beginning (or modifying) your project.

Easement and Right-of-Way
Issuance of a water right change authorization by this department does not convey a right of access to, or other right to use, land which the applicant does not legally possess. Obtaining such a right is a private matter between applicant and owner of that land.

Water Use Efficiency
Use of water under this authorization will be contingent upon the water right holder's maintenance of efficient water delivery systems and use of up-to-date water conservation practices consistent with established regulation requirements and facility capabilities.

Proof of Appropriation
The water right holder must file the notice of Proof of Appropriation of water (under which the certificate of water right is issued) when the permanent distribution system has been constructed and the quantity of water required by the project has been put to full beneficial use. The certificate will reflect the extent of the project perfected within the limitations of the superseding permit. Elements of a proof inspection may include, as appropriate, the source(s), system instantaneous capacity, beneficial use(s), annual quantity, place of use, and satisfaction of provisions.

Schedule and Inspections
Department of Ecology personnel, upon presentation of proper credentials, will have access at reasonable times, to the project location, and to inspect at reasonable times, records of water use, wells, measuring devices and associated distribution systems for compliance with water law.

Findings of Facts
Upon reviewing the investigator's report, I find all facts, relevant and material to the subject application, have been thoroughly investigated and that the subject permit (G1-00720P) is in good standing and is eligible for change. Furthermore, I find the change of water right as recommended is from the same body of public groundwater, and will not be detrimental to existing rights or the public interest.

Therefore, I ORDER the change to consolidate the multiple points of withdrawal requested in Change Application No. CG1-00720P@1, be approved, subject to existing rights and the provisions specified above, and a superseding permit be issued.

Your Right To Appeal

You have a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of the Order.

File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

- You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503 **Pollution Control Hearings Board** 1111 Israel RD SW Suite 301 Tumwater, WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

- Please send a copy of your appeal to:

  Tom Buroker, Section Manager
  Water Resources Program
  Northwest Regional Office
  3190 – 160th Avenue SE
  Bellevue, WA 98008

Signed at Bellevue, Washington, this 26th day of August 2016.

Tom Buroker, Section Manager

For additional information visit the Environmental Hearings Office Website: http://www.eho.wa.gov. To find laws and agency rules visit the Washington State Legislature Website: http://www1.leg.wa.gov/CodeReviser.

BACKGROUND

This report serves as the written findings of fact concerning Water Right Application Number CG1-00720P@1.

On November 19, 2014, the City of Ferndale (City) filed four Applications for Change with the Washington State Department of Ecology (Ecology) to consolidate withdrawal locations for all of the City's sources for four water rights and allow flexibility among three existing points of withdrawal and additional future points of withdrawal. The additional points of withdrawal will be determined based on test wells to evaluate locations with appropriate water quality and production capabilities to meet the City's needs. The four applications are:

Table 1. Change Applications Filed by the City of Ferndale

Change Application	Source	Water Right	Type	Priority Date
CG1-*02509C@1	PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952
CG1-*03899C	PW-1 Shop Well	GWC 3058	Certificate	2/28/1955
CG1-00720P@1	PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971
CG1-*10690C	PW-4 Central City Well	GWC 7700	Certificate	3/10/1970

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

The City's water system currently serves a residential population of approximately 12,920 people with approximately 6,611 equivalent residential units (ERUs). The City's water system consists of water withdrawal, conveyance, storage, and treatment facilities. The place of use is consistent with the 2010 update to the 2006 City of Ferndale Water System Plan, which is within the designated City water service area (Reichhardt & EBE Engineering Inc. 2010).

Existing and requested water right attributes for the specific water right addressed by this Report of Examination (ROE) are as follows:

EXISTING Water Right Attributes

Water Right Owner:	City of Ferndale
Priority Date:	July 22, 1971
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer		1 - Nooksack

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	1,000	GPM	1,614	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8605	-122.6226

Datum: NAD83/WGS84

WRIA = Water Resource Inventory Area; GPM = Gallons per Minute; Ac-ft/yr = Acre-feet per year; Twp = Township; Rng = Range; Sec. = Section; QQ Q = Quarter-quarter of a section

REQUESTED Water Right Attributes

Applicant Name:	**City of Ferndale**
Date of Application:	November 19, 2014
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer[1]		1 - Nooksack

[1] Also referred to as Deep Confined Aquifer

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	1,000	GPM	1,614	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8447	-122.6088
PW-3 (Thornton Road Well)	390124392440	BHX510	39N	1E	24	NW NE	48.8605	-122.6226
PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[2]	See area outlined on Figure 1 (Attached)							

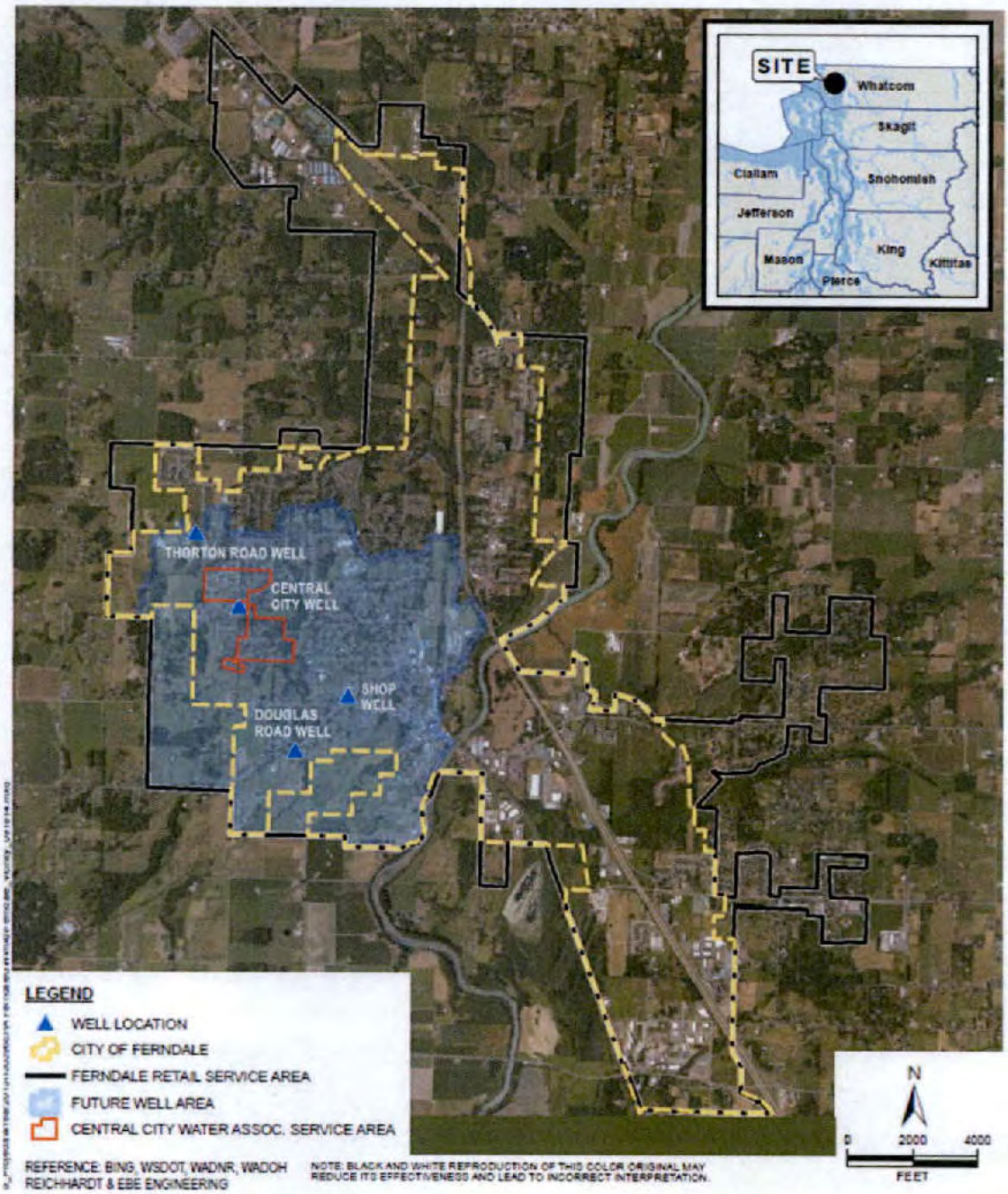
Datum: NAD83/WGS84

[2] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Cost Reimbursement

This application is being processed under a cost reimbursement agreement between the applicant the Department of Ecology. This report has been prepared by Aspect Consulting, LLC (Aspect) and reviewed by Ecology.

Figure 1. City of Ferndale Well Locations and Vicinity (source: AESI, 2013, modified by AESI in 2015)



Legal Requirements for Requested Change

Public Notice

RCW 90.03.280 requires that notice of a water right application be published once a week, for two consecutive weeks, in a newspaper of general circulation in the county or counties where the water is to be stored, diverted and used. Notice of this application was published in the Ferndale Record on February 11, 2015 and February 18, 2015.

Protest

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows.

Consultation with the Department of Fish and Wildlife

The Department must give notice to the Department of Fish and Wildlife (WDFW) of applications to divert, withdraw, or store water. Notice was provided to WDFW on January 14, 2016, of the four change applications filed by the City.

On January 29, 2016, Steve Boessow of WDFW responded in a letter to Ecology that:

> *"...based on impacts to fish and/or wildlife and the habitat they rely on, and pursuant to Chapter 77.57.020 RCW, WDFW does not oppose the issuance of these applications. These change applications do not increase the quantity of water allowed under any of the 4 water rights. Consolidation of wells is unlikely to impact fish."*

State Environmental Policy Act (SEPA)

A water right application is subject to a SEPA threshold determination (i.e., an evaluation whether there are likely to be significant adverse environmental impacts) if any one of the following conditions are met:

- It is a surface water right application for more than 1 cubic foot per second, unless that project is for agricultural irrigation, in which case the threshold is increased to 50 cubic feet per second, so long as that irrigation project will not receive public subsidies;
- It is a groundwater right application for more than 2,250 gallons per minute;
- It is an application that, in combination with other water right applications for the same project, collectively exceed the amounts above;
- It is a part of a larger proposal that is subject to SEPA for other reasons (e.g., the need to obtain other permits that are not exempt from SEPA);
- It is part of a series of exempt actions that, together, trigger the need to do a threshold determination, as defined under WAC 197-11-305.

This project is not categorically exempt from SEPA, because the four change applications associated with the project total more than 2,250 gallons per minute in additive instantaneous quantity. The total instantaneous quantity associated with the combined change applications is 2930 gallons per minute (gpm).

The City prepared a SEPA checklist and notice was posted in the Ferndale Record on February 10, 2016. No public comments were received during the public comment period, and a Determination of Non-Significance (DNS) was issued.

Water Resources Statutes and Case Law

RCW 90.03.380(1) states that a water right that has been put to beneficial use may be changed. The point of diversion, place of use, and purpose of use may be changed if it would not result in harm or injury to other water rights. The Washington Supreme Court has held that Ecology, when processing an application for change to a water right, is required to make a tentative determination of extent and validity of the claim or right. This is necessary to establish whether the claim or right is eligible for change. *R.D. Merrill v. PCHB* and *Okanogan Wilderness League v. Town of Twisp.*

RCW 90.03.386(3) requires a municipal water supplier to apply cost-effective water conservation measures as part of its water system planning. The water supplier must also evaluate the effects of delaying the use of inchoate water rights before it may increase use of those inchoate rights. RCW 90.03.320 requires Ecology to consider the public water supplier's use of conserved water when establishing a surface or ground water right construction schedule. The City's conservation program is outlined in Chapter 4 of the current water system plan (Reichhardt & EBE Engineering Inc. 2010).

RCW 90.03.386(2) states that a municipal water supplier may change its service area through the water system plan approval process. As long as the municipal water supplier is in compliance with the approved plan, the place of use for the water right is the service area of the plan.

RCW 90.44.100 allows Ecology to amend a ground water permit to: (1) allow the user to construct a replacement or additional well at a new location outside of the location of the original well, or to (2) change the manner or place of use of the water, if:

- The additional or replacement well taps the same body of public ground water as the original well. RCW 90.44.100(2)(a),
- Where a replacement well is approved, the user must discontinue use of the original well and properly decommission the original well. RCW 90.44.100(2)(b),
- Where an additional well is constructed, the user may continue to use the original well, but the combined total withdrawal from all wells shall not enlarge the right conveyed by the original permit or certificate. RCW 90.44.100(2)(c),
- Other existing rights shall not be impaired. RCW 90.44.100(2)(d).

When changing or adding points of withdrawal to groundwater rights (RCW 90.44.100), or when consolidating exempt wells with an existing permit or certificate (RCW 90.44.105), the wells must draw from the *same body of public groundwater*. Indicators that wells tap the *same body of public groundwater* include:

(a) Hydraulic connectivity.
(b) Common recharge (catchment) area.
(c) Common flow regime.
(d) Geologic materials that allow for storage and flow, with recognizable boundaries or effective barriers to flow.

INVESTIGATION

In consideration of this application, Aspect reviewed available documents pertaining to the application's site conditions, existing well installations, and the potential effect of the proposed change on existing water right holders and established minimum instream flows. This review included information submitted by the applicant, including well construction and testing reports, water system plan, and water level data, along with pertinent Ecology records, including well logs and water rights records. The review also included reports from multiple investigations characterizing the hydrogeology of the Ferndale area and Mountain View Upland.

A site visit was performed on July 21, 2015. Carl Einberger of Aspect met with City representative Mike Olinger to discuss the application, visit existing well locations and the area proposed as future withdrawal points, and to discuss the City's current water system operations.

Using the available information in the Ecology file record, existing reports, the site visit, and communications with the City, Aspect evaluated potential effects of the proposed consolidation of withdrawal locations for the four water rights involved in the package of change applications. The City's water rights are discussed in more detail in the following section.

Existing Water Rights

The following table summarizes the City's existing water rights. The subject of this report is G1-00720P, however all of these water rights have change applications being processed together, and all are discussed in this report.

Table 2. City of Ferndale's Water Rights Portfolio

Source	Water Right	Type	Priority Date	Qi in gpm	Qa in ac-ft/yr	
					Additive	Non-Additive
PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952	1000	1615	-
PW-1 Shop Well	GWC 3058	Certificate	2/28/1955	870	440[1]	-
PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971	1000	-	1614[1]
PW-4 Central City Well	GWC 7700	Certificate	3/10/1970	60	85	-
			Total	2930	2140	1614

[1]There is some confusion in the water right record as to the total annual quantity allowed to be withdrawn under all City of Ferndale water rights. As a result, Reports of Examination prepared for changes to GWC 1513 and G1-00720P in 2004 tentatively determined that the City of Ferndale should be allowed under its then existing water rights to withdraw up to a combined 2,055 acre-feet per year from all three of its then existing water rights and permits. The Superseding Permit issued in 2004 for G1-00720P noted that the total annual quantity from GWC 1513, GWC 3058, and G1-00720 shall not exceed 2,055 acre-feet per year. In 2014, the City of Ferndale acquired GWC 7700, giving the City a total combined annual quantity from the four water rights of 2,140 acre-feet per year. A recent review of files as part of this investigation suggests the interpretation noted in Table 2 is the intent of the original water right approvals.

Table 3 summarizes the nomenclature historically applied to these water rights:

Table 3. Water right and change reference numbers

Source	Original Designation	Previous Change Reference #'s	Current Change Reference #'s
PW-2 Douglas Road Well	GWC 1513	G1-*02509C	CG1-*02509C@1
PW-1 Shop Well	GWC 3058	G1-*03899C	CG1-*03899C
PW-2 Douglas Road Well	G1-00720P	-	CG1-00720P@1
PW-4 Central City Well	GWC 7700	-	CG1-*10690C

The Thornton Creek Well, PW-3, did not have any water rights associated with it as of the time of submittal of this change application, but is a requested point of withdrawal under this consolidation project and change request.

History of Water Use

The City has a complicated water supply history dating back to the early 1950s. All four of the water rights that have change applications filed for points of withdrawal consolidation are discussed in this summary.

A synopsis of key historical information includes:

- The City obtained two water rights in the early 1950s: GWC 1513 with a priority date of 5/9/52 and GWC 3058 with a priority date of 2/28/55. Both of these rights were certificated in the 1950s.

- The above water rights and associated wells near the City shop provided the main source of water for the City until 1975 (Reichhardt & EBE Engineering Inc. 2010).

- In 1971, the City obtained a permit for an additional water right at the City shop (G1-00720P).

- In 1974 the City entered into an agreement with Whatcom County Public Utilities District No. 1 (PUD 1) to provide water from the Nooksack River. It appears this was done to address water quality concerns in the existing wells. A water treatment plant was constructed in 1975 to switch to potable treated water from the Nooksack River. The well now known as the City Shop Well (PW-1) remained connected and used and relied on as an emergency and back-up water source; however, use of the well as a main source of water temporarily ceased.

- In early 1994, the City relocated one well (not the existing Shop Well) from the City shop area to the Douglas Road site to allow construction of a library near the shop location. This well (PW-2) was drilled but was not connected to the system (Reichhardt & EBE Engineering Inc. 2010) at that time. The City of Ferndale filed change applications for GWC 1513 and G1-00720P in 1992 for this relocation. GWC 3058 remained associated with a second well at the City Shop Well.

- In 2003, Ecology prepared a Hydrogeologic Report (Ecology, 2003) and ROEs supporting the above changes were completed in 2004. The change to G1-00720P was approved in a Superseding Permit on June 8, 2004. The change to GWC 1513 was approved by Ecology in a Superseding Certificate issued on February 25, 2005.

- Several years ago, the City began evaluating the possibility of switching off PUD water and returning to the City's back-up groundwater sources as the City's primary source of water. This switch had been encouraged by the Washington State Department of Health (DOH) for several years. The City also wanted to gain more control over costs of water delivery and treatment options for the water system (Associated Earth Sciences, Inc., 2013). This switch occurred on December 14, 2012.

- Soon after switching to the City's production wells as the primary source of water, the City encountered water quality changes from the both the Shop Well and the Douglas Road Well, with unanticipated increases in hardness and chloride. In response to this, the City installed a nanofiltration (reverse osmosis) treatment system to improve the quality of water delivered to its customers (Associated Earth Sciences, Inc., 2013).

- Records provided by the City indicate the City's two active wells (Douglas Well and the Shop Well), have had increasing production annually in the period from 2012 to 2015. In 2014, the Douglas and Shop Wells produced approximately 775 ac-ft/yr and 485 ac-ft/yr, respectively. In 2015, the Douglas and Shop Wells produced approximately 1,062 ac-ft/yr and 277 ac-ft/yr, respectively. Based on the change applications described above, the City currently exercises GWC 1513 and a portion of G1-00720P from the Douglas Well and exercises GWC 3058 from the Shop Well. Annual quantities associated with each of these wells and their corresponding water rights are set forth in Table 5 below. See also Table 2 describing the City's water rights portfolio, including authorized annual quantities.

- In 2014, the City acquired a water right (GWC 7700) from the Central City Water Association (CCWA). The CCWA water right was originally certificated for community domestic supply (and municipal as a matter of law) and is authorized for 60 gpm and 85 ac-ft/yr. While the water right has been inactive since the acquisition, as part of this consolidation request the City intends to reactivate beneficial use of this water right. A review of records filed with DOH from 2009 to 2014 indicates that this water right was actively used prior to acquisition for 15 or more connections. In 2014, Ecology issued an amended certificate to the City for GWC 7700 conforming its purpose of use to municipal supply for the authorized 60 gpm and 85 ac-ft/yr.

City-Wide Growth and Diligence

As set forth in Table 5 below, the City's water use records show that it has exercised in full the quantities authorized under GWC 3058 (authorizing 440 ac-ft/yr) from the Shop Well, and has exercised up to 1,062 ac-ft/yr out of the total authorized under GWC 1513 (authorizing 1,615 ac-ft/yr) and G1-00720P (providing supplemental non-additive annual quantities) from the Douglas Well, leaving approximately 553 ac-ft/yr of municipal inchoate water under GWC 1513 and G1-00720P. The City has and continues to exercise good faith and diligence in development of this inchoate portion of its water rights.

In a letter dated June 3, 2016, Joseph A. Rehberger of Cascadia Law Group, on behalf of the City of Ferndale, provided the following information on City-wide growth and diligence in growing into the inchoate portions of GWC 1513, G1-00729P, and GWC 3058. Mr. Rehberger's letter included a number of attachments which are now on file with Ecology.

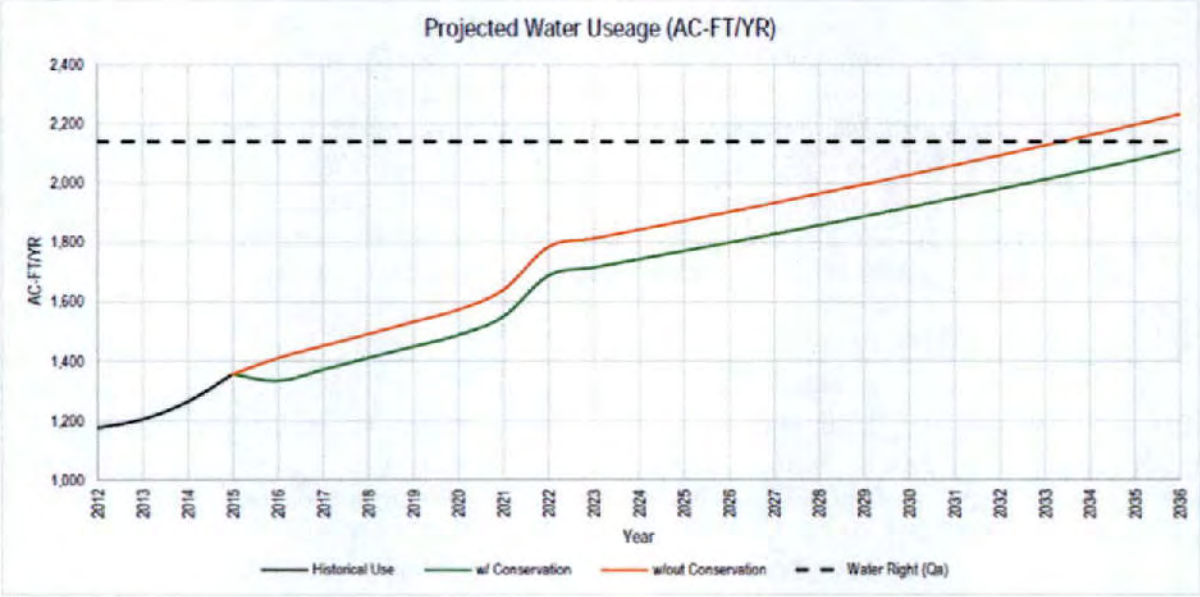
The City of Ferndale has been a growing community within Whatcom County for decades. That growth is expected to continue. The following table and graph from the City's *2016 Water System Plan, City of Ferndale* (Working Draft May 2016) describe the City's population growth from 1980 through 2015 and projected water usage through 2036 (see table and graph below).

Table 4.

Year	Population
1980	3,855
1990	5,398
2000	8,758
2010	11,415
2013	11,831
2014	12,710
2015	12,920

Source: Washington State Office of Financial Management
City of Ferndale, May 2016

Figure 2.



The following table shows the City's water use trends and increased use associated with current growth (units are in thousand gallons).

Table 5.

Month	2012		2013		2014		2015	
	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well
January	0	0	20,044	9,753	11,653	16,424	12,963	18,146
February	0	0	17,448	8,455	10,976	15,379	10,602	16,742
March	9,888	13,274	20,843	10,267	12,239	17,100	11,528	19,158
April	9,880	17,152	18,390	8,920	11,746	16,578	11,623	19,257
May	13,088	21,028	19,020	12,270	13,465	18,693	13,083	24,416
June	12,566	19,298	20,113	14,273	15,998	21,443	13,993	36,822
July	16,377	19,930	22,057	27,815	14,842	32,414	9,520	44,060
August	23,287	20,150	16,437	27,333	14,306	30,416	6,115	40,504
September	25,066	9,249	11,860	20,049	12,239	24,548	80	32,429
October	22,132	7,189	11,586	17,614	13,072	20,778	398	31,921
November	18,546	9,897	10,827	16,307	13,531	18,588	112	31,265
December	19,158	10,209	12,149	17,039	13,965	19,637	471	31,286
Total	169,988	147,376	200,774	190,095	158,032	251,998	90,488	346,006
Combined Total	317,364		390,869		410,030		436,494	

The City's Annexation History Map (on file with Ecology), shows the City's progressive annexation and growth of its municipal boundaries from the 1940s through present. The City's current urban growth area (UGA) and future growth and annexation phasing plan through 2034 are described in the City of Ferndale *Annexation Blueprint, Annexation Phasing Plan: 2013-2034* (also on file with Ecology).

The City is in the process of updating its Water System Plan (*2016 Water System Plan, City of Ferndale).* The City's May 2016 working draft estimates a City-wide population growth rate of approximately 2.32%, increasing from a population of 12,920 in 2015 to 20,072 in 2036.

Table 6.

Year	District								Total Pop.
	1	2	3	4	5	6	7	8	
2013	269	333	759	1,403	7,311	1,036	508	212	11,831
2014	282	352	817	1,518	7,831	1,131	548	231	12,710
2015	283	354	829	1,555	7,936	1,165	560	238	12,920
2016	283	357	847	1,600	8,079	1,208	574	246	13,194
2017	283	360	865	1,646	8,224	1,252	589	255	13,474
2018	284	363	883	1,693	8,371	1,298	604	264	13,760
2019	284	366	902	1,741	8,521	1,346	619	273	14,052
2020	284	369	921	1,790	8,673	1,395	635	283	14,350
2021	285	372	940	1,840	8,827	1,445	651	294	14,654
2022	285	375	960	1,892	8,984	1,498	667	304	14,965
2036	290	417	1,278	2,776	11,455	2,431	937	488	20,072
Growth Rate	0.33%	0.98%	2.29%	3.01%	1.97%	3.78%	2.70%	3.69%	2.32%

This corresponds to a projected increase in ERUs from 6,611 in 2015 to an estimated 11,352 ERUs in 2036.

Table 7.

Year	ERUs				Total
	Single-Family	Multi-Family	Commercial / Industrial	Irrigation	
2013	4,071	682	1,008	525	6,286
2014	4,169	689	1,149	567	6,574
2015	4,286	689	997	639	6,611
2016	4,365	704	1,074	659	6,802
2017	4,446	719	1,153	680	6,998
2018	4,529	733	1,232	700	7,194
2019	4,614	748	1,307	721	7,390
2020	4,701	763	1,380	742	7,586
2021	4,790	778	1,578	762	7,908
2022	4,881	793	2,150	783	8,607
2036	6,420	1,046	2,722	1,164	11,352

Using these projections, the City is expected to be at or in excess of its current water rights (2,140 af/yr) by 2036.

Table 8.

			ADD (MGD)		MDD (MGD)		PHD (GPM)		Annual (AC-FT/YR)	
Year	Total Population	ERUs	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons
2013	11,831	6,286	1.08	1.08	1.91	1.91	2,194	2,194	1,205	1,205
2014	12,710	6,574	1.13	1.13	1.91	1.91	1,300	1,300	1,265	1,265
2015	12,920	6,611	1.21	1.21	2.07	2.07	2,366	2,366	1,356	1,356
2016	13,194	6,802	1.19	1.26	2.07	2.21	2,371	2,526	1,334	1,410
2017	13,474	6,998	1.22	1.29	2.13	2.27	2,438	2,596	1,372	1,451
2018	13,760	7,194	1.26	1.33	2.19	2.34	2,504	2,667	1,411	1,491
2019	14,052	7,390	1.29	1.37	2.25	2.40	2,571	2,738	1,449	1,532
2020	14,350	7,586	1.33	1.40	2.31	2.47	2,637	2,809	1,488	1,573
2021	14,654	7,908	1.38	1.46	2.41	2.57	2,746	2,925	1,551	1,639
2022	14,965	8,607	1.51	1.59	2.63	2.80	2,983	3,177	1,688	1,784
2036	20,072	10,770[1]	1.88	1.99	3.28	3.50	3,716	3,958	2,112	2,232

Based on the information provided by the City and upon Ecology's review, it is tentatively determined that the subject water right permit is in good standing and is eligible for change. The City is a growing system, in good-standing, with a State Department of Health green operating permit.

Proposed Use

The only change proposed for G1-00720P is to allow the authorized quantities to be used with flexibility at any of the City's current points of withdrawal, and at possible new points of withdrawal within the area outlined on Figure 1. The goal is to allow the City the opportunity to tailor water withdrawals to water needs throughout the City's service area. In addition, the City is interested in finding potential new points of withdrawal that may have improved water quality compared to the current source wells.

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

Investigation of New Points of Withdrawal

The City has engaged Wilson Engineering and AESI to assist with identifying potential locations for new wells and with drilling test wells. A hydrogeologic evaluation in support of this goal was completed in 2013 that proposed drilling and testing of a new well at a location near the northwest corner of the City limits. This was designated as the "Thornton Road Well" location (AESI, 2013).

AESI considered the Thornton Road location to be promising from both a water quantity and quality standpoint. In addition, AESI recognized that the Thornton Road location was in the same surface water drainage basin as the existing Douglas Road, Shop, and Central City Wells, supporting the ability to withdraw from the same source of groundwater as these wells, thus aiding the addition of this location as a point of withdrawal. AESI noted that the nearby Thornton Road Water Association well has lower concentrations of sodium, chloride, conductivity, TDS, and manganese than the City's production wells.

In 2014, a test well was drilled under AESI's supervision at the Thornton Road Well location to 450 feet of depth. AESI concluded that the well could achieve a long-term yield of approximately 350 to 375 gpm. Test pumping of the well for 24 hours at 315 gpm did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well. Elevated water quality for manganese, conductivity, color, and total dissolved solids were noted, indicating that the water would require treatment to meet DOH standards for public water supply. No decision on future use of this well by the City has been made at this time, and additional locations within the proposed 'future well area' outlined on Figure 1 may be investigated for potential production well drilling and construction.

Other Rights Appurtenant to the Place of Use

As part of this investigation, Aspect obtained water right records from Ecology's database for the area proposed for potential future wells identified in Figure 1, including a ½ mile buffer outside of this area. Note that this area also includes the City's existing points of withdrawal.

Thirteen certificated groundwater rights were identified, with the majority of these being for domestic use. The largest of these were two domestic and stockwater rights owned by F. Imhoff, with each authorized for an instantaneous withdrawal (Qi) of 50 gpm and annual quantity (Qa) of 80 ac-ft/yr.

These are located approximately ½ mile southeast of the City's Douglas Well. A review of the associated well log indicates a completion depth of 195 feet, likely within the Regional Aquifer.

In addition, there are 68 claims, all for groundwater use, within the search area. It is expected that many of the water rights found in this review are not being exercised, given the availability of public water supply from the City's system in much of the search area.

Hydrologic/Hydrogeologic Evaluation

The portions of the City of Ferndale area of interest for this investigation are located west of the Nooksack River near River Mile 6 (Figure 1), in the Fraser-Whatcom basin (additional incorporated areas of the City are located east of the Nooksack River). The western portion of the City water service area is within the Mountain View Upland, with elevations up to 360 feet near the Thornton Road Well. Areas closer to the river are lower in elevation and are part of the Nooksack River valley, with elevations as low 20 feet.

The Fraser-Whatcom basin was subject to repeated glaciation during the Pleistocene Epoch, and several hundred feet of glacial and interglacial sediments are present in the area, with bedrock found at considerable depth. The deepest well in the project area was drilled to a depth of 440 feet and did not encounter bedrock (AESI, 2013).

Overview of Groundwater Occurrence

Groundwater in the Ferndale area is found in discontinuous perched groundwater aquifers and in a single Regional Aquifer that appears to be composed of predominantly pre-Vashon deposits. Aspect (2009) conducted a study of the Mountain View Upland, which extends from the western upland portions of the City of Ferndale west to the Strait of Georgia. Seven hydrostratigraphic units were delineated:

> *The upper fine-grained unit (F1/F2) consists predominantly of glacial marine drift and potentially Sumas and Vashon age till. Shallow perched groundwater occurs above the F1 unit and within coarse-grained lenses interbedded with the F1 unit. A coarse-grained unit (C2) underlies the F1 unit and appears to be correlative with Vashon advance outwash (Mountain View Sand and Gravel). The C2 unit is generally unsaturated. Deeper units, interpreted as the Cherry Point silt and other pre-Vashon, fine-grained deposits, are found beneath the C2 units and form a lower aquitard (F3).* ***The regional aquifer in the study area is present predominantly in the coarse-grained C3 unit that is thought to be correlative with the pre-Fraser deposits, and in more permeable portions of the F3 unit (typically silty sands), as indicated by several productive wells completed within these zones.***

A review of well logs for the City's existing four wells and stratigraphic cross sections (Aspect, 2009) suggests that they are completed in the same source of water, the Regional Aquifer (see Table 9).

Table 9. Existing City Wells and Interpreted Aquifer		
Source	Completion Depth (feet)	Interpreted Aquifer
Douglas Road Well	152	Regional Aquifer
Shop Well	160	Regional Aquifer
Central City Well	290	Regional Aquifer
Thornton Road Well	450	Regional Aquifer

Groundwater Flow in the Regional Aquifer

Aspect (2009) also evaluated groundwater flow directions in the Regional Aquifer in the Mountain View Upland. Based on a review of these data, mapped for both March and October of 2008, groundwater flows in the southeastern portion of the Mountain View Upland near Ferndale generally trend southeast toward the Nooksack River. All of the area of interest for this investigation appears to be in the same source of water, with the Regional Aquifer flowing toward the Nooksack River. In addition to being consistent with Aspect's previous interpretation, this is also consistent with Ecology's previous interpretation in the hydrogeologic report for changes to the City's GWC 1515 and G1-00720P water rights (Ecology, 2003).

Key Aquifer Test Data and Potential Impairment

Ecology (2003) reviewed pumping tests conducted in 1994 on the Douglas Road Well. A step test and a 26-hour constant rate pumping test were conducted by GeoEngineers, with a well approximately 2200 feet away used as a monitoring well. This well had very limited drawdown observed during the test (0.33 feet). GeoEngineers (1994) also conducted an additional impairment analysis. This suggested that a nearby well (at Ferndale Mobile Village), would have experienced approximately 13 feet of drawdown from the 26-hour pumping test. Ecology concluded that no impairment would occur at this well, given the 120 feet of available drawdown.

As noted previously, the test well drilled into the Regional Aquifer in 2014 at the Thornton Road well location did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well, during a 24 hour pump test.

In general, based on a review of selected well logs, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1).

Impairment Considerations

Impairment of Minimum Instream Flow Water Rights

The term "instream flow" is used to identify a specific stream flow (typically measured in cubic feet per second, or cfs) at a specific location for a defined time, and typically following seasonal variations.

Instream flows are usually defined as the stream flows needed to protect and preserve instream resources and values, such as fish, wildlife and recreation. Instream flows are most often described and established in a formal legal document, typically an adopted state rule.

Once established, a minimum flow constitutes an appropriation with a priority date as of the effective date of the rule establishing the minimum flow (RCW 90.03.345). Thus, a minimum flow set by rule is an existing right which may not be impaired (RCW 90.03.345; RCW 90.44.030).

Minimum instream flows were established for the Nooksack River Water Resource Inventory Area (WRIA 1) by WAC 173-501 in 1985. None of the four water rights involved with this project are junior to the instream flow rule, and as such, they are not subject to curtailment when instream flows are not met. No additional impacts to instream flows are expected to result from authorization of this change request, given that there is no enlargement of the water right through this consolidation process. WDFW has concurred with this opinion, as noted in their January 29, 2016, letter to Ecology.

Impairment, Qualifying Ground Water Withdrawal Facilities, and Well Interference

There are three concepts that are important when considering whether a withdrawal of water from a well would impair another existing water right. The concepts are defined as follows:

1. Impairment is an adverse impact on the physical availability of water for a beneficial use that is entitled to protection (i.e., water rights that are both senior and junior in priority to the right the applicant seeks to change).

2. Qualifying ground water withdrawal facilities are defined as those wells which in the opinion of the Department are adequately constructed. An adequately constructed well is one that (a) is constructed in compliance with well construction requirements; (b) fully penetrates the saturated thickness of an aquifer or withdraws water from a reasonable and feasible pumping lift (WAC 173-150); (c) the withdrawal facilities must be able to accommodate a reasonable variation in seasonal pumping water levels; and (d) the withdrawal facilities including pumping facilities must be properly sized to the ability of the aquifer to produce water.

3. Well interference may occur when several wells penetrate and withdraw ground water from the same aquifer. Each pumping well creates a drawdown cone. When several wells pump from the same aquifer, well density, aquifer characteristics, and pumping demand may result in individual drawdown cones that intersect and form a composite drawdown cone. At any point in an aquifer, the composite drawdown caused by pumping wells will be greatly influenced by the transmissivity (T) of the aquifer. In aquifers with high Ts, composite drawdown will generally be much less than in aquifers with similar properties but with low Ts. Transmissivity is related to hydraulic conductivity (K) and the saturated thickness (b) of an aquifer by the relationship T=Kb.

   An aquifer's hydraulic conductivity (K) is derived from the physical properties of both the fluid and geologic materials that form an aquifer. Once formed, an aquifer's saturated thickness (b) becomes important in evaluating its transmissivity. For regions of similar K in an aquifer, a large saturated thickness will result in a much higher T than a small saturated thickness. As a result, regions of similar K in an aquifer with a large saturated thickness will experience less composite drawdown or well interference than with a small saturated thickness.

Some conditions, however, will increase or steepen composite drawdown in an aquifer. For instance, where characteristics (such as very fine, clay-rich, or poorly sorted sediments) of an unconfined aquifer cause significant drawdown relative to the saturated thickness, the composite drawdown will increase as saturated thickness is reduced and T becomes smaller. Additionally, in regions where negative or no-flow boundaries occur, such as near the edges of a valley fill aquifer where it is bounded by bedrock, composite drawdown will be steeper than in the central part (generally the greatest thickness region) of the aquifer. Consequently, it is commonly understood that the greatest composite drawdown or well interference is more likely to occur in regions of low transmissivities, thin saturated thicknesses and near negative or no-flow boundaries than in regions of high transmissivities, large saturated thicknesses, and away from negative or no-flow boundaries.

As noted in the review of pump test information and well log review noted previously, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1). No impairment issues are anticipated based on approval of the consolidation project and this associated change request.

Public Interest Considerations

No potential for detriment to the public interest was identified during the investigation of this water right change application.

Consideration of Protests and Comments

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows. However, this is a change application and not an application for new (consumptive) water use. Because the quantities of water involved will remain unchanged, there will be no increase in consumptive use, and each of the sources will pump from the same body of public water, therefore no additional or new impacts are associated with the change being recommended for approval. A provision has been added that specifically identifies that this right is subject to senior water rights.

CONCLUSIONS

The full quantities (Qi and Qa) of water allocated under the subject permit are eligible to be changed.

Tentative Determination

Groundwater Permit G1-00720P is in good standing with the Department of Ecology and is therefore eligible for change.

Same Source Considerations

All of the existing points of withdrawal considered under this change are within the same source of water, the Regional Aquifer. In addition, all of the existing City wells and the area proposed for future new wells are all within the same surface water drainage basin (Schell) as delineated by Whatcom County. Provided any new points of withdrawal are limited to the area proposed in Figure 1 and the

wells are completed in the Deep Aquifer, they can be considered to also be within the same source of water.

Potential for Impairment of Existing Rights

The change requested will not impair existing rights.

Potential for Detriment to the Public Interest

The change requested will not be detrimental to the public interest.

RECOMMENDATIONS

Based on the above investigation and conclusions, I recommend this request for change be approved in the amounts and within the limitations listed below and subject to the provisions listed above.

Purpose of Use and Authorized Quantities

The amount of water recommended is a maximum limit and the water user may only use that amount of water within the specified limit that is reasonable and beneficial:

Q_i = 1,000 gpm
Q_a = 1,614 acre-feet per year (non-additive)
For Municipal Use

Points of Withdrawal

See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by AESI to support the City's water right change.

The City's existing wells also are located within this area as illustrated by Figure 1.

Place of Use

The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.



Carl M. Einberger

Carl Einberger, LG, LHG, License #1100

August 26, 2016
Date



J. R. "BUCK" SMITH

Reviewed Buck Smith, LG, LHG, License #1479

8/26/16
Date

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Selected References

Aspect Consulting, 2009. Aquifer Study of the Mountain View Upland – Lummi River Area, Whatcom County and Lummi Nation, Washington. March 2009.

Associated Earth Sciences, Inc. (AESI), 2013. City of Ferndale Hydrogeologic Evaluation, Whatcom County, Washington. December 2013.

AESI, 2014. Installation and Testing of the Thornton Road Well, Ferndale Washington. December 2014.

GeoEngineers, Inc., 2004. Installation and Testing of Production Well No. 3 Ferndale, Washington. April 1994.

Reichhardt & EBE Engineering Inc. 2010, City of Ferndale 2006 Water System Plan. Updated 2010.

Washington Department of Ecology, 2003. Hydrogeologic Report for Change to GWC 1513 and G1-00720P (City of Ferndale). November 2003.

WR File NR CG1-*03899C
WR Doc ID 6360549

DEPARTMENT OF ECOLOGY
State of Washington

State of Washington
Protested
Report of Examination for Water Right Change

Changed/added points of withdrawal

PRIORITY DATE	WATER RIGHT NUMBER
February 28, 1955	CG1-*03899C

MAILING ADDRESS	SITE ADDRESS (IF DIFFERENT)
City of Ferndale 2095 Main Street, PO Box 936 Ferndale, WA 98248	2341 Douglas Road Ferndale, WA 98248

Total Quantity Authorized for Withdrawal

WITHDRAWAL RATE	UNITS	ANNUAL QUANTITY (AF/YR)
870	GPM	440

The total annual quantity available under all four rights involved in the City's package of change requests: CG1-*02509C@1 (GWC 1513), CG1-00720P@1 (G1-00729P), CG1-*03899C (GWC 3058), CG1-*10690C (GWC 7700); shall not exceed 2,140 af/yr with a maximum withdrawal rate (Qi) of 2,930 gpm.

Purpose

PURPOSE	WITHDRAWAL RATE ADDITIVE	WITHDRAWAL RATE NON-ADDITIVE	UNITS	ANNUAL QUANTITY (AF/YR) ADDITIVE	ANNUAL QUANTITY (AF/YR) NON-ADDITIVE	PERIOD OF USE (mm/dd)
Municipal	870		GPM	440		01/01-12/31

IRRIGATED ACRES ADDITIVE	IRRIGATED ACRES NON-ADDITIVE	PUBLIC WATER SYSTEM INFORMATION WATER SYSTEM ID	PUBLIC WATER SYSTEM INFORMATION CONNECTIONS
		24850 M	5,099

Source Location

COUNTY	WATERBODY	TRIBUTARY TO	WATER RESOURCE INVENTORY AREA
Whatcom	Regional Aquifer		1 - Nooksack

SOURCE FACILITY/DEVICE	PARCEL	WELL TAG	TWN	RNG	SEC	QQ Q	LATITUDE	LONGITUDE
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8447	-122.6088
PW-3 (Thornton Road Well)	390124392440	BHX510	39N	1E	24	NW NE	48.8605	-122.6226

PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[1]	See area outlined on Figure 1 (Attached)						-	-

Datum: NAD83/WGS84

[1] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Place of Use (See Attached Map)

LEGAL DESCRIPTION OF AUTHORIZED PLACE OF USE

The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.

Proposed Works

The City of Ferndale has four existing wells (designated as the Shop, Douglas Road, Thornton Road, and Central City Wells). Additional future wells (Figure 1) in the Regional Aquifer may be incorporated into the City's existing water system as part of this consolidation project.

Development Schedule

BEGIN PROJECT	COMPLETE PROJECT	PUT WATER TO FULL USE
Begun	December 31, 2031	December 31, 2036

Measurement of Water Use

How often must water use be measured?	Daily
How often must water use data be reported to Ecology?	Annually
What volume should be reported?	Total Annual Volume for each well
What rate should be reported?	Annual Peak Rate of Withdrawal (gpm) for each well

Provisions

No Impairment of Existing Rights

This authorization to make use of public waters of the state is subject to existing rights, including any existing rights held by the United States for the benefit of tribes under treaty or settlement. If impairment does occur, the City will be required to diminish or cease pumping, or mitigate for this impairment.

Same Source Requirement

Any new wells installed under this change authorization shall be completed within the Regional Aquifer (i.e., the same source of water as the City's four existing wells). The City must file with the Department of Ecology a Showing of Compliance with RCW 90.44.100(3) prior to the use of any new wells.

Wells, Well Logs and Well Construction Standards
All wells constructed in the state must meet the construction requirements of WAC 173-160 titled "Minimum Standards for the Construction and Maintenance of Wells" and RCW 18.104 titled "Water Well Construction". Any well which is unusable, abandoned, or whose use has been permanently discontinued, or which is in such disrepair that its continued use is impractical or is an environmental, safety or public health hazard must be decommissioned.

Flowing wells must be constructed and equipped with valves to ensure that the flow of water can be completely stopped when not in use. Likewise, the well must be continuously maintained to prevent the waste of water through leaky casings, pipes, fittings, valves, or pumps -- either above or below land surface.

All wells must be tagged with a Department of Ecology unique well identification number. If you have an existing well and it does not have a tag, please contact the well-drilling coordinator at the Department of Ecology Northwest Regional Office. This tag must remain attached to the well. If you are required to submit water measuring reports, reference this tag number.

Installation and maintenance of an access port as described in WAC 173-160- 291(3) is required.

Measurements, Monitoring, Metering and Reporting
An approved measuring device must be installed and maintained for each of the sources identified by this water right in accordance with the rule "Requirements for Measuring and Reporting Water Use", WAC 173-173.

Department of Ecology personnel, upon presentation of proper credentials, must have access at reasonable times, to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.

WAC 173-173 describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition the Department of Ecology for modifications to some of the requirements.

Water Level Measurements
In order to maintain a sustainable supply of water, pumping must be managed so that static water levels do not progressively decline from year to year. Static water level is defined as the water level in a well when no pumping is occurring and the water level has fully recovered from previous pumping. Static water levels must be measured and recorded twice a year (April and October), using a consistent methodology. Data for the previous year must be submitted by January 31 to the Department of Ecology.

Static water level data must be submitted in digital format and must include the following elements:

Unique Well ID Number
Measurement date and time
Measurement method (air line, electric tape, pressure transducer, etc.)
Measurement accuracy (to nearest foot, tenth of foot, etc.)
Description of the measuring point (top of casing, sounding tube, etc.)
Measuring point elevation above or below land surface to the nearest 0.1 foot

Land surface elevation at the well head to the nearest foot.
Static water level below measuring point to the nearest 0.1 foot.

Department of Health Requirements
Prior to any new construction or alterations of a public water supply system, the State Board of Health rules require public water supply owners to obtain written approval from the Office of Drinking Water of the Washington State Department of Health. Please contact the Office of Drinking Water at Northwest Drinking Water Operations, 20435 72nd Avenue S, Suite 200, K17-12, Kent, WA 98032-2358, (253) 396-6750, prior to beginning (or modifying) your project.

Easement and Right-of-Way
Issuance of a water right change authorization by this department does not convey a right of access to, or other right to use, land which the applicant does not legally possess. Obtaining such a right is a private matter between applicant and owner of that land.

Water Use Efficiency
Use of water under this authorization will be contingent upon the water right holder's maintenance of efficient water delivery systems and use of up-to-date water conservation practices consistent with established regulation requirements and facility capabilities.

Schedule and Inspections
Department of Ecology personnel, upon presentation of proper credentials, will have access at reasonable times, to the project location, and to inspect at reasonable times, records of water use, wells, measuring devices and associated distribution systems for compliance with water law.

Findings of Facts
Upon reviewing the investigator's report, I find all facts, relevant and material to the subject application, have been thoroughly investigated and that the subject certificate (Ground Water Certificate No. 3058 ("GWC 3058")) is in good standing and is eligible for change. Furthermore, I find the change of water right as recommended is from the same body of public groundwater, and will not be detrimental to existing rights or the public interest.

Therefore, I ORDER the change to consolidate the multiple points of withdrawal requested in Change Application No. CG1-*03899C, be approved, subject to existing rights and the provisions specified above.

Your Right To Appeal

You have a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of the Order.

File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

- You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503 **Pollution Control Hearings Board** 1111 Israel RD SW Suite 301 Tumwater, WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

- Please send a copy of your appeal to:

  Tom Buroker, Section Manager
  Water Resources Program
  Northwest Regional Office
  3190 – 160th Avenue SE
  Bellevue, WA 98008

Signed at Bellevue, Washington, this 26th day of August 2016.

Tom Buroker, Section Manager

For additional information visit the Environmental Hearings Office Website: http://www.eho.wa.gov. To find laws and agency rules visit the Washington State Legislature Website: http://www1.leg.wa.gov/CodeReviser.

INVESTIGATOR'S REPORT
Water Right Control Number CG1-*03899C
City of Ferndale

BACKGROUND

This report serves as the written findings of fact concerning Water Right Application Number CG1-*03899C.

On November 19, 2014, the City of Ferndale (City) filed four Applications for Change with the Washington State Department of Ecology (Ecology) to consolidate withdrawal locations for all of the City's sources for four water rights and allow flexibility among three existing points of withdrawal and additional future points of withdrawal. The additional points of withdrawal will be determined based on test wells to evaluate locations with appropriate water quality and production capabilities to meet the City's needs. The four applications are:

Table 1. Change Applications Filed by the City of Ferndale

Change Application	Source	Water Right	Type	Priority Date
CG1-*02509C@1	PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952
CG1-*03899C	PW-1 Shop Well	GWC 3058	Certificate	2/28/1955
CG1-00720P@1	PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971
CG1-*10690C	PW-4 Central City Well	GWC 7700	Certificate	3/10/1970

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

The City's water system currently serves a residential population of approximately 12,920 people with approximately 6,611 equivalent residential units (ERUs). The City's water system consists of water withdrawal, conveyance, storage, and treatment facilities. The place of use is consistent with the 2010 update to the 2006 City of Ferndale Water System Plan, which is within the designated City water service area (Reichhardt & EBE Engineering Inc. 2010).

Existing and requested water right attributes for the specific water right addressed by this Report of Examination (ROE) are as follows:

EXISTING Water Right Attributes

Water Right Owner:	City of Ferndale
Priority Date:	February 28, 1955
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer		1 - Nooksack

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	870	GPM	440	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023

Datum: NAD83/WGS84

WRIA = Water Resource Inventory Area; GPM = Gallons per Minute; Ac-ft/yr = Acre-feet per year; Twp = Township; Rng = Range; Sec. = Section; QQ Q = Quarter-quarter of a section

REQUESTED Water Right Attributes

Applicant Name:	**City of Ferndale**
Date of Application:	November 19, 2014
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer[1]		1 - Nooksack

[1] Also referred to as Deep Confined Aquifer

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	870	GPM	440	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8447	-122.6088
PW-3 (Thornton Road Well)	390124392440	BHX510	39N	1E	24	NW NE	48.8605	-122.6226
PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[2]	See area outlined on Figure 1 (Attached)							

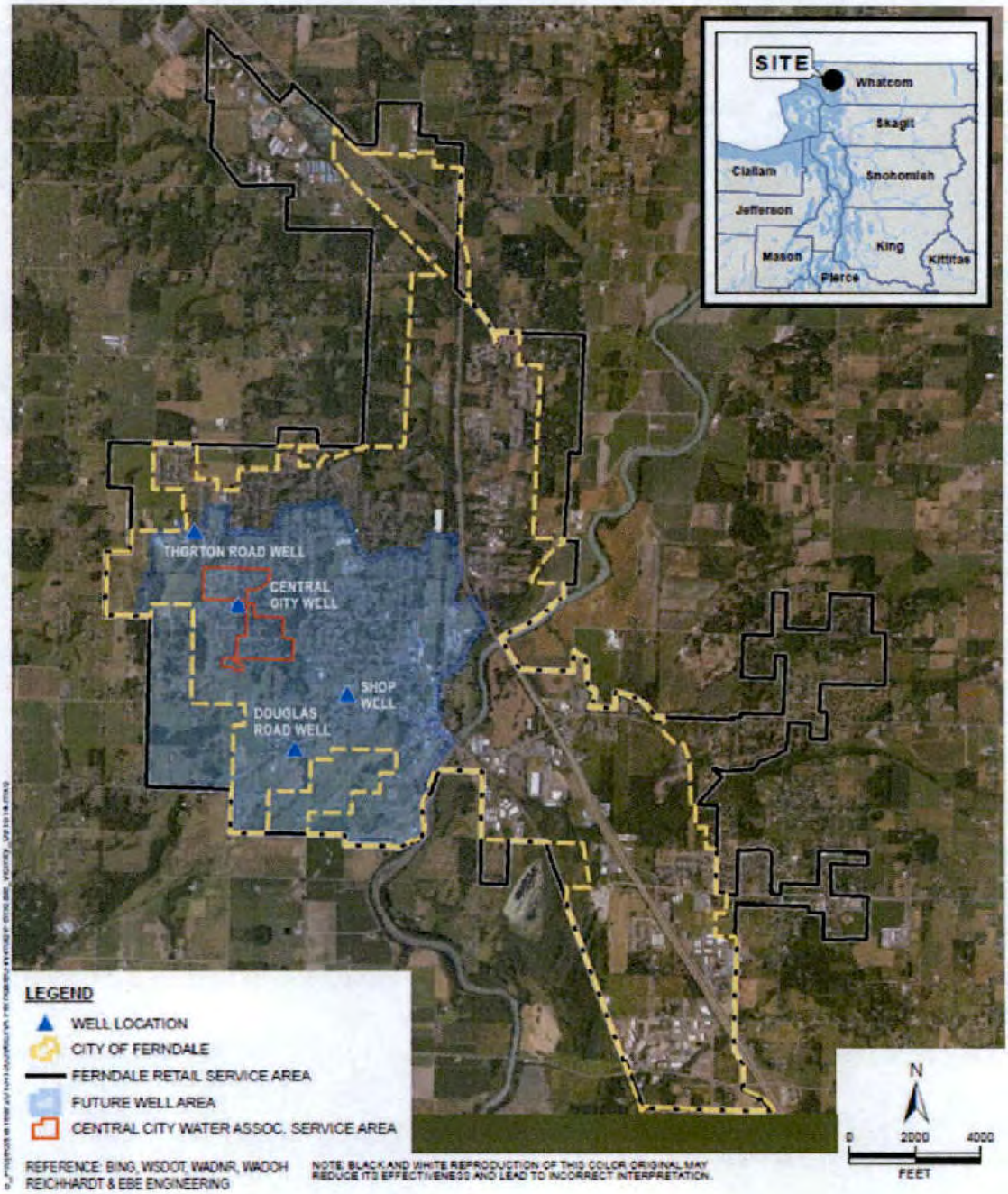
Datum: NAD83/WGS84

[2] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Cost Reimbursement

This application is being processed under a cost reimbursement agreement between the applicant the Department of Ecology. This report has been prepared by Aspect Consulting, LLC (Aspect) and reviewed by Ecology.

Figure 1. City of Ferndale Well Locations and Vicinity (source: AESI, 2013, modified by AESI in 2015)



Legal Requirements for Requested Change

Public Notice

RCW 90.03.280 requires that notice of a water right application be published once a week, for two consecutive weeks, in a newspaper of general circulation in the county or counties where the water is to be stored, diverted and used. Notice of this application was published in the Ferndale Record on February 11, 2015 and February 18, 2015.

Protest

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows.

Consultation with the Department of Fish and Wildlife

The Department must give notice to the Department of Fish and Wildlife (WDFW) of applications to divert, withdraw, or store water. Notice was provided to WDFW on January 14, 2016, of the four change applications filed by the City.

On January 29, 2016, Steve Boessow of WDFW responded in a letter to Ecology that:

> *"...based on impacts to fish and/or wildlife and the habitat they rely on, and pursuant to Chapter 77.57.020 RCW, WDFW does not oppose the issuance of these applications. These change applications do not increase the quantity of water allowed under any of the 4 water rights. Consolidation of wells is unlikely to impact fish."*

State Environmental Policy Act (SEPA)

A water right application is subject to a SEPA threshold determination (i.e., an evaluation whether there are likely to be significant adverse environmental impacts) if any one of the following conditions are met:

- It is a surface water right application for more than 1 cubic foot per second, unless that project is for agricultural irrigation, in which case the threshold is increased to 50 cubic feet per second, so long as that irrigation project will not receive public subsidies;
- It is a groundwater right application for more than 2,250 gallons per minute;
- It is an application that, in combination with other water right applications for the same project, collectively exceed the amounts above;
- It is a part of a larger proposal that is subject to SEPA for other reasons (e.g., the need to obtain other permits that are not exempt from SEPA);
- It is part of a series of exempt actions that, together, trigger the need to do a threshold determination, as defined under WAC 197-11-305.

This project is not categorically exempt from SEPA, because the four change applications associated with the project total more than 2,250 gallons per minute in additive instantaneous quantity. The total instantaneous quantity associated with the combined change applications is 2930 gallons per minute (gpm).

The City prepared a SEPA checklist and notice was posted in the Ferndale Record on February 10, 2016. No public comments were received during the public comment period, and a Determination of Non-Significance (DNS) was issued.

Water Resources Statutes and Case Law

RCW 90.03.380(1) states that a water right that has been put to beneficial use may be changed. The point of diversion, place of use, and purpose of use may be changed if it would not result in harm or injury to other water rights. The Washington Supreme Court has held that Ecology, when processing an application for change to a water right, is required to make a tentative determination of extent and validity of the claim or right. This is necessary to establish whether the claim or right is eligible for change. *R.D. Merrill v. PCHB* and *Okanogan Wilderness League v. Town of Twisp.*

RCW 90.03.386(3) requires a municipal water supplier to apply cost-effective water conservation measures as part of its water system planning. The water supplier must also evaluate the effects of delaying the use of inchoate water rights before it may increase use of those inchoate rights. RCW 90.03.320 requires Ecology to consider the public water supplier's use of conserved water when establishing a surface or ground water right construction schedule. The City's conservation program is outlined in Chapter 4 of the current water system plan (Reichhardt & EBE Engineering Inc. 2010).

RCW 90.03.386(2) states that a municipal water supplier may change its service area through the water system plan approval process. As long as the municipal water supplier is in compliance with the approved plan, the place of use for the water right is the service area of the plan.

RCW 90.44.100 allows Ecology to amend a ground water permit or certificate to: (1) allow the user to construct a replacement or additional well at a new location outside of the location of the original well, or to (2) change the manner or place of use of the water, if:

- The additional or replacement well taps the same body of public ground water as the original well. RCW 90.44.100(2)(a),
- Where a replacement well is approved, the user must discontinue use of the original well and properly decommission the original well. RCW 90.44.100(2)(b),
- Where an additional well is constructed, the user may continue to use the original well, but the combined total withdrawal from all wells shall not enlarge the right conveyed by the original permit or certificate. RCW 90.44.100(2)(c),
- Other existing rights shall not be impaired. RCW 90.44.100(2)(d).

When changing or adding points of withdrawal to groundwater rights (RCW 90.44.100), or when consolidating exempt wells with an existing permit or certificate (RCW 90.44.105), the wells must draw from the *same body of public groundwater*. Indicators that wells tap the *same body of public groundwater* include:

(a) Hydraulic connectivity.
(b) Common recharge (catchment) area.
(c) Common flow regime.
(d) Geologic materials that allow for storage and flow, with recognizable boundaries or effective barriers to flow.

INVESTIGATION

In consideration of this application, Aspect reviewed available documents pertaining to the application's site conditions, existing well installations, and the potential effect of the proposed change on existing water right holders and established minimum instream flows. This review included information submitted by the applicant, including well construction and testing reports, water system plan, and water level data, along with pertinent Ecology records, including well logs and water rights records. The review also included reports from multiple investigations characterizing the hydrogeology of the Ferndale area and Mountain View Upland.

A site visit was performed on July 21, 2015. Carl Einberger of Aspect met with City representative Mike Olinger to discuss the application, visit existing well locations and the area proposed as future withdrawal points, and to discuss the City's current water system operations.

Using the available information in the Ecology file record, existing reports, the site visit, and communications with the City, Aspect evaluated potential effects of the proposed consolidation of

withdrawal locations for the four water rights involved in the package of change applications. The City's water rights are discussed in more detail in the following section.

Existing Water Rights

The following table summarizes the City's existing water rights. The subject of this report is Groundwater Certificate (GWC) 3058, however all of these water rights have change applications being processed together, and all are discussed in this report.

Table 2. City of Ferndale's Water Rights Portfolio

Source	Water Right	Type	Priority Date	Qi in gpm	Qa in ac-ft/yr	
					Additive	Non-Additive
PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952	1000	1615	-
PW-1 Shop Well	GWC 3058	Certificate	2/28/1955	870	440[1]	-
PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971	1000	-	1614[1]
PW-4 Central City Well	GWC 7700	Certificate	3/10/1970	60	85	-
			Total	2930	2140	1614

[1]There is some confusion in the water right record as to the total annual quantity allowed to be withdrawn under all City of Ferndale water rights. As a result, Reports of Examination prepared for changes to GWC 1513 and G1-00720P in 2004 tentatively determined that the City of Ferndale should be allowed under its then existing water rights to withdraw up to a combined 2,055 acre-feet per year from all three of its then existing water rights and permits. The Superseding Permit issued in 2004 for G1-00720P noted that the total annual quantity from GWC 1513, GWC 3058, and G1-00720 shall not exceed 2,055 acre-feet per year. In 2014, the City of Ferndale acquired GWC 7700, giving the City a total combined annual quantity from the four water rights of 2,140 acre-feet per year. A recent review of files as part of this investigation suggests the interpretation noted in Table 2 is the intent of the original water right approvals.

Table 3 summarizes the nomenclature historically applied to these water rights:

Table 3. Water right and change references numbers

Source	Original Designation	Previous Change Reference #'s	Current Change Reference #'s
PW-2 Douglas Road Well	GWC 1513	G1-*02509C	CG1-*02509C@1
PW-1 Shop Well	GWC 3058	G1-*03899C	CG1-*03899C
PW-2 Douglas Road Well	G1-00720P	-	CG1-00720P@1
PW-4 Central City Well	GWC 7700	-	CG1-*10690C

The Thornton Creek Well, PW-3, did not have any water rights associated with it as of the time of submittal of this change application, but is a requested point of withdrawal under this consolidation project and change request.

History of Water Use

The City has a complicated water supply history dating back to the early 1950s. All four of the water rights that have change applications filed for points of withdrawal consolidation are discussed in this summary.

A synopsis of key historical information includes:

- The City obtained two water rights in the early 1950s: GWC 1513 with a priority date of 5/9/52 and GWC 3058 (the subject of this ROE) with a priority date of 2/28/55. Both of these rights were certificated in the 1950s.

- The above water rights and associated wells near the City shop provided the main source of water for the City until 1975 (Reichhardt & EBE Engineering Inc. 2010).

- In 1971, the City obtained a permit for an additional water right at the City shop (G1-00720P).

- In 1974 the City entered into an agreement with Whatcom County Public Utilities District No. 1 (PUD 1) to provide water from the Nooksack River. It appears this was done to address water quality concerns in the existing wells. A water treatment plant was constructed in 1975 to switch to potable treated water from the Nooksack River. The well now known as the City Shop Well (PW-1) remained connected and used and relied on as an emergency and back-up water source; however, use of the well as a main source of water temporarily ceased.

- In early 1994, the City relocated one well (not the existing Shop Well) from the City shop area to the Douglas Road site to allow construction of a library near the shop location. This well (PW-2) was drilled but was not connected to the system (Reichhardt & EBE Engineering Inc. 2010) at that time. The City of Ferndale filed change applications for GWC 1513 and G1-00720P in 1992 for this relocation. GWC 3058 remained associated with a second well at the City Shop Well.

- In 2003, Ecology prepared a Hydrogeologic Report (Ecology, 2003) and ROEs supporting the above changes were completed in 2004. The change to G1-00720P was approved in a Superseding Permit on June 8, 2004. The change to GWC 1513 was approved by Ecology in a Superseding Certificate issued on February 25, 2005.

- Several years ago, the City began evaluating the possibility of switching off PUD water and returning to the City's back-up groundwater sources as the City's primary source of water. This switch had been encouraged by the Washington State Department of Health (DOH) for several years. The City also wanted to gain more control over costs of water delivery and treatment options for the water system (Associated Earth Sciences, Inc., 2013). This switch occurred on December 14, 2012.

- Soon after switching to the City's production wells as the primary source of water, the City encountered water quality changes from the both the Shop Well and the Douglas Road Well, with unanticipated increases in hardness and chloride. In response to this, the City installed a nanofiltration (reverse osmosis) treatment system to improve the quality of water delivered to its customers (Associated Earth Sciences, Inc., 2013).

- Records provided by the City indicate the City's two active wells (Douglas Well and the Shop Well), have had increasing production annually in the period from 2012 to 2015. In 2014, the Douglas and Shop Wells produced approximately 775 and 485 ac-ft/yr, respectively. In 2015, the Douglas and Shop Wells produced approximately 1,062 ac-ft/yr and 277 ac-ft/yr, respectively. Based on the change applications described above, the City currently exercises GWC 1513 and a portion of G1-00720P from the Douglas Well and exercises GWC 3058 from the Shop Well. Annual quantities associated with each of these wells and their corresponding water rights are set forth in Table 5 below. See also Table 2 describing the City's water rights portfolio, including authorized annual quantities.

- In 2014, the City acquired a water right (GWC 7700) from the Central City Water Association (CCWA). The CCWA water right was originally certificated for community domestic supply (and municipal as a matter of law) and is authorized for 60 gpm and 85 ac-ft/yr. While the water right has been inactive since the acquisition, as part of this consolidation request the City intends to reactivate beneficial use of this water right. A review of records filed with DOH from 2009 to 2014 indicates that this water right was actively used prior to acquisition for 15 or more connections. In 2014, Ecology issued an amended certificate to the City for GWC 7700 conforming its purpose of use to municipal supply for the authorized 60 gpm and 85 ac-ft/yr.

City-Wide Growth and Diligence

As set forth in Table 5 below, the City's water use records show that it has exercised in full the quantities authorized under GWC 3058 (authorizing 440 ac-ft/yr) from the Shop Well, and has exercised up to 1,062 ac-ft/yr out of the total authorized under GWC 1513 (authorizing 1,615 ac-ft/yr) and G1-00720P (providing supplemental non-additive annual quantities) from the Douglas Well, leaving approximately 553 ac-ft/yr of municipal inchoate water under GWC 1513 and G1-00720P. The City has and continues to exercise good faith and diligence in development of this inchoate portion of its water rights.

In a letter dated June 3, 2016, Joseph A. Rehberger of Cascadia Law Group, on behalf of the City of Ferndale, provided the following information on City-wide growth and diligence in growing into the inchoate portions of GWC 1513, G1-00729P, and GWC 3058. Mr. Rehberger's letter included a number of attachments which are now on file with Ecology.

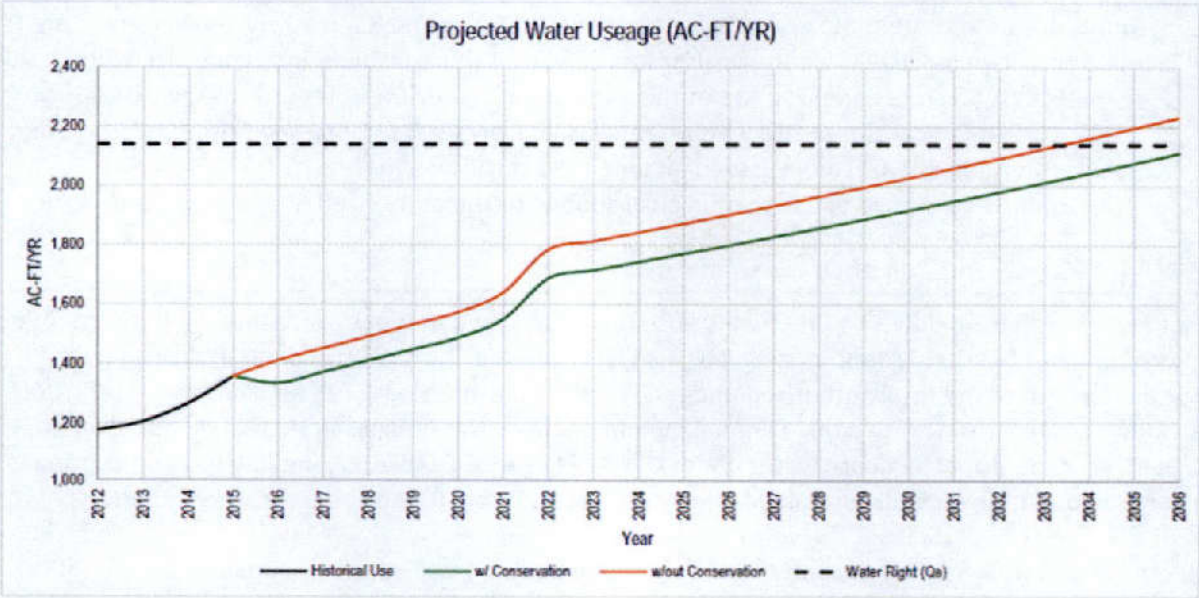
The City of Ferndale has been a growing community within Whatcom County for decades. That growth is expected to continue. The following table and graph from the City's *2016 Water System Plan, City of Ferndale* (Working Draft May 2016) describe the City's population growth from 1980 through 2015 and projected water usage through 2036 (see table and graph below).

Table 4.

Year	Population
1980	3,855
1990	5,398
2000	8,758
2010	11,415
2013	11,831
2014	12,710
2015	12,920

Source: Washington State Office of Financial Management
City of Ferndale, May 2016

Figure 2.



The following table shows the City's water use trends and increased use associated with current growth (units are in thousand gallons).

Table 5.

Month	2012		2013		2014		2015	
	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well	Shop Well	Douglas Well
January	0	0	20,044	9,753	11,653	16,424	12,963	18,146
February	0	0	17,448	8,455	10,976	15,379	10,602	16,742
March	9,888	13,274	20,843	10,267	12,239	17,100	11,528	19,158
April	9,880	17,152	18,390	8,920	11,746	16,578	11,623	19,257
May	13,088	21,028	19,020	12,270	13,465	18,693	13,083	24,416
June	12,566	19,298	20,113	14,273	15,998	21,443	13,993	36,822
July	16,377	19,930	22,057	27,815	14,842	32,414	9,520	44,060
August	23,287	20,150	16,437	27,333	14,306	30,416	6,115	40,504
September	25,066	9,249	11,860	20,049	12,239	24,548	80	32,429
October	22,132	7,189	11,586	17,614	13,072	20,778	398	31,921
November	18,546	9,897	10,827	16,307	13,531	18,588	112	31,265
December	19,158	10,209	12,149	17,039	13,965	19,637	471	31,286
Total	169,988	147,376	200,774	190,095	158,032	251,998	90,488	346,006
Combined Total	317,364		390,869		410,030		436,494	

The City's Annexation History Map (on file with Ecology), shows the City's progressive annexation and growth of its municipal boundaries from the 1940s through present. The City's current urban growth area (UGA) and future growth and annexation phasing plan through 2034 are described in the City of Ferndale *Annexation Blueprint, Annexation Phasing Plan: 2013-2034* (also on file with Ecology).

The City is in the process of updating its Water System Plan (*2016 Water System Plan, City of Ferndale).* The City's May 2016 working draft estimates a City-wide population growth rate of approximately 2.32%, increasing from a population of 12,920 in 2015 to 20,072 in 2036.

Table 6.

Year	District								Total Pop.
	1	2	3	4	5	6	7	8	
2013	269	333	759	1,403	7,311	1,036	508	212	11,831
2014	282	352	817	1,518	7,831	1,131	548	231	12,710
2015	283	354	829	1,555	7,936	1,165	560	238	12,920
2016	283	357	847	1,600	8,079	1,208	574	246	13,194
2017	283	360	865	1,646	8,224	1,252	589	255	13,474
2018	284	363	883	1,693	8,371	1,298	604	264	13,760
2019	284	366	902	1,741	8,521	1,346	619	273	14,052
2020	284	369	921	1,790	8,673	1,395	635	283	14,350
2021	285	372	940	1,840	8,827	1,445	651	294	14,654
2022	285	375	960	1,892	8,984	1,498	667	304	14,965
2036	290	417	1,278	2,776	11,455	2,431	937	488	20,072
Growth Rate	0.33%	0.98%	2.29%	3.01%	1.97%	3.78%	2.70%	3.69%	2.32%

This corresponds to a projected increase in ERUs from 6,611 in 2015 to an estimated 11,352 ERUs in 2036.

Table 7.

Year	ERUs				Total
	Single-Family	Multi-Family	Commercial / Industrial	Irrigation	
2013	4,071	682	1,008	525	6,286
2014	4,169	689	1,149	567	6,574
2015	4,286	689	997	639	6,611
2016	4,365	704	1,074	659	6,802
2017	4,446	719	1,153	680	6,998
2018	4,529	733	1,232	700	7,194
2019	4,614	748	1,307	721	7,390
2020	4,701	763	1,380	742	7,586
2021	4,790	778	1,578	762	7,908
2022	4,881	793	2,150	783	8,607
2036	6,420	1,046	2,722	1,164	11,352

Using these projections, the City is expected to be at or in excess of its current water rights (2,140 af/yr) by 2036.

Table 8.

			ADD (MGD)		MDD (MGD)		PHD (GPM)		Annual (AC-FT/YR)	
Year	Total Population	ERUs	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons	w/ Cons	w/out Cons
2013	11,831	6,286	1.08	1.08	1.91	1.91	2,194	2,194	1,205	1,205
2014	12,710	6,574	1.13	1.13	1.91	1.91	1,300	1,300	1,265	1,265
2015	12,920	6,611	1.21	1.21	2.07	2.07	2,366	2,366	1,356	1,356
2016	13,194	6,802	1.19	1.26	2.07	2.21	2,371	2,526	1,334	1,410
2017	13,474	6,998	1.22	1.29	2.13	2.27	2,438	2,596	1,372	1,451
2018	13,760	7,194	1.26	1.33	2.19	2.34	2,504	2,667	1,411	1,491
2019	14,052	7,390	1.29	1.37	2.25	2.40	2,571	2,738	1,449	1,532
2020	14,350	7,586	1.33	1.40	2.31	2.47	2,637	2,809	1,488	1,573
2021	14,654	7,908	1.38	1.46	2.41	2.57	2,746	2,925	1,551	1,639
2022	14,965	8,607	1.51	1.59	2.63	2.80	2,983	3,177	1,688	1,784
2036	20,072	10,770[1]	1.88	1.99	3.28	3.50	3,716	3,958	2,112	2,232

Based on the information provided by the City and upon Ecology's review, it is tentatively determined that the subject water right is in good standing and is eligible for change. This is a municipal water supply water right that is not subject to relinquishment. The full certificated instantaneous rate (870 gpm) has been perfected through beneficial use. The full annual quantity is not yet fully perfected through actual beneficial use. However, the City is a growing system, in good-standing, with a State Department of Health green operating permit. Their demand analysis indicates the City can easily grow into their full annual allocation. Therefore, the full certificated annual quantity of 440 ac-ft/yr shall be eligible for change.

Proposed Use

The only change proposed for GWC 3058 is to allow the authorized quantities to be used with flexibility at any of the City's current points of withdrawal, and at possible new points of withdrawal within the area outlined on Figure 1. The goal is to allow the City the opportunity to tailor water withdrawals to water needs throughout the City's service area. In addition, the City is interested in finding potential new points of withdrawal that may have improved water quality compared to the current source wells.

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

Investigation of New Points of Withdrawal

The City has engaged Wilson Engineering and AESI to assist with identifying potential locations for new wells and with drilling test wells. A hydrogeologic evaluation in support of this goal was completed in 2013 that proposed drilling and testing of a new well at a location near the northwest corner of the City limits. This was designated as the "Thornton Road Well" location (AESI, 2013).

AESI considered the Thornton Road location to be promising from both a water quantity and quality standpoint. In addition, AESI recognized that the Thornton Road location was in the same surface water drainage basin as the existing Douglas Road, Shop, and Central City Wells, supporting the ability to withdraw from the same source of groundwater as these wells, thus aiding the addition of this location as a point of withdrawal. AESI noted that the nearby Thornton Road Water Association well has lower concentrations of sodium, chloride, conductivity, TDS, and manganese than the City's production wells.

In 2014, a test well was drilled under AESI's supervision at the Thornton Road Well location to 450 feet of depth. AESI concluded that the well could achieve a long-term yield of approximately 350 to 375 gpm. Test pumping of the well for 24 hours at 315 gpm did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well. Elevated water quality for manganese, conductivity, color, and total dissolved solids were noted, indicating that the water would require treatment to meet DOH standards for public water supply. No decision on future use of this well by the City has been made at this time, and additional locations within the proposed 'future well area' outlined on Figure 1 may be investigated for potential production well drilling and construction.

Other Rights Appurtenant to the Place of Use

As part of this investigation, Aspect obtained water right records from Ecology's database for the area proposed for potential future wells identified in Figure 1, including a ½ mile buffer outside of this area. Note that this area also includes the City's existing points of withdrawal.

Thirteen certificated groundwater rights were identified, with the majority of these being for domestic use. The largest of these were two domestic and stockwater rights owned by F. Imhoff, with each authorized for an instantaneous withdrawal (Qi) of 50 gpm and annual quantity (Qa) of 80 ac-ft/yr. These are located approximately ½ mile southeast of the City's Douglas Well. A review of the associated well log indicates a completion depth of 195 feet, likely within the Regional Aquifer.

In addition, there are 68 claims, all for groundwater use, within the search area. It is expected that many of the water rights found in this review are not being exercised, given the availability of public water supply from the City's system in much of the search area.

Hydrologic/Hydrogeologic Evaluation

The portions of the City of Ferndale area of interest for this investigation are located west of the Nooksack River near River Mile 6 (Figure 1), in the Fraser-Whatcom basin (additional incorporated areas of the City are located east of the Nooksack River). The western portion of the City water service area is within the Mountain View Upland, with elevations up to 360 feet near the Thornton Road Well. Areas closer to the river are lower in elevation and are part of the Nooksack River valley, with elevations as low 20 feet.

The Fraser-Whatcom basin was subject to repeated glaciation during the Pleistocene Epoch, and several hundred feet of glacial and interglacial sediments are present in the area, with bedrock found at considerable depth. The deepest well in the project area was drilled to a depth of 440 feet and did not encounter bedrock (AESI, 2013).

Overview of Groundwater Occurrence

Groundwater in the Ferndale area is found in discontinuous perched groundwater aquifers and in a single Regional Aquifer that appears to be composed of predominantly pre-Vashon deposits. Aspect (2009) conducted a study of the Mountain View Upland, which extends from the western upland portions of the City of Ferndale west to the Strait of Georgia. Seven hydrostratigraphic units were delineated:

> *The upper fine-grained unit (F1/F2) consists predominantly of glacial marine drift and potentially Sumas and Vashon age till. Shallow perched groundwater occurs above the F1 unit and within coarse-grained lenses interbedded with the F1 unit. A coarse-grained unit (C2) underlies the F1 unit and appears to be correlative with Vashon advance outwash (Mountain View Sand and Gravel). The C2 unit is generally unsaturated. Deeper units, interpreted as the Cherry Point silt and other pre-Vashon, fine-grained deposits, are found beneath the C2 units and form a lower aquitard (F3).* ***The regional aquifer in the study area is present predominantly in the coarse-grained C3 unit that is thought to be correlative with the pre-Fraser deposits, and in more permeable portions of the F3 unit (typically silty sands), as indicated by several productive wells completed within these zones.***

A review of well logs for the City's existing four wells and stratigraphic cross sections (Aspect, 2009) suggests that they are completed in the same source of water, the Regional Aquifer (see Table 9).

Table 9. Existing City Wells and Interpreted Aquifer		
Source	Completion Depth (feet)	Interpreted Aquifer
Douglas Road Well	152	Regional Aquifer
Shop Well	160	Regional Aquifer
Central City Well	290	Regional Aquifer
Thornton Road Well	450	Regional Aquifer

Groundwater Flow in the Regional Aquifer

Aspect (2009) also evaluated groundwater flow directions in the Regional Aquifer in the Mountain View Upland. Based on a review of these data, mapped for both March and October of 2008, groundwater flows in the southeastern portion of the Mountain View Upland near Ferndale generally trend southeast toward the Nooksack River. All of the area of interest for this investigation appears to be in the same source of water, with the Regional Aquifer flowing toward the Nooksack River. In addition to being consistent with Aspect's previous interpretation, this is also consistent with Ecology's previous interpretation in the hydrogeologic report for changes to the City's GWC 1515 and G1-00720P water rights (Ecology, 2003).

Key Aquifer Test Data and Potential Impairment

Ecology (2003) reviewed pumping tests conducted in 1994 on the Douglas Road Well. A step test and a 26-hour constant rate pumping test were conducted by GeoEngineers, with a well approximately 2200 feet away used as a monitoring well. This well had very limited drawdown observed during the test (0.33 feet). GeoEngineers (1994) also conducted an additional impairment analysis. This suggested that a nearby well (at Ferndale Mobile Village), would have experienced approximately 13 feet of drawdown from the 26-hour pumping test. Ecology concluded that no impairment would occur at this well, given the 120 feet of available drawdown.

As noted previously, the test well drilled into the Regional Aquifer in 2014 at the Thornton Road well location did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well, during a 24 hour pump test.

In general, based on a review of selected well logs, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1).

Impairment Considerations

Impairment of Minimum Instream Flow Water Rights

The term "instream flow" is used to identify a specific stream flow (typically measured in cubic feet per second, or cfs) at a specific location for a defined time, and typically following seasonal variations.

Instream flows are usually defined as the stream flows needed to protect and preserve instream resources and values, such as fish, wildlife and recreation. Instream flows are most often described and established in a formal legal document, typically an adopted state rule.

Once established, a minimum flow constitutes an appropriation with a priority date as of the effective date of the rule establishing the minimum flow (RCW 90.03.345). Thus, a minimum flow set by rule is an existing right which may not be impaired (RCW 90.03.345; RCW 90.44.030).

Minimum instream flows were established for the Nooksack River Water Resource Inventory Area (WRIA 1) by WAC 173-501 in 1985. None of the four water rights involved with this project are junior to the instream flow rule, and as such, they are not subject to curtailment when instream flows are not met. No additional impacts to instream flows are expected to result from authorization of this change request, given that there is no enlargement of the water right through this consolidation process. WDFW has concurred with this opinion, as noted in their January 29, 2016, letter to Ecology.

Impairment, Qualifying Ground Water Withdrawal Facilities, and Well Interference

There are three concepts that are important when considering whether a withdrawal of water from a well would impair another existing water right. The concepts are defined as follows:

1. Impairment is an adverse impact on the physical availability of water for a beneficial use that is entitled to protection (i.e., water rights that are both senior and junior in priority to the right the applicant seeks to change).

2. Qualifying ground water withdrawal facilities are defined as those wells which in the opinion of the Department are adequately constructed. An adequately constructed well is one that (a) is constructed in compliance with well construction requirements; (b) fully penetrates the saturated thickness of an aquifer or withdraws water from a reasonable and feasible pumping lift (WAC 173-150); (c) the withdrawal facilities must be able to accommodate a reasonable variation in seasonal pumping water levels; and (d) the withdrawal facilities including pumping facilities must be properly sized to the ability of the aquifer to produce water.

3. Well interference may occur when several wells penetrate and withdraw ground water from the same aquifer. Each pumping well creates a drawdown cone. When several wells pump from the same aquifer, well density, aquifer characteristics, and pumping demand may result in individual drawdown cones that intersect and form a composite drawdown cone. At any point in an aquifer, the composite drawdown caused by pumping wells will be greatly influenced by the transmissivity (T) of the aquifer. In aquifers with high Ts, composite drawdown will generally be much less than in aquifers with similar properties but with low Ts. Transmissivity is related to hydraulic conductivity (K) and the saturated thickness (b) of an aquifer by the relationship T=Kb.

   An aquifer's hydraulic conductivity (K) is derived from the physical properties of both the fluid and geologic materials that form an aquifer. Once formed, an aquifer's saturated thickness (b) becomes important in evaluating its transmissivity. For regions of similar K in an aquifer, a large saturated thickness will result in a much higher T than a small saturated thickness. As a result, regions of similar K in an aquifer with a large saturated thickness will experience less composite drawdown or well interference than with a small saturated thickness.

Some conditions, however, will increase or steepen composite drawdown in an aquifer. For instance, where characteristics (such as very fine, clay-rich, or poorly sorted sediments) of an unconfined aquifer cause significant drawdown relative to the saturated thickness, the composite drawdown will increase as saturated thickness is reduced and T becomes smaller. Additionally, in regions where negative or no-flow boundaries occur, such as near the edges of a valley fill aquifer where it is bounded by bedrock, composite drawdown will be steeper than in the central part (generally the greatest thickness region) of the aquifer. Consequently, it is commonly understood that the greatest composite drawdown or well interference is more likely to occur in regions of low transmissivities, thin saturated thicknesses and near negative or no-flow boundaries than in regions of high transmissivities, large saturated thicknesses, and away from negative or no-flow boundaries.

As noted in the review of pump test information and well log review noted previously, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1). No impairment issues are anticipated based on approval of the consolidation project and this associated change request.

Public Interest Considerations

No potential for detriment to the public interest was identified during the investigation of this water right change application.

Consideration of Protests and Comments

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows. However, this is a change application and not an application for new (consumptive) water use. Because the quantities of water involved will remain unchanged, there will be no increase in consumptive use, and each of the sources will pump from the same body of public water, therefore no additional or new impacts are associated with the change being recommended for approval. A provision has been added that specifically identifies that this right is subject to senior water rights.

CONCLUSIONS

The full quantities (Qi and Qa) of water allocated under the subject certificate are eligible to be changed.

Tentative determination

Groundwater Certificate 3058 is in good standing with the Department of Ecology and is therefore eligible for change. In accordance with RCW 90.14.140(2)(d), rights for municipal supply purposes are not subject to relinquishment.

Potential for Enlargement

No potential for enlargement of the existing water right exists, provided the City does not withdraw more than a total of 870 gpm and 440 ac-ft/yr (additive) under this water right at the existing and potential new points of withdrawal.

Same Source Considerations

All of the existing points of withdrawal considered under this change are within the same source of water, the Regional Aquifer. In addition, all of the existing City wells and the area proposed for future new wells are all within the same surface water drainage basin (Schell) as delineated by Whatcom County. Provided any new points of withdrawal are limited to the area proposed in Figure 1 and the wells are completed in the Deep Aquifer, they can be considered to also be within the same source of water.

Potential for Impairment of Existing Rights

The change requested will not impair existing rights.

Potential for Detriment to the Public Interest

The change requested will not be detrimental to the public interest.

RECOMMENDATIONS

Based on the above investigation and conclusions, I recommend this request for change be approved in the amounts and within the limitations listed below and subject to the provisions listed above.

Purpose of Use and Authorized Quantities

The amount of water recommended is a maximum limit and the water user may only use that amount of water within the specified limit that is reasonable and beneficial:

Q_i = 870 gpm
Q_a = 440 acre-feet per year (additive)
For Municipal Use

Points of Withdrawal

See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by AESI to support the City's water right change.

The City's existing wells also are located within this area as illustrated by Figure 1.

Place of Use

The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.



Carl M. Einberger

Carl M. Einberger

August 26, 2016

Carl Einberger, LG, LHG, License #1100 *Date*



J. R. "BUCK" SMITH

Buck Smith 8/26/16

Reviewed Buck Smith, LG, LHG, License #1479 *Date*

If you need this publication in an alternate format, please call Water Resources Program at (360) 407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Selected References

Aspect Consulting, 2009. Aquifer Study of the Mountain View Upland – Lummi River Area, Whatcom County and Lummi Nation, Washington. March 2009.

Associated Earth Sciences, Inc. (AESI), 2013. City of Ferndale Hydrogeologic Evaluation, Whatcom County, Washington. December 2013.

AESI, 2014. Installation and Testing of the Thornton Road Well, Ferndale Washington. December 2014.

GeoEngineers, Inc., 2004. Installation and Testing of Production Well No. 3 Ferndale, Washington. April 1994.

Reichhardt & EBE Engineering Inc. 2010, City of Ferndale 2006 Water System Plan. Updated 2010.

Washington Department of Ecology, 2003. Hydrogeologic Report for Change to GWC 1513 and G1-00720P (City of Ferndale). November 2003.

DEPARTMENT OF ECOLOGY
State of Washington

State of Washington
Protested
Report of Examination for Water Right Change

Changed/added points of withdrawal

PRIORITY DATE	WATER RIGHT NUMBER
March 10, 1970	CG1-*10690C (GWC 7700)

MAILING ADDRESS	SITE ADDRESS (IF DIFFERENT)
City of Ferndale 2095 Main Street, PO Box 936 Ferndale, WA 98248	2341 Douglas Road Ferndale, WA 98248

Total Quantity Authorized for Withdrawal

WITHDRAWAL RATE	UNITS	ANNUAL QUANTITY (AF/YR)
60	GPM	85

The total annual quantity available under all four rights involved in the City's package of change requests: CG1-*02509C@1 (GWC 1513), CG1-00720P@1 (G1-00729P), CG1-*03899C (GWC 3058), CG1-*10690C (GWC 7700); shall not exceed 2,140 af/yr with a maximum withdrawal rate (Qi) of 2,930 gpm.

Purpose

	WITHDRAWAL RATE			ANNUAL QUANTITY (AF/YR)		
PURPOSE	ADDITIVE	NON-ADDITIVE	UNITS	ADDITIVE	NON-ADDITIVE	PERIOD OF USE (mm/dd)
Municipal	60		GPM	85		01/01-12/31

IRRIGATED ACRES		PUBLIC WATER SYSTEM INFORMATION	
ADDITIVE	NON-ADDITIVE	WATER SYSTEM ID	CONNECTIONS
		24850 M	5,099

Source Location

COUNTY	WATERBODY	TRIBUTARY TO	WATER RESOURCE INVENTORY AREA
Whatcom	Regional Aquifer		1 - Nooksack

SOURCE FACILITY/DEVICE	PARCEL	WELL TAG	TWN	RNG	SEC	QQ Q	LATITUDE	LONGITUDE
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8447	-122.6088
PW-3 (Thornton Road Well)	390124392440	BHX510	39N	1E	24	NW NE	48.8605	-122.6226

PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[1]	See area outlined on Figure 1 (Attached)						-	-

Datum: NAD83/WGS84

[1] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Place of Use (See Attached Map)

LEGAL DESCRIPTION OF AUTHORIZED PLACE OF USE

The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.

Proposed Works

The City of Ferndale has four existing wells (designated as the Shop, Douglas Road, Thornton Road, and Central City Wells). Additional future wells (Figure 1) in the Regional Aquifer may be incorporated into the City's existing water system as part of this consolidation project.

Development Schedule

BEGIN PROJECT	COMPLETE PROJECT	PUT WATER TO FULL USE
Begun	December 31, 2031	December 31, 2036

Measurement of Water Use

How often must water use be measured?	Daily
How often must water use data be reported to Ecology?	Annually
What volume should be reported?	Total Annual Volume for each well
What rate should be reported?	Annual Peak Rate of Withdrawal (gpm) for each well

Provisions

No Impairment of Existing Rights

This authorization to make use of public waters of the state is subject to existing rights, including any existing rights held by the United States for the benefit of tribes under treaty or settlement. If impairment does occur, the City will be required to diminish or cease pumping, or mitigate for this impairment.

Same Source Requirement

Any new wells installed under this change authorization shall be completed within the Regional Aquifer (i.e., the same source of water as the City's four existing wells). The City must file with the Department of Ecology a Showing of Compliance with RCW 90.44.100(3) prior to the use of any new wells.

Wells, Well Logs and Well Construction Standards
All wells constructed in the state must meet the construction requirements of WAC 173-160 titled "Minimum Standards for the Construction and Maintenance of Wells" and RCW 18.104 titled "Water Well Construction". Any well which is unusable, abandoned, or whose use has been permanently discontinued, or which is in such disrepair that its continued use is impractical or is an environmental, safety or public health hazard must be decommissioned.

Flowing wells must be constructed and equipped with valves to ensure that the flow of water can be completely stopped when not in use. Likewise, the well must be continuously maintained to prevent the waste of water through leaky casings, pipes, fittings, valves, or pumps -- either above or below land surface.

All wells must be tagged with a Department of Ecology unique well identification number. If you have an existing well and it does not have a tag, please contact the well-drilling coordinator at the Department of Ecology Northwest Regional Office. This tag must remain attached to the well. If you are required to submit water measuring reports, reference this tag number.

Installation and maintenance of an access port as described in WAC 173-160- 291(3) is required.

Measurements, Monitoring, Metering and Reporting
An approved measuring device must be installed and maintained for each of the sources identified by this water right in accordance with the rule "Requirements for Measuring and Reporting Water Use", WAC 173-173.

Department of Ecology personnel, upon presentation of proper credentials, must have access at reasonable times, to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.

WAC 173-173 describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition the Department of Ecology for modifications to some of the requirements.

Water Level Measurements
In order to maintain a sustainable supply of water, pumping must be managed so that static water levels do not progressively decline from year to year. Static water level is defined as the water level in a well when no pumping is occurring and the water level has fully recovered from previous pumping. Static water levels must be measured and recorded twice a year (April and October), using a consistent methodology. Data for the previous year must be submitted by January 31 to the Department of Ecology.

Static water level data must be submitted in digital format and must include the following elements:

Unique Well ID Number
Measurement date and time
Measurement method (air line, electric tape, pressure transducer, etc.)
Measurement accuracy (to nearest foot, tenth of foot, etc.)
Description of the measuring point (top of casing, sounding tube, etc.)
Measuring point elevation above or below land surface to the nearest 0.1 foot

Land surface elevation at the well head to the nearest foot.
Static water level below measuring point to the nearest 0.1 foot.

Department of Health Requirements
Prior to any new construction or alterations of a public water supply system, the State Board of Health rules require public water supply owners to obtain written approval from the Office of Drinking Water of the Washington State Department of Health. Please contact the Office of Drinking Water at Northwest Drinking Water Operations, 20435 72nd Avenue S, Suite 200, K17-12, Kent, WA 98032-2358, (253) 396-6750, prior to beginning (or modifying) your project.

Easement and Right-of-Way
Issuance of a water right change authorization by this department does not convey a right of access to, or other right to use, land which the applicant does not legally possess. Obtaining such a right is a private matter between applicant and owner of that land.

Water Use Efficiency
Use of water under this authorization will be contingent upon the water right holder's maintenance of efficient water delivery systems and use of up-to-date water conservation practices consistent with established regulation requirements and facility capabilities.

Schedule and Inspections
Department of Ecology personnel, upon presentation of proper credentials, will have access at reasonable times, to the project location, and to inspect at reasonable times, records of water use, wells, measuring devices, and associated distribution systems for compliance with water law.

Findings of Facts
Upon reviewing the investigator's report, I find all facts, relevant and material to the subject application, have been thoroughly investigated and that the subject certificate (Ground Water Certificate No. 7700 ("GWC 7700")) is in good standing and is eligible for change. Furthermore, I find the change of water right as recommended is from the same body of public groundwater, and will not be detrimental to existing rights or the public interest.

Therefore, I ORDER the change to consolidate the multiple points of withdrawal requested in Change Application No. CG1-*10690C, be approved, subject to existing rights and the provisions specified above.

Your Right To Appeal

You have a right to appeal this Order to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this Order. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of the Order.

File your appeal and a copy of this Order with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

- Serve a copy of your appeal and this Order on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

- You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503 **Pollution Control Hearings Board** 1111 Israel RD SW Suite 301 Tumwater, WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608 **Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

- Please send a copy of your appeal to:

  Tom Buroker, Section Manager
  Water Resources Program
  Northwest Regional Office
  3190 – 160th Avenue SE
  Bellevue, WA 98008

Signed at Bellevue, Washington, this 26th day of August 2016.

Tom Buroker, Section Manager

For additional information visit the Environmental Hearings Office Website: http://www.eho.wa.gov. To find laws and agency rules visit the Washington State Legislature Website: http://www1.leg.wa.gov/CodeReviser.

INVESTIGATOR'S REPORT
Water Right Control Number CG1-*10690C
City of Ferndale

BACKGROUND

This report serves as the written findings of fact concerning Water Right Application Number CG1-*10690C.

On November 19, 2014, the City of Ferndale (City) filed four Applications for Change with the Washington State Department of Ecology (Ecology) to consolidate withdrawal locations for all of the City's sources for four water rights and allow flexibility among three existing points of withdrawal and additional future points of withdrawal. The additional points of withdrawal will be determined based on test wells to evaluate locations with appropriate water quality and production capabilities to meet the City's needs. The four applications are:

Table 1. Change Applications Filed by the City of Ferndale

Change Application	Source	Water Right	Type	Priority Date
CG1-*02509C@1	PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952
CG1-*03899C	PW-1 Shop Well	GWC 3058	Certificate	2/28/1955
CG1-00720P@1	PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971
CG1-*10690C	PW-4 Central City Well	GWC 7700	Certificate	3/10/1970

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

The City's water system currently serves a residential population of approximately 12,920 people with approximately 6,611 equivalent residential units (ERUs). The City's water system consists of water withdrawal, conveyance, storage, and treatment facilities. The place of use is consistent with the 2010 update to the 2006 City of Ferndale Water System Plan, which is within the designated City water service area (Reichhardt & EBE Engineering Inc. 2010).

Existing and requested water right attributes for the specific water right addressed by this Report of Examination (ROE) are as follows:

EXISTING Water Right Attributes

Water Right Owner:	City of Ferndale (the right was formerly owned by Central City Water Association)
Priority Date:	March 10, 1970
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer		1 - Nooksack

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	60	GPM	85	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164

Datum: NAD83/WGS84

WRIA = Water Resource Inventory Area; GPM = Gallons per Minute; Ac-ft/yr = Acre-feet per year; Twp = Township; Rng = Range; Sec. = Section; QQ Q = Quarter-quarter of a section

REQUESTED Water Right Attributes

Applicant Name:	City of Ferndale
Date of Application:	November 19, 2014
Place of Use	City of Ferndale approved water service area consistent with the most recently approved Water System Plan

County	Waterbody	Tributary To	WRIA
Whatcom	Regional Aquifer[1]		1 - Nooksack

[1] Also referred to as Deep Confined Aquifer

Purpose	Rate	Unit	Ac-ft/yr	Begin Season	End Season
Municipal	60	GPM	85	Year Round	

Source Name	Parcel	Well Tag	Twp	Rng	Sec	QQ Q	Latitude	Longitude
PW-1 (Shop Well)	390219409029	AMF090	39N	2E	19	SW SE	48.8495	-122.6023
PW-2 (Douglas Road Well)	390230188340	BCB347	39N	2E	30	SE NW	48.8447	-122.6088
PW-3 (Thornton Road Well)	390124392440	BHX510	39N	1E	24	NW NE	48.8605	-122.6226
PW-4 (Central City Well)	390219010345	AGK343	39N	2E	19	SW NW	48.8567	-122.6164
Potential Future Wells[2]	See area outlined on Figure 1 (Attached)							

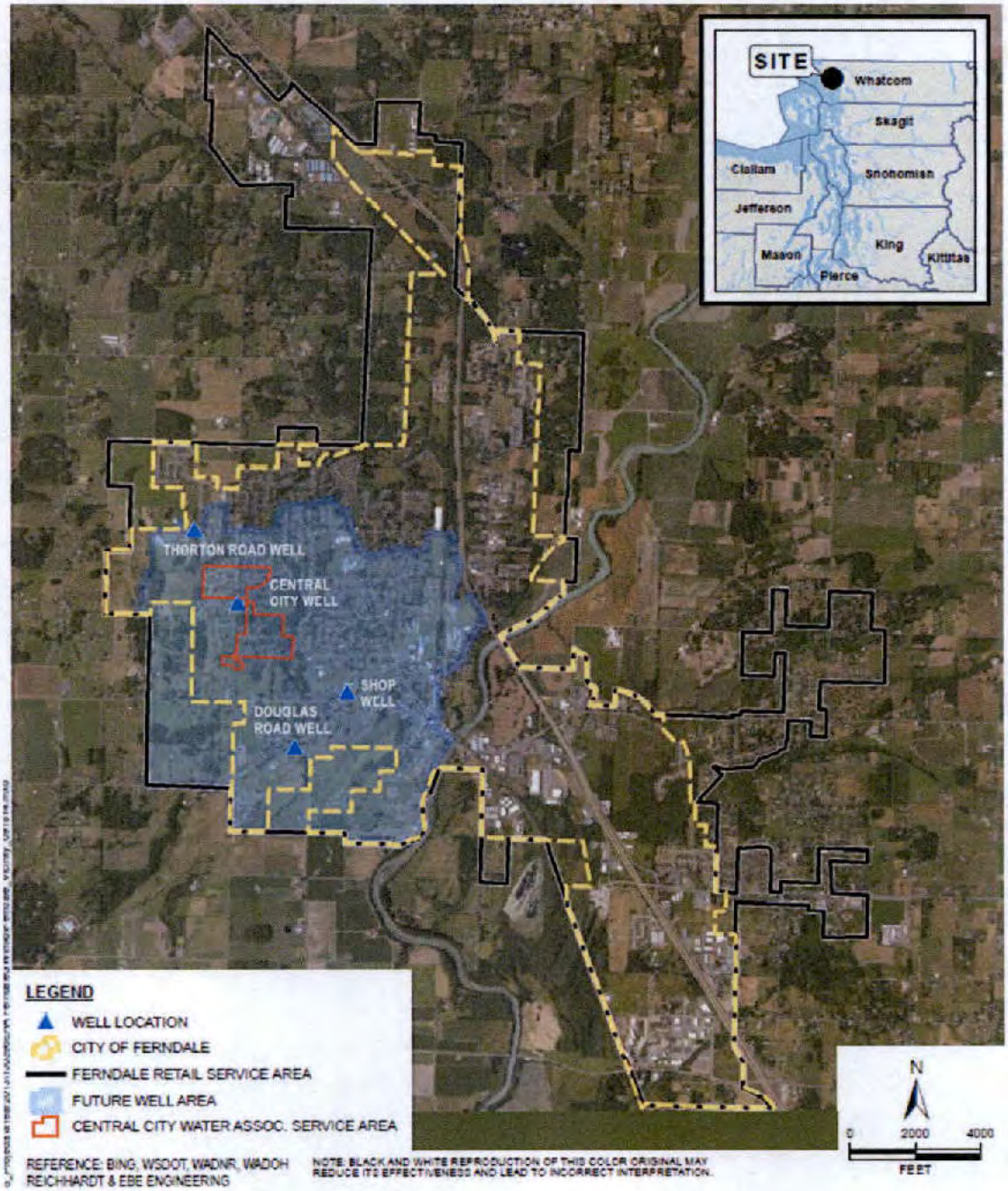
Datum: NAD83/WGS84

[2] See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S ½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 prepared by Associated Earth Sciences, Inc. (AESI) to support the City's water right change.

Cost Reimbursement

This application is being processed under a cost reimbursement agreement between the applicant the Department of Ecology. This report has been prepared by Aspect Consulting, LLC (Aspect) and reviewed by Ecology.

Figure 1. City of Ferndale Well Locations and Vicinity (source: AESI, 2013, modified by AESI in 2015)



Legal Requirements for Requested Change

Public Notice

RCW 90.03.280 requires that notice of a water right application be published once a week, for two consecutive weeks, in a newspaper of general circulation in the county or counties where the water is to be stored, diverted and used. Notice of this application was published in the Ferndale Record on February 11, 2015 and February 18, 2015.

Protest

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows.

Consultation with the Department of Fish and Wildlife

The Department must give notice to the Department of Fish and Wildlife (WDFW) of applications to divert, withdraw, or store water. Notice was provided to WDFW on January 14, 2016, of the four change applications filed by the City.

On January 29, 2016, Steve Boessow of WDFW responded in a letter to Ecology that:

> *"...based on impacts to fish and/or wildlife and the habitat they rely on, and pursuant to Chapter 77.57.020 RCW, WDFW does not oppose the issuance of these applications. These change applications do not increase the quantity of water allowed under any of the 4 water rights. Consolidation of wells is unlikely to impact fish."*

State Environmental Policy Act (SEPA)

A water right application is subject to a SEPA threshold determination (i.e., an evaluation whether there are likely to be significant adverse environmental impacts) if any one of the following conditions are met:

- It is a surface water right application for more than 1 cubic foot per second, unless that project is for agricultural irrigation, in which case the threshold is increased to 50 cubic feet per second, so long as that irrigation project will not receive public subsidies;
- It is a groundwater right application for more than 2,250 gallons per minute;
- It is an application that, in combination with other water right applications for the same project, collectively exceed the amounts above;
- It is a part of a larger proposal that is subject to SEPA for other reasons (e.g., the need to obtain other permits that are not exempt from SEPA);
- It is part of a series of exempt actions that, together, trigger the need to do a threshold determination, as defined under WAC 197-11-305.

This project is not categorically exempt from SEPA, because the four change applications associated with the project total more than 2,250 gallons per minute in additive instantaneous quantity. The total instantaneous quantity associated with the combined change applications is 2930 gallons per minute (gpm).

The City prepared a SEPA checklist and notice was posted in the Ferndale Record on February 10, 2016. No public comments were received during the public comment period, and a Determination of Non-Significance (DNS) was issued.

Water Resources Statutes and Case Law

RCW 90.03.380(1) states that a water right that has been put to beneficial use may be changed. The point of diversion, place of use, and purpose of use may be changed if it would not result in harm or injury to other water rights. The Washington Supreme Court has held that Ecology, when processing an application for change to a water right, is required to make a tentative determination of extent and validity of the claim or right. This is necessary to establish whether the claim or right is eligible for change. *R.D. Merrill v. PCHB* and *Okanogan Wilderness League v. Town of Twisp.*

RCW 90.03.386(3) requires a municipal water supplier to apply cost-effective water conservation measures as part of its water system planning. The water supplier must also evaluate the effects of delaying the use of inchoate water rights before it may increase use of those inchoate rights. RCW 90.03.320 requires Ecology to consider the public water supplier's use of conserved water when establishing a surface or ground water right construction schedule. The City's conservation program is outlined in Chapter 4 of the current water system plan (Reichhardt & EBE Engineering Inc. 2010).

RCW 90.03.386(2) states that a municipal water supplier may change its service area through the water system plan approval process. As long as the municipal water supplier is in compliance with the approved plan, the place of use for the water right is the service area of the plan.

RCW 90.44.100 allows Ecology to amend a ground water permit or certificate to: (1) allow the user to construct a replacement or additional well at a new location outside of the location of the original well, or to (2) change the manner or place of use of the water, if:

- The additional or replacement well taps the same body of public ground water as the original well. RCW 90.44.100(2)(a),
- Where a replacement well is approved, the user must discontinue use of the original well and properly decommission the original well. RCW 90.44.100(2)(b),
- Where an additional well is constructed, the user may continue to use the original well, but the combined total withdrawal from all wells shall not enlarge the right conveyed by the original permit or certificate. RCW 90.44.100(2)(c),
- Other existing rights shall not be impaired. RCW 90.44.100(2)(d).

When changing or adding points of withdrawal to groundwater rights (RCW 90.44.100), or when consolidating exempt wells with an existing permit or certificate (RCW 90.44.105), the wells must draw from the *same body of public groundwater*. Indicators that wells tap the *same body of public groundwater* include:

(a) Hydraulic connectivity.
(b) Common recharge (catchment) area.
(c) Common flow regime.
(d) Geologic materials that allow for storage and flow, with recognizable boundaries or effective barriers to flow.

INVESTIGATION

In consideration of this application, Aspect reviewed available documents pertaining to the application's site conditions, existing well installations, and the potential effect of the proposed change on existing water right holders and established minimum instream flows. This review included information submitted by the applicant, including well construction and testing reports, water system plan, and water level data, along with pertinent Ecology records, including well logs and water rights records. The review also included reports from multiple investigations characterizing the hydrogeology of the Ferndale area and Mountain View Upland.

A site visit was performed on July 21, 2015. Carl Einberger of Aspect met with City representative Mike Olinger to discuss the application, visit existing well locations and the area proposed as future withdrawal points, and to discuss the City's current water system operations.

Using the available information in the Ecology file record, existing reports, the site visit, and communications with the City, Aspect evaluated potential effects of the proposed consolidation of withdrawal locations for the four water rights involved in the package of change applications. The City's water rights are discussed in more detail in the following section.

Existing Water Rights

The following table summarizes the City's existing water rights. The subject of this report is Groundwater Certificate (GWC) 7700, however all of these water rights have change applications being processed together, and all are discussed in this report.

Table 2. City of Ferndale's Water Rights Portfolio

Source	Water Right	Type	Priority Date	Qi in gpm	Qa in ac-ft/yr	
					Additive	Non-Additive
PW-2 Douglas Road Well	GWC 1513	Certificate	5/9/1952	1000	1615	-
PW-1 Shop Well	GWC 3058	Certificate	2/28/1955	870	440[1]	-
PW-2 Douglas Road Well	G1-00720P	Permit	7/21/1971	1000	-	1614[1]
PW-4 Central City Well	GWC 7700	Certificate	3/10/1970	60	85	-
			Total	2930	2140	1614

[1]There is some confusion in the water right record as to the total annual quantity allowed to be withdrawn under all City of Ferndale water rights. As a result, Reports of Examination prepared for changes to GWC 1513 and G1-00720P in 2004 tentatively determined that the City of Ferndale should be allowed under its then existing water rights to withdraw up to a combined 2,055 acre-feet per year from all three of its then existing water rights and permits. The Superseding Permit issued in 2004 for G1-00720P noted that the total annual quantity from GWC 1513, GWC 3058, and G1-00720 shall not exceed 2,055 acre-feet per year. In 2014, the City of Ferndale acquired GWC 7700, giving the City a total combined annual quantity from the four water rights of 2,140 acre-feet per year. A recent review of files as part of this investigation suggests the interpretation noted in Table 2 is the intent of the original water right approvals.

Table 3 summarizes the nomenclature historically applied to these water rights:

Table 3. Water right and change references numbers

Source	Original Designation	Previous Change Reference #'s	Current Change Reference #'s
PW-2 Douglas Road Well	GWC 1513	G1-*02509C	CG1-*02509C@1
PW-1 Shop Well	GWC 3058	G1-*03899C	CG1-*03899C
PW-2 Douglas Road Well	G1-00720P	-	CG1-00720P@1
PW-4 Central City Well	GWC 7700	-	CG1-*10690C

The Thornton Creek Well, PW-3, did not have any water rights associated with it as of the time of submittal of this change application, but is a requested point of withdrawal under this consolidation project and change request.

History of Ferndale's Water Rights

The City has a complicated water supply history dating back to the early 1950s. All four of the water rights that have change applications filed for points of withdrawal consolidation are discussed in this summary.

A synopsis of key historical information includes:

- The City obtained two water rights in the early 1950s: GWC 1513 with a priority date of 5/9/52 and GWC 3058 with a priority date of 2/28/55. Both of these rights were certificated in the 1950s.

- The above water rights and associated wells near the City shop provided the main source of water for the City until 1975 (Reichhardt & EBE Engineering Inc. 2010).

- In 1971, the City obtained a permit for an additional water right at the City shop (G1-00720P).

- In 1974 the City entered into an agreement with Whatcom County Public Utilities District No. 1 (PUD 1) to provide water from the Nooksack River. It appears this was done to address water quality concerns in the existing wells. A water treatment plant was constructed in 1975 to switch to potable treated water from the Nooksack River. The well now known as the City Shop Well (PW-1) remained connected and used and relied on as an emergency and back-up water source; however, use of the well as a main source of water temporarily ceased.

- In early 1994, the City relocated one well (not the existing Shop Well) from the City shop area to the Douglas Road site to allow construction of a library near the shop location. This well (PW-2) was drilled but was not connected to the system (Reichhardt & EBE Engineering Inc. 2010) at that time. The City of Ferndale filed change applications for GWC 1513 and G1-00720P in 1992 for this relocation. GWC 3058 remained associated with a second well at the City Shop Well.

- In 2003, Ecology prepared a Hydrogeologic Report (Ecology, 2003) and ROEs supporting the above changes were completed in 2004. The change to G1-00720P was approved in a Superseding Permit on June 8, 2004. The change to GWC 1513 was approved by Ecology in a Superseding Certificate issued on February 25, 2005.

- Several years ago, the City began evaluating the possibility of switching off PUD water and returning to the City's back-up groundwater sources as the City's primary source of water. This switch had been encouraged by the Washington State Department of Health (DOH) for several years. The City also wanted to gain more control over costs of water delivery and treatment options for the water system (Associated Earth Sciences, Inc., 2013). This switch occurred on December 14, 2012.

- Soon after switching to the City's production wells as the primary source of water, the City encountered water quality changes from the both the Shop Well and the Douglas Road Well,

with unanticipated increases in hardness and chloride. In response to this, the City installed a nanofiltration (reverse osmosis) treatment system to improve the quality of water delivered to its customers (Associated Earth Sciences, Inc., 2013).

- Records provided by the City indicate the City's two active wells (Douglas Well and the Shop Well), have had increasing production annually in the period from 2012 to 2015. In 2014, the Douglas and Shop Wells produced approximately 775 and 485 ac-ft/yr, respectively. In 2015, the Douglas and Shop Wells produced approximately 1,062 ac-ft/yr and 277 ac-ft/yr, respectively. Based on the change applications described above, the City currently exercises GWC 1513 and a portion of G1-00720P from the Douglas Well and exercises GWC 3058 from the Shop Well.

- In 2014, the City acquired a water right (GWC 7700) (the subject of this ROE) from the Central City Water Association (CCWA). The CCWA water right was originally certificated for community domestic supply (and municipal as a matter of law) and is authorized for 60 gpm and 85 ac-ft/yr. While the water right has been inactive since the acquisition, as part of this consolidation request the City intends to reactivate beneficial use of this water right. A review of records filed with DOH from 2009 to 2014 indicates that this water right was actively used prior to acquisition for 15 or more connections. In 2014, Ecology issued an amended certificate to the City for GWC 7700 conforming its purpose of use to municipal supply for the authorized 60 gpm and 85 ac-ft/yr.

Extent & Validity Analysis of GWC 7700

In a letter dated June 3, 2016, Joseph A. Rehberger of Cascadia Law Group, on behalf of the City of Ferndale, provided the following extent and validity information for GWC 7700.

Central City Water Use Records

The following table shows water use records for CCWA for the second half of 2003 through year 2013. In 2014, CCWA began purchasing water from the City of Ferndale.

Table 4. Annual Water Use Records

Year	Water Pumped (gallons)	Water Use (ac-ft/yr)
2003	7,935,138 (July-Dec)	
2004	17,094,956	52.5
2005	10,990,964	33.7
2006	10,003,766	30.7
2007	9,897,889	30.4
2008	10,919,516	33.5
2009	9,959,107	30.6
2010	7,406,428	22.7
2011	7,297,560	22.4
2012	7,146,092	21.9
2013	7,223,866	22.2

The above reflects a peak use in 2004 of 52.5 ac-ft/yr. Water use for the second-half of 2003 shows water use was approximately 12% higher during 2003 than in 2004 (7,935,138 gallons in the second half of 2003 versus 7,7077,976 in the second half of 2004). Based on this extrapolation, 12% greater water use in 2003 would amount to a peak water use of 58.8 ac-ft/yr in 2003. Accordingly, 52.5 to 58.8 ac-ft/yr of the CCWA right has been perfected through actual use, and that, to the extent there was any reduction in use after perfection, such quantity is exempted from relinquishment by the municipal exception because the right qualifies as being for municipal purposes because it has continually been exercised to serve 15 or more connections. Therefore, 26.2 to 32.5 ac-ft/yr remains inchoate because it has never been put to use, which requires ascertaining whether the remaining inchoate quantity remains in good standing through reasonable diligence, etc.

Intent of Original Water Right Application and Certificate

CCWA's water right was issued in the 1970s based on a system capacity of 60 gpm and 85 ac-ft/yr to provide community domestic supply (municipal) within the "[a]rea served by Central City Water Association within Sec. 19. T. 29 N. R. 2 E., W.M. and Sec. 24, T. 39, R. 1 E., W.M." Sections 19 and 24 represent a combined approximate 1,280 acres of land. At the time, this property was located just west of the City of Ferndale's city limits. Maps in Ecology's files submitted as part of CCWA's water right application in 1970 show the then present City municipal boundaries as extending into the West ½ of Section 19. Accordingly, the unincorporated area at the time included the E ½ of Section 19 and the E ½ E ½ of the NW ¼ of Section 19, an area of 360 acres, plus the additional up to 640 acres in Section 24. The intent of the original application and certificated water right was to serve this area.

Potential Future Growth Projections

CCWA's actual service area has changed over the years in response to water needs and the City's progressive annexation at and around this area. In support of this change application, the City analyzed potential future demand within the area(s) commonly considered to be CCWA's existing service area at and immediately prior to consolidation into the City's water system.

The property within CCWA's service area is primarily zoned RS-8, with some portion west of Church Road zoned as RS-10. RS-8 provides for a zoning density of 4 to 7 units per acre. RS-10 provides for a zoning density of 3 to 5 units per acre. Based on this analysis, the City estimates that between 130 and 228 equivalent residential units (ERUs) remain capable of being developed within CCWA's service area.

The above analysis was adjusted downward based on known or understood development constraints. Further, the projected future development potential does not include zoning allowed for conditional uses (golf course, duplexes, and others) which may generate additional and higher water demand, nor does it include potential future demand based on authorized accessory dwelling units (ADUs) on existing developed parcels. These uses could have led to further increased usage.

AESI Water Rights Demand Analysis

Under contract for the City, Associated Earth Sciences, Inc. (AESI) estimated water use demand for GWC 7700 based on potential future development. Based on an 11-year average demonstrated use of 253 gpd per ERU within the CCWA water system, an additional 130 to 228 ERUs represents an additional potential water use demand of 37 to 65 ac-ft/yr.

Based on an 11-year average demonstrated use of 253 gpd per ERU within the CCWA water system, the water demand at full build-out of 342 ERUs (consisting of the 114 existing ERUs plus an additional

potential 228 ERUs) is approximately 97 ac-ft/yr (342 x 253 x 365 = 31,581,990 gallons = 96.92 ac-ft/yr), which exceeds the CCWA water right Qa of 85 ac-ft/yr.

Tentatively Determined Quantities Eligible for Change

Based on the information provided by the City and upon Ecology's review, it is tentatively determined that GWC 7700 is in good standing and is eligible for change. This is a municipal water supply water right that is not subject to relinquishment. The full certificated instantaneous rate was perfected through beneficial use in the early 1970s (shown on the Proof of Appropriation form filed on March 1, 1972). The full annual quantity is not yet fully perfected through actual beneficial use. However, prior to takeover by the City, CCWA was a growing system, in good-standing, with a State Department of Health green operating permit. The demand analysis provided by the City shows that CCWA could easily have grown into their annual allocation of 85 ac-ft/yr. Therefore, the full certificated quantities of 60 gpm and 85 ac-ft/yr shall be eligible for change.

Proposed Use

The only change proposed for GWC 7700 is to allow the authorized quantities to be used with flexibility at any of the City's current points of withdrawal, and at possible new points of withdrawal within the area outlined on Figure 1. The goal is to allow the City the opportunity to tailor water withdrawals to water needs throughout the City's service area. In addition, the City is interested in finding potential new points of withdrawal that may have improved water quality compared to the current source wells.

Future use of the existing appropriations will continue to be for municipal supply, and no changes in the type of use or in the total allowable instantaneous or annual withdrawal quantities are proposed.

Investigation of New Points of Withdrawal

The City has engaged Wilson Engineering and AESI to assist with identifying potential locations for new wells and with drilling test wells. A hydrogeologic evaluation in support of this goal was completed in 2013 that proposed drilling and testing of a new well at a location near the northwest corner of the City limits. This was designated as the "Thornton Road Well" location (AESI, 2013).

AESI considered the Thornton Road location to be promising from both a water quantity and quality standpoint. In addition, AESI recognized that the Thornton Road location was in the same surface water drainage basin as the existing Douglas Road, Shop, and Central City Wells, supporting the ability to withdraw from the same source of groundwater as these wells, thus aiding the addition of this location as a point of withdrawal. AESI noted that the nearby Thornton Road Water Association well has lower concentrations of sodium, chloride, conductivity, TDS, and manganese than the City's production wells.

In 2014, a test well was drilled under AESI's supervision at the Thornton Road Well location to 450 feet of depth. AESI concluded that the well could achieve a long-term yield of approximately 350 to 375 gpm. Test pumping of the well for 24 hours at 315 gpm did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well. Elevated water quality for manganese, conductivity, color, and total dissolved solids were noted, indicating that the water would require treatment to meet DOH standards for public water supply. No decision on future use of this well by the City has been made at this time, and additional locations within the proposed 'future well area' outlined on Figure 1 may be investigated for potential production well drilling and construction.

Other Rights Appurtenant to the Place of Use

As part of this investigation, Aspect obtained water right records from Ecology's database for the area proposed for potential future wells identified in Figure 1, including a ½ mile buffer outside of this area. Note that this area also includes the City's existing points of withdrawal.

Thirteen certificated groundwater rights were identified, with the majority of these being for domestic use. The largest of these were two domestic and stockwater rights owned by F. Imhoff, with each authorized for an instantaneous withdrawal (Qi) of 50 gpm and annual quantity (Qa) of 80 ac-ft/yr. These are located approximately ½ mile southeast of the City's Douglas Well. A review of the associated well log indicates a completion depth of 195 feet, likely within the Regional Aquifer.

In addition, there are 68 claims, all for groundwater use, within the search area. It is expected that many of the water rights found in this review are not being exercised, given the availability of public water supply from the City's system in much of the search area.

Hydrologic/Hydrogeologic Evaluation

The portions of the City of Ferndale area of interest for this investigation are located west of the Nooksack River near River Mile 6 (Figure 1), in the Fraser-Whatcom basin (additional incorporated areas of the City are located east of the Nooksack River). The western portion of the City water service area is within the Mountain View Upland, with elevations up to 360 feet near the Thornton Road Well. Areas closer to the river are lower in elevation and are part of the Nooksack River valley, with elevations as low 20 feet.

The Fraser-Whatcom basin was subject to repeated glaciation during the Pleistocene Epoch, and several hundred feet of glacial and interglacial sediments are present in the area, with bedrock found at considerable depth. The deepest well in the project area was drilled to a depth of 440 feet and did not encounter bedrock (AESI, 2013).

Overview of Groundwater Occurrence

Groundwater in the Ferndale area is found in discontinuous perched groundwater aquifers and in a single Regional Aquifer that appears to be composed of predominantly pre-Vashon deposits. Aspect (2009) conducted a study of the Mountain View Upland, which extends from the western upland portions of the City of Ferndale west to the Strait of Georgia. Seven hydrostratigraphic units were delineated:

> *The upper fine-grained unit (F1/F2) consists predominantly of glacial marine drift and potentially Sumas and Vashon age till. Shallow perched groundwater occurs above the F1 unit and within coarse-grained lenses interbedded with the F1 unit. A coarse-grained unit (C2) underlies the F1 unit and appears to be correlative with Vashon advance outwash (Mountain View Sand and Gravel). The C2 unit is generally unsaturated. Deeper units, interpreted as the Cherry Point silt and other pre-Vashon, fine-grained deposits, are found beneath the C2 units and form a lower aquitard (F3).* ***The regional aquifer in the study area is present predominantly in the coarse-grained C3 unit that is thought to be correlative with the pre-Fraser deposits, and in more permeable portions of the F3 unit (typically silty sands), as indicated by several productive wells completed within these zones.***

A review of well logs for the City's existing four wells and stratigraphic cross sections (Aspect, 2009) suggests that they are completed in the same source of water, the Regional Aquifer (see Table 5).

Table 5. Existing City Wells and Interpreted Aquifer		
Source	**Completion Depth (feet)**	**Interpreted Aquifer**
Douglas Road Well	152	Regional Aquifer
Shop Well	160	Regional Aquifer
Central City Well	290	Regional Aquifer
Thornton Road Well	450	Regional Aquifer

Groundwater Flow in the Regional Aquifer

Aspect (2009) also evaluated groundwater flow directions in the Regional Aquifer in the Mountain View Upland. Based on a review of these data, mapped for both March and October of 2008, groundwater flows in the southeastern portion of the Mountain View Upland near Ferndale generally trend southeast toward the Nooksack River. All of the area of interest for this investigation appears to be in the same source of water, with the Regional Aquifer flowing toward the Nooksack River. In addition to being consistent with Aspect's previous interpretation, this is also consistent with Ecology's previous interpretation in the hydrogeologic report for changes to the City's GWC 1515 and G1-00720P water rights (Ecology, 2003).

Key Aquifer Test Data and Potential Impairment

Ecology (2003) reviewed pumping tests conducted in 1994 on the Douglas Road Well. A step test and a 26-hour constant rate pumping test were conducted by GeoEngineers, with a well approximately 2200 feet away used as a monitoring well. This well had very limited drawdown observed during the test (0.33 feet). GeoEngineers (1994) also conducted an additional impairment analysis. This suggested that a nearby well (at Ferndale Mobile Village), would have experienced approximately 13 feet of drawdown from the 26-hour pumping test. Ecology concluded that no impairment would occur at this well, given the 120 feet of available drawdown.

As noted previously, the test well drilled into the Regional Aquifer in 2014 at the Thornton Road well location did not produce any observable drawdown at the nearest observation well located approximately 2000 feet southwest, the Central City Well, during a 24 hour pump test.

In general, based on a review of selected well logs, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1).

Impairment Considerations

Impairment of Minimum Instream Flow Water Rights

The term "instream flow" is used to identify a specific stream flow (typically measured in cubic feet per second, or cfs) at a specific location for a defined time, and typically following seasonal variations.

Instream flows are usually defined as the stream flows needed to protect and preserve instream resources and values, such as fish, wildlife and recreation. Instream flows are most often described and established in a formal legal document, typically an adopted state rule.

Once established, a minimum flow constitutes an appropriation with a priority date as of the effective date of the rule establishing the minimum flow (RCW 90.03.345). Thus, a minimum flow set by rule is an existing right which may not be impaired (RCW 90.03.345; RCW 90.44.030).

Minimum instream flows were established for the Nooksack River Water Resource Inventory Area (WRIA 1) by WAC 173-501 in 1985. None of the four water rights involved with this project are junior to the instream flow rule, and as such, they are not subject to curtailment when instream flows are not met. No additional impacts to instream flows are expected to result from authorization of this change request, given that there is no enlargement of the water right through this consolidation process. WDFW has concurred with this opinion, as noted in their January 29, 2016, letter to Ecology.

Impairment, Qualifying Ground Water Withdrawal Facilities, and Well Interference
There are three concepts that are important when considering whether a withdrawal of water from a well would impair another existing water right. The concepts are defined as follows:

1. Impairment is an adverse impact on the physical availability of water for a beneficial use that is entitled to protection (i.e., water rights that are both senior and junior in priority to the right the applicant seeks to change).

2. Qualifying ground water withdrawal facilities are defined as those wells which in the opinion of the Department are adequately constructed. An adequately constructed well is one that (a) is constructed in compliance with well construction requirements; (b) fully penetrates the saturated thickness of an aquifer or withdraws water from a reasonable and feasible pumping lift (WAC 173-150); (c) the withdrawal facilities must be able to accommodate a reasonable variation in seasonal pumping water levels; and (d) the withdrawal facilities including pumping facilities must be properly sized to the ability of the aquifer to produce water.

3. Well interference may occur when several wells penetrate and withdraw ground water from the same aquifer. Each pumping well creates a drawdown cone. When several wells pump from the same aquifer, well density, aquifer characteristics, and pumping demand may result in individual drawdown cones that intersect and form a composite drawdown cone. At any point in an aquifer, the composite drawdown caused by pumping wells will be greatly influenced by the transmissivity (T) of the aquifer. In aquifers with high Ts, composite drawdown will generally be much less than in aquifers with similar properties but with low Ts. Transmissivity is related to hydraulic conductivity (K) and the saturated thickness (b) of an aquifer by the relationship T=Kb.

   An aquifer's hydraulic conductivity (K) is derived from the physical properties of both the fluid and geologic materials that form an aquifer. Once formed, an aquifer's saturated thickness (b) becomes important in evaluating its transmissivity. For regions of similar K in an aquifer, a large saturated thickness will result in a much higher T than a small saturated thickness. As a result, regions of similar K in an aquifer with a large saturated thickness will experience less composite drawdown or well interference than with a small saturated thickness.

Some conditions, however, will increase or steepen composite drawdown in an aquifer. For instance, where characteristics (such as very fine, clay-rich, or poorly sorted sediments) of an unconfined aquifer cause significant drawdown relative to the saturated thickness, the composite drawdown will increase as saturated thickness is reduced and T becomes smaller. Additionally, in regions where negative or no-flow boundaries occur, such as near the edges of a valley fill aquifer where it is bounded by bedrock, composite drawdown will be steeper than in the central part (generally the greatest thickness region) of the aquifer. Consequently, it is commonly understood that the greatest composite drawdown or well interference is more likely to occur in regions of low transmissivities, thin saturated thicknesses and near negative or no-flow boundaries than in regions of high transmissivities, large saturated thicknesses, and away from negative or no-flow boundaries.

As noted in the review of pump test information and well log review noted previously, it appears that existing wells completed in the Regional Aquifer have sufficient available drawdown given their depths and groundwater elevations to limit any impairment issues from adding potential new points of withdrawal within the future well area proposed by the City (Figure 1). No impairment issues are anticipated based on approval of the consolidation project and this associated change request.

Public Interest Considerations

No potential for detriment to the public interest was identified during the investigation of this water right change application.

Consideration of Protests and Comments

This application was protested by the Lummi Indian Business Council. Their June 29, 2016, protest letter indicates the change application is for points of withdrawal located within the WRIA 1 watershed. Their protest is based on concerns over current and future potential impacts on instream flows. However, this is a change application and not an application for new (consumptive) water use. Because the quantities of water involved will remain unchanged, there will be no increase in consumptive use, and each of the sources will pump from the same body of public water, therefore no additional or new impacts are associated with the change being recommended for approval. A provision has been added that specifically identifies that this right is subject to senior water rights.

CONCLUSIONS

The full quantities (Qi and Qa) of water allocated under the subject certificate are eligible to be changed.

Tentative determination

Groundwater Certificate 7700 is in good standing with the Department of Ecology and is therefore eligible for change for the full certificated quantities. In accordance with RCW 90.14.140(2)(d), rights for municipal supply purposes are not subject to relinquishment.

Potential for Enlargement

No potential for enlargement of the existing water right exists, provided the City does not withdraw more than a total of 60 gpm and 85 ac-ft/yr (additive) under this water right at the existing and potential new points of withdrawal.

Same Source Considerations

All of the existing points of withdrawal considered under this change are within the same source of water, the Regional Aquifer. In addition, all of the existing City wells and the area proposed for future new wells are all within the same surface water drainage basin (Schell) as delineated by Whatcom County. Provided any new points of withdrawal are limited to the area proposed in Figure 1 and the wells are completed in the Deep Aquifer, they can be considered to also be within the same source of water.

Potential for Impairment of Existing Rights

The change requested will not impair existing rights.

Potential for Detriment to the Public Interest

The change requested will not be detrimental to the public interest.

RECOMMENDATIONS

Based on the above investigation and conclusions, I recommend this request for change be approved in the amounts and within the limitations listed below and subject to the provisions listed above.

Purpose of Use and Authorized Quantities

The amount of water recommended is a maximum limit and the water user may only use that amount of water within the specified limit that is reasonable and beneficial:

Q_i =60 gpm
Q_a = 85 acre-feet per year (additive)
For Municipal Use

Points of Withdrawal
See Figure 1, representing a portion of the area requested in the public notice for potential points of withdrawal: Section 19, S½ of Section 18, W½ of Sections 20 and 29, and N¾ of Section 30, in T39N, R2E, W.M.; and S½ of Section 13, and Sections 24 and 25, in T39N, R1E, W.M. Figure 1 was prepared by AESI to support the City's water right change.

The City's existing wells also are located within this area as illustrated by Figure 1.

Place of Use
The place of use (POU) of this water right is the service area described in the most recent City of Ferndale Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.



Carl M. Einberger

Carl Einberger, LG, LHG, License #1100

August 26, 2016
Date



J. R. "BUCK" SMITH

8/26/16

Reviewed by Buck Smith, LG, LHG, License #1479 Date

If you need this publication in an alternate format, please call Water Resources Program at (360) 407-6600. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Selected References

Aspect Consulting, 2009. Aquifer Study of the Mountain View Upland – Lummi River Area, Whatcom County and Lummi Nation, Washington. March 2009.

Associated Earth Sciences, Inc. (AESI), 2013. City of Ferndale Hydrogeologic Evaluation, Whatcom County, Washington. December 2013.

AESI, 2014. Installation and Testing of the Thornton Road Well, Ferndale Washington. December 2014.

GeoEngineers, Inc., 2004. Installation and Testing of Production Well No. 3 Ferndale, Washington. April 1994.

Reichhardt & EBE Engineering Inc. 2010, City of Ferndale 2006 Water System Plan. Updated 2010.

Washington Department of Ecology, 2003. Hydrogeologic Report for Change to GWC 1513 and G1-00720P (City of Ferndale). November 2003.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

REPORT OF EXAMINATION FOR CHANGE TO GROUND WATER PERMIT
TO APPROPRIATE PUBLIC WATERS OF THE STATE OF WASHINGTON

☐ Surface Water (Issued in accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the Department of Ecology.)

☒ Ground Water (Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology.)

PRIORITY DATE	APPLICATION NUMBER	PERMIT NUMBER	CERTIFICATE NUMBER
July 22, 1971	12073	G1-00720P	

NAME
City of Ferndale

ADDRESS (STREET)	(CITY)	(STATE)	(ZIP CODE)
P.O. Box 936	Ferndale	Washington	98248

PUBLIC WATERS TO BE APPROPRIATED

SOURCE
Well

TRIBUTARY OF (IF SURFACE WATERS)

MAXIMUM CUBIC FEET PER SECOND	MAXIMUM GALLONS PER MINUTE	MAXIMUM ACRE FEET PER YEAR
	1000*	1614**

QUANTITY, TYPE OF USE, PERIOD OF USE

Municipal water supply purposes – Continuously

* The maximum instantaneous withdrawal rate that can be pumped, from this water right, at the proposed well is 300 gpm. The remaining 700 gpm under this water right can be withdrawn through another well as long as it is an approved point of withdrawal for the water right through RCW 90.44.100(2) or RCW 90.44.100(3). Therefore, the total maximum instantaneous withdrawal rate that can be pumped from the proposed well is 1300 gpm from GWC 1513 and G1-00720.

**Total annual quantity from GWC 1513, GWC 3058, and G1-00720 shall not exceed 2055 acre-feet per year.

LOCATION OF DIVERSION/WITHDRAWAL

APPROXIMATE LOCATION OF DIVERSION--WITHDRAWAL

Approximately 1930 feet east and 1430 feet south of NW corner of Section 30, Township 39 North, Range 2 East, W.M.

LOCATED WITHIN (SMALLEST LEGAL SUBDIVISION)	SECTION	TOWNSHIP N.	RANGE, (E. OR W.) W.M.	W.R.I.A.	COUNTY
NE ¼, SE ¼, NW¼	30	39	2 E	1	Whatcom

RECORDED PLATTED PROPERTY

LOT	BLOCK	OF (GIVE NAME OF PLAT OR ADDITION)

LEGAL DESCRIPTION OF PROPERTY ON WHICH WATER IS TO BE USED

The place of use of this water right shall be consistent with the service area map and/or description contained within the most recently approved water system plan (including amendments).

DESCRIPTION OF PROPOSED WORKS

The water supply system consists of two wells and a raw water connection to the Whatcom PUD #1 diversion from the Nooksack River. Water from the proposed well will need to be routed through the treatment plant to remove hydrogen sulphide odor. Washington State Department of Health water system ID number 24850.

DEVELOPMENT SCHEDULE

BEGIN PROJECT BY THIS DATE:	COMPLETE PROJECT BY THIS DATE:	WATER PUT TO FULL USE BY THIS DATE:
Started	March 1, 2014	March 1, 2034

REPORT

BACKGROUND INFORMATION

On July 22, 1971, the Department of Ecology received a ground water application (#12073) from the town of Ferndale to appropriate 1000 gallons per minute (gpm) for continuous municipal supply.

On August 15, 1983, the Department of Ecology issued Ground Water Permit G1-00720P to the city of Ferndale. The permit authorized the withdrawal of ground water from a well at a rate of 1000 gpm and 1614 acre-feet per year (supplemental to existing rights) for continuous municipal supply. The point of withdrawal was to be located in the SE ¼, SW ¼, SE ¼, Sec. 19, T39N, R2E, W.M. approximately 1650 feet west and 50 feet north of the SE corner of Section 19. The place of use is described as the area served by the City of Ferndale. The development schedule on this permit called for the project to be started by June 1985, completed by June 1986, and the water put to full beneficial use by June 1987.

In the permit file there are a number of documents indicating that extension fees were paid on a number of occasions. Based on red pen alterations to the permit, it appears that the development schedule was updated by the permit extensions, so that the project was to be started by June 1993, completed by June 1994, and the water put to full beneficial use by June 1995.

On June 13, 1992, the Department of Ecology received a change application from the city of Ferndale to change the point of withdrawal of G1-00720P. The proposed point of withdrawal is located in the NE ¼, SE ¼, NW ¼, Sec. 30, T39N, R2E.

The city of Ferndale was granted a Preliminary Permit on June 21, 1993, to drill and test the proposed well.

On March 1, 2004, the Department of Ecology approved a request to extend G1-00720P for 11 years. This permit extension was approved and the new development schedule is that the project was to be started by June 2004, completed by June 2005, and the water put to full beneficial use by June 2006.

Attributes of the Permit

Name on Permit:	City of Ferndale
Priority Date:	July 22, 1971
Instantaneous Quantity:	1000 gallons per minute (gpm)
Annual Quantity:	1614 acre-feet per year (afy) (supplemental to existing rights)
Points of Withdrawal:	SE¼, SW¼, SE¼ of Section 19, Township 39 North, Range 2 East, W.M.
Purpose of Use:	Municipal supply
Period of Use:	Continuously
Place of Use:	Area served by the city of Ferndale

Proposed Change

Name of Applicant:	City of Ferndale
Date of Application for Change:	June 13, 1992
Point of Withdrawal:	NE¼, SE¼, NW¼, of Section 30, Township 39 North, Range 2 East
Notice of Publication:	Westside Record-Journal on January 6 and 13, 1993
Protests:	Lummi Indian Business Council protested the change application on September 10, 1992. Protest was withdrawn by the Lummi Indian Business Council on September 14, 1992.

INVESTIGATION

In considering this application, my investigation included, but was not limited to research and/or review of:

- The State Water Code
- The State Environmental Policy Act
- Existing water rights on file for the City of Ferndale
- Records of other water rights in the vicinity
- Notes from site visit on June 3, 2003 and November 7, 2003
- Correspondence with Loren Sperry (city of Ferndale Public Works Director), Steve Boessow (state of Washington Department of Fish and Wildlife, Water Rights Biologist), John Thielemann (Washington State Department of Health, Whatcom County Regional Engineer)
- Topographic and local area maps
- City of Ferndale Water System Plan (PEI Consultants, Inc, 1989)
- Whatcom County Coordinated Water System Plan Update (February, 2000)
  Hydrogeologic Report for Change to GWC 1513 and G1-00720P (City of Ferndale) (Andrew B. Dunn, November 24, 2003)

- Cox, Stephen E. and Kahle, Sue C., 1999, Hydrogeology, Ground-Water Quality, and Sources of Nitrate in Lowland Glacial Aquifers of Whatcom County, Washington, and British Columbia, Canada: U.S. Geological Survey Water Resources Investigations Report 98-4195, 250 p., 5 plates
- Easterbrook, D. J., 1976, Geologic Map of Western Whatcom County, Washington: U.S. Geological Survey Miscellaneous Investigations Series Map I-854-B
- GeoEngineers, Inc., April 29, 1994, Installation and Testing of Production Well No. 3 Ferndale, Washington: For city of Ferndale

State Water Code

Chapters 90.03 and 90.44 RCW authorize the appropriation of public water for beneficial use and describe the process for obtaining water rights including the process to amend or change existing rights. Laws specifically governing the water right permitting process are RCW 90.03.250 through 90.03.340 and RCW 90.44.060. Changes or amendments to these rights are covered under RCW 90.03.380 and RCW 90.44.100.

State Environmental Policy Act (SEPA)

This water right change is categorically exempt under SEPA WAC 197-11-305 and WAC 197-11-800(4).

State of Washington Department of Fish and Wildlife Comments

In a letter dated December 2, 2002, the state of Washington Department of Fish and Wildlife indicated that they had no comments on this change application.

Existing Rights for the City of Ferndale

The city of Ferndale currently has two certificates and one permit. All three rights are for municipal purpose of use to be used continuously. The original points of withdrawal for all three rights are located in SW¼, SE¼, Section 19, T39N, R2E, W.M. These rights are summarized in Table 1. The city of Ferndale also currently has a change application that is being processed for GWC 1513 to change the point of withdrawal to the same well requested under this change application.

Table 1. Existing Water Rights for the City of Ferndale

Water Rights	Priority Date	Type	Qi (gpm)	Qa (afy)	Tentative Determination on Type of Annual Right
GWC 1513	May 9, 1952	Certificate	1000	1615	Primary
GWC 3058	February 28, 1955	Certificate	870	440	Supplemental
G1-00720P	July 22, 1971	Permit	1000	1614	Primary and Supplemental
		Total	**2870**	**2055**	

Instantaneous Quantity

The maximum combined instantaneous withdrawal rate that the city of Ferndale is allowed to pump under all three of its water rights from their respective approved points of withdrawal is tentatively determined to be 2870 gpm.

Annual Quantity

There is some confusion in the water right record as to the total annual quantity allowed to be withdrawn under all city of Ferndale water rights. GWC 1513 was the first right obtained from the State and is for a maximum annual quantity of 1615 acre-feet per year. In the recommendations section of the report of examination for water right GWC 3058, the report writer indicates that *"the water right is for 440 acre-feet per year, less any amount diverted to this use under existing water rights now enjoyed by the Town of Ferndale."* This wording suggests that the annual quantity of both GWC 1513 and GWC 3058 are not to exceed 1615 acre-feet per year. However, the annual quantity was not indicated as supplemental on the succeeding permit or certificate. In the report of examination for water right G1-00720 the report writer indicated that the town of Ferndale currently has 2055 acre-feet per year (1615 afy + 440 afy = 2055 afy) and their total annual withdrawal from all rights shall not exceed 2055 acre-feet per year. In this same document the report writer calculates the estimated water requirement for the projected 10,640 residents living in the city in the year 2000, based on average use per person of 167 gallons per day, as 1991 acre-feet per year (167 gallons per person per day * 10,640 people * 365 days per year = 648,561,200 gallons per year = 1991 acre-feet per year). Since the report writer believed that the existing rights totaled 2055 acre-feet per year, he made the right supplemental to existing rights. On the face of the permit for G1-00720P it indicates that the annual quantity of 1614 acre-feet per year is *"supplemental to existing rights."*

Based on the confusing water rights record, it is tentatively determined that the city of Ferndale should be allowed to withdraw up to a combined annual quantity of 2055 acre-feet per year from all three of its water rights.

Other Water Rights in the Vicinity

There is 1 water right declaration, 4 water right certificates, no permits, 2 claims, and approximately 6 exempt wells within a 2200 foot radius of the proposed well in addition to the water rights currently held by the City of Ferndale (Figure 1).

Declarotion
GWC 1086-D

- Frank Imhoff
- Priority Date: March 1942
- Instantaneous Rate: 50 gpm
- Annual Quantity: 80 acre-feet per year

Certificates

GWC 5412

- Frank Imhof
- Priority Date: October 6, 1959
- Instantaneous Rate: 50 gpm
- Annual Quantity: 80 acre-feet per year

GWC 1205

- Fertile Meadows Water Association
- Priority Date: April 10, 1952
- Instantaneous Rate: 17 gpm
- Annual Quantity: 27 acre-feet per year

GWC 7644

- Homer H. Hughes
- Priority Date: June 2, 1971
- Instantaneous Rate: 15 gpm
- Annual Quantity: 18 acre-feet per year

G1-21554C

- Robert B. Scheer
- Priority Date: April 30, 1974
- Instantaneous Rate: 60 gpm
- Annual Quantity: 22.5 acre-feet per year

Claims

G1-009713CL

- Alton N. Parker
- Instantaneous Rate indicated as used at time of filing: 4 gpm
- Annual Quantity indicated as used at time of filing: 0.13 acre-feet per year

G1-021456CL

- Orville J. Pheifer
- Instantaneous Rate indicated as used at time of filing: 32 gpm
- Annual Quantity indicated as used at time of filing: 51 acre-feet per year

Vested ground water rights were created by beneficial use of ground water prior to the enactment of chapter 90.44 RCW in 1945. Since both of the above mentioned water right claims indicate that the date of first putting the water to use was in the 1960s, they likely do not represent vested rights. However, official confirmation of the validity of these water right claims can only be determined through a water right adjudication in Whatcom County Superior Court.

Site Visits

On June 3, 2003, Andrew B. Dunn (Ecology) met with Loren Sperry (city of Ferndale Public Works Director). During the site visit we discussed the water rights on file with the Department of Ecology, the historic water system, and the current water system. We also toured the city visiting sites of interest related to their water rights and the water system.

The property that contained the original two wells approved as points of withdrawal under GWC 1513 was visited. Loren indicated that the wells had been decommissioned prior to the city of Ferndale library being constructed over the top of them. The library was built on the southern half of property that was once entirely used as the city maintenance shop.

The existing city maintenance shop facilities are now located north of the library. The point of withdrawal for GWC 3058, which is owned by the city of Ferndale, is located on this property. The well is hooked directly into the water main and the water is not treated prior to being distributed to customers. Presumably many years after the well was drilled an Ecology Unique Well ID tag was attached to the well. The Unique Well ID tag for this well is AFM 090. Loren indicated that there is currently no water meter attached to this well to record the volume pumped. There is a 60hp shaft turbine motor positioned atop the well. Loren indicated that he runs the well for about 30 minutes each month to maintain the pump.

The proposed well is 12 inches in diameter. It is located in a field and is not currently connected to the water system and does not have a pump installed in it at this time. The well is flowing artesian in nature and a valve was turned on top of the well and water flowed freely. There was a slight smell of sulfur from the water.

We visited the current Whatcom PUD #1 (PUD) diversion and settling pond adjacent to the city of Ferndale treatment plant. The City currently obtains almost all of its water from the PUD at this location. The PUD pumps water from the Nooksack River. The PUD then sells the raw water to the city and the city treats the water to be delivered to its customers.

We visited a site reported by Loren Sperry to be the location of an old surface water diversion by the city of Ferndale directly out of the Nooksack River. This diversion was reportedly ceased when the bridge for Interstate 5 was constructed across the site in the early 1970's. An office review of water rights could not find a surface water right or claim held by the city of Ferndale for this location.

We also visited a site near the corner of Vista Drive and Gardiner Drive in the SE ¼, NE ¼, Section 19, Township 39 North, Range 2 East where Loren indicated that the town used to have a number of wells and a water tank. There are now homes built on this site. An office review of water rights could not find a ground water right or claim held by the city of Ferndale for this location.

On November 7, 2003, Andrew B. Dunn (Ecology) drove by the proposed well site looking for any wells that were located closer to the proposed well than those identified in the GeoEngineers report from 1994. None were identified.

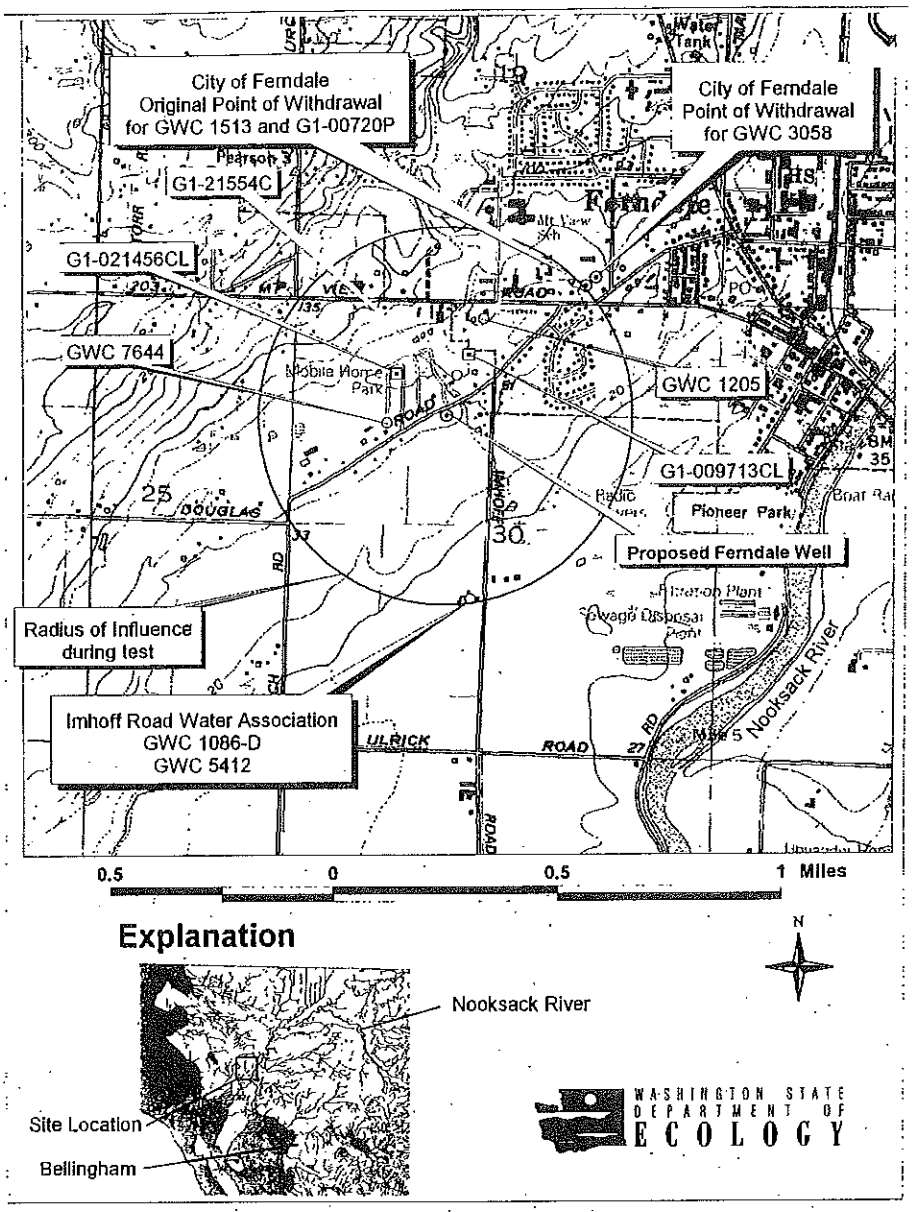


Figure 1. Nearby Identified Wells with Water Right Certificates and Water Right Claims. The radius of influence during the pumping test was approximately 2200 feet.

Topographic and Local Area Maps

The Ferndale, Blaine, and Bertrand Creek USGS 1:24,000 scale topographic maps and the WRIA 1, 2514 Watershed Planning Group, Surface Water Delineation Boundaries in WRIA 1, Version 1 map dated May 18, 2001, were used during this investigation. WRIA 1, 2514 Watershed Planning Group, May 18, 2001, Surface Water Delineation Boundaries in WRIA 1, Version 1 Map.

Historic Water Use

To date, there has been no water use under G1-00720P by the city of Ferndale. However, since this is a ground water permit that has a current development schedule, RCW 90.44.100 allows for a change in the point of withdrawal for the full allocated instantaneous and annual quantity. When this permit goes to certificate, only the perfected quantity of water, within the allocated quantity, will be certificated.

Currently, the city of Ferndale obtains all of its water from the Whatcom PUD #1 diversion from the Nooksack River just south of the city. This arrangement has been in place since approximately 1975.

Relinquishment/Abandonment Analysis

Since G1-00720P is a ground water permit that has a current development schedule, it does not appear to have been abandoned and is not subject to relinquishment. The City applied to the Department of Ecology, in June 1992, to change the point of

withdrawal to the new well. The new well was drilled and tested under a preliminary permit issued by the Department of Ecology in June 1993.

Based on the above information, I do not believe that any part of the water right has been lost to statutory relinquishment or common law abandonment.

Hydrogeology

The remainder of the Investigation section of this report is taken directly or is slightly altered from Dunn (2003) and deals with the hydrogeologic questions posed when changing the point of withdrawal of a ground water right.

Geographic Setting of the City of Ferndale

The city of Ferndale lies to the west of the lower Nooksack River (near River Mile 6) and to the east of the Mountain View Upland. The Nooksack River flows south past the city on its way to discharging into Bellingham Bay. The Mountain View Upland is an area that rises up to a maximum elevation of approximately 360 feet. It is bounded on the west by the Strait of Georgia and on the north, east, and south by low-lying (<50 feet elevation) river and stream drainages.

Geologic History of the Ferndale Area, Whatcom County, Washington (Cox and Kahle, 1999)

The hydrogeology of the Ferndale area is dependent on glacial deposits of the Fraser Glaciation. The Fraser Glaciation began approximately 18,000 years ago and lasted until about 10,000 years ago. The three phases of this glaciation, from oldest to youngest, are the Vashon Stade, the Everson Interstade, and the Sumas Stade. The Vashon glacial period (Stade) began approximately 18,000 years ago. At that time, the Vashon glacier advanced southward from Canada into the Puget Sound Lowland. Water flowing from the glacier deposited advance outwash, which was then overridden by the advancing glacier as it moved deeper into the Puget Sound Lowland. Advance outwash is typically cross-bedded sand and gravel. Vashon till, which was formed below the glacier, is a compact and poorly sorted mixture of cobbles, pebbles, and sand in a matrix of silt and clay. After its maximum advance, the Vashon glacier began to melt and retreat back toward Canada. The Everson Interstade was initiated when marine waters reoccupied the Puget Sound and the retreating glacier began to float on the water. In the northern Puget Sound Lowland, Everson glaciomarine drift was deposited under the marine water as sediment was shed from the melting glacier. Glaciomarine drift is primarily silt and clay with scattered gravel, cobbles and boulders and the occasional layer or lens of sand and gravel. During this time, the vicinity of Ferndale was submerged beneath sea level. The Sumas Stade began when the sea level dropped and a small lobe of the Vashon glacier readvanced from the Canadian border into the Sumas River Valley of Whatcom County. This glacier deposited the sand and gravel Sumas outwash. Eventually, all of the glaciers retreated from the Puget Sound Lowland. Most recently, the Nooksack River and other streams have incised and deposited alluvium within their current floodplains.

Hydrogeology of the Ferndale Area, Whatcom County, Washington (GeoEngineers, 1994)

There are at least two aquifers that have been utilized for water supply in the Ferndale area. These will be referred to as the shallow unconfined aquifer and the deep confined aquifer. These aquifers are separated by a relatively thick aquitard.

The shallow unconfined aquifer consists of sand and gravel with minor silt that was deposited as glacial outwash during the Sumas Stade of the Fraser Glaciation. This aquifer is directly connected to the surface water streams and rivers in the area. Underlying the shallow unconfined aquifer is an aquitard that is composed of two geologic units. The two units forming the aquitard are the Everson Interstade glaciomarine drift and the Vashon glacial till. The glaciomarine drift is composed primarily of silt and clay that was deposited under the marine water that was floating the retreating glacier. Beneath the glaciomarine drift lies Vashon glacial till. This glacial till was deposited beneath the Vashon glacier as it advanced into the Puget Sound lowland. The glacial till is a compact and unsorted mixture of silty sand with gravel. Beneath the aquitard is the deep confined aquifer. The deep confined aquifer consists of sand and gravel with some silt that was deposited as advance glacial outwash during the Vashon Stade of the Fraser Glaciation. Advance outwash was deposited by streams and rivers flowing in front of the advancing glacier. It is unknown if there are other aquifers at greater depth because no wells have been drilled that deep.

Near Ferndale, most wells are completed within the deep confined aquifer and only a few are completed in the shallow unconfined aquifer.

The deep confined aquifer has a potentiometric surface that is near or above the ground surface. This causes the proposed well, along with others in the area, to flow freely if they are not properly capped. When the proposed production well was drilled, the static water level was approximately 9 feet above the ground surface.

Well Construction Information

The depths at which each of the geologic units were encountered when drilling the proposed production well are detailed in Table 1.

Table 1. Proposed Production Well Construction

Approximate Depth Below Ground Surface (feet)	Geologic Unit
0 – 10	Sumas outwash (shallow unconfined aquifer)
10 – 80	Everson glaciomarine drift (aquitard)
80 – 122	Vashon till (aquitard)
122 – 171+	Vashon advance outwash (deep confined aquifer)

The application that led to G1-00720P indicated that the planned well for this water right would be approximately 170 feet deep, similar to the other wells operated under other city of Ferndale water rights (GWC 1513 and GWC 3058). So, while no well was actually drilled under this permit, the existing city of Ferndale wells are an accurate representation of what would have been encountered. Table 2 compares the well construction of the currently approved points of withdrawal for the City and the proposed point of withdrawal.

Table 2. Well Construction Information						
Well	Approximate Ground Surface Elevation (ft)	Depth of Well (ft)	Depth of Screened Interval (ft)	Elevation of Screened Interval (ft)	Depth to Water on Well Log (ft)	Water Level Elevation (ft)
Original Point of Withdrawal*	60	157	127 through 157	-67 through -97	19	41
Point of Withdrawal Approved After 1972 Change Application*	60	118	93 through 118	-33 through -58	6	54
Proposed Point of Withdrawal	40	171	152 through 166	-112 through -126	9 feet above ground surface	49
*Note: The relationship of these wells and GWC 1513 is uncertain. These well logs were found within the water rights record, and while unlabelled, are assumed to be correct.						

The GeoEngineers (1994) report indicates that the design screen capacity of the well screen installed is 1300 gpm. Since the change application for GWC 1513 has been approved to pump 1000 gpm from this same well that only leaves 300 gpm until the design screen capacity of the well is reached. Therefore, pumping at the full 1000 gpm rate authorized by this water right is not physically possible and any more than a combined pumping rate of 1300 gpm could damage the well screen.

Ground Water Flow Directions

GeoEngineers (1994) suggests that the recharge area for the proposed production well is located to the north on the Mountain View Upland. They indicate that ground water flow in the confined aquifer is to the south beneath the proposed production well at an approximate hydraulic gradient of 0.014 (70 feet per mile).

I agree with GeoEngineers (1994) that the recharge area for the deep confined aquifer is most likely the Mountain View Upland. However, I think that the aquifer is being recharged to the northwest instead of just the north. Also, I think that the ground water flow direction is likely more to the southeast than the south (Figure 3). This interpretation is based on three observations: 1.) the similarity of water levels for wells lying along Douglas Road, which suggests that they are all along an equal potentiometric surface contour, 2.) the alignment of the Nooksack River, which is the likely discharge point for the aquifer, as it flows past Ferndale, and 3.) the physical orientation of the Mountain View Upland primarily to the northwest of the site. Eventually, I would expect the water in the deep confined aquifer to discharge nearly vertically upward to the Nooksack River just south of Ferndale.

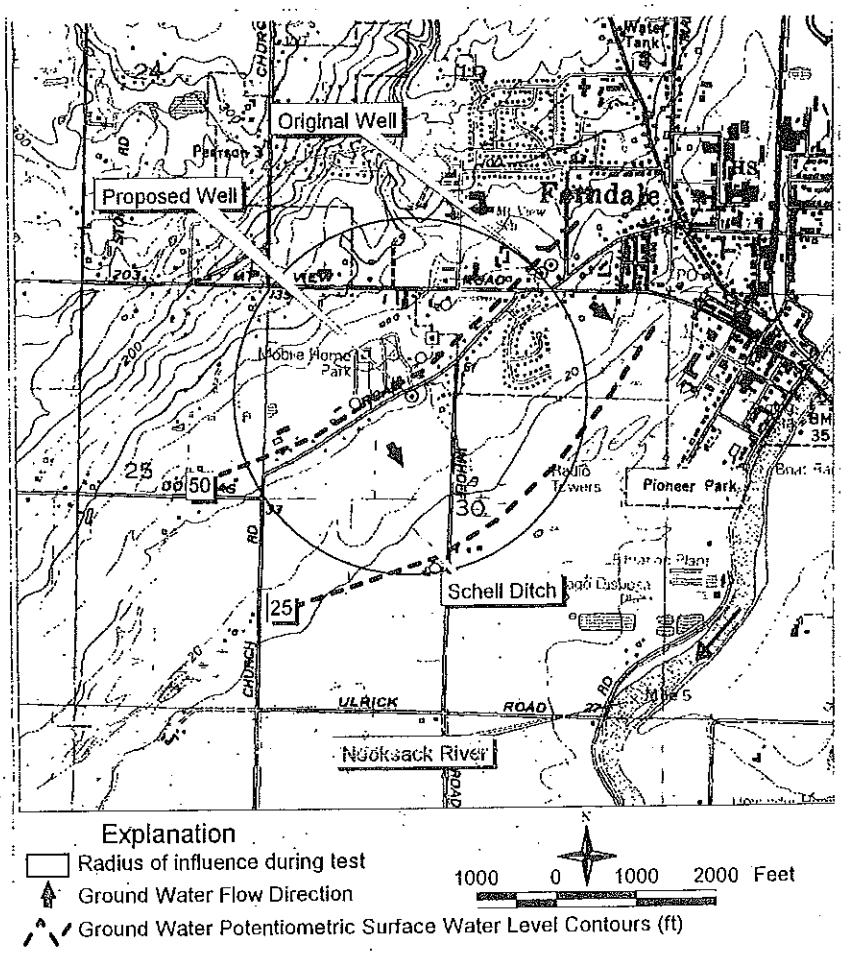


Figure 3. Hydrogeology and Hydrology in the Vicinity of the Proposed Well. Potentiometric level elevation contours are for the advance outwash confined aquifer. The Nooksack River is flowing to the south.

Pumping Tests

From February 21 to 23, 1994, GeoEngineers preformed a four-hour step pumping test and a 26-hour constant rate pumping test.

A step rate pumping test was performed to determine at what pumping rate the constant rate test should be pumped. Each pumping rate during the step test was pumped for one hour before progressing to the next higher pumping rate. This process continued until the well had been pumped at four increasing intervals for a total test time of four hours. The pumping rates used during the test were 500 gpm, 825 gpm, 1205 gpm, and finally 1820 gpm.

For the constant rate pumping test, the well was pumped at an average of 1805 gpm for 26 hours and then the recovery of the water level in the well was monitored for approximately 16.7 hours (1000 minutes) at the end of pumping. At the conclusion of pumping, the depth to water measured from the top of the casing was approximately 120 feet (127 feet below the static water level). The Imhoff Road Water Association well was used as an observation well (OW-1) during the pumping test. Well OW-1 is located in the same aquifer approximately 2200 feet away to the south (Figure 1). During the test the drawdown measured in well OW-1 was approximately 0.33 feet. The report also indicated that the Imhoff Road Water Association well also experienced well interference when the city of Ferndale pumped their original wells. This correlation between the Imhoff Road Water Association well and the original and proposed wells under the city of Ferndale water rights supports the geologic interpretation that the city of Ferndale's wells are all completed in the same aquifer and are tapping the same body of public ground water.

Approximately 420 minutes into the constant rate pumping test, the data suggests that an aquifer boundary was encountered. This aquifer boundary could represent a reduction in the transmissivity of the aquifer materials or the edge of the aquifer. Either way, the result of this boundary was that the rate of drawdown in the well increased in order to maintain a constant discharge rate of 1805 gpm. The drawdown in the well was still increasing when the pumping portion of the test was terminated. This was unfortunate in that it makes the analysis harder to perform given the uncertainty of the aquifer to produce the quantity pumped on a long-term (continuous) basis as the water rights allow.

Based on the results of the 26-hour pumping test, the specific capacity of the well was determined to be 13.99 gpm per ft drawdown at 1805 gpm. The specific capacity of the well would be expected to decline with increasing pumping rate and increased pumping duration. During the step test the specific capacity of the well was determined to be approximately 21 gpm per ft drawdown at 1205 gpm and 18 gpm per ft drawdown at 1805 gpm.

The hydraulic conductivity of the aquifer was estimated to be 125 ft/day with an aquifer thickness of 48 feet (transmissivity is approximately 6000 ft^2/day). This value for hydraulic conductivity is said to be typical of relatively permeable sand and gravel aquifers. The storage coefficient could not be calculated since the drawdown in the observation well used did not provide good enough data.

The radius of influence for pumping the proposed well at 1805 gpm for 26 hours is estimated to be approximately 2200 feet.

The total drawdown measured for the constant rate pumping test was approximately 127 feet. Using a transmissivity of 6000 ft^2/day, a storativity of 0.003, and an effective well radius of 0.5 feet, the theoretical drawdown at the well was calculated to be 78 feet. Based on these values, it appears that the well is approximately 60% efficient.

Impairment Analysis Based on Pumping Test

As mentioned above, it does not appear that 1805 gpm is a sustainable pumping rate for the proposed well, since drawdown was actually increasing with time and had not reached a dynamic steady state after 26 hours of pumping. RCW 90.44.070 does not allow for a permit to be granted to withdraw water beyond the capacity of the underground bed or formation. I believe that this statute would also apply to change requests to move to a new point of withdrawal. In the GeoEngineers (1994) report, the maximum recommended pumping rate for the well based on the design well screen capacity is 1300 gpm.

GeoEngineers (1994) performed their impairment analysis of nearby wells based on a pumping rate of 1300 gpm for 26 hours from the proposed point of withdrawal. At this rate, the closest well, used by the Ferndale Mobil Village (Possibly G1-21554C) and approximately 700 feet away, will experience approximately 13 feet of interference drawdown related to the pumping of the proposed well at 1300 gpm for 26 hours (Figure 1). The depth to water in the Village well is approximately 10 feet below the top of the well and their pump is reportedly at a depth of 130 feet below the top of the well. This equates to 120 feet of water above the pump intake during static conditions. The 13 feet of interference drawdown reduces the maximum available drawdown in the well to 107 feet. The Village well was reportedly tested for 4 hours at 34 gpm and only had 1 foot of drawdown. So, even with the well interference of the Ferndale well pumping at 1300 gpm as opposed to the 1000 gpm allowed under this water right, there is plenty of available drawdown in this well and it will not be impaired. A similar analysis was made with nearby wells identified by GeoEngineers (1994) and it appears that none of the wells will be impaired due to pumping of the Ferndale well at 1300 gpm for 26 hours at a time.

However, as discussed above, GWC 1513 and G1-00720P appear to have a combined annual quantity (2055 acre-feet per year) that is equal to pumping the well at 1275 gpm continuously for the entire year. To be conservative, I estimated the drawdown in the aquifer after a full year (8760 hours) of pumping at 1275 gpm, instead of looking at the drawdown produced by 26 hours of pumping as GeoEngineers (1994) had done. It may be unlikely that the well would be operated continuously, but the water right allows it, so I must make sure that it will not cause impairment. For this analysis I used some of the data provided in the GeoEngineers (1994) report and estimates of other parameters based on the pumping test results. The estimated values that I used in my analysis were 44,883 gpd/ft (6,000 ft^2/day) for transmissivity, 0.003 for storativity, and 1 year (8760 hours) for pumping duration. Since the aquifer is confined, I used the Theis and Cooper-Jacob methods to estimate drawdown in neighboring wells. The closest neighboring well is approximately 700 feet from the proposed well and would be expected to have just over 26 feet of drawdown after a year of pumping at 1275 gpm in an infinite aquifer that does not have any boundaries. With an available drawdown of 120 feet, subtracting 1 foot for the operation of the well and 26 feet for interference drawdown, this still leaves 93 feet of water in the well (120-1-26 = 93). Since the aquifer test showed that the aquifer likely does have a nearby boundary, the drawdown would likely be larger, but even if the inference drawdown more than doubled, it would still not be considered an impairment of other rights.

position on these wells is changed by the city of Ferndale providing them with the appropriate information. On September 16, 1992, the Department of Ecology received a letter from the Lummi Indian Business Council. The letter indicated that they had spoken with the city of Ferndale and would like to withdraw their protest of this change application.

RECOMMENDATIONS

I recommend the request for change to G1-00720P be approved, subject to the provisions listed below:

This authorization to make use of public waters of the state is subject to existing rights, including any existing rights held by the United States for the benefit of Tribes under treaty or settlement.

The maximum instantaneous withdrawal rate that can be pumped, under this water right, at the proposed well is 300 gpm. The remaining 700 gpm under this water right can be withdrawn through another well as long as it is an approved point of withdrawal for the water right through RCW 90.44.100(2) or RCW 90.44.100(3).

The amount of water granted is a maximum limit that shall not be exceeded and the water user shall be entitled only to that amount of water within the specified limit that is beneficially used and required.

Flowing artesian wells shall be equipped with a pressure gage that indicates the shut-in pressure. The height, in feet, of water measured above the pressure gage is equal to the pressure (in pounds per square inch, or psi) multiplied by 2.311.

Flowing wells shall be constructed and equipped with valves to ensure that the flow of water can be completely stopped when not in use. Likewise, the well shall be continuously maintained to prevent the waste of water through leaky casings, pipes, fittings, valves, or pumps either above or below land surface.

In order to protect the resource, pumping must be managed so that static water levels do not progressively decline from year to year. **The static water level (SWL) shall be measured at least once each month in the proposed pumping well.** Measurements shall be taken after the pump has been shut off a reasonable time to allow water level to return to normal. Ecology's Water Resources section (NWRO) shall be notified if a below normal seasonal drop is measured in any of the water levels. **This data shall be submitted to Ecology by January 31 of the following year.**

Metering Provision from Order No. DE 02WRNR-3769 dated April 1, 2002

An approved measuring device shall be installed and maintained for each diversion/withdrawal of the sources identified by this water right in accordance with the rule "Requirements for Measuring and Reporting Water Use," Chapter 173-173 WAC.

Water use data shall be recorded weekly. The maximum monthly instantaneous rate of diversion/withdrawal and the monthly total volume shall be submitted to Ecology by January 31 of the following year. Ecology is requiring submittal of monthly meter readings to collect seasonal information for water resource planning, management and compliance.

The following information shall be included with each submittal of water use data: owner, contact name if different, mailing address, daytime phone number, Permit/Certificate/Claim No., source name, volume including units, Department of Health WFI water system number and source number(s) (for public drinking water systems), and well tag number (for ground water withdrawals). In the future, Ecology may require additional parameters to be reported or more frequent reporting. Ecology prefers web based data entry, but does accept hard copies. Ecology will provide forms and electronic data entry information.

Chapter 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requirements. Installation, operation and maintenance requirements are enclosed as a document entitled "Water Measurement Device Installation and Operation Requirements."

Department of Ecology personnel, upon presentation of proper credentials, shall have access at reasonable times, to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.

If it can be shown that the requested change has a detrimental effect on existing rights, it shall be the responsibility of the operator to mitigate for this impact and/or alter or cease withdrawal of water.

The water right holder is advised that a certificate of water right will issue for only that quantity of water that has been withdrawn and applied to actual beneficial use. Such quantity applied to actual beneficial use shall not exceed the quantity specified and will be calculated based on metering data.

A certificate of water right will not be issued until a final investigation is made.

CONCLUSIONS

In accordance with chapters 90.03 and 90.44 RCW, I conclude that G1-00720P is in good standing and is eligible for change. I have determined that the change to G1-00720P will not enlarge the original intent of the water right. Approval of this change request will not cause impairment of existing rights or be detrimental to the public interest. Based on these conclusions, this change request should be approved subject to existing rights and the above-indicated provisions and a superseding permit should be issued.

REPORT BY: Andrew B Chan DATE: 3/29/2004

In looking at the pumping test data provided, extrapolation suggests that the water level in the well would be down to the top of the screen after as little as 3.5 days or as long as 38 days of continuous pumping at 1805 gpm. These are only estimates, but it does show that there is the possibility for this aquifer to be overpumped and lower pumping rates spread over more wells tapping a larger portion of the aquifer would likely provide the best way of utilizing the ground water resource in the aquifer in a sustainable manner.

The change applications together (for GWC 1513 and G1-00720P) have requested to transfer a combined 2000 gpm to the proposed well, yet it has been shown that after 26 hours of pumping the water level did not stabilize at 1805 gpm and the Town's own consultant recommended no more than 1300 gpm be pumped from the well. Therefore, a decision was made to transfer the full instantaneous rate for GWC 1513 (1000 gpm) since it has a senior priority date and to only allow part of the instantaneous rate for G1-00720P (300 gpm out of 1000 gpm total) to be withdrawn from the proposed well. An additional well, or wells, will have to be drilled if the Town hopes to fully perfect the full instantaneous withdrawal rate authorized by this ground water permit.

Surface Water:

Both the original wells and the proposed well are located within the Schell subbasin as defined by the WRIA 1, 2514 Watershed Planning Group (2001). However, ground water flow in the deep confined aquifer in this area is likely somewhat independent of the surface water drainage boundaries. Pumping from the new point of withdrawal will not cause greater impacts on any surface water body (Schell Ditch or the Nooksack River) than pumping that water from the original point of withdrawal.

FINDINGS

In accordance with state law, the following considerations must be addressed during the process of evaluating this change request:

- Will the change create an enlargement of the original right?
- Will the change cause impairment to other existing rights?
- Does the new point of withdrawal tap the same body of public ground water as the original right?
- Will the public interest be impaired?
- What are the protestors concerns?

Potential for Enlargemeut

As long as the water right holder: 1.) does not withdraw more than 1000 gpm and 1614 acre-feet per year from this water right, 2.) the withdrawal is from the approved point of withdrawal, 3.) does not withdraw more than 2870 gpm and 2055 acre-feet per year from all of their existing rights (GWC 1513, GWC 3058, and G1-00720), this water right change will not be considered an enlargement of the right.

Impairment of Other Rights

If the aquifer was of infinite extent and no aquifer boundaries, either no-flow or recharge, were encountered by pumping the well at 1275 gpm for a full year (total annual quantity allowed), the drawdown in the pumping well should be around 96 feet (assuming a 60% efficient well) and the drawdown at the closest neighboring well (700 feet away) should be around 26 feet. Even with this interference, the neighboring well will not have its water right impaired due to the change because it will still have sufficient available drawdown above its pump (120-26 = 94 feet) and GeoEngineers (1994) indicated that when pumped at 34 gpm for 4 hours, there was only one foot of drawdown measured in the well. The aquifer likely does have boundaries, as shown during the pumping test, so the drawdown could be greater. But even if the interference drawdown was doubled, it would still not impair the surrounding water rights.

It is important to note that the proposed well is already approved as the point of withdrawal for GWC 1513 through a change application submitted at the same time as this change application. Since the well can not physically produce the 2000 gpm allowed under the two water rights, the instantaneous rate that can be withdrawn under G1-00720P shall be limited to 300 gpm from this specific well. Pumping above a combined rate of 1300 gpm from the proposed well could lead to impairment of existing rights and damage to the well. That leaves 700 gpm under this right that will not currently be attached to a specific well. As long as G1-00720P is an active permit, this instantaneous quantity will be available to the water right holder to be withdrawn from a well as long as it is legally allowed under the water code.

Same Body of Public Ground Water

The original points of withdrawal tap the same body of public ground water as the proposed point of withdrawal based on the following findings:

1.) The original and proposed points of withdrawal are all completed within the same geologic unit (Vashon advance outwash) as determined by well log analysis and also aquifer testing,
2.) The proposed point of withdrawal is relatively close to the original points of withdrawal (2300 feet away),
3.) The recharge area for the wells is the Mountain View Upland to the northwest, and
4.) The water captured by the wells likely would have naturally discharged to the Nooksack River in the vicinity of Ferndale.

Public Interest

No detriment to the public interest could be identified during the investigation of this application for change.

Protests

On September 11, 1992, the Department of Ecology received a letter of protest from the Lummi Indian Business Council. The letter indicated that they would like to make the protest a matter of the record and they would contact Ecology if their

G. P. No. 9231—1-57—311 6078.

CERTIFICATE RECORD NO. 7 PAGE NO. 3058-A

STATE OF WASHINGTON, COUNTY OF Whatcom

Certificate of Ground Water Right

Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the State Supervisor of Water Resources thereunder.

THIS IS TO CERTIFY That TOWN OF FERNDALE, WASHINGTON

of _____, has made proof to the satisfaction of the State Supervisor of Water Resources of Washington, of a right to the use of the ground waters of a well

located within the NE¼SE¼SW¼

Sec. 19, Twp. 39 N., R. 2 E. W. M.,

for the purpose of municipal supply

under and subject to provisions contained in Ground Water Permit No. 4458 issued by the State Supervisor of Water Resources and that said right to the use of said ground waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the State Supervisor of Water Resources of Washington and entered of record in Volume 7 at page 3058-A; that the right hereby confirmed dates from February 28, 1955; that the quantity of ground water under the right hereby confirmed for the purposes aforesaid, is limited to an amount actually beneficially used for said purposes, and shall not exceed 870 gallons per minute; 440 acre-feet per year for municipal supply.

A description of the lands to which such ground water right is appurtenant, and the place where such water is put to beneficial use, is as follows:

Town of Ferndale, Whatcom County, Washington.

The right to the use of the ground water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in Sections 6 and 7, Chapter 122, Laws of 1929.

WITNESS the seal and signature of the State Supervisor of Water Resources affixed this 31st day of March, 1950.

ENGINEERING DEPT. OK

State Supervisor of Water Resources.

B. F. No. 1194—3-51—75C. 27371.

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
DIVISION OF WATER RESOURCES

Permit to Appropriate Public Ground Waters of the State of Washington

Book No. 5 of Ground Water Permits, on page 2330 under Application No. 2309

TOWN OF FERNDALE, WASHINGTON

of

is hereby granted a permit to appropriate the following described public ground waters of the State of Washington, subject to existing rights, and to the limitations and provisions set out herein.

Priority date of this permit is May 9, 1952

Source of the proposed ground water appropriation is a well

within area, sub-area

zone. Name or number of works is

Quantity of water appropriated shall be limited to the amount which can be beneficially applied and not to exceed 1000 gallons per minute; 1615 acre-feet per year, to be used for the following purposes: municipal supply

as more definitely set out below.

Location of the well, tunnel, or infiltration trench is 1100 feet East and 300 feet North of South quarter corner

being within the E½ of SE¼ of SW¼ of SE¼ of Sec. 19, Twp. 39 N., Rge. 3 E.W.M.

county of Whatcom

Use, or uses to which water is to be applied.

For municipal supply: 1000 gallons per minute; 1615 acre-feet per year,

to supply the Town of Ferndale.

For irrigation: gallons per minute; acre-feet per year,

for the irrigation of acres.

For miscellaneous uses: gallons per minute; acre-feet per year,

for

LEGAL DESCRIPTION OF PROPERTY ON WHICH WATER IS TO BE USED

Town of Ferndale, Whatcom County, Washington.

DESCRIPTION OF WORKS FROM WHICH WATER IS TO BE WITHDRAWN

The well will be drilled and have a diameter of 12 inches, and depth of 150 feet.
(Dug or drilled)

Description of tunnel or infiltration trench:

(Please read carefully provisions below)

Particular specifications required by the Supervisor of Water Resources for the purpose of preventing waste of public waters:

Construction work shall begin on or before Started

and shall thereafter be prosecuted with reasonable diligence and completed on or before February 1, 1954

and complete application of water to proposed use shall be made on or before February 1, 1955

Given under my hand and the seal of this office at Olympia, Washington, this 15th day of August, 1952.

W. Bradley, Asst.
State Supervisor of Water Resources

Update
GWC 1513

CERTIFICATE OF CHANGE TO ADD AN ADDITIONAL
POINT OF WITHDRAWAL OF GROUND WATERS

THIS IS TO CERTIFY THAT the City of Ferndale, Ferndale, Washington has complied with the requirements of the Revised Code of Washington 90.44.100 and is hereby granted a change to add an additional well for municipal and industrial use, as granted in Ground Water Certificate No. 1513.

That the well is 1150 feet east and 190 feet north from the South Quarter corner of Sec. 19, T. 39 N., R. 01 E.W.M., for use in the area served by the City of Ferndale in accordance with Certificate No. 1513.

That the instantaneous quantity shall be no more than 1000 gallons per minute, with a maximum annual quantity of 1615 acre-feet per year.

Given under my hand and seal of this office, Department of Ecology, Northwest Region, this 23rd day of February, 1984.

Department of Ecology
Donald W. Moos, Director

By Robert K. McCormick
Northwest Regional Manager

RECORDED:

Volume I-1, 49
Certificate of Change

OK

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

PERMIT

TO APPROPRIATE PUBLIC WATERS OF THE STATE OF WASHINGTON

☐ Surface Water (Issued in accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the Department of Ecology.)

☒ Ground Water (Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology.)

PRIORITY DATE	APPLICATION NUMBER	PERMIT NUMBER	CERTIFICATE NUMBER
July 22, 1971	G*12073	G1-00720P	

NAME
CITY OF FERNDALE

ADDRESS (STREET)	(CITY)	(STATE)	(ZIP CODE)
P. O. Box 936, 5694 Second Avenue,	Ferndale	Washington	98248

The applicant is, pursuant to the Report of Examination which has been accepted by the applicant, hereby granted a permit to appropriate the following described public waters of the State of Washington, subject to existing rights and to the limitations and provisions set out herein.

PUBLIC WATER TO BE APPROPRIATED

SOURCE
Well

TRIBUTARY OF (IF SURFACE WATERS)

MAXIMUM CUBIC FEET PER SECOND	MAXIMUM GALLONS PER MINUTE	MAXIMUM ACRE-FEET PER YEAR
	1000	1614 (supplemental to ~~existing rights~~)

QUANTITY, TYPE OF USE, PERIOD OF USE
Municipal supply - continuously

LOCATION OF DIVERSION/WITHDRAWAL

APPROXIMATE LOCATION OF DIVERSION–WITHDRAWAL
1650 feet west and 50 feet north of the SE corner of Sec. 19

LOCATED WITHIN (SMALLEST LEGAL SUBDIVISION)	SECTION	TOWNSHIP N.	RANGE, (E. OR W.) W.M.	W.R.I.A.	COUNTY
SE¼SW¼SE¼	19	39	02 E	1	Whatcom

RECORDED PLATTED PROPERTY

LOT	BLOCK	OF (GIVE NAME OF PLAT OR ADDITION)

LEGAL DESCRIPTION OF PROPERTY ON WHICH WATER IS TO BE USED

Area served by the City of Ferndale.

DESCRIPTION OF PROPOSED WORKS

DEVELOPMENT SCHEDULE

BEGIN PROJECT BY THIS DATE:	COMPLETE PROJECT BY THIS DATE:	WATER PUT TO FULL USE BY THIS DATE:
June 1985	June 1986	June 1987

PROVISIONS

Installation and maintenance of an access port as described in Ground Water Bulletin No. 1 is required. An air line and gauge may be installed in addition to the access port.

All water wells constructed within the state shall meet the minimum standards for construction and maintenance as provided under RCW 18.104 (Washington Water Well Construction Act of 1971) and Chapter 173-160 WAC (Minimum Standards for Construction and Maintenance of Water Wells).

An approved measuring device shall be installed and maintained in accordance with RCW 90.03.360, WAC 508-64-020 through WAC 508-64-040.

This permit shall be subject to cancellation should the permittee fail to comply with the above development schedule and/or fail to give notice to the Department of Ecology on forms provided by that Department documenting such compliance.

Given under my hand and the seal of this office at Redmond *Washington, this* 15th *day of* August, *19* 83

ENGINEERING DATA
OK

Department of Ecology

by Robert K. McCormick
ROBERT K. McCORMICK, Regional Manager

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

SUPERSEDING PERMIT
TO APPROPRIATE PUBLIC WATERS OF THE STATE OF WASHINGTON

☐ Surface Water (Issued in accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the Department of Ecology.)

☒ Ground Water (Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology.)

PRIORITY DATE	APPLICATION NUMBER	PERMIT NUMBER	CERTIFICATE NUMBER
July 22, 1971	12073	G1-00720P	

NAME
City of Ferndale

ADDRESS (STREET)	(CITY)	(STATE)	(ZIP CODE)
P.O. Box 936	Ferndale	Washington	98248

PUBLIC WATERS TO BE APPROPRIATED

SOURCE
Well

TRIBUTARY OF (IF SURFACE WATERS)

MAXIMUM CUBIC FEET PER SECOND	MAXIMUM GALLONS PER MINUTE	MAXIMUM ACRE FEET PER YEAR
	1000*	1614**

QUANTITY, TYPE OF USE, PERIOD OF USE

Municipal water supply purposes – Continuously

* The maximum instantaneous withdrawal rate that can be pumped, from this water right, at the proposed well is 300 gpm. The remaining 700 gpm under this water right can be withdrawn through another well as long as it is an approved point of withdrawal for the water right through RCW 90.44.100(2) or RCW 90.44.100(3). Therefore, the total maximum instantaneous withdrawal rate that can be pumped from the proposed well is 1300 gpm from GWC 1513 and G1-00720.

**Total annual quantity from GWC 1513, GWC 3058, and G1-00720 shall not exceed 2055 acre-feet per year.

LOCATION OF DIVERSION/WITHDRAWAL

APPROXIMATE LOCATION OF DIVERSION--WITHDRAWAL

Approximately 1930 feet east and 1430 feet south of NW corner of Section 30, Township 39 North, Range 2 East, W.M.

LOCATED WITHIN (SMALLEST LEGAL SUBDIVISION)	SECTION	TOWNSHIP N	RANGE (E. OR W.) W.M.	W.R.I.A.	COUNTY
NE ¼, SE ¼, NW¼	30	39	2 E	1	Whatcom

RECORDED PLATTED PROPERTY

LOT	BLOCK	OF (GIVE NAME OF PLAT OR ADDITION)

LEGAL DESCRIPTION OF PROPERTY ON WHICH WATER IS TO BE USED

The place of use of this water right shall be consistent with the service area map and/or description contained within the most recently approved water system plan (including amendments).

DESCRIPTION OF PROPOSED WORKS

The water supply system consists of two wells and a raw water connection to the Whatcom PUD #1 diversion from the Nooksack River. Water from the proposed well will need to be routed through the treatment plant to remove hydrogen sulphide odor. Washington State Department of Health water system ID number 24850.

DEVELOPMENT SCHEDULE

BEGIN PROJECT BY THIS DATE:	COMPLETE PROJECT BY THIS DATE:	WATER PUT TO FULL USE BY THIS DATE:
Started	March 1, 2014	March 1, 2034

PROVISIONS

This authorization to make use of public waters of the state is subject to existing rights, including any existing rights held by the United States for the benefit of Tribes under treaty or settlement.

The maximum instantaneous withdrawal rate that can be pumped, under this water right, at the proposed well is 300 gpm. The remaining 700 gpm under this water right can be withdrawn through another well as long as it is an approved point of withdrawal for the water right through RCW 90.44.100(2) or RCW 90.44.100(3).

The amount of water granted is a maximum limit that shall not be exceeded and the water user shall be entitled only to that amount of water within the specified limit that is beneficially used and required.

Flowing artesian wells shall be equipped with a pressure gage that indicates the shut-in pressure. The height, in feet, of water measured above the pressure gage is equal to the pressure (in pounds per square inch, or psi) multiplied by 2.311.

Flowing wells shall be constructed and equipped with valves to ensure that the flow of water can be completely stopped when not in use. Likewise, the well shall be continuously maintained to prevent the waste of water through leaky casings, pipes, fittings, valves, or pumps either above or below land surface.

In order to protect the resource, pumping must be managed so that static water levels do not progressively decline from year to year. **The static water level (SWL) shall be measured at least once each month in the proposed pumping well.** Measurements shall be taken after the pump has been shut off a reasonable time to allow water level to return to normal. Ecology's Water Resources section (NWRO) shall be notified if a below normal seasonal drop is measured in any of the water levels. **This data shall be submitted to Ecology by January 31 of the following year.**

Metering Provision from Order No. DE 02WRNR-3769 dated April 1, 2002

An approved measuring device shall be installed and maintained for each diversion/withdrawal of the sources identified by this water right in accordance with the rule "Requirements for Measuring and Reporting Water Use," Chapter 173-173 WAC.

Water use data shall be recorded weekly. The maximum monthly instantaneous rate of diversion/withdrawal and the monthly total volume shall be submitted to Ecology by January 31 of the following year. Ecology is requiring submittal of monthly meter readings to collect seasonal information for water resource planning, management and compliance.

The following information shall be included with each submittal of water nse data: owner, contact name if different, mailing address, daytime phone number, Permit/Certificate/Claim No., source name, volume including units, Department of Health WFI water system number and source number(s) (for public drinking water systems), and well tag number (for ground water withdrawals). In the future, Ecology may require additional parameters to be reported or more frequent reporting. Ecology prefers web based data entry, but does accept hard copies. Ecology will provide forms and electronic data entry information.

Chapter 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to petition Ecology for modifications to some of the requiremeuts. Installation, operation and maintenance requirements are contained in the document entitled "Water Measurement Device Installation and Operation Requirements."

Department of Ecology personnel, upon presentation of proper credentials, shall have access at reasonable times, to the records of water use that are kept to meet the above conditions, and to inspect at reasonable times any measuring device used to meet the above conditions.

If it can be shown that the requested change has a detrimental effect on existing rights, it shall be the responsibility of the operator to mitigate for this impact and/or alter or cease withdrawal of water.

The water right holder is advised that a certificate of water right will issue for only that quantity of water that has been withdrawn and applied to actual beneficial use. Such quantity applied to actual beneficial use shall not exceed the quantity specified and will be calculated based on metering data.

A certificate of water right will not be issued until a final investigation is made.

This permit shall be subject to cancellation should the permittee fail to comply with the above development schedule and/or fail to give notice to the Department of Ecology on forms provided by that Department documenting such compliance.

Given under my hand and the seal of this office at Bellevue, Washington, this 16th *day of* June, *2004.*

DEPARTMENT OF ECOLOGY
ENGINEERING DATA
STATE OF WASHINGTON

Department of Ecology

By Buck Swenson
for Daniel L. Swenson, Section Supervisor, Water Resources

SUPERSEDING PERMIT

No. G1-00720P

G.F. No. 7252—(Rev. 6-70).

CERTIFICATE RECORD NO. 16, PAGE NO. 7709-A

STATE OF WASHINGTON, COUNTY OF Chelan

CERTIFICATE OF GROUND WATER RIGHT

(Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology thereunder.)

THIS IS TO CERTIFY That CENTRAL CITY WATER ASSOCIATION

of Ferndale, Washington, has made proof to the satisfaction of the Department of Ecology of a right to the use of the public ground waters of the State of Washington from a well

located within Government Lot 2

Sec. 19, Twp. 30 N., R. 2 E.W.M.,

for the purpose(s) of community domestic supply

under and specifically subject to provisions contained in Ground Water Permit No. 10582

issued by the Department of Ecology and that said right to the use of said ground waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the Department of Ecology and entered of record in Volume 16 at page 7709-A; that the priority of the right hereby confirmed dates from March 20, 1970; that the quantity of ground water under the right hereby confirmed for the aforesaid purposes, is limited to an amount actually beneficially used for said purposes, and shall not exceed 60 gallons per minute; 83 acre-feet per year, during onetre year, for community domestic supply.

A description of the lands to which such ground water right is appurtenant is as follows:

Area served by Central City Water Association within Sec. 19, T. 30 N., R. 2 E.W.M. AND Sec. 26, T. 30 N., R. 1 E.W.M.

The right to use of water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in RCW 90.03.380, 90.03.390 and 90.44.020.

This certificate of ground water right is specifically subject to relinquishment for nonuse of water as provided in RCW 90.14.180.

Given under my hand and seal of this office at Olympia, Washington, this 26th day of April, 19 72.

JOHN A. BIGGS, Director
Department of Ecology

by R. Jerry Bollen

Engineering Data
OK

DEPARTMENT OF ECOLOGY
te of Washington

Water Resources Program
Application for Change/Transfer of Water Right

For Ecology Use
(Date Stamp)

RECEIVED

NOV 19 2014

DEPT OF ECOLOGY
NWRO - WR

For filing with the Department of Ecology or with County Water Conservancy Boards

A NON-REFUNDABLE MINIMUM FEE OF $50.00 MUST ACCOMPANY THIS APPLICATION IF FILED WITH THE DEPARTMENT OF ECOLOGY

(Check all that apply.)

- ☐ Change purpose(s) of use
- ☐ Add purpose(s) of use
- ☐ Change point(s) of diversion/withdrawal
- ☒ Add point(s) of diversion/withdrawal
- ☒ Change/transfer place of use
- ☐ Other (i.e. consolidation, intertie, trust water)

Explain:_____

FOR OFFICIAL USE ONLY

DATE APPLICATION RECEIVED: 11/19/14
CHECK NO. _____ FEE $ _____
DATE ACCEPTED 11/19/14 BY DM
CHANGE NO. _____
COUNTY Whatcom WRIA 1
SPECIAL AREA _____
SEPA ☒ EXEMPT ☐ NOT EXEMPT
ECY CODING: 001-002-WR10285-000011
APP NO. _____ PERMIT NO. _____
CERT NO. _____ CERT OF CHG NO. _____

IF MORE SPACE IS NEEDED, ATTACH ADDITIONAL SHEETS (PLEASE PRINT OR TYPE CLEARLY)

1. Applicant Information

APPLICANT/BUSINESS NAME	PHONE NO.	FAX NO.
City of Ferndale	360-384-4006	
ADDRESS		
2095 Main Street, PO Box 936		
CITY	STATE	ZIP CODE
Ferndale	WA	98248

CONTACT (IF DIFFERENT FROM ABOVE)	PHONE NO.	FAX NO.
Mike Olinger	360-384-4607	
ADDRESS		
2095 Main Street, PO Box 936		
CITY	STATE	ZIP CODE
Ferndale	WA	98248

LEGAL LAND OWNER or PART OWNER OF PROPOSED PLACE OF USE	PHONE NO.	FAX NO.
City of Ferndale	360-384-4607	
ADDRESS		
2095 Main Street, PO Box 936		
CITY	STATE	ZIP CODE
Ferndale	WA	98248

2. Water Right Information

WATER RIGHT OR CLAIM NUMBER	RECORDED NAME(S)
G1-*03899C Certificate No. 3058	Town of Ferndale

DO YOU OWN THE RIGHT TO BE CHANGED? ☒ YES ☐ NO

IF NO, PROVIDE OWNER(S) NAME and ADDRESS: _____

HAS THE WATER BEEN PUT TO BENEFICIAL USE IN THE LAST FIVE (5) YEARS? ☒ YES ☐ NO

Please attach copies of any documentation that demonstrates consistent, historical use of water since the right was established. Also, if you have a water system plan or conservation plan, please include a copy with your application. See Attachment A

3. Point(s) of Diversion/Withdrawal:

A. Existing

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
Shop Well	PW-1	SW	SE	19	39N	2E	390219409029	AMF090

B. Proposed

SOURCE	NO.	¼	¼	SEC.	TWP.	RGE.	PARCEL #	WELL TAG #
Shop Well	PW-1	SW	SE	19	39N	2E	390219409029	AMF090
Douglas Road Well	PW-2	SE	NW	30	39N	2E	390230188340	BCB347
Thornton Road Well	PW-3	NW	NE	24	39N	1E	390124392440	BHX510
Central City Well	PW-4	SW	NW	19	39N	2E	390219010345	AGK343
Future Wells	See Attachment B and Figure 1							

DO YOU OWN THE EXISTING AND PROPOSED POINT(S) OF DIVERSION/WITHDRAWAL?

EXISTING: ☒ YES ☐ NO PROPOSED: ☒ YES ☐ NO – IF NO, PROVIDE OWNER(S) NAME: _____

Please include copies of all water well reports involved with this proposal. Also, if you know the distances from the nearest section corner to the above point(s) of diversion/withdrawal, please include that information in Item No. 6 (remarks) or as an attachment. The City currently owns PW-1, PW-2, PW-3 and PW-4. See Attachment B and Figure 1.

4. Purpose of Use:

A. Existing

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
Municipal Water Supply	870 gpm	440 afy	Continuous

B. Proposed

PURPOSE OF USE	GPM or CFS	ACRE-FT/YR	PERIOD OF USE
Municipal Water Supply	870 gpm	440 afy	Continuous

5. Place of Use:

A. Existing

LEGAL DESCRIPTION OF LANDS WHERE WATER IS PRESENTLY USED:							
Town of Ferndale, Whatcom County, Washington – See comment below							
¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
					Whatcom		

DO YOU OWN ALL THE LANDS IN THE EXISTING PLACE OF USE? ☐ YES ☒ NO

IF NO, PROVIDE OWNER(S) NAME: It should be noted that RCW 90.03.386 may have the effect of revising the place of use of this water right, and the requested change herein merely reflects the operative effect of RCW 90.03.386. See Attachment A and Figure 1.

B. Proposed

LEGAL DESCRIPTION OF LANDS WHERE NEW USE IS PROPOSED:

The place of use (POU) of this water right is the service area described in the most recent Water System Plan approved by the Washington State Department of Health, so long as the water system is and remains in compliance with the criteria in RCW 90.03.386(2). RCW 90.03.386 may have the effect of revising the place of use of this water right.

¼	¼	SEC.	TWP.	RGE.	COUNTY	PARCEL #	# OF ACRES
					Whatcom		

DO YOU OWN ALL THE LANDS IN THE PROPOSED PLACE OF USE? ☐ YES ☒ NO

IF NO, PROVIDE OWNER(S) NAME: See Attachment A and Figure 1.

Attach a detailed map of your proposed change/transfer. The map should show existing and proposed point(s) of diversion/withdrawal, place of use and any other features involved with this application. If platted property, please include a certified copy of the plat map. See Attachment A and Figure 1.

Are there any ADDITIONAL WATER rights OR CLAIMS RELATED to the same property as the ONE PROPOSED FOR CHANGE/TRANSFER?

☒ YES ☐ NO – IF YES, PROVIDE THE WATER RIGHT/CLAIM NUMBER(S): G1-*10690C, G1-*02509C, G1-00720P

6. Remarks and Other Relevant Information:

IF FOR SEASONAL OR TEMPORARY, START DATE ___/___/_____ END DATE ___/___/_____

Certain applications may incur a Real Estate Excise Tax liability for the seller of the water rights. The Department of Revenue has requested notification of potential taxable water right related actions and therefore may be provided with a copy of this request. For further information, contact: Department of Revenue, Real Estate Excise Tax, PO Box 47477, Olympia, WA 98504-7477. Phone (360) 570-3265.

7. Signatures:

I certify that the information above is true and accurate to the best of my knowledge. I understand that in order to process my application, I am hereby granting staff from the Department of Ecology or the Conservancy Board access to the above site(s) for inspection and monitoring purposes. If assisted in preparing this above application, I understand that all responsibility for the accuracy of the information rests with me.

GARY S. JENSEN - MAYOR *Applicant Printed Name – Title*	*Applicant Signature*	11/18/2014 *(Date)*
GARY JENSEN *Water Right Holder Printed Name*	*Water Right Holder Signature*	11/18/2014 *(Date)*
GARY JENSEN *Land Owner of Existing Place of Use Printed Name*	*Land Owner of Existing Place of Use Signature*	11/18/2014 *(Date)*
GARY JENSEN *Land Owner of Proposed Place of Use Printed Name*	*Land Owner of Proposed Place of Use Signature*	11/18/2014 *(Date)*

Please check the region in which the project is located:

***Submit your application to:** DEPARTMENT OF ECOLOGY CASHIERING SECTION PO BOX 47611 OLYMPIA, WA 98504-7611	☐ Central Regional Office 15 W Yakima Avenue, Suite 200 Yakima, WA 98902 (509) 575-2490	☐ Eastern Regional Office 4601 N. Monroe Street Spokane, WA 99205-1295 (509) 329-3400
	☒ Northwest Regional Office 3190 – 160th Avenue SE Bellevue, WA 98008-5452 (425) 649-7000	☐ Southwest Regional Office PO Box 47775 Olympia, WA 98504-7775 (360) 407-6300

WE ARE RETURNING YOUR APPLICATION FOR THE FOLLOWING REASON(S):

☐ APPLICATION FEE NOT ENCLOSED ☐ MAP NOT INCLUDED or INCOMPLETE

☐ ADDITIONAL SIGNATURES REQUIRED ☐ SECTION _____ IS INCOMPLETE

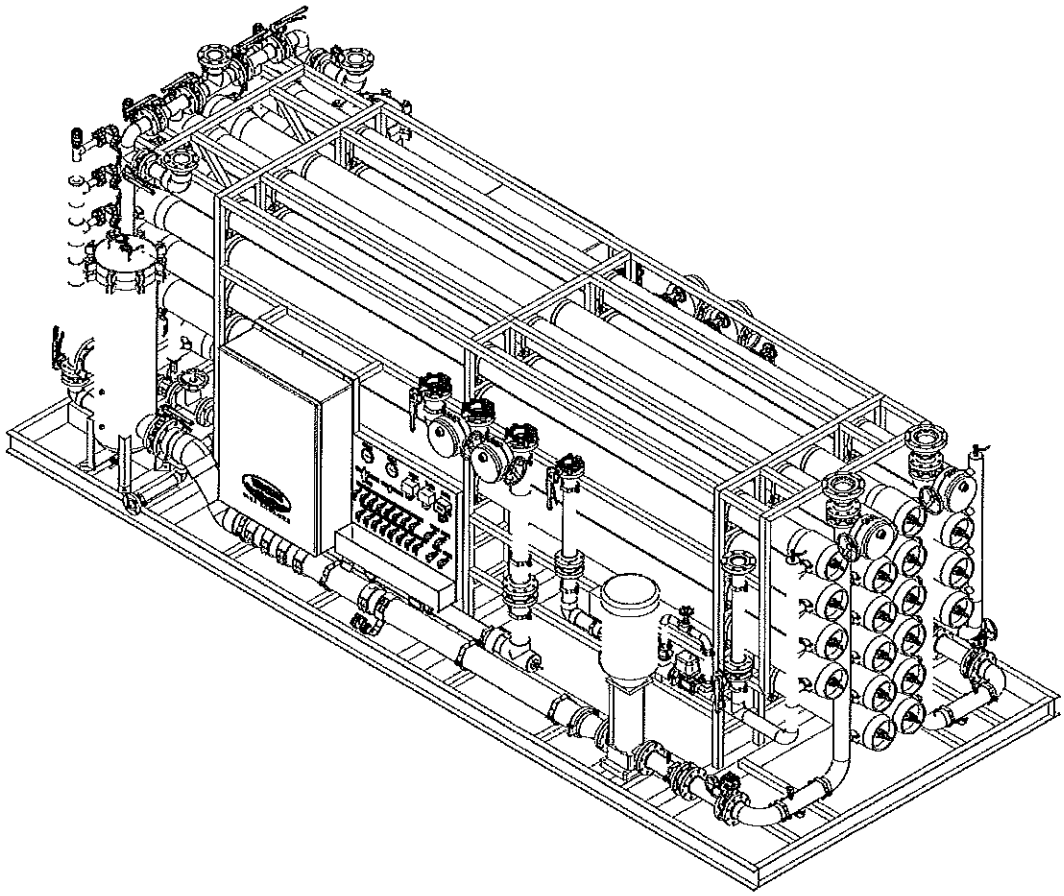
☐ OTHER/EXPLANATION:_____

STAFF: _____ ***DATE:*** ____/____/____

J. WATER TREATMENT PLANT

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RO WATER TREATMENT SYSTEM OPERATION & MAINTENANCE MANUAL

CITY OF FERNDALE, WA
WATER TREATMENT PLANT

JOB #C-3318-0414

640 PAGE DOCUMENT
ON FILE AT CITY

302 Lake Hazeltine Drive • Chaska, MN 55318 U.S.A.
Phone: (952) 448-4884 or (800) 240-3330 • Fax: (952) 448-4886 • E-mail: mail@wigen.com
WWW.WIGEN.COM

Douglas and Shop Wells Pump Stations and Groundwater Treatment Plant Operations and Maintenance Manual

DRAFT



Prepared By RH2 Engineering, Inc.

Douglas and Shop Wells Pump Stations and Groundwater Treatment Plant Operations and Maintenance Manual

Prepared By: RH2 Engineering, Inc.

Prepared For: City of Ferndale

This Operation and Maintenance Manual was prepared under the direct supervision of the following Professional Engineers licensed in the State of Washington.









THE CONTENT OF THIS DOCUMENT, AS A MEANS OF PROFESSIONAL SERVICE, IS PROTECTED BY 17 U.S.C. § 101, ET SEQ. AS SUCH, IT SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT OR PURPOSE WITHOUT WRITTEN AUTHORIZATION FROM RH2 ENGINEERING. ©2008 RH2 ENGINEERING, INC.

City of Ferndale
Douglas and Shop Wells Pump Stations and Groundwater Treatment Plant
Operations and Maintenance Manual
Table of Contents

CHAPTER 1 1

Overview 1

Purpose of Manual 1

Commonly Used Abbreviations and Acronyms 1

Facility Locations 1

Component Description 2
Douglas Well Pump System 2
Shop Well Pump System 2
Groundwater Treatment System 2

Emergency Power System 2
Douglas Well Pump System 2
Shop Well Pump System 2
Groundwater Treatment System 2

Effect of Loss 3
General 3
Douglas Well Pump System 3
Shop Well Pump System 3
Groundwater Treatment System 3
Emergency Power System 3
Douglas Well 3
Shop Well 3
Groundwater Treatment Plant 4

Summary of Operation 4
Douglas Well System 4
Well Pump 4
Emergency Chlorination 4
Emergency Power System 4
Shop Well System 4
Well Pump 4
Emergency Chlorination 4
Emergency Power System 5
Groundwater Treatment Plant 5
Water Sources 5
Chlorination System 5
pH Adjustment System 5
Filtration System 6

DRAFT

Clear Well....6
High Service Pump Station....6
Backwash System....6
Finished Water Quality Monitoring....6
Emergency Power System....6

Site Plan....6

CHAPTER 2....1

Component Descriptions....1

Overall Process....1

Douglas Well....2
Building....2
Water Supply....2
Wastewater....2
Electric Supply and Distribution....2
Primary Service....2
Standby Service....2
Emergency Chlorination....3

Shop Well....4
Building....4
Water Supply....4
Wastewater....4
Electric Supply and Distribution....4
Primary Service....4
Standby Service....4
Heating, Ventilation and Dehumidification....5
Emergency Chlorination....5

Groundwater Treatment Plant....6
Building....6
Water Supply....6
Wastewater....6
Electric Supply and Distribution....6
Primary Service....6
Standby Service....6
Treatment Process....7
Water Sources....7
Chlorination....**Error! Bookmark not defined.**
....9
pH Adjustment....9
Filter Vessels....10
Filter Media....11
Filter Controls....11
Online Water Quality Monitoring....12

DRAFT

Backwash System....12
General....12
Control....13
Backwash Process....13
Backwash Waste Disposal....14
Filter to Waste....14
Water Quality Test Laboratory....14

Control System and SCADA Functional Descriptions....14
A. Overview....14
B. Well Operations....15
C. Normal Filter Operation....21
D. Backwash Operations....21
E. Filter Over-flow Protection....**Error! Bookmark not defined.**
F. Backwash and Process Waste Disposal....22
G. Water Quality and Control Monitoring....23
H. Chlorination Process....23
I. pH Adjustment Process....24
J. Process Flows....25
K. Well Building Emergency Power System....25
L. Heating and Ventilation Control....26
M. Intrusion Alarm System....26
N. Setpoint Adjustment....26

CHAPTER 3....1

Operation and Maintenance....1

General....1

Daily Activity....1

Weekly Activity....2

Monthly Activity....3

Bi-Monthly Activity....4

Quarterly Activity....4

Semi-Annual Activity....4

Annual Activity....5

Other Frequency Activity....7

CHAPTER 4....1

DRAFT

Troubleshooting and Alarms 1

General 1
Troubleshooting 1
Alarms 2
Contact List 16
Setpoints 17

Appendices
Appendix A – Site and Building Layouts
Appendix B – Process and Instrumentation Diagrams
Appendix C – Water Quality Reporting Forms

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Chapter 1

Overview

Purpose of Manual

This Operations and Maintenance Manual (Manual) contains general operation and maintenance information for the City of Ferndale's (City) Douglas Well, Shop Well and Groundwater Treatment Plant. The intent of this Manual is to provide an overview of the operating scheme for the system and aid in troubleshooting operating problems. This Manual is to be supplemented by the manufacturer-supplied manuals for each piece of equipment, which will provide detailed instructions for operation and maintenance.

This Manual is a living document that will be updated regularly as equipment and operational details are changed. This is a tool for the system operators and will become of little value if not accurately maintained. A CD with the document in Word 2007 format is provided at the end of the binder.

Commonly Used Abbreviations and Acronyms

EG	Engine Generator
GPM	Gallons per Minute
HMI	Human Machine Interface
OIT	Operator Interface Terminal
SF	Square Feet
TESC	Temporary Erosion and Sedimentation Control
WTP	Water Treatment Plant

[Placeholder]



General Location Map

Facility Locations

The City's Groundwater Treatment Plant is located at 5405 Ferndale Road, Ferndale, Washington 98248. The Douglas Well Pump Station is located at 2341 Douglas Road, Ferndale, Washington 98248. The Shop Well Pump Station is located at 5735 Legoe Avenue, Ferndale, Washington 98248. A general location map is provided above.

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Component Description

Douglas Well Pump System

The Douglas Well Pump System consists of a vertical turbine pump and a well control building that contains the valves, controls and other components necessary for operation of the well. Water from the Douglas Well is routed to the groundwater treatment plant via dedicated transmission main.

Shop Well Pump System

The Shop Well Pump System consists of a vertical turbine pump and a well control building that contains the valves, controls and other components necessary for operation of the well. Water from the Shop Well is routed to the groundwater treatment plant via dedicated transmission main.

Groundwater Treatment System

The groundwater treatment system is located at the City's water treatment plant and is equipped with a sodium hypochlorite on-site generation system, pH adjustment system and filtration system. These systems are designed to remove manganese from both wells and reduce the potential for corrosion of the Shop Well. Both wells also have elevated levels of ammonia; however, both sources are chlorinated at the groundwater treatment plant and the clearwell provides contact time for the breakpoint reaction.

Emergency Power System

Douglas Well Pump System

The emergency power system is comprised of a standby 200-kilowatt (kW) diesel-powered engine generator with automatic start and transfer switching. The output is 480/277 volts, 3 phase. The diesel fuel storage tank is located below the generator as a sub-base, double wall, fuel tank.

Shop Well Pump System

The emergency power system is comprised of a standby 100-kilowatt (kW) diesel-powered engine generator with automatic start and transfer switching. The output is 480/277 volts, 3 phase. The diesel fuel storage tank is located below the generator as a sub-base, double wall, fuel tank.

Groundwater Treatment System

The water plant shares an existing standby power generator with the wastewater treatment plant. No modifications were made to the existing emergency power system.

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Effect of Loss

General

The individual systems are typically comprised of several components. This section presents the "worst case" scenario of total loss of each system. The Troubleshooting and Alarms Chapter addresses the effect of loss of individual pieces of the systems and emergency operating options.

Douglas Well Pump System

The loss of the Douglas Well or its pump will leave the water system with only the Shop Well for water supply. The water is pumped from the well using a vertical turbine pump controlled by a variable frequency controller (VFD). If the Douglas Well VFD is down and the City wants to operate the well, the City would need to modify the backpressure sustaining valve at the groundwater treatment plant in order to ensure the well discharges at its allowed instantaneous flow rate. The City currently has future plans to drill and develop a supplementary Douglas Well to provide additional capacity.

Shop Well Pump System

The loss of the Shop Well or its pump will leave the water system with only the Douglas Well for water supply. The water is pumped from the well using a vertical turbine pump controlled by a VFD. If the Douglas Well VFD is down and the City wants to operate the well, the City would need to modify the backpressure sustaining valve at the groundwater treatment plant in order to ensure the well discharges at its allowed instantaneous flow rate.

Groundwater Treatment System

The loss of the treatment system eliminates the ability to remove manganese from the well sources and reduce the potential for corrosion from the Shop Well. Both well sources are equipped with emergency chlorination systems and can discharge directly to the distribution system bypassing filtration and pH adjustment if the groundwater treatment plant is down.

Emergency Power System

Douglas Well

The loss of the emergency power system will leave the Douglas Well with no backup power in the event of a loss of primary power. The Shop Well and the groundwater treatment plant have their own backup power supply.

Shop Well

The loss of the emergency power system will leave the Shop Well with no backup power in the event of a loss of primary power. The Douglas Well and the groundwater treatment plant have their own backup power supply.

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Groundwater Treatment Plant

The loss of the emergency power system will leave the groundwater treatment plant with no backup power in the event of a loss of primary power. The Douglas and Shop Wells have their own backup power supply.

Summary of Operation

Douglas Well System

Well Pump

The Douglas Well pump system is controlled by the water treatment plant clearwell level through the City's SCADA system. When the water level falls to an elevation less than an operator adjustable setpoint, the Douglas Well pump is turned on. The Douglas Well pump provides up to 1,300 gallons of water supply per minute.

Emergency Chlorination

The emergency chlorination system disinfects the Douglas Well water supply when the treatment plant is down. When the treatment plant is down, the City will need to manually configure valves to route Douglas Well water directly to distribution instead of the plant, provide a drum of sodium hypochlorite, and connect the chemical feed system's suction and discharge piping. Once this is done, emergency chlorination will be flow paced based on the flow rate of the Douglas Well.

Emergency Power System

The engine-driven generator provides power for the Douglas Well when commercial power is not available. The control system monitors the incoming power and, after sensing a power loss for a specific period of time, starts the engine and automatically switches the power to the generator supply when the generator output stabilizes. With the return of the commercial power supply, the control system starts and automatically transfers back to the commercial supply. The engine generator continues to run for a short period of time for cooling purposes and shuts down with a return to standby status automatically.

Shop Well System

Well Pump

The Shop Well pump system is controlled by the water treatment plant clearwell level through the City's SCADA system. When the water level falls to an elevation less than an operator adjustable setpoint, the Shop Well pump is turned on. The Shop Well pump provides up to 870 gallons of water supply per minute.

Emergency Chlorination

The emergency chlorination system disinfects the Shop Well water supply when the treatment plant is down. When the treatment plant is down, the City will need to manually configure valves to route Shop Well water directly to distribution instead of the plant, provide a drum of sodium hypochlorite, and connect the chemical feed system's suction and discharge piping.

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Once this is done, emergency chlorination will be flow paced based on the flow rate of the Shop Well.

Emergency Power System

The engine-driven generator provides power for the Shop Well when commercial power is not available. The control system monitors the incoming power and, after sensing a power loss for a specific period of time, starts the engine and automatically switches the power to the generator supply when the generator output stabilizes. With the return of the commercial power supply, the control system starts and automatically transfers back to the commercial supply. The engine generator continues to run for a short period of time for cooling purposes and shuts down with a return to standby status automatically.

Groundwater Treatment Plant

Water Sources

The Douglas and Shop Well sources feed the groundwater treatment plant and are controlled by the clearwell water level through the City's SCADA system. When the clearwell water level falls to an elevation less than an operator adjustable setpoint, the lead pump is turned on. Operators can adjust the pumps to be lead or lag.

Chlorination System

The disinfection chemical used in this facility is 0.8 percent sodium hypochlorite. This is supplied by an on-site generation process. In this process, a brine solution is pumped through electrolytic cells, where it reacts to form liquid sodium hypochlorite and hydrogen gas. The dilute (0.8 percent) sodium hypochlorite solution is stored in product tanks and the small quantity of hydrogen gas generated is vented outside of the building. The dilute hypochlorite solution is injected into the raw main from the product tanks with a metering pump.

The on-site hypochlorite generator is sized to generate 100 pounds per day (ppd) of chlorine equivalent. The two 1,700-gallon product tanks are sized to provide approximately 3.5 days of storage during average production. If the electrolytic cell breaks down, a dilute bleach solution can be mixed into the product tanks as a standby until the cell is repaired.

Two pre-chlorination metering pumps are provided and will alternate with every startup. Water pumped from the groundwater wells need to be chlorinated for disinfection and to oxidize manganese for the removal process. One post-chlorination metering pump is provided downstream of the high service water pumps to boost free-chlorine residual, if needed.

pH Adjustment System

A caustic soda feed system is provided to raise the pH of the Shop Well whenever it is in operation. This will reduce the potential for corrosion from the Shop Well.

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Filtration System

Piping and flumes transport the chemically treated water to the filter bays by gravity. The water treatment filter bays consist of two identical skid mounted units with four individual units in each row. The filters cleanse the water by passing it through a GreensandPlus and anthracite filter bed, after which it is discharged to a clearwell below the filter bays. The filter bays are periodically backwashed to restore treatment capacity.

Clear Well

Finished water flows into the finish water clearwell, where it is held until being pumped into the distribution system.

High Service Pump Station

Clear well water is then sent through one of three parallel vertical turbine high service pumps to the 234 Main Zone in the water system. There are three identical pumps for the station, which is located in the water treatment building. The Main Zone is also connected to Reservoir No. 1.

Backwash System

The filter cells collect precipitated contaminants and, over time, must be cleaned. Only one filter cell can be cleaned at a time. Filter cell valves are configured to reverse water flow and a backwash pump with a VFD withdraws water from the clearwell and supplies the water for this process. Each filter cell contains an air scour grid. A blower introduces air during the backwash procedure to agitate and thoroughly cleanse the media.

After the backwash, the valves are configured back to normal operation and treated water is filtered-to-waste for an operator adjustable duration to minimize turbidity spikes. All backwash and filter-to-waste water is disposed to sewer.

Finished Water Quality Monitoring

Water quality is measured continuously from three points in the process: 1) post-chemical feed, 2) post-filtration, and 3) finished water in distribution. Total chlorine and pH is measured at the post-chemical feed and post-filtration points. Free chlorine and pH is measured at the finished water point.

Emergency Power System

The engine-driven generator provides power for the treatment facility when commercial power is not available. The control system monitors the incoming power and, after sensing a power loss for a specific period of time, starts the engine and automatically switches the power to the generator supply when the generator output stabilizes. With the return of the commercial power supply, the control system starts and automatically transfers back to the commercial supply. The engine generator continues to run for a short period of time for cooling purposes and shuts down with a return to standby status automatically.

Site Plan

Please see **Appendix A** for the general site and building layouts.

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CHAPTER 2

Component Descriptions

Overall Process

The City of Ferndale Groundwater Treatment Plant is designed to treat up to 2,170 gallons per minute (gpm) of combined discharge flow from two well sources: Douglas Well and Shop Well. The proposed Douglas Well pump [P-101] will be VFD controlled and is designed for an initial flow rate range of 800 to 1,300 gpm. The proposed Shop Well pump [P-201] will be VFD controlled and is designed for an 870 gpm capacity. Discharges from both proposed pump stations are combined into a single transmission main that conveys the water to the water treatment plant. Provisions for emergency pumping directly to the City's distribution system have been included for both well pump discharges. The Douglas Well discharge water main branches and connects to the City's 234 zone near the well site. The Shop Well discharge piping within the proposed building branches and connects on site to the City's 234 zone.

The water will be normally treated for removal of manganese and hydrogen sulfide through an oxidation/filtration process and removal of ammonia through a breakpoint chlorination process. The filtration process consists of two existing gravity filter vessels containing anthracite and GreensandPlus media. Chemicals to be added to the water include: 0.8% sodium hypochlorite for disinfection, oxidation of manganese and hydrogen sulfide, regeneration of the GreensandPlus media, for breakpoint chlorination of the ammonia naturally present and to maintain a persistent free chlorine residual and 25% sodium hydroxide for adjustment of the Shop Well's pH to reduce the potential for corrosion.

Each well pump station is housed in a single room building. Each pump station has its own backup power supply engine generator set located outdoors at the building sites. The treatment facility has five (5) rooms, a decommissioned below-grade raw water well basin and a below-grade clear well. The rooms in the building consist of: a combined mechanical and electrical room, shop room, office and laboratory, restroom, and pH adjustment room. The combined mechanical and electrical room contains the proposed raw groundwater piping, the proposed 90 pound per day on-site generation system package (which includes a brine tank, electrolyzer, rectifier, and product tanks), the proposed sodium hypochlorite metering pump feed systems, the existing reactor vessels, the existing filter vessels, the proposed air scour system, the proposed backwash supply pump and existing finished water high service pumps. The pH adjustment room contains the sodium hydroxide dilution system and sodium hydroxide metering pump feed system.

Please see **Appendix B** for the process and instrumentation diagrams.

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Douglas Well



Douglas Well Building

Building

The building's footings and foundations are constructed of concrete. The above-grade walls are concrete masonry units with a door for personnel and equipment removal. The roof is manufactured trusses with a plywood deck topped with metal roof and decking.

Water Supply

Domestic water is supplied from the City's distribution system. The service is 1-inch in diameter. The line enters through the west side of the building. Upon entering, the flow passes through a pressure reducing valve and a reduced backflow device, including isolation valves, before serving the pump and building.

Wastewater

There currently is no sanitary sewer utility near the Douglas Well. All floor drains are routed outside to daylight and are handled by the storm water system.

Electric Supply and Distribution

Primary Service

Commercial 480/277 volt, 3 phase power is provided by Puget Sound Energy. There are pole-mounted transformers located on the south side of Douglas Road. Commercial power is connected to a main disconnect switch that allows total manual isolation from the commercial power grid. After the disconnect switch, an automatic transfer switch that is normally closed provides commercial power to the facility. Power then terminates at a motor control center which distributes power to the facility electrical loads.



Douglas Well Engine Generator

Standby Service

Standby (emergency) power is provided by an engine-driven generator. Transfer from primary to standby service is made automatically upon loss of commercial power.

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Emergency Chlorination

The emergency Douglas Well chlorination pump is automatically flow-paced with the flow rate of the Douglas Well. The flow-pace equation is as follows.

$$Feedrate(gal/hr) = \frac{Dose(mg/L) \cdot flow(gpm) \cdot 8.34(lb/gal) \cdot 100\%}{Concentration(\%) \cdot Density(lb/gal) \cdot 24(hr) \cdot 0.00144}$$

The emergency chlorination pump has a maximum capacity of 1.98 gph. Operators will need to set the dose, chemical concentration and chemical density in the control panel. Descriptions of the parameters that the operators can adjust are provided below.

- Dose (mg/L): The desired amount of sodium hypochlorite to be injected into the water. A dose range between 1.6 – 2.7 mg/L would be adequate to oxidize manganese, satisfy ammonia demands and provide a stable free-chlorine residual.
- Chemical Concentration (%): The concentration of sodium hypochlorite. A drum of bulk sodium hypochlorite typically contains 12.5 percent solution. This parameter should be modified before operation if the drum or MSDS sheets state otherwise.
- Density (lb/gal): The density of 12.5 percent sodium hypochlorite is 9.51 lb/gal. This parameter should be modified before operation if the drum of MSDS sheets state otherwise.

The metering pump will automatically adjust its speed according to the Douglas Well flow rate to provide the desired dose. This assumes that the metering pump is properly calibrated; please refer to **Appendix D** for details.



Douglas Well Emergency Chlorination Board

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Shop Well



Shop Well Building

Building

The building's footings and foundations are constructed of concrete. The above-grade walls are concrete masonry units with a variety of access doors for personnel and equipment. The roof is manufactured trusses with a plywood deck topped with metal roof and decking.

Water Supply

Domestic water is supplied from the City's distribution system. The service is 1-inch in diameter. The line is tapped from distribution-side piping located within the building and serves the pump and building fixtures.

Wastewater

All floor drains are routed to local sewer.

Electric Supply and Distribution

Primary Service



Douglas Well Engine Generator

Commercial 480/277 volt, 3 phase power is provided by Puget Sound Energy. There are pole-mounted transformers located near the engine-driven generator fuel tank on the western perimeter of the site. Commercial power is connected to a main disconnect switch that allows total manual isolation from the commercial power grid. After the disconnect switch, an automatic transfer switch that is normally closed provides commercial power to the facility. Power then terminates at a motor control center which distributes power to the facility electrical loads.

Standby Service

Standby (emergency) power is provided by an engine-driven generator. Transfer from primary to standby service is made automatically upon loss of commercial power.

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Heating, Ventilation and Dehumidification

Heating of the building is accomplished by electric heaters. Ventilation is provided as necessary by an exhaust fan and an automatic intake louver.

Emergency Chlorination

The emergency Shop Well chlorination pump is automatically flow-paced with the flow rate of the Shop Well. The flow-pace equation is as follows.

$$Feedrate(gal/hr) = \frac{Dose(mg/L) \cdot flow(gpm) \cdot 8.34(lb/gal) \cdot 100\%}{Concentration(\%) \cdot Density(lb/gal) \cdot 24(hr) \cdot 0.00144}$$

The emergency chlorination pump has a maximum capacity of 1.98 gph. Operators will need to set the dose, chemical concentration and chemical density in the control panel. Descriptions of the parameters that the operators can adjust are provided below.

- Dose (mg/L): The desired amount of sodium hypochlorite to be injected into the water. A dose range between 1.6 – 2.7 mg/L would be adequate to oxidize manganese, satisfy ammonia demands and provide a stable free-chlorine residual.
- Chemical Concentration (%): The concentration of sodium hypochlorite. A drum of bulk sodium hypochlorite typically contains 12.5 percent solution. This parameter should be modified before operation if the drum or MSDS sheets state otherwise.
- Density (lb/gal): The density of 12.5 percent sodium hypochlorite is 9.51 lb/gal. This parameter should be modified before operation if the drum of MSDS sheets state otherwise.

The metering pump will automatically adjust its speed according to the Shop Well flow rate to provide the desired dose. This assumes that the metering pump is properly calibrated; please refer to **Appendix D** for details.



Shop Well Emergency Chlorination Board

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Groundwater Treatment Plant

Building



Water Treatment Facility Building

The treatment building is constructed of concrete for the footings, foundation and floor. The above grade walls are concrete masonry units with a variety of access doors for personnel and equipment. This building contains the sodium hypochlorite on-site generation and feed system, pH adjustment feed system, filtration system, clear well and high service pumps. The water treatment plant operator office and laboratory is also within this building.

Water Supply

Domestic water is supplied from the City's distribution system. The service is 2-inch in diameter. The line enters through the north of the building near the high service pumps. Upon entering the building, the flow passes through a pressure reducing valve and a reduced backflow device, including isolation valves, before routing along the east, south and west sides of the building to serve the building and the treatment processes.

Wastewater

All floor drains and backwash water are routed to sewer. Sewer service is provided by the City. The Sewer Treatment Plant is located on the same site as the groundwater treatment plant.

Electric Supply and Distribution

Primary Service

Commercial 480/277 volt, 3 phase power is provided by Puget Sound Energy. There is a pad-mounted transformer near the building with the meter and entrance panel on the outside of the structure. The building's electrical control center is located in the treatment area. Commercial power enters the building's control center and is connected to a disconnect switch that allows total manual isolation from the commercial power grid.

Standby Service

The water plant shares a standby power generator with the wastewater treatment plant. The engine driven unit is considered to be part of the wastewater plant, and operation and maintenance is also attached to that facility. There is a transfer switch in the water treatment plant that provides for transfer of power to the generator system in the event commercial power is interrupted.

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Treatment Process

Water Sources

Raw water from the Douglas and Shop Wells are directed to the groundwater treatment plant via dedicated transmission main. Water from both wells is hydraulically regulated by the backpressure sustaining valve.

Downstream of the backpressure sustaining valve, the raw water flows through the reactor tank and into the flume before being dispersed into the filter vessels.



Water Treatment Facility Backpressure Sustaining Valve

On-site Sodium Hypochlorite Generation

Sodium hypochlorite is generated on-site as a 0.8 percent solution. Softened water and a saturated salt brine solution combine within the electrolyzer cell and the rectifier provides electricity to catalyze a chemical reaction to create sodium hypochlorite. Operators will need to ensure that the brine tank is well stocked with salt on a daily basis.

The solution is stored in two 1,700 gallon chemical product tanks. Two pre-chlorination metering pumps feed sodium hypochlorite into the raw water upstream of the backpressure sustaining valve. Sodium hypochlorite is used to oxidize manganese, catalyze the ammonia breakpoint reaction and regenerate the GreensandPlus filter media. A static mixer is located downstream of the chemical injection point to fully mix sodium hypochlorite into the process water. One post-chlorination metering pump feeds sodium hypochlorite into the finished water in the meter manhole and is used to boost free-chlorine levels, if necessary.

Sodium Hypochlorite Feed

The pre-chlorine metering pumps are automatically flow-paced with the flow rate of the Douglas and Shop Wells. The post-chlorine metering pumps are automatically flow-paced with the flow rate of the high service pump effluent header. The flow-pace equation is as follows.

$$Feedrate(gal/hr) = \frac{Dose(mg/L)\cdot flow(gpm)\cdot 8.34(lb/gal)\cdot 100\%}{Concentration(\%)\cdot Density(lb/gal)\cdot 24(hr)\cdot 0.00144}$$

The pre-chlorine and post-chlorine sodium hypochlorite metering pumps all have a maximum capacity of 99 gph. Operators will need to set the dose, chemical concentration and chemical density in the control panel. Descriptions of the parameters that the operators can adjust are provided below.

- Dose (mg/L): The desired amount of sodium hypochlorite to be injected into the water.

  Regarding the pre-chlorine metering pumps, preliminary chemical studies indicated that a dose range between 2.1 – 3.2 mg/L would be adequate to oxidize manganese, satisfy ammonia demands, recharge the GreensandPlus filter media and provide a stable free-chlorine residual.

  Regarding the post-chlorine metering pump, the desired dose will add additional chlorine to the water pumped to distribution from the clearwell. This may be necessary if water in the clearwell is stagnant for an extended period of time or if there are additional chlorine demands in the raw water or filter media.

- Chemical Concentration (%): The concentration of sodium hypochlorite. The on-site generation system is designed to consistently generate a 0.8% sodium hypochlorite solution. The concentration can be verified with a titration kit and the new concentration can be set in the control panel. If the concentration is higher than 0.8%, the metering pump would need to operate at a lower speed to provide the desired dose. If the concentration is less than 0.8%, the metering pump would need to operate at a higher speed to provide the desired dose.

- Density (lb/gal): The density of 0.8 percent sodium hypochlorite is similar to that of water, 8.34 lb/gal. This parameter should not be modified.

The metering pump will automatically adjust its speed according to the raw water flow rate to provide the desired dose. This assumes that the metering pump is properly calibrated; please refer to **Appendix D** for details.



On-Site Generation System Brine Tank



On-Site Generation System Rectifier (left) and Electrolyzer (right)

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On-Site Generation System Product Tanks



Pre-chlorination Metering Pumps (left) and Post-chlorination Metering pump (right)

pH Adjustment

Caustic soda is fed upstream of the backpressure sustaining valve and is used to raise the raw water pH when the Shop Well is in operation. This will reduce the potential for corrosion from the Shop Well.



Outdoor Caustic Soda Tank

A tanker truck will deliver 25 percent caustic soda to the 6,650 gallon outdoor chemical storage tank. Caustic soda will flow via gravity from this tank to the dilution skid within the treatment facility which will automatically dilute 25 percent caustic soda to 10 percent. Two metering pumps feed the 10 percent caustic soda into the raw water upstream of the backpressure sustaining valve. A static mixer is located downstream of the chemical injection point to fully mix sodium caustic soda into the process water.

The caustic soda metering pumps are automatically flow-paced with the flow rate of the Shop Well. The flow-pace equation is as follows.

$$Feedrate(gal/hr) = \frac{Dose(mg/L) \cdot flow(gpm) \cdot 8.34(lb/gal) \cdot 100\%}{Concentration(\%) \cdot Density(lb/gal) \cdot 24(hr) \cdot 0.00144}$$

The caustic soda metering pumps each have a maximum capacity of 15.9 gph. Operators will need to set the dose, chemical concentration and chemical density in the control panel. Descriptions of the parameters that the operators can adjust are provided below.

- Dose (mg/L): The desired amount of sodium hypochlorite to be injected into the water.

  Regarding the pre-chlorine metering pumps, preliminary chemical studies indicated that a dose range between 7.0 – 14.0 mg/L would be adequate for corrosion control.

- Chemical Concentration (%): The concentration of caustic soda. The dilution system is designed to dilute 25 percent caustic soda to 10 percent. The 25% caustic soda is delivered by a chemical supplier and the exact concentration should be verified with each delivery; the feed solution concentration should be modified in the dilution system's control panel if it is not 25 percent.
- Density (lb/gal): The density of 10 percent caustic soda is 9.24 lb/gal. This parameter should not be modified.

The metering pump will automatically adjust its speed according to the raw water flow rate to provide the desired dose. This assumes that the metering pump is properly calibrated; please refer to **Appendix D** for details.

$$Feedrate(gal/hr) = \frac{8.34(lb/gal)\cdot dosage(mg/L)\cdot flow(mgd)\cdot 100\%}{24(hr)\cdot Concentration(\%)\cdot Density(lb/gal)}$$

If the caustic concentration and density changes the operators are able to modify these parameters in the control panel.



Caustic Soda Dilution System



Caustic Soda Metering Pump System

Filter Vessels

The water treatment filter vessels consist of two identical skid mounted units with four individual units in each row. Each filter cell contains approximately 70 square feet of filter media. The filters cleanse the water by passing it through a mixed media filter bed, after which it is discharged to a clear well directly beneath the filter bays. The media consists of gravel which supports 1-foot of GreensandPlus capped with 1-foot of anthracite. The filter loading rates vary depending on the sources in a operation and are as follows.

Source and Flow Rate	Filter Loading Rate
Douglas and Shop Wells (2,170 gpm)	3.89 gpm/sf
Douglas Well (1,300 gpm)	2.29 gpm/sf
Shop Well (870 gpm)	1.53 gpm/sf

A filter unit must be backwashed to remove the trapped solids from the spaces between the filter media particles. A backwash consists of reversing the flow direction through the filter bed and expanding and agitating the filter media to cleanse the accumulated particles and remove the particulates. An air scour procedure introduces air to the backwash process and increases agitation, resulting in a more thorough media cleaning.

Only one filter cell can be backwashed at a time. The other filter cells can continue to produce water normally during a backwash.



Top View of South Filter Vessel

Filter Media

The components of the filter bed are 12 inches of anthracite coal and 12 inches of GreensandPlus on a gravel support bed. The GreensandPlus has a specific gravity of 2.4 and anthracite coal has a specific gravity of 1.6. Although the media gets interspersed during a backwash, the different specific gravity values allow the heavier GreensandPlus to settle into the bottom layer and the lighter anthracite coal to settle into the upper layer during a high rate backwash. The large physical particulates are removed by the anthracite and the less easily removed manganese is chemically bound to the GreensandPlus.

Filter Controls

Each filter bay has continuous turbidity monitoring that is controlled via telemetry to backwash each of the eight filter bay units. A backwash can be started by turbidity, loss of head or operator schedule.

Online Water Quality Monitoring

Water quality analyzers are located south of the reactor vessel to continuously measure and record water quality from three sampling points in the process: 1) post-chemical feed, 2) post-filtration, and 3) finished water in distribution. The post-chemical feed sampling point is located directly upstream of the backpressure sustaining valve. The post-filtration sampling point is in the combined filter effluent header and a pump is used to transfer this water to the water quality analyzer board. The finished water sampling point is located in the sampling manhole.

Total chlorine and pH is measured at the post-chemical feed and post-filtration points. This is used to monitor the pH and the progress of the ammonia breakpoint reaction after chemical has been fed. Free chlorine and pH is measured from the finished water point and this monitoring location is used to boost free-chlorine if the chlorine concentration drops below a setpoint in distribution.

The analyzers are connected to the control system for recording data. Manual water quality samples, such as manganese, are required for compliance with water quality regulations and are part of the water system operations plan. Please see **Appendix C** for the Department of Health (DOH) water quality reporting form.



Water Quality Analyzer Board



Water Quality Transfer Pump

Backwash System

General

The routine maintenance for a filter system is to backwash the filter media to purge it of accumulated particles and reset headloss. A backwash consists of the backwash pump withdrawing finished water from the clearwell to provide reverse water flow through a filter cell. This expands the filter media while agitating and cleaning the media of accumulated particles. Spent filter backwash water crests into the filter backwash troughs which carry the

water to sewer disposal. The filter cell is then ready for normal forward operation; however, filtered water from the cell should be sent to waste for a period of time to ensure quality finished water.

Control

The filter backwash frequency is controlled by two parameters. Backwash can be initiated by an increase in headloss across the filter that exceeds the operating parameters or manually. Only one filter cell is in backwash at any given time.

Backwash Process

The backwash pump is equipped with a variable frequency drive to provide different water flow rates during the backwash process. When a filter cell is ready for backwashing, its effluent valve closes and the backwash valve opens automatically to be configured for reverse flow. A typical backwash process consists of an air scour step and a high rate water step.

The air scour step uses combined air and water to thoroughly scour the media for a deep cleaning. According to the GreensandPlus manufacturer, water should be provided at a flow rate between 280 – 315 gpm (4.0 – 4.5 gpm/sf) and air is provided at a loading rate of 2.6 scfm/sf). After an operator programmable duration (typically 3 – 5 minutes), the air scour blower stops to prevent media from blowing out into the troughs and the process transitions to high rate water. The backwash pump's variable frequency drive increases the flow rate to at least 840 gpm (12 gpm/sf). This step expands and stratifies the filter media while purging all accumulated particles through the backwash troughs for disposal to sewer. The water level raises high enough to prevent raw water influent from entering through use of the flapper gate.

Each of the components of the filter media has a unique specific gravity. This difference allows the filter bed to expand for cleaning and then return to the stratified media layers as designed. Too high a flow rate blow the media into the backwash troughs and too low a flow rate will not provide sufficient flow to adequately clean the filter media of contaminants.



Air Scour Blower



Air Scour Grid

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Backwash Waste Disposal

During the high rate water step, as the water level increases, spent filter backwash water crests into the backwash troughs and is transported for sewer disposal.

Filter to Waste

At the conclusion of the high rate water backwash step, the filter cell is configured for normal operation but all treated water is sent to sewer for an operator-adjustable duration (typically 3-5 minutes). This is to ensure quality water and prevent turbidity spikes from entering the clearwell. The valves automatically configure for normal flow once the filter to waste step is complete.

Water Quality Test Laboratory

The water quality test laboratory is located in the treatment building. It contains a basic lab bench with a sink. A hot water tank provides hot water to the sink and emergency eye wash stations. Water treatment facility operators will need to measure finished water iron and manganese concentrations manually and record in the reporting forms as shown in **Appendix C** for submittal to DOH.

Control System and SCADA Functional Descriptions

These functional descriptions describe the control strategy for each loop in the facilities. These descriptions are intended to be an extension of the plans that are provided as part of the contract documents. Please refer to **Appendix B**, the Process and Instrumentation Diagrams, for equipment tag identification.

A. Overview

The City of Ferndale Groundwater Treatment Plant is designed to treat up to 2,170 gallons per minute (gpm) of combined discharge flow from two well sources: Douglas Well and Shop Well. The proposed Douglas Well pump [P-101] will be VFD controlled and is designed for an initial flow rate range of 800 to 1,300 gpm. The proposed Shop Well pump [P-201] will be VFD controlled and is designed for an 870 gpm capacity. Discharges from both proposed pump stations are combined into a single transmission main that conveys the water to the water treatment plant. Provisions for emergency pumping directly to the City's distribution system have been included for both well pump discharges. The Douglas Well discharge water main branches and connects to the City's 234 zone near the well site. The Shop Well discharge piping within the proposed building branches and connects on site to the City's 234 zone.

The water will be normally treated for removal of manganese and hydrogen sulfide through an oxidation/filtration process and removal of ammonia through a breakpoint chlorination process. The filtration process consists of two existing gravity filter vessels containing anthracite and GreensandPlus media. Chemicals to be added to the water include: 0.8% sodium hypochlorite for disinfection, oxidation of manganese and hydrogen sulfide, regeneration of the GreensandPlus media, for breakpoint chlorination of the ammonia naturally present and to maintain a persistent free chlorine residual and 25% sodium hydroxide for adjustment of the Shop Well's pH to reduce the potential for corrosion.

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Each well pump station will be housed in a single room building. Each pump station will have its own backup power supply engine generator set located outdoors at the building sites. The treatment facility has five (5) rooms, a decommissioned below-grade raw water well basin and a below-grade clear well. The rooms in the building will consist of: a combined mechanical and electrical room, shop room, office and laboratory, restroom, and pH adjustment room. The combined mechanical and electrical room will contain the proposed raw groundwater piping, the proposed 90 pound per day on-site generation system package (which includes a brine tank, electrolyzer, rectifier, and product tanks), the proposed sodium hypochlorite metering pump feed systems, the existing reactor vessels, the existing filter vessels, the proposed air scour system, the proposed backwash supply pump and existing finished water high service pumps. The pH adjustment room will contain the sodium hydroxide dilution system and sodium hydroxide metering pump feed system.

B. Well Operations

1. Pumping to the Groundwater Treatment Plant

General

P-101 will start when called from the telemetry system (auto) or when the HOA switch is in the Hand position. P-201 will also start when called from the telemetry system (auto) or when the HOA switch is in the Hand position. P-101 and P-201 will be operated alone, or in combination based on level setpoints in the water treatment plant clearwell which is monitored by an existing level sensor in the water treatment plant. Each well pump will have a clearwell start and stop setpoint associated with it. The operator shall determine which pump is the lead or lag pump by adjusting the start and stop setpoints. See Water Treatment Plant section below for the function of the Combination Back Pressure and Solenoid Shut-Off Valve [BPSV-005] during well(s) start-up and shutdown.

The following is a list of conditions that exist for all automatic control situations:

1. Under no condition shall both well pumps start simultaneously.
2. If a pump fails, an alarm signal shall be sent and the next to run pump shall be called to start.
3. All setpoints shall be user adjustable from the HMI computer and RTU's.
4. In the event that a pump fails, the telemetry system shall remove the pump call from that pump and shall take the pump offline until the pump fail alarm is manually reset from the MTU system.

Douglas Well

The Douglas Well pump discharge piping includes a Booster Pump Control Valve on the main line [PCV-103] and a Deep Well Pump Control Valve [PCV-105] on a branch line. PCV-103 is solenoid controlled, energized to open and normally close when P-101 is off. The Douglas Well is artesian, so PCV-105 is normally closed (NC) to prevent well discharge when P-101 is off. PCV-105 is solenoid controlled and de-energized to open.

When P-101 is called to start by the PLC, the pre-lube solenoid valve, V-109, is energized to open by the motor control center via an operator adjustable time delay relay. After this time delay is expired, PCV-105 is de-energized to open and V-109 is de-energized to close. Once PCV-105 is fully opened, P-101 is allowed to start. The pump shall run with PCV-105 open

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for an operator adjustable time via a time delay relay in the motor control center. After P-101 is running and the time delay is expired, PCV-105 will be energized to close and will modulate to maintain the pressure setting. P-101 start-up will include a slow ramp up to an operator adjustable "overboard" speed setpoint. During this part of pump start-up operations, the well discharge is sent to an on-site water handling system. After an operator adjusted time delay relay in the MCC has timed out, PCV-103 will be energized to slowly open allowing discharge water into the water main and PCV-105 will remain energized to close. After PCV-103 is fully open, P-101 is slowly ramped up beyond the "overboard" speed setpoint to provide the "target flow rate" (between 800 to 1,300 gpm), which is an operator adjustable setpoint.

When operating alone, the flow range of 800 to 1,300 gpm corresponds to a pump speed range of 60% to 86% speed. When operating along with the Shop Well operating at 870 gpm, the flow range of 800 to 1,300 gpm corresponds to a pump speed range of 67% to 91% speed.

During P-101 operation, the discharge flow rate is monitored and used as feedback to control the speed of P-101. Flow rate is monitored by a flow meter and transmitted via Ft-104. In addition to flow monitoring, the well water level is monitored to prevent it from decreasing below the "well low-low level" setpoint. Well water level is monitored by a level transducer and transmitted via Lt-102. PCV-105 includes a pressure relief override with an operator adjusted pressure setting, which is manually adjusted via a screw on the valve. When the discharge pressure from P-101 exceeds this setting, PCV-105 is opened to relieve the excess pressure. Once the discharge pressure decreases below this setting, PCV-105 closes and normal pumping operation to the main line continues.

P-101's shutdown routine will occur due to several scenarios that may occur: the water treatment plant clearwell level "pump stop" setpoint is reached, power failure at the water treatment plant or alarm setpoints are reached as listed in section P. Control System Alarm Listing. Shutdown routine begins with the call to P-101 being removed. The PLC shall continue to send the speed signal to the VFD until the VFD is no longer running. PCV-103 is slowly closed and PCV-105 is slowly opened. After PCV-103 is fully closed, the relay logic in the motor control center shall allow P-101 to stop and the pump shall be slowly ramped down. After P-101 is off and an operator adjusted time delay occurs via a time delay relay in the motor control center, PCV-105 is closed to its normal pump off position.

When power failure occurs at the Douglas Well pump station, the solenoids for PCV-103, PCV-105 and BPSV-005 will be immediately de-energized and the valves will move to their normal pump off positions, with the exception that PCV-105 will de-energized and open. In addition, the proposed engine generator will be used to provide power to the facility. Only the power source will change, so the operations described above will remain the same when operated by engine generator power.

When power failure occurs at the water treatment plant, the telemetry system shall remove the pump call from that pump and shall take the pump offline until power is restored to the plant from either the backup generator or utility power.

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Shop Well

The Shop Well pump discharge piping includes a Booster Pump Control Valve on the main line [PCV-203] and a Deep Well Pump Control Valve [PCV-205] on a branch line. PCV-203 is solenoid controlled, energized to open and normally closed when P-201 is off. PCV-205 is normally open (NO) when P-201 is off. PCV-205 is solenoid controlled and de-energized to open.

When P-201 is called to start by the PLC, the pre-lube solenoid valve, V-209, is energized to open by the motor control center via an operator adjustable time delay relay. After this time delay is expired, V-209 is de-energized to close and P-201 is allowed to start. After P-201 is running for an operator adjustable amount of time via a time delay relay in the motor control center, PCV-205 will be energized to close and will modulate to maintain the pressure setting. P-201 start-up will include a slow ramp up to an operator adjustable "overboard" speed setpoint. During this part of pump start-up operations, the well discharge is sent to an on-site catch basin and associated storm conveyance system. After an operator adjusted time delay relay in the motor control center has timed out, PCV-203 will be energized to slowly open allowing discharge water into the water main and PCV-205 will remain energized to close. After PCV-203 is fully opened, P-201 is slowly ramped up beyond the "overboard" speed setpoint to provide the "target flow rate" (870 gpm), which is an operator adjustable setpoint.

When operating alone, the flow rate of 870 gpm corresponds to a pump speed of 82%. When operating along with the Douglas Well operating at 1,300 gpm, the flow rate of 870 gpm corresponds to a pump speed of 93%.

During P-201 operation, the discharge flow rate is monitored and used as feedback to control the speed of P-201. Flow rate is monitored by a flow meter and transmitted via Ft-204. In addition to flow monitoring, the well water level is monitored to prevent it from decreasing below the "well low-low level" setpoint. Well water level is monitored by a level transducer and transmitted via Lt-202. PCV-205 includes a pressure relief override with an operator adjusted pressure setting, which is manually adjusted via a screw on the valve. When the discharge pressure from P-201 exceeds this setting, PCV-205 is opened to relieve the excess pressure. Once the discharge pressure decreases below this setting, PCV-205 closes and normal pumping operation to the main line continues.

When P-201 is selected as the lag pump, it will be called to start after the P-101 start-up routine (see above) and an operator adjusted time delay. The start-up routine for P-201 as the lag pump is the same as when it is the lead pump.

P-201's shutdown routine will occur due to several scenarios that may occur: the water treatment plant clearwell level "pump stop" setpoint is reached, power failure at the water treatment plant or alarm setpoints are reached as listed in section P. Control System Alarm Listing. Shutdown routine begins with the call to P-201 being removed. The PLC shall continue to send the speed signal to the VFD until the VFD is no longer running. PCV-203 is slowly closed and PCV-205 is slowly opened. After PCV-203 is fully closed, the relay logic in the motor control center shall allow P-201 to stop and the pump shall be slowly ramped down. After P-201 shuts off, PCV-205 will remain open (normal pump off position).

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When power failure occurs at the Shop Well pump station, the solenoids for PCV-203, PCV-205 and BPSV-005 will be immediately de-energized and the valves will move to their normal pump off positions. In addition, the proposed engine generator will be used to provide power to the facility. Only the power source will change, so the operations described above will remain the same when operated by engine generator power.

When power failure occurs at the water treatment plant, the telemetry system shall remove the pump call from that pump and shall take the pump offline until power is restored to the plant from either the backup generator or utility power.

Water Treatment Plant

BPSV-005 is used to maintain a constant backpressure in the transmission main and well pump discharge mains during pump operations. Also, BPSV-005 is used to prevent the mains from emptying into the treatment plant based on the lower elevation of the treatment plant in comparison to the pump station elevations. BPSV-005 is NC when P-101 and P-201 are off. BPSV-005 is solenoid controlled and is energized to open. When the lead pump is called to start, BPSV-005 will be slowly opened at the same time the PCV valves, corresponding to the lead pump, are being opened and closed, respectively. When the lead pump is called to shutdown, BPSV-005 will be slowly closed at the same time the PCV valves, corresponding to the lead pump, are being closed and opened, respectively. BPSV-005 should not close during lag pump shutdown because the lead pump is still in operation. During P-101 and/or P-201 operations BPSV-005 will be hydraulically controlled to maintain an operator adjusted constant backpressure.

When one pump station is in operation and experiences power failure resulting in instant pump shut-off, BPSV-005 should close immediately. If P-101 and P-201 are both in operation and both lose power, BPSV-005 should close immediately. If P-101 and P-201 are both in operation and only one pump loses power, BPSV-005 should remain open to sustain constant backpressure for the pump still in operation. See well pump station power failure shutdown descriptions above.

Operational Changes due to VFD Failure

When one or both VFD's fail and require replacement, changes in well pump operations will be required by the City. The City will have to make a decision on whether or not to operate only one pump or both dependent on several factors not discussed in detail here. Regardless of the City's approach to operation of the well(s) in this scenario, start-up and shutdown routines for each pump will be similar to the operations described above.

A bypass contactor is installed within each pump station building MCC to allow the well pumps to be operated without the VFD's. When the VFD is unable to be used for pump operation, the operated adjusted constant backpressure on BPSV-005 will be increased by the City. This is required to increase the system head the pump encounters to prevent it from pumping more than the maximum flow rate while operating at full speed (1,300 gpm for Douglas Well and 870 gpm for Shop Well). If only one VFD is down and the other pump is operated on VFD, increasing the constant backpressure on BPSV-005 may decrease the flow rate capability of the VFD controlled pump due to increased system head.

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Start-up and shutdown routines without use of the VFD, for either the Douglas Well or Shop Well, will remain the same as stated above with the following exceptions: 1) no slow ramp up and ramp down available without the VFD, so pump on and off results in full speed or zero speed respectively and 2) discharge flow rate will continue to be monitored, but will not be able to control the speed of the pump.

2. Pumping to the Distribution System – Emergency Condition

General

When the City is not able to pump to the water treatment plant, the proposed well discharge connections to the distribution system will be utilized. Each well connects to the distribution system in a unique location. The pumps can be operated individually or simultaneously, but unlike the Pumping to the Groundwater Treatment Plant scenarios, there is no lead-lag pump selection during pump start-up or shut down because of the unique discharge points. P-101 and/or P-201 will start based on an operator adjustable reservoir level setpoint measured by the existing level transducer at Reservoir No. 1. Individual or simultaneous pumping for this scenario is chosen by the City at the water treatment plant HMI. When simultaneous pumping is selected, both pumps will be called to start when the reservoir level start setpoint is reached for each pump. These emergency pumping scenarios also include provisions for disinfection by 12.5% sodium hypochlorite, with chemical injection at the well pump stations.

Douglas Well

Prior to emergency operation of P-101, the City will manually open and close gate valves at and near the Douglas Well site. In addition, the City will manually increase the pressure relief override setting on PCV-105. To provide sodium hypochlorite disinfection during emergency pumping, the City will install a 55-gallon drum below the chemical metering pump [P-106] and insert the pump suction lance within the drum. The City will also install an injection quill at the chemical injection point and run tubing from the injection quill to the sodium hypochlorite valve board.

See section titled Pumping to the Groundwater Treatment Plant for valve operation when the pump is required. Instead of matching a target flow rate, P-101 is slowly ramped up to 100% speed to provide the maximum flow rate based on system head conditions. Once PCV-103 begins to open (not fully closed), P-106 is called to start to provide chlorine disinfection.

During P-101 operation, the discharge flow rate is monitored and used as feedback to control the speed of P-101. Flow rate is monitored by a flow meter and transmitted via Ft-104. It is very unlikely that the system head conditions will be such that the pump can operate up to 1,300 gpm; however, the pump speed should be controlled to maintain a maximum pumping flow rate of 1,300 gpm. The discharge flow rate is also used to flow-pace control P-106 to provide the "target chlorine dose". Downstream chlorine level is NOT monitored and measured.

P-101's shutdown routine will occur due to several scenarios that may occur: "pump stop" setpoint reached at Reservoir No. 1, power failure at the water treatment plant or alarm

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setpoints are reached as listed in section P. Control System Alarm Listing. During the shutdown routine when PCV-103 is fully closed, P-106 is called to stop.

Shop Well

Prior to emergency operation of P-201, the City will manually open and close gate valves within the pump station building and at the site. In addition, the City will manually increase the pressure relief override setting on PCV-205. To provide sodium hypochlorite disinfection during emergency pumping, the City will install a 55-gallon drum below the chemical metering pump [P-206] and insert the pump suction lance within the drum. The City will also install an injection quill at the chemical injection point and run tubing from the injection quill to the sodium hypochlorite valve board.

See section titled Pumping to the Groundwater Treatment Plant for valve operation when the pump is required. Instead of matching a target flow rate P-201 is slowly ramped up to 100% speed to provide the maximum flow rate based on system head conditions. Once PCV-203 begins to open (not fully closed), P-206 is called to start to provide chlorine disinfection.

During P-201 operation, the discharge flow rate is monitored and used as feedback to control the speed of P-201. Flow rate is monitored by a flow meter and transmitted via Ft-204. It is very unlikely that the system head conditions will be such that the pump can operate up to 870 gpm; however, the pump speed should be controlled to maintain a maximum pumping flow rate of 870 gpm. The discharge flow rate is also used to flow-pace control P-206 to provide the "target chlorine dose" setpoint. Downstream chlorine level is NOT monitored and measured.

P-201's shutdown routine will occur due to several scenarios that may occur: "pump stop" setpoint reached at Reservoir No. 1, power failure at the water treatment plant or alarm setpoints are reached as listed in section P. Control System Alarm Listing. During the Shutdown routine when PCV-203 is fully closed, P-206 is called to stop.

Operational Changes due to VFD Failure

When the VFD for either the Douglas Well or Shop Well fails and the City is operating the pumps to discharge to the distribution system, slight changes in the well pump start-up and shutdown routines will be required.

A bypass contactor is installed within each pump station building MCC to allow the well pumps to be operated without the VFD's. Start-up and shutdown routines without use of the VFD, for either the Douglas Well or Shop Well, will remain the same as stated above with the following exceptions: 1) no slow ramp up and ramp down available without the VFD, so pump on and off results in full speed or zero speed respectively and 2) discharge flow rate will continue to be monitored, but will not be able to control the speed of the pump.

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C. Normal Filter Operation

During normal operation, water is pumped from the well sources and flow rate is measured at each source. Chlorine is added upstream of a static mixer for mixing prior to entering the filter. Caustic soda is only added upstream of a static mixer when the Shop Well is in operation. The water then enters the existing reactor vessel and the raw water flume to be distributed into two existing gravity filter vessels. Each filter vessel has four cells, each containing 18 inches of anthracite, 18 inches of GreensandPlus and an existing gravel underdrain. Each cell has six existing motor operated valves that will be used for controlling normal and backwash operations. The filter cells operate to maintain a water level above the filter media. As headloss increases within the filter, each filter cell's existing effluent valve modulates open to ensure that the water level does not change.

A typical startup consists of the following steps:

1. The well pump(s) will be called to start. Water will be purged through the deep well pump control valve bypass line for disposal for an operator adjustable duration.
2. The deep well pump control valve will slowly close, allowing water into the plant.
3. Once flow is detected above a setpoint by the raw water flow meter(s) [Ft-104 and Ft-204], the prechlorination feed system [P-301, P-302] will turn on and inject chlorine upstream of the static mixer.
4. Once flow is detected above a setpoint by the Shop Well raw water flow meter transmitter [Ft-204], the pH adjustment system [P-401, P-402] will turn on and inject caustic soda upstream of the static mixer.
5. A finished water quality analyzer will measure free chlorine [CL2-602] downstream of the existing high service pumps. If this level is below an operator adjustable setpoint, the operator will have a choice to call the post-chlorination metering pump [P-303]to start to inject chlorine downstream of the high service pumps.
6. The filter cell timers will begin; head loss across the filter cells will be reported back to the control panel in the form of the effluent modulating valve (existing) status.
7. The well pump(s) will be called to stop either by the telemetry system (levels in tanks or other setpoint in the City's system), or by high-high or low-low pressure setpoints, or by high-high or low-low chemical setpoints, or by the operator's manual call to stop
8. The deep well pump control valve will slowly open to discharge well water to waste, and the well pump will be shut off. The filter cell run timers will pause when both well pumps are offline.
9. Once flow rate below a setpoint is detected, all chemical feed equipment will be shut down.

The filter plant is run in normal operation mode until either the turbidity level in the filter effluent is excessive, or the filter run time setpoint is reached, or the filter cell loss of head switch triggers. When any of these three occur, the filter cell backwash operations will begin.

D. Backwash Operations

The backwash operations will begin according to the following steps described below. A manual override capability in the control system will allow the operators to select whether the backwash operations will be initiated with or without an operator's input. Each filter cell is backwashed individually one at a time. There are two different backwash processes, an air

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scour process and a water-only process. The air scour process provides a more thorough cleaning compared to the water-only process, and requires air to be blown into the filter cell to vigorously agitate the media.

Air Scour Process
At the start of the air scour process, the filter cell's effluent valve will close and the air supply valve [A-006 to A-013] will open. The blower [B-501] will turn on and provide air to the filter at 170 scfm for an operator adjustable duration, initially set at 5 minutes.

After an operator adjustable duration, initially set at 4 minutes, open the backwash supply valve and start the backwash supply pump [P-701]. Gradually increase the backwash water rate up to 280 gpm until the air scour duration has completed. Once the air scour step is complete, close the air supply valve and stop the blower. Increase the backwash water rate up to 840 gpm for an operator adjustable duration, initially set at 5 minutes. Once the backwash step is complete, close the backwash valve and open the filter-to-waste valve. Allow water to filter-to-waste for an operator adjustable duration, initially set at 755 seconds, or when turbidity falls below an operator adjustable setpoint, whichever occurs first. If the telemetry system requires the source to run at the completion of the rinse duration, the filter effluent valve will open and the filter-to-waste valve will close to provide treated water to the distribution. If the telemetry system does not require the source to run, the well pump(s) will be called to stop, the filter-to-waste valve will be called to stop and the effluent valve will be called to open. The filter cell is ready for normal operation. The filter run timer will be reset.

Water-Only Backwash Process
At the start of the water-only backwash process, the filter cell's influent valve will close, the backwash supply valve will open and the backwash supply pump [P-701] will start. Gradually increase the backwash water rate up to 840 gpm for an operator adjustable duration, initially set at 10 minutes. Once the backwash step is complete, close the backwash valve and open the filter-to-waste valve. Allow water to filter-to-waste for an operator adjustable duration, initially set at 5 minutes. If the telemetry system requires the source to run at the completion of the rinse duration, the filter effluent valve will open and the filter-to-waste valve will close to provide treated water to the distribution. If the telemetry system does not require the source to run, the well pump(s) will be called to stop, the filter-to-waste valve will be called to stop and the effluent valve will be called to open. The filter cell is ready for normal operation. The filter run timer will be reset.

The remaining filter cells will remain in operation during the backwash process. All chemical systems will function as normal.

E. Backwash and Process Waste Disposal

All backwash and filter-to-waste process streams will be sent via gravity to the waste manhole. This waste manhole will direct all plant process waste to the City's wastewater treatment plant headworks manhole via gravity for handling.

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F. Water Quality and Control Monitoring

Water quality sample taps for manual sample collection will be provided at the locations noted on the P&IDs and drawing no. M14 for online monitoring. These analyses will include pH and chlorine residual. The water quality data will be available locally and over the telemetry system.

The filter cells are each equipped with treated water turbidimeters and three electrically actuated valve motors and one hydraulically controlled for opening/closing different lines during normal and backwash operations.

All water quality alarms related to turbidity, chlorine residual, and pH shall be disabled when the well pump is not in operation. All water quality alarms shall have an initial start timer as well as a normal time setpoint associated with the alarms. The initial start time shall be adjusted at startup to ignore any water quality alarms during startup of the process to allow for stabilization. The normal time setpoint associated with the alarm shall allow for eliminating nuisance alarms during a temporary spike.

Alarms shall be generated based on setpoints for low, low-low, high, and high-high for chlorine residual, high and high-high for pH, and high and high-high for turbidity. The well pump and filter system will be called to shutdown based on the high-high and low-low alarms of the water quality analyzers with the exception of pH. Alarm for high-high pH will only shut down the pH system. Water quality alarms shall be ignored for an operator adjustable duration after well startup to allow for water to change over in the sample lines.

All analyzers shall have an alarm triggered by a flow switch [Fs-001, Fs-603, Fs-702]. This indicates that there is no flow of water to the analyzer. An alarm shall be generated at the RTU and HMI to notify the operator that the analyzer has no flow. Both the Post-Chem Feed Water analyzer and the filtered water analyzer will have a solenoid valve [XV-014, XV-706] on the incoming water line. This solenoid shall be energized when either well pump is running.

G. Chlorination Process

A packaged on-site sodium hypochlorite generation system shall generate the sodium hypochlorite used in the chlorination process. This system has its own control panel that will control the generation process. The process shall start and stop based on the level in the product storage tank. The chlorination control panel shall communicate status and alarms to the RTU. The control system integrator shall coordinate with the on-site generation system manufacturer to obtain an alarm list and memory address list. Alarms and status shall be displayed at the RTU and HMI computer. The contractor and control system integrator shall be responsible for providing all equipment necessary to ensure that the chlorination control panel PLC can communicate with the RTU via an Ethernet connection.

The RTU shall control the operation of the chlorine metering pumps. The 0.8% solution will be injected with one prechlorination metering pump [P-301, P-302] (second pump is redundant) and one post-chlorination metering pump [P-303}. The stroke frequency shall be automatically adjusted by the RTU. The RTU shall do the following: alternate the prechlorination pumps every other start, start all pumps and stop them based on adjustable

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flow rate setpoints, and control their stroke frequency. The prechlorination metering pump will start based on two independent signals – well pump running and well pump flow rate (Sum of Ft-104 and Ft-204) greater than an operator adjustable set point for each well. The prechlorination metering pump shall stop based on the flow rate dropping below an operator adjustable flow rate. P-303 will start if the free Cl2 residual analyzer [CL2-602] reads an operator-adjustable low chlorine setpoint (initially set at 0.03 ppm) or below, a finished water pump is on and the finished water flow rate [Ft-601] is greater than an operator-adjustable setpoint. P-303 will stop if the free Cl2 residual analyzer [CL2-602] reads an operator-adjustable high chlorine setpoint (initially set at 1.2 ppm) or higher or the finished water flow rate drops below the setpoint.

The stroke frequency for the prechlorination metering pump will be adjusted linearly with changes in flow rate data received from the sum of the raw water flow meters [Ft-104 and Ft-204]. The operator shall enter the maximum capacity of the pump (mL/min), the pump stroke setting in percent of maximum, the specific gravity of the chemical metered, the percent concentration of the chemical metered, and a setpoint for the target (mg/L or ppm) to be achieved. From these setpoints, the speed of the operating pump will be adjusted to meet the target mg/L dosing rate. The metering pump shall be shut down on a low product storage tank level alarm, low or high chlorine residual, or flow rate below an operator-adjustable setpoint.

The stroke frequency for the post-chlorination metering pump will be adjusted linearly with changes in flow rate data received from the finished water flow rate meter [Ft-601]. The operator shall enter the maximum capacity of the pump (mL/min), the pump stroke setting in percent of maximum, the specific gravity of the chemical metered, the percent concentration of the chemical metered, and a setpoint for the target (mg/L or ppm) to be achieved. From these setpoints, the speed of the operating pump will be adjusted to meet the target mg/L dosing rate. The metering pump shall be shut down on a low product storage tank level alarm, high free chlorine residual, or finished water flow rate below an operator-adjustable setpoint.

One total chlorine residual analyzer [CL2-002] will analyze total chlorine concentration from a sample line downstream of the static mixer. One total chlorine residual analyzer [CL2-703] will analyze total chlorine concentration from the filter effluent. One free chlorine residual analyzer [Cl2-602] will analyze free chlorine from a sample line downstream of the post-chlorination injection point. High-High and low-low chlorine residual alarm setpoints from downstream of the static mixer and from the filter effluent shall shutdown the well pump(s). High-High and low-low chlorine residual alarm setpoints from the post-chlorination point shall shut down the higher service pump(s). The system will not run until the alarm has been manually reset. Chlorine residual alarming will be automatically turned off when the well pump is not in operation.

H. pH Adjustment Process

25% caustic soda will be delivered by a tanker truck to the outdoor storage tank. This will be connected to the dilution system. The dilution system will have its own control panel which will control the transfer pump, mixing pump, and solenoid valves to dilute the 25% caustic soda to 10% caustic soda. The following alarms and status will be available from the

DRAFT

controller to the main control panel: slow neat chemical transfer, slow water transfer, slow dilute chemical feed, maximum daily chemical usage, high dilution tank level, batch strength not available, 4-20 mA transmission of dilute chemical available, 4-20 mA transmission of system operational status, and 4-20 mA transmission of neat chemical remaining.

The 10% solution will be injected with metering pumps [P-401, P-402]. The stroke frequency will be automatically adjusted by the RTU. The RTU will need to do the following: alternate the pumps every other start, start the pumps and stop them based on adjustable flow rate setpoints, and control their stroke frequency in two modes. The metering pumps shall start based on two independent signals – well pump running and flow rate reaching an operator adjustable set point. The metering pumps shall stop based on the flow rate dropping to an operator adjustable flow rate.

The stroke frequency for the metering pump will be adjusted linearly with changes in flow rate data received from the sum of the raw water flow meters [Ft-104 and Ft-204]. The operator shall enter the maximum capacity of the pump (mL/min), the pump stroke setting in percent of maximum, the specific gravity of the chemical metered, the percent concentration of the chemical metered, and a setpoint for the target (mg/L or ppm) to be achieved. From these setpoints, the speed of the operating pump will be adjusted to meet the target mg/L dosing rate. The metering pump shall be shut down on a low product storage tank level alarm, high pH, or flow rate below an operator-adjustable setpoint.

Caustic soda weight and usage will be measured by the dilution system. A backpressure valve and a normally closed solenoid valve (energize to open) will prevent the normally higher head in the bulk tank from equalizing with the lower head in the dilution system. If a high level setpoint is reached or the high level switch is tripped, the solenoid valve shall be closed. A redundant metering pump system will inject the chemical in the main water line and will be paced from the RTU based on flow rate in the Shop Well raw water line [Ft-204]. The dilution system volumes will be monitored with a scale, and the rate of the loss-of-weight will be calculated and compared to a setpoint. If the rate is higher than the setpoint, the chemical injection process will be shut down because too much chemical is being used. High-High pH measurements will also shut down this process.

I. Process Flows

Flow rates and totalized quantities shall be monitored by proposed flow meters installed at each facility.

The flow rates and totalized flow quantities shall be accessible from the operator interface devices on the front of the RTU's and at the HMI computer.

All flow data and trending shall be available at the computer through the HMI.

J. Well Building Emergency Power System

An EG set, and Automatic Transfer Switch (ATS) connected to the utility power and the generator shall monitor the incoming utility power. In the event that utility power is lost to either well pump station, the ATS shall sense that condition and send a start call to the generator. After the generator has started, the ATS shall transfer power to the emergency

DRAFT

system. The ATS shall continue to monitor the utility power for its return. When the utility power is restored to the facility the ATS shall sense that condition and switch back to utility power after a timed period. The generator shall continue to operate for timed period before stopping. The automatic transfer switch shall send both the transfer switch position status and a pre-transfer signal to the RTU. The pre-transfer signal indicates that the transfer switch is about to transfer from emergency to utility power. This will allow for a controlled shutdown of the pumps. The RTU shall perform a controlled shutdown of the pumps when the pre-transfer signal is received. See Division 16 for additional details on the emergency power system.

K. Heating and Ventilation Control

At both proposed pump stations, the heating and cooling units include local heating and cooling thermostats for equipment temperature protection and/or climate control.

Heating System

Each well pump station control system provides logic to operate the heater for climate control. The heater operates from commands provided by the heating thermostat. Heater start temperature is operator adjustable and initially set for 65 degrees. Temperatures below the selected setting on the heating thermostat will engage the heater. Once the temperature rises above the selected setting, the heater turns off.

Ventilation System

Each well pump station control system provides logic to operate the ventilation fans for equipment temperature protection and climate control. The ventilation fan operates from commands provided by the cooling thermostat. Ventilation fan start temperature is operator adjustable and initially set for 75 degrees. Temperatures above the selected setting on the cooling thermostat will engage the fan. Once the temperature decreases below the selected setting, the ventilation turns off.

L. Intrusion Alarm System

Intrusion switches shall be located on all exterior doors located at the well sites. An intrusion alarm disable key switch shall be located on the interior of each well building. The operator shall operate the key switch to allow entry into the building without triggering the intrusion alarm. There shall be both an operator adjustable entry and exit timer at the operator interface. An alarm shall not be triggered unless both the entry or exit time delay has expired.

M. Setpoint Adjustment

All control setpoints for operations and alarms shall be stored in the PLC. These setpoints shall be adjustable from the operator interface screen. Certain setpoints shall also be adjustable from the HMI computer screen. The System Programmer and the operations staff shall identify which setpoints shall be adjustable at the HMI computer screen.

All control and alarm setpoints shall have min/max limits set in the program to prevent operators from entering an erroneous value. The min/max values shall be adjustable from the OIT with password protection. The program shall recognize setpoint crossover and latch an alarm until the crossover is corrected.

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Chapter 3

Operation and Maintenance

General

This Chapter is provided as a quick reference and summary of the activities necessary or recommended for the preservation and operation of the facility. The operation and maintenance manuals provided by the various suppliers contain the detailed procedures recommended by the various manufacturers. This document is not intended to replace the detailed manuals and does not contain the level of detail necessary to accomplish some of the tasks.

The following conventions are used in the tables below.

Volume	Refers to Manufacturer's Volume Number
Tab, Page	Refers to the manual section, tab and page number within the tab or manual
Equipment	Description of equipment
Action	Brief description of the required maintenance action

These tables will need to be updated upon receipt of manuals from other suppliers.

Sample checklists are provided in **Appendix D** for the listed actions.

Daily Activity

Volume	*Tab, Page*	*Equipment*	*Action*
		Water Quality	Perform all water quality testing and meter reading to complete the daily log form
		Housekeeping	Perform a walk around of the entire facility looking for vandalism, breaches in security systems and maintenance needs
X of 4	[Placeholder]	Salt Saturator	Check entire unit for leaks; repair as necessary
X of 4	[Placeholder]	Water Quality Analyzer/Controller	Check the entire flow block assembly for leakage
X of 4	[Placeholder]	Water Quality Analyzer/Controller	Comparative measurement of flow block assembly; calibrate if necessary

DRAFT

X of 4	[Placeholder]	Water Quality Analyzer/Controller	Measure free chlorine residual using colorimeter; calibrate controller if variance exceeds allowance
X of 4	[Placeholder]	Filter Vessel	Inspect the filter effluent water for signs of discoloration or foul odors
X of 4	[Placeholder]	Filter Vessel	Check the chemical concentration levels in the filters cells; adjust as necessary
X of 4	[Placeholder]	Engine Generators	Check coolant heater
X of 4	[Placeholder]	Engine Generators	Check oil level
X of 4	[Placeholder]	Engine Generators	Check coolant level
X of 4	[Placeholder]	Engine Generators	Check fuel level
X of 4	[Placeholder]	Engine Generators	Drain fuel-water separator
X of 4	[Placeholder]	Engine Generators	Inspect drive belt
X of 4	[Placeholder]	Engine Generators	Check air cleaner restriction
X of 4	[Placeholder]	Engine Generators	Check crankcase breather tube
X of 4	[Placeholder]	Engine Generators	Inspect cooling fan
X of 4	[Placeholder]	Engine Generators	Check charge air piping

Weekly Activity

Volume	*Tab, Page*	*Equipment*	*Action*
		Housekeeping	Check lighting for burned out lamps, including security lighting operation
		Housekeeping	Sweep or wash down interior floors as appropriate
X of 4	[Placeholder]	Water Softener	Check input and output water hardness to ensure proper operation
X of 4	[Placeholder]	Salt Saturator	Check salt level; add as necessary to insure minimum level is maintained
		Emergency Eyewash	Operate safety eyewash and shower
		Emergency Eyewash	Check thermostatic mixing valve for proper operation while operating eyewash and shower
X of 4	[Placeholder]	Water Quality Analyzer/Controller	Check electrolyte level in the flow block assembly
X of 4	[Placeholder]	Water Quality Analyzer/Controller	Check sand level in the flow block assembly
X of 4	[Placeholder]	Water Quality Analyzer/Controller	Perform comparative pH measurement

X of 4	[Placeholder]	Filter Vessel	Perform and observe a filter backwash for anomolies with respect to normal operation
X of 4	[Placeholder]	Engine Generator	Check charge air piping
X of 4	[Placeholder]	Engine Generator	Check air cleaner
X of 4	[Placeholder]	Engine Generator	Check battery charging system
X of 4	[Placeholder]	Engine Generator	Drain fuel filter(s)
X of 4	[Placeholder]	Engine Generator Transfer Switch	Operate engine generator and observe for proper operation

Monthly Activity

Volume	*Tab, Page*	*Equipment*	*Action*
		Housekeeping	Complete and send the monthly plant log to the Department of Health, Office of Drinking Water
X of 4	[Placeholder]	Sodium Hypochlorite Storage tank	Visually check all connections and tighten as necessary to eliminate leaks
X of 4	[Placeholder]	Water Quality Analyzers	Clean and calibrate the pH electrodes
X of 4	[Placeholder]	Water Quality Analyzers	Remove and clean the strainer in the sample water supply lines
X of 4	[Placeholder]	Butterfly Valves	Check for flaws, cracks or deformation on the valve
X of 4	[Placeholder]	Butterfly Valves	Check for leaks
X of 4	[Placeholder]	Butterfly Valves	Check for deformation of seat or disk
X of 4	[Placeholder]	Butterfly Valves	Check for smoothness of handle operation
X of 4	[Placeholder]	Filter Vessel	Check that all backwash valves open, close and seat properly
X of 4	[Placeholder]	Filter Vessel	Verify the flow rates and times of the backwash operation
X of 4	[Placeholder]	Filter Vessel	Check the backwash water for loss of media
X of 4	[Placeholder]	Air Scour Blower	Listen to the air scour blower in operation for non-typical sounds
X of 4	[Placeholder]	Air Scour Blower	Check air wash blower belts for damage, wear and correct tension
X of 4	[Placeholder]	Air Scour Blower	Check the housing for rust, corrosion, debris or weathering; repair as necessary
X of 4	[Placeholder]	Air Scour Blower	Check/replace the air filter
X of 4	[Placeholder]	Air Scour Blower	Check the oil level

X of 4	[Placeholder]	Engine Generators	Drain sediment and water from fuel tank
X of 4	[Placeholder]	Engine Generators	Drain exhaust condensate trap
X of 4	[Placeholder]	Engine Generators	Inspect and clean starting batteries
X of 4	[Placeholder]	Engine Generators	Check anti-freeze and DCA concentration
X of 4	[Placeholder]	Engine Generators	Check drive belt

Bi-Monthly Activity

Volume	*Tab, Page*	*Equipment*	*Action*
X of 4	[Placeholder]	On-Site Generation System Rectifier	Clean transformer, semi-conductors, heat sinks and terminal board connections
X of 4	[Placeholder]	Water Quality Analyzer/controller	Clean filters

Quarterly Activity

Volume	*Tab, Page*	*Equipment*	*Action*
X of 4	[Placeholder]	On-Site Generation System - Bus Bars	Check surface temperature with thermocouple type thermometer; if over 194°F (90° C) shut down electrolyzer and clean
X of 4	[Placeholder]	On-Site Generation System - Solenoid Valves	Clean valve and strainer
X of 4	[Placeholder]	Turbidimeters	Clean flow-through cuvettes
X of 4	[Placeholder]	Engine Generators	Check specific gravity of starting battery cells
X of 4	[Placeholder]	Engine Generators	Sample the resistance of the connections; clean as necessary

Semi-Annual Activity

Volume	*Tab, Page*	*Equipment*	*Action*
X of 4	[Placeholder]	On-Site Generation System - Rectifier Unit	Clean cabinet and ventilation slots clear

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X of 4	[Placeholder]	On-Site Generation System - Rectifier Unit	Electrically isolate rectifier and check connections for tightness
X of 4	[Placeholder]	On-Site Generation System Differential pressure switch	Rotate vent drain plug and return to original position
X of 4	[Placeholder]	Water Quality Analyzers	Replace reference electrolyte
X of 4	[Placeholder]	Water Quality pH Sensors	Clean and calibrate the sensor
X of 4	[Placeholder]	Ventilation Fans	Clean exterior surfaces, including motor; do not use solvents or saturate motor
X of 4	[Placeholder]	Water Quality Transfer Pump	Lubricate motor
X of 4	[Placeholder]	Isolation Valves	Fully operate valve and return to proper position
X of 4	[Placeholder]	Cla-Val Backpressure Sustaining Valve	Inspect control valve; adjust or repair as necessary
X of 4	[Placeholder]	Engine Generators	Change coolant filter
X of 4	[Placeholder]	Engine Generators	Change oil and oil filter
X of 4	[Placeholder]	Engine Generators	Replace fuel filter
X of 4	[Placeholder]	Engine Generators	Check supplemental coolant additive and coolant
X of 4	[Placeholder]	Engine Generators	Check engine wiring
X of 4	[Placeholder]	Engine Generators	Check sacrificial plug

Annual Activity

Volume	*Tab, Page*	*Equipment*	*Action*
X of 4	[Placeholder]	On-site Generation System - Electrodes	Acid clean electrode assemblies
X of 4	[Placeholder]	Chlorination Metering Pumps	Replace diaphragm, disc and crosshead bellow seal
X of 4	[Placeholder]	Chlorination Metering Pumps	Replace valve sets (seat, ball, retainer/guide and O-ring)
X of 4	[Placeholder]	Chlorination Metering Pumps	Lubricate

X of 4	[Placeholder]	Chlorination Metering Pumps	Replace belt
X of 4	[Placeholder]	Emergency Chlorination Pumps	Replace ball check valves and diaphragm
X of 4	[Placeholder]	Emergency Chlorination Pumps	Replace ball check valves and diaphragm
X of 4	[Placeholder]	pH Adjustment Pump	Replace PTFE diaphragm, disc and crosshead bellow seal
X of 4	[Placeholder]	pH Adjustment Pump	Replace valve sets (seat, ball, retainer/guide and O-ring)
X of 4	[Placeholder]	pH Adjustment Pump	Lubricate
X of 4	[Placeholder]	pH Adjustment Pump	Replace belt
X of 4	[Placeholder]	Valve Board Pressure Relief Valves	Replace diaphragm and adjustment spring if necessary
X of 4	[Placeholder]	Air Scour System	Check air scour pattern
X of 4	[Placeholder]	Filter Vessel	Take core sample, check media depth
X of 4	[Placeholder]	Water Heater	Manually operate the temperature-pressure relief valve
X of 4	[Placeholder]	Water Heater	Drain the water heater and flush sediment from tank
X of 4	[Placeholder]	Siemens MCC	Perform infrared scan
X of 4	[Placeholder]	Siemens MCC	Visually inspect and clean the enclosure prior to opening panels
X of 4	[Placeholder]	Siemens MCC	Bus Bar: visually inspect insulators
X of 4	[Placeholder]	Siemens MCC	Bus Bar: visually inspect wiring
X of 4	[Placeholder]	Siemens MCC	Disconnects: visually inspect and clean
X of 4	[Placeholder]	Siemens MCC	Disconnects: verify proper operation
X of 4	[Placeholder]	Siemens MCC	Contactors: visually inspect and clean
X of 4	[Placeholder]	Siemens MCC	Electrical Interlocks: inspect
X of 4	[Placeholder]	Siemens MCC	Mechanical Interlocks: inspect
X of 4	[Placeholder]	Engine Generators	Change coolant filter
X of 4	[Placeholder]	Engine Generators	Change fuel filters
X of 4	[Placeholder]	Engine Generators	Clean cooling system
X of 4	[Placeholder]	Engine Generators	Test rupture basin leak detect switch
X of 4	[Placeholder]	Engine Generators	Adjust overhead set

DRAFT

X of 4	[Placeholder]	Engine Generators	Check water pump
X of 4	[Placeholder]	Engine Generators	Check turbocharger
X of 4	[Placeholder]	Engine Generators	Check engine mounting bolts
X of 4	[Placeholder]	Engine Generators	Check for air leaks, intake and exhaust systems
X of 4	[Placeholder]	Engine Generators	Check air cleaner assembly
X of 4	[Placeholder]	Engine Generators	Check cooling system hoses
X of 4	[Placeholder]	Engine Generators	Check batteries
X of 4	[Placeholder]	Engine Generators	Check air cleaner restriction
X of 4	[Placeholder]	Engine Generators	Clean engine

Other Frequency Activity

Volume	*Tab, Page*	*Equipment*	*Action*	*Frequency*
X of 4	[Placeholder]	Metering Pumps	Replace gearbox oil (initial)	Once
X of 4	[Placeholder]	Force Flow drum scales	Replenish load cell oil	As Necessary
X of 4	[Placeholder]	Siemens MCC	Bus Bar: check connections for tightness and proper torque	2 years
X of 4	[Placeholder]	Siemens MCC	Bus Bar: electrical test	2 years
X of 4	[Placeholder]	Siemens MCC	Motor Overload Relays: check connections for tightness	2 years
X of 4	[Placeholder]	Siemens MCC	Motor Overload Relays: perform cleaning, calibration and function tests	3 years
X of 4	[Placeholder]	Siemens MCC	Molded Case Circuit Breakers: visual inspection and cleaning	3 years
X of 4	[Placeholder]	Siemens MCC	Molded Case Circuit Breakers: mechanical test	2 years
X of 4	[Placeholder]	Siemens MCC	Molded Case Circuit Breakers: electrical test	3-5 years
X of 4	[Placeholder]	Engine Generators	Clean, flush and refill cooling system	2 years

X of 4	[Placeholder]	Engine Generators	Check vibration damper	2 years
X of 4	[Placeholder]	Engine Generators	Check fan drive idler pully	2 years
X of 4	[Placeholder]	Engine Generators	Check fan hub, belt driven	2 years
X of 4	[Placeholder]	Engine Generators	Check turbocharger	2 years
X of 4	[Placeholder]	Engine Generators	Check air compressor	2 years

DRAFT

Chapter 4

Troubleshooting and Alarms

General

Troubleshooting

The manufacturer or supplier of each piece of equipment installed in this facility has provided a detailed description of the operation, maintenance and troubleshooting for the equipment. Refer to that manual for the specific troubleshooting process.

An index for the manufacturer-provided operations and maintenance information is provided here for ease of reference.

Volume Number	Tab	Equipment Description	Manufacturer
1		Fiberglass Reinforced Plastic Structural Shapes	American Grating
1		Thermal and Moisture Protection	Border and Sons Quality Roofing
1		Motor Actuated Damper	Dorse and Company
1		Radiant Space Heaters	Dorse and Company
1		Automatic Vehicle Access Gate System	Gateway Controls
1		Common Work for Hydraulic Control Valves	HD Fowler
1		Globe Silent Check Valves	HD Fowler
1		Vertical Turbine Pumps	Pump Tech Inc.
1		Non-Submerged Pump Motors - Shop Well	Pump Tech Inc.
1		Non-Submerged Pump Motors - Douglas Well	Pump Tech Inc.
1		Non-Submerged Pump Motors - Water Treatment Plant	Pump Tech Inc.
1		Safety Station w/ Eye/Face Wash	Guardian Equipment
1		Water Heater	Rheem
1		Air Scour System	Roberts Water Technologies Inc.
1		Filter Media	Roberts Water Technologies Inc.
1		Electric Motor Valve Actuators	Roberts Water Technologies Inc.
1		Vault Hatches	Simonis & Associates
1		Chemical Dilution System	TMG Services Inc.
1		Metal Doors and Frames	West Coast Windows
1		Specialty Doors	Milgard Windows and Doors
1		Door Rim Device and Surface Vertical Rod Device	Von Duprin

DRAFT

2		Automatic Controls	L2 Systems LLC
3		Utility Service	Milbank / Seven Sisters
3		Circuit Breaker	SQD - Schneider Electric / Seven Sisters
3		HOA Lighting Switch	Hubbell Wiring Devices / Seven Sisters
3		Lighting	Lithonia Lighting / Seven Sisters
3		Heaters	Q-Mark / Seven Sisters
3		Douglas Well Generator	Pacific Power Generation / Seven Sisters
3		Douglas Well Generator Transfer Switch	Pacific Power Generation / Seven Sisters
3		Shop Well Generator	Pacific Power Generation / Seven Sisters
3		Shop Well Generator Transfer Switch	Pacific Power Generation / Seven Sisters
4		On-Site Electrolytic Chlorination System	Severn Trent / Whitney Equipment
4		Chemical Storage Tank	PolyProcessing / Whitney Equipment
4		Reagentless Chlorine Analyzer	Hach / Whitney Equipment
4		Level Transmitter	Rosemount / Whitney Equipment
4		Water Quality Transfer Pump	Grundfos / Whitney Equipment
4		15.9 - 248.3 gph Chemical Metering Pump	Grundfos / Whitney Equipment
4		0.66 - 12.68 gph Chemical Metering Pump	Grundfos / Whitney Equipment
4		Chlorine Sensor	Grundfos / Whitney Equipment
4		pHD Sensor	Grundfos / Whitney Equipment

Alarms

The control panels for several of the systems have alarms and displays to assist in operating the system. Equipment alarms vital to the operation of the facility are sent to the facility control system for logging and tracking. All system alarms are shown below.

All alarms shall have a delay setpoint in seconds associated to it. If this setpoint is set to zero (0) seconds using the operator interface, then that alarm is disabled. The alarm delay setpoint screen shall include text stating that any alarm set to zero by the operator will disable the alarm. In addition to this statement any alarm delay that is set to zero will flash on the screen to bring attention to the setpoint. Alarms consist of direct alarms typically detected from discrete inputs and virtual alarms that are typically detected by a high or low analog condition or a control sequence failing to engage.

Compute equipment fail to run and fail to stop alarms based on disagreement of control output to run status with transitions time delays.

Compute repeat cycle start/stop control based on interval and duration setpoints. Pump runs x seconds every y minutes where x and y are operator entered setpoint values.

DRAFT

Compute valve fail to open and fail to close alarms based on disagreement of control output to position status with transition time delays.

Douglas/Shop Well Pump Stations and Groundwater Treatment Plant Alarms and Responses List			
Item	**Type**	**Setpoint**	**Notes:**
Well Pump Stations			
Well Level Lt-102/202	Status	NA	
Well Low Level Lt-102/202	Alarm	Set in Field	This alarm will be triggered when the well level has reached a low level setpoint.
Well Low-Low Level Lt-102/202	Alarm, shutdown Well Pump	Set in Field	This alarm will be triggered when the well level has reached a low-low level pump cutoff setpoint.
Well Flow Ft-104/204	Status	NA	
Well High Flow Ft-104/204	Alarm	Set in Field	This alarm will be triggered when the well flow rate has reached a high flow setpoint.
Well High-High Flow Ft-104/204	Alarm, shutdown Well Pump	Set in Field	This alarm will be triggered when the well flow rate has reached a high-high flow setpoint. This is a lockout condition that requires a manual reset on the operator interface.
Well Flow Failure P-101/201	Alarm, Shutdown Well Pump	Set in Field	This alarm will be triggered when the pump is called to run and flow is not being read after a specific delay time. This is a lockout condition that requires a manual reset on the operator interface.
Well Discharge Pressure Pt-108/208	Status	NA	
Well High Discharge Pressure Pt-108/208	Alarm	Set in Field	This alarm will be triggered during pump runs when a high discharge pressure setpoint is reached.
Well High-High Discharge Pressure	Alarm, Shutdown Well Pump	Set in Field	This alarm will be triggered during pump runs when a high-high discharge pressure setpoint is

DRAFT

Pt-108/208			reached. This is a lockout condition that requires a manual reset on the operator interface.
Well Low Discharge Pressure Pt-108/208	Alarm	Set in Field	This alarm will be triggered during pump runs when a low discharge pressure setpoint is reached.
Well Low-Low Discharge Pressure Pt-108/208	Alarm, Shutdown Well Pump	Set in Field	This alarm will be triggered during pump runs when a low-low discharge pressure setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Well Pump Run P-101/201	Status	NA	Indicates that the pump is running either from the VFD or bypass contactor.
Well Pump in Hand P-101/201	Status	NA	Indicates that the pump H-O-A switch is in the hand position.
Well Pump in Auto P-101/201	Status	NA	Indicates that the pump H-O-A switch is in the auto position.
Well VFD Fail P-101/201	Alarm, Shutdown Well Pump	NA	This alarm will be triggered when a VFD failure has occurred. This is a lockout condition that requires a manual reset on the VFD and operator interface.
Well Bypass Contactor Fail P-101/201	Alarm, Shutdown Well Pump	NA	This alarm will be triggered when the bypass contactor overload has tripped. This is a lockout condition that requires a manual reset on the operator interface.
Well Pump Call Failure P-101/201	Alarm, Shutdown Well Pump	NA	This alarm will be triggered when the pump is called to run and pump run verification is not received after a specific time delay. This is a lockout condition that requires a manual reset on the operator interface.
Well High Discharge Pressure Switch Ps-109/209	Alarm, Shutdown Well Pump	NA	This alarm will be triggered when the well discharge high pressure switch is tripped. This is a lockout condition that requires a manual reset on the operator interface.

DRAFT

PCV-103/203 Open Status	Status	NA	
PCV-103/203 Closed Status	Status	NA	
PCV-103/203 Valve Failure	Alarm, Shutdown Well Pump	NA	This alarm is triggered when the valve position is in disagreement with the position the valve should be in. This is a lockout condition that requires a manual reset on the operator interface.
PCV-105/205 Open Status	Status	NA	
PCV-105/205 Closed Status	Status	NA	
PCV-105/205 Valve Failure	Alarm, Shutdown Well Pump	NA	This alarm is triggered when the valve position is in disagreement with the position the valve should be in. This is a lockout condition that requires a manual reset on the operator interface.
Chlorination Metering Pump Failure – P-106/206	Alarm, Shutdown Well Pump	NA	This alarm is triggered when the metering pump fail alarm is triggered and the Well pump is pumping to the distribution system. This is a lockout condition that requires a manual reset on the operator interface.
Well VFD Current P-101/201	Status	NA	
Well VFD Frequency (Hz) P-101/201	Status	NA	
Power Monitor Data	Status	NA	Display status of critical station power data (Current, Voltage, Power, Power Factor, Etc.)
Intrusion Alarm	Alarm	Entry and Exit Timers	This means that someone has accessed the building and has not turned off the alarm in the time allowed.
Operator in Trouble	Alarm	NA	This alarm indicates that an operator is in trouble and help is required.

DRAFT

Control System Status Alarms	Alarm	NA	Control System Integrator shall provide alarms such as communication fail, RTU AC Power Fail, RTU DC Power Fail, RTU UPS Fault, and PLC Fault.
Smoke Alarm	Alarm	NA	Indicates that smoke has been detected.
MCC Phase Fail Alarm	Alarm, Shutdown Well Pump	NA	Indicates that the phase fail relay in the MCC has tripped. This is a lockout condition that requires a manual reset on the operator interface.
ATS Pre-Transfer Signal	Status, Shutdown Well Pump	NA	This is a notification from the ATS that power will be transferred from generator to utility power. The RTU shall perform a controlled shutdown of the well pump prior to transferring power.
ATS in Utility Position	Status	NA	This event notifies the City that the transfer switch is in the normal utility position.
ATS in Emergency Position	Status	NA	This event notifies the City that utility power is not available and the transfer switch is in the emergency position.
EG Run	Status	NA	This event notifies the City that the EG set is running.
EG Fail	Alarm	NA	This alarm notifies the City that the EG set has failed.
EG Trouble	Alarm	NA	This alarm notifies the City that there is a potential problem with the EG set.
EG Low Fuel	Alarm	NA	This alarm notifies the City that the fuel level is low and refilling is required.
Pump Station Flood Switch	Alarm, Shutdown Well Pump	NA	This alarm is triggered when the flood switch is tripped. This is a lockout condition that requires a manual reset on the operator interface.
Groundwater Treatment Plant			
Sodium Hypochlorite	Alarm	NA	This alarm indicates that the sodium hypochlorite generator system has

DRAFT

Generation System Common alarm Cp-300			had a failure. The City will be notified so they can respond and correct.
Sodium Hypochlorite Tank 1 and 2 Low Level Cp-300	Alarm	Set in Field	This alarm will be triggered when the product storage tank level has reached a low level setpoint.
Sodium Hypochlorite Tank 1 and 2 Low-Low Level Cp-300	Alarm, shutdown of metering pumps	1 Ft.	This alarm will be triggered when the product storage tank level has reached a low-low level setpoint and no more chemical is available.
Sodium Hypochlorite Generation System Alarms and Status Cp-300	Status and Alarm	NA	Based on available alarms and status provided by the onsite generation system manufacturer. Coordinate with manufacturer.
Pre Chlorination Metering Pump Failure P-301/302	Alarm, shutdown of metering pumps and Well Pumps	NA	This alarm is triggered when the metering pump fail alarm is triggered. This is a lockout condition that requires a manual reset on the operator interface.
Post Chlorination Metering Pump Failure P-303	Alarm, shutdown of metering pumps	NA	This alarm is triggered when the metering pump fail alarm is triggered. This is a lockout condition that requires a manual reset on the operator interface.
Distribution Flow Ft-601	Status	NA	
Distribution Water Quality Analyzer No Flow Fs-603	Alarm	NA	This alarm is triggered when the distribution analyzer flow switch is tripped.
Distribution Free Chlorine Residual CL2-602	Status	NA	

DRAFT

Distribution High Free Chlorine Residual CL2-602	Alarm	Set in Field	This alarm will be triggered when the high chlorine residual setpoint is reached.
Distribution High-High Free Chlorine Residual CL2-602	Alarm, Shutdown of High Service Pump(s)	2.00 ppm	This alarm will be triggered when the high-high chlorine residual setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Distribution Low Free Chlorine Residual CL2-602	Alarm	Set in Field	This alarm will be triggered when the low chlorine residual setpoint is reached.
Distribution Low-Low Free Chlorine Residual CL2-602	Alarm, Shutdown of High Service Pump(s)	0.50 ppm	This alarm will be triggered when the low-low chlorine residual setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Distribution pH pH-604	Status	NA	
Distribution High pH pH-604	Alarm	Set in Field	This alarm will be triggered when the high pH setpoint is reached.
Distribution High-High pH pH-604	Alarm, Shutdown of pH adjustment process	8.5	This alarm will be triggered when the high-high pH setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Outlet Water Quality Analyzer No Flow Fs-702	Alarm	NA	This alarm is triggered when the distribution analyzer flow switch is tripped.
Filter Outlet Free Chlorine Residual CL2-703	Status	NA	
Filter Outlet High Free Chlorine	Alarm	Set in Field	This alarm will be triggered when the high chlorine residual setpoint is reached.

DRAFT

Residual CL2-703			
Filter Outlet High-High Free Chlorine Residual CL2-703	Alarm, Shutdown of Well Pump	Set in Field	This alarm will be triggered when the high-high chlorine residual setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Outlet Low Free Chlorine Residual CL2-703	Alarm	Set in Field	This alarm will be triggered when the low chlorine residual setpoint is reached.
Filter Outlet Low-Low Free Chlorine Residual CL2-703	Alarm, Shutdown of Well Pump	Set in Field	This alarm will be triggered when the low-low chlorine residual setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Outlet pH-704	Status	NA	
Filter Outlet High pH pH-704	Alarm	Set in Field	This alarm will be triggered when the high pH setpoint is reached.
Filter Outlet High-High pH pH-704	Alarm, Shutdown of pH adjustment process	8.5	This alarm will be triggered when the high-high pH setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Inlet Water Quality Analyzer No Flow Fs-001	Alarm	NA	This alarm is triggered when the distribution analyzer flow switch is tripped.
Filter Inlet Free Chlorine Residual CL2-002	Status	NA	
Filter Inlet High Free Chlorine Residual CL2-002	Alarm	Set in Field	This alarm will be triggered when the high chlorine residual setpoint is reached.
Filter Inlet High-High Free	Alarm, Shutdown of	Set in Field	This alarm will be triggered when the high-high chlorine residual

DRAFT

Chlorine Residual CL2-002	Well Pump		setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Inlet Low Free Chlorine Residual CL2-002	Alarm	Set in Field	This alarm will be triggered when the low chlorine residual setpoint is reached.
Filter Inlet Low-Low Free Chlorine Residual CL2-002	Alarm, Shutdown of Well Pump	Set in Field	This alarm will be triggered when the low-low chlorine residual setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Inlet pH-003	Status	NA	
Filter Inlet High pH pH-003	Alarm	Set in Field	This alarm will be triggered when the high pH setpoint is reached.
Filter Inlet High-High pH pH-003	Alarm, Shutdown of pH adjustment process	Set in Field	This alarm will be triggered when the high-high pH setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Inlet Pressure Pt-004	Status	NA	
Filter Inlet High Pressure Pt-004	Alarm	Set in Field	This alarm will be triggered during pump runs when a high inlet pressure setpoint is reached.
Filter Inlet High-High Pressure Pt-004	Alarm, Shutdown of Well Pump	Set in Field	This alarm will be triggered during pump runs when a high-high inlet pressure setpoint is reached. This is a lockout condition that requires a manual reset on the operator interface.
Filter Inlet Low Pressure Pt-004	Alarm	Set in Field	This alarm will be triggered during pump runs when a low inlet pressure setpoint is reached.
Filter Inlet Low-Low Pressure Pt-004	Alarm, Shutdown of Well Pump	Set in Field	This alarm will be triggered during pump runs when a low-low inlet pressure setpoint is reached. This is a lockout condition that requires a manual reset on the operator

DRAFT

			interface.
BPSV-005 Valve Open Status	Status	NA	
BPSV-005 Valve Closed Status	Status	NA	
BPSV-005 Valve Fail	Alarm, Shutdown of Well Pump	NA	This alarm is triggered when the valve position is in disagreement with the position the valve should be in. This is a lockout condition that requires a manual reset on the operator interface.
Air Scour Blower High Discharge Pressure Ps-502	Alarm, Shutdown of Blower	NA	This alarm will be triggered after the blower discharge high pressure switch is tripped during blower runs. This is a lockout condition that requires a manual reset on the operator interface.
Dilution System Slow Neat Chemical Transfer Alarm Cp-400	Alarm	NA	This alarm will notify the City that the dilution system is in an alarm condition and shall notify the City of the specific alarm.
Dilution System Slow Water Transfer Alarm Cp-400	Alarm	NA	This alarm will notify the City that the dilution system is in an alarm condition and shall notify the City of the specific alarm.
Dilution System Slow Dilute Chemical Feed Cp-400	Alarm	NA	This alarm will notify the City that the dilution system is in an alarm condition and shall notify the City of the specific alarm.
Dilution System Max. Daily Chemical Usage Cp-400	Alarm	NA	This alarm will notify the City that the dilution system is in an alarm condition and shall notify the City of the specific alarm.
Dilution System High Dilution Tank Level Cp-400	Alarm	NA	This alarm will notify the City that the dilution system is in an alarm condition and shall notify the City of the specific alarm.

DRAFT

Dilution System Batch Strength Not Available Cp-400	Alarm	NA	This alarm will notify the City that the dilution system is in an alarm condition and shall notify the City of the specific alarm.
Dilution System Dilute Chemical Available Cp-400	Status	NA	
Dilution System Neat Chemical Available Cp-400	Status	NA	
Dilution System Active/ Inactive Cp-400	Status	NA	
pH Adjustment Tank Overflow Ls-405	Alarm	NA	This alarm indicates that he pH adjustment tank has overflowed.
pH Adjustment Tank Level Lt-406	Status	NA	
pH Adjustment Tank Low Level Lt-406	Alarm	Set in Field	This alarm will be triggered when the product storage tank level has reached a low level setpoint.
pH Adjustment Tank Low-Low Level Lt-406	Alarm, Shutdown metering pumps	Set in Field	This alarm will be triggered when the product storage tank level has reached a low level setpoint and no more chemical is available.
pH Adjustment Metering Pump Failure P-401/402	Alarm, shutdown of metering pumps	NA	This alarm is triggered when the metering pump fail alarm is triggered. This is a lockout condition that requires a manual reset on the operator interface.
Lab Expansion Smoke Alarm	Alarm	NA	Indicates that smoke has been detected
Air Scour Valve Open Status A-006 to A-013	Status	NA	

DRAFT

Air Scour Valve Closed Status A-006 to A-013	Status	NA	
Air Scour Valve Fail Alarm A-006 to A-013	Alarm	NA	This alarm is triggered when the valve position is in disagreement with the position the valve should be in. This is a lockout condition that requires a manual reset on the operator interface.
Filter Cell Level Lt-006 to Lt-013	Status	NA	
Filter Cell Low Level Lt-006 to Lt-013	Alarm	Set in Field	This alarm is triggered when the filter cell level reaches a low level setpoint.
Filter Cell High Level Lt-006 to Lt-013	Alarm	Set in Field	This alarm is triggered when the filter cell level reaches a high level setpoint.
Filter Cell High-High Level Lt-006 to Lt-013	Alarm, Shutdown Well Pumps	Set in Field	This alarm is triggered when the filter cell level reaches a high-high level setpoint. This is a lockout condition that requires a manual reset on the operator interface.
Backwash Pump Run P-701	Status	NA	Indicates that the pump is running either from the VFD or bypass contactor.
Backwash Pump in Hand P-701	Status	NA	Indicates that the pump H-O-A switch is in the hand position.
Backwash Pump in Auto P-701	Status	NA	Indicates that the pump H-O-A switch is in the auto position.
Backwash Pump VFD Fail P-701	Alarm, Shutdown Pump	NA	This alarm will be triggered when a VFD failure has occurred. This is a lockout condition that requires a manual reset on the VFD and operator interface.
Backwash Pump Bypass Contactor Fail P-701	Alarm, Shutdown Pump	NA	This alarm will be triggered when the bypass contactor overload has tripped. This is a lockout condition that requires a manual reset on the operator interface.

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Backwash Pump Call Failure P-701	Alarm, Shutdown Pump	NA	This alarm will be triggered when the pump is called to run and pump run verification is not received after a specific time delay. This is a lockout condition that requires a manual reset on the operator interface.
Backwash Pump Flow Failure P-701	Alarm, Shutdown Pump	Set in Field	This alarm will be triggered when the pump is called to run and flow is not being read after a specific delay time. This is a lockout condition that requires a manual reset on the operator interface.
Transfer Pump Run P-705	Status	NA	Indicates that the pump is running.
Transfer Pump in Hand P-705	Status	NA	Indicates that the pump H-O-A switch is in the hand position.
Transfer Pump in Auto P-705	Status	NA	Indicates that the pump H-O-A switch is in the auto position.
Transfer Pump Fail P-705	Alarm, Shutdown Pump	NA	This alarm will be triggered when the contactor overload has tripped. This is a lockout condition that requires a manual reset on the operator interface.
Transfer Pump Call Failure P-705	Alarm, Shutdown Pump	NA	This alarm will be triggered when the pump is called to run and pump run verification is not received after a specific time delay. This is a lockout condition that requires a manual reset on the operator interface.
Air Scour Blower Run B-501	Status	NA	Indicates that the blower is running.
Air Scour Blower in Hand B-501	Status	NA	Indicates that the blower H-O-A switch is in the hand position.
Air Scour Blower in Auto B-501	Status	NA	Indicates that the blower H-O-A switch is in the auto position.

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Air Scour Blower Fail B-501	Alarm, Shutdown Blower	NA	This alarm will be triggered when the contactor overload has tripped. This is a lockout condition that requires a manual reset on the operator interface.
Air Scour Blower Call Failure B-501	Alarm, Shutdown Blower	NA	This alarm will be triggered when the blower is called to run and blower run verification is not received after a specific time delay. This is a lockout condition that requires a manual reset on the operator interface.
Control System Status Alarms	Alarm	NA	Control System Integrator shall provide alarms such as communication fail, RTU AC Power Fail, RTU DC Power Fail, RTU UPS Fault, and PLC Fault.
MCC Phase Fail Alarm	Alarm, Shutdown Equipment Associated with MCC	NA	Indicates that the phase fail relay in the MCC has tripped. This is a lockout condition that requires a manual reset on the operator interface.
Raw Water Tank Flood Alarm	Alarm	1 Ft.	The existing raw water level transmitter will be re-used to indicate a flood alarm in this tank. The alarm will be triggered if the water level reaches the operator flood alarm setpoint.

Select alarms indicating problems that may result in water quality issues are listed below and the response procedures can be found in **Appendix D**.

Alarm	Alarm Condition	Response Procedure
Pre-Chlorine Fault	Problem with the pre-chlorination feed system	Pre-Chlorine Fault Alarm Procedure
Post-Chlorine Fault	Problem with the post-chlorination feed system	Post-Chlorine Fault Alarm Procedure
pH Adjustment System Fault	Problem with the pH adjustment feed system	pH Adjustment Feed Fault Alarm Procedure
Filter Inlet Cl2 Residual Low	Cl2 residual is below safe limits – shuts metering pumps down	Cl2 Low Alarm Procedure
Filter Inlet Cl2 Residual High	Cl2 residual is above safe limits – shuts metering pumps down	Cl2 High Alarm Procedure

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Alarm	Alarm Condition	Response Procedure
Filter Outlet Cl2 Residual Low	Cl2 residual is below safe limits – shuts metering pumps down	Cl2 Low Alarm Procedure
Filter Outlet Cl2 Residual High	Cl2 residual is above safe limits – shuts metering pumps down	Cl2 High Alarm Procedure
Distribution Cl2 Residual Low	Cl2 residual is below safe limits – shuts metering pumps down	Cl2 Low Alarm Procedure
Distribution Cl2 Residual High	Cl2 residual is above safe limits – shuts metering pumps down	Cl2 High Alarm Procedure
Chlorine Low Level	Product tanks are empty	Chlorine Low Level Procedure
Caustic Low Level	Day tank is empty	Caustic Low Level Procedure

RTU calculated alarms are alarms that have been determined by the PLC based on local or remote setpoints. The calculated alarms are as follows:

- Communications Failure.
- Pump Failure based on calling pump and not receiving a pump call after a specific delay time. This is a lockout condition that will require a manual reset on the operator interface.
- Flow Failure based on running pumps but no flow detected. This is a lockout condition for the pumps that will require a manual reset on the operator interface.
- Analog Instrumentation Failure.
- High Discharge Pressure during pump runs. This is a lockout condition for pumps that will require a manual reset on the operator interface.
- Low Discharge Pressure during pump runs. This is a lockout condition for all pumps that will require a manual reset on the operator interface.
- Abnormal Setpoint Failure.

Pictures of the control panel alarm screens are shown below for reference in case any of the delays get reset.

Contact List

The following personnel/companies were involved in the design and construction of this facility.

DRAFT

	Company	Contact Name	Address	Phone
General Contractor	RAZZ Construction, Inc.	Dave Rasmussen	4055 Hammer Drive Bellingham, WA 98226	(360) 752-0011 (360) 319-5739
Major Equipment Supplier	Whitney Equipment Company	Scott Vande Vusse	21222 30th Drive SE, Suite 110 Bothell, WA 98021	(425) 486-9499 (206) 947-6397
Major Equipment Supplier	The Roberts Filter Group			
Major Equipment Supplier	L2	Glen Lee		
Major Equipment Supplier	Seven Sisters	Bob Stewart		
Major Equipment Supplier	GC Systems	Gary Fletcher		
Major Equipment Supplier	PumpTech	Doug Davidson		
Engineer	RH2 Engineering, Inc.	Dan Burwell, P.E.	454 W. Horton Road Bellingham, WA 98226	(425) 951-5342
Engineer	RH2 Engineering, Inc.	Dan Mahlum, P.E.	22722 29th Drive SE Suite 210 Bothell, WA 98021	(425) 951-5340
Engineer	RH2 Engineering, Inc.	Barney Santiago, P.E.	22722 29th Drive SE Suite 210 Bothell, WA 98021	(425) 951-5456
Engineer	RH2 Engineering, Inc.	Chris Roberts, P.E.	22722 29th Drive SE Suite 210 Bothell, WA 98021	(425) 951-5358

Setpoints

The following are screenshots of the original setpoints for the control of the facility for reference.

[Placeholder for Control Panel Photos with setpoints identified]

DRAFT

K. INTERTIES

WATER CONNECTION AGREEMENT

THIS AGREEMENT is entered into this 7th day of July, 1980, by and between the CITY OF FERNDALE, a Washington municipal corporation, hereinafter referred to as "City", and the BAKERVIEW WATER ASSOCIATION, a Washington non profit corporation, hereinafter referred to as "Association".

IN CONSIDERATION of the mutual benefits derived from this agreement, the parties hereto agree as follows:

1. Water Connection: The Association hereby agrees that the City may connect its main water distribution lines to the Association's main water distribution lines in order to provide the Association with an alternate source or supply of water for emergency purposes. At time of connection, the City agrees to provide adequate pressure reducing valves (if required), a main line meter, and a main line valve at its cost and expense.

2. Water Supply: The City agrees to supply water to the Association during emergency situations and only when the Association shall approve and request the same through its designated officer or agent. The City further agrees upon approval and request by the Association to supply all of the Association's water on a permanent basis; provided, that a permanent supply of water to the Association shall be subject to established rules and regulations of the City and any amendments or modifications thereof as may be adopted by the City, regulating and controlling the use and distribution of the water supply by the water department of the City.

3. Water Rates: It is mutually agreed that the Association will pay the City for any water supplied by the City to the Association in accordance with this Agreement that rate established by Ordinance 537 of the City or any amendments thereto; provided, that if the supply is for emergency purposes only and for a period of less than one calendar month, the minimum rate established in Schedule A of said ordinance shall be pro-rated on a per diem basis for the number of days that water is supplied to the Association. It is further mutually agreed, that in the event the Association shall approve and request a permanent supply of water from the City, the City and the Association shall negotiate a rate to be charged in accordance with the then-prevailing water rate ordinance.

THIS AGREEMENT is dated this 7th day of July, 1955.

BAKERVIEW WATER ASSOC.

By _____
Its President

By _____
Its Secretary

THE CITY OF FERNDALE

By _____
Cecil Barr Mayor

ATTEST:

_____
Roland Signett
Clerk - Treasurer

WATER CONNECTION AGREEMENT

THIS AGREEMENT is entered into this 7th day of July, 1980, by and between the CITY OF FERNDALE, a Washington municipal corporation, hereinafter referred to as "City", and the MOUNTAINVIEW WATER ASSOCIATION, a Washington non profit corporation, hereinafter referred to as "Association".

IN CONSIDERATION of the mutual benefits derived from this agreement, the parties hereto agree as follows:

1. Water Connection: The Association hereby agrees that the City (may) will connect its main water distribution lines to the Association's main water distribution lines with interties being made in order to provide the Association with an alternate source or supply of water for emergency purposes. At time of connection, the City agrees to provide adequate pressure reducing valves (if required), a main line meter, and a main line valve at its cost and expense. delete — No cost or expense to the Association

2. Water Supply: The City agrees to supply water to the Association during emergency situations and only when the Association shall approve and request the same through its designated officer or agent. The City further agrees upon approval and request by the Association to supply all of the Association's water on a permanent basis; provided, that a permanent supply of water to the Association shall be subject to established rules and regulations of the City and any amendments or modifications thereof as may be adopted by the City, regulating and controlling the use and distribution of the water supply by the water department of the City.

1.

Also - be it understood that the Assn. will not be required To purchase water from the city of Ferndale and that any useage will be strictly at the request of the Assn.

3. Water Rates: It is mutually agreed that the Association will pay the City for any water supplied by the City to the Association in accordance with this Agreement that rate established by Ordinance 537 of the City or any amendments thereto; provided, that if the supply is for emergency purposes only and for a period of less than one calendar month, the minimum rate established in Schedule A of said ordinance shall be pro-rated on a per diem basis for the number of days that water is supplied to the Association. It is further mutually agreed, that in the event the Association shall approve and request a permanent supply of water from the City, the City and the Association shall negotiate a rate to be charged in accordance with the then-prevailing water rate ordinance.

THIS AGREEMENT is dated this 7th day of July, 1978.

MOUNTAINVIEW WATER ASSOC.

By _____
Its President

By _____
Its Secretary

THE CITY OF FERNDALE

By _____
Cecil Barr Mayor

ATTEST:

_____
Roland Signett
Clerk - Treasurer

WATER CONNECTION AGREEMENT

THIS AGREEMENT is entered into this 3rd day of DECEMBER, 1986, by and between the CITY OF FERNDALE, a Washington municipal corporation, hereinafter referred to as "City", and the NORTH STAR WATER ASSOCIATION, a Washington nonprofit corporation, hereinafter referred to as "Association".

IN CONSIDERATION of the mutual benefits derived from this agreement, the parties hereto agree as follows:

1. Water Connection. The City and the Association hereby agree that the Association may at its own expense connect its main water distribution line to a City main water distribution line at an agreed convenient location in order to provide the Association with an alternate source or supply of water for occasional and temporary use during emergencies when the Association could not otherwise provide water to its customers due to equipment or well failures.

2. Water Meter and Equipment. The Association agrees to install, maintain, repair and replace at its expense a water meter, back flow prevention device and other equipment required by the City to effectuate and continue the agreed connection in a manner that will allow the City to conveniently read the meter and that will allow the alternate source or supply of water to be provided without causing any damage to water lines or facilities of the City, the Association or their respective customers.

3. Water Supply. The City agrees to supply water to the Association only during emergency situations when the Association shall request the same through its designated agent and only for the period of time necessary to promptly restore the Association's normal service to its customers. The name(s) of the Association's designated agent(s) for this purpose shall be provided to the City in writing.

4. Water Rates. It is mutually agreed that the Association will pay the City promptly upon billing for any water supplied by the City to the Association in accordance with this agreement at the industrial rate for similar service to others specified in City Ordinance 756 or in any amendments thereto, including without limitation the twenty-five percent (25%) surcharge set forth in said ordinance for service outside the City limits.

5. Liability. The City warrants that the water in its main water [illegible] lines is and will be safe for human consumption, but otherwise [illegible] actual or other liability to the Association or its customers [illegible]ion of this alternate source or supply of water. The [illegible]release, indemnify and hold the City harmless from any damage [illegible]erson in any manner arising out of this water connection [illegible]or a failure of the City to maintain safe water [illegible] main [illegible] line.

[illegible] Agreement. This agreement shall [illegible] exceeds eighty (80) connections or [illegible] gallons per month, at which point [illegible] act its transmission lines to City [illegible] the City [illegible] condition of continue[illegible] otherwise be terminate[illegible]

either party without the necessity of cause or any particular stated reason by giving the other party at least eighteen (18) months advance written notice of termination by certified or registered mail. This agreement may also be terminated for cause in event of a breach of this agreement by giving the breaching party at least thirty (30) days advance written notice of termination and the reason therefor by certified or registered mail. In event of termination of this agreement, the Association's line shall be immediately disconnected from the City's line at the Association's expense.

THIS AGREEMENT is dated this 3rd day of DECEMBER, 1986.

NORTH STAR WATER ASSOCIATION

BY David E. Bowser
DAVID E. BOWSER President

BY Robert L. Davis
ROBERT L. DAVIS Secretary

CITY OF FERNDALE

BY Ronald S. Peterson
Ronald S. Peterson, City Manager

ATTEST:

Roland D. Signett
Clerk/Treasurer

WATER CONNECTION AGREEMENT

BETWEEN THE CITY OF FERNDALE

AND

NORTHWEST WATER ASSOCIATION, INC.

Fifth Draft a

THIS AGREEMENT is entered into this 29th day of October, 2004, by and between THE CITY OF FERNDALE, a Washington municipal corporation, hereinafter referred to as the "City," and the NORTHWEST WATER ASSOCIATION, INC. a Washington non-profit corporation, hereinafter referred to as the "Association."

IN CONSIDERATION of the mutual benefits derived from this agreement the parties hereto agree as follows:

RECITAL:

The City has heretofore executed the "Ferndale Letter of Intent", dated May 8, 2003, a copy of which is attached hereto and made a part hereof and marked Exhibit "A". The parties hereto desire to amend and supersede the "Ferndale Letter of Intent" to comply with the intent of said letter. Let it be noted herein that the City and the Association hereby agree that the Association has completed the "... preliminary portion of the connection ..." as specified in Exhibit "A", sections 1.4 and 2.1, and that this connection, hereinafter referred to as the "Point of Interconnection", now belongs to the City. The Association has agreed to construct an extension to the City's water main in accordance with Federal, Washington State, and Whatcom County standards and specifications approximately 1,100 feet south along the Graveline Road from the Point of Interconnection located in the County Right Of Way. Said extension is hereinafter referred to as the "Supplemental Water Transmission Line" or "SWTL". It is mutually agreed that the Association will install, maintain, own, and repair if necessary, all equipment and appurtenances attached to the SWTL. The SWTL serves two purposes: 1) transmit water, purchased by the Association from the City on a wholesale (bulk) basis, from the City's Smith Road main to the Association's main storage tank, and 2) provide Whatcom County RR1 zone fire flow. The SWTL will not provide service.

1. Water Meter and Locking Maintenance Bypass. The Association agrees to install a Four (4) inch INVENSYS Turbo Meter model W-1000 DRS with the TouchRead® System, hereinafter referred to as the "Master Meter", with a maximum capacity sufficient to simultaneously provide fire flow (as described in Fire Flow below) along the SWTL, and deliver enough potable water to meet the needs of the Association. (See "on-demand" Limits and Water Volume below.) The manufacturer's Description and Specifications for the Master Meter are attached hereto and made a part hereof and marked Exhibit "B1". The Association agrees to install and equip the Master Meter with a locking maintenance bypass, hereinafter referred to as the "Locking Maintenance Bypass", in accordance with the INVENSYS standard installation package as partially (without reference to a locking mechanism) represented in the manufacturer's INSTALLATION RECOMMENDATIONS, which are attached hereto and made a part hereof and marked Exhibit "B2". It is mutually agreed that the City and the Association shall have mutual, equal, and not necessarily simultaneous access to the vault containing the Master Meter and Locking Maintenance Bypass to facilitate the ease with which the City or the Association may read the Master Meter at will. It is mutually agreed that the City shall retain the sole ability to lock and unlock the Locking Maintenance Bypass. It is mutually agreed that the City shall respond in a timely manner to any request made by the Association of the City to unlock or lock the Locking Maintenance Bypass for purposes related to maintenance or emergency.

2. Cross-Connection Control. It is mutually agreed that the SWTL will be equipped with an approved double check valve back flow prevention device and a sufficient air gap above the Association's main storage tank in accordance with Federal, Washington State, and Whatcom County standards and specifications.

3. Water Quality. The City will furnish to the Association, at the Point of Interconnection, potable water that meets the water quality standards of the Safe Drinking Water Act and the Washington State Department Of Health, including future amendments thereto, and all other federal, state and county water quality requirements mandated for municipal water systems in the State of Washington.

4. Water Supply. The City agrees to supply water to the Association on a semi-continual "on-demand" basis in the same manner as it supplies water to its municipal customers in compliance with State and Federal laws and subject to the special terms and conditions of this Agreement.

5. "on-demand" Limits. It is mutually agreed that the Association will not draw more than Three Million (3,000,000) gallons of water through the SWTL in any Thirty (30) day period, Two Hundred and Ten (210) gallons per minute during normal operations, and One Thousand (1,000) gallons per minute during Fire Flow conditions on the SWTL.

6. Water Rates. It is mutually agreed that the Association will pay the City promptly for any water supplied by the City to the Association in accordance with this Agreement at the initial rate of $2.79 per One Hundred (100) cubic feet, said rate shall be hereinafter referred to as the "Current Rate". The Current Rate is One Hundred Forty Five point One (145.1) percent of the City's residential customers inside the City's city limits rate. The Current Rate shall vary by the same percentage as the rate paid by the City's residential customers inside the City's city limits. The City shall notify the Association at least One (1) Month prior to any resulting change in the Current Rate. (See Billing Procedure below.)

7. Water Volume. It is mutually agreed that the Association will pay the City for the greater of: One Million (1,000,000) gallons of water annually or Twelve and One Half (12.5) percent of the Association's total annual water use. In turn, the City will make available to the Association a maximum of Twenty Five Million (25,000,000) gallons of water annually.

8. Water Rights. The City and the Association acknowledge and agree that: (a) the Association's Water Utility Service Area is located within the WHOLESALE SERVICE AREA of PUBLIC UTILITY DISTRICT NO. 1 OF WHATCOM COUNTY (PUD), (b) the PUD supplies water to the City, and (c) the City subsequently treats and distributes said water to the Point of Interconnection. Facts (a), (b) and (c), in conjunction with Washington State House Bill 1338, grant the Association the right to purchase water from the City and to distribute and sell said water within the Association's Water Utility Service Area. Documentation of the WHOLESALE SERVICE AREA of PUBLIC UTILITY DISTRICT NO. 1 OF WHATCOM COUNTY is attached hereto and made a part hereof and marked Exhibit "C". Additional water right details are documented in the Association's Small Water System Management Program – Element 11 – Water Right Documentation. No action is required on the City's part with regard to Water Rights that affect this agreement.

9. Association Service Connections. The City and the Association acknowledge and agree that: The Association shall not exceed Two Hundred and Sixty (260) Equivalent Residential Units (ERUs). The Association shall pay the City a fee, hereinafter referred to as the "Per New Connection Fee", of Six Hundred dollars ($600) for each new Share, or new service, or new ERU, the Association connects to its distribution system with the following exception; the outstanding unconnected Association Shares numbered: 137, 148, 164, 167, 191, 206, 213, 222, 224, 225, and no# - Option To Buy – Martha Benedict. Additional documentation pertaining to said unconnected Association Shares is attached hereto and made a part hereof and marked Exhibit "D1". All of the Association Shares connected to the Association's distribution system prior to the execution of this Agreement are exempt from this Per New Connection Fee. The Association shall keep a record of each Per New Connection Fee collected. The Association shall provide the City with a copy of said record attached to payment to the City for each Per New Connection Fee, and do so within Thirty (30) days of the physical connection to the Association's system of a new Share, or new service, or new ERU that is subject to the Per New Connection Fee. The City shall have the right to inspect annually the Association's new connection records. Let it be noted herein that the City and the Association hereby agree that the purpose of the Per New Connection Fee is to accommodate to the satisfaction of the City the

Amendment #1 AMENDMENT TO INTERLOCAL AGREEMENT FOR FERNDALE'S REIMBERSEMENT TO PUD NO. 1 FOR COSTS ON SMITH ROAD EXTENSION PROJECT, a copy of which is attached hereto and made a part hereof and marked Exhibit "D3". Pursuant to the intent of Exhibit "D3", providing for the designation by the City of parcels benefiting from the SMITH ROAD EXTENSION PROJECT, the City and the Association herein acknowledge and agree to extend and enlarge the applicability of the PUBLIC UTILITY DISTRICT NO. 1 OF WHATCOM COUNTY SMITH ROAD WATER MAIN EXTENSION TRASMISSION MAIN SERVICE ZONE (herein marked "Exhibit A" within Exhibit "D3") to include all parcels within the Association's (future) Water Utility Service Area. Said extension and enlargement of "Exhibit A" within Exhibit "D3" is hereinafter referred to as the "Service Zone Amendment". The sole purpose of the Service Zone Amendment is to extend and enlarge the physical area subject to the Per New Connection Fee to include the Association's entire (future) Water Utility Service Area. A map denoting the physical boundaries of the Association's (future) Water Utility Service Area is attached hereto and made a part hereof and marked Exhibit "D4". The Nilsen Water Association, although surrounded by the Association's (future) Water Utility Service Area, is not a part thereof and therefore is not a Party subject to the terms and conditions of this Agreement.

10. Other Fees. The City and the Association acknowledge and agree that there are no other fees of any kind associated with this Agreement other than those stipulated herein.

11. Association System. The Association shall be responsible for complying with all State Department of Health testing requirements and for the repair and maintenance of all lines and equipment which are installed or located on the Association's side of the Point of Interconnection, including the Master Meter and Locking Maintenance Bypass.

12. Fire Flow. The City and the Association acknowledge and agree that the Association's existing system is not capable of, and not required to, provide fire flow in the Association's R5A zoned Water Utility Service Area. The City and the Association acknowledge that the SWTL, located in the Association's (future) RR1 zoned Water Utility Service Area, will provide Whatcom County RR1 zone fire flow at the rate of Five Hundred (500) Gallons Per Minute and be equipped with Three (3) fire hydrants equally spaced at Six Hundred (600) foot intervals, beginning at the Point of Interconnection and continuing south.

13. Liability. The City and the Association acknowledge and agree to release, defend, indemnify, and hold harmless the other Party, its officers, employees, agents and representatives from all claims, actions, suits, losses, harm, liabilities, damages, costs and expenses, including but not limited to, reasonable attorney's fees, arising out of the negligent acts or omissions by the releasing and indemnifying Party's respective Commissioners, officers, employees, agents and representatives in connection with the performance of this Agreement by the releasing and indemnifying Party. Where negligence by both Parties is concurrent and contributes to a Claim, the Parties shall be responsible and liable in proportion to the degree of their own negligence. Nothing in this Agreement shall be construed to preclude either Party from pursuing any remedy against a third party.

14. Failure to Deliver. The City will, at all times, operate and maintain its system in an efficient manner and will take such action as may be necessary to furnish the Association with quantities of water required by the Association's demands. Temporary or partial failure to deliver water shall be remedied with all possible dispatch. In the event of an extended shortage of water, or the supply of water available to the City is otherwise diminished over an extended period of time, the supply of water to the Association shall be reduced or diminished in the same ratio or proportion as the supply to the City's consumers inside the City's city limits is reduced or diminished.

15. Modification of Contract. The provisions of this Agreement pertaining to the schedule of rates to be paid by the Association for water delivered are subject to modification from time to time as the inside City limits water rate is changed. Other provisions of this Agreement may be modified or altered by mutual agreement of the parties.

16. Duration of Contract. The City and the Association acknowledge and agree that the City shall provide wholesale supplemental water to the Association under the terms and provisions of this agreement in perpetuity; duly noted herein pursuant to WAC 246-290-132(3)(a)(x).

17. Successor to the Association. In the event of any occurrence rendering the Association incapable of performing under this Agreement, any successor of the Association, whether the result of legal process, assignment

or otherwise, shall succeed to the rights of the Association hereunder.

18. Billing Procedure. The City shall read the Master Meter and bill the Association on the last day of every even numbered month for the amount of water furnished to the Association during the preceding month. The Association shall read the Master Meter at the end of every odd numbered month and furnish the City with an itemized statement of the amount of water furnished to the Association during the preceding month. The Association shall pay the City each month, on a Moving Average Payment basis. The Association shall commence paying said Moving Average Payments to the City by Association check immediately following the second Tuesday of the month following the month in which Commencement of Use occurs.

19. Miscellaneous. The construction of the SWTL and associated improvements by the Association are being financed by a loan made by the State Of Washington Drinking Water State Revolving Fund Loan Program submittal #2003-038, and the provisions hereof pertaining to the undertakings of the Association are conditioned upon the approval, in writing, of that loan.

20. Commencement of Use. The City and the Association acknowledge and agree that the Association shall commence drawing water from the City's main at the Point of Interconnection immediately after the City's water main and the Association's SWTL are connected at the Point of Interconnection and the Association's associated improvements are capable of receiving water from the City.

IN WITNESS WHEREOF the parties have executed this Agreement the day and year first above written.

NORTHWEST WATER ASSOCIATION, INC.

BY _____
Fred Neil President

Attest: _____
Thomas Merlina Secretary

THE CITY OF FERNDALE

BY _____
Jerry Landcastle Mayor

Attest: _____
Linda Knutson Clerk

Exhibit A

CITY HALL
2095 Main Street
P.O. Box 936 - Ferndale, WA 98248

Ferndale Letter of Intent

May 8, 2003
To whom it may concern:

This letter demonstrates the City of Ferndale's (COF) intention to sell water to the Northwest Water Association (NWWA) and outlines the general conditions under which a contract will be drawn up by the COF. The contract will describe in detail the terms and conditions that the COF and the NWWA will abide by. The COF understands that this letter of intent is an integral part of the NWWA's State Revolving Fund (SRF) loan application process and that some of its contents are crucial to the satisfaction of certain conditions of their SRF loan application. This letter will remain in effect for a period of two years following the date of signature to provide sufficient time for the NWWA to obtain funds through the SRF program.

The City of Ferndale will:

1.1) ... sell water to the NWWA at a flat rate as yet to be negotiated. This rate will vary by the same percentage as a typical Ferndale residence.

1.2) ... place no special priority on the availability of water to the NWWA. However, in the event of loss of supply from the PUD or some catastrophic event affecting the COF's water supply; the COF will notify the NWWA as quickly as possible of that event.

1.3) ... will read the meter (installed as per 2.1 and bill the NWWA bi-monthly for the water use indicated by that meter.

1.4) ... will grant the NWWA permission to make the preliminary portion of the connection to our water main by installing approximately 20' of D.I pipe at the intersection of Smith Road and Graveline Road as early as June 2003. Said line shall be installed to COF standards and inspected. The COF understands that doing so saves the NWWA a considerable sum of money due to the timing of Whatcom County construction at that intersection.

The Northwest Water Association will

2.1) ... assume all financial responsibility for making the connection to the COF's water main at the intersection of Smith Road and Graveline Road. This will include placing a meter with maintenance bypass and appropriate box to contain them at that intersection which shall be inspected and approved by the COF. It is understood that the meter and maintenance bypass are not considered part of the preliminary portion of the connection and will be installed when the SRF funds are available and the bulk of the project begins.

2.2) ... be responsible for maintaining and keeping in good working order the connecting line from the meter south along Graveline Road.

2.3) ... implement conservation and generally cooperate with the COF in any way possible to accommodate an event such as that described in 1.2.

2.4) ... modify its Bylaws to protect the integrity of its ability to meet its financial obligations.

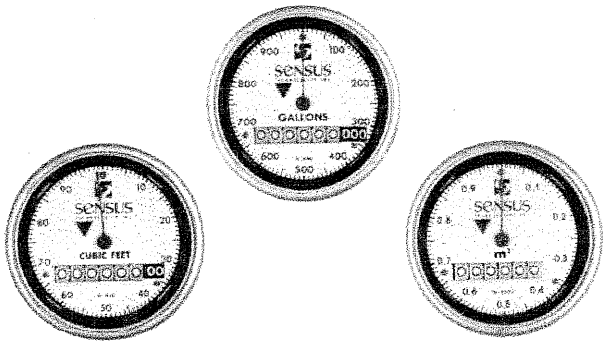
Roland Signett
Ferndale City Administrator

Exhibit B1

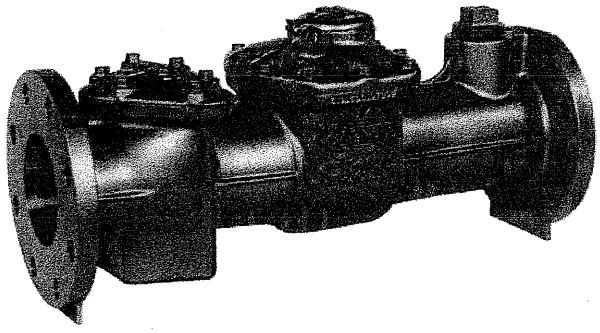
SERIES "W" TURBO METERS

Invensys
Metering Systems

MODEL W-1000 DRS
Bronze Magnetic Drive Flanged Ends Size 4" (DN 100mm)



Direct Reading Registers



W-1000 DRS Turbo Meter

DESCRIPTION

MODEL: W-1000 DRS Turbo Meter is based on the turbine principle of measurement; its operating range is from 15 to 1000 gallons per minute (3.4 to 225 m^3/h) with registration accuracy of 100% ±1.5% of actual thruput.

CONFORMANCE TO STANDARDS: Invensys Turbo Meters comply with ANSI/AWWA Standard C701 (most recent revision). Each meter is performance tested to insure compliance.

PERFORMANCE: The meter's unique principle of measurement assures extended accuracy life. The W-1000 DRS has no restrictions as to sustained flow rates within its operating range. The design permits continuous operation up to its rated maximum flow capacity, without affecting long term accuracy or causing undue wear.

CONSTRUCTION: The meter consists of two basic assemblies—the maincase and the measuring chamber. Straightening vanes in the maincase minimize the swirl upstream of the meter so as to direct the flow evenly to the rotor. The measuring chamber assembly includes the rotor, adjusting vane (for calibration) and sealed Direct Reading (DR) register.

MAGNETIC DRIVE: The Right Angle Magnetic Drive eliminates conventional worm or miter gears normally required for horizontally mounted rotors or turbine measuring elements. Registration is accomplished by combining the magnetic actions of a driver magnet (embedded in the rear face of the rotor), a three-legged flux carrier and a cylindrical follower magnet attached to the gear train shaft inside the register's magnet well. Water flowing through the meter causes the rotor (with magnet) to turn; as one of the magnet poles passes one of the flux carrier legs, the magnetic force is transmitted through the flux carrier leg to the follower magnet, causing the register shaft to rotate. The only moving part in water is the rotor assembly.

ROTOR: The thermoplastic rotor with graphite bearing rotates on a chrome plated stainless steel shaft. The rotor assembly is virtually weightless in water, thus adding to bearing life.

MAINTENANCE: The measuring chamber and straightening vanes can be removed, repaired and/or replaced without disturbing the maincase in the line. A spare chamber can be utilized in the event maintenance is required. Cover plates are also available to keep the line in service while the measuring chamber is repaired and recalibrated. A test outlet is provided in the outlet end for ease of flushing or accuracy testing. Factory testing, repair and measuring chamber exchange programs are available.

STRAINER: The Model W-1000 DRS Turbo Meter is designed with an integral "V" shaped stainless steel strainer built into its inlet end. A removable cover plate permits easy access to the strainer for routine cleaning.

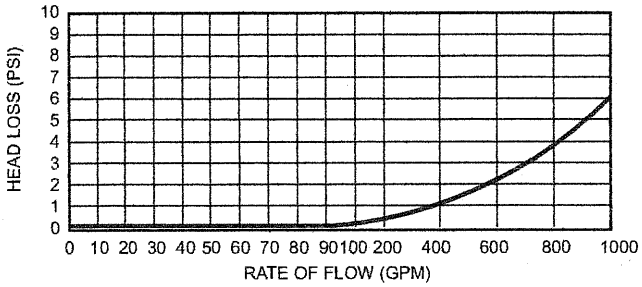
SPECIFICATIONS

SERVICE	Measurement of potable cold water with flow in one direction only.
OPERATING RANGE	Continuous Flows: 15 to 1000 gpm (3.4 to 225 m^3/h) Intermittent Flows: 1250 gpm max. (285 m^3/h)
ACCURACY	100% ± 1.5% of actual thruput
LOW FLOW	95% at 10 gpm (2.3 m^3/h)
PRESSURE LOSS	6.3 psi at 1000 gpm (.4 bar at 225 m^3/h)
MAXIMUM OPERATING PRESSURE	150 psi (10.0 bar)
FLANGE	4" U.S. ANSI B 16.1 Class 125. Optional drillings, if specified, British Standard B.S. 10 or metric standard ISO R2084
REGISTER	Hermetically Sealed Direct Reading Register with Low Flow Indicator.
METER REGISTRATION	1,000,000,000 gallons 1,000 gallons/sweep hand revolution 100,000,000 cubic feet 100 cubic feet/sweep hand revolution 1,000,000 m^3 1 m^3/h sweep hand revolution
MATERIALS	Maincase—Bronze Measuring Chamber—Thermoplastic Straightening Vanes—Thermoplastic Rotor—Thermoplastic Radial Bearing—Graphite Trim—Stainless Steel Thrust Bearings—Tungsten Carbide Magnets—Ceramic Strainer Screen—Stainless steel Strainer Cover—Bronze Test Plug—2" Tapered Pipe Threads

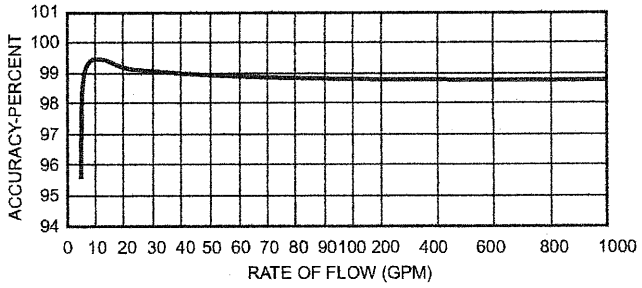
SERIES "W" TURBO METERS

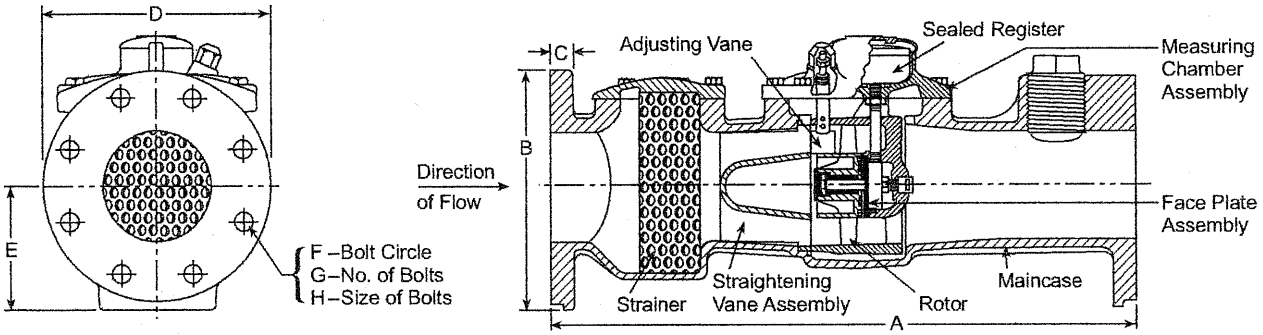
MODEL W-1000 DRS
Bronze Magnetic Drive Flanged Ends Size 4" (DN 100mm)

Head Loss Curve



Accuracy Curve





Meter and Pipe Size	Normal Operating Range GPM Minimum	Maximum	Connections	Dimensions A	B	C	D	E	F	G	H	Net Weight	Shipping Weight
4" DN 100mm	15 3.4m³/h	1000① 225m³/h	Flanged	23"	10-7/8"	7/8"	9"	4-3/4"	7-1/2"	8	5/8"	77 lbs.	85 lbs.
				584mm	227mm	22mm	229mm	121mm	191mm	8	16mm	35 kg	39 kg

Remote Systems—For use with all sizes of Invensys Water Meters

All Invensys AMR systems work with the same absolute encoder Electronic Communications Registers (ECR), enabling the utility to mix and match or easily move from one system to another without changing registers for each.

The TouchRead® Automated Meter Reading and Billing System—is a multi-purpose encoder remote system suitable for indoor and/or outdoor use. The ECR Register uses a wired connection between the meter and an outside remote for inside set meters—or a pitlid mounted module, enabling underground meters to be read automatically without opening the meter box or vault. All wired connections and terminals of the TouchRead PitLid (TR/PL) modules and registers are fully sealed at the factory using a special process to ensure protection from water infiltration. The connection terminals of ECR/WP registers are also factory sealed.

Meters equipped for TouchRead System reading can be read with a visual reading device, stand alone AutoGun, and/or reading gun with an AutoRead Hand-Held Device. For more information on TouchRead System equipment refer to bulletins AMR-TR, AMR-401, AMR-403, AMR-312, EXSUMHH, RS-983, TR-984 and TR-995.

PhonRead® AMR—is a reliable telephone based call-in system that does not require batteries for operation. It also does note require equipment to be installed at telephone company facilities. PhonRead Meter Interface Units (MIU) automatically call "in" to the utility office for transferring meter reading data from the meter site to a PC. PhonRead is a transparent AMR system that does not interfere with customers' telephone service. For more information refer to bulletins AMR-PR and AMR-302.

RadioRead® AMR—uses superior Direct Sequence Spread Spectrum modulation to provide reliable, safe and virtually interference free radio-based transmission of reading data from underground or inside-set meters that are equipped with Meter Transceiver Units (MXU). A choice of meter reading options is available. A radio frequency hand-held device (RF-HHD) can be used by a meter reader on foot. The RF-HHD can also be used to collect readings from TouchRead equipped meters, or for manual meter reading entries. A more powerful Vehicle Transceiver Unit (VXU) can be used in any car or truck to read meters while on the move. (A dedicated meter reading vehicle is not required.) For more information refer to bulletins AMR-RR, AMR-301 and AMR-303, and AMR-401.

MultiRead® Port Expanders—can provide the capability to connect multiple ECR equipped meters to a single PhonRead MIU or RadioRead MXU to save the utility time and money for installations such as apartment complexes and shopping centers. Refer to bulletin AMR-305, AMR-306 and AMR-308.

invensys
Metering Systems

Invensys Metering Systems
P.O. Box 487
450 N. Gallatin Avenue
Uniontown, PA 15401

1-800-METER-IT
1-800-638-3748

FAX (Direct to Factory)
Local: (724) 439-7729
Toll Free: 1-800-888-2403

Web site: www.ims.invensys.com
select *North American Water*
Email: h2oinfo@ims.invensys.com

AUTHORIZED INVENSYS DISTRIBUTOR

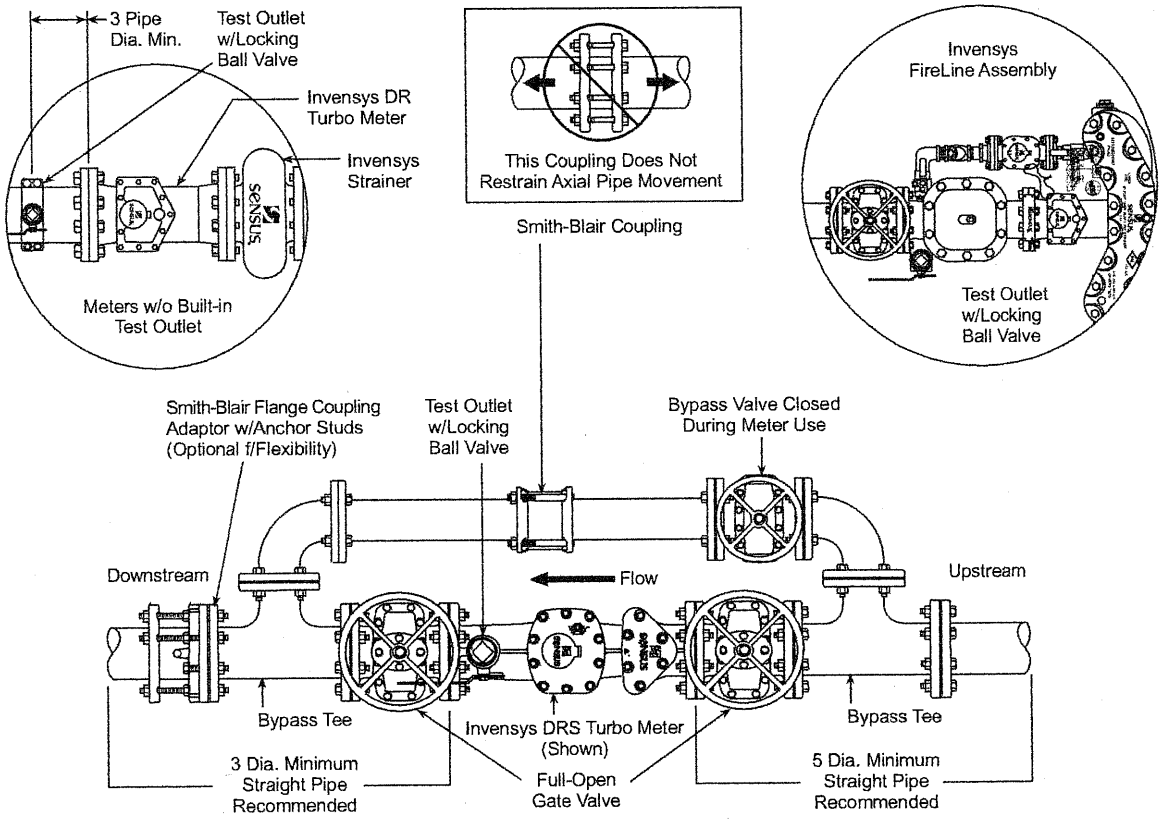
Exhibit B2

INSTALLATION RECOMMENDATIONS

Invensys W-Series Turbo Meters

To insure valid registration and proper performance, the following factors should be considered when installing Invensys Turbo Meters or other velocity style meters.

1. When installing Turbo Meters with a strainer, a minimum of five (5) pipe diameters of straight run of pipe or equivalent full open components is required upstream of the meter strainer inlet flange. A minimum of ten (10) pipe diameters of full open components should be used upstream of the meter's inlet flange when installed without a strainer. The deletion of a strainer, however, is not recommended on any meter. Full open flow components may consist of: straight pipe, full open gate valves, bypass tees and concentric reducers (1 nominal reduction only).
2. Do not install elbows, bends, nonconcentric reducers, check valves, back flow preventers and/or pressure reducing devices within ten (10) pipe diameters upstream or five (5) pipe diameters downstream of the meter.
3. Do not install butterfly valves within five (5) pipe diameters upstream or three (3) pipe diameters downstream of the meter.
4. Gate valves located immediately upstream of the meter setting are acceptable, provided they are fully open during meter service and are not used to throttle flow rates through the meter.
5. Accuracy levels may be determined by comparison accuracy testing either by using an Invensys Portable Large Meter Tester or by removing the suspect meter and testing it on a calibrated test bench. The Turbo Meter's adjusting vane is factory set and its position is marked for reference. Accuracy level adjustments may be accomplished by changing the adjusting vane setting. A linear accuracy adjustment of ± 3% is typical within the normal operating range of the Turbo Meter.



Invensys Metering Systems
P.O. Box 487
450 N. Gallatin Avenue
Uniontown, PA 15401

1-800-METER-IT
1-800-638-3748

FAX (Direct to Factory)
Local: (724) 439-7729
Toll Free: 1-800-888-2403

Web site: www.ims.invensys.com
select *North American Water*
Email: h2oinfo@ims.invensys.com

AUTHORIZED INVENSYS DISTRIBUTOR

Exhibit C

COPY

Resolution No. 387

A Resolution of the Board of Commissioners of Public Utility District No. 1 of Whatcom County ("PUD") Adopting a Service Area Policy

WHEREAS, the PUD agreed to participate in Whatcom County's development of a Coordinated Water System Plan (CWSP); and

WHEREAS, the CWSP process calls on water purveyors to define their service areas; and

WHEREAS, the official minutes of the PUD Board of Commissioner meetings reflect that a draft service area policy was discussed at the September 27, 1994 meeting; and

WHEREAS, Whatcom County has requested that water purveyors submit updates to their service area policies;

NOW, THEREFORE, BE IT RESOLVED by the Board of Commissioners of Public Utility District No.1 of Whatcom County that the following represent the PUD's official service area policy:

Service Area Policy

1. **General Service Area Claimed by the Public Utility District No.1 of Whatcom County (PUD):**

The PUD is a public water utility authorized under RCW 54 to provide county-wide water service. The PUD's municipal/corporate boundaries are co-extensive with Whatcom County and it provides both direct retail and wholesale water supplies to customers located in the county. The PUD holds water rights for municipal water supply purposes – including residential, commercial, industrial uses – in addition to rights for agricultural use. Pursuant to Washington State law, the PUD develops and provides water supply within its service area in accordance with authoritative demand and/or population projections.

The PUD will consider petitions for service or assistance from all areas in Whatcom County which are not presently claimed by cities, water districts, or other purveyors operating within the county. The level of service to be provided to PUD customers requesting service or new supply shall be consistent with relevant capital facility and/or land use plans and policies in existence at the time of service extension.

2. **Wholesale Water Service Area**

The PUD recognizes and claims as its wholesale water service area all of Whatcom County west of the national forest boundary, excluding the following areas:

> Nooksack Tribal Reservation and Trust Lands, the Lummi Tribal Reservation, the City of Bellingham service area, and that portion of Whatcom County west and south of the City of Bellingham.

Jurisdictional, legal and economic factors will be considered when assessing the ability of the PUD to provide water to fee-hold lands on the Lummi Reservation.

The PUD will, within its wholesale water service area, consider petitions and/or requests from other purveyors to supply service from the PUD's existing water rights after review to determine if the proposed service extension is feasible from a financial, engineering, and water availability standpoint. Such wholesale supply may include extensions to existing as well as new systems for the purpose of providing industrial, commercial, and residential/domestic supplies.

3. **Retail Service Area**

The PUD, through the Coordinated Water System Plan, has accepted responsibility for providing all water service required in the Cherry Point Heavy Industrial Area and the Grandview Light Industrial Area. Service to be provided to the industrial/commercial enterprises within this area may include both raw and potable water supply.

The PUD will endeavor to supply the service needs of its retail service area after review to determine if the project is feasible from a financial, engineering, and water availability standpoint. Subject to the above conditions, expansion of the PUD's retail service area will be accomplished through the petition process. When found practical, appropriate amendments will be made to the Coordinated Water System Plan and the PUD's Comprehensive Water System Plan.

ADOPTED by the Board of Commissioners of Public Utility District No. 1 of Whatcom County at a regular meeting thereof held this 6th day of ~~March~~ April, 1999.

Public Utility District No. 1 of Whatcom County

President/Commissioner

Commissioner

Attest: Secretary/Commissioner

Exhibit D1

Water Shares that do not have meters on them yet. 5-11-99/1-3-02/3-31-03/6-13-03

	NAME 6-10-97	SHARE #	YEAR	CERT	PREVIOUS OWNER	SHARE	PAID	BALANCE	
1	PAPPAS, CAROL 1	137, '80	11-20-80	1980	NEW sent ck 11-15-80	$1,000.00	$1,000.00	$0.00	
2	JAMPSA, DONALD 1	191,'91	7-24-91	1982	LAROSE, JIM 141 '82	$1,000.00	$1,000.00	$0.00	
3	HANSON, GARY 1	148, '83	12-9-83	1983	WATSON, 60 '83	?		$0.00	Carroll York sold to Gary Hanson 2003
4	RHEA, STAN 1	147 '97	10-4-97	1983	RUSH, CAROL '83	?		$0.00	Nunn 147 '83
5	RASMUSSEN,DAVE 2	163/164,'97	12-20-97	1986	RUTQUIST E163/164'86	$4,000.00	$4,000.00	$0.00	
6	WOOD, GRANT 1	167 '87	8-26-87	1987	NEW 2nd shr 87	$1,000.00	$1,000.00	$0.00	92 '71 1st share
7	CARLSON, RON 1	222, '93	11-30-93	1988	URQUHART '88	$500.00	$300.00	$200.00	170/145/2
8	POTTLE, HARVEY 1	206, '93	3/4/1993	1993	PRATHER '90	$3,500.00	$3,500.00	$0.00	133 '90,180
9	HEFFRING, D. 1	213,'93	6-15-93	1993	NEW Lindquist '93	$3,500.00	$3,500.00	$0.00	
10	DEMEYER, DOUG 1	224, '94	3-6-94	1994	NEW pmts from '78	$950.00	$950.00	$0.00	Anderson126
11	ERICKSON, IRENE 1	225, '94	3-19-94	1994	CALLOPY, MARGE '55	$500.00	$500.00	$0.00	BE Perry rents DIED 4-02
12	BENEDICT, MARTHA1	no#			OPTION TO BUY	$2,000.00		$2,000.00	
					TOTALS	$17,950.00	$15,750.00	$2,200.00	

Nadine told me that the money for shares was deposited into the checking account and there were only a few places where individual notations were made. She said that there were no other receipt books to look at so I guess the individuals will need to let us know .

Exhibit D3

Original agreement July 13, 1992

Amendment #1

AMENDMENT TO
INTERLOCAL AGREEMENT FOR FERNDALE'S
REIMBURSEMENT TO PUD NO. 1 FOR
COSTS ON SMITH ROAD EXTENSION PROJECT

THIS AMENDMENT made and entered into this 8th day of December, 1992, by and between the CITY OF FERNDALE (Ferndale) and PUBLIC UTILITY DISTRICT NO. 1 OF WHATCOM COUNTY (PUD).

RECITAL:

On July 13, 1992 Ferndale and PUD entered into an agreement wherein Ferndale agreed to reimburse PUD for its contribution toward the Smith Road Water Line Extension Project. Since said agreement was signed the method for determining the reimbursement amount has been changed and the parties therefore desire to amend said agreement so that the change is incorporated therein.

NOW, THEREFORE, the PUD and Ferndale agree as follows:

1. Section 1. (a) of the Interlocal Agreement for Ferndale's Reimbursement to PUD No. 1 for Costs on Smith Road Extension Project dated July 13, 1992 is hereby amended to read as follows:

(a) Ferndale shall reimburse the PUD an amount in lieu of acreage charges for each single family residential equivalent connection on property which has not already been assessed an institutional or industrial acreage charge to help fund the project. The amount to be reimbursed for each single family residential equivalent connection shall be $1,800 for parcels having frontage on the line and $600 for all other parcels designated by Ferndale to benefit from the project, plus the interest that has accrued on said amount at the rate charged to Ferndale for the PUD Contribution. Properties subject to the respective charges are identified on the attached Exhibit "A". Ferndale shall be authorized to collect the respective amounts listed herein for each parcel from property owners desiring to have water service for such property from the project water line in addition to its normal charges for connection and service.

Said reimbursement shall be made to PUD until the declining balance of the PUD Contribution and interest thereon is reimbursed to the PUD, provided that in any event the total principal balance of PUD Contribution and interest shall be paid in full on or before fifteen (15) years after the date of completion and acceptance of the project. Ferndale shall pay each connection reimbursement within thirty (30) days of its receipt thereof. The parties anticipate a PUD Contribution amount equal to roughly $176,000 if the LUD and per acreage assessments are received as planned. If this amount is substantially greater for any reason, this payback provision, as set forth hereinabove, shall be subject to reconsideration at Ferndale's request.

2. The terms and conditions of this amendment shall be retroactive to July 13, 1992, the date of the original agreement referred to herein.

3. All other terms and conditions of the original agreement remain in full force and affect.

IN WITNESS WHEREOF, the parties have executed this agreement the day and year first above written.

Public Utility District No.1
of Whatcom County

By _____
President

ATTEST: _____
Secretary

City of Ferndale

By _____
Mayor

ATTEST: _____
City Clerk

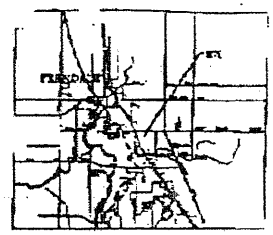
CITY OF FERNDALE - WEST SMITH ROAD EXTENSION

	MONTH	# DAYS	INTEREST EARNED	DATE PERIOD		TOTAL	PRINCIPAL	INTEREST
	SUBTOTAL 12/31/2003		**4,157.35**			**80,911.46**	**72,300.62**	**8,610.84**
INTEREST	01/01/04	12/31/04						
	JAN	31	353.09	01/01/04	01/31/04	81,264.55	72,300.62	8,963.93
	FEB	29	330.30	02/01/04	02/28/04	81,594.85	72,300.62	9,294.23
	MAR	31	353.09	03/01/04	03/31/04	81,947.94	72,300.62	9,647.32
	APR	30	341.70	04/01/04	04/30/04	82,289.64	72,300.62	9,989.02
	MAY	31	353.09	05/01/04	05/31/04	82,642.73	72,300.62	10,342.11
	JUN	30	341.70	06/01/04	06/30/04	82,984.43	72,300.62	10,683.81
	JUL	31	353.09	07/01/04	07/31/04	83,337.52	72,300.62	11,036.90
	AUG	31	353.09	08/01/04	08/31/04	83,690.61	72,300.62	11,389.99
	SPT	30	341.70	09/01/04	09/30/04	84,032.31	72,300.62	11,731.69
	OCT	31	353.09	10/01/04	10/31/04	84,385.40	72,300.62	12,084.78
	NOV	30	341.70	11/01/04	11/30/04	84,727.10	72,300.62	12,426.48
	DEC	31	353.09	12/01/04	12/31/04	85,080.19	72,300.62	12,779.57
	SUBTOTAL 12/31/2004		**4,168.73**			**85,080.19**	**72,300.62**	**12,779.57**

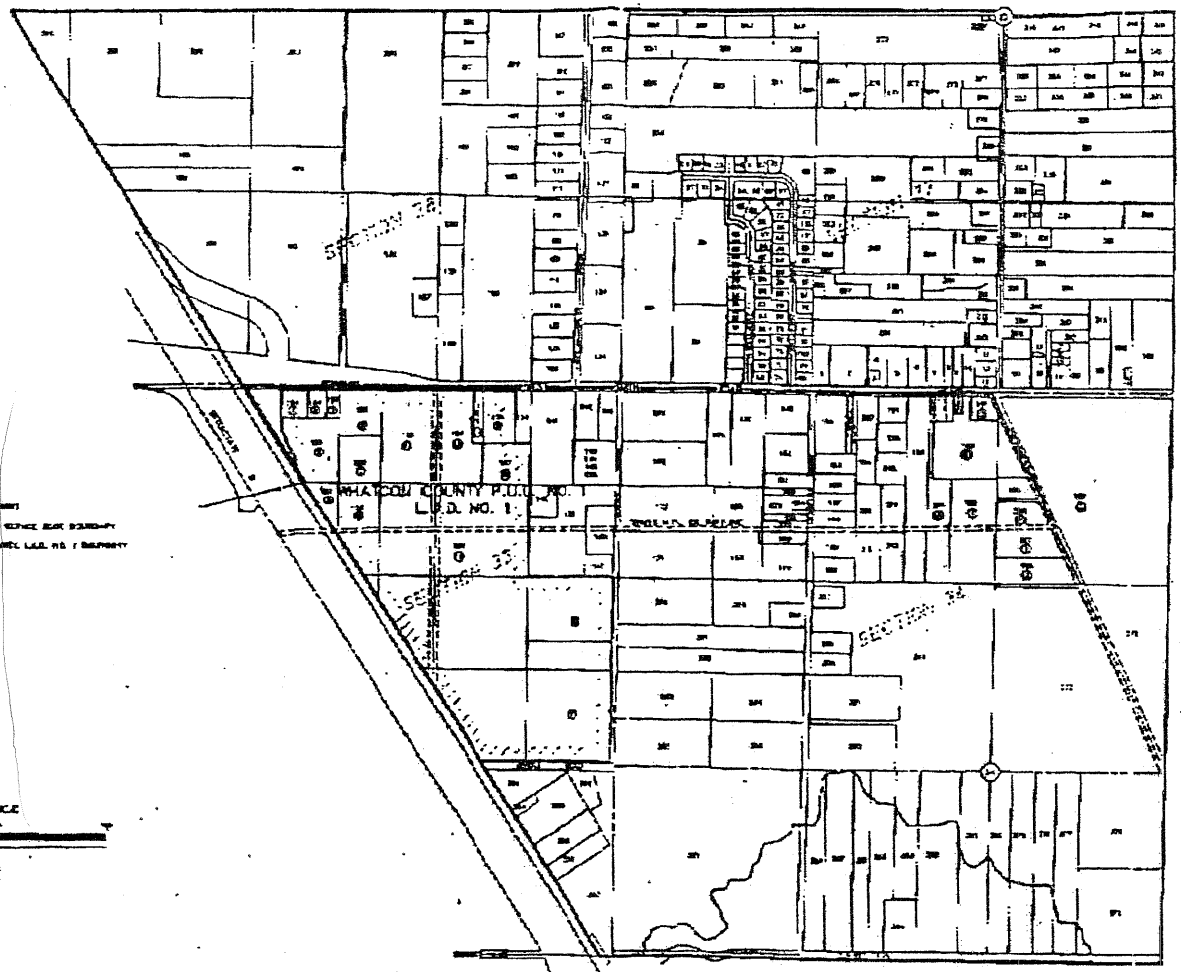
From:PUD1 WHATCOM COUNTY 360+384+4849 01/16/2004 12:28 #459 P.004/004

"Exhibit A"

SEC. 27,28,33,& 34, TWP. 39 N., RGE. 2E., W.M.



VICINITY MAP



LEGEND

GRAPHIC SCALE

WEDEN ENGINEERING, INC.
119 GRAND AVENUE, SUITE D
BELLINGHAM, WA. 98225 671-8200

PUBLIC UTILITY DISTRICT NO.1 OF WHATCOM COUNTY
SMITH ROAD WATER EXTENSION
TRANSMISSION MAIN SERVICE ZONE

Exhibit D4

"Exhibit D4" – Northwest Water Association, Inc. (future) Water Utility Service Area – Service Zone Amendment

WATER CONNECTION AGREEMENT

THIS AGREEMENT is entered into this 7th day of July, 1980, by and between the CITY OF FERNDALE, a Washington municipal corporation, hereinafter referred to as "City", and the THORNTON WATER ASSOCIATION, a Washington non profit corporation, hereinafter referred to as "Association".

IN CONSIDERATION of the mutual benefits derived from this agreement, the parties hereto agree as follows:

1. Water Connection: The Association hereby agrees that the City may connect its main water distribution lines to the Association's main water distribution lines in order to provide the Association with an alternate source or supply of water for emergency purposes. At time of connection, the City agrees to provide adequate pressure reducing valves (if required), a main line meter, and a main line valve at its cost and expense.

2. Water Supply: The City agrees to supply water to the Association during emergency situations and only when the Association shall approve and request the same through its designated officer or agent. The City further agrees upon approval and request by the Association to supply all of the Association's water on a permanent basis; provided, that a permanent supply of water to the Association shall be subject to established rules and regulations of the City and any amendments or modifications thereof as may be adopted by the City, regulating and controlling the use and distribution of the water supply by the water department of the City.

3. Water Rates: It is mutually agreed that the Association will pay the City for any water supplied by the City to the Association in accordance with this Agreement that rate established by Ordinance 537 of the City or any amendments thereto; provided, that if the supply is for emergency purposes only and for a period of less than one calendar month, the minimum rate established in Schedule A of said ordinance shall be pro-rated on a per diem basis for the number of days that water is supplied to the Association. It is further mutually agreed, that in the event the Association shall approve and request a permanent supply of water from the City, the City and the Association shall negotiate a rate to be charged in accordance with the then-prevailing water rate ordinance.

THIS AGREEMENT is dated this 7th day of July, 1980.

THORNTON WATER ASSOC.

Conway R. Nelson
John B. Nelson
Lawrence L. Jones
Dave Schwegler
Board Members

By Russ Engler Jr.
Its President

By C. M. Benedict
Its Secretary

THE CITY OF FERNDALE

By Cecil Barr
Cecil Barr Mayor

ATTEST:

Roland Signett
Clerk - Treasurer

L. FERNDALE URBAN GROWTH AREAS – WATER AVAILABILITY

Ferndale Urban Growth Areas – Water Availability

City of Ferndale
PO Box 936 | 2095 Main Street
Ferndale, WA 98248



October, 2016

Provided For:

City of Ferndale
2095 Main St.
Ferndale, WA 98248
Phone: (360) 384-4302

Prepared By:

Reichhardt & Ebe Engineering, Inc.
423 Front St.
Lynden, WA 98264
Phone: (360) 354-3687

Table of Contents

Table of Contents 2

Ferndale Urban Growth Areas – Water Availability 7

INTRODUCTION 7

Plate 1, Annexation Phasing Plan 9

SHORT TERM SUBAREA 1 - THORNTON NORTH 10

AREA 10

PROPOSED ZONING 10

EXISTING WATER SERVICE 10

PROJECTED WATER USE 10

Table 1, Short Term Subarea 1 Projected Water Use 10

FUTURE WATER SERVICE 10

SHORT TERM SUBAREA 2 - SCHELL MARSH 11

AREA DESCRIPTION 11

PROPOSED ZONING 11

EXISTING WATER SERVICE 11

PROJECTED WATER USE 11

FUTURE WATER SERVICE 11

SHORT TERM SUBAREA 3 - SLATER ROAD WSDOT PROPERTY 12

AREA DESCRIPTION 12

PROPOSED ZONING 12

EXISTING WATER SERVICE 12

PROJECTED WATER USE 12

FUTURE WATER SERVICE 12

SHORT TERM SUBAREA 4 - NUBGAARD ROAD 13

AREA DESCRIPTION 13

PROPOSED ZONING 13

EXISTING WATER SERVICE 13

PROJECTED WATER USE 13

Table 2, Short Term Subarea 4 Projected Water Use 13

FUTURE WATER SERVICE 13

SHORT TERM SUBAREA 5 - SCHOOL DISTRICT 14

AREA DESCRIPTION 14

PROPOSED ZONING 14
EXISTING WATER SERVICE 14
PROJECTED WATER USE 14
FUTURE WATER SERVICE 14
SHORT TERM SUBAREA 6 – NORTH CHURCH “ERICKSON FARM” 15
AREA DESCRIPTION 15
PROPOSED ZONING 15
EXISTING WATER SERVICE 15
PROJECTED WATER USE 15
Table 3, Short Term Subarea 6 Projected Water Use 15
FUTURE WATER SERVICE 15
SHORT TERM SUBAREA 7 – NORTH DOUGLAS 16
AREA DESCRIPTION 16
PROPOSED ZONING 16
EXISTING WATER SERVICE 16
PROJECTED WATER USE 16
Table 4, Short Term Subarea 7 Projected Water Use 16
FUTURE WATER SERVICE 16
MID TERM SUBAREA 8 – CENTRAL ALDERGROVE 17
AREA DESCRIPTION 17
PROPOSED ZONING 17
EXISTING WATER SERVICE 17
PROJECTED WATER USE 17
FUTURE WATER SERVICE 17
MID TERM SUBAREA 9 – EAST ALDERGROVE 18
AREA DESCRIPTION 18
PROPOSED ZONING 18
EXISTING WATER SERVICE 18
PROJECTED WATER USE 18
FUTURE WATER SERVICE 18
MID TERM SUBAREA 10 - GRANDVIEW BUSINESS CENTER and MID TERM SUBAREA 12 - I-5 BUSINESS PARK 19
AREA DESCRIPTION 19
PROPOSED ZONING 19
EXISTING WATER SERVICE 19

PROJECTED WATER USE 19
FUTURE WATER SERVICE 19
Option 1 19
Option 2. 20
Option 2a. 20
Option 2b. 20
MID TERM SUBAREA 11 - NORTHEAST GRANDVIEW 21
AREA DESCRIPTION 21
PROPOSED ZONING 21
EXISTING WATER SERVICE 21
PROJECTED WATER USE 21
FUTURE WATER SERVICE 21
Option 1. 21
Option 2 22
LONG TERM SUBAREA 13 – SOUTH GRANDVIEW 23
AREA DESCRIPTION 23
PROPOSED ZONING 23
EXISTING WATER SERVICE 23
PROJECTED WATER USE 23
FUTURE WATER SERVICE 23
Option 1 23
Option 2 23
LONG TERM SUBAREA 14 – SOUTHWEST GRANDVIEW 24
AREA DESCRIPTION 24
PROPOSED ZONING 24
EXISTING WATER SERVICE 24
PROJECTED WATER USE 24
FUTURE WATER SERVICE 24
Option 1 24
Option 2 24
LONG TERM SUBAREA 15 – NORTH MALLOY and LONG TERM SUBAREA 16 – SOUTH MALLOY 25
AREA DESCRIPTION 25
PROPOSED ZONING 25
EXISTING WATER SERVICE 25

PROJECTED WATER USE 25
FUTURE WATER SERVICE 25
LONG TERM SUBAREA 17 – DELTA LINE 26
AREA DESCRIPTION 26
PROPOSED ZONING 26
EXISTING WATER SERVICE 26
PROJECTED WATER USE 26
FUTURE WATER SERVICE 26
Option 1. 26
Option 2 26
UGA RESERVE SUBAREA 18 – SLATER EAST 27
AREA DESCRIPTION 27
PROPOSED ZONING 27
EXISTING WATER SERVICE 27
PROJECTED WATER USE 27
FUTURE WATER SERVICE 27
UGA RESERVE SUBAREA 19 – ENTERPRISE ROAD 28
AREA DESCRIPTION 28
PROPOSED ZONING 28
EXISTING WATER SERVICE 28
PROJECTED WATER USE 28
FUTURE WATER SERVICE 28
UGA RESERVE SUBAREA 20 –BROWN ROAD 29
AREA DESCRIPTION 29
PROPOSED ZONING 29
EXISTING WATER SERVICE 29
PROJECTED WATER USE 29
FUTURE WATER SERVICE 29
UGA RESERVE SUBAREA 22 –MOUNTAIN VIEW 30
AREA DESCRIPTION 30
PROPOSED ZONING 30
EXISTING WATER SERVICE 30
PROJECTED WATER USE 30
FUTURE WATER SERVICE 30

UGA RESERVE SUBAREAS 21, 23 and 24 31
APPENDIX 32
1. Grandview Water Association Service Area Map 33
2. Interlocal Agreement, Ferndale and PUD No. 1 34
3. Plate 2 – Subareas 1, 5, 6, 8, 9, 21 35
4. Plate 3 – Subareas 2, 4, 7, 22, 23, 24 36
5. Plate 4 – Subareas 10, 11, 12, 13, 14, 15, 16, 17, 20 37
6. Plate 5 – Subareas 3, 18 38

Ferndale Urban Growth Areas – Water Availability

INTRODUCTION

The City of Ferndale developed a planning document titled "Annexation Blueprint, Annexation Phasing Plan: 2013 – 2034" to manage anticipated growth and plan for capital facilities required to serve future annexations. The purpose of this report is to address the ability to serve the City's Urban Growth Areas with potable and fire suppression water service. It also addresses future growth into Urban Reserve areas.

The City's Service Area Boundaries include all of the property within the city limits; areas outside the City that have historically been provided with water service and property within designated Urban Growth Areas. The City's Retail Service Area includes only land within the city limits, and other areas presently served with water.

Water service for each of the parcels identified in the Annexation Blueprint has been evaluated. Some of the properties currently have water provided from sources other than the city. These sources include private wells, water associations and Whatcom County PUD No. 1. When properties are annexed, One of the issues that must be addressed is existing water service. If the subarea to be annexed is provided with water from a private water association or the PUD, and the City is taking over water service, the service area boundaries must be adjusted in accordance with the Coordinated Water Service Plan. This is a process that is conducted through the County Planning Department and the Department of Health, and will address a multitude of issues including water rights, pipeline locations and upgrades, latecomer agreements, rates and potential consolidation. Property annexed into the City requires sewer for development. City policy prohibits providing sewer service without also providing water service. It may be possible for Subareas with existing water service to stay connected to their existing source, subject to conditions and approval by the City.

This document is a guideline showing general location and sizing of water facilities. As infrastructure is extended into annexed areas, water is normally included along with roads and other utilities. Actual location of water lines must be addressed and coordinated with both the proposed development and with other utilities.

The annexation blueprint presents a schedule for annexation for each parcel, as shown on the attached Annexation Phasing Plan. Short term parcels are generally adjacent to the city, and are currently eligible for annexation. These include Subareas 1 through 7, which generally have one or more of the following attributes:

1. Properties are currently served by City utilities and take access from City roads
2. Properties are adjacent to City utilities of sufficient size to support the land uses anticipated by the comprehensive plan, and road improvements are limited to frontage improvements typical for development
3. Properties consist of developed neighborhoods or commercial/industrial sites that are at or close to the full build out contemplated by the comprehensive plan.

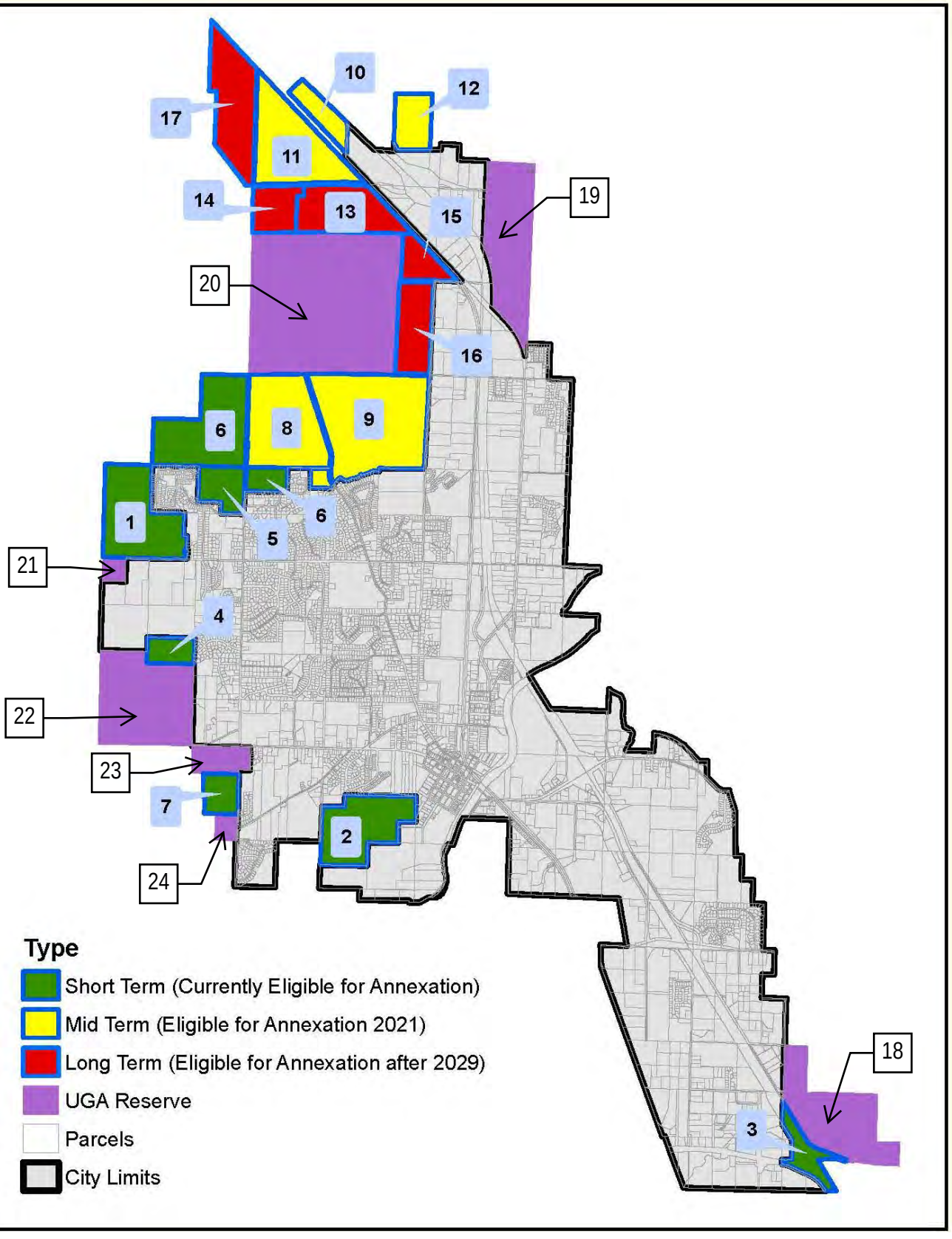
Mid Term properties, which include Subareas 8 through 12, are not considered eligible for annexation until about the year 2022 or later, as infrastructure required to serve them is included in 6-year capital facilities plans, and will probably not be available until then.

Long Term Subareas, which include Subareas 13 through 17, are generally under-developed properties that require the extension of services to or through adjacent properties prior to annexation. These subareas are eligible for annexation after the year 2029. They are not included in the 20 year planning period, but infrastructure to serve them is identified and sized for them.

UGA Reserves include Subareas 18 through 24, and consist of properties not currently within the City's UGA, but have been identified for potential further inclusion. These areas are not subject to a timeline for annexation, and one or more could be included in the next update of UGAs. At that time they would be designated as Long Term Subareas. UGA Reserve Subarea 18 at the Northwest quadrant of the I-5/Slater Road Interchange is to have its status changed to Urban Growth Area. Because it has the attributes necessary for inclusion in the Mid Term Subarea category it may be eligible for annexation at any time.

This report analyzes each Subarea and provides estimates of water demands, fire flow requirements, and the water infrastructure required to serve them. Since many of the Subareas consist of more than one property owner, and some are in split into more than one pressure zone, only the primary water lines are shown. These waterlines are the backbone of the water system and generally serve larger areas than the individual Subareas. Smaller water lines will be required throughout the Subareas, but their size and location will depend on the layout of individual facilities and developments. A separate analysis must be performed for each individual development. Provisions should be made in the various layouts to loop lines wherever feasible.

Water use has been projected for full buildout in order to size infrastructure, and should not be confused with normal growth projections. Full buildout may take many years beyond the 20 year planning period to occur, and changes in land use, or large scale uses may require additional analysis.



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PLATE 1
ANNEXATION PHASING PLAN

SHORT TERM SUBAREA 1 - THORNTON NORTH

AREA

This subarea is currently zoned by Whatcom County as UR-4, Urban Residential 4 Units/Acre. It contains 110 acres, mostly agriculture and large lot residential. The location is shown on Plate 2.

PROPOSED ZONING

After annexation by the City, the anticipated use is Low Density Residential, single family with potential for some multifamily, per the Annexation Blueprint.

EXISTING WATER SERVICE

The area is currently not served by a public water system.

PROJECTED WATER USE

At full buildout, at 4 dwelling units per acre (net) the Subarea will support 440 ERUs. Projected water use per ERU per the City's WSP is:

Table 1, Short Term Subarea 1 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 440 ERUs*
Average Day Demand	175 gpd	77,000 gpd
Maximum Day Demand	305 gpd	134,200 gpd
Peak Hourly Demand	0.349 gpm	154 gpm
Annual Use	0.196 AFY	86 AFY
Fire Demand	2,000 gpm	2,000 gpm

Buildout is expected to occur over many years and development of this Subarea has been included in the City's growth projections and water infrastructure planning process.

FUTURE WATER SERVICE

The Subarea is adjacent to Thornton road on the south and Pacific Heights on the north, and is entirely within the Bakerview Pressure Zone. The pressure zone is served by the Bakerview Tank and Bakerview Pump Station. 12" water mains are located in both Thornton Road and Pacific Highlands. A future 12" main through the subarea from Thornton Road to Pacific Highlands will result in a looped system capable of providing required fire flow. Other mains throughout the future residential areas will be 8" unless the future development layout and land use requires larger lines for fire flow. Internal mains should be looped when feasible.

SHORT TERM SUBAREA 2 - SCHELL MARSH

AREA DESCRIPTION

This subarea is located in the southwestern portion of the City, bordering Pioneer Park and the Conoco Phillips ballfields to the east and Imhof Road to the west. It is currently zoned by Whatcom County as Agricultural. It contains 85 acres, mostly wetland with a home and a farm on the south edge. The location is shown on Plate 3.

PROPOSED ZONING

After annexation by the City, the anticipated use is for public uses such as parks, wetland mitigation areas, regional storm water ponds and some limited residential development on higher ground.

EXISTING WATER SERVICE

The area is currently not served by a public water system.

PROJECTED WATER USE

Water use in this subarea is projected to be minimal, since very little development is likely to occur.

FUTURE WATER SERVICE

Water service is available from the Pioneer Park area on the east side of the subarea. In the event water is required on the west side along Imhof Road, an extension south on Imhof from Douglas Road would be available. There is a short length of 4" water main on Imhof, but it would need to be replaced with a minimum 8" water main if a small number of residential units were built.

SHORT TERM SUBAREA 3 - SLATER ROAD WSDOT PROPERTY

AREA DESCRIPTION

This subarea is located in the southeastern portion of the City and is comprised of parcels owned by the Washington State Department of Transportation. The subarea is part of a larger Whatcom County General Commercial Zone, although the subarea itself is mostly freeway interchange. The location is shown on Plate 5. This subarea is adjacent to the East Slater Subarea 18, and it may be practical to combine the two.

PROPOSED ZONING

After annexation by the City, the anticipated use is for transportation improvements.

EXISTING WATER SERVICE

The area is currently not served by a public water system.

PROJECTED WATER USE

There is no projected water use for this subarea.

FUTURE WATER SERVICE

NA

SHORT TERM SUBAREA 4 - NUBGAARD ROAD

AREA DESCRIPTION

The Nubgaard Road Subarea is located at the north end of Storr Road, west of Lakeridge Estates and southeast of the Meadows plat, formerly known as the Blomquist property. This subarea is currently zoned by Whatcom County as UR-4, Urban Residential 4 Units/Acre. It contains approximately 25 acres, with several large lot residences. The location is shown on Plate 3.

PROPOSED ZONING

After annexation by the City, the anticipated use is Low to Medium Density Single Family Residential, which could change the density to more than 4 dwelling units per acre..

EXISTING WATER SERVICE

The area is currently served by Mountain View Water Association.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre (net) in the currently undeveloped area, the Subarea will have approximately 50 ERUs. Projected water use per ERU per the City's WSP is:

Table 2, Short Term Subarea 4 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 50 ERUs*
Average Day Demand	175 gpd	8,750 gpd
Maximum Day Demand	305 gpd	15,250 gpd
Peak Hourly Demand	0.349 gpm	18 gpm
Annual Use	0.196 AFY	10 AFY
Fire Demand	1,500 gpm	1,500 gpm

Buildout is expected to occur over many years and development of this Subarea has been included in the City's growth projections and water infrastructure planning process.

FUTURE WATER SERVICE

The Subarea is adjacent to Lakeridge Estates on the east and the Meadows to the northwest, and is entirely within the Bakerview Pressure Zone. The pressure zone is served by the Bakerview Tank and Bakerview Pump Station. An 8" water main is located in Lakeridge Drive, and can be extended into Nubgaard Road to provide fire flow to the Subarea. The area west of the Nubgaard Subareas is in an Urban Reserve, and when it is annexed the northerly portion in the Bakerview Pressure Zone should be tied into the Nubgaard Road water main. The adjacent Urban Reserve is the Mountain View Subarea 5, and is addressed separately in this report.

Internal mains should be looped when feasible. When tying into adjacent properties in different pressure zones, lines should be separated with pressure reducing valves where appropriate.

SHORT TERM SUBAREA 5 - SCHOOL DISTRICT

AREA DESCRIPTION

The School District Subarea is located on the west side of Church Road between Church Road and Pacific Highlands. It is directly north of Cascadia Elementary School. This subarea is currently zoned by Whatcom County as UR-4, Urban Residential 4 Units/Acre. It contains approximately 35 acres, with three residences and associated agricultural outbuildings. The location is shown on Plate 2.

PROPOSED ZONING

After annexation by the City, the anticipated use is future school facilities. Zoning would be for public uses.

EXISTING WATER SERVICE

The area is currently served by private wells.

PROJECTED WATER USE

The school district has not released planning for this area. School facilities in this area will probably include some degree of athletic and playfields which could use substantial amounts of water for irrigation in the summer months. School buildings, if built on the site will require institutional fire flow. The City policy is to require a minimum of 3,000 gpm for 4 hours. If the area is not utilized as a school facility, and becomes residential or mixed use, the water requirements will result in lesser demands, particularly for fire flow.

FUTURE WATER SERVICE

The School Subarea is in the Bakerview Pressure Zone and is served by the Bakerview Tank and the Bakerview Booster Pump Station. Both currently serve two schools, and have the capacity to serve institutional fire flow. A 12" water main on Church Road extends past the southerly portion of the Subarea. The 12" line should extend to the north boundary of the Subarea. Mains within the subarea must be designed to serve the specific school facilities. A stub out may be required on the north side to serve future development in the adjacent Subarea and provide a looped distribution system.

SHORT TERM SUBAREA 6 – NORTH CHURCH "ERICKSON FARM"

AREA DESCRIPTION

The North Church Subarea is divided in two parcels. Approximately 120 acres is located on the west side of Church Road from Aldergrove Road to approximately ½ mile south, bordering on Pacific Highlands. Another 20 acres is located on the east side of Church Road adjacent to the City Limits on the east and south. This subarea is currently zoned by Whatcom County as UR-4, Urban Residential 4 Units/Acre. The existing land use is agricultural with associated farm residences and agricultural outbuildings. The location is shown on Plate 2.

PROPOSED ZONING

After annexation by the City, the anticipated use is for residential development at 3 to 5 dwelling units per acre, although higher densities with a mix of uses may also occur.

EXISTING WATER SERVICE

The Subarea is currently served by Baker View Water Association. The northerly portion is also within the service area of the Aldergrove Water Association.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre in the the Subarea will have approximately 560 ERUs. Projected water use per ERU per the City's WSP is:

Table 3, Short Term Subarea 6 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 560 ERUs*
Average Day Demand	175 gpd	98,000 gpd
Maximum Day Demand	305 gpd	170,800 gpd
Peak Hourly Demand	0.349 gpm	195 gpm
Annual Use	0.196 AFY	110 AFY
Fire Demand	3,000 gpm	3,000 gpm

Buildout is expected to occur over many years and development of this Subarea has been included in the City's growth projections and water infrastructure planning process. Although residential fire demand is 1,000 gpm for 2 hours, there may be some commercial use that would require greater fire flow.

FUTURE WATER SERVICE

The Subarea is in the Bakerview Pressure Zone and is served by the BakerviewTank and the Bakerview Booster Pump Station. The existing water main on Church Road at the existing City Limits on Church Road should be extended north to Aldergrove Road. An existing 12" water main is stubbed out on the southwest corner of the westerly Subarea. This water main should be extended northerly and easterly through the property, connecting into the main on Church Road to provide a looped system through the property.

SHORT TERM SUBAREA 7 – NORTH DOUGLAS

AREA DESCRIPTION

The North Douglas Subarea contains approximately 25 acres bounded by South Church Road on the east and two Urban Reserve areas on the north and south. This subarea is currently zoned by Whatcom County as UR-4, Urban Residential 4 Units/Acre. The existing land use is large lot residential. The location is shown on Plate 3.

PROPOSED ZONING

After annexation by the City, the anticipated use is for residential development at 3 to 5 dwelling units per acre.

EXISTING WATER SERVICE

The area is currently served by Mountain View Water Association.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre in the the Subarea will have approximately 100 ERUs. Projected water use per ERU per the City's WSP is:

Table 4, Short Term Subarea 7 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 100 ERUs*
Average Day Demand	175 gpd	17,500 gpd
Maximum Day Demand	305 gpd	30,500 gpd
Peak Hourly Demand	0.349 gpm	35 gpm
Annual Use	0.196 AFY	20 AFY
Fire Demand	2,000 gpm	2,000 gpm

Buildout is expected to occur over many years and development of this Subarea has been included in the City's growth projections and water infrastructure planning process. Although residential fire demand is 1,000 gpm for 2 hours, there may be some higher density residential development that would require greater fire flow.

FUTURE WATER SERVICE

The Subarea is in the Main Pressure Zone and is served by the Thornton Tank and the Water Treatment Plant Booster Pumps. Water service can be provided by the existing 12" water main on South Church Road that runs the full length along the easterly boundary of the Subarea. Water mains properly sized for fire flow should be extended and looped through the subarea as development occurs.

MID TERM SUBAREA 8 – CENTRAL ALDERGROVE

AREA DESCRIPTION

The Central Aldergrove Subarea contains approximately 135 acres bounded by Church Road on the west, Vista Drive to the East, Aldergrove Road on the north and the City limits on the south. This subarea is currently zoned by Whatcom County as UR-4, Urban Residential 4 Units/Acre. The existing land use is large lot residential. The location is shown on Plate 2.

PROPOSED ZONING

After annexation by the City, the anticipated use is for residential development at 3 to 5 dwelling units per acre, although higher densities with a mix of uses may also occur.

EXISTING WATER SERVICE

The eastern and northern portion of the Subarea is currently served by Orchard Water Association.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre in the Subarea will have approximately 540 ERUs. Projected water use per ERU per the City's WSP is:

Table 5, Mid Term Subarea 8 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 540 ERUs*
Average Day Demand	175 gpd	94,500 gpd
Maximum Day Demand	305 gpd	164,700 gpd
Peak Hourly Demand	0.349 gpm	188 gpm
Annual Use	0.196 AFY	106 AFY
Fire Demand	2,000 gpm	2,000 gpm

Buildout is expected to occur over many years and development of this Subarea has been included in the City's growth projections and water infrastructure planning process. Although residential fire demand is 1,000 gpm for 2 hours, there may be some higher density residential development that would require greater fire flow.

FUTURE WATER SERVICE

The Subarea is in the Mid Pressure Zone and is served by the BakerviewTank and the Church Road and Thornton Booster Pump Stations. The Orchard Water Association that currently serves many of the existing residences in the Subarea is likely to be impacted, as development will take a substantial number of their customer base. This must be addressed during the annexation proceedings. A 12" water main on Church Road is planned to serve the North Church Short Term Subareas that are eligible for annexation prior to the Central Aldergrove Subarea annexation. A 12" water main is projected to be extended along Vista Drive to serve the Grandview Area and the adjacent Subarea 9 east of the Central Aldergrove Subarea. An additional 12" water main is planned along Aldergrove Road on the north boundary of the Subarea to provide a looped system. Water mains properly sized for fire flow should be extended and looped through the subarea as development occurs. Some of the lower elevations may require pressure reducing valves.

MID TERM SUBAREA 9 – EAST ALDERGROVE

AREA DESCRIPTION

The East Aldergrove Subarea contains approximately 140 acres bounded by Vista Drive on the west, Malloy Road to the East, Aldergrove Road on the north and the City limits on the south. This subarea is currently zoned by Whatcom County as UR-4, Urban Residential 4 Units/Acre. The existing land use is large lot residential. The location is shown on Plate 2.

PROPOSED ZONING

After annexation by the City, the anticipated use is for residential development at 3 to 5 dwelling units per acre, although higher densities with a mix of uses may also occur.

EXISTING WATER SERVICE

The western portion of the Subarea along Vista Drive is currently served by Orchard Water Association.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre in the Subarea will have approximately 560 ERUs. Projected water use per ERU per the City's WSP is:

Table 6 Mid Term Subarea 9 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 560 ERUs*
Average Day Demand	175 gpd	98,000 gpd
Maximum Day Demand	305 gpd	170,800 gpd
Peak Hourly Demand	0.349 gpm	195 gpm
Annual Use	0.196 AFY	110 AFY
Fire Demand	3,000 gpm	3,000 gpm

The above water use is for estimated full buildout, which may take many years. Although residential fire demand is 1,000 gpm for 2 hours, there may be some higher density residential and commercial use that would require greater fire flow.

FUTURE WATER SERVICE

The Subarea is in the Mid Pressure Zone and is served by the Bakerview Tank and the Church Road and Thornton Booster Pump Stations. The Orchard Water Association currently serves many of the existing residences in the Subarea and is likely to be impacted, as development will take a substantial number of their customer base. This must be addressed during the annexation proceedings. A 12" water main is planned to serve the Central Aldergrove and the East Aldergrove Subareas as well as the Grandview Area. A 16" water main is projected to extended along Malloy Road to serve the Grandview Subareas and adjacent industrial zoned land within the City Limits that does not currently have City water service. The 16" main on Malloy Road is in the Mid Pressure Zone, sized to provide industrial fire flow to the Grandview Subareas and the industrial zoned property east of the Subarea. This will require pressure reducing valves in the lower elevations in the East Aldergrove Subarea. An additional 12" water main is planned along Aldergrove Road on the north boundary of the Subarea to provide a looped system. Water mains properly sized for fire flow should be extended and looped through the subarea as development occurs.

MID TERM SUBAREA 10 - GRANDVIEW BUSINESS CENTER
and
MID TERM SUBAREA 12 - I-5 BUSINESS PARK

AREA DESCRIPTION

These two Subareas are zoned by Whatcom County as Light Industrial Impact. Subarea 10 contains approximately 28 acres, of which 85% is developed, and Subarea 12 contains approximately 60 acres, of which 25% is developed. The location is shown on Plate 4.

PROPOSED ZONING

After annexation by the City, the anticipated use is Light Industrial and Office, per the Annexation Blueprint. This is consistent with the existing land use in both Subareas.

EXISTING WATER SERVICE

Both of these UGAs currently obtain water from the PUD No. 1 Grandview Water System. The system has two parallel and separate water systems, one for domestic water and one for fire suppression. The domestic system is served by a well with water rights of 116 gpm and 92 AFY. Water rights for the fire suppression system are instantaneous for fire flow purposes only. The fire system currently is served by a well and pumped surface water from a pond. Water mains for the potable system are 6" PVC and DI. The fire suppression system consists of 8" through 16" PVC and DI pipe. The surface water source for fire suppression has become un-reliable, and the PUD is investigating a new source consisting of constructing a pipeline from their high pressure pipeline on Aldergrove Road, approximately one mile to the south. The City and PUD have an interlocal agreement that addresses transfer of all or a portion of the water system from the PUD to the City. However the PUD could continue to provide water service to these subareas and possibly other nearby subareas after they are annexed into the City. A copy of the interlocal agreement is included in the appendix.

PROJECTED WATER USE

Based upon PUD water records for 2015, the average day demand for potable water use in the Grandview Area is approximately 140 gpd per developed acre. Estimated average day demand for Subarea 10 when fully developed is 3,960 gpd, and 8,400 gpd for Subarea 12. City of Ferndale Fire flow requirement for Commercial and Industrial Zoning is 3,000 gpm for 4 hours.

FUTURE WATER SERVICE

Two options were evaluated for water service to these subareas.

Option 1. ***The PUD continues to own and operate the water system.*** Subareas 10 and 12 are adjacent to a part of the City that currently does not have City water service. Since they are currently being served by the PUD and the PUD has the capacity to continue to serve them, the City could allow them to continue with service after annexation. Under the existing interlocal agreement the City could provide service in the future if it becomes available. The PUD service area also covers the area south of Subarea 12 that is within the City Limits, but is isolated by I-5, and that will be difficult to serve economically with City water. This area could also obtain water service from the PUD. One disadvantage to this option is the lack of public sewer. Current development in Subareas 10 and 12

utilize septic systems, but future development will require public sewer. If sewer is brought into the area, water will probably also be brought in.

Option 2. The *City takes over the portion of the Grandview Water System lying east of Portal Way* . Per the Interlocal Agreement, the Grandview Water System must be isolated from the City system at Portal Way. In order to accomplish this, the City must extend water mains through areas of the City that do not currently have water service to reach the Grandview Subareas. There are two routes that can be utilized.

Option 2a. Extend a 16" water main north on Malloy and tie into the Grandview Water Main on Portal Way. The existing 8" Grandview Water System water main on Portal Way would require replacement with a 16" main in order to provide 3,000 gpm of fire flow. The existing 12" main on Malloy would be capable of supplying the required fire flow, providing it was converted from the main pressure zone to the higher mid pressure zone. This will require reconfiguring mains on Thornton Road and installing pressure reducing valves on services affected by the pressure change. The existing 12" main on Malloy would be upgraded to 16" in the future as improvements are made. The PUD is considering constructing a 16" water main on Malloy Road from Aldergrove Road to Grandview Road. It is possible that Ferndale could take over that line in the future and serve the entire Grandview UGA.

Option 2b. Extend a 16" water main north on Enterprise from Portal Way to Grandview Road and then west to tie into the existing Grandview Water System Main. The existing undersized Grandview Water System main on Grandview Road east of I-5 would require replacement with a 16" main in order to provide fire flow. The 12" main on Portal Way is not capable of providing 3000 gpm, and an intertie across the BNSF tracks and I-5 at Aldergrove would be needed. This option would require approximately 1.5 miles of 16" water main extended through areas that are not in the Ferndale UGA.

MID TERM SUBAREA 11 - NORTHEAST GRANDVIEW

AREA DESCRIPTION

This Subarea is zoned by Whatcom County as Light Industrial Impact and contains approximately 120 acres, of which approximatly80% is developed. The Subarea is known as the Grandview Light Industrial Park and is located in a triangle north of Grandview Road, west of the BNSF Railroad and east of Delta Line Road. A small part of the Subarea along Grandview Road is in residential use. The Subarea is part of a larger industrial area known as the Grandview Area, comprised of several Mid-term and Long-Term Urban Growth Subareas. These Subareas are at the Grandview / I-5 Freeway Interchange and are becoming highly developed with commercial and industrial enterprises. Three subareas, 10, 11 and 12 are within the six year Mid Term Annexation timeline, and when City water service becomes available for one it is likely to become available for all three. The location is shown on Plate 4.

PROPOSED ZONING

After annexation by the City, the anticipated use is Light Industrial and Office, per the Annexation Blueprint. This is consistent with existing land use.

EXISTING WATER SERVICE

This UGA currently obtains water from the PUD No. 1 Grandview Water System. The system has two parallel and separate water systems, one for domestic water and one for fire suppression. The domestic system is served by a well with water rights of 116 gpm and 92 AFY. Water rights for the fire suppression system are instantaneous for fire flow purposes only. The fire system currently is served by a well and surface water pumped from a pond. Water mains for the potable system are 6" PVC and DI. The fire suppression system consists of 8" through 16" PVC and DI pipe. The surface water source for fire suppression has become un-reliable, and the PUD is investigating a new source that consists of constructing a pipeline from their high pressure surface water pipeline on Aldergrove Road, approximately one mile to the south. The route will be either along Malloy Road or Vista Drive. The City and PUD have an interlocal agreement that addresses transfer of all or a portion of the water system from the PUD to the City. However the PUD could continue to provide water service to this subarea and possibly other nearby subareas after they are annexed into the City. A copy of the interlocal agreement is included in the appendix.

PROJECTED WATER USE

Based upon PUD water records for 2015, the average day demand for potable water use in the Subarea is approximately 140 gpd per developed acre. Estimated average day demand for the entire Subarea when fully developed is 21,600 gpd. City of Ferndale Fire flow requirement for Commercial and Industrial Zoning is 3,000 gpm for 4 hours.

FUTURE WATER SERVICE

Two options were evaluated for water service to these subareas.

*Option 1. **The PUD continues to own and operate the water system.*** Subarea 11 is adjacent to a part of the City that currently does not have water service. Since the Subarea is currently being served by the PUD and the PUD has the capacity to continue service, the City could allow them to continue to

supply water service after annexation. Under the interlocal agreement the City could provide service in the future if it becomes available. The PUD service area also covers several UGA Subareas south of Subarea 11, and has the capacity and ability to serve them. One disadvantage to this option is the lack of public sewer. All developed properties in Subarea 11 utilize septic systems, but future development may require public sewer. If sewer is brought into the area, water will probably also be brought in.

Option 2. ***The City takes over the portion of the Grandview Water System lying east of Portal Way and extends it to include Subarea 11.*** The City would take over the entire Grandview Water System from the PUD. Under this option, the City will have already extended water to Subareas 10 and 12 lying east of Portal way, or must extend the water main on Malloy Road/ Portal Way to the Grandview area as described in Option 2 of the Subarea 10 and 12 section of this report. At that point the City must determine if they want to keep separate potable and fire systems, or convert the larger fire system to serve both potable and fire needs. If the existing fire system is used for potable water it would need to be disinfected, tested and services changed over.

LONG TERM SUBAREA 13 – SOUTH GRANDVIEW

AREA DESCRIPTION

This Subarea is located South of Grandview Road and west of the BNSF Railroad. It includes approximately 80 acres zoned by Whatcom County for Light Industry. The easterly half is composed of the Northgate Industrial Park which has two facilities located on it. The westerly portion is a farm. This Subarea is immediately south of the Grandview Light Industrial Park, which is in the Mid Term UGA, and is presumed to have been previously annexed and served with City Water. This Subareas is outside of the 20 year planning window, but since it is in the UGA, any portion of the water system that will serve it must be designed to accommodate it in the future. The location is shown on Plate 4.

PROPOSED ZONING

After annexation by the City, the anticipated use is Light Industrial and Office.

EXISTING WATER SERVICE

The Northgate Industrial Park in this Subarea currently obtains water from the Grandview Water System, which has two separate water systems, one for potable water and one for fire suppression.

PROJECTED WATER USE

Based upon PUD water records for 2015, the average day demand for potable water use in the Grandview Area is approximately 140 gpd per developed acre. Estimated average day demand for Subarea 13 when fully developed is 11,200 gpd. City of Ferndale Fire flow requirement for Commercial and Industrial Zoning is 3,000 gpm for 4 hours.

FUTURE WATER SERVICE

Two options were evaluated for water service to these subareas.

Option 1. ***The PUD continues to own and operate the water system.*** Subarea 13 is currently being served by the PUD, and since the PUD has the capacity to continue service, the City could allow the PUD to supply water service after annexation. Under an interlocal agreement the City could provide service in the future if it becomes available. One disadvantage to this option is the lack of public sewer. All developed properties in Subareas 13 utilize septic systems, but future development may require public sewer. If City sewer is brought into the area, City water will probably also be brought in.

Option 2. ***The City takes over the Grandview Water System extends it to Subarea 13.*** The City would take over the entire Grandview Water System from the PUD. Under this option, the City will have already extended water to the Grandview Area, or must extend the water main on Malloy Road/ Portal Way to the Grandview area as described in Option 2 of the Subarea 10 and 12 section of this report. At that point the City must determine if they want to keep separate potable and fire systems, or convert the larger fire system to serve both potable and fire needs. If the existing fire system is used for potable water it would need to be disinfected, tested and services changed over.

LONG TERM SUBAREA 14 – SOUTHWEST GRANDVIEW

AREA DESCRIPTION

This Subarea is located South of Grandview Road and east of Vista Drive. It includes approximately 40 acres zoned by Whatcom County as UR4. A mobile home park is located on the easterly portion and the remainder is large lot residential and agriculture. This Subarea is immediately south of the Grandview Light Industrial Park, which is in the Mid Term UGA, and is presumed to have been previously annexed and served with either PUD or City Water. This Subarea is outside of the 20 year planning window, but since it is in the City's Long Term UGA, any future portion of the water system that will serve it must be designed to accommodate it in the future. The location is shown on Plate 4.

PROPOSED ZONING

After annexation by the City, the anticipated use is Light Industrial and Office.

EXISTING WATER SERVICE

The mobile home park is served by the Fairfield Mobile Home Park water system.

PROJECTED WATER USE

Based upon PUD water records for 2015, the average day demand for potable water use in the Grandview Area is approximately 140 gpd per developed acre. Estimated average day demand for Subarea 14 when fully developed is 5,600 gpd. City of Ferndale Fire flow requirement for Commercial and Industrial Zoning is 3,000 gpm for 4 hours.

FUTURE WATER SERVICE

Two options were evaluated for water service to these subareas.

Option 1. ***The PUD continues to own and operate the Grandview Water System.*** Subarea 14 is adjacent to Mid Term Subarea 11, and is within the PUDs Service Area. Since Subarea 11 is currently being served by the PUD, the City could allow them to continue to supply water service after annexation, and expand service into Subarea 14. Under the interlocal agreement the City could provide service in the future if it becomes available. One disadvantage to this option is the lack of public sewer. All developed properties in Subarea 14 utilize septic systems, but future development may require public sewer. If sewer is brought into the area, water will probably also be brought in.

Option 2. ***The City takes over the Grandview Water System and extends it to Subarea 14.*** The City would take over the entire Grandview Water System from the PUD. Under this option, the City will have already extended water to the Mid Term Subareas in the Grandview Area, or will have extended the water main on Malloy Road/ Portal Way to the Grandview area as described in Option 2 of the Subarea 10 and 12 section of this report. City service to the Grandview Area will be from the Mid Pressure zone, required for fire flow. This zone is served by the Bakerview Tank and the Church Road and Thornton Road Booster Stations. The lower elevations within the Subareas will require use of pressure reducing valves. Water mains properly sized for fire flow should be extended and looped through the subareas as development occurs.

LONG TERM SUBAREA 15 – NORTH MALLOY and LONG TERM SUBAREA 16 – SOUTH MALLOY

AREA DESCRIPTION

These Subareas are located west of Malloy Road between Aldergrove Road and Portal Way. Subarea 15 is approximately 35 acres in size and is located north of Brown Road. Subarea 16 is approximately 60 acres in size and is located south of Brown Road. Both Subareas are zoned UR4 by Whatcom County. The Subareas are currently used for large area residential and hobby farming. The Subareas are outside of the 20 year planning window, but since they are in the UGA, any future portion of the water system that will serve them must be designed to accommodate them in the future. The location is shown on Plate 4.

PROPOSED ZONING

After annexation by the City, the anticipated use of both Subareas is Low Density Residential.

EXISTING WATER SERVICE

There is no public water service to this area.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre in the Subareas will have approximately 560 ERUs. Projected water use per ERU per the City's WSP is:

Table 7, Long Term Subareas 15 and 16 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 140 ERUs (Subarea 15)*	*Water Use for 240 ERUs (Subarea 16)*
Average Day Demand	175 gpd	24,500 gpd	42,000 gpd
Maximum Day Demand	305 gpd	42,700 gpd	73,200 gpd
Peak Hourly Demand	0.349 gpm	49 gpm	84 gpm
Annual Use	0.196 AFY	27 AFY	47 AFY
Fire Demand	1,000 gpm	1,000 gpm	1,000 gpm

The above water use is for estimated full buildout, which may take many years. Growth projections by the Ferndale Community Development Department include these Subareas, and have been utilized in the Water System Plan to estimate future water demands and Capital Improvements required to serve the entire City and its Urban Growth Areas.

FUTURE WATER SERVICE

Subarea 15 is within the PUD Service Area, and it is possible that the PUD may serve them, if the PUD continues to serve the Grandview Area. However both Subareas are adjacent to undeveloped land east of Malloy Road that does not have water service. When the City extends water service North on Malloy to serve the property within the City, the water mains will go past these Subareas. The proposed water main on Malloy Road is a 16" main. The water main will be served by the Mid Zone as required to get fire flow to the Grandview Area. This pressure zone is served by the Bakerview Tank and the Church Road and Thornton Booster Stations. The lower elevations within the Subareas will require use of pressure reducing valves. Water mains properly sized for fire flow should be extended and looped through the subareas as development occurs.

LONG TERM SUBAREA 17 – DELTA LINE

AREA DESCRIPTION

This Subarea is located north of Grandview Road and Vista Drive, and south of the BNSF Railroad. It is adjacent to Subarea 11 to the east. It includes approximately 90 acres zoned by Whatcom County as Light Impact Industrial. Delta Tech Industrial Park is located on the northern third of the property and the remainder is large lot residential and agriculture. This Subarea is immediately west of the Grandview Light Industrial Park, which is in the Mid Term UGA, and is presumed to have been previously annexed and served with City Water. Subarea 17 is outside of the 20 year planning window, but since it is in the UGA, any future portion of the water system that will serve it must be designed to accommodate it in the future. The location is shown on Plate 4.

PROPOSED ZONING

After annexation by the City, the anticipated use is Light Industrial and Office.

EXISTING WATER SERVICE

The Delta Tech Industrial Park is served by a private well.

PROJECTED WATER USE

Based upon PUD water records for 2015, the average day demand for potable water use in the Grandview Area is approximately 140 gpd per developed acre. Estimated average day demand for Subarea 17 when fully developed is 12,600 gpd. The City of Ferndale Fire flow requirement for Commercial and Industrial Zoning is 3,000 gpm for 4 hours.

FUTURE WATER SERVICE

Two options were evaluated for water service to these subareas.

*Option 1. **The PUD continues to own and operate the Grandview Water System.*** Subarea 17 is adjacent to Mid Term Subarea 11, and is within the PUDs Service Area. Since Subarea 11 is currently being served by the PUD, the City could allow them to continue to supply water service after annexation, and expand service into Subarea 17. Under the interlocal agreement the City could provide service in the future if it becomes available. One disadvantage to this option is the lack of public sewer. All developed properties in Subarea 14 utilize septic systems, but future development may require public sewer. If sewer is brought into the area, water will probably also be brought in.

Option 2. ***The City takes over the Grandview Water System and extends it to Subarea 17***. The City would take over the entire Grandview Water System from the PUD. Under this option, the City will have already extended water to the Mid Term Subareas in the Grandview Area as described in Option 2 of the Subarea 10 and 12 section of this report. The City service to the Grandview Area will be from the higher Mid Pressure zone, which is required for fire flow. This zone is served by the Bakerview Tank and the Church Road and Thornton Road Booster Stations. A 12" water main should be extended from Grandview Road north on Delta Line Road, and tied into the water main on Salashan Parkway to form a looped system. Water mains properly sized for fire flow should be extended and looped through the subareas as development occurs. The lower elevations within the Subareas will require use of pressure reducing valves.

UGA RESERVE SUBAREA 18 – SLATER EAST

As part of the 2016 Comprehensive Plan Update, Whatcom County converted Subarea 18 from Urban Growth Area Reserve to Urban Growth Area. The conversion was based on a proposal made by the City of Ferndale on behalf of land owners in that area. The conversion followed an analysis by the City and its consultants, which demonstrated that Ferndale has sufficient water capacity to support future build out of the area. Future conveyance of City services will depend upon development proposals within the area, and will likely be paid for by the applicant as a condition of development approval. Future updates to this plan may identify future City improvements or extension of services, but none are anticipated as part of this update.

AREA DESCRIPTION

Subarea 18 is located at the northeast quadrant of the I-5/Slater Road interchange. It includes 144 acres composed of large lot residences, two businesses and agricultural land. It is zoned "Rural Residential - 5 Acres" by Whatcom County. The location is shown on Plate 5.

PROPOSED ZONING

After annexation by the City, the anticipated use is commercial.

EXISTING WATER SERVICE

Subarea 18 is located within the Northwest Water Association Service Area.

PROJECTED WATER USE

This Subarea is located on a major freeway interchange, and could have many different uses. The most probable uses are large scale retail, warehousing and light industrial. These uses are anticipated to use water consistent with other such existing developments in the Grandview Area, which is also located on a major interchange. The historical water use in the Grandview Area is 140 gallons per day, or 0.8 ERUs, per gross acre. At this rate, full buildout of Subarea 18 would require approximately 20,000 gpd, and be equivalent to 115 ERUs. Fire flow requirements would be 3,000 gpm for 4 hours.

FUTURE WATER SERVICE

The northwest corner of the Subarea is adjacent to the City Limits. There is an existing 12" looped City water main at that point that can be extended into the Subarea, and southeast along Slater Road. The property is in the Main Pressure Zone, and is served by the Thornton Road Tank and the Water Treatment Plant Booster Pumps.

UGA RESERVE SUBAREA 19 – ENTERPRISE ROAD

AREA DESCRIPTION

Subarea 19 is located west of Enterprise Road from Portal Way on the south to approximately ¼ mile north of Grandview Road. It is bounded on the west by I-5 and the City Limits. It includes approximately 90 acres composed primarily of agricultural uses. It is zoned "Rural - 5 Acres" by Whatcom County. The location is shown on Plate 5.

PROPOSED ZONING

After annexation by the City, the anticipated use is Commercial.

EXISTING WATER SERVICE

The Subarea does not have public water service.

PROJECTED WATER USE

This Subarea is located east of a major freeway interchange, and has freeway exposure. The most probable use is light industrial and commercial. These uses are anticipated to use water consistent with other such development in the Grandview Area. The historical water use in the Grandview Area is 140 gallons per day, or 0.8 ERUs, per gross acre. At this rate Subarea 19 would use approximately 12,600 gpd, and be equivalent to 72 ERUs. Fire flow requirements would be 3,000 gpm for 4 hours.

FUTURE WATER SERVICE

A 12" water main is located on Enterprise Road at the south boundary of the Subarea. This water main should be extended north along, or just west of Enterprise Road to Grandview Road, where it could connect to the Grandview Water System. In order to be capable of providing the required fire flow, a tie in across I-5 at Aldergrove Road or Matz Road would be required. The property is in the Main Pressure Zone, and is served by the Thornton Road Tank and the Water Treatment Plant Booster Pumps. The water main to serve the Grandview Area may be required before this Subarea is annexed. In that case the main extension will be through County controlled property and will be subject to County requirements.

UGA RESERVE SUBAREA 20 –BROWN ROAD

AREA DESCRIPTION

Subarea 20 is located between Aldergrove Road on the south and Brown Road on the north. Vista Drive runs through the westerly portion of the Subarea and the easterly boundary is adjacent to Subareas 15 and 16. It includes approximately 395 acres composed primarily of agricultural uses and large tract residential. It is zoned "Rural - 10 Acres" by Whatcom County. The location is shown on Plate 4.

PROPOSED ZONING

After annexation by the City, the anticipated use is residential as neighborhood commercial.

EXISTING WATER SERVICE

The portion of the Subarea along Vista Drive is served by the Orchard Water Association.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre in the Subareas will have approximately 1,580 ERUs. Projected water use per ERU per the City's WSP is:

Table 8, UGA Reserve Subarea 20 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 1,580 ERUs*
Average Day Demand	175 gpd	276,500 gpd
Maximum Day Demand	305 gpd	481,900 gpd
Peak Hourly Demand	0.349 gpm	550 gpm
Annual Use	0.196 AFY	310 AFY
Fire Demand	3,000 gpm	3,000 gpm

The above water use is for estimated full buildout, which may take many years. Growth projections by the Ferndale Community Development Department include these Subareas, and have been utilized in the Water System Plan to estimate future water demands and Capital Improvements required to serve the entire City and its Urban Growth Areas. Fire flow requirements would be 3,000 gpm for 4 hours for commercial facilities and 1,000 to 2,000 gpm for residential.

FUTURE WATER SERVICE

A 12" water main on Vista Drive to the south would be extended north on Vista Drive and connect into the Grandview System to the north. The Subarea would also be served by 12" water mains on Aldergrove Road and Brown Road. Internal water mains required to serve the future development will require sizing and placement consistent with the specific development and land use. Water mains should be looped whenever feasible. The Subarea is in the Mid Pressure Zone, and is served by the Bakerview Tank and the Church Road and Thornton Booster Pump Stations.

UGA RESERVE SUBAREA 22 –MOUNTAIN VIEW

AREA DESCRIPTION

Subarea 22 is located north of Mountain View Road (Main Street) and extends northerly approximately one half mile to the existing City limits on the north. It extends from the existing City Limits on the east approximately on half mile west. It includes approximately 155 acres composed primarily of agricultural uses and large tract residential. It is zoned "Rural - 10 Acres" by Whatcom County. The location is shown on Plate 3.

PROPOSED ZONING

After annexation by the City, the anticipated use is low density residential.

EXISTING WATER SERVICE

The Subarea along Vista Drive is served by the Mountain View Water Association.

PROJECTED WATER USE

At full buildout at 4 dwelling units per acre in the Subareas will have approximately 620 ERUs. Projected water use per ERU per the City's WSP is:

Table 9, UGA Reserve Subareas 15 and 16 Projected Water Use

Water Use	*Water Use per ERU*	*Water Use for 620 ERUs*
Average Day Demand	175 gpd	108,500 gpd
Maximum Day Demand	305 gpd	189,100 gpd
Peak Hourly Demand	0.349 gpm	216 gpm
Annual Use	0.196 AFY	122 AFY
Fire Demand	2,000 gpm	2,000 gpm

The above water use is for estimated full buildout, which may take many years. Growth projections by the Ferndale Community Development Department include these Subareas, and have been utilized in the Water System Plan to estimate future water demands and Capital Improvements required to serve the entire City and its Urban Growth Areas. Fire flow requirements would be1,000 gpm for low density residential, but may be greater for mixed use.

FUTURE WATER SERVICE

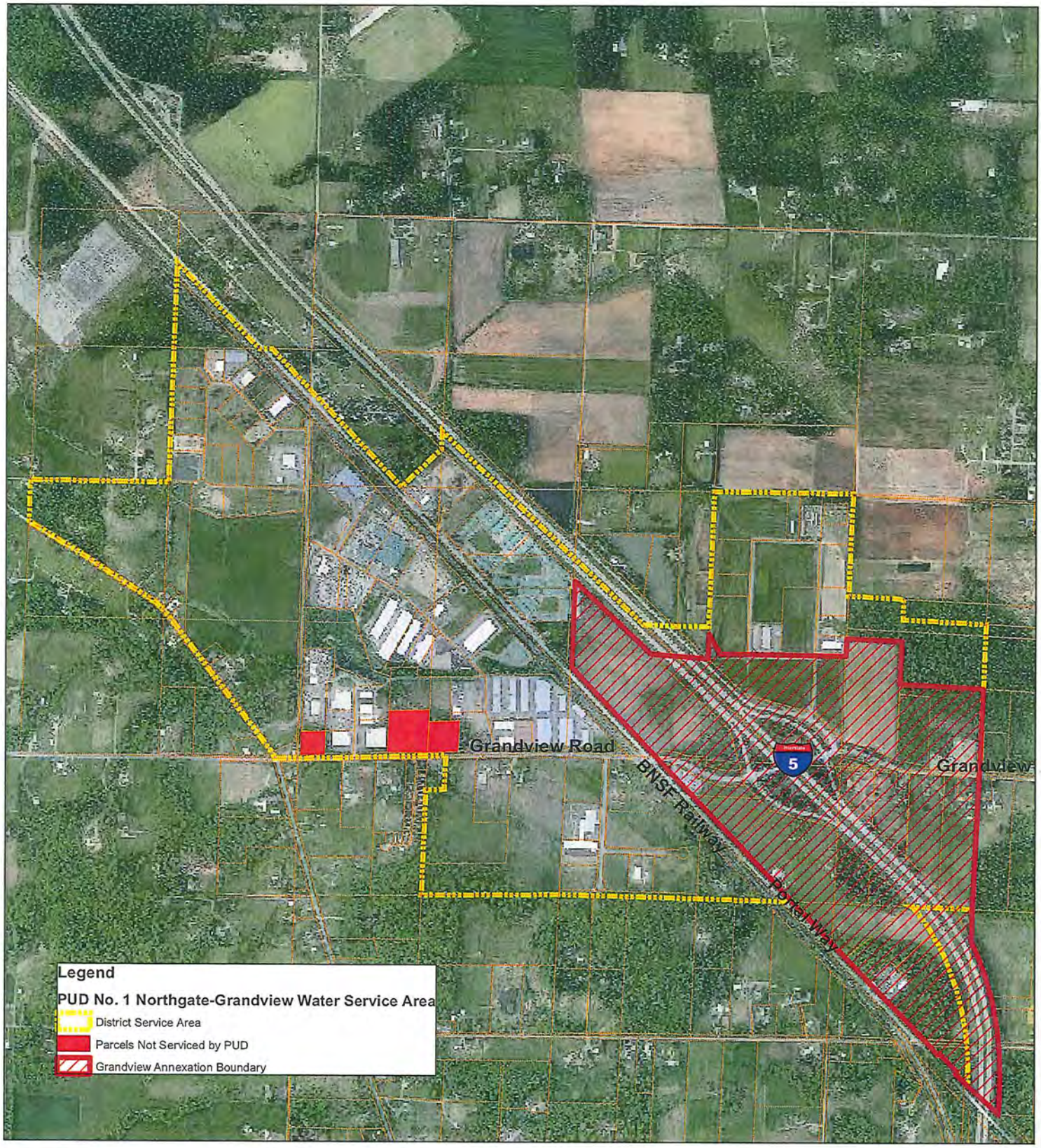
A 12" water main on Main Street to the east would be extended west along Mountain View Road to the west edge of the Subarea. The Subarea is primarily in the Mid Pressure Zone, but butts against the Bakerview Pressure Zone on the north. This will require virtually a complete looped water system throughout the Subarea. Some of the property on the north at higher elevations may require service from the Bakerview Pressure Zone.

UGA RESERVE SUBAREAS 21, 23 and 24

These three Subareas are smaller areas adjacent to the City Limits and currently have water utilities available or nearby. They are mostly fill-in contiguous areas. They are shown on Plates 2 and 3.

APPENDIX

PUD No. 1 Service Area
Grandview



City of Ferndale
WASHINGTON

DISCLAIMER: USE OF THIS MAP IMPLIES THE USER'S AGREEMENT WITH THE FOLLOWING STATEMENT:

The City of Ferndale disclaims any warranty of merchantability or warranty of fitness of this map for any particular purpose, either express or implied. No representation or warranty is made concerning the accuracy, currency, completeness or quality of data depicted on this map. Any user of this map assumes all responsibility for use thereof, and further agrees to hold the City of Ferndale harmless from and against any damage, loss, or liability arising from any use of this map.

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PUBLIC UTILITY DISTRICT NO. 1
of Whatcom County
1705 Trigg Road • Ferndale, WA 98248
P: (360) 384-4288 • F: (360) 384-4849
email: info@pudwhatcom.org
www.pudwhatcom.org

August 24, 2010

Greg Young
City Administrator
City of Ferndale
PO Box 936
Ferndale, WA 98248

RE: Grandview Annexation Interlocal Agreement

Dear Mr. Young,

The Board of Commissioners of Public Utility District No. 1 approved the Interlocal Agreement for the Grandview Annexation at their regular meeting this morning. Please find enclosed one fully signed copy. The City will need to record this document with the County. If you have any questions please contact Stephan Jilk at 384-4288 extension 12.

Sincerely,

Ann Grimm
Administrative Assistant

Enc.

Commissioners: Paul Kenner, Jeff McClure, Mike Murphy • Stephan (Steve) Jilk, General Manager

INTERLOCAL AGREEMENT
BETWEEN THE CITY OF FERNDALE AND
PUBLIC UTILITY DISTRICT NO. 1 OF WHATCOM COUNTY
RELATED TO THE CITY'S 2010 GRANDVIEW ANNEXATION

FINAL

This Interlocal Agreement ("Interlocal") dated August 10, 2010 is between the City of Ferndale ("City"), and the Public Utility District No 1of Whatcom County ("PUD") is made by and between the parties pursuant to the Interlocal Cooperation Act, RCW 39.34 and is based upon the following:

Whereas, the PUD owns and operates a potable and non-potable water system with water for those systems supplied by PUD owned and operated wells ("Grandview Water System") in an area north of the current City limits; and

Whereas, this system provides water services to the Northgate, Grandview, and Interstate 5 Industrial Zones as well as additional properties along I-5, Portal Way, and Grandview Road ("Grandview Service Area" - see Exhibit A); and

Whereas, the PUD holds water rights for the groundwater wells that serve the Grandview Water System; and

Whereas, these water rights have been determined by the PUD to be sufficient to serve those properties included in the Grandview Service Area; and

Whereas, certain Grandview Water System improvements were completed by the PUD through the formation of a Local Utility District ("LUD") in 2004, for which outstanding debt remains; and

Whereas, the overall service area of the PUD Grandview Water System includes properties currently being served by the PUD as a result of the LUD as well as properties not currently being served but within the Grandview Service Area; and

Whereas, the PUD Grandview Service Area is on both the east and west side of Portal Way; and

Whereas, the overall service area of the Grandview Water System is greater than the current Ferndale Urban Growth Area ("UGA") in this portion of the City; and

Whereas, the City is currently considering an annexation of some but not all of the UGA in this area ("2010 Grandview Annexation") and;

Whereas, the 2010 Grandview Annexation will bring certain properties into the City, all of which are located on the east side of Portal Way; and

Whereas, the 2010 Grandview Annexation will bring certain active service areas of the PUD's Grandview Water System into the city limits; and

Whereas, both Parties are interested in establishing an understanding as to the current and future ownership, operation, and expansion of the Grandview Water System following completion of the 2010 Grandview Annexation; and

Whereas, the City's 2010 Grandview Annexation of a portion of the PUD Grandview Service Area necessitates that the parties establish through an Interlocal certain understandings, commitments, undertakings, and obligations to facilitate and to enable the 2010 Grandview Annexation to occur without challenge from the PUD, to establish cooperative relations that may allow the City to acquire all or a portion of the Grandview Water System, and to establish a binding agreement to ensure the protection of the Grandview Water System, the Grandview LUD, and to establish mechanisms that facilitate connection to the City's Water and Wastewater systems.

NOW THEREFORE, THE FOLLOWING IS HEREBY AGREED AND THE PARTIES AGREE TO BE BOUND AS FOLLOWS:

Section 1. Intention of the Parties

It is the intention of the Parties to set out a framework whereby the City could assume ownership and operation of all or some of the Grandview Water System. It is also the intention of the Parties to outline operational control responsibilities between the PUD and the City following the 2010 Grandview Annexation but prior to the assumption of ownership by the City of any portion of the Grandview Water System including but not limited to the provision of new and/or additional water service to customers within the Grandview Water System Service Area, and limitations thereto.

Section 2. Capital and Operational Review

The City is currently undertaking a study of the Grandview Water System infrastructure together with a review of the Grandview Water System operations and financial management. It is anticipated that this study and review will be completed by June 30, 2011. The purpose of this study is to identify the current and future infrastructure needs of the Grandview Water System so the City can determine if the system is viable and in the best interest of the City to acquire, in whole or in part, as well as a review of the operational issues that would become salient following acquisition of the system by the City.

The Study will also address the technical issues that would allow the City to acquire some but not all of the Grandview Water System. This review shall determine the technical aspects of the City initially acquiring the portion of the Grandview Water System located on the east side of Portal Way following the extension of City water lines into the 2010 Grandview Annexation area together with the ability for the PUD to continue providing water service to the remainder of their Service Area located on the west side of Portal Way from their existing wells.

The PUD agrees to cooperate with the City in the completion of the study and will supply all publically available information to aid in the completion of this review. The cost of this review shall be solely the City's responsibility.

Section 3. Assumption of Grandview Water System Ownership and Operation

Following the completion of the studies outlined in Section 2 of this Interlocal and following a determination by the City that it is viable and in the best interests of the City to acquire all or a portion of the Grandview Water

System, the City will enter into negotiations with the PUD leading to the possible transfer of ownership and operation of the Grandview Water System as well as eventual transfer of water rights to the City.

Assuming that the results of the reviews detailed in Section 2 do not identify current deficiencies unacceptable to the City, the transfer of ownership of the eastern portion of the Grandview Water System could occur when a new 100,000 square foot or greater retail customer applies for and is granted a building permit from the City and it is determined by the City that the extension of City water lines into the annexed area can be accomplished and then only pursuant to a City and PUD mutually acceptable agreement for the City's acquisition of all or a portion of the Grandview Water System.

Under this scenario, the City may take over operation of the Grandview Water System Service Area on the eastern side of Portal Way with the supply of water being a developer-paid extension of City water lines into the annexed area. The current PUD water line(s) supplying the eastern portion of the Service Area (from PUD wells located on the western side of Portal Way) would be valved shut or otherwise disconnected, allowing the PUD to supply the Service Area on the western side of Portal Way independently.

It is the intention of the Parties that, in the event that the City does acquire the eastern portion of the Grandview Water System, the PUD will no longer have any operational responsibilities related to the eastern portion Grandview Water System following the transfer to the City as contemplated above. It is the intention of the parties to ensure the ability of the other Party to adequately supply water to the portions of the original Service Area for which either the City or the PUD retain. This may take the form of a transfer of easements, right-of-way or other provisions, possibly including the development of new facilities to replace needed functions for the remaining portion of the PUD Grandview Water System and/or to ensure either ownership or operational control over the water system infrastructure within the bifurcated Service Areas. The parties shall contemporaneously with any such action amend their water system plans and their retail service areas to reflect their respective revised service areas.

While this Interlocal addresses the issues related to the 2010 Grandview Annexation of properties on the eastern side of Portal Way, should the City move to annex the properties within their UGA on the western side of Portal Way, the Parties do hereby pledge to develop a follow-on Interlocal Agreement leading to the acquisition of the entire Grandview Water System by the City as well as the transfer of the PUD water rights to the City.

Should the review contemplated in Section 2 reflect significant current deficiencies in the Grandview Water System, the City and the PUD do hereby pledge to discuss the deficiencies and to develop a strategy to cure such deficiencies that do not result in an undue financial burden on either party. Should the City and the PUD be unable to craft an acceptable strategy for curing identified deficiencies, the City reserves the right to not acquire the Grandview Water System. Additionally, nothing in this Interlocal obligates the PUD to transfer all or a portion of the Grandview Water System to the City.

Section 4. Retention of the LUD Administration

The PUD will continue to manage the LUD, the collection of payments and the payment of debt service for all properties included in the 2004 LUD. Following the acquisition of the Grandview Water System by the City, the PUD will continue to fully administer the 2004 LUD until the outstanding debt is fully retired.

Section 5. PUD Provision of Water Service Following the 2010 Grandview Annexation

Following the completion of the 2010 Grandview Annexation but prior to the possible assumption of the eastern portion of the water system outlined in Section 3 by the City, the PUD will remain the designated water service provider in their Service Area. The City shall not extend any water service to any properties within the

Grandview Service Area, unless approved by the PUD. The City and the PUD will work cooperatively to design, permit, and approve any new connections, expansions or improvements to the Grandview Water System as well as any improvements or expansions to the system by existing customers with the understanding that such improvements shall be to current City standards and paid for by the customer(s) requesting or needing such improvements.

Prior to the issuance of any building permit within the annexed area, the City shall first contact the PUD to ascertain whether there is adequate PUD-supplied potable and non-potable service (which includes without limitation water supply, water pressure and duration of the supply and pressure) for the proposed use. If the PUD determines that there is inadequate water service for the proposed use or structure, the City shall not issue a building permit or zoning approval of any kind, provided however, that in the event that the PUD determines that there is inadequate water supply, the City may, in its discretion, extend water service to the proposed development.

Section 6. Annexation and the Boundary Review Board (BRB)
The purpose and intent of this Interlocal is to address issues relating to the continued supply of water in the PUD Grandview Service Area following the 2010 Grandview Annexation and the circumstances under which the City could potentially acquire and operate some or all of the Grandview Water System. It is agreed between the parties that this Interlocal does address these concerns and therefore the PUD will not invoke BRB jurisdiction for the 2010 Grandview Annexation.

Section 7. Wastewater
Once the 2010 Grandview Annexation is complete, the City will be the permitting agency for all development within the annexed area and may require the connection to the City wastewater system as a precursor for any development and/or expansion of existing uses in this area. It is agreed that the PUD will not provide any new water service in the annexed area without City approval, provided however that the foregoing does not prevent the PUD from expanding its water service to an existing customer within the annexed area provided that the City determines that existing on-site wastewater treatment facilities are able to adequately operate given the potential expansion of use.

Section 8. Recording
This Interlocal is intended to be recorded with the Whatcom County Auditor.

Section 9. Integration, Modification, Waiver
This Interlocal constitutes the complete and final expression of the agreement of the parties relating to the premises, and supersedes all previous contracts, agreements, and understandings of the parties, either oral or written, relating to the premises. This Interlocal cannot be modified, or any of the terms hereof waived, except by an instrument in writing executed by the City and the PUD.

Section 10. Governing Law, Jurisdiction and Venue
This Interlocal shall be governed by the laws of the State of Washington as to all matters, including but not limited to matters of validity, construction, effect, and performance and any action thereon shall be brought in Whatcom County Superior Court.

Section 11. Neutral Authorship
Each provision of this Interlocal has been reviewed and negotiated and represents the combined work product of all parties hereto. No presumption or other rules of construction which would interpret the provisions of this Interlocal in favor of or against the party preparing the same shall be applicable in connection with the construction or interpretation of any provisions of this Agreement.

Section 12. Notice
All notices and demands shall be in writing and sent to the addresses as follows:

TO CITY: Greg Young, City Administrator
City of Ferndale
PO Box 936
Ferndale WA 98248

TO PUD: Stephan Jilk, General Manager
Public Utility District No. 1 of Whatcom County
1705 Trigg Road
Ferndale WA 98248

Section 13. Severability
If a court of competent jurisdiction holds that any part, term, or provision of this Agreement to be illegal or invalid in whole or in part, the validity of the remaining provisions shall not be affected, and the parties' rights and obligations shall be construed and enforced as if the Agreement did not contain the particular provision held to be invalid. If any provision of this Agreement is in direct conflict with any statutory provision of the State of Washington, that provision shall be deemed inoperative and null and void insofar as it may conflict, and shall be deemed modified to conform to such statutory provision.

Section 14. No Third Party Beneficiaries
This Interlocal is entered into solely for the benefit of the parties hereto. This Agreement shall confer no benefits, direct or indirect, on any third persons or parties. No person or entity other than the parties of this Agreement themselves may rely upon or enforce any provisions of this Agreement.

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE EXECUTED THIS Interlocal Agreement the date and year first written above.

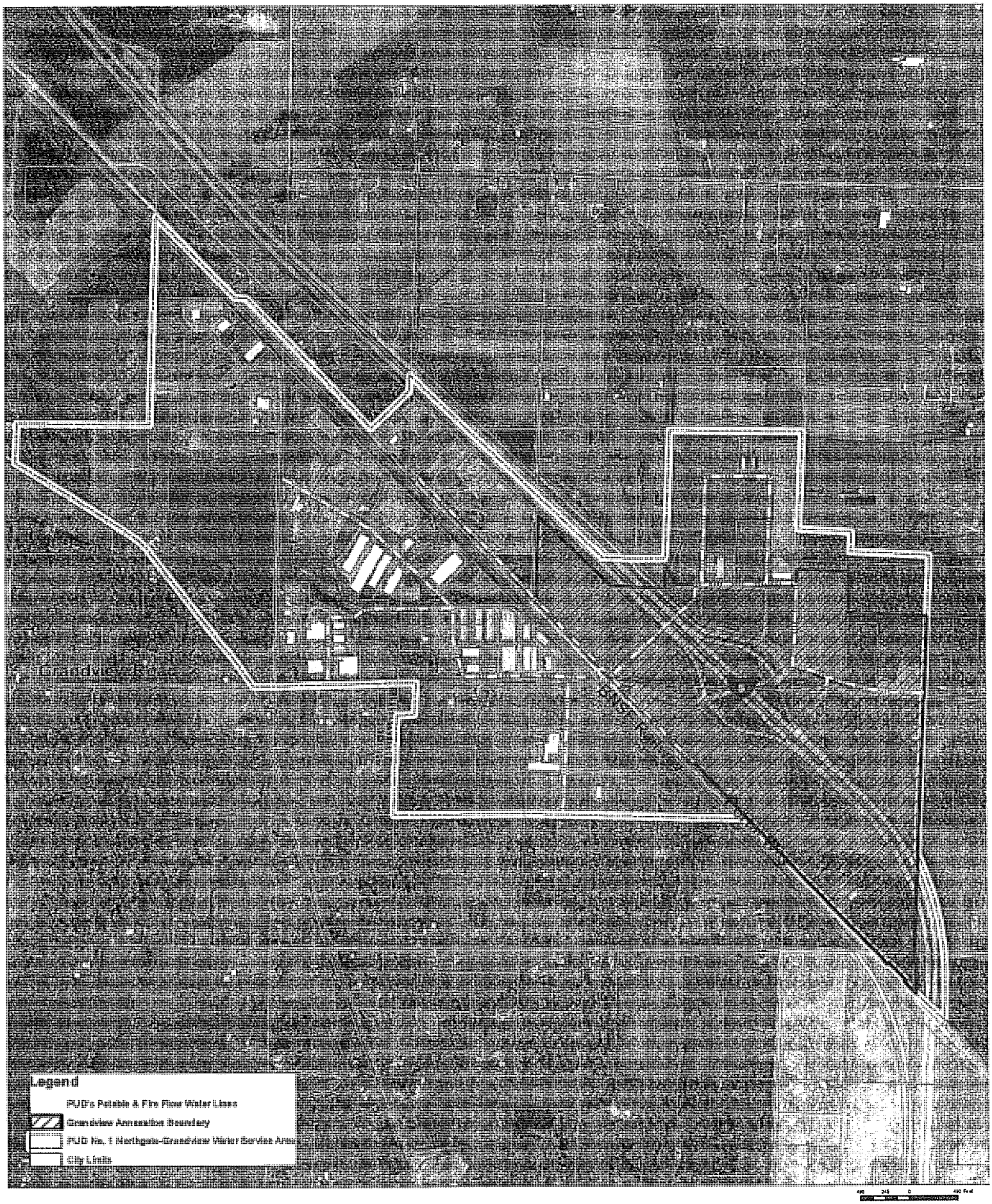
City of Ferndale

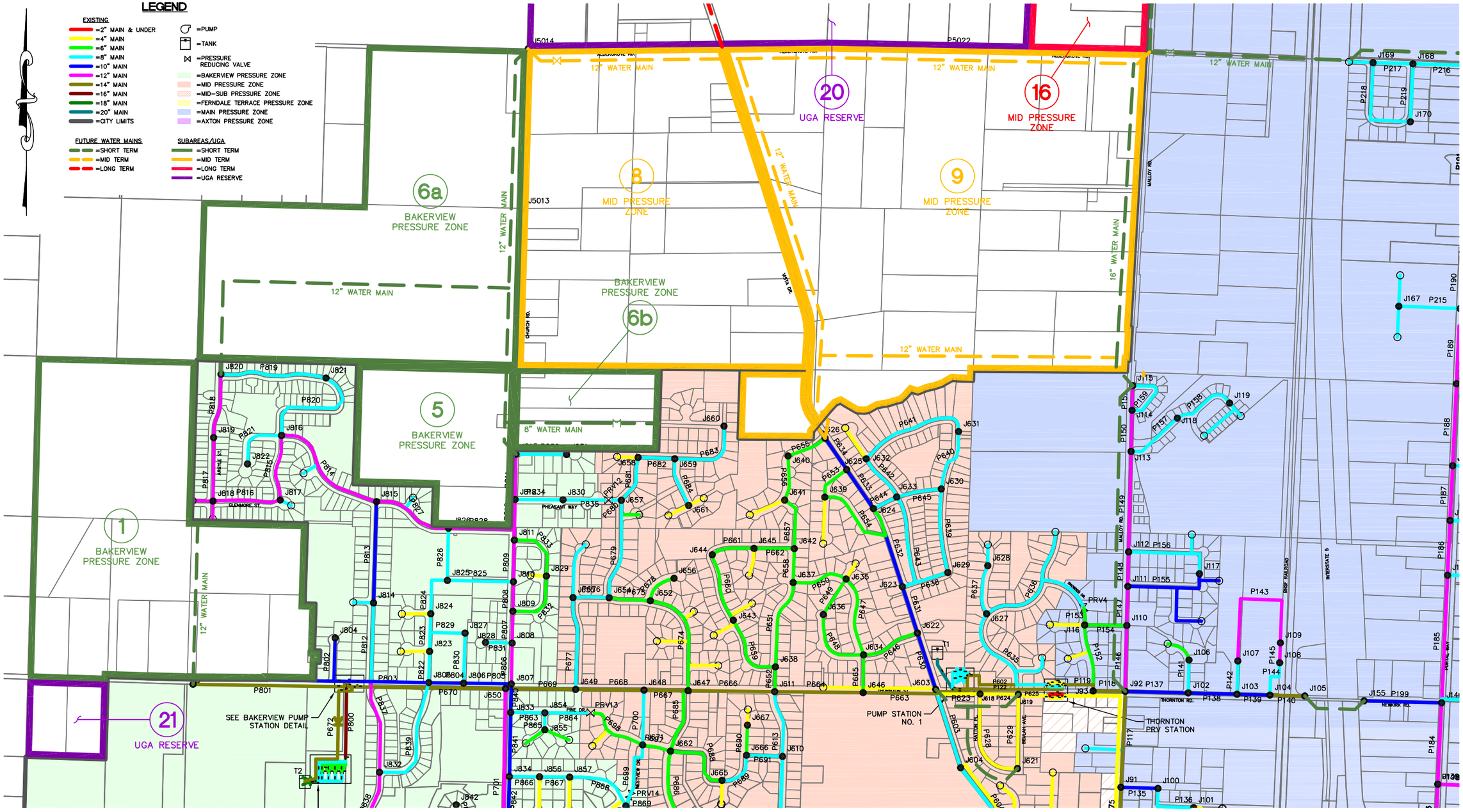
By: _____
Gary Jensen, Mayor

Whatcom County PUD No. 1

By: _____
Stephan Jilk, General Manager

Grandview Annexation Area





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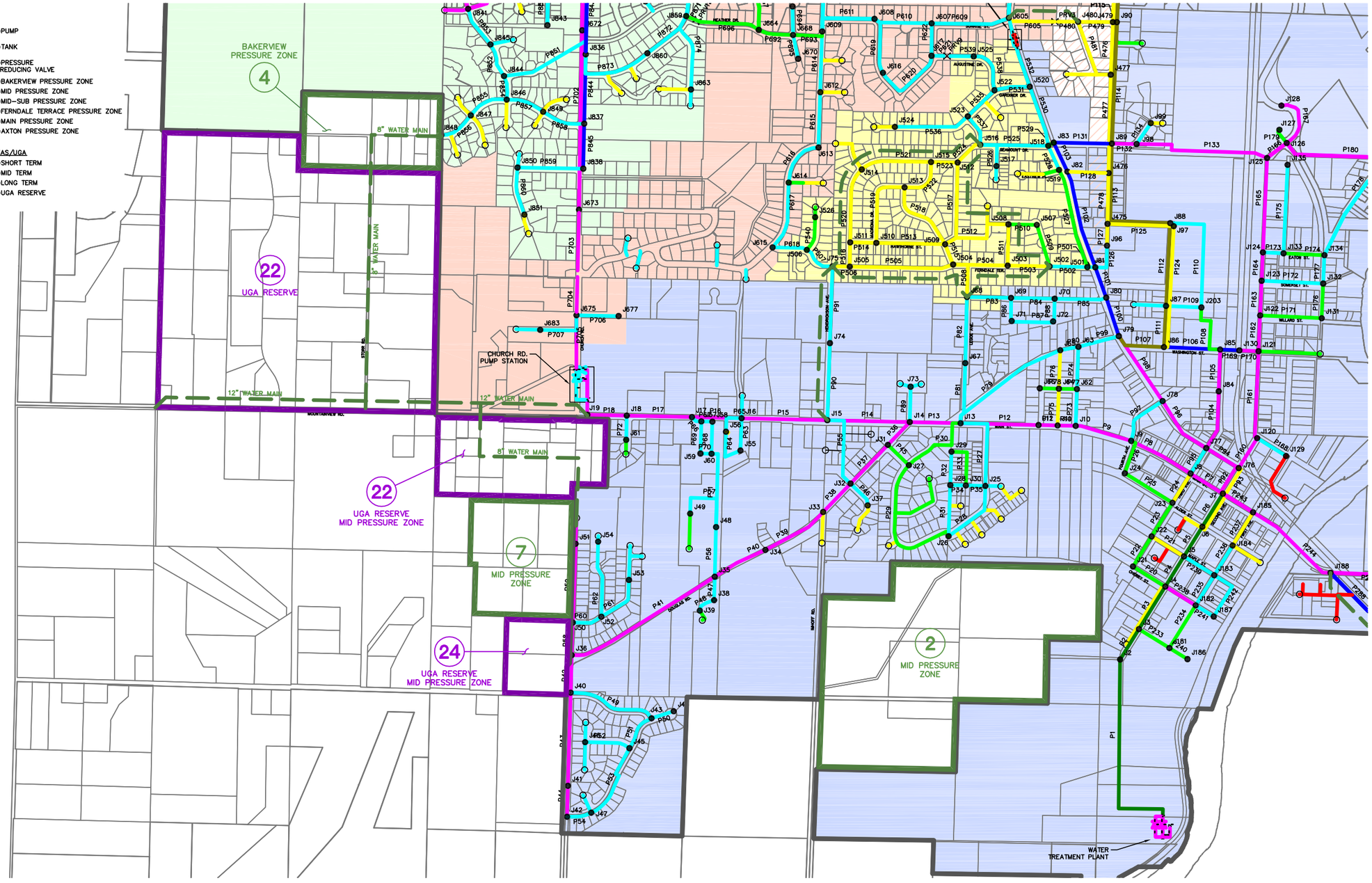
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- =CITY LIMITS

- =PUMP
- =TANK
- =PRESSURE REDUCING VALVE
- =BAKERVIEW PRESSURE ZONE
- =MID PRESSURE ZONE
- =MID-SUB PRESSURE ZONE
- =FERNDALE TERRACE PRESSURE ZONE
- =MAIN PRESSURE ZONE
- =AXTON PRESSURE ZONE

FUTURE WATER MAINS
- =SHORT TERM
- =MID TERM
- =LONG TERM

SUBAREAS/UGA
- =SHORT TERM
- =MID TERM
- =LONG TERM
- =UGA RESERVE



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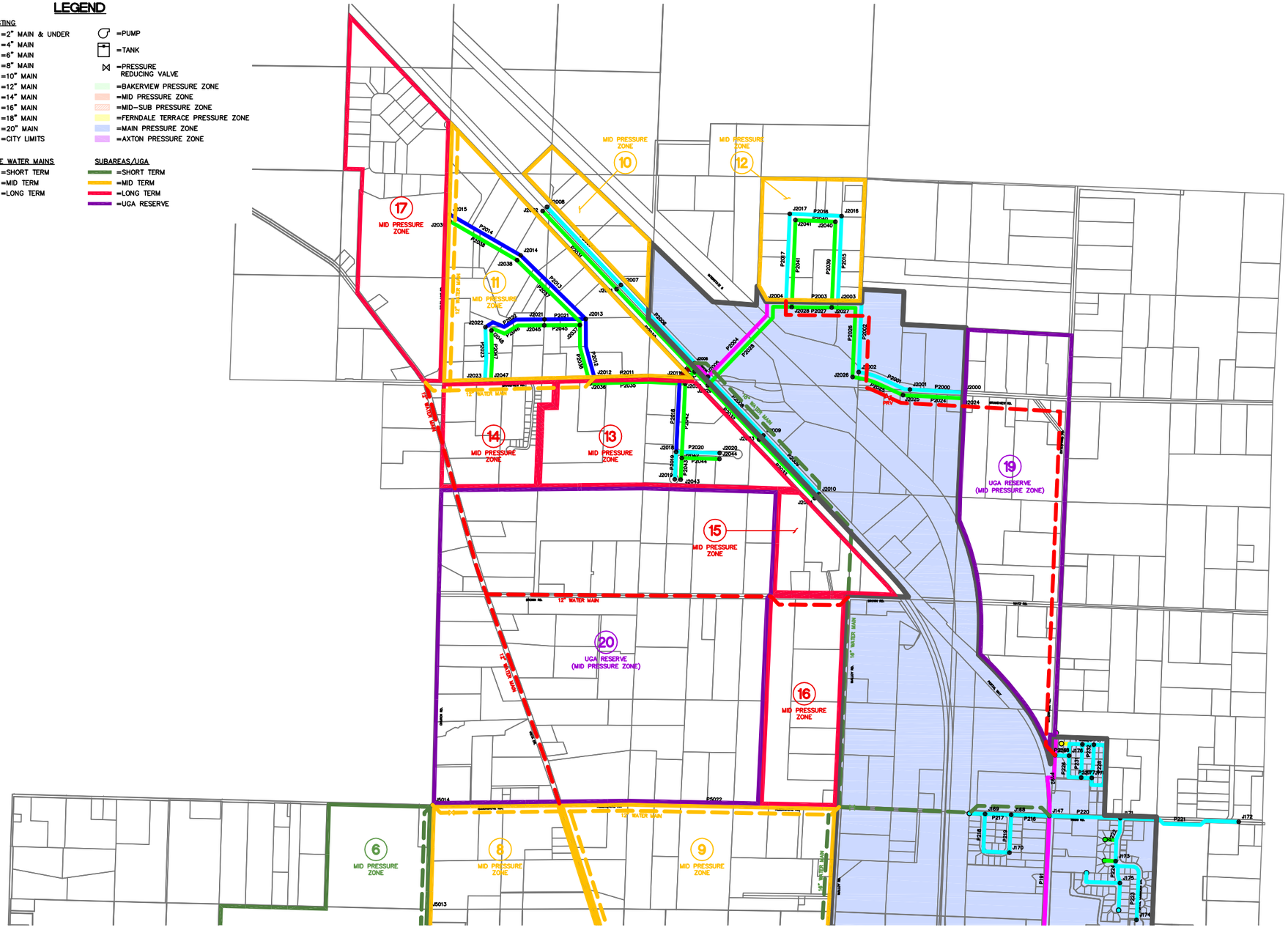
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FUTURE WATER MAINS

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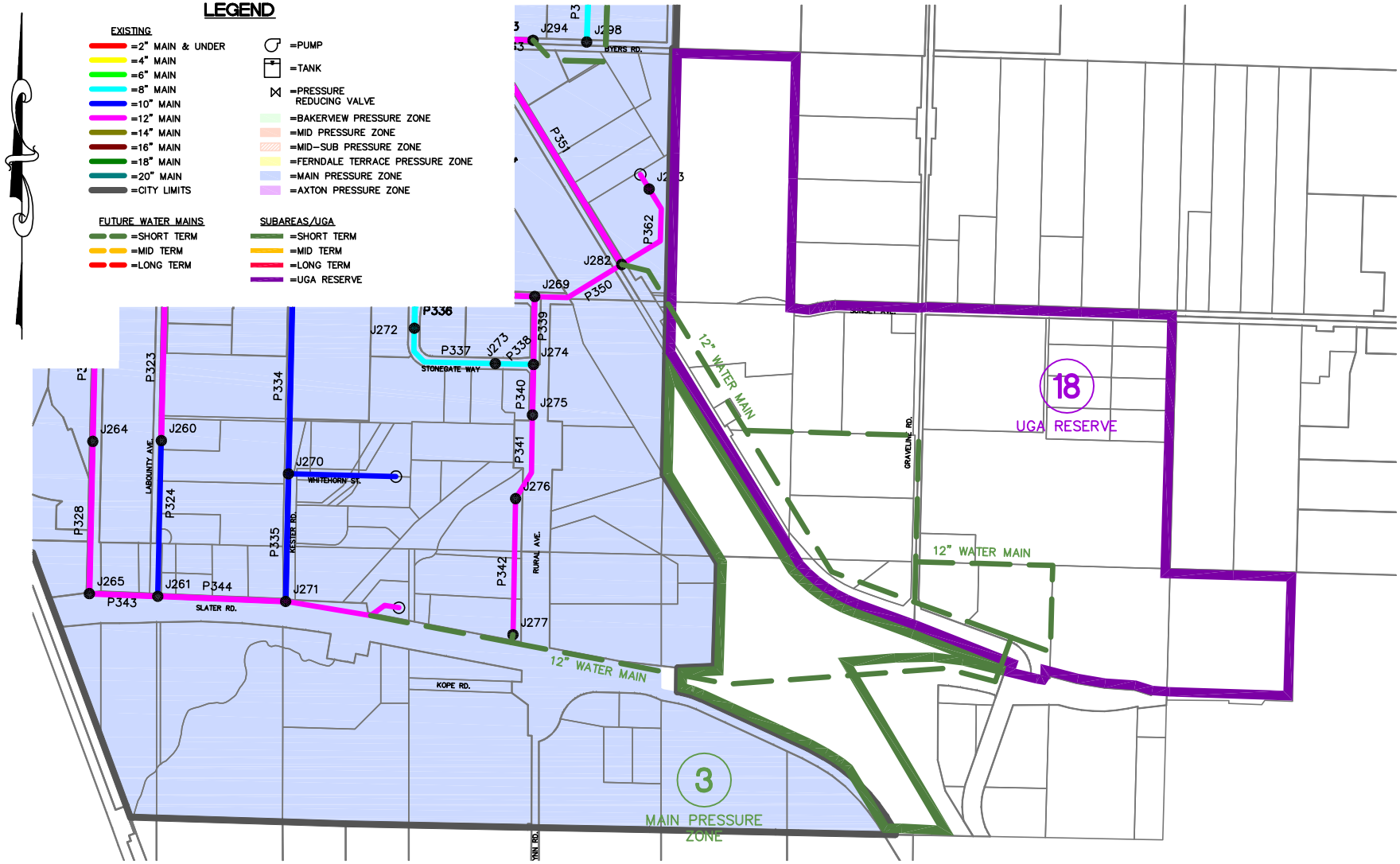
SUBAREAS/UGA

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- =UGA RESERVE



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R&E Reichhardt & Ebe ENGINEERING INC

423 Front St., Lynden, WA 98264 (360) 354-3687

813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

CITY OF FERNDALE

SUBAREAS 3, 18

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M. ANNEXATION BLUEPRINT

CITY OF FERNDALE

ANNEXATION BLUEPRINT

ANNEXATION PHASING PLAN: 2013-2034







City of Ferndale
WASHINGTON

TABLE OF CONTENTS

I. Purpose	4
II. Annexation Schedule	5
III. Legal Authority and Existing Regulations	6
IV. Annexation Policy	10
V. Annexation Methods	12
VI. Urban Growth Area History	14
VII. Limits of Annexation Blueprint	22
VIII. Annexation Areas	22
Short Term Annexation Areas (Currently Eligible for Annexation)	23
Thornton North ("Friberg Farm") Subarea 1	24
Schell Marsh (Subarea 2)	27
Slater Road WSDOT Property (Subarea 3)	30
Nubgaard Road (Subarea 4)	32
School District (Subarea 5)	34
North Church "Erickson Farm" (Subarea 6)	37
North Douglas (Subarea 7)	40
Mid-Term Annexation Areas (Eligible for Annexation 2021)	42
Central Aldergrove (Subarea 8)	43
East Aldergrove (Subarea 9)	47
Grandview Business Center (Subarea 10)	51
Northeast Grandview (Subarea 11)	53
I-5 Business Park (Subarea 12)	56
Long Term Annexation Areas (Eligible for Annexation After 2029)	58
Southeast Grandview (Subarea 13)	59
Southwest Grandview (Subarea 14)	62
North Malloy (Subarea 15)	65
Central Malloy (Subarea 16)	67
Delta Line (Subarea 17)	70
Urban Reserves	73
Enterprise Road	74
South Main	75
Mountain View	76
Brown Road	77

Slater East	78
Sources	79

MAPS AND FIGURES

Map 1: Ferndale Urban Growth Area	8
Map 2: Annexation Phasing Plan	9
Map 3: Ferndale Annexation History	15
Map 4: Pre 1997: Provisional UGA	17
Map 5: 1997-2009: Ferndale UGA	17
Map 6: Current UGA	17
Map 7: Sewer Model – Loading Map	19
Map 8: Adjacent Water Purveyor Map	20
Map 9: Water System Plan	21

I. Purpose

The City of Ferndale has created this annexation blueprint in order to manage anticipated growth and related capital facilities programs, as required by the Washington State Growth Management Act (GMA). The Growth Management Act requires that cities and counties work together to forecast projected population changes, to determine the appropriate location for that population, to establish areas in which the City can expand within a twenty year planning period (Urban Growth Areas, or UGA's), and to prepare plans demonstrating that necessary public facilities can be provided to serve future City populations.

The Growth Management Act does not identify a specific mechanism through which these actions should take place, only that they must occur. The City of Ferndale has determined that the most appropriate way to manage growth is to plan for it, and to make those plans publicly available in order to provide consistent expectations to individual citizens, property owners, and affected agencies.

The annexation phasing schedule is based primarily on the capital facilities elements (transportation, water, sewer, stormwater) of the City's comprehensive plan – and the capital projects necessary to meet the objectives of each of those elements. The schedule is further balanced by the inventory of available land within the existing City limits, and the goal of maintaining a sufficient balance of residential, industrial, commercial and public land within the city at all times.The Annexation Blueprint identifies sixteen potential annexation areas and seven urban reserve study areas. The characteristics of each area are identified within this document, describing existing conditions, soil types, existing land use, projected land use, and more. The City has also identified the approximate timing that the annexation of specific areas may be proposed by property owners for City consideration. In some cases, additional conditions of annexation may be applied to specific areas.

The blueprint shall be used to provide the City and the larger community with a broad understanding of the anticipated impacts annexation will have on the City and the affected parcels. The City shall utilize this information to improve capital facilities planning, including roads, sewer, storm water, water, and parks. The information will also be used to guide the annexation process, including the timing of specific annexations as well as the obstacles and opportunities that each annexation might present.

The blueprint is intended to be flexible in its requirements, to a point: substantial flexibility shall be provided for annexations within designated subareas (partial annexations of subareas), for example. However the relative timing of annexations as described by this plan should be adhered to unless the blueprint is revised to reflect changing market or environmental conditions, or alterations to growth pressures (including the City's ability to serve) that may affect the lands in question.

II. Annexation Schedule

The annexation areas identified below are grouped into three seven-year timeframes. Within each timeframe, the areas are listed alphabetically, not chronologically. Use the letter following the area name with the related map. The City will proceed with annexation as efficiently and effectively as possible, consistent with State law requirements and popular support.

Annexation of areas as identified in this schedule cannot be assumed without City Council approval. The annexation schedule is subject to change based on development and market trends, City regulations, and more. Any numbering of annexation areas or subareas shown within this document or any other documents is intended for identification purposes only, and is not intended to reflect a specific annexation pattern.

The City does not anticipate initiating a major capital facilities project in the unincorporated Urban Growth Area within the first seven- year period of this plan. In addition, the inventory of developable commercial, industrial, and residential land within the incorporated City limits is sufficient for anticipated growth over that period. As a result, **within the first seven years** following adoption (2013-2020), the City projects that new annexations will generally be limited to areas with low-to-moderate development potential or which have one or more of the following attributes:

1. Properties are currently served by City utilities and take access from existing City roads

2. Properties are adjacent to City utilities of sufficient size to support the land uses anticipated by the comprehensive plan, and road improvements are limited to frontage improvements typical for development

3. Properties consist of developed neighborhoods or commercial/ industrial sites that are at or close to densities/ level of development anticipated by the comprehensive plan.

The second seven- year period (2021-2028) includes residential land areas in close proximity to Malloy Road, as well as developed industrial properties at and around Grandview Roads. It is unlikely that the property owners of either area will be willing or able to pay the full costs of extending City services despite their proximity to the existing City limits. While capital projects to extend services have been identified in the City's twenty-year water and sewer comprehensive plans, no projects have been included in 6-year capital facilities plans.

The third planning period (2029-2036) consists of properties in the northern portion of the UGA that will require the extension of services to adjacent parcels prior to annexation. These properties include the west side of Malloy (north of Aldergrove Road), as well as areas to the north and south of Grandview, all east of Vista Drive. The majority of these properties are currently under-developed.

Within each seven-year timeframe, the areas are listed by the numbers provided for identification purposes only, as shown in Map 2. The numbers are not intended to determine the timing of annexations relative to one another.

Future amendments to the Ferndale Urban Growth Area may become necessary depending upon population and employment growth, and these modifications will be included in future updates to this document. The City also recognizes that existing dense residential developments east of the City are frequently serviced by City water, and that existing onsite sewage systems (septic tanks) may fail during the twenty-year period or beyond. If widespread failures of septic systems occurs in this area, and if there is no reasonable way to resolve the emergency without extending City sewer to the area, the City may petition Whatcom County to include the area within the Urban Growth Area and/or City limits.

The order in which each annexation area is annexed is flexible within the related seven-year phase, and dependant on securing the required property owner support. It is also anticipated that smaller areas within each subarea may annex independently of the larger area. In some cases, the annexation of specific areas may be delayed due to lack of support from property owners,, slower growth within the rest of the City, or other factors. No penalties will be associated with areas that are not annexed within the specified timeframe, and property owners should not feel compelled to petition for an annexation during that period. Conversely, the City shall not be compelled to approve annexations, even if they are submitted within the timeframe. In such cases where annexations do not occur as projected, this Annexation Blueprint shall be amended accordingly.

Annex within 0-7 years

Thornton North (Subarea 1)

Schell Creek (Subarea 2)

WSDOT Slater Road (Subarea 3)

Nubgaard Road (Subarea 4)

School District (Subarea 5)

Erickson Farm (Subarea 6)

North Douglas (Subarea 7)

Annex within 8-15 years

Central Aldergrove (Subarea 8)

East Aldergrove (Subarea 9)

Grandview Business Center (Subarea 10)

Northeast Grandview (Subarea 11)

I-5 Business Park (Subarea 12)

Annex within 16-21 years

Southeast Grandview (Subarea 13)

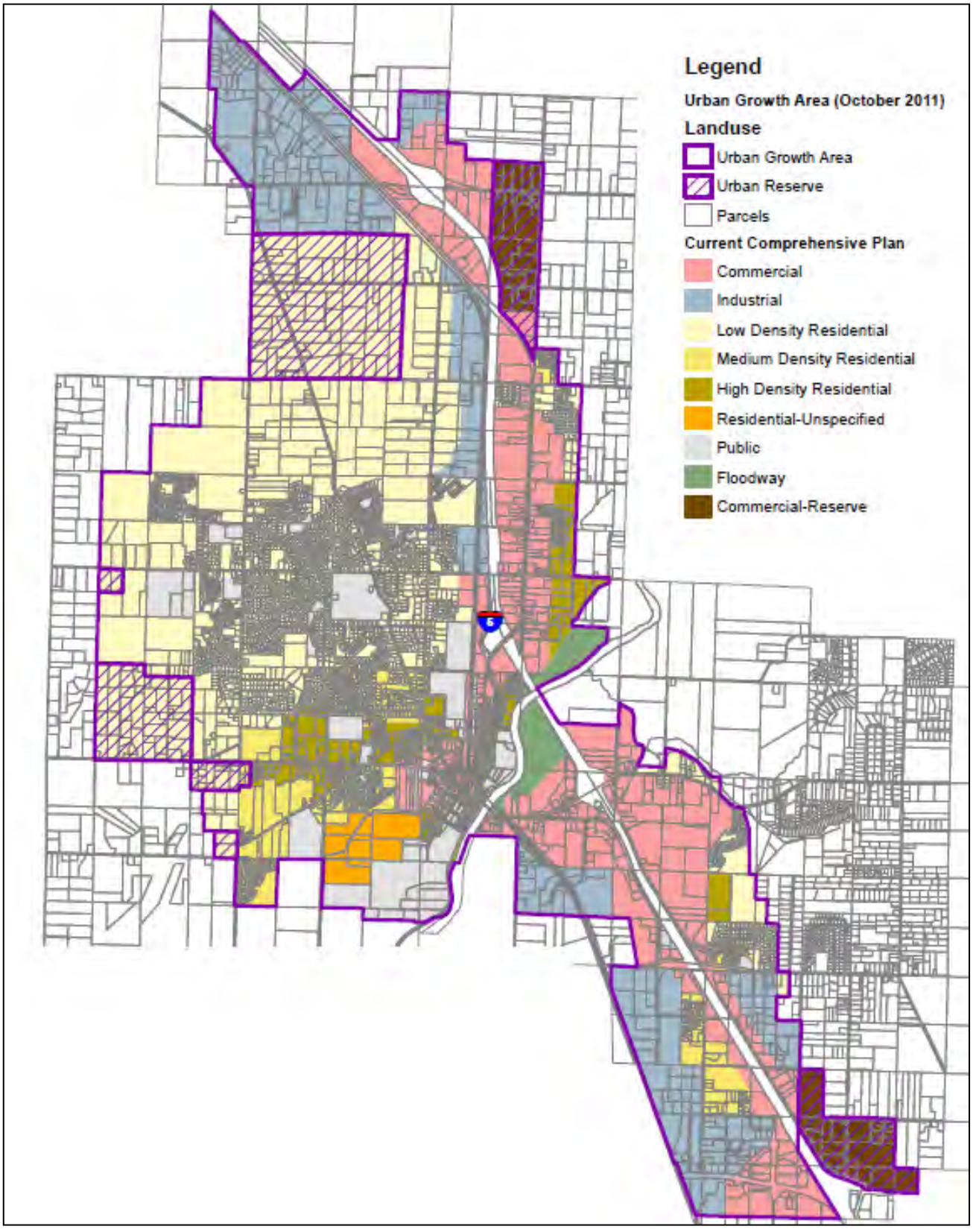
Southwest Grandview (Subarea 14)

North Malloy (Subarea (15)

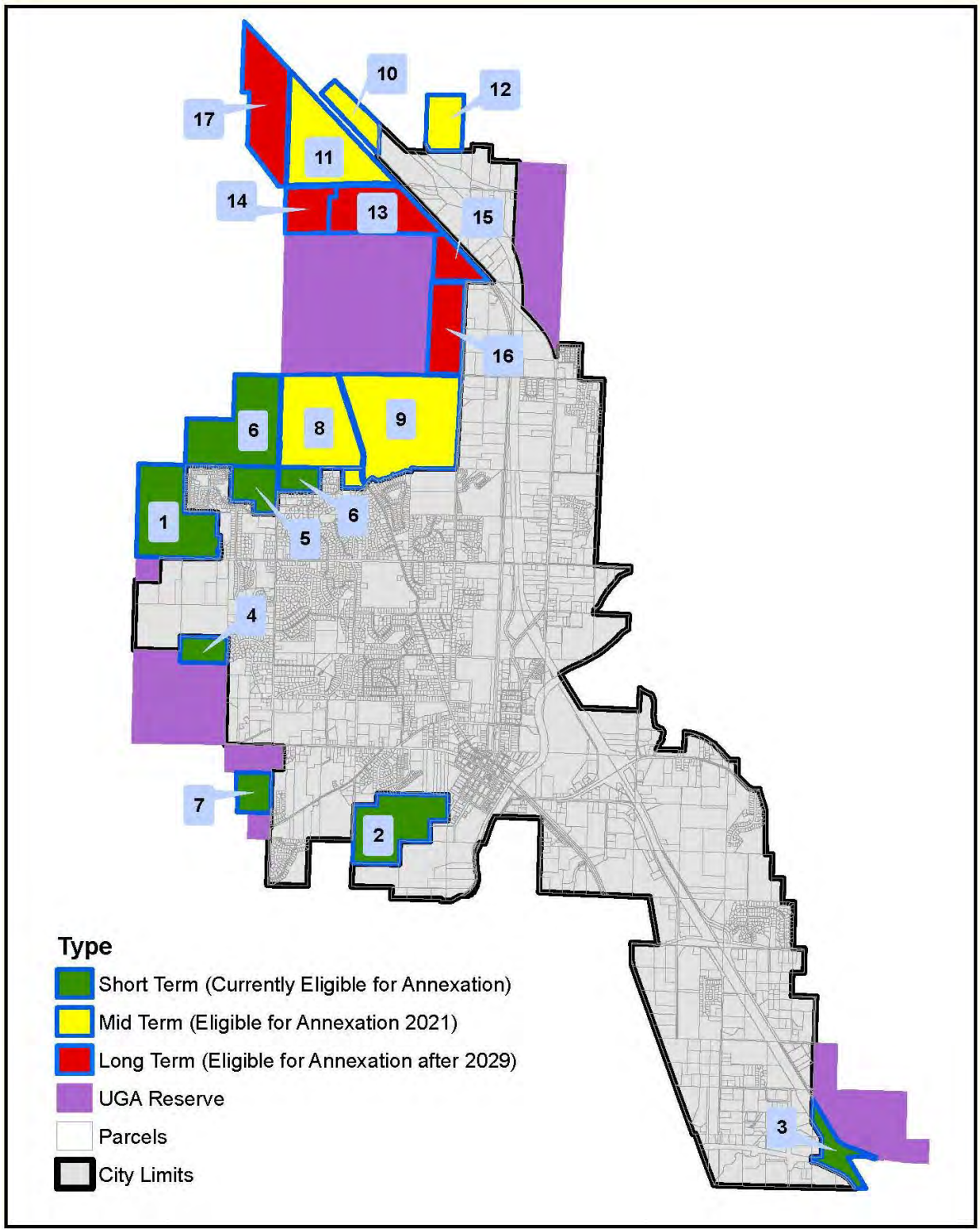
Central Malloy (Subarea 16)

Delta Line (Subarea 17)

MAP 1, FERNDALE URBAN GROWTH AREA



MAP 2, ANNEXATION PHASING PLAN*



* Numbers shown in relation to subareas in the map above are for identification purposes only and are not intended to reflect or predict a specific annexation pattern.

III. Legal Authority and Existing Regulations

City of Ferndale Annexation Goal: "**Provide for the orderly expansion and development of the city as required to meet the growth needs of the community."** (Ferndale Comprehensive Plan: Land Use – Chapter II, P. 42).

The City of Ferndale utilizes a variety of methods for annexation as provided for in the Revised Code of Washington (RCW) Chapter 35.13. The majority of these methods are initiated by residents, property owners, and/or business owners, rather than the City. Ferndale Municipal Code (FMC) Chapter 13.38 identifies the specific methods and requirements for annexation proposals.

The Annexation Blueprint is an annexation phasing plan developed by the City of Ferndale with consultation from Whatcom County and the general public. The plan is intended to identify the timing for specific areas of land to become eligible for annexation. The plan is also designed to phase annexations (and subsequent development) with utility improvements and expansions. The plan provides consistency and clear expectations for property owners in the unincorporated Urban Growth Area, and replaces Whatcom County's Long-Term and Short-Term Planning Areas. Finally, the plan enables the City, County and other affected agencies to proactively plan for future annexations.

The Ferndale Annexation Blueprint was established in 2013 and shall be amended as part of Comprehensive Plan updates required by the Revised Code of Washington. The next scheduled update is planned for 2016, in order to reflect the scheduled Comprehensive Plan Review and Update. Thereafter, the next required review would not be scheduled until 2022.

IV. Annexation Policy

Growth Management Act (1990): In 1991, Washington State Legislature implemented the Washington State Growth Management Act, or GMA. The GMA was implemented in order to control unplanned and uncoordinated growth. The GMA requires that cities and counties that must plan under the act establish Urban Growth Areas (UGA's). Urban Growth Areas typically consist of both the incorporated city and unincorporated areas surrounding the City, and identify the area(s) in which the City may grow (annex) within a twenty-year timeframe. It is the responsibility of the County to work with cities to establish UGA's that are large enough to support future population growth in that twenty-year period, without the UGA's becoming so large that more land than is needed for growth is annexed into the City. It is the responsibility of each city to develop comprehensive plans which demonstrate that the UGA can be served with urban levels of service (roads, water, sewer, etc.) upon their annexation and subsequent development. Land outside the UGA cannot be annexed and will not be served with City utilities unless a health emergency exists.

City of Ferndale Comprehensive Plan: The 1996 Ferndale Comprehensive Plan was the first comprehensive plan adopted by the City subject to the GMA. In addition to annual amendments to the document, the Comprehensive Plan was updated in 2005 and will be updated again in 2016. The plan includes a variety of elements and utility plans, including transportation, water, sewer, parks, and capital facilities. The Comprehensive Plan also establishes population projections, planned residential densities

and housing goals, commercial and industrial land use goals, and methodology to project future population growth. The plan anticipates that the City of Ferndale will annex all land within the Urban Growth Area over the course of the twenty-year planning period.

Whatcom County Comprehensive Plan: Whatcom County adopted its first GMA-compliant Comprehensive Plan in 1997. The Comprehensive Plan has been amended annually since that time, including substantial updates in 2005. In 2010, the Washington State Legislature extended the deadline for Comprehensive Plan updates from 2011 to 2014, and in 2011 extended the schedule again, to 2016, in recognition of the economic uncertainties at that time. However, in 2011 the City of Ferndale proceeded with substantial updates to the plan, including a complete revision to the Transportation Element, the cooperative establishment of a capital facilities plan for Whatcom County Fire District 7, an update to the City's Sewer plan, and a partial update to the Capital Facilities element. The City also adopted the Annexation Blueprint in 2011. An update to the Parks, Recreation and Trails Master Plan as well as a further amendment to the Capital Facilities Element are scheduled for 2013.

The next scheduled full update to the Comprehensive Plan is June 2016, at which point all Comprehensive Plan Elements will be reviewed, with particular emphasis on the Housing and Land Use elements of the plan.

All elements of the Ferndale Comprehensive Plan must be coordinated with the Whatcom County Comprehensive Plan. Whatcom County has established a goal to direct no less than 85% of total residential growth into the seven incorporated cities within Whatcom County. The County Comprehensive Plan also anticipates that all portions of existing Urban Growth Areas will be annexed into cities by the end of the planning period. The Annexation Blueprint is intended as a tool that can be used to verify the manner in which growth has or has not been directed to the City of Ferndale, and will also provide a timeline for future annexations.

V. Annexation Methods

The City of Ferndale is a Code City, and utilizes five methods of annexation as provided in RCW 35A.14. The Washington State Legislature frequently authorizes additional methods of annexation or amends existing methods. For more information, the Municipal Research Services Center (MRSC) has published an Annexation Handbook, which can be downloaded for free at www.mrsc.org. The following is a brief description of the annexation methods available to the City of Ferndale. Ferndale Municipal Code 13.38 (Annexations) also describes the City procedures necessary to review each annexation. To date, all annexations to the City of Ferndale after the adoption of the Growth Management Act have followed the sixty percent petition method of annexation. All annexation methods require a pre-application with the City of Ferndale, a pre-application neighborhood meeting, and the completion of a professional study analyzing the fiscal impacts of annexation to the City. If a petition for annexation is approved by the City, Whatcom County and Boundary Review Board processes will still be required.

A. Election Method Annexation: Residents of a proposed annexation area file a petition with the City, signed by not less than 10 percent of the registered voters in the area who voted in the last general election. Alternatively, the City Council may initiate the process through resolution. In either case, the City Council must consider the fiscal impact the annexation may have on City services, as well as other costs and benefits of the new annexation. These elements are typically provided in a professional study paid for by the applicant and managed by the City. The Boundary Review Board (BRB) then reviews the annexation proposal and may either expand or contract the area to be annexed base on certain criteria.

The City may accept the revised proposal in concept or reject it entirely. If the City chooses to proceed, it then forwards a resolution to the Whatcom County Council requesting that the matter be placed on the ballot. The County Council then adopts an ordinance setting the date for an election on the question of annexation. Only registered voters within the proposed annexation area may cast ballots in the election, and the annexation is approved by a simple majority of those voting.

B. Direct Petition Method (60% Petition): The Direct Petition Method is by far the most popular annexation method in the City of Ferndale. Annexation is initiated by filing two separate petitions with the city. The first petition (Notice of Intent to Annex) is signed by owners of property representing not less than 10% of the assessed value of the properties in the area proposed to be annexed. This filing notifies the city of the residents' intent to annex. The City Council then accepts in concept, rejects the proposal, or geographically modifies the proposed annexation concept. By their action, the City Council can terminate an annexation at this time, but it cannot formally approve the annexation. A second petition must then be signed by the owners of properties representing not less than 60% of the assessed valuation of the area (i.e., not all owners must sign or agree). Property owners shall submit this petition, along with funds necessary to complete an annexation study (as described in [A], above) to the City for review. The City shall notify Whatcom County of this petition and will coordinate subsequent reviews with Whatcom County as necessary. The City Planning Commission holds a public hearing, followed by a second public hearing by City Council. Should the annexation be approved by the Ferndale City Council, Whatcom County shall also be notified and the matter forwarded to the BRB for final review, and to hear any appeals that may arise from the annexation. Should no appeals be filed, the annexation goes into effect by ordinance of the City Council.

C. 50/50 Direct Petition Method: In this method, annexation is initiated by securing signatures of both landowners and registered voters. The community initiators (owners of not less than 10% of the land area or not less than 10% of the area's residents) must notify the City Council of their intention to commence annexation. The City Council approves in concept, rejects the proposal, or modifies the land area. If approved in concept or modified, a second petition is prepared and must be signed by at least 50% of the registered voters in the area and the owners of at least 50% of the acreage of the area. Following submittal of the petition and completion of required studies, the Planning Commission holds a public hearing, followed by a public hearing before City Council. The City Council then decides whether to annex (a petition may be rejected, despite having a valid petition).

D. Annexation of Small Unincorporated Islands Method: This method is only available to areas of less than 100 acres in size where at least 80% of the area boundaries are contiguous to the City. A public hearing must be held by the City Council, after which the City passes an ordinance to annex. The annexation is subject to resident referendum (it can be overturned) if a petition signed by a number of residents of the area equal to at least 10% of the area residents voting in the last general election is filed with the City within 45 days of the date the ordinance is adopted. If such a petition is filed, an election on the issues is held and the annexation must be approved by not less than 50% of those persons in the area voting on the matter.

E. Annexation by Interlocal Agreement Method: Allows for annexation to occur based on an agreement between the City and the County. However, the agreement (and thus the annexation) can be overturned by residents of the proposed annexation area. This method may only be used to annex areas bordered at least 60% by the City. Following a public hearing(s) and approval of the annexation agreement by the city and County, the city council adopts an ordinance annexing the territory. The ordinance must set an annexation effective date at least 45 days following the date the ordinance is adopted. If, during that 45 day period, a petition is filed with the city signed by not less than 15% of the registered voters of the area, then an election on the question must be held at which at least a simple majority of those persons voting on the matter approve the annexation.

VI. Urban Growth Area History

Unlike many Western Washington cities, until the last two decades of the twentieth century Ferndale's growth had been relatively slow. In 1880, the Ferndale area had a population of 265. By the time the City was incorporated in 1907, the population had doubled. Ferndale's population did not rise above 800 until the mid 1950's, when the General Petroleum refinery was constructed at Cherry Point, approximately five miles west of the City. By 1980, a second refinery and an aluminum smelter had been constructed and the City's population had swelled to over 2,000 residents. While it took almost thirty years for the population to double between 1880 and 1907, it took nearly seventy years to double again. However, between 1980 and 1990, the population more than doubled, and has more than doubled once more since 1990, to over 11,800 people in 2013.

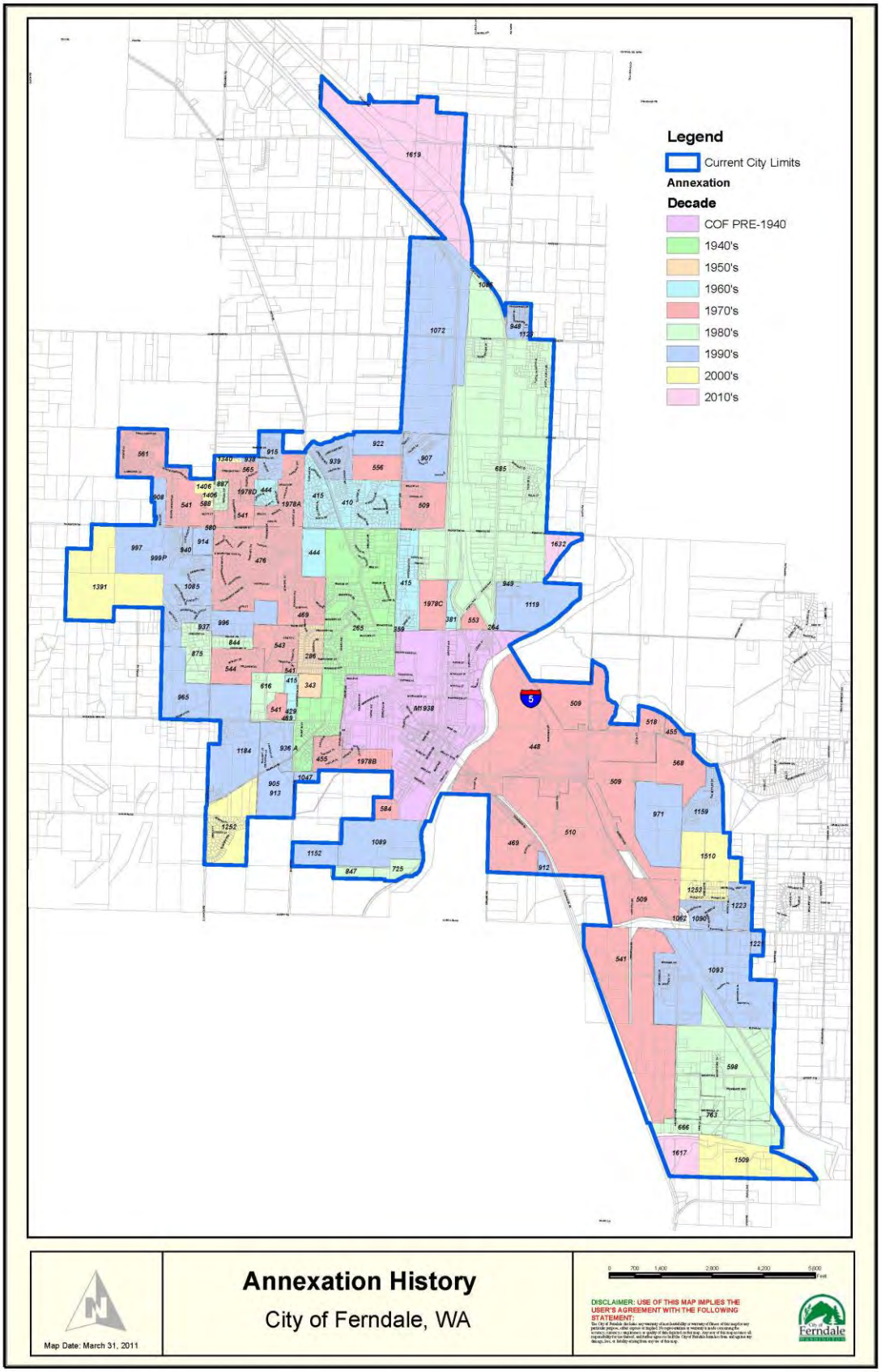
The City's boundaries have expanded over the time period as well (Map 6). Prior to the second world war, the Ferndale City limits were exclusively west of the Nooksack River, extending from Pioneer Park north to Cedar Street, and west to the intersection of Washington and Main. A large annexation immediately following WWII expanded the residential area of the City north to Thornton Street and west to Imhoff Road. Minor residential annexations occurred in the 1950's and 1960's, generally west of the City core. In the 1970's, following the construction of Interstate Five, the City annexed significant commercial and industrially-zoned properties east of the Nooksack River, including land in the vicinity of Barrett Road and LaBounty Drive. During that decade, the City also annexed several areas in the northwestern portion of the City in the vicinity of Thornton Street.

Land annexed during the 1980's included the single largest annexation (in terms of land area) in the City's history, as the area in and around Portal Way became part of the City. The annexation included a combination of manufacturing, commercial, and both single family and multi-family zoned properties. Additional annexations during the 1980's included commercial/industrial properties along the north side of Slater Road as well as residential areas in the western portion of the City.

The 1990's expanded the City's territory west along Thornton and Main Streets, and Douglas Road. These annexations were primarily residential in nature, but did include school district property at Thornton Street. Additional annexations took place in the northern area of Ferndale along Vista Drive and Malloy, and included a significant residential/industrial annexation along Malloy Road. The City also annexed territory west of Ferndale Road that would later become the Conoco Phillips Ballfields. Land was also added to the City in the vicinity of Smith Road, with residential area added north of Smith and commercial/industrial land to the south.

The City's western expansion continued from 2000-2010, as properties along the western portion of Thornton Street and Douglas Road were annexed for residential purposes, as were properties on Church Street north of Thornton. The City also annexed a residential area north of Shields Road and a commercial area south of Slater.

MAP 3, FERNDALE ANNEXATION HISTORY



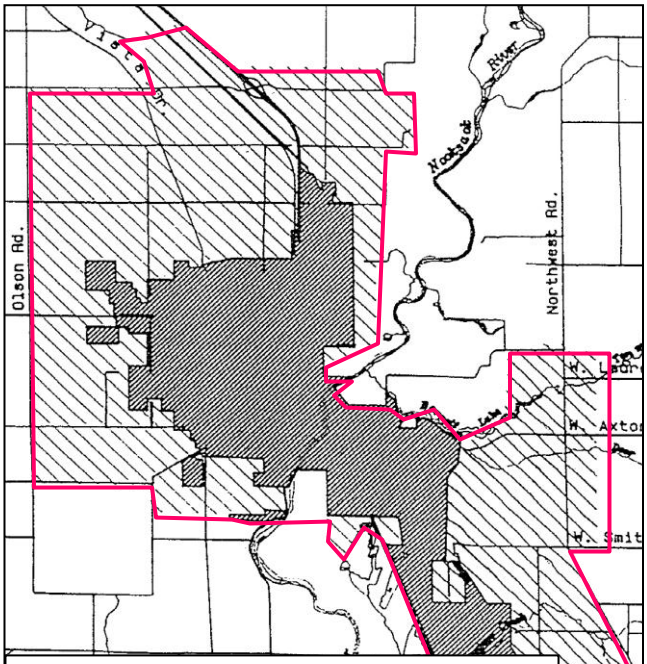
Annexations beginning in 2010 included the "Grandview" annexation for commercial purposes, as well as residential land at Newkirk Road and industrial land south of Slater.

Prior to the 1991 adoption of the Washington State Growth Management Act, annexations were considered based on need for additional inventory, availability of urban services, and existing or potential densities. Long range growth planning was based primarily on the availability of services. As early as 1972, the City's long range water plan projected that the City's services would ultimately extend as far east as Aldrich Road, north nearly to the Birch Bay Lynden Road, south to the Bellingham International Airport, and west to the Cherry Point refineries and Neptune Beach . While such plans demonstrated a long range vision for future growth, they often lacked mechanisms to ensure that such development was possible, practical, or affordable.

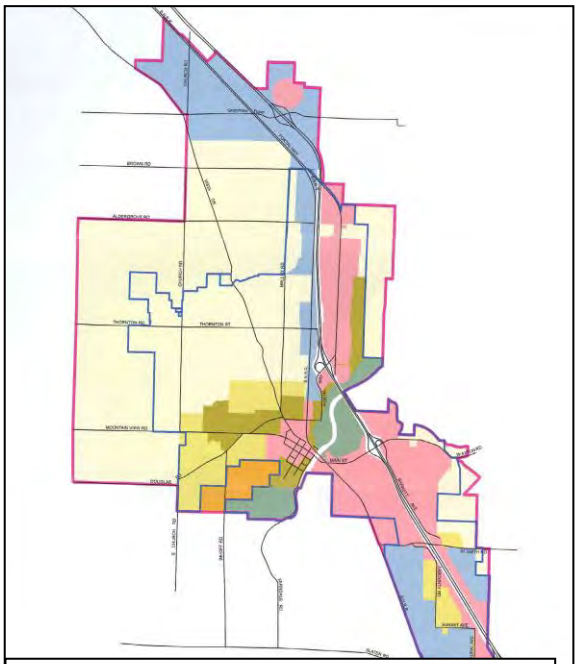
The size of Ferndale's Urban Growth Area has changed over time as a result of modified population projections, revised land capacity analysis, and updates to the City and County's comprehensive plans. Ferndale's interim UGA included the North Bellingham area east of the City and was based on population projections which were nearly twice the rate of actual population growth. The final UGA adopted by Whatcom County in 1997 removed the North Bellingham area and included the Vista/Malloy corridor.

In 2009, the Ferndale Urban Growth Areas designated for future residential were reduced by approximately 1,400 acres. The majority of these reductions occurred in the vicinity of Olson and Douglas Roads. The 2009 reductions also eliminated nearly all of the unincorporated UGA east of the existing City limits. Subsequent challenges to this decision resulted in further reductions in 2011 in the vicinity of Vista/Malloy and Mountain View Road.

The 2009 UGA decision introduced the Urban Reserve concept, and those areas that were removed from the UGA in 2011 were also placed in Urban Reserve status. Two commercial areas that had not previously been included in the City's long range planning were added as Urban Reserve areas in 2010: Enterprise Road and East Slater Road.



MAP 4, PRE 1997: PROVISIONAL UGA



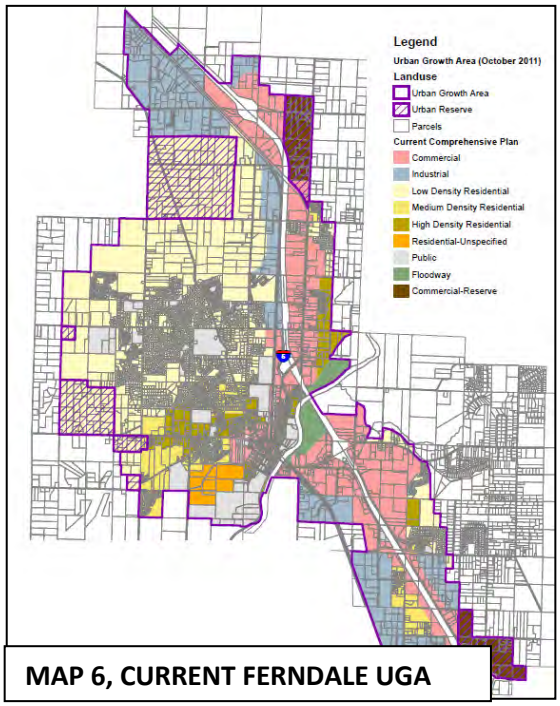
MAP 5, 1997-2009: FERNDALE UGA

The evolution of Ferndale's Urban Growth Area.

Upper left: Ferndale's provisional UGA (pre-1997) extended west to Olson Road and north to Grandview Road, as well as significant land east of Portal Way. The provisional UGA also included the "North Bellingham" neighborhood east of the City, from Slater Road north to Paradise Road, and including both side of Northwest Drive. Land use decisions made during this time include residential developments on Axton Road east of the existing City limits.

Upper right: the City's UGA from 1997-2009 reduced the City's UGA by eliminating land north of Brown Road and generally west of Vista Drive. Territory northeast of the intersection of Portal Way and Grandview Roads was also eliminated. The majority of land not within the existing City limits was also withdrawn from the UGA.

Right: the City's current UGA. Territory west of the existing City limits to Olson Road was removed from the UGA, as were all remaining land not already annexed east of Portal Way. The "Vista/Malloy" corridor was also removed from the UGA and placed in Urban Reserve. Two additional commercial Urban Reserve areas were added, at Enterprise Road and East Slater.



MAP 6, CURRENT FERNDALE UGA

II. Service Providers

There are a number of service providers serving customers in the Ferndale Urban Growth Area. Many of these service providers will continue providing regardless of whether an area is located inside the City

limits or not, but some will change upon annexation. Below is a general list of the common service providers, with an indication of which service providers will change upon annexation.

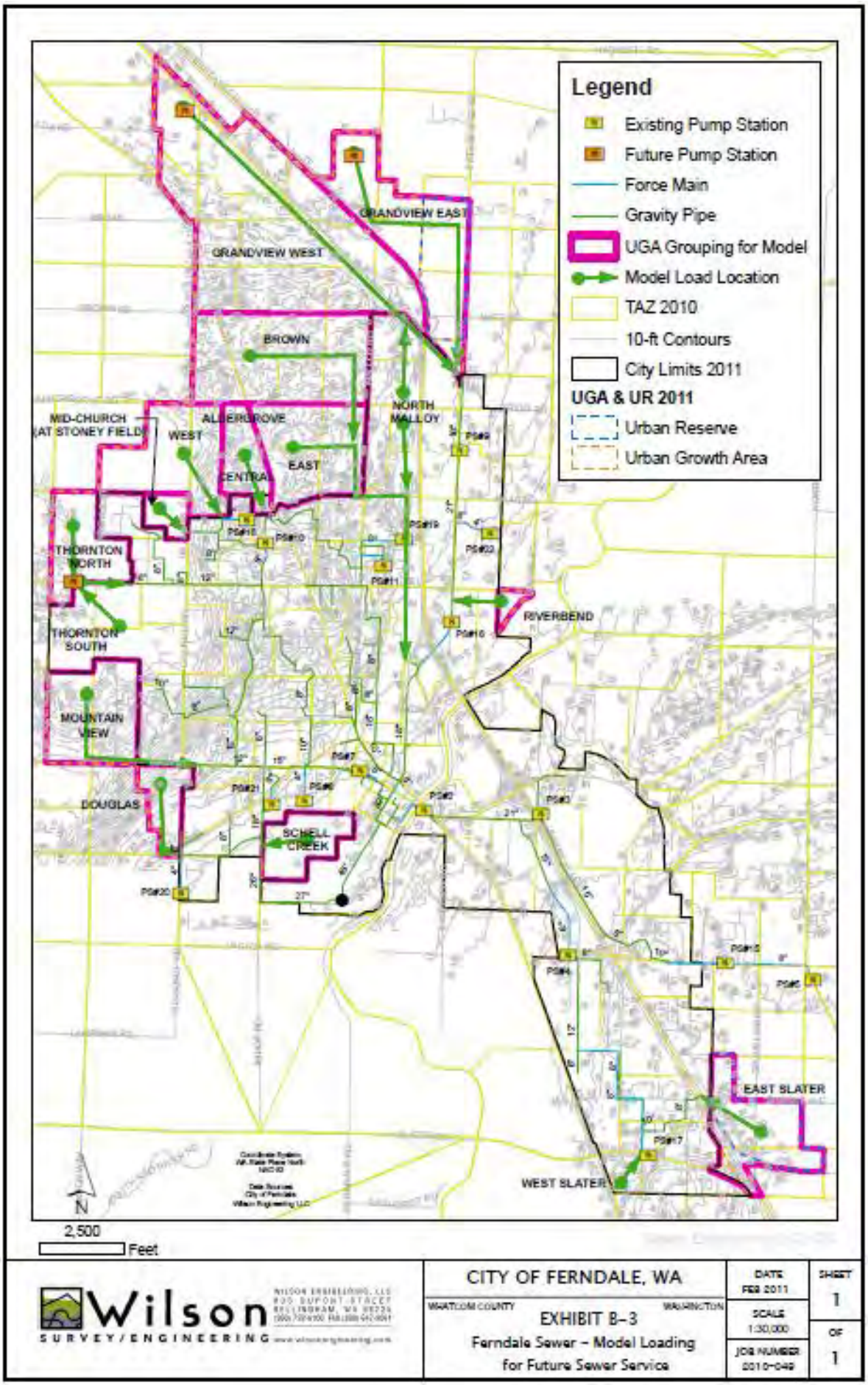
Service Providers Not Affected by Annexations

1. School Districts (Ferndale School District 502)
2. Whatcom County: Whatcom County and the City of Ferndale have adopted interlocal agreements that guide the transfer of administrative authority upon annexation.
    a. Assessment and tax collection
    b. Health Services
3. Waste collection (sanitary service)
4. Water and sewer providers (While connections to City services are not required at the time of annexation, connection to City services is required at the time of development, customers who wish to convert to public water must also convert to public sewer if it is available within 200' of the property). Map 7, reflects sewer modeling assumptions within the 2011 Ferndale Urban Growth Area. Map 8 shows existing water purveyors, circa 2011. Both maps are found within the 2011 Sewer Comprehensive Plan. Map 9 shows the City's 2006 Water System Plan, updated for 2010.
5. Port Districts
6. Fire Districts (Whatcom County Fire District 7 services all areas within the City and the UGA. Whatcom County Fire District 8 services the Slater Urban Reserve area).

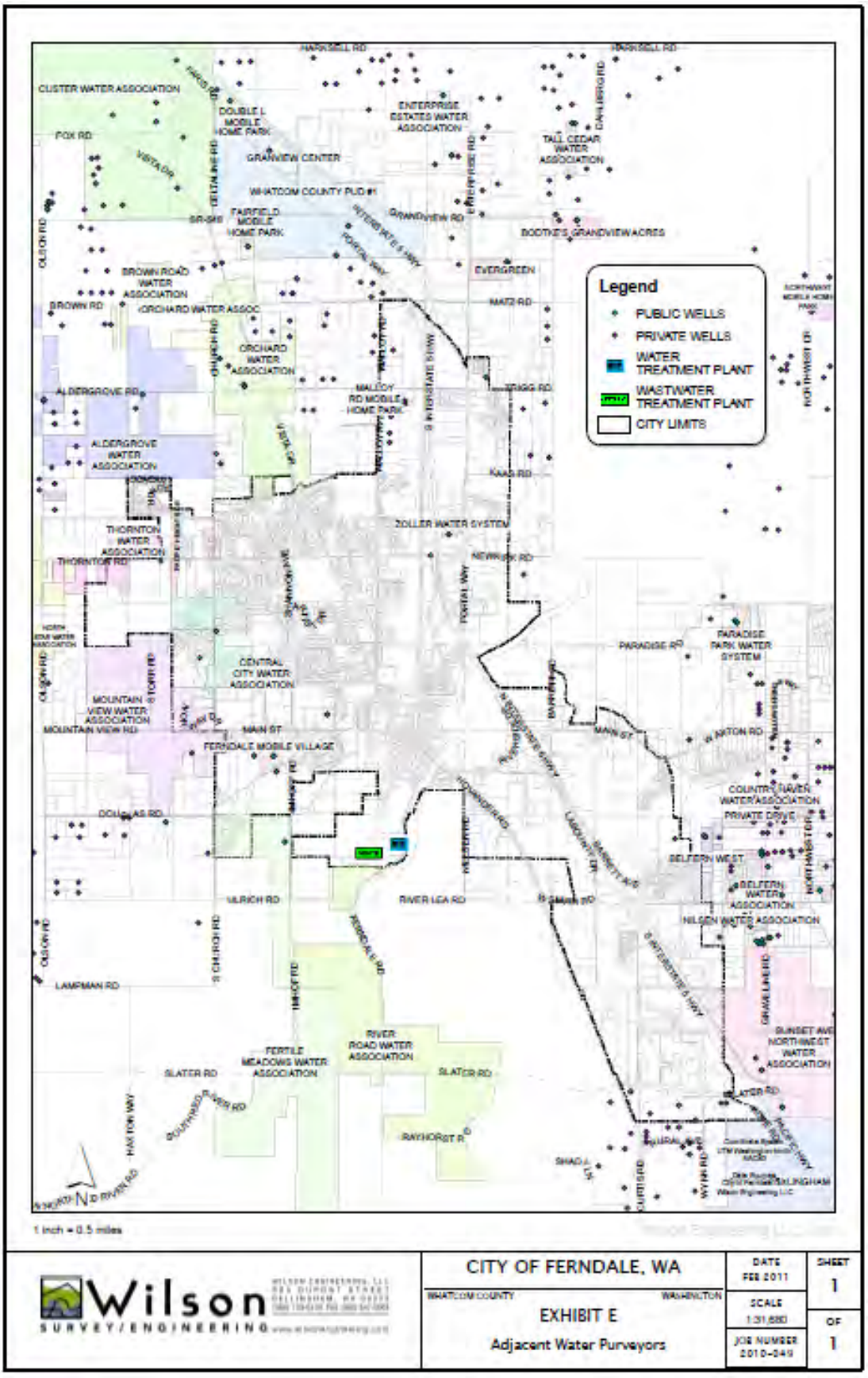
Service Providers That Are Affected by Annexations

1. Police, general administration, parks, public works, land use and planning transfer from Whatcom County to the City of Ferndale immediately upon the effective date of the annexation.

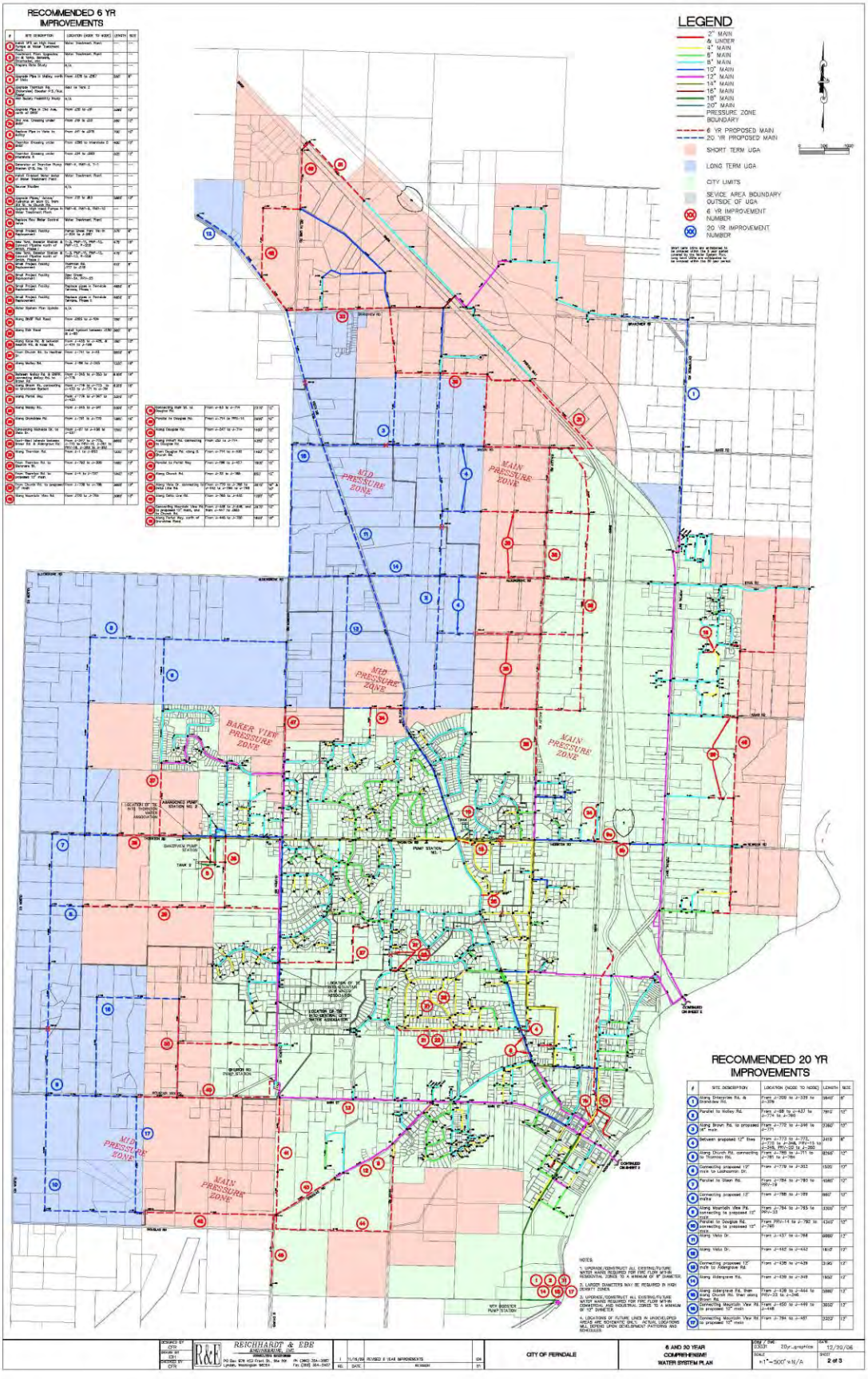
MAP 7: SEWER MODEL-LOADING MAP



MAP 8: ADJACENT WATER PURVEYOR MAP



MAP 9: WATER SYSTEM PLAN



VII. Limits of Annexation Blueprint

As noted above, this document is intended to guide the pattern and timing of future annexations to the City of Ferndale. This will enable improved coordination between the City and its residents, the City and Whatcom County, as well as providing a nexus between this document and related planning and capital facilities documents.

However, the annexation blueprint is not intended to project specific development patterns (or their timing) following annexation, or to suggest the specific manner in which infrastructure, both public and private, will be designed or regulated. In addition, existing and potential future land uses (and restrictions on them) may change over time. Critical areas, wetlands, and stormwater conveyance also change over time (both naturally, and as the result of human actions), as does the manner in which they are controlled. This plan does not propose specific mitigation measures, stormwater design, the preference for mitigation in-place or off-site, the establishment of low impact stormwater or regional facilities, etc. – simply because this plan must not seek to pre-empt or otherwise vest against the development regulations that are in place at the time a land use application is submitted. In some instances, guidance is appropriate, such as the general nature of future land use designations and zoning. In certain cases where development potential is likely limited, or where significant opportunities exist for specific infrastructure, that potential is noted.

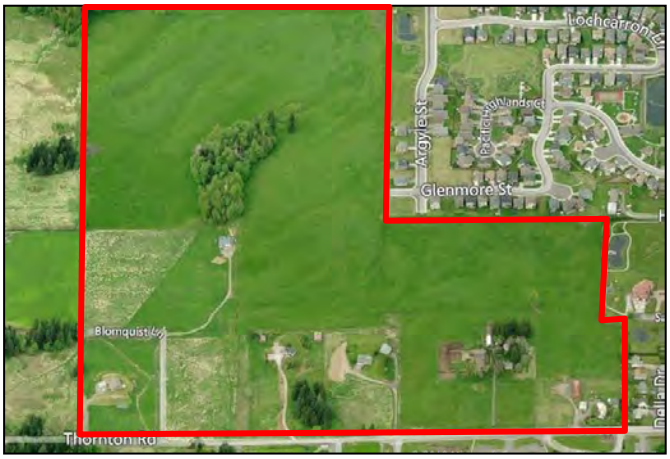
VIII. Annexation Areas

The remainder of this document describes in detail each of the annexation areas listed on Pages 6 and 7. There are 17 identified annexation areas, plus Urban Reserves. Each annexation area description contains a summary sheet, a current zoning map, and an aerial photo. The aerial photo demonstrates which land was built or vacant as of 2012.

The Blueprint anticipates the phased annexation of Ferndale's Urban Growth Area. The 20-year plan is divided into three separate phases. Each annexation area is assigned to one of the phases based on general criteria including social, geographic, service provision, and local policy.

SHORT TERM ANNEXATION AREAS (CURRENTLY ELIGIBLE FOR ANNEXATION)

THORNTON NORTH ("FRIBERG FARM") (SUBAREA 1)



Location and General Description: Within the north side of the 2700 block of Thornton Road, including properties representing the northern and western extents of the Ferndale Urban Growth Area. The majority of properties within this subarea are owned by the Friberg family, and include agricultural structures from the former Friberg Farm. Remaining properties, generally abutting Thornton Road, have been developed as large lot (~4 acre) single family residences.

Annexation Area Size: 110 acres

Subareas within annexation area: Several, including annexation of eastern properties to create a uniform boundary boundary with Pacific Highlands that could occur prior to the remainder properties.

History and Additional Notes: The Friberg Farm was operated as a private farm for many years. In the 1990's the parcel was subdivided into its current configuration. The Friberg Farm is subject to fees related to ULID 5, for which the properties were assessed in the early 1980's. Following a ruling by the Washington State Supreme Court, these fees have continued to accrue and will be payable at the time the properties are converted from Open Space taxation. Such conversion will not occur automatically at the time of annexation.



General subarea description (existing)
Existing land use types: The annexation area consists of several large-lot single family residences, as well as remaining agricultural buildings associated with the Friberg Farm. Agricultural uses are limited to haying of larger properties in the summer months, as well as small vegetable gardens.
Average parcel size: 10 acres (parcels range in size from 3.8 acres to 40 acres)
Existing water/sewer conveyance (including septic): onsite sewage system (septic)
Approximate age of septic systems (if present): 15-40 years old (installed 1970-1995)

Change in Service providers (pre and post-annexation):

Fire/ 911, School District, Waste Collection, Port District: No change

Police: Whatcom County Sheriff (pre-annexation), Ferndale Police Department (post-annexation)
Health and Tax Assessment: No change (Whatcom County)
General Administration: Whatcom County (pre-annexation), City of Ferndale (post annexation)
Water and Sewer Providers: No Change until failure of existing systems/ land use development/ voluntary conversion to City of Ferndale services

Anticipated need for change in service area boundary (pre and post-annexation): Annexation would include the Thornton Road right of way, and maintenance responsibilities would transfer from Whatcom County to City of Ferndale upon annexation. The City of Ferndale Sewer Comprehensive Plan (2011) projects that the area could be served by an 8- to 10-inch gravity sewer collection system, with a gravity feed to a pump station at a lower elevation near Thornton Road, prior to being pumped east to existing collection systems on Thornton Road. A pump station, shared between this area and areas within the existing City limits to the south may also be possible.



The 2006 Water System Plan (amended in 2010) identifies a 12" water line extension from Thornton Street north to Glenmore Street, in order to convey water within this subarea.

Resulting agreements (if any): None anticipated

Existing land use designation/ zoning: Urban Growth Area (Land Use Designation)/ UR4 (Zoning) – Residential Uses
Soil Type: Whatcom Silt Loam 3-15% slopes, Whatcom-LaBounty Silt Loam, 0-15% slopes, LaBounty silt loam, drained, 0-2% slopes
Slopes: 0-15% - a relatively substantial grade change occurs in the southwestern portion of the area, with an elevation differential of approximately eighty feet in some areas. The majority of the site is rolling or flat, with higher elevations to the north and east.
Wetland and/or critical areas: Probable wetland areas have been identified in lower elevations of the northwestern portion of the site, likely associated with more extensive wetlands west of the UGA boundaries. Minor wetlands may exist in isolated pockets in the eastern portion of the site.

Watershed: Birch Bay Watershed (approximately 95%), Lower Mainstem Nooksack Watershed (approximately 5%)
Specific watershed conditions: Compliance with applicable stormwater conditions
Stormwater Basin: Cedar Creek Basin
Existing agricultural uses: None
School District: Ferndale School District 502
Bus routes: None
Publicly owned parcels, including park and school land: None

Road ownership: Thornton Road

Planning
Current planning authority (City or County): County
Anticipated type and scale of uses: Low Density Residential – single family with a potential mix of multifamily/ cluster development. Anticipated densities: 4-5 units per net acre
Road maintenance/ improvement responsibility: County (post annexation: City)
Road improvements required: Full frontage improvements upon development of adjacent properties
Park or trail acquisition potential: Moderate – frontage improvements and interior sidewalks/ trails will link development to school ballfields and Bender Park. Pacific Highlands park is private. Additional parks and/or connectivity required to achieve <10 minute walk time to park.
Contact information for community representative (if applicable): John Friberg, Serge Slagle, Rhonda Oxford
Annexation Status (if applicable): Not applicable

SCHELL MARSH (SUBAREA 2)

Annexation Area Boundary: Within the southwestern portion of the City, bordering Pioneer Park and the Conoco Phillips ballfields to the east and Imhof Road to the west.

Annexation Area Size: 85 acres

Subareas within annexation area: Limited due to development restrictions. Properties adjacent to City facilities at Pioneer Park may be considered for annexation more rapidly than properties nearby



History: The Schell Marsh area includes much of the drainage basin of Schell Creek, which drains much of the central area of the City of Ferndale. Over the past several decades, drainage to this area has increased, agricultural uses once present in the area have been abandoned, and wetland areas have established themselves.

Mapping Area

General subarea description (existing)

Existing land use types: Large-lot residential, agriculture (pasture grass)

Average parcel size: ~ 20 acres (lands in separate ownership range from 11 acres to 32 acres)
Existing water/sewer conveyance (including septic): public water, well, onsite sewer (septic).
Approximate age of septic systems (if present): Twenty years or older
Service providers (pre and post-annexation): Fertile Meadows Water Association, private well/septic
Anticipated need for change in service area boundary (pre and post-annexation): No change in service area boundaries will be required at the time of annexation. Subsequent development (if any) will require City services (water and sewer).



Resulting agreements (if any): None
Existing land use designation/ zoning: County: Urban Growth Area (Land Use Designation), Agriculture (Zoning Designation). City: Unspecified Residential (Land Use Designation)
Soil Type: Eliza silt loam, drained, 0-1% slopes, Mt. Vernon fine sandy loam, 0-2% slopes, Sumas silt loam, drained, 0-2% slopes, Tacoma silt loam, 0-1% slopes, Whatcom-Labounty silt loams, 0-8% slopes.
Slopes: Generally flat, 0-2% slopes
Wetland and/or critical areas: The vast majority of the site contains probable wetlands, with the exception of some upland areas adjacent to existing development at Imhoff Road as well as areas in the center of the area. The entire area is within the 100-Year Floodplain of the Nooksack River, and much of this area is within the City's shoreline jurisdiction.

Watershed: Properties are located within the Lummi Bay Watershed
Specific watershed conditions: Compliance with current stormwater requirements
Stormwater Basin: Schell Marsh Basin
Existing agricultural uses: Field hay in the southwest portion of the site
School District: Ferndale School District 502
Bus routes: None
Publicly owned parcels, including park and school land: None
Road ownership: Public – Imhoff Road is maintained by the City with the exception of the approximately 700 feet of frontage to the south, which is maintained by Whatcom County. Annexation of southern properties will transfer maintenance authority from Whatcom County to Ferndale.



Planning

Current planning authority (City or County): Whatcom County

Anticipated type and scale of uses: Little or no additional commercial or residential development is anticipated within this subarea, but is subject to change based on professional wetland delineation and mitigation plans. Without such additional information, the highest and best use will likely be a combination of existing uses and public uses such as regional storm ponds, offsite wetland mitigation areas, and possible recreational expansions.

Road maintenance/ improvement responsibility: Primarily City of Ferndale, with the exception of southern properties at Imhoff Road.

Road improvements required: None identified beyond standard maintenance. Full frontage improvements are not forecast within the planning period unless significant development is proposed in the area (or connectivity to Pioneer Park is required).

Park or trail acquisition potential: Moderate to High: The City has identified a potential opportunity to improve pedestrian connectivity through a boardwalk between Pioneer Park and the proposed Ferndale Public Library at Main Street. While such a boardwalk could likely be established on existing properties within the existing City limits, an opportunity may exist for potential expansion.

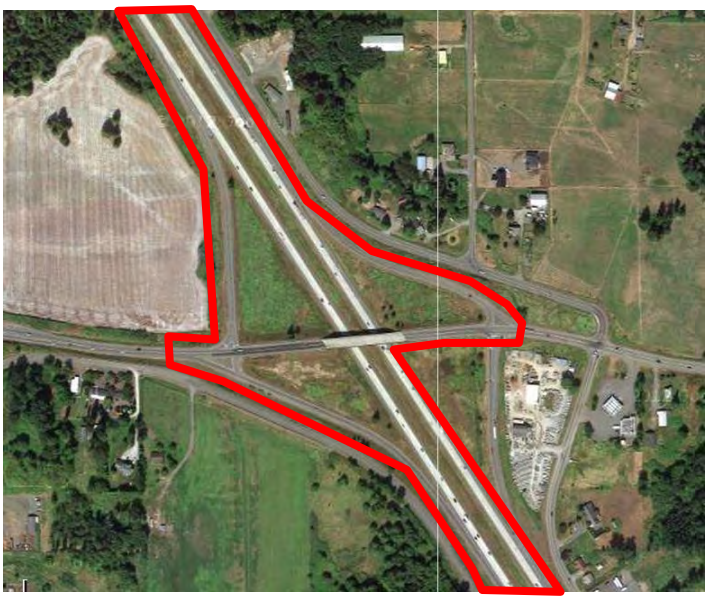
Additional Notes: The area appears to be an excellent candidate for offsite wetland mitigation measures

Contact information for community representative (if applicable): None identified.

Annexation Status (if applicable): Not applicable

SLATER ROAD WSDOT PROPERTY (SUBAREA 3)

Annexation Area Boundary: The annexation area is located southeast of the existing City limits and is comprised of parcels owned by the Washington State Department of Transportation. The area includes the Interstate Five mainline, the freeway overpass, as well as all on and off-ramps excluding the northbound offramp. The area has been analyzed by the Transportation Element of the Comprehensive Plan and transportation improvement projects have been identified at all ramp locations. The properties abut the unincorporated City of Bellingham Urban Growth Area to southeast.



Annexation Area Size: ~ 20 acres

Subareas within annexation area: None

History: The properties have been utilized for their existing purposes following the construction of Interstate Five and the Slater Road exit.

Mapping Area
General subarea description (existing)
Existing land use types: Interstate travel
Average parcel size: ~ 20 acres
Existing water/sewer conveyance (including septic): None existing. No City water or sewer lines are present
Approximate age of septic systems (if present): N/A
Service providers (pre and post-annexation): No change identified. The Washington State Department of Transportation will retain primary control for maintaining the mainline and structural elements of the overpass. Whatcom County is currently responsible for non-structural roadway repairs along Slater Road, and this responsibility would be transferred to the City at the time of annexation.

Anticipated need for change in service area boundary (pre and post-annexation): None
Resulting agreements (if any): None
Existing land use designation/ zoning: County – UGA (land use designation), General Commercial (zoning), City – Commercial (land use designation)
Slopes: Generally flat
Wetland and/or critical areas: None identified
Watershed: Silver Creek
Specific watershed conditions: None
Stormwater Basin: Silver Creek Basin
Existing agricultural uses: None

School District: 502
Bus routes: None
Publicly owned parcels, including park and school land: 100% - Washington State Department of Transportation/ Federal Highway Administration
Road ownership: Washington State Department of Transportation/ Federal Highway Administration. Non-structural maintenance of Slater Road: Whatcom County.

Planning
Current planning authority (City or County): County
Anticipated type and scale of uses: Interstate Highway
Road maintenance/ improvement responsibility: Washington State Department of Transportation (mainline, ramps, structural overpass), Whatcom County (non-structural overpass maintenance)
Road improvements required: Construction of two-lane roundabouts at ramp terminals (north and south-bound), related ramp and overpass improvements. Multi-agency funding sources.
Park or trail acquisition potential: None
Contact information for community representative (if applicable): Todd Carlson, Washington State Department of Transportation

Annexation Status (if applicable): N/A

NUBGAARD ROAD (SUBAREA 4)

Annexation Area Boundary: The Nubgaard Road annexation area is located at the north end of Storr Road, west of the Lakeridge Estates subdivision and east of the property formerly known as the "Blomquist" property. The area includes properties on the north and east side of Nubgaard Road.



Annexation Area Size: ~25 acres

Subareas within annexation area: Limited – properties south of Nubgaard Road will likely not be permitted to be annexed prior to properties north of the street, thus creating an "island" of unincorporated UGA.

History: The Nubgaard neighborhood was established in the early 1970's, and is composed relatively large-lot single family residences. Properties within the area east of Storr Road have been developed to a much greater extent than properties to the west.

Mapping Area
General subarea description (existing)
Existing land use types: Single family residential
Average parcel size: ~ 2 acres
Existing water/sewer conveyance (including septic): Water is provided by the Mountain View Water Association (serving 186 people) sewer is conveyed to private onsite systems.
Approximate age of septic systems (if present): Approximately 20-40 years (1970-1990)
Service providers (pre and post-annexation): City of Ferndale water and sewer service will be extended to the area at the time of development and will be the responsibility of the applicant. Private development proposals in the Blomquist area west of Nubgaard were not required to extend utilities along Nubgaards as a condition of development. Prior to development within the Nubgaard area, utility extensions may only be considered in those situations where a failing onsite system represents a health risk, in the judgment of the Whatcom County Health Department.
Anticipated need for change in service area boundary (pre and post-annexation): No immediate change in service area boundaries will be required at time of annexation. The City of Ferndale Sewer Comprehensive Plan (2011) assumes that a portion of the Nubgaard Road area could be served by a gravity sewer to the west.
Resulting agreements (if any): None
Existing land use designation/ zoning – County: UGA (land use designation)/ UR4 (zoning). City: Low Density Residential (land use designation)

Soil Type: Birch Bay silt loam, 0-3% slope, Labounty silt loam, drained, 0-2% slopes, Laxton loam, 3-8% slopes, Whatcom silt loam, 8-15% slopes, Whitehorn silt loam, 0-2% slopes



Slopes: Eastern properties slope up to the north, with more significant downward slopes in the south. Western properties have more pronounced slopes and rolling terrain.

Wetland and/or critical areas: Several small ponds exist in the area, generally to the south, as well as west of Storr Road. It is likely that a wetland corridor runs from the north to the south, west of Storr Road.

Watershed: The majority of the site drains to the Birch Bay watershed, although portions may also drain to Lummi Bay.

Specific watershed conditions: Compliance with current stormwater regulations

Stormwater Basin: Nubgaard Basin

Existing agricultural uses: Minor (field hay)

School District: Ferndale School District 502

Bus routes: None

Publicly owned parcels, including park and school land: Approximately 3.2 acres in the southwestern portion of the subject area are owned by Whatcom County.



Road ownership: Private

Planning

Current planning authority (City or County): Whatcom County

Anticipated type and scale of uses: Low to Medium density single family residences (4-7 dwelling units per acre)

Road maintenance/ improvement responsibility: Whatcom County

Road improvements required: None identified at this time. Extension of full curb/gutter sidewalks is unlikely unless additional development is proposed. Isolated seasonal flooding may occur due to drainage in and around existing terrain.

Park or trail acquisition potential: High. Trail connectivity between Lakeridge Estates and the "Blomquist" development, either through the creation of sidewalks or trails, is desirable.

Contact information for community representative (if applicable): None identified.

Annexation Status (if applicable): Not applicable

SCHOOL DISTRICT (SUBAREA 5)

Annexation Area Boundary: The "school district" annexation area, includes a thirty-acre property owned by the Ferndale School District, as well as a five acre property to the south in private ownership. The area abuts existing city boundaries to the south (Cascadia Elementary School, Pacific Highlands) and west (Pacific Highlands, "Erickson Farm"). North of the site is the a continuation of the Erickson Farm and east is unincorporated residential land ("Central Aldergrove"). The school district property includes two residences and associated agricultural outbuildings, the property in private ownership includes one single family residence.

Annexation Area Size: ~ 35 acres



Subareas within annexation area: None identified. The relatively small size of the five acre parcel in private ownership does not lend itself to annexation prior to the larger school district property. The size, location, and relative value of the school district property will likely exceed minimum thresholds for annexation petitions, compelling the annexation of the smaller property .

History: Both properties were previously part of the Erickson Farm, and continue to be used for agricultural purposes (livestock grazing and field hay).

Mapping Area

General subarea description (existing)

Existing land use types: Single family residential, field hay (vacant).

Average parcel size: ~ 17 acres

Existing water/sewer conveyance (including septic): In 2011, water and sewer service was extended to the residence in private ownership when the existing septic system failed and could not be replaced. Residences on the school district property are supplied by a public water association and onsite sewer (septic).

Approximate age of septic systems (if present): 15-20 years old (installed in early 1990's).

Service providers (pre and post-annexation): Pre Annexation: Bakerview Water, private septic. Post-annexation: City of Ferndale. The City of Ferndale Sewer Comprehensive Plan (2011) anticipates that sewer could be served by an 8- to 10-inch gravity sewer connection to the existing sewer system, with the actual point of connection depending on topography and development layout. The 2006 Water System Plan (amended in 2010) assumes the extension of a 12" water line along Church Road to facilitate water connections.

Anticipated need for change in service area boundary (pre and post-annexation): None. Extension of City services will occur at the time of development, unless private infrastructure fails and replacements cannot be approved.



Resulting agreements (if any): None

Existing land use designation/ zoning – County: UGA (land use designation)/ UR4 (zoning). City: Low Density Residential. The City anticipates that an amendment to the land use designation could be considered for properties owned by the Ferndale School District to Public, in order to establish the Public/Institutional Zone in that location.

Soil Type: Whatcom silt loam, 3-8% slopes, Whatcom silt loam, 30-60% slopes, Whatcom-Labounty silt loams, 0-8% slopes

Slopes: With the exception of a relatively steep ravine in the northern portion of the school property, the annexation area is relatively flat, sloping down from the west to the east.

Wetland and/or critical areas: Probably wetland or critical areas are anticipated within the ravine identified above, which flows from an existing pond in the southwestern portion of the school property to the east. This ravine may be associated with a larger stream complex, and would represent a portion of the headwaters of Whiskey Creek.

Watershed: Lower Mainstem Nooksack

Specific watershed conditions: Compliance with current stormwater regulations.

Stormwater Basin: Cedar Creek Basin

Existing agricultural uses: Field hay, dairy cows

School District: Ferndale School District 502

Bus routes: None

Publicly owned parcels, including park and school land: Approximately thirty acres in this subarea are owned by the Ferndale School District and are intended for future school facilities.

Road ownership: Whatcom County

Planning

Current planning authority (City or County): County

Anticipated type and scale of uses: The Ferndale School District has identified the majority of the site as a location for future public school facilities.
Road maintenance/ improvement responsibility: Pre-annexation – Whatcom County. Post-annexation – City of Ferndale.
Road improvements required: Right of way acquisition, full frontage improvements (upon development of adjacent parcels).
Park or trail acquisition potential: High. Should the Ferndale School District develop its properties, trail connectivity to the school facility would likely be considered as a "safe routes to school" expectation. Recreational facilities available at the school district may also serve as park facilities when schools are not in session.
Contact information for community representative (if applicable): Mark Deebach, Ferndale School District

Annexation Status (if applicable): Not Applicable

NORTH CHURCH "ERICKSON FARM" (SUBAREA 6)

Annexation Area Boundary: The North Church "Erickson Farm" subarea is named after the Erickson family, which has maintained ownership of the area west of Church Road for several generations. The area is bordered on the east by Church Road, to the north by Aldergrove Road and residential properties outside of the Ferndale Urban Growth Area. West of the site are additional residential properties of approximately forty acres in size. Approximately twenty acres of the subarea are located east of Church Road, immediately adjacent to City properties to the south and east.

Annexation Area Size: ~135 acres

Subareas within annexation area: West Church (Erickson Farm)/ East Church (remaining properties). The Erickson property is considered two legal lots of record, and could be further subdivided prior to annexation. Should such subdivisions occur, additional subareas may be created. Properties east of Church Road are held in separate ownership and are located adjacent to subdivisions created 2000-2010, and which include future road and utility extensions. These properties may be annexed and developed without substantial extension costs.

History: Historically, the Erickson Farm property has been utilized for the raising of dairy cattle. Properties on the east side of Church Road were utilized for large lot single family residences and agricultural properties.

Mapping Area
General subarea description (existing)
Existing land use types: Single family, agricultural (dairy farm).
Average parcel size: ~16 acres
Existing water/sewer conveyance (including septic): Bakerview Water Association, onsite sewer (septic).
Approximate age of septic systems (if present): Approximately 5 years (installed 2005-2010).
Service providers (pre and post-annexation): Pre Annexation: Bakerview Water Association, private septic. Post-annexation: City of Ferndale.
Anticipated need for change in service area boundary (pre and post-annexation): None. Extension of City services will occur at the time of development, unless private infrastructure fails and replacements cannot be approved. The 2006 Water System Plan (amended in 2010) identifies a 12" water main connecting through the subject area to Lochcarron Drive, within the Pacific Highlands to the west.

Resulting agreements (if any): None
Existing land use designation/ zoning – County: UGA (land use designation)/ UR4 (zoning). City: Low Density Residential.
Soil Type: Whatcom silt loam, 0-60% slopes
Slopes: The properties include the crown of Ferndale's "Swede Hill" in the southwest portion of the site, and generally slope down in all directions from that point. These slopes are gradual, with the exception of slopes associated with a manmade manure lagoon near the center of the property.

Wetland and/or critical areas: A mature stand of trees, including several that date to early in Ferndale's history, occupies the southwestern portion of the site. City mapping suggests that a wetland may exist within this area. It is unlikely that the manure lagoon will be considered a wetland or critical area, although future development will likely be required to mitigate this area. A creek system which originates west of Church Road in the Pacific Highlands subdivision crosses the northwest portion of properties east of Church Road before continuing to the north and east of the subject area.



Watershed: Drayton Harbor, Lower Mainstem Nooksack, Birch Bay
Specific watershed conditions: Compliance with current stormwater regulations.
Stormwater Basin: North Whiskey Creek Basin, Cedar Creek Basin
Existing agricultural uses: Field hay, dairy cows
School District: Ferndale School District 502
Bus routes: None
Publicly owned parcels, including park and school land: None
Road ownership: Whatcom County

Planning
Current planning authority (City or County): County
Anticipated type and scale of uses: Residential. Unless a comprehensive plan amendment is approved allowing for higher residential densities or mixed use development, upon annexation the property will likely be zoned for between three and five units per net acre. The size, location and topography may enable future development to achieve much higher densities (or a mix of uses).
Road maintenance/ improvement responsibility: Pre-annexation – Whatcom County. Post-annexation – City of Ferndale.
Road improvements required: Right of way acquisition, full frontage improvements (upon development of adjacent parcels). The development of Pacific Highlands to the south has anticipated a future extension of Argyle Street into the wooded area in the southwestern portion of the Erickson site. The Stoneyfield and Roseberry Heights neighborhoods to the south and east of Church Road include road extensions that will be completed as a condition of new development.
Park or trail acquisition potential: High. With or without a public school immediately to the south, connectivity to Pacific Highlands and other areas will likely be a requirement of future development within the Erickson Farm itself. The preservation of some or all of the existing wooded area has also been identified as a desirable option, through which "heritage" vegetation could be preserved. East of Church Road, trail connectivity may be sought between the future school site, existing tails and sidewalks south of the site, and a future park site in the unincorporated UGA to the north.
Contact information for community representative (if applicable): Rod Erickson (Erickson Farm only)
Annexation Status (if applicable): Not Applicable

NORTH DOUGLAS: (SUBAREA 7)

Annexation Area Boundary: The subject area is bordered by South Church Road and the existing City limits to the east, large-lot single family residential properties within the City of Ferndale Urban Reserve to the south and north, and large-lot single family residential development outside of the City's UGA or reserve to the west.

Annexation Area Size: ~25 acres

Subareas within annexation area: None identified

History: Nearly all residential units in this area were constructed between 1990 and 2010. Prior to 1990, parcels were undivided. Historic use of the area for agriculture had diminished by the early 1980's, although livestock operations continued through the 1990's east of the site.

Mapping Area

General subarea description (existing)

Existing land use types: Large-lot single family residential

Average parcel size: 5 acres

Existing water/sewer conveyance (including septic): Mountain View Water Association (serving 186 people), City of Ferndale water (two residences), septic

Approximate age of septic systems (if present): ~1-15 years

Service providers (pre and post-annexation): Pre-Annexation: Whatcom County, Mountain View Water Association. Post-annexation: City of Ferndale, Mountain View Water Association



Anticipated need for change in service area boundary (pre and post-annexation): None. The City of Ferndale Comprehensive Sewer Plan (2011) projects that the area will be served by an 8- to 10-inch gravity sewer connection to a trunk sewer in Douglas Road. The City's water system plan anticipates a 12" water line extending along Douglas Road, but this line may no longer be necessary as the result of significant reductions within the Ferndale UGA in this area.

Resulting agreements (if any): None

Existing land use designation/ zoning – County: UGA/ UR4, City: Low Density Residential

Soil Type: Birch Bay silt loam, 0-3% slopes, Whatcom silt loam, 8-15% slopes, Labounty silt loam, drained, 0-2% slopes, Laxton loam, 3-8% slopes, Whitehorn silt loam, 0-2% slopes
Slopes: 0-15%
Wetland and/or critical areas: The City has identified potential wetlands at and around existing pond areas that may also related to larger wetland complexes to the northeast.
Watershed: Lummi Bay
Specific watershed conditions: Compliance with current stormwater regulations
Stormwater Basin: Schell Marsh Basin
Existing agricultural uses: Private gardens
School District: Ferndale School District 502
Bus routes: None
Publicly owned parcels, including park and school land: None
Road ownership: All existing roads are in private ownership



Planning
Current planning authority (City or County): Whatcom County
Anticipated type and scale of uses: Low to Medium density single family
Road maintenance/ improvement responsibility: Private
Road improvements required: Should future development be proposed following annexation, the City may require expansion and dedication of roadways, including the construction of frontage improvements.

Park or trail acquisition potential: Moderate. As the properties are along the western boundaries of the Urban Growth Area, north to south trails may be redundant to road and trail connectivity anticipated east of the site. However, the City may wish to consider trails or easements that may facilitate trail connectivity to the west, should the UGA be expanded in the future.

Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable

MID-TERM ANNEXATION AREAS (ELIGIBLE FOR ANNEXATION 2021)

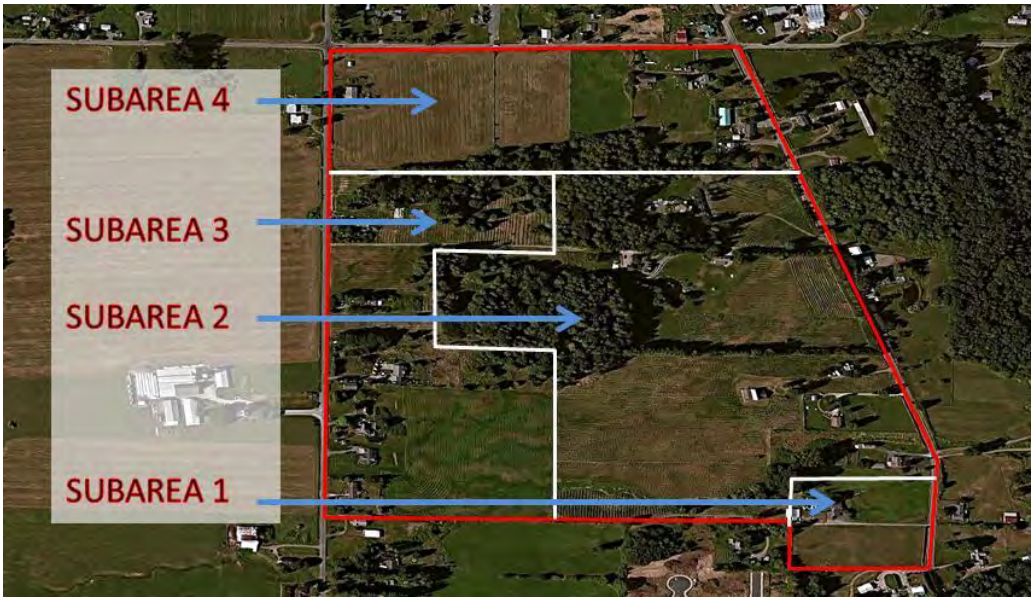
CENTRAL ALDERGROVE: (SUBAREA 8)

Annexation Area Boundary: The Central Aldergrove subarea is bordered by Church Road to the west, Aldergrove to the north, Vista Drive to the east, and the existing City limits to the south.

Annexation Area Size: ~135 acres

Subareas within annexation area: Several subareas may be considered within the larger Central Aldergrove area:

- **Subarea 1:** The annexation of properties in the southern portion of the site may be considered for annexation separately from the remainder area, establishing a more-consistent northern City boundary.
- **Subarea 2:** The several properties under one ownership in the center/east of the subarea may be considered for annexation separately from properties to the west (**Subarea 3**).
- **Subarea 4:** Properties fronting on Aldergrove Road may be considered separately and following the annexation of other properties within this area.



History: The Central Aldergrove subarea is and has been characterized by large-lot single family residential development for decades.

Mapping Area
General subarea description (existing)

Existing land use types: large lot single family residential
Average parcel size: ~ 4 acres
Existing water/sewer conveyance (including septic): private well/ water association; septic

Approximate age of septic systems (if present): ~10-30 years old (1980-2000)
Service providers (pre and post-annexation): Pre-annexation: Orchard Water Association (serving 153 people), private wells, onsite sewer. Post-annexation: no change unless existing systems fail, extension of City services upon development.
Anticipated need for change in service area boundary (pre and post-annexation): None. The City of Ferndale Sewer Comprehensive Plan proposes that the southeastern-sloping areas could be served by an 8- to 10-inch gravity sewer connection to the existing sewer collection system, with the actual point of connection depending on topography and the design of future build-out. The 2006 Water System Plan (amended in 2010), includes two projects within this study area. A 12" water line has been identified connecting Nicholas Drive to Vista Drive, as well as a north-south 12" main connecting Aldergrove South to the 2013 City limits.
Resulting agreements (if any): None
Existing land use designation/ zoning – County: UGA (land use designation)/ UR4 (zoning), City: Low Density Residential (land use designation)
Soil Type: Whatcom silt loam, 0-60% slopes



Slopes: 0-60%. The most significant slopes in the area occur to the southeast, associated with a substantial ravine adjacent to the existing City limits. With the exception of properties immediately east of Church Road, the subarea is characterized by rolling topography, generally sloping down from the southwest to the east and northeast. Additional slope variations occur within the central portion of the property (generally between Subarea 2 and 3), resulting in substantial gradient changes within a ridgeline currently obscured by vegetation and trees.

Wetland and/or critical areas: the area appears to consist of several relatively small wetlands or ponds, many of which are likely "perched" wetlands that exist due to the rolling topography.

Watershed: The majority of the site (Subareas 1-3) are within the Lower Mainstem Nooksack watershed, while portions of Subarea 4 are within the Drayton Harbor Watershed.

Specific watershed conditions: Compliance with current stormwater regulations.

Stormwater Basin: North Whiskey Creek Basin, South Whiskey Creek Basin, Cedar Creek Basin

Existing agricultural uses: Agricultural uses are not the predominant land use in the area, although there are several properties that do include agricultural activities.
School District: Ferndale School District
Bus routes: None
Publicly owned parcels, including park and school land: None
Road ownership: Whatcom County

Planning
Current planning authority (City or County): Whatcom County
Anticipated type and scale of uses: Low Density Residential, 3-5 dwelling units per acre. The City may consider amendments to the Comprehensive Plan that would allow higher densities and/or a mix of commercial uses in a "neighborhood commercial" environment. While limited mix-use opportunities may be available through the Planned Unit Development process, density modifications would require a comprehensive plan amendment, including a public process, and are not considered as part of this document.



Road maintenance/ improvement responsibility: Pre-annexation: Whatcom County. Post-annexation: City of Ferndale

Road improvements required: Potential widening of Church Road, Vista Drive, Aldergrove Road. Installation of frontage improvements. Improvements would be required as a condition of development.



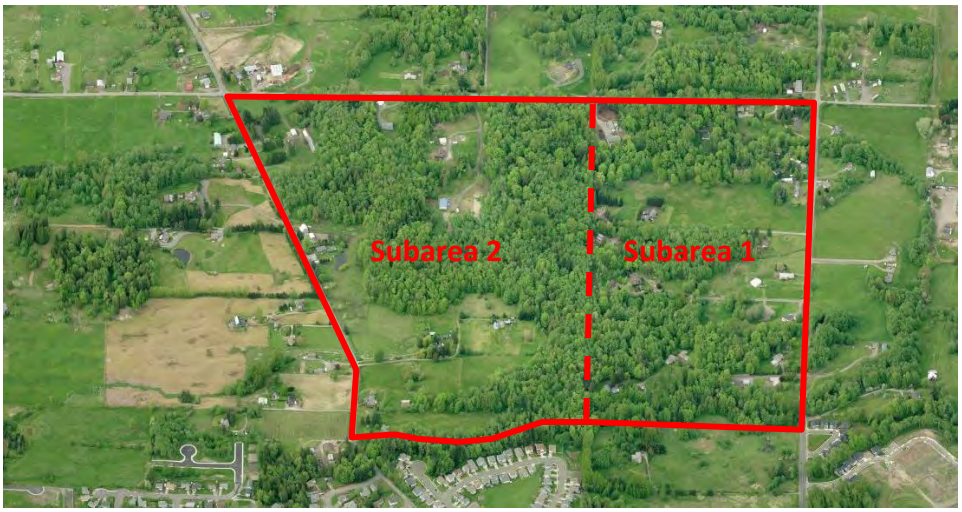
Park or trail acquisition potential: Very high. When fully developed, the Central Aldergrove area will likely support a significant number of residential units, in an area that is not within walking distance of a park. In addition, should a park be established in this subarea, it would likely be easily accessible to surrounding areas. Finally, property owners in the area have indicated a desire to retain features that

characterize the existing rural atmosphere. The City projects that a neighborhood park, or even a community park could be developed within this area as a condition of development or as a public/private partnership. Such a park would include trail connectivity to surrounding areas.

Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable

EAST ALDERGROVE (SUBAREA 9)



Annexation Area Boundary: Vista Drive borders the site to the west, with Aldergrove Road acting as the northern boundary and Malloy Road as the eastern boundary. The area terminates at the existing City limits, to the south.

Annexation Area Size: ~140 acres

Subareas within annexation area: The East Aldergrove Annexation area is large, and may be further separated into two or more subareas. The configuration and access for existing parcels suggests that annexation proposals will occur from the south to the north along roadways, rather than east to west between Vista Drive and Malloy Road. Realistically, property owners are most likely more familiar with their neighbors who take access from the same roadway than they are with neighbors who are directly behind them (and often separated by woodland), taking access from another road. In addition, the requirements for infrastructure improvements (frontage improvements, extension of water and sewer) will likely be shared more easily along a roadway, than between a roadway.



There is the potential for additional subarea variations, particularly in the southwest portion of the site. Parcel(s) located to the southwest are likely constrained from immediate development due to anticipated requirements to improve roadway stream crossings immediately north of the existing City limits. Should utilities become available from the east or west, the costs of developing the southwestern sites may be moderately decreased, thus triggering the more rapid annexation of all or a portion of Subarea 2.

History: As part of the 1979 Cherry Point Subarea plan, Whatcom County designated the subject area SF 5 – Suburban Farm Five acre district. Properties along Malloy Road had historically remained undeveloped until existing residences were established. Along Vista Drive, several properties were utilized as small-scale farm operations. Relatively substantial residential development occurred in the

1980's and 1990's, but slowed significantly following the establishment of the Urban Growth Area in the late 1990's.

Mapping Area

General subarea description (existing)

Existing land use types: Large lot single family residential

Average parcel size: ~ 5 acres (approximately 30 parcels)

Existing water/sewer conveyance (including septic): private well/ onsite sewer/septic

Approximate age of septic systems (if present): Approximately twenty years

Service providers (pre and post-annexation): Private

Anticipated need for change in service area boundary (pre and post-annexation): None prior to development, unless existing systems fail. The Ferndale Sewer Comprehensive Plan (2011) seeks to take advantage of the land sloping to the east by installing an 8- to 10-inch gravity sewer connection to a trunk sewer in Malloy Road.

The 2006 Water System Plan (amended in 2010) identifies three potential projects in the area: a 12" water line along Vista Drive, a 12" line parallel and west of Malloy Road, and an 8" line between the two aforementioned lines.



Resulting agreements (if any): None

Existing land use designation/ zoning- County: Urban Growth Area (land use designation)/UR4 (zoning), City: Low Density Residential (land use designation)

Soil Type: Whatcom silt loam, 0-60% slopes

Slopes: The East Aldergrove area, as one of the primary runoff basins in the Urban Growth Area, includes several systems of fairly dramatic slopes, particularly in the eastern half portion of the properties. The southern border of the area is characterized by a substantial ravine, with an equivalent hillside just to the north. Further north lies another system of hills and gullies. Along Vista Drive, the properties gradually gain in elevation, while along Malloy Road the center portion of the site appears to be within a moderate valley.

Wetland and/or critical areas: Several potential wetland areas have been identified in the City's GIS mapping software, the majority of which appear to be associated with creeks and streams in the north, central, and southern portions of the site, all flowing from west to east. Additional wetland areas may exist in depressions that may be natural or man-made.

Watershed: Lower Mainstem Nooksack. However, surface water may flow to Drayton Harbor as the result of Interstate Five and other infrastructure between the subject area and the Nooksack River.

Specific watershed conditions: Compliance with current stormwater regulations.

Stormwater Basin: South Whiskey Creek Basin, Cedar Creek Basin

Existing agricultural uses: Agricultural uses in the area are limited to hobby farming. The topography of the area, as well as the wooded conditions appear to limit the potential for significant agricultural uses.

School District: Ferndale School District 502.

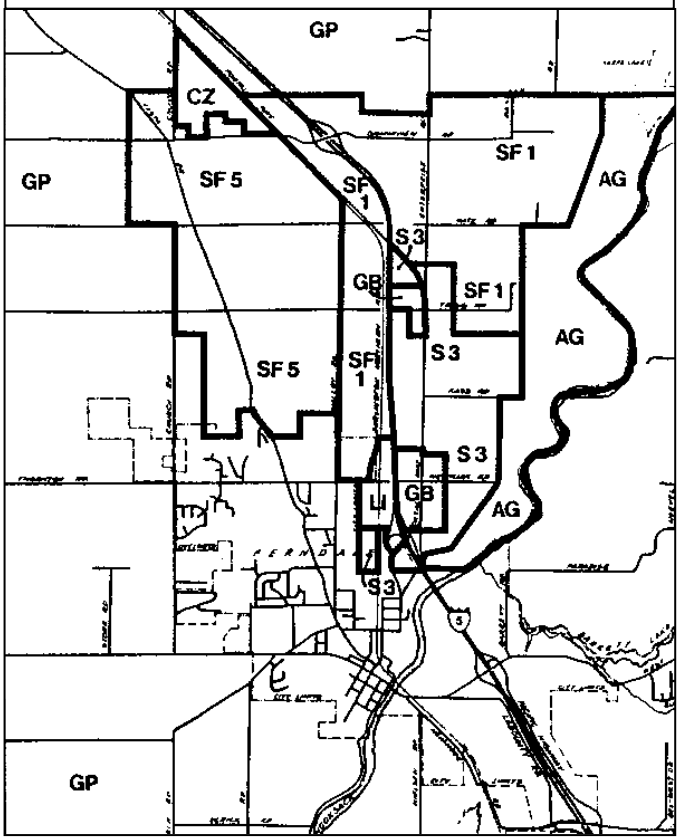
Bus routes: None

Publicly owned parcels, including park and school land: None

Road ownership (Pre-annexation): Vista Drive – Whatcom County, Malloy Road – City of Ferndale. Post-Annexation: City of Ferndale

1979 Cherry Point Subarea Zoning (Whatcom County – pre-GMA)

SF5 – Suburban Farm Five Acre District
SF1 – Suburban Farm One Acre District
GB – General Business District



Planning

Current planning authority (City or County): Whatcom County

Anticipated type and scale of uses: Low Density Residential.

Road maintenance/ improvement responsibility (pre-annexation – Vista Drive): Whatcom County, post-annexation: City of Ferndale. Malloy Road is currently considered a City street and will remain so post-annexation.

Road improvements required: Improvements to the stream crossings at Vista Drive will likely be required as a condition of development. Full frontage improvements will be required at the time of development on both Vista Drive and Malloy Road, and may include the dedication of right of way consistent with City development standards. In addition, it is likely that new public street(s) will be required, creating parallel infrastructure to Aldergrove Road and Vista/ Malloy.

Park or trail acquisition potential: High. If a private park is not included in development proposals, it is likely that such a park will be required to meet City of Ferndale Level of Service and connectivity requirements at or before final build-out. Such a park may be desirable in the center-north portion of the area, or at the intersection of interior roadways. Trail connectivity will be required upon the development of properties within the area, in order to link this area to existing and potential corridors and parks.

Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable

GRANDVIEW BUSINESS CENTER (SUBAREA 10)

Annexation Area Boundary: The Grandview Business Center annexation area is bordered on the southwest by Portal Way, to the southeast by existing vacant properties within the City, to the northeast by Interstate Five, and to the north by partially vacant land beyond current Urban Growth Area boundaries.

Annexation Area Size: 25 acres



Subareas within annexation area: None identified

History: The Grandview Business Center was established with one 10,000 square foot building in 1993, and has since expanded to over 250,000 square feet in 21 buildings. Adjacent land to the north exists in separate ownership. Prior to development, the land was utilized as fill extraction pits and sand supply for road base materials during the construction of Interstate Five.
Mapping Area

General subarea description (existing)
Existing land use types: The subarea is dominated by the existing Grandview Business Center which includes a variety of light industrial and retail businesses. A vehicle storage facility has also been established immediately north of the site.
Average parcel size: ~ 2.5 acres (11 lots in three ownerships)
Existing water/sewer conveyance (including septic): PUD Water, Community septic
Approximate age of septic systems (if present): ~3-20 years
Service providers (pre and post-annexation): The City and PUD 1 have entered into an interlocal agreement to determine the appropriate transfer of responsibility as the unincorporated UGA serviced by the PUD is annexed. This review will include an analysis of existing conveyance, in order to determine if an extension of City water lines is required, or if existing lines can be utilized following annexation and further development. Existing septic systems may be allowed to continue, but the City will require extension of City sewer lines for new development, following annexation. City of Ferndale

Police services will extend to the area upon annexation, as will administrative functions, Community Development, and Public Works.

Anticipated need for change in service area boundary (pre and post-annexation): PUD service boundary will likely be reduced following annexation, police and administrative services will also be amended.
Resulting agreements (if any): 2010 interlocal between PUD #1 and City of Ferndale
Existing land use designation/ zoning – County: Urban Growth Area/ Light Impact Industrial. City: Industrial.
Soil Type: Edmonds-Woodlyn loams, 0-2% slopes, Hale silt loam, drained, 0-2% slope, Laxton laom, 3-8% slopes, Lynden sandy loam, 0-3% slopes, Tromp loam, 0-2% slopes. As the result of sand and material extraction during the construction of Interstate Five, the water table at this and nearby areas is relatively high.
Slopes: 0-8%
Wetland and/or critical areas: With the exception of man-made ponds within the Grandview Business Center, there are no wetlands indicated on City of Ferndale wetland maps.
Watershed: Drayton Harbor
Specific watershed conditions: Compliance with current stormwater regulations
Stormwater Basin: California Creek Basin
Existing agricultural uses: None
School District: Ferndale School District
Bus routes: None
Publicly owned parcels, including park and school land: None
Road ownership: Whatcom County

Planning
Current planning authority (City or County): Whatcom County
Anticipated type and scale of uses: Light industrial, scale likely similar to existing.
Road maintenance/ improvement responsibility – Pre-annexation: County, Post-annexation: City.
Road improvements required: Frontage improvements (curb, gutter, sidewalks), repaving of road service (at time of future development)
Park or trail acquisition potential: Low – likely park or trail acquisition would likely be limited to the addition of dedicated bicycle lanes along Portal Way.
Contact information for community representative (if applicable): Joel Douglas

Annexation Status (if applicable): Not applicable.

NORTHEAST GRANDVIEW (SUBAREA 11)

Annexation Area Boundary: The Northeast Grandview annexation area is bordered on the south by Grandview Road, and to the east by Portal Way. Delta Line Road acts as the areas' western boundary.

Annexation Area Size: ~ 120 acres

Subareas within annexation area: Subareas within the Northeast Grandview area may be limited, due to the fact that the Grandview Light Industrial Park General and Specific Binding Site Plan (AF 920110138) describes shared responsibilities for maintenance and infrastructure, and encompasses nearly the entire area. This binding site plan has subsequently been amended over time.

History: Similar to surrounding areas, the Northeast Grandview area was historically composed of a mixture of single family residential, agricultural, and vacant uses until construction of Interstate Five, and later, the construction of heavy industries at Cherry Point. In 1979, the Northeast Grandview subarea was zoned by Whatcom County as a Contract Zone District, which allowed for large-scale commercial/ industrial development projects. However, it was not until 1992 that the Grandview Light Industrial Park General and Specific Binding Site Plan was recorded. This Binding Site Plan (and its amendments) remains the primary planning instrument for the subarea, and has resulted in the development of the majority of parcels within the area.



Mapping Area

General subarea description (existing)

Existing land use types: Light industrial, commercial, light manufacturing.

Average parcel size: ~ 5 acres

Existing water/sewer conveyance (including septic): The majority of the area is serviced by PUD #1 for water, with community septic systems in place for sewer.

Approximate age of septic systems (if present): Twenty years (1992) or less.

Service providers (pre and post-annexation): PUD #1 would continue to provide water service until such time as a transfer of authority is mutually agreed by the PUD and City. The City anticipates that the area will also convert to public sewer at the time such services become available, or if the existing onsite septic systems fail.

Anticipated need for change in service area boundary (pre and post-annexation): A transfer of utility services will likely be required, though may not become necessary immediately upon annexation.

Resulting agreements (if any): 2010 interlocal between City of Ferndale and PUD #1.

Existing land use designation/ zoning – Whatcom County: UGA/ Light Impact Industrial, City of Ferndale: Industrial.
Soil Type: Edmonds-Woodlyn loams, 0-2% slopes, Hale silt loam, drained, 0-2% slopes, Laxton loam, 3-15% slopes, Lynden sandy loam, 0-3% slopes, Shalcar much, drained, 0-2% slope, Tromp loam, 0-2% slope, Whitehorn silt loam, 0-2% slope
Slopes: As part of a valley stretching to the northeast, this subject properties have not historically included substantial slopes. For the most part, those slopes that did once exist were removed during site preparation in the 1990's. As a result, the most substantial remaining slopes occur in the center of the area adjacent to Grandview Road, on parcels not within the Grandview Light Industrial Park, and extend to the northwest, connecting to existing (and protected) wetlands, creating a plateau effect in the southwestern portion of the area.



Wetland and/or critical areas: Wetlands identified as part of the Grandview Light Industrial Park are located east of Delta Line Road in the center of the study area. These wetlands have been protected, and are precluded from future development. Additional wetlands likely exist on those parcels that have not been included in the Grandview Light Industrial Park. City wetland maps also suggest that wetlands may have established themselves in the northwestern portion of the site, potentially resulting from drainage associated with Delta Line Road. California Creek, a direct tributary to Drayton Harbor, is identified on the recorded binding site plan, within a twenty foot drainage easement.
Watershed: Drayton Harbor Watershed
Specific watershed conditions: Compliance with current stormwater regulations. This subarea represents the most heavily developed subarea within the City of Ferndale UGA, and the majority of this development predates the designation of Drayton Harbor as a protected water body. Opportunities to limit impacts to the watershed, to evaluate the health of California Creek in this area, or mitigation measures that could be employed (if necessary) to improve conditions have not yet been studied by the City.
Stormwater Basin: California Creek Basin
Existing agricultural uses: None
School District: Ferndale School District
Bus routes: 70x
Publicly owned parcels, including park and school land: None
Road ownership: Delta Line Road is a public road maintained by Whatcom County. Salashan Parkway and Salashan Loop are private roads, maintained by property owners within the subject area.

Planning

Current planning authority (City or County): Whatcom County
Anticipated type and scale of uses: Light industrial/ manufacturing in a range of intensities.
Road maintenance/ improvement responsibility: Responsibility for maintaining private roads will remain private upon annexation, responsibility for maintaining public roads will transfer to the City upon annexation. Delta Line Road will be included in the annexation of this subarea.
Road improvements required: None identified. Existing roadways are not built with full frontage improvements. Limited future development may be required to complete such improvements along Delta Line Road, particularly in the adjacent subarea west of the Delta Line Road.

Park or trail acquisition potential: Low. The mixture and type of uses within the subarea do not lend themselves to the development of parks or trails, or the use of trails by the general public. However, there are a number of natural features (particularly along California Creek and existing ponds in the area) that could create attractive connectivity between this area and lands to the west.

Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not Applicable

I-5 BUSINESS PARK (SUBAREA 12)

Annexation Area Boundary: Includes the entire unincorporated Urban Growth Area east of Interstate Five and north of Grandview Road.

Annexation Area Size: ~ 50 acres (Industrial

Subareas within annexation area: N/A



History: The area which now includes the I-5 Business Park was included in the first Ferndale Urban Growth Area established by Whatcom County in 1997. At that time, the properties were vacant fields that were used for hay, rather than agricultural purposes. In 2004, the I-5 Industrial Park General and Specific Binding Site Plan was recorded, and subsequent commercial/light industrial development has followed.

Mapping Area
General subarea description (existing)
Existing land use types: Commercial (office)/ Industrial
Average parcel size : Approximately four acres, ranging in size from 2.3 acres to 5 acres.
Existing water/sewer conveyance (including septic): Sewer: onsite sewer system with drainfield. Water: Public Utilities District # 1
Approximate age of septic systems (if present): Septic system installed in 2004.
Service providers (pre and post-annexation):

Pre-annexation: sewer – The onsite sewer system with drainfield may be utilized for new development within the binding site plan until capacity is reached. Water: PUD #1
Post Annexation: Existing onsite sewer system may continue to be utilized until public sewer is within 200' of the end user; properties may be asked to participate in a latecomers agreement/ ULID for sewer extension.
The City of Ferndale and PUD # 1 are in the process of developing a agreement through which the City may extend public water to this area and/or utilize existing infrastructure in this area.

Anticipated need for change in service area boundary (pre and post-annexation): The Public Utilities District has indicated a desire to transfer services from the PUD to the City of Ferndale as the Grandview

area is annexed to the City. The City seeks to extend public sewer to the area and to minimize the establishment of new onsite septic systems.

Resulting agreements (if any): In 2010, the City of Ferndale and PUD # 1 established an interlocal agreement that would lead to the transfer of some or all PUD infrastructure to the City, following an assessment of water capacity and conveyance in the area.

Existing land use designation/ zoning: County: Urban Growth Area (Land Use Designation), Light Impact Industrial (Zoning).
City: Industrial land use designation, Light Industrial or General Business zoning designation.
Soil Type: Edmonds-Woodlyn loams, 0-2% slopes, Tromp loam, 0-2% slopes
Slopes: Generally flat ground
Wetland and/or critical areas: None identified
Watershed: Drayton Harbor
Specific watershed conditions: Compliance with applicable stormwater regulations
Stormwater Basin: California Creek Basin
Existing agricultural uses: None
School District: Ferndale School District 502
Bus routes: Whatcom Transportation Authority (WTA) Route 70x
Publicly owned parcels, including park and school land: None
Road ownership: All roads within the I-5 Industrial Park are private roads

Planning
Current planning authority (City or County): County
Anticipated type and scale of uses: Light Industrial/ office
Road maintenance/ improvement responsibility: property owners
Road improvements required: None identified (private road)
Park or trail acquisition potential: Limited. Potential trail area(s) may be incorporated into required vegetative buffer, common areas and made available to the public upon agreement by property owners.
Contact information for community representative (if applicable): Al Jansen

Annexation Status (if applicable): Not applicable

LONG TERM ANNEXATION AREAS (ELIGIBLE FOR ANNEXATION AFTER 2029)

SOUTHEAST GRANDVIEW (SUBAREA 13)

Annexation Area Boundary: The Southeast Grandview area is bordered to the east by the Burlington Northern Railroad, and to the north by Grandview Road. West of the site is the Fairfield Mobile Home Park. The southern border consists of wooded areas that act as a buffer for residential properties to the south.



Annexation Area Size: ~75 acres

Subareas within annexation area: The Northgate Industrial Park, which occupies the eastern portion of the annexation area and includes land on either side of Northgate Way, is a potential subarea. There are no clear boundaries among the remaining parcels.

History: The subject area was included in Whatcom County's Cherry Point/ Ferndale Subarea plan as early as 1981. At that time, the Southeast Grandview Subarea was identified for Light Industrial Park uses (see Figure X, below). However, little if any industrial uses were established prior to the creation of the Ferndale Urban Growth Area in the early-1990's – at that time, the subarea was still characterized by large lot single family residences and agricultural buildings dating from the 1950's and 1960's. The zoning associated with the Urban Growth Area maintained zoning for industrial uses, and the Northgate Industrial Park Binding Site Plan was established in 1991 in the eastern portion of the subarea. Since that time, there have been three specific binding site plans, which further partitioned the site and resulted in the construction of three buildings. The remaining parcels in the area are single family residences, including pasture and associated building for horses.



Mapping Area

General subarea description (existing)

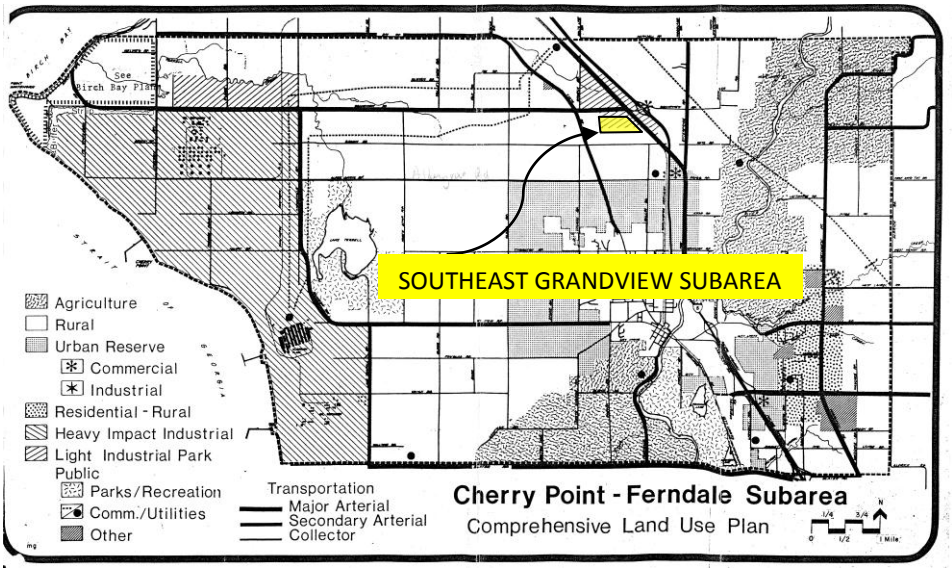
Existing land use types: Light industrial, residential, light agriculture (livestock).

Average parcel size: ~ 6 acres

Existing water/sewer conveyance (including septic): Public Utility District # 1 (water), onsite sewer (septic).

Approximate age of septic systems (if present): ~5-30 years

Service providers (pre and post-annexation): The City and PUD 1 have entered into an interlocal agreement to determine the appropriate transfer of responsibility as the unincorporated UGA serviced by the PUD is annexed. This review will include an analysis of existing conveyance, in order to determine if an extension of City water lines is required, or if existing lines can be utilized following annexation and further development. Existing septic systems may be allowed to continue, but the City will require extension of City sewer lines for new development, following annexation.



Anticipated need for change in service area boundary (pre and post-annexation): PUD service boundary will likely be reduced following annexation.

Resulting agreements (if any): 2010 interlocal between PUD 1 and City of Ferndale

Existing land use designation/ zoning – County: Urban Growth Area (land use designation)/ Light Impact Industrial (zoning). City: Industrial (land use designation).

Soil Type: Birchbay slit loam, 3-8% slopes, Hale silt loam, drained, 0-2% slopes, Edmonds-Woodlyn loams, 0-2% slopes, Laxton loam, 3-8% slopes, Tromp loam, 0-2% slopes

Slopes: Elevations gradually increase from the northeast to the southwest. A substantial ravine is found along the western boundary of the subarea.

Wetland and/or critical areas: Wetland areas likely exist along the Burlington Northern Railway, resulting in part from seasonal flooding and ponding due to drainage from Swede Hill to the south.

Additional wetland complexes may also be located in fields in the southwestern portion of the site, as well as within the ravine area to the west.
Watershed: Drayton Harbor
Specific watershed conditions: Compliance with current stormwater regulations
Stormwater Basin: California Creek Basin
Existing agricultural uses: Livestock (equestrian)
School District: 502
Bus routes: 70x
Publicly owned parcels, including park and school land: None.
Road ownership: Northgate Industrial Park (private), Grandview Road (State)

Planning
Current planning authority (City or County): Whatcom County
Anticipated type and scale of uses: Light Industrial
Road maintenance/ improvement responsibility: Northgate Industrial Park – maintained by property owners. Grandview Road – maintained by Washington State

Road improvements required: None identified. Grandview Road lacks frontage improvements, which may be required as a condition of development.

Park or trail acquisition potential: Low to Moderate. Light industrial uses are often incompatible with public uses such as parks and trails. However, the subarea represents a potential connection point between residential uses to the south and commercial uses to the northeast. The City may seek to establish trail uses through the subarea for connectivity purposes.

Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable

SOUTHWEST GRANDVIEW (SUBAREA 14)

Annexation Area Boundary: The Southwest Grandview subarea is bordered on the west by Vista Drive (the subarea follows township, range and section lines, and therefore the northwestern-most properties at the southeast intersection of Grandview Road and Vista Drive are excluded from the City's UGA, while properties in the southwestern portion of the subarea, west of Vista Drive, are included). To the north of the subarea is Grandview Road, and the Southeast Grandview subarea is immediately to the east of the site. South of the site are properties within the Ferndale Urban Reserve area.

Annexation Area Size: ~35 acres



Subareas within annexation area: The Fairfield Mobile Home Park, located in the eastern portion of this subarea, may be considered for annexation prior to the remainder of the site. It is unlikely that the Fairfield park will follow the remainder of the subarea unless it is annexed together with (or following) the annexation of the Northeast Grandview subarea.

History: The Fairfield Mobile Home Park consists of twenty-five spaces for mobile or manufactured home units, and was constructed in 1971. Historically, properties in this area were predominantly agricultural, reflected in the remnant barns and agricultural buildings that occupy this area. This area represents the southern portion of a relatively flat valley that stretches northward from Swede Hill.

Mapping Area
General subarea description (existing)
Existing land use types: Large lot single family residential
Average parcel size: 3.5 (individual lots within Fairfield Mobile Home Park are not considered separate lots of record).
Existing water/sewer conveyance (including septic): The Fairfield Mobile Home Park is serviced by a community septic system. The park is serviced by a community water association. Adjacent properties are serviced by onsite sewer (septic) and private wells or PUD #1.

Approximate age of septic systems (if present): Up to forty years old (circa 1971)
Service providers (pre and post-annexation): Pre-annexation: Fairfield Mobile Home Park Water Association (serving 66 people), community septic. Post-annexation: Due to the non-conforming nature of the existing land use, the City is unlikely to permit connections to public water and sewer unless the water or septic systems fail.

Anticipated need for change in service area boundary (pre and post-annexation): No change in service boundaries are required as the result of annexation, beyond the transfer of police service and general City administration/planning/public works. Those properties that are serviced by PUD #1 may be subject to a service transfer, pursuant to a 2010 interlocal agreement between the City and PUD.
Resulting agreements (if any): 2010 interlocal agreement between City of Ferndale and PUD #1.

Existing land use designation/ zoning – County: UGA (land use designation)/UR4), City: Industrial.
Soil Type: Laxton loam, 3-8% slopes, Tromp loam, 0-2% slopes, Whatcom silt loam, 0-15% slopes

Slopes: The majority of land adjacent to Grandview Road is relatively flat, with southern properties increasingly influenced by Swede Hill and higher elevations. In the southwestern portion of the site, a ravine traveling from the south to the north acts as a natural eastern boundary for the Fairfield Mobile Home Park.

Wetland and/or critical areas: Wetlands are anticipated within the various ponds that are found in the southwestern portion of the site, and along the ravine channel that has been obscured by tree growth.



Watershed: Drayton Harbor
Specific watershed conditions: Compliance with current stormwater regulations
Stormwater Basin: California Creek Basin
Existing agricultural uses: Equestrian, personal gardens
School District: Ferndale School District
Bus routes: 70x (within walking distance)
Publicly owned parcels, including park and school land: None
Road ownership: Private (Fairfield Lane), Public – Washington State (Grandview Road), Whatcom County (Vista Drive).

Planning
Current planning authority (City or County): County
Anticipated type and scale of uses: Existing residential uses in this subarea are considered legal non-conforming uses. Those uses may continue in perpetuity prior to and following annexation. However, expansions to such uses are limited and should any use be abandoned, it may be restricted from restarting.

Future uses anticipated within the Industrial land use category will likely consist of light industrial, light manufacturing, office, or a combination of these uses, consistent with existing development north of Grandview Road.

Road maintenance/ improvement responsibility: Private (Fairfield Lane), Washington State Department of Transportation (Grandview Road), County (Vista Drive). Roadways subject to County responsibility will transfer to the City upon annexation.

Road improvements required: No improvement requirements have been identified as the result of annexation. Road frontage improvements (curb, gutter, sidewalk), and possible road widening will likely become a condition of development. The intersection of Grandview Road and Vista Drive has been identified as an intersection requiring improvements within the twenty-year planning period. These improvements will be the responsibility of Whatcom County, unless annexation occurs first. Improvements consist of improved signalization of the intersection, with construction of eastbound and westbound left-turn lanes on Grandview Road, or the construction of a single lane roundabout.



Park or trail acquisition potential: Low. With the exception of park or trail space that may be made available to employees of future land uses (which may or may not be made available to the public), park and trail uses in this area will likely be minimized. The City will seek to establish non-motorized connectivity along Grandview Road and Vista Drive, and may support internal trail connectivity should bicycle lanes be incompatible with traffic on Grandview Road.

Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable

NORTH MALLOY (SUBAREA 15)

Annexation Area Boundary: The Burlington Northern Santa Fe Railroad borders the North Malloy annexation area to the east, with Brown Road acting as the southern boundary. To the west are properties included in the City of Ferndale Urban Growth Area Reserve.

Annexation Area Size: ~ 30 acres

Subareas within annexation area: None

History: The North Malloy area is and has been a single family residential area, with several of the residences including an agricultural component (generally livestock). Properties to the east are generally at lower elevations than western properties, and the majority of residences are set back from the BNSF railway by several hundred feet. The area has gradually become more developed over time, but due to limitations on development within the Urban Growth Area, the annexation area has now likely been fully developed, not including the further establishment of accessory structures.

Mapping Area

General subarea description (existing)

Existing land use types: Single family residential, accessory agricultural (livestock) uses.

Average parcel size: ~4 acres (seven parcels)

Existing water/sewer conveyance (including septic): Private well/ onsite septic



Approximate age of septic systems (if present): Pre-2000 and older

Service providers (pre and post-annexation): No change prior to development. The 2006 Water System Plan (amended in 2010), anticipates that public water will be provided to this area along a 16" water line connecting to Brown Road to the Grandview system.

Anticipated need for change in service area boundary (pre and post-annexation): None

Resulting agreements (if any): None

Existing land use designation/ zoning – County: Urban Growth Area (land use designation)/

Soil Type: Lynden sandy loam, 0-3% slopes, Tromp Loam, 0-2% slopes, Whatcom silt loam, 8-15% slopes, Yelm loam, 3-8% slopes.

Slopes: Slopes of up to 15% are found in the annexation area, with higher elevations found to the west, associated with Swede Hill. Topography is generally rolling, although the majority of home sites in the center of the study area are built on a moderate plateau. Properties to the east are significantly lower.
Wetland and/or critical areas: Few wetlands are identified by City of Ferndale GIS maps, and the majority of critical areas are likely associated with agricultural activity or human-made ponds. Lands to the east may experience seasonal wetlands, resulting from ponding that occurs at and around railroad embankments.
Watershed: Drayton Harbor Watershed
Specific watershed conditions: Compliance with current stormwater regulations.
Stormwater Basin: California Creek Basin
Existing agricultural uses: There are several small livestock farms within the annexation area, the most active of which is a commercial bison farm that includes the retail sign of bison meat.
School District: 502.
Bus routes: None
Publicly owned parcels, including park and school land: None
Road ownership: Whatcom County/ City of Ferndale. The western half of Brown Road (west of Malloy Road) is maintained by Whatcom County, the eastern half by the City of Ferndale. Responsibilities would transfer to the City of Ferndale upon annexation.

Planning
Current planning authority (City or County): Whatcom County
Anticipated type and scale of uses: Low Density Residential.
Road maintenance/ improvement responsibility: Whatcom County/ City of Ferndale. See above.
Road improvements required: The development of adjacent properties will likely require full curb, gutter and sidewalk improvements. Improvements to the BNSF railroad crossing may also become necessary as traffic increases, particularly for westbound traffic that may back up from Portal Way.
Park or trail acquisition potential: Moderate to high. There are no public parks or trails in close proximity to the subject properties, and the location of the area adjacent to the intersections of Brown and Malloy/ Portal Way may be an advantage for future parks planning. However, due to the relatively small size of parcels in separate ownership, it is more likely that a park will be identified to the south and that the subject area will be optimized for trail connectivity to the north and/or the east.
Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable.

CENTRAL MALLOY (SUBAREA 16)

Annexation Area Boundary: Malloy Road is the eastern boundary to this annexation area, with Brown and Aldergrove Roads acting as the northern and southern boundaries, respectively, and the Ferndale Urban Growth Area reserve serving as the western boundary.



Annexation Area Size: ~60 acres

Subareas within annexation area: None identified.

History: Properties within the Central Malloy subarea were zoned as Suburban Five Acre Farming, the intent of which was preserved following the creation of the Ferndale Urban Growth Area in the mid-1990's, establishing one unit per five acre allowances without public water and sewer. These provisions have resulted in the further parcelization of the area, although historically only the northern sections were utilized for agricultural purposes.

Mapping Area

General subarea description (existing)

Existing land use types: Large lot single family residential, commercial landscaping, livestock

Average parcel size: ~ 9 acres (seven parcels)

Existing water/sewer conveyance (including septic): private well/ onsite sewer/septic

Approximate age of septic systems (if present): Approximately twenty- thirty years

Service providers (pre and post-annexation): Private

Anticipated need for change in service area boundary (pre and post-annexation): None prior to development, unless existing systems fail. The 2006 Water System Plan (amended in 2010) identifies two projects: a 12" line along Malloy Road, and two east-west 12" laterals between Brown Road and Aldergrove Road.
Resulting agreements (if any): None
Existing land use designation/ zoning- County: Urban Growth Area (land use designation)/UR4 (zoning), **City:** Low Density Residential (land use designation)
Soil Type: Labounty silt loam, drained, 0-2% slopes, Whatcom silt loam, 0-15% slopes, Yelm loam, 3-8% slopes
Slopes: The Central Malloy subarea includes localized areas of significant topographical changes – the land area consists of a large number of small hills. Overall, the land area slopes down from the southwest and results in a total elevation change of approximately thirty feet.
Wetland and/or critical areas: Despite the hilly terrain, a relatively small number of wetlands are identified on the City's wetland maps, although more may be identified following a professional delineation. The most significant wetlands are likely located in the northern portion of the site, associated with a natural drainage path that extends to the southwest of the site. An additional wetland has been identified at Aldergrove Road, stretching south to the East Aldergrove subarea.



Watershed: Lower Mainstem Nooksack, Drayton Harbor.
Specific watershed conditions: Compliance with current stormwater regulations.
Stormwater Basin: South Whiskey Creek Basin, Cedar Creek Basin

Existing agricultural uses: Agricultural uses in the area are limited to hobby farming, including a small herd of cattle within the northern portion of the site.
School District: Ferndale School District 502.
Bus routes: None
Publicly owned parcels, including park and school land: None
Road ownership (Pre-annexation): Aldergrove Road, western portions of Brown Road – Whatcom County. Malloy Road is currently owned and maintained by the City of Ferndale. Following annexation, all roads will transfer to City ownership.

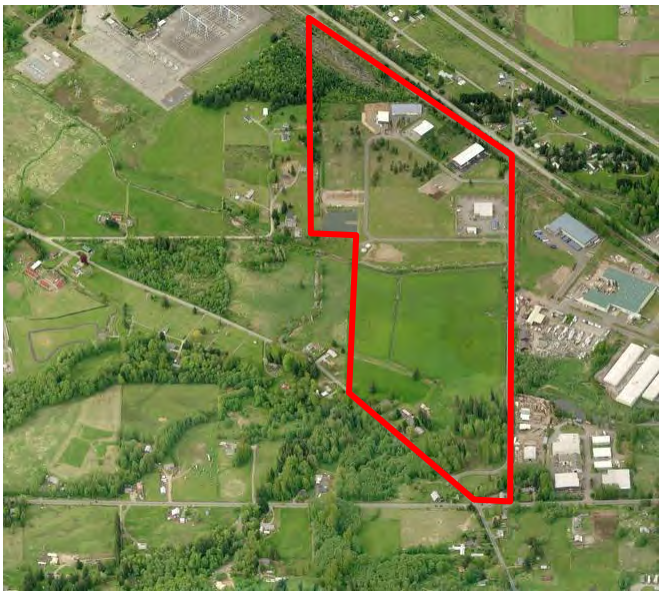
Planning
Current planning authority (City or County): Whatcom County

Anticipated type and scale of uses: Low Density Residential.
Road maintenance/ improvement responsibility (pre-annexation – Vista Drive): Whatcom County, post-annexation: City of Ferndale. Malloy Road is currently considered a City street and will remain so post-annexation.
Road improvements required: Full frontage improvements will be required at the time of development, and may include road dedications and intersection improvements, if determined to be warranted at the time.
Park or trail acquisition potential: High. If a private park is not included in development proposals, it is likely that such a park will be required to meet City of Ferndale Level of Service and connectivity requirements at or before final build-out. Such a park may be desirable in the center-north portion of the area, or at the intersection of interior roadways. Trail connectivity will be required upon the development of properties within the area, in order to link this area to existing and potential corridors and parks.
Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable

DELTA LINE (SUBAREA 17)

Annexation Area Boundary: Delta Line Road is the eastern boundary of the site, the Burlington Northern Santa Fe Railway is the northern boundary. The unincorporated UGA is the western boundary, and the area terminates at Vista Drive to the south.



Annexation Area Size**: ~90 acres**

Subareas within annexation area: The Delta Tech Industrial Park, comprising the northern third of the property, has received development entitlements from Whatcom County and may fully develop prior to annexation. The southern portions of the property have not received similar approvals, and may be limited from development until annexation – depending on the establishment of Whatcom County development restrictions.

History: Properties in the annexation area had historically been associated with agricultural uses prevalent in the Custer Valley, and the hedgerows at and around drainage lines and California Creek bear evidence of these historic uses. In 2004 the Delta Tech Industrial Park Binding Site Plan was approved, establishing twenty-four lots as well as onsite septic, stormwater, and a private well. Since that time approximately 1/3 of the lots have been further developed.

Mapping Area

General subarea description (existing)

Existing land use types: Light industrial, non-conforming single family residential, agricultural.

Average parcel size: ~ 3 acres, although twenty-three of the twenty-four lots within the Delta Tech Industrial Park are less than two acres in size.

Existing water/sewer conveyance (including septic): private well/ onsite sewer/septic

Approximate age of septic systems (if present): Approximately eight years (2004 – Delta Tech Industrial Park), approximately thirty years (single family residences)
Service providers (pre and post-annexation): Private
Anticipated need for change in service area boundary (pre and post-annexation): None prior to development, unless existing systems fail.
Resulting agreements (if any): None
Existing land use designation/ zoning- County: Urban Growth Area (land use designation)/Light Impact Industrial (zoning), **City:** Industrial (land use designation)
Soil Type: Labounty silt loam, drained, 0-2% slopes, Laxton loam, 3-15% slopes, Shalcar muck, drained, 0-2% slopes



Slopes: There are few significant elevation changes in the subarea, though the site does slope down from the south to the north, and includes a somewhat significant decrease immediately adjacent to Vista Drive.
Wetland and/or critical areas: Potential wetlands have been identified in the southern portion of the site adjacent to Delta Line Road (most likely associated with ponding of California Creek to the east of the roadway), and in the western portion of the site.
Watershed: Drayton Harbor.
Specific watershed conditions: Compliance with current stormwater regulations.
Stormwater Basin: California Creek Basin
Existing agricultural uses: Limited agricultural uses exist in the southern portion of the site.
School District: Ferndale School District 502.
Bus routes: Route 70x is located to the east of the site.
Publicly owned parcels, including park and school land: None
Road ownership (Pre-annexation): Vista Drive and Delta Line Road are Whatcom County roads. Delta Loop Road is private.



Planning
Current planning authority (City or County): Whatcom County

Anticipated type and scale of uses: Light Industrial
Road maintenance/ improvement responsibility: Whatcom County is currently responsible for public roads. The City of Ferndale will be responsible for these roads at the time of annexation.
Road improvements required: Full frontage improvements will likely be required for undeveloped properties along Vista Drive and Delta Line Road. Properties without full frontage improvements should not anticipate such improvements as the result of annexation.
Park or trail acquisition potential: Low. The nature of proposed uses does not lend itself to future park or trail potential, and the subject area is not convenient to nearby residential development. However, California Creek and its buffer provide a protected linear path that may accommodate future trail space.
Contact information for community representative (if applicable): Not applicable

Annexation Status (if applicable): Not applicable

URBAN RESERVES

Urban Reserves are those areas that have been identified for potential future inclusion in the City's UGA. As described previously, the UGA is intended to ensure that the area in which the City is allowed to expand is sufficient to support the City's projected growth over the course of the planning period. If growth occurs more quickly than projected and/or if the City's land inventory is diminished to the extent that more land is necessary, the Urban Reserves can be transferred into the City's Urban Growth Area and then annexed into the City.

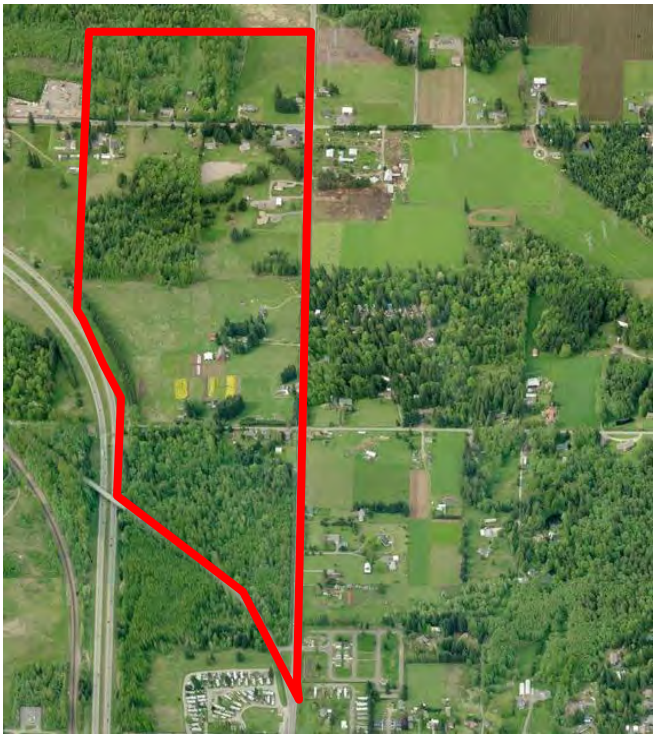
In order to accommodate Urban Reserves, the City has identified preliminary land use designations and incorporated the territory into the City's capital facilities plans. This will ensure that the City has planned for the future growth of these areas at the time they become part of the UGA – a requirement of the Whatcom County Comprehensive Plan. In some cases, lands within Urban Reserves (particularly along the Vista/ Malloy corridor and Portal Way) may be utilized as utility corridors in order to efficiently convey services to the northern portions of the City.

The Annexation Blueprint does not identify a specific timing for the transfer of Urban Reserves into the UGA. Based on Whatcom County Land Capacity Analysis', the City and its UGA are of sufficient size to accommodate population and employment growth over the next twenty years.

AREA NAME: ENTERPRISE ROAD

Size: ~ 90 acres

Preliminary Land Use Designation: Commercial



Existing Uses: Large lot single family residential, community church

Existing Infrastructure: Private well/ septic. Enterprise Road is a two-lane County road without curb gutter or sidewalk, and minimal shoulder width. Grandview Road is a State Highway without curb, gutter, or sidewalk and moderate shoulder width.

Known Critical Areas: Probable critical areas have been identified north of Grandview Road, within existing woodland. Additional critical areas may be located south of Grandview Road, also within woodland.

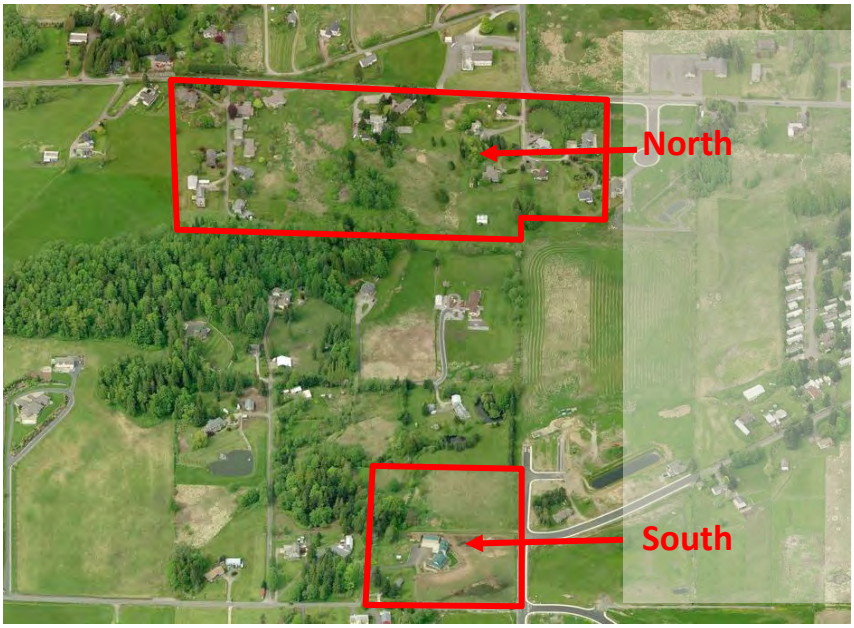
Agricultural Use/ Zoning: Properties in the southern portion of the study area have devoted land to the raising of specific crops, and the majority of land within the area was clearly used for agriculture in the past. Cattle are raised east of the site, outside of the Urban Growth Area and reserve.

Special Conditions: The Enterprise Urban Reserve area may be utilized to convey City utilities (water, sewer) prior to annexation or inclusion in the Ferndale UGA. Such extension shall not be a basis for providing water and sewer connections to properties outside of the existing City limits.

AREA NAME: SOUTH MAIN

Subareas: South Main North, South Main South

Size: 34 acres (South Main North: approximately 24 acres, South Main South: approximately 10 acres)



Preliminary Land Use Designation: Low Density Residential

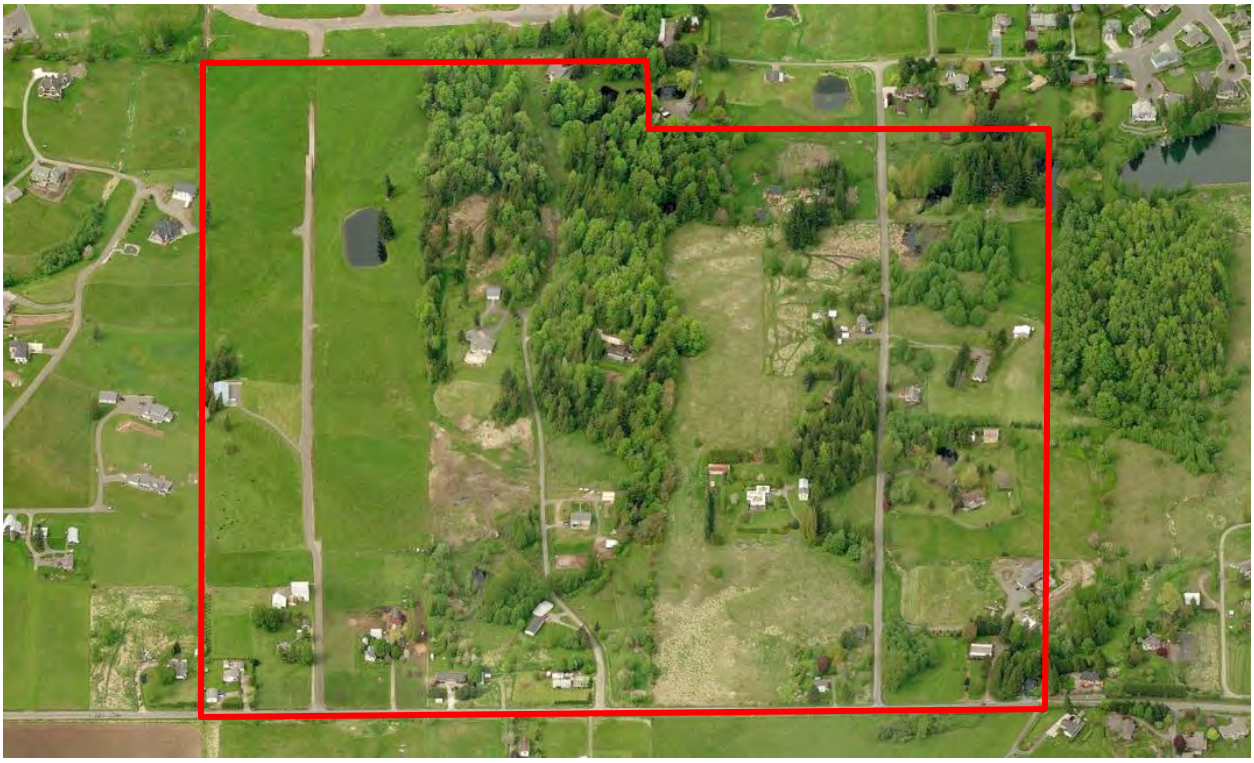
Existing Uses: Existing uses include medium to large-lot single family residences, a small bison farm is located in the southern portion of the study area.

Existing Infrastructure: City water and sewer is available adjacent to the southern study area and east of the northern study area. Main Street is a City street adjacent to the northern study area. Douglas Road is a City street east of the southern study area, but becomes a County road west of the Church Road connection. The City expects to require a connection to Church Road from Douglas at the time this area is developed. Sewer connections for the southern portion of this annexation area will likely be to the existing lines to the south and east, while to the north, sewer will be pumped north to existing lines in Main Street.

AREA NAME: MOUNTAIN VIEW

Size: ~150 acres

Preliminary Land Use Designation: Low Density Residential



Existing Uses: Large lot single family residential

Existing Infrastructure: Private well/water association, private sewer/septic. Storr Road is the primary public road in this area. The City of Ferndale Sewer Comprehensive Plan projects that the area could be served by an 8- to 10-inch gravity sewer connection to a 12-inch trunk sewer in Mountain View Road, with the trunk continuing east to connect to existing sewer systems in Main Street.

Known Critical Areas: Several critical areas have been identified, but appear to be relatively isolated due to the rolling topography of the area.

Agricultural Use/ Zoning: Agricultural uses are generally associated with "hobby farming," and the majority of the site has been subdivided consistent with the maximum development allowed within the Urban Growth Area, of which this area was formerly a part.

Special Conditions: None identified.

AREA NAME: BROWN ROAD

Size: ~ 395 acres

Preliminary Land Use Designation: Low Density Residential



Existing Uses: Large lot single family residential, moderate agriculture

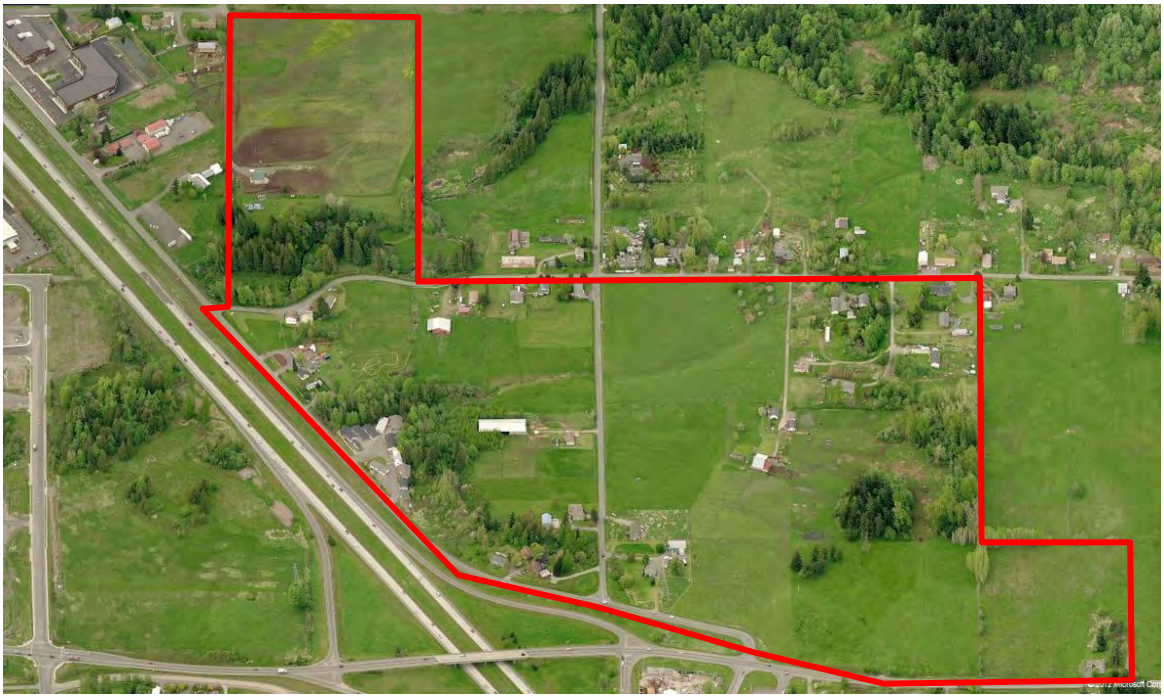
Existing Infrastructure: Private well and septic facilities, public and private roads.

Known Critical Areas: Despite varying terrain, few critical areas of substantial size have been identified.

Agricultural Use/ Zoning: Several agricultural uses exist within the subject area, and are concentrated in the vicinity of Aldergrove Road. The subject area is zoned Rural, one unit per ten acre (R10A) by Whatcom County.

Special Conditions: The City may consider establishing "Neighborhood Commercial" or similar zoning in the area, in order to avoid an exclusively-residential district from Main Street north to Grandview Road. This area was planned as an Urban Growth Area from the mid-1990's through 2009. The City of Ferndale Comprehensive Sewer Plan (2011) anticipates that the area could be served by an 8-10 inch gravity sewer down to a trunk sewer in Malloy Road.

AREA NAME: SLATER EAST



Subareas: None Identified

Size: 114 Acres

Preliminary Land Use Designation: Commercial

Existing Uses: Existing uses include large-lot single family residences, pastureland, and two businesses.

Existing Infrastructure: City water and sewer is available within Pacific Highway to the north, existing County roads in the area include Pacific Highway, Sunset Avenue, and Graveline Road. Each of these roads would transfer to City jurisdiction upon annexation.

Known Critical Areas: A portion of Silver Creek (and associated wetlands) have been identified within the northwest portion of this study area. A secondary stream channel has also been identified south of Sunset Avenue and west of Graveline Road.

Agricultural Use/ Zoning: Agricultural uses in the area include pastureland for cattle grazing. The properties have been zoned R5A – Rural, one dwelling unit per five acres.

Special Conditions: The City and County are required to consult with the City of Bellingham prior to the transfer of the Slater East Urban Reserve to the City of Ferndale Urban Growth Area. According to the 2011 Sewer Comprehensive Plan, the flow from this area may be able to be served by a gravity sewer crossing under I-5, and that pump stations receiving the increased flow will need to be re-analyzed and upgraded, as necessary.

Sources

The following resources were utilized to prepare this document.

City of Ferndale Comprehensive Plan; City of Ferndale. Updated 2005, Amended March 2012: http://www.cityofferndale.org/CDD/comprehensiveplan.php

City of Ferndale Comprehensive Sewer Plan; Wilson Engineering, City of Ferndale. Adopted March 2011: http://www.cityofferndale.org/publicWorks/plansAndStandards/sewerCompPlan/sewerCompPlan.php

City of Ferndale Comprehensive Stormwater Plan: Reichardt and Ebe Engineering, City of Ferndale, Adopted October 2005: http://www.cityofferndale.org/publicWorks/plansAndStandards/stormCompPlan/CompStormPlan.pdf

City of Ferndale Water System Plan; Reichhardt and Ebe Engineering, City of Ferndale. Adopted 2006, amended 2010: http://www.cityofferndale.org/publicWorks/plansAndStandards/waterCompPlan/waterCompPlan.php

City of Ferndale Parks, Recreation and Trails Master Plan; City of Ferndale. Adopted 2008, amended 2012: http://www.cityofferndale.org/cdd/parkplanupdate.php

City of Ferndale Geographic Information System (GIS); City of Ferndale, ATSI (wetland data layer). Implemented 2008, updated 2008-2012: http://www.cityofferndale.org/GIS/GIS.php

City of Ferndale Municipal Code; City of Ferndale. Updated September 2012 (through Ordinance 1734): http://www.codepublishing.com/wa/Ferndale/

Google Maps (www.maps.google.com)

Bing Maps (www.bing.com/maps)

Whatcom County Code; Whatcom County. Updated July 2012 (through Ordinance 2012-031): http://www.codepublishing.com/wa/whatcomcounty/

Whatcom County Comprehensive Plan; Whatcom County. Updated through 2011: http://www.whatcomcounty.us/pds/planning/comp_plan/comp_plan.jsp

Site Reconnaissance: City of Ferndale Staff, Summer/Fall 2012

Soil Survey of Whatcom County Area, Washington; United States Department of Agriculture Soil Conservation Service. 1992

Cherry Point Ferndale Subarea, a component of the Whatcom County Comprehensive Land Use Plan; Whatcom County. Adopted 1981.

"Recorded Document Search;" Whatcom County Auditor. Miscellaneous Records. Updated 2012: http://www.whatcomcounty.us/paris/

"Surface Water Delineation Boundaries of Whatcom County;" P. Gill, Whatcom County Planning and Development. 2005.

"Transit Maps;" Whatcom Transportation Authority. 2012: http://www.ridewta.com/transit_maps

"GrandviewLUDMap (unpublished);" Whatcom County Public Utilities District 1. Provided August 21, 2012 by PUD #1 to City of Ferndale.

Vancouver Urban Growth Area Annexation Blueprint: 20-Year Plan; City of Vancouver – Clark County. 2007 Update: http://www.cityofvancouver.us/upload/images/Planning/Annexation/2007_Annexation_Blueprint_120507%5b1%5d.pdf

N. WATER SUPPLY AND STORAGE ANALYSIS

WATER SUPPLY AND STORAGE ALTERNATIVE ANALYSIS

FOR

CITY OF FERNDALE, WASHINGTON

October 2016



Provided For:

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TABLE OF CONTENTS

TABLE OF CONTENTS ii
WATER SUPPLY AND STORAGE ALTERNATIVE ANALYSIS 1
1.1 INTRODUCTION 1
1.1.1 Existing Source 1
1.1.2 Existing Storage 1
1.1.3 Analysis of Alternatives 1
1.2 SOURCE ANALYSIS 1
1.2.1 Water Rights 1
Table 1, City of Ferndale, Existing Water Rights 2
1.2.2 Water Quality and Treatment 2
1.2.2.1 Well Water 2
1.2.2.2 Interties and Water Compatibility 2
1.3 EXISTING WELLS 3
1.3.1 DOUGLAS WELL 4
1.3.1.1 General 4
1.3.1.2 Water Quality and Treatment 4
1.3.1.2 Capacity 4
1.3.1.3 Wellhead Protection 4
1.3.2 CITY SHOP WELL 4
1.3.2.1 General 4
1.3.2.2 Water Quality and Treatment 4
1.3.2.3 Capacity 5
1.3.2.4 Wellhead Protection 5
1.3.3 Central City Well 5
1.3.3.1 General 5
1.3.3.2 Water Quality and Treatment 5
1.3.3.3 Capacity 5
1.3.3.4 Wellhead Protection 6
1.3.4 THORNTON WELL 6
1.3.4.1 General 6
1.3.4.2 Water Quality and Treatment 6

1.3.4.3 Anticipated Capacity 6
1.3.4.4 Wellhead Protection 6
1.4 PROPOSED NEW WELL SITES 7
1.4.1 General 7
1.4.2 DOUGLAS RD. WELL SITE 7
1.4.2.1 General 7
1.4.2.2 Water Quality and Treatment 7
1.4.2.3 Anticipated Capacity 7
1.4.2.4 Wellhead Protection 8
1.4.3 NEW CITY SHOP WELL SITE 8
1.4.3.1 General 8
1.4.3.2 Water Quality and Treatment 8
1.4.3.3 Anticipated Capacity 8
1.4.3.4 Wellhead Protection 8
1.4.4 CENTRAL CITY WELL SITE 8
1.4.4.1 General 8
1.4.4.2 Water Quality and Treatment 9
1.4.4.3 Anticipated Capacity 9
1.4.4.4 Wellhead Protection 9
1.5 AQUIFER STORAGE AND RECOVERY (ASR) 9
1.6 OTHER WELL SITES 10
INTERTIE ALTERNATIVES 11
2.1 GENERAL 11
2.2 EMERGENCY INTERTIE REQUIREMENTS 11
Table3, Intertie Requirements 11
2.3 POTENTIAL EMERGENCY INTERTIES 12
2.3.1 CITY OF BELLINGHAM 12
2.3.1.1 Description 12
2.3.1.2 Route and Pipe Size 12
2.3.1.3 Ability to Serve Additional Properties 12
2.3.1.4 Permitting 12
2.3.2 CITY OF BLAINE/BIRCH BAY WATER AND SEWER DISTRICT 13
2.3.2.1 Description 13
2.3.2.2 Interlocal Agreement 13

2.3.2.3 Route and Pipe Size 13
2.3.2.4 Water Blending Considerations 14
2.3.2.5 Permitting and Water Rights 14
2.3.3 DEER CREEK WATER ASSOCIATION 14
2.3.3.1 General 14
2.3.3.2 Interlocal Agreement 15
2.3.3.3 Route and Pipe Size 15
2.3.3.4 Water Blending Considerations 15
2.3.3.5 Permitting 15
2.3.3.6 Water Rights 15
WATER STORAGE 16
3.1 Existing Water Storage 16
3.1.1 General 16
3.1.2 Projected Storage Needs 17
WATER STORAGE ALTERNATIVES 19
4.1 SMITH RD. (BELLAIRE ESTATES) 19
4.1.1 Zoning of Site 19
4.1.2 Location of Facility 19
4.1.3 Size of Facility 19
4.1.4 Connection to Existing Infrastructure 19
4.1.4.1 Belfern Dr. 20
4.1.4.2 Utility Easement 20
4.1.5 Permitting 20
4.2 BAKERVIEW TANK SITE 20
4.2.1 Size of Facility 20
4.2.2 Elevation Considerations 21
4.2.3 Water Quality Considerations 21
4.2.4 Connection to Existing Infrastructure 21
4.2.5 Permitting 21
4.3 CITY OF BELLINGHAM MARIETTA RESERVOIR 21
4.3.1 Size of Facility 22
4.3.2 Elevation Considerations 22
4.3.3 Water Quality Considerations 22
4.3.4 Connection to Existing Infrastructure 22

4.3.5 Permitting 22
4.4 SOUTH OF SLATER RD. 23
4.4.1 Size of Facility 23
4.4.2 Elevation Considerations 23
4.4.3 Water Quality Considerations 23
4.4.4 Connection to Existing Infrastructure 23
4.4.5 Permitting 23
4.5 BROWN RD. VICINITY 23
4.5.1 Size of Facility 24
4.5.2 Elevation Considerations 24
4.5.3 Water Quality Considerations 24
4.5.4 Connection to Existing Infrastructure 24
4.5.5 Permitting 25
RECOMMENDATIONS 26
5.1 WATER SOURCE 26
5.2 INTERTIES 26
5.3 WATER STORAGE 27

APPENDIX

WATER SUPPLY AND STORAGE ALTERNATIVE ANALYSIS

1.1 INTRODUCTION

1.1.1 Existing Source

The City of Ferndale currently utilizes two ground water wells for its domestic water supply. The water from both wells is pumped through a dedicated line to the water treatment plant where it is treated to remove manganese and hardness. The wells are capable of providing 2,170 gpm. There are no interties with other purveyors that could supplement the City's source in an emergency.

1.1.2 Existing Storage

The City has two above ground water storage tanks, and one underground storage facility at the water treatment plant. The existing facilities are located at different elevations and primarily serve different pressure zones. Through a system of pumps and pressure reducing valves, the storage facilities can serve the entire distribution system. The combined storage is 2.95 million gallons.

1.1.3 Analysis of Alternatives

This report describes and evaluates existing source and storage facilities, evaluates several potential options for additional source, emergency interties, and storage facilities. It also addresses the relationship between source, storage and hydraulic factors that affect the ability of the system to provide adequate fire flow. Specifically, the source alternatives include new wells at the Douglas Road site, the Shop Well vicinity, the Central City Well, the Thornton Well at the Bakerview Tank site and Aquifer Storage and Recovery. Alternatives for interties include the City of Bellingham, Birch Bay/Blaine, and Deer Creek Water Association. Alternatives for additional storage include the City of Bellingham Marietta Tank, the Smith Road/Bellaire Estates site, the existing Bakerview Tank site, and a new site in the Brown Road/Grandview area.

1.2 SOURCE ANALYSIS

1.2.1 Water Rights

In 1952 the City of Ferndale was granted a water right (No. 1513) for 1,000 gallons per minute (gpm) and 1,615 acre feet per year (ac-ft/yr). In 1955, the City obtained another water right (No. 3058) for 870 gpm and 440 ac-ft/yr. In 1971 the City was granted another water right (No. G1-00720P) for 1,000 gpm and 1,614 ac-ft/yr supplemental to the City's existing water rights. A superseding permit was issued to the City in 2004 stating that the maximum instantaneous withdrawal rate from No. 1513 and G1-00720P was limited to 1,300 gpm, and the total annual quantity of all water rights shall not exceed 2,055 ac-ft/yr. In 2014 the City acquired the Central City water system, including their water right (GWC 7700). In 2014 the City filed an application to consolidate withdrawal locations of all of the City's sources for their four water rights and allow flexibility among three existing points of withdrawal and additional future points of withdrawal. The

Department of Ecology approved the application in 2016 with the provision that withdrawal from all four water rights shall not exceed 2,140 acre feet per year.

Table 1-1 summarizes the City's current water rights.

Table 1, City of Ferndale, Existing Water Rights

Cert./Permit	Date	Location	Location	Quantity	Comments
G1-*03899C (GWC 3058)	2/28/55	City Shop	SW¼, SE¼, S19, T39N, R2E	870 gpm 440 af/yr	Serves as City's water source
G1-*02509C (GWC 1513)	5/9/52	Douglas Rd.	SE¼, NW¼, S30, T39N, R2E	1,000 gpm 1,615 af/yr	Serves as City's water source
G1-00720P	7/22/71	Douglas Rd.	SE¼, NW¼, S30, T39N, R2E	1,000 gpm 1,614 af/yr	Not Installed
G1-*10690C (GWC 7700)	3/10/70	Central City	Govt' Lot 1 S19, T39N, r2E	60 gpm 85 af/yr	Not Connected

Source: Washington State Department of Ecology, Water Resources, August, 2015.

The City is allowed to add additional well sources as backup, or reserve, as long as the withdrawal rate and annual quantity does not exceed the water right. Additional well capacity is useful in case a source is out of service.

1.2.2 Water Quality and Treatment

1.2.2.1 Well Water

Well water in the Ferndale area meets the US Environmental Protection Agency's (EPA) national primary drinking water requirements. However, the water quality does not meet the EPA's secondary drinking water requirements for manganese. The secondary contaminants are generally aesthetic in nature, and are not harmful. The water is also considered to be hard and is objectionable to customers. Manganese tends to leave black deposits, while hardness leaves calcium deposits. The City treats the existing Douglas and Shop well water at the Water Treatment Plant. Currently the City uses a combination of greensand filter and reverse osmosis to treat the well water to meet the secondary MCLs. Both wells deliver raw water to the plant via a dedicated 16" transmission main. The main runs from the Shop Well to the Douglas Well and then to the Treatment Plant. There are no services on the transmission main. The 16" main can carry approximately 5,000 gpm without exceeding a velocity of 7 ft/sec., which is almost double the existing water right. It is anticipated that new wells in the City will also require treatment, and depending upon their location, will either pump the raw water to the treatment plant, utilize onsite treatment or blend with treated water. The location and method of treatment is discussed for each of the wells covered in this report.

1.2.2.2 Interties and Water Compatibility

The City has a number of interties with small water associations that are generally for the purpose of supplying water to them in an emergency. These interties are not for the purpose of, or in most cases capable of, providing water back to the City. There are no interties with adjacent purveyors that would

enable the City to draw an adequate amount of water in an emergency or on an interim use basis. The small systems with emergency interties with the City use ground water, and are not anticipated to have compatibility problems with temporary use of City water.

Ferndale is in need of an intertie with another source that can provide an adequate emergency supply. The only nearby potable systems capable of supplying the required capacity are Bellingham, Blaine/Birch Bay and Deer Creek Water Association through its Bellingham intertie. The Whatcom PUD formerly supplied surface water to the Ferndale water treatment plant, but the plant was re-configured to treat well water instead of non-potable surface water. PUD water would need to be treated through a new surface water treatment plant in order to be utilized as potable water by Ferndale.

Interties, in most cases, will require long, larger diameter pipelines. The water should be turned over on a regular basis in order to stay "fresh" and to maintain the required chlorine residual. Emergency pipelines are not used often and water quality could become a problem.

1.3 EXISTING WELLS

The City has four wells. Two of them are active, the Douglas Well and the Shop Well. The Central City Well has a pump installed, but is not connected to the system. The Thornton Well is a recently drilled well, but does not have a pump installed, and is not connected to the system. Well details are shown in Table 2. Locations are shown on the Vicinity Map in Appendix A.

Table 2, City of Ferndale, Existing Well Details

Well Details	Douglas Road	City Shop	Central City	Thornton
Ecology Tag	BCB347	AMF090	AGK343	BHX510
Diameter (in)	12	12	8	8
Ground Surface Elevation (ft)	37.71	67.87	310 (est)	365 (est)
Casing Stickup (ft)	3.125	3.125		
Top of Casing Elevation (ft)	40.84	71.00		
Pump Intake Elevation (ft)	-93.79	-45.23	40	
Original Static Water Elevation (ft)	50.51	57.87	62	53
Original Static Water Elevation Date	1994	1955	1970	2014
Top of Well Screen Elevation (ft)	-103.79	-55.23	30	-28
Bottom of Well Screen Elevation (ft)	-124.29	-80.93	20	-48
Yield (gpm)	1300	870	140	320
Pump Capacity (gpm)	1300	870	Unknown	NA

Well details have been compiled from various hydrological reports and well reports on file at the City of Ferndale and listed In Appendix A.

1.3.1 DOUGLAS WELL

1.3.1.1 General

The site of this source is on Douglas Rd., West of Imhoff Rd. The site address is 2341 Douglas Rd. and the parcel number is 390230 188340. The well was drilled in 1994, is 12" diameter and 170' deep. A well installation and testing report prepared by GeoEngineers on April 29, 1994 recommended that the well not be pumped at rates higher than the 1,300 gpm well screen capacity. The well log and pump curve are included in Appendix A.2.

1.3.1.2 Water Quality and Treatment

Raw water is pumped to the Treatment Plant via a 16" dedicated transmission line where it is treated to remove manganese and hardness.

1.3.1.2 Capacity

The well yield for this site is 1,300 gpm. A Variable Frequency Drive on the pump motor allows the operator to change the flow rate to match daily demand. The pump is operated nearly continuously, either alone or in conjunction with the Shop well pump, in order to provide constant flow through the treatment plant.

1.3.1.3 Wellhead Protection

A Wellhead Protection Plan was prepared for this well by Wilson Engineering and AESI. A copy is on file at the Public Works Department and is also included in the 2016 Water System Plan.

1.3.2 CITY SHOP WELL

1.3.2.1 General

The site of this existing well is located inside the public works yard on Legoe Ave. The site address is 5375 Lego Ave. and the parcel number is 390219 409029. The well was drilled in 1955, is 12" diameter and 160 feet deep. Well details are shown in Table 2. A well log and pump curve are included in Appendix A.3.

1.3.2.2 Water Quality and Treatment

Raw water is pumped to the Treatment Plant via a 16" dedicated transmission line where it is treated for hardness and manganese, a secondary MCL.

1.3.2.3 Capacity

The well pump is capable of supplying 870 gpm, however recent testing indicates that the actual production rate may be less during sustained pumping periods in the summer months. A Variable Frequency Drive on the pump motor allows the operator to change the flow rate to match daily demand. The pump is operated nearly continuously, either alone or in conjunction with the Douglas Road well pump, in order to provide constant flow through the treatment plant.

1.3.2.4 Wellhead Protection

A Wellhead Protection Plan was prepared for this well by Wilson Engineering and AESI. A copy is on file at the Public Works Department and is also included in the 2016 Water System Plan.

1.3.3 Central City Well

1.3.3.1 General

The site of this well is located at 5900 Church Road. (parcel number 390219 010345), The property is owned by the City, and is the source of the former Central City Water Association. The well was drilled in 1970, is 8" in diameter and 290' deep. Well details are shown in Table 2. It is not currently connected to the City system, but is used for monitoring. Future treatment and connection to the system is being considered. The water right for this well is 60 gpm instantaneous and 85 AF annual. However in accordance with the approved DOE Change Application CG1-*10690C the City could pump additional water from this well as long as the total water right from the Regional Aquifer is not exceeded. The well yielded 140 gpm in the original pump test, but it is unknown if the well can currently provide that amount under sustained pumping. The well log is included in Appendix A.4.

1.3.3.2 Water Quality and Treatment

The existing well water quality is similar to that of the Douglas Well and the Shop Well, high in manganese, although hardness is similar to that of the treated water from the Water Treatment Plant. The water will require treatment for manganese, although it could be blended by pumping directly to the City's Bakerview tank.

1.3.3.3 Capacity

It is assumed that the well can produce 60 gpm, but it will take a pump drawdown test to determine the actual production rate. The well is small and if the production rate is too low, it may not be economically feasible to treat and transport the water. However if another well is located nearby, it may be feasible to pipe the water to the other well, or blend it.

1.3.3.4 Wellhead Protection

The existing well site is large enough for a 100' sanitary easement. A Wellhead Protection Plan was prepared for this well by Wilson Engineering and AESI. A copy is on file at the Public Works Department and is also included in the 2016 Water System Plan.

1.3.4 THORNTON WELL

1.3.4.1 General

The site of this source is located near the City's existing Bakerview Water Storage Tank just south of Thornton Rd. The site address is 2601 Thornton Rd., the parcel number is 390124 392440, and the site is currently owned by the City. In 2013, an 8" well was drilled to a depth of 450 feet at this site under the supervision of Associated Earth Sciences, Inc. (AESI), and was tested as a potential new production well. The well log and construction details are included in Appendix A.5.

1.3.4.2 Water Quality and Treatment

An inorganic chemical test confirmed that the water quality is in compliance with DOH MCLs. However the water is high in manganese, conductivity, color, and TDS, and is not in compliance with DOH Secondary MCLs. As a result the water will need to be treated. There are three options for treating. The first is to construct a dedicated water line to tie into the existing raw water transmission line between the shop well and the treatment plant. The second option is to treat the water onsite with a pressure filtration system and deliver the treated water directly into the distribution system. A third option might be to pipe the water directly to the adjacent water storage tank and blend it with incoming treated City water. This option will require a careful analysis to be sure the resulting blended water is not degraded to a point where it is objectionable to customers.

1.3.4.3 Anticipated Capacity

The well yield for this site was determined by AESI to be approximately 350 to 375 gpm, although it is noted on the construction details that the screen was designed for approximately 280 gpm.

1.3.4.4 Wellhead Protection

A wellhead protection plan was prepared for this well by Wilson Engineering and AESI. A copy is on file at the Public Works Department and is included in the 2016 Water System Plan. A copy is on file at the Public Works Department and is included in the 2016 Water System Plan.

1.4 PROPOSED NEW WELL SITES

1.4.1 General

The City's current water rights allow wells to be drilled in the Future Well Area delineated on the Vicinity Map in Appendix A.1. This well area is referred to in this report as the "Regional Aquifer", and is generally recognized as the source for all of the City's wells. Good practice would necessitate spreading the wells throughout this area in order to avoid overpumping. Wells could be drilled relatively close to each other in highly productive areas. However they must be carefully monitored to avoid overpumping the aquifer. Additional wells could be used as backup in the event a primary well is out of service. It is unknown if there is a deeper aquifer with suitable water quality under the Regional Aquifer. An option would be to drill a deeper exploratory well. If a deeper aquifer is not found, the casing could be pulled back and a production well could be developed in the existing Regional Aquifer as a primary or backup well.

Water quality in all known wells in the Regional Aquifer is relatively consistent, and requires treatment or blending in order to meet the City's drinking water policy. This prohibits pumping directly from the wells into the distribution system, except in emergency situations. There are several treatment options for future wells. The first is to construct a dedicated water line to tie into the existing dedicated line between the shop well and the treatment plant. The second option is to treat the water onsite with a pressure filtration system and deliver the treated water directly into the distribution system. A third option would be to pipe water from two or more wells to a new treatment plant more centrally located. A fourth option might be to pipe the water directly to an adjacent water storage tank and blend it with incoming treated water. This fourth option will require a careful analysis to be sure the resulting blended water is not degraded to a point where it is noticeable to customers, and that it is chemically compatible with the treated water.

1.4.2 DOUGLAS RD. WELL SITE

1.4.2.1 General

The site of this new source would be near the City's existing well on Douglas Rd., west of Imhoff Rd. The site address is 2341 Douglas Rd. and the parcel number is 390230 188340. The new well would be located on existing City property.

1.4.2.2 Water Quality and Treatment

It is anticipated that the water quality from this well would be similar to the existing Douglas Well. Treatment would be at the Water Treatment Plant, and the well could easily be connected to the dedicated raw water transmission line.

1.4.2.3 Anticipated Capacity

This site is near the existing Douglas Well. The well yield for this site is anticipated to be 1,300 gpm, similar to the Douglas Well. However based upon a preliminary hydraulic analysis by AESI and others, and consistent with pumping records of the Douglas Well, it is very unlikely that the total from both wells

pumping at the same time will produce much more than 1,300 gpm. At the best, a well at this site would serve as a backup well in case the Douglas Well is out of service. A second option would be to drill an exploratory well in this location to determine if there is a deeper aquifer that has suitable water quality and quantity.

1.4.2.4 Wellhead Protection

A wellhead protection plan was prepared for the nearby Douglas well by Wilson Engineering and AESI. It is assumed that the plan could be expanded to cover this well.

1.4.3 NEW CITY SHOP WELL SITE

1.4.3.1 General

The site of this new potential source is located at 2208 Washington St. (parcel number 390219 422015), currently the site of a private residence. This site is very near the Shop Well and would require acquisition of private property. A replacement well could also be drilled near the existing Shop Well on City property at 5375 Lego Ave.

1.4.3.2 Water Quality and Treatment

It is anticipated that the water quality from this well would be similar to that of the existing Shop Well, and require treatment. This new well could be connected to the nearby raw water transmission main to the City's Water Treatment Plant.

1.4.3.3 Anticipated Capacity

The well yield for this site is anticipated to be 1000 gpm or greater.

1.4.3.4 Wellhead Protection

A wellhead protection plan was prepared for the nearby existing City Shop well by Wilson Engineering and AESI. It is assumed that the plan could be expanded to cover this well.

1.4.4 CENTRAL CITY WELL SITE

1.4.4.1 General

This is the same site as discussed in Section 1.3.3 and would involve drilling a replacement well near the existing well.

1.4.4.2 Water Quality and Treatment

It is assumed that the water quality of a new well at this site would be similar to that of the existing well. In order to meet the City's standard of reduced hardness and manganese, the water would need to be treated or blended. Treatment could be either onsite, at a nearby central area, or at the Treatment Plant. An onsite treatment plant would consist of a pressure filtration system to remove the manganese. The well is close enough to the Bakerview tank that it may be feasible to blend the water by pumping it directly to the tank rather than treating it.

1.4.4.3 Anticipated Capacity

It is assumed that the Central City well would be approximately the same as the new Bakerview Well, which is approximately ¼ mile northwest of this site and has a yield calculated to be 350 to 375 gpm. The Bakerview Well is an 8" well, but a larger diameter Central City well may produce more water.

1.4.4.4 Wellhead Protection

A wellhead protection plan was prepared for the existing Central City well by Wilson Engineering and AESI. It is assumed that the plan would cover this replacement well.

1.5 AQUIFER STORAGE AND RECOVERY (ASR)

1.5.1 General

ASR is the process of injecting water into an aquifer, where it is stored for use at a later time. The stored water is considered as an underground reservoir by definition (RCW 90.03.370), which allows Ecology to issue reservoir permits to authorize ASR projects. Ecology adopted the ASR rule, Chapter 173-257 WAC – Underground Artificial Storage and Recovery, establishing standards for review of ASR proposals and standards for mitigation of adverse impacts in the following areas:

- Aquifer vulnerability and hydraulic continuity
- Potential impairment of existing water rights
- Geotechnical impacts and aquifer boundaries and characteristics
- Chemical compatibility of surface and ground waters
- Recharge and recovery treatment requirements
- System operation
- Water rights and ownership of water stored for recovery
- Environmental impacts

ASR may be a way of storing excess water from the Nooksack River in the Regional Aquifer, allowing it to be withdrawn in the summer months. Water would be pumped from the river in the winter during periods when the river is high. As an example, if approximately 65 mg was stored in the aquifer in a 6 month period when excess water is in the river, it could then be withdrawn during the two driest summer months at a rate of approximately 1 mgd. The withdrawn water may also require treatment in order to meet drinking water standards.

1.5.2 Water Quality and Treatment

Water stored in an aquifer must meet water quality standards for groundwaters of the State of Washington. Injected surface water must be treated to drinking water standards, and must be compatible with the water in the aquifer. This would require a separate treatment plant to treat injected surface water and may also be required to treat water withdrawn from the aquifer.

1.6 OTHER WELL SITES

Other wells could be drilled in the outer edges of the Regional Aquifer in the area shown as Future Well Area on the Vicinity Map in Appendix A.1. These sites would have the advantage of withdrawing water from areas further away from the existing wells, which could reduce the impacts on the aquifer.

Wells outside of the Regional Aquifer area would require new water rights. However it may be possible to obtain existing water rights and convert them to municipal use. Some wells north of Ferndale are known to be of better water quality, and may not require treatment. One such well is the Grandview Industrial Park Well, which is owned by Whatcom County PUD No. 1. That well is located just southwest of the I-5/Grandview interchange.

INTERTIE ALTERNATIVES

2.1 GENERAL

Interties between public water systems are regulated by the DOH, and are addressed in WAC 246-290-132. They consist of two basic types: emergency and non-emergency. Both require DOH approval, and are subject to conditions. Non-emergency interties are for use of water to supplement existing supplies, and can be used on an intermittent or regular basis. Conditions of approval include demonstration of source capacity and adequate water rights, an assessment of water quality and treatment issues, an intertie agreement, and identification of alternate sources when the intertie agreement expires. Emergency Interties are defined as interconnections between public water systems permitting the temporary exchange or delivery of water between those systems only in the case of emergency that result in permanent supplies being unavailable for use. The conditions of approval are less stringent, but in the event the emergency intertie is used frequently or on a long term basis, it must be approved as a non-emergency intertie. All interties should be addressed in a Water System Plan.

Water quality and treatment is a concern when mixing water from two different sources. In an emergency it is not as important because it is assumed that this is a very temporary situation. When the water is introduced on a semi-permanent basis or for longer periods of time, it can be an issue. Surface water sources such as the City of Bellingham's have different and stricter water quality monitoring and testing requirements than well sources such as Ferndale has. A non-emergency intertie between a system utilizing surface water and one using well water will require both systems to use the more stringent surface water requirements.

Ferndale has two wells supplying all of its water. If one of them is out of service for repair or maintenance, it may be difficult for the remaining well to supply an adequate supply of water. In that case an emergency intertie could be used. If Ferndale has a problem with its wells, such as a declining water table, it may be necessary to supplement the supply with water from another purveyor through a non-emergency intertie.

2.2 EMERGENCY INTERTIE REQUIREMENTS

Table3, Intertie Requirements

If the City's largest well, the Douglas Well, is out of service, the Shop Well can only provide 1.25 mgd. Table 3 shows the Intertie requirement to meet MDD with only one well, and assuming that additional wells with a minimum capacity of 700 gpm will be in service before 2022.

Year	MDD (MGD)	Well Water Avail. (MGD)	Intertie Req. (MGD)	Intertie Req. (GPM)
2016	2.07	1.25	0.85	590
2022	2.68	2.26	0.42	291
2036	3.96	2.26	1.70	1180

This section evaluates several potential interties with adjacent purveyors who have the potential to furnish water to Ferndale on a supplemental and/or emergency basis.

2.3 POTENTIAL EMERGENCY INTERTIES

2.3.1 CITY OF BELLINGHAM

2.3.1.1 Description

The City of Bellingham has an existing water main along Marietta Ave running in an east-west direction from the vicinity of Interstate 5 to Curtis Rd. The water main is a 16 inch ductile iron pipe, installed in 1970 between Interstate 5 and the City of Bellingham's Marietta Reservoir.

2.3.1.2 Route and Pipe Size

The most direct route for the City of Ferndale to connect to the City of Bellingham's water main is along Wynn Rd., from Curtis Road to Slater Road, a total length of approximately 4,300 feet. The location is shown on Exhibit B.1 in Appendix B.

This emergency intertie would be supplied by the City of Bellingham's North Pressure Zone (276') and feed the City of Ferndale's Main Pressure Zone (234'). A pressure reducing valve, backflow preventer and meter would be required.

Bellingham North Zone = 276 ft
Ferndale Main Zone = 234 ft
Head Difference = 42 ft = 18 psi

Assuming the largest source is out of service, a 12" water main could deliver approximately 2,000 gpm to the Main Zone at Slater Road at the required pressure.

2.3.1.3 Ability to Serve Additional Properties

The route of the intertie passes through undeveloped land, mostly outside of Bellingham and Ferndale Urban Growth Areas. However much of the adjacent property is land in trust for the Lummi Nation, and is not subject to Urban Growth requirements. The Tribe indicates that the property is being held for commercial development, and could take water from either Bellingham or Ferndale. If the water is obtained from Ferndale, the pipeline could be used as both a distribution line from Ferndale, with an emergency intertie to Bellingham's system. If the pipeline is to serve the area with fire flow, a 16" main may be required.

2.3.1.4 Permitting

The majority of this intertie would take place outside of Ferndale City Limits. The permitting agency would therefore be Whatcom County.

2.3.2 CITY OF BLAINE/BIRCH BAY WATER AND SEWER DISTRICT

2.3.2.1 Description

The City of Blaine and the Birch Bay Water and Sewer District obtain their water from a group of wells located within the Dakota Creek watershed. Blaine has adequate water rights and well capacity for its service area, and is not subject to the Nooksack basin groundwater restrictions. Water quality is excellent and does not require treatment, other than chlorination. An intertie could be either an emergency or non-emergency type.

2.3.2.2 Interlocal Agreement

Prior to expending time and effort on this intertie, the parties should attempt to work out an agreement that addressed the amount of water available, the time periods it can be utilized, the route the pipeline would take, ownership of the pipeline, the cost of water, use of the line by others along the route, and other such factors.

2.3.2.3 Route and Pipe Size

Ferndale and Birch Bay are several miles apart, separated by an area in Whatcom County that is outside of Urban Growth Areas. Bell Bay Jackson, Old Settlers and Custer Water Associations have smaller pipelines in the area between Birch Bay and the Ferndale service area. These pipelines are mostly 6" diameter and operate at different pressures. Although it would be possible to wheel water from Birch Bay to Ferndale through the small water mains by pumping, it would be difficult to get an adequate amount of water through the small water mains to help Ferndale in an emergency. It would, however benefit the water associations by giving them an emergency intertie.

Constructing a new intertie from Birch Bay to the Ferndale Service Area at Vista and Grandview would require approximately 4.3 miles of water transmission lines. The most practical route would be to keep the water lines in the lower elevations from the Birch Bay tank at the intersection of Bay Road and Kickerville Road, along the Bay Road to Vista Drive, and from Vista Drive to Grandview Road, where it would be tied into the Grandview Water System. There are two alternatives to connect from the Grandview System to the Ferndale System. Both would require converting a portion of the Grandview fire mains to potable mains.

- Alternative 1 would tie into the Ferndale Mid Pressure Zone via a 1.1 mile 16" transmission main the PUD is proposing to construct on Vista Drive between Grandview Road and Aldergrove Road, and then constructing a new 0.6 mile transmission line on Vista Drive from Aldergrove Road to the City's distribution system. A second booster pump system would be required to boost pressure to the Mid Pressure Zone, and allow the intertie to supply the Bakerview Tank.
- Alternative 2 would be to tie the Grandview System into the Ferndale Main Pressure zone by constructing a new transmission line from the existing Grandview system at Portal Way and Grandview Road by a 1.75 mile 16" transmission and distribution main on Portal Way to the City's main pressure zone distribution system on Malloy Ave. This main would also supply property that is within the City Limits but does not currently have water service. The 16" main would allow the City to supply fire service to the Grandview Area.

This intertie will cost several million dollars and will require a study to determine the best and most cost effective alternative. Items that need evaluation include:

1. Route alternatives, including evaluation of a dedicated water main or wheeling water through upgraded Water Association mains.
2. Quantity of water needed.
3. Hydraulic analysis, including pipe size, pumping and pressure reducing requirements.
4. Permitting, through Whatcom County.
5. Interlocal agreements with Birch Bay, Blaine and affected Water Associations.
6. Water Rights issues, particularly if the supply is non-emergency.
7. Health Department Approval
8. Cost and Funding.

The location of this intertie and alternatives is shown on Exhibit B.2 in Appendix B.

2.3.2.4 Water Blending Considerations

Blaine water and Ferndale water are both from groundwater sources, but different aquifers. Blaine water is good quality, relatively free of hardness and other contaminants such as iron and manganese. Water chemistry should be addressed, but is not expected to be a problem.

2.3.2.5 Permitting and Water Rights

If the intertie is strictly an emergency intertie, water rights do not need to be addressed. If the water will be used to supplement existing supplies, either for Ferndale or other users along the way, Blaine and Birch Bay will need to address their service areas to include the new areas served. The Blaine Water is from the Dakota Creek Watershed and would be considered as "foreign water" to the Nooksack Watershed. It may be valuable as mitigation water for obtaining additional water rights in the Nooksack system. The intertie will be under Whatcom County jurisdiction and will require County permitting.

2.3.3 DEER CREEK WATER ASSOCIATION

2.3.3.1 General

The Deer Creek Water Association (DCWA) has an existing 8 inch diameter water main along W. Smith Rd. from Guide Meridian to just west of Waschke Rd. This water main is located in DCWA's Guide Meridian Pressure Zone (290'). DCWA has two wells that can produce a total of approximately 500 gpm. The water is treated to remove manganese. DCWA also has an emergency intertie with a 16" City of Bellingham water main at the intersection of West Smith and Guide Meridian. If the amount of water used by Ferndale and Deer Creek combined exceeds the capacity of Deer Creek's source capabilities the Bellingham Emergency Intertie could be utilized. To effectively use the intertie with Bellingham, two pressure reducing stations should be constructed; one on Guide Meridian in the Axton Road vicinity and one on West Smith Road.

2.3.3.2 Interlocal Agreement

The intertie would require an interlocal agreement between the Deer Creek Water Association and the City of Ferndale. The City of Bellingham's existing intertie agreement with the Deer Creek Water Association would also need to be addressed if Bellingham water is to be used.

2.3.3.3 Route and Pipe Size

The most direct route for the City of Ferndale to connect to DCWA's water main is along W. Smith Rd. from Waschke Road to the City's system on Northwest Road., a total length of approximately 2,650 feet. This intertie would be supplied by the DCWA's Guide Meridian Pressure Zone (290') and feed the City of Ferndale's Main Pressure Zone (234'). The total length of 8" main from Guide Meridian to Northwest Road would be approximately 13,200 feet.

DCWA Guide Meridian Zone = 290 ft
Ferndale Main Zone = 234 ft
Head Difference = 56 ft = 24 psi

$$\text{Allowable Loss} = \frac{24 \text{ psi}}{13{,}200 \text{ ft}} = 0.0090 \frac{\text{psi}}{\text{ft}} = \frac{0..18 \text{ psi loss}}{100 \text{ feet of pipe}}$$

An 8 inch diameter water main will provide approximately 500 gallons per minute of flow from DCWA's Guide Meridian Pressure Zone. To most effectively use the Bellingham intertie as s source of emergency water, the Deer Creek system could be reconfigured with pressure reducing valves on both Guide Meridian and West Axton to avoid pressure problems in the Deer Creek system when the intertie is opened.

The location of this intertie is shown on Exhibit B.3 in Appendix B.

2.3.3.4 Water Blending Considerations

Deer Creek water and Ferndale water are both from groundwater sources. Deer Creek water is treated for iron and manganese. Water chemistry should be addressed, but is not expected to be a problem. If the Bellingham Intertie to the Deer Creek System is utilized, there may be short term effects from combining Bellingham's surface water with Ferndale's groundwater.

2.3.3.5 Permitting

This intertie would take place outside of City Limits, requiring permits from Whatcom County.

2.3.3.6 Water Rights

This intertie would be strictly for emergency purposes and would not require water right changes.

WATER STORAGE

3.1 Existing Water Storage

3.1.1 General

The City has three water storage facilities totaling nearly 3 million gallons. The tanks are linked via booster pump stations and pressure reducing valves in such a way as to allow all stored water to benefit the entire City, regardless of pressure zones.

- Reservoir 1, Thornton/Vista Road Storage Tank, 950,600 gal, HWL = 233.5' Main Zone
- Reservoir 2, Thornton/Church Road Storage Tank, 1,760,600 gal, HWL = 404.5' Mid Zone and Bakerview Zone
- Water Treatment Plant Clearwell, 304,000 gal, Pumps to HWL 233' Main Zone

The raw water storage facility in the Water Treatment Plant could be modified and connected to the Clearwell to provide an additional 150,000 gallons of storage.

The DOH Water System Design Manual and WAC 246-290 give general guidance and recommendations for determining the amount of storage required for system reliability and emergency response. This is generally considered to be two days of Average Day Demand, with the largest source out of service. When the Average Day Demand can be met by the remaining source(s), the minimum amount of Standby Storage recommended is 200 gallons per ERU. Fire Suppression Storage can be either in addition to, or part of Standby Storage, depending on local ordinances or the fire protection authority.

Ferndale currently has two sources, Well 1 (Douglas) with a pumping capacity of 1,300 gpm and Well 2 (Shop) with a pumping capacity of 870 gpm. The minimum recommended amount of Standby Storage per the DOH Design Manual is two days of Average Day Demand less the amount of water the smaller source can produce in the two day period, but not less than 200 gpd per ERU.

The components of storage consist of:

- Operating Storage (OS) – The normal range between "pump on" and "pump off". It is set by the operator and usually consists of the top foot of water in the tank.
- Equalizing Storage (ES) – The difference between what the source can supply and the peak system demand. It is approximated by Equation 9-1 in the DOH Manual, which is the Peak Hour Demand (gpm) less the full supply source capacity (gpm) for 150 minutes. When the source cannot meet the Maximum Day Demand, additional ES must be provided.
- Standby Storage (SB) – Two days of storage at Average Day Demand (ADD) less the amount of water the source can provide with the largest well out of service, but not less than 200 gpd per ERU. This is a recommended amount and can vary with the needs and structure of the system. The goal for City of Ferndale is two days of storage.
- Fire Suppression Storage (FSS) – The amount of storage in gallons that are needed to satisfy the requirement of the local fire authority. In Ferndale the maximum FS is 3,000 gpm for 4 hours, or 720,000 gallons. Depending upon local fire authority or local ordinances, this amount may be included in SB storage. In that case, called nesting, the larger of SB or FSS is used to calculate the effective storage of the tank.

- Dead Storage (DS) – The amount of water in the bottom of the tank that cannot be used, usually because of pressure constraints or vortexing..

Ferndale's minimum storage needs for 2016 are calculated below, based upon the following conditions and assumptions which have been derived from City records:

- 6,802 ERUs = (N)
- ADD = 175 gpd/ERU
- MDD = 305 gpd/ERU
- PHD = 2,371 gpm
- OS = 82,875 gal. (top 1.0' of all tanks)
- DS = 41,438 gal (bot. 0.5' of all tanks)
- FSS = 720,000 gal. (assumed nested in SB through 2021)
- Well 1 = 1,300 gpm
- Well 2 = 870 gpm

OS = 82,875 gal
ES = (PHD) – (Well 1 + Well 2) x 150 min. = 30,150 gal
SB = 6,802 ERUs x 200 gpd/ERU =1,360,400 gal (DOH Recommendation)
FSS = 0 (Nested in Standby)
DS = 41,438 gal. (bottom 6" in tanks)

Total minimum recommended, DOH = 1,514,863 gal
Total Storage Available = 3,015,600 gal
Surplus Capacity = 1,500,737 gal (with nested FSS)
2nd day Standby (Ferndale Goal) = 1,360,400 gal
Surplus Capacity with Ferndale Goal = 140,337 gal

The total water required for the Maximum Day Demand is MDD x N = 2.1 m gal. With the largest well out of service, a maximum of 1.25 m gal can be produced by the smaller well. This indicates that at maximum demand with the largest pump out of service there is enough standby storage to last a little over one day, Large well pumps can take several weeks to repair or replace. If this condition occurs, it will be necessary to either rely on an emergency intertie or impose severe water use restrictions.

3.1.2 Projected Storage Needs

Ferndale's current water rights allow a maximum of 2,930 gpm instantaneous withdrawal. This is 760 gpm more than is available from the two existing production wells. Calculations for projected storage needs are based upon the assumption that additional wells will be added to the system, allowing instantaneous withdrawal at the maximum rate.

Growth used in calculating future storage requirements is based upon growth projections provided by the City Planning Department. In the period 2021-2022 a new jail is proposed to be constructed, which causes a large jump in water use seen for that period. It is further assumed that when a large public institution with

full time incarcerated residents will require a higher degree of fire protection. For that reason, in the year 2022 the FSS is no longer nested in SB storage, resulting in an increased storage capacity requirement.

Growth projections indicate that there will be 8,607 ERUs in the year 2022 and 11,352 ERUs in the year 2036. Ferndale will require additional source capacity by 2022. It is assumed that one or two additional wells will have been put into production by then, and that there will be enough production capacity with the largest well out of service to eliminate the need for equalizing storage. Using the methodology in the previous section, the estimated water storage requirement is shown in Table 4.

Table 4, Projected Water Storage

Year	ERUs	Pump Capacity (gpm)	Available Storage (gal)	Storage (gal) Recommended by DOH	Surplus / Deficit (gal) DOH Recommendation	*Storage Goal (gal) Ferndale*	*Surplus / Deficit (gal) Ferndale*
2016	6,802	2,170	3,015,600	1,514,900	1,500,600	*2,875,300*	*140,300*
2022	8,607	2,930	3,015,600	2,565,700	449,900	*4,287,100*	*(1,271,500)*
2036	11,35	2,930	3,015,600	3,114,700	(99,100)	*5,385,100*	*(2,369,500)*

Note: Additional Fire Storage added in 2022, (720,000 gal.)

These projections show that in 2022 the City will have a surplus of storage per DOH recommendation for one day of standby storage, but a deficit per Ferndale's goal of 2 days of standby storage. In 2022 additional fire storage is included for the new County Jail.

Water storage requires turnover in order to maintain water quality. Currently the minimum day water use is approximately 0.9 mgd. At this rate, in 2036 with 5.5 mg of storage water is estimated to turn over every 7 days. This turnover rate is acceptable, provided adequate mixing and chlorine residuals are addressed, and that the system is designed to assure that each tank in the system is receiving adequate water for turnover.

An analysis of the City's fire flow requirements found in Chapter 3 of the Water System Plan indicates that operation of the high head pumps in the Water Treatment Plant is required in order to provide the minimum allowable pressure for the maximum fire flow requirement of 3,000 gpm in certain areas of the City. In accordance with the DOH Water System Design Manual, it is recommended that the fire flow analysis be completed under the assumption that the largest source is out of service. In this condition, with only the smaller Shop Well supplying water to the treatment plant, and the high head pumps supplying 3,000 gpm fire flow plus maximum day demand, the clearwell will be drained in approximately 2.4 hours. In order to extend the duration to 4 hours it will be necessary to either bring on additional sources to compensate for the largest source out of service, or expand the clearwell reservoir. It is assumed that additional sources will be brought online by the year 2018. However it may be desirable to increase the clearwell reservoir capacity by converting the unused former raw water chamber into additional clearwell storage. This will increase the fire flow duration at 3,000 gpm to approximately 4 hours without providing an additional source. As part of the conversion of the Water Treatment Plant from a surface water treatment facility to a manganese treatment facility, a preliminary design was done by RH2 Engineers to modify the raw water chamber to include it as part of the clearwell.

WATER STORAGE ALTERNATIVES

4.1 SMITH RD. (BELLAIRE ESTATES)

This site is a one acre tract that was acquired by the City for the express purpose of construction of a new water storage reservoir. The quit claim deed has a reversionary clause that requires the City to utilize the site for water storage. If the site is not kept in the "Comprehensive Water Plan" or if it is publicly announced that it is not going to be used for water storage purposes the property reverts to the grantor. The property is located outside of the City Limits and is under the jurisdiction of Whatcom County. Since the site was acquired, the surrounding area has been re-zoned and developed into a fairly dense single family residential development. It is likely that nearby residents would object to a large water storage tank at the site.

4.1.1 Zoning of Site

Whatcom County zoning is RR-2A, which allows public facilities as a conditional use. The maximum height is 35 ft, and maximum lot coverage is 20%. The site is one acre in size (43,560 sf.) Setbacks are 5 ft.

4.1.2 Location of Facility

The site is located north of West Smith Road at the northwesterly end of Belfern Drive, parcel No 390227 012140. The property is outside of the City Limits, and is not in a UGA. A reservoir at this location would serve the City's Main Pressure Zone (234') and Axton Pressure Zone (220'). The elevation of the site is approximately 91 feet (NGVD29). At this elevation the reservoir could be filled from both the WTP pumps and Reservoir No. 1, and would require a booster station to pump the water back to the Main Pressure Zone. The location is shown on Exhibit C.1 in Appendix C.

4.1.3 Size of Facility

The tank size is limited by zoning. The maximum lot coverage is 20%, or 8,712 s.f. The maximum tank diameter that could be constructed on the site would be approximately 100 ft. With a maximum height in of 35 ft in this zone, the largest tank allowed would be 2 mg. A larger tank might be allowed by variance.

4.1.4 Connection to Existing Infrastructure

The site is located near the end of Belfern Dr., a dead end road in a residential neighborhood. The site can be reached via a recorded access easement along the northerly property line of two adjacent residences. The closest City water main is an 8" main on Bellaire Dr. to the southeast. This main not large enough to handle fire flow to the distribution system. An additional pipe with a minimum diameter of 12" would need to be constructed to connect the tank to the existing 12" water main in Smith Road. Two options for connecting the City's existing water main have been identified and shown on Exhibit XX.

4.1.4.1 Belfern Dr.

This option would require the City to construction a water main east along Belfern Dr., then south along Cypress Dr., then south on Bellaire Way to the existing water main on Smith Road. The total length of this route is approximately 2,600 linear feet.

4.1.4.2 Utility Easement

This option would require the City to acquire a utility easement through a private residence located southeast of the site, allowing the City to connect to the existing water main on Bellaire Dr. Based on aerial photography, the private residences in this area appear to be fairly close together. The proximity of the residence to one another may prevent the acquisition of a utility easement.

4.1.5 Permitting

This site is outside of the City's current city limits, urban growth area, and urban reserve. Therefore, Whatcom County would be the permitting agency for proposed construction on the site.

The construction of a water storage tank is expected to require the following permits:

- Whatcom County Building Permit
- Whatcom County Conditional Use Permit
- SEPA Environmental Checklist
- Revocable Encroachment Permit

4.2 BAKERVIEW TANK SITE

This proposed tank site is adjacent to the existing Bakerview Tank. The site was designated for a second tank, and inlet/outlet piping connection points are nearby. The tank would serve the Bakerview and Mid Pressure Zones as well as the Grandview Industrial Area, which requires higher pressure for fire flow. Pressure Reducing Valves allow the storage in the Bakerview Tank to also serve the lower pressure zones. One disadvantage to storing water at this location for use in lower pressure zones is lost energy. Water must be pumped to the higher Bakerview Tank and then released through pressure reducing valves to the lower zones. The location is shown on Exhibit C.2 in Appendix C.

4.2.1 Size of Facility

The City will need a 1.3 mg tank by 2022 and a 2.4 million gallon tank (per Table 4) by 3036 to meet their storage goals. The site is large enough to construct a 2.4 mg tank.

4.2.2 Elevation Considerations

This site already contains a reservoir (Bakerview Reservoir No. 2) and is set up for the addition of another reservoir. Piping installed during the installation of the Bakerview Booster Pump Station allows for the connection of another reservoir with minor piping additions and modifications.

A reservoir located on this site would serve the City's Bakerview Pressure Zone via the Bakerview Booster Pump Station, the City's Mid Pressure Zone (404') via gravity, and the remaining pressure zones, if required, via existing pressure reducing valves. The reservoir could also be configured to serve a larger portion of the distribution system and to maintain water levels in the City's Reservoir No. 1.

4.2.3 Water Quality Considerations

Serving a larger portion of the distribution system will increase water circulation and prevent stagnation. Poor water circulation can lead to a loss of disinfectant residual, microbial growth, sediment accumulation, and formation of disinfection byproducts, taste and odor problems, and other water quality issues.

If the City decides to develop the Thornton Well water source at the Bakerview Tank site, and onsite treatment or blending is implemented, both the existing and the new tank could be used to provide adequate disinfection contact time for the new well water.

4.2.4 Connection to Existing Infrastructure

As previously mentioned, piping onsite was installed to allow for the installation of another tank. Minor modifications to the existing tank fill line and booster pump suction line must be made to bring a proposed tank online. The Bakerview Tank supply line from the Thornton Pump Station could be extended to the east to Malloy Road and be used for future high pressure service to the Grandview area.

4.2.5 Permitting

This tank site is within City limits, therefore the City of Ferndale would be the permitting agency for proposed construction at this site. Since there is already a tank onsite, and the property is back from public roads and public view, there will probably be little or no opposition to location of a tank at this site.

4.3 CITY OF BELLINGHAM MARIETTA RESERVOIR

The Marietta Reservoir is not being used by the City of Bellingham, and it is possible that ownership could go to the City of Ferndale, or that Ferndale could utilize the reservoir in some manner. This section describes how the reservoir would operate if it were taken over by the City of Ferndale. The location is shown on Exhibit C.3 in Appendix C.

4.3.1 Size of Facility

The Marietta Reservoir is an above ground steel cylindrical tank built in 1969 with a capacity of 3 million gallons, and an overflow at 51 feet above the tank floor. The tank is considered to be in "mostly good condition" according to the City of Bellingham's 2009 Water System Plan. In 2008, the exterior of the tank was painted. In 2012, the tank was retrofitted to separate the inlet and outlet to promote better mixing. The piping was also modified to allow for a future connection to Ferndale.

4.3.2 Elevation Considerations

The elevation of the site is approximately 220 feet, thereby making the maximum water level approximately 270'. The tank site would be located in the City's Main Pressure Zone (234'), meaning that a small booster pump system would be required to fill the tank, and a pressure reducing valve to supply the distribution system.

4.3.3 Water Quality Considerations

The remote location of the tank and length of transmission line will require an operating plan that provides for turnover in the tank and the transmission line. It may be possible to operate the tank at reduced capacity for a time. The estimated storage needed by 2022 is 1.6 mg, which is slightly over half the volume of the tank. A mixer should also be installed in the tank to eliminate dead zones and temperature stratification.

4.3.4 Connection to Existing Infrastructure

The site is located on Marietta Ave. approximately 650 feet west of Wynn Rd. The closest City water main is near the intersection of Slater Rd. and Rural Ave. to the north. The most likely option for connecting to the City's existing water main is east along Marietta Ave., then north Along Wynn Rd., a total length of approximately 5,000 linear feet. The Lummi Nation owns a considerable amount of land along the pipeline route, and could be a major user of water. If the tribal land is developed into major retail or commercial uses, fire flow will be required and the transmission line should be sized to handle it. If fire flow is not required along the transmission line, the diameter can be reduced.

4.3.5 Permitting

This site is outside of Bellingham and Ferndale city limits, urban growth areas, and urban reserves. Therefore, Whatcom County would be the permitting agency for proposed construction on the site.

4.4 SOUTH OF SLATER RD.

4.4.1 Size of Facility

4.4.2 Elevation Considerations

The area on Wynn Road south of Slater Rd. is a fairly flat area sloping downward from Marietta Ave. to Slater Rd. The City of Bellingham Marietta Reservoir is located on the highest part of this area, surrounded by existing homes. If a site close to the Marietta Tank at elevation 220 or higher could be obtained it would be possible to serve Ferndale's Main Pressure Zone by gravity. Otherwise a tank at a lower elevation would require a booster pump to supply water back to the City.

An elevated tank or standpipe could be constructed, but would be costlier than a ground elevation storage tank.

4.4.3 Water Quality Considerations

A tank in this area would be several thousand feet from the Ferndale water system, and turnover in both the tank and transmission line would be an issue that would need to be addressed in design. The tank could have a mixer installed to keep water circulating, but substantial amounts of water would need to be exchanged in the transmission line to keep it fresh.

4.4.4 Connection to Existing Infrastructure

The tank would be connected to the City's distribution system on the North side of Slater Road at Rural Ave. A short section of pipeline on Slater Road west of Rural Avenue would need to be constructed to complete a loop at the point of connection. If a booster pump is required to fill the tank, it would be set up with a parallel solenoid valve to close the fill line when the pump is drawing water from the tank.

4.4.5 Permitting

With the exception of small area south of Slater Rd., the majority of this area is outside of the City's current city limits, urban growth area, and urban reserve. Therefore, Whatcom County would be the permitting agency for proposed construction on the site.

4.5 BROWN RD. VICINITY

A tank in the Brown Road/Vista intersection would primarily benefit the Grandview Industrial area and the area north of Aldergrove Road. The City has no water service facilities in this area. In order to provide 3,000 gpm fire flow to the industrial areas of the City in the Grandview interchange area the City will need to install several miles of large diameter water mains from the existing tanks, or construct a reservoir in the northerly area of the City. This location is the highest point within the City's Urban Growth Area north of

Brown Road that could be used for a gravity storage tank serving the City's Main Pressure Zone. The location is shown on Exhibit C.4 in Appendix C.

4.5.1 Size of Facility

The tank would need to be sized to handle fire flow and standby storage, estimated to be approximately 1 mg. The City is projected to have an estimated 1.3 mg storage deficiency by the year 2022, and a 2.5 mg storage deficiency by the year 2036.

4.5.2 Elevation Considerations

The high water level in the tank should match the hydraulic grade line of the Ferndale Main Pressure Zone which is the high water elevation of the Thornton Tank. Ground level in the area proposed is approximately 35 ft below the elevation of the Thornton Road Tank, which could result in a substantial amount of dead (unusable) storage. The dead storage could be utilized by creation of a separate pressure zone for the Grandview area and utilization of an altitude valve or a pressure sustaining valve at the tank.

4.5.3 Water Quality Considerations

The tank would be located approximately 3 miles from the water treatment plant, and will be supplied by a relatively large transmission line. Depending upon water use in the northerly part of the service area, stagnation could be a problem. Design of the tank should include an analysis of water quality issues including residence time, circulation, chlorine residual and mixing.

4.5.4 Connection to Existing Infrastructure

There are several options for supplying water to the tank.

Option 1. Construct a new water main along Vista Drive from the end of the existing 10" main at the northerly city limits. Vista Drive is in the Mid Pressure Zone, served by the Bakerview Tank. The Grandview Area is in the lower pressure Main Zone, but may require higher pressure for industrial fire flow. The transmission line would run approximately 1.2 miles through Urban Growth Areas 8 and 9, which are anticipated to be zoned for low density residential after annexation. Fire flow requirements would be 2,000 gpm, resulting in a minimum 12" water transmission line to the tank. If commercial development will occur in this area a larger line may be required. The transmission line also passes through an Urban Reserve, which is anticipated to develop into low density residential uses. The tank could also operate in conjunction with a future intertie with Blaine/Birch Bay.

Option 2. Construct a new transmission main along Malloy Avenue and Portal Way to connect into the existing PUD 16" water main at Portal Way and Grandview Road. Water would be routed north and west through the PUD mains on Portal Way and Grandview Road and then South on Vista Drive to the tank site. This route would serve existing undeveloped Malloy Avenue properties within the City limits on the east and Mid Term and Long Term UGAs on the west. The existing 12" main on Malloy is in the Main Pressure Zone and could be reconfigured to the Mid Pressure Zone in order to be capable of providing fire flow

through the long transmission lines to the proposed commercial and industrial zoned areas that are within the city limits, but do not yet have water or sewer service. This may require upgrading the existing water mains along Malloy from 12" to 16". A new 16" transmission main west along Grandview and Vista Drive to the Brown Road Tank would be required. Isolation valves and pressure regulating valves would be required to separate potable water from the non-potable fire supply. If the existing Grandview Water System is reconfigured to provide both potable and fire suppression water in the same mains, the existing non-potable mains would need to be disinfected and tested.

4.5.5 Permitting

The proposed Brown Road tank location is in Whatcom County, but within Ferndale's Urban Reserve UGA. If the UGA is not annexed before the tank is built it will require a Conditional Use Permit from Whatcom County. Water Transmission mains larger than 12" through UGAs that have not been annexed will also require Conditional Use Permits from the County. The proposed tank site is in a rural residential area and obtaining a suitable building site may be a problem, due to resistance from adjacent property owners.

RECOMMENDATIONS

5.1 WATER SOURCE

Ferndale needs additional source capacity for backup in the event of an emergency, and will need it for growth at some point after the next six years, particularly if the Whatcom County Jail is constructed. It is recommended that an aggressive program of source development be initiated. This will consist of construction of new well and pump systems at the Shop Well and Douglas Well Sites, bringing the existing Thornton and Central City wells online, and conducting an Aquifer Storage and Recovery Study.

a. Douglas Well Site and Shop Well Site. Retain the services of a hydrogeologist to locate the best site on existing City property, prepare specifications and contract documents for drilling the wells, monitoring construction, sizing the screen, testing the well, recommending the pumping rate for the pump, preparing wellhead protection documents and filing water rights and well construction information with the Department of Ecology. Retain the services of an engineer to design the pump, piping, control and telemetry systems, prepare plans and specifications, obtain Department of Health approval and monitor construction.

b. Central City Site. Retain the services of a hydrogeologist and engineer to evaluate the existing well and pumping system. The work should include:

- A well test to determine the production rate of the existing well
- A recommendation to either use the existing well or drill a new one adjacent to it
- Recommend the type of treatment or method blending that will be required.
- Determine which of the adjacent pressure zones the water should be pumped into.

c. Thornton Site. Retain the services of an engineer to conduct a pilot study on the well water for water quality treatment, prepare project reports for the treatment and pumping system for the Department of Health, prepare final plans and specifications for construction of the pumping, piping, treatment, control and telemetry systems.

d. Aquifer Storage and Recovery (ASR). Retain the services of a hydrogologist to investigate the potential for ASR in the Ferndale area. If water rights can be obtained and it appears feasible, a full study including drilling of test wells should be initiated.

c. Water Rights. Retain the services of a hydrogologist and water rights attorney to begin the process of applying for and obtaining additional ground water rights. There are several water associations with water rights located in the Ferndale Urban Growth Areas. These water rights should be transferred to Ferndale as part of the annexation process. The ASR process may also require additional water rights.

5.2 INTERTIES

Ferndale is in immediate need of an emergency intertie to supplement the water supply in case one of the two existing source wells is out of service. Ferndale and Bellingham have been in preliminary discussions over use of the Marietta Tank and an emergency intertie. The intertie could be constructed immediately and

the tank option added at any time in the future. Dialog should also be continued with the Lummi Nation regarding water service to their properties in the Marietta Area, which could affect the size of the pipeline required for a Bellingham intertie. Ferndale should finalize an agreement with Bellingham for an emergency intertie, and retain an engineer to permit and design the intertie.

In the event the Bellingham Intertie cannot proceed in a timely manner, the City should negotiate with the Deer Creek Water Association for an intertie with their system.

5.3 WATER STORAGE

Ferndale does not need additional storage until the jail is built, or until after 2022 if it is not built. If the source is improved with additional wells and substantial additional capacity, the requirement for storage may also be delayed beyond 2022. The Smith Road Reservoir site should be retained to provide additional storage for future development, particularly to the area located directly to the north of it, and in the Slater Road area. If the City of Bellingham's Marietta tank becomes available, the City should proceed with design of the changes required to integrate the tank into the system. If the Marietta tank is not available, the City should proceed with planning for another tank at the Bakerview tank site. It is recommended that the City update planning on a regular basis to determine when and where another tank is required, and begin planning permitting and engineering at least two years prior to the time it is needed. One of several developments could trigger the need. These include the need to supply water to the Grandview Area, new Jail or Marietta area, as well as availability of the Marietta Tank.

For fire protection it is recommended that the former raw water well at the Water Treatment Plant be converted to additional Clearwell Storage. This will allow the high head pumps at the treatment plant to operate during fire events for up to four hours.

APPENDICES

Appendix A Source Exhibits

1. Vicinity Map Showing Future Well Area

2. Douglas Road Well
    a. Well Log
    b. Pump Curve

3. Shop Well
    a. Well Log
    b. Pump Curve

4. Central City Well
    a. Well Log
    b. No Pump Curve Available

5. Thornton Well
    a. Well Log
    b. Construction Schematic
    c. No Pump in Well

List of available source reports and information on file at the Ferndale Public Works Department

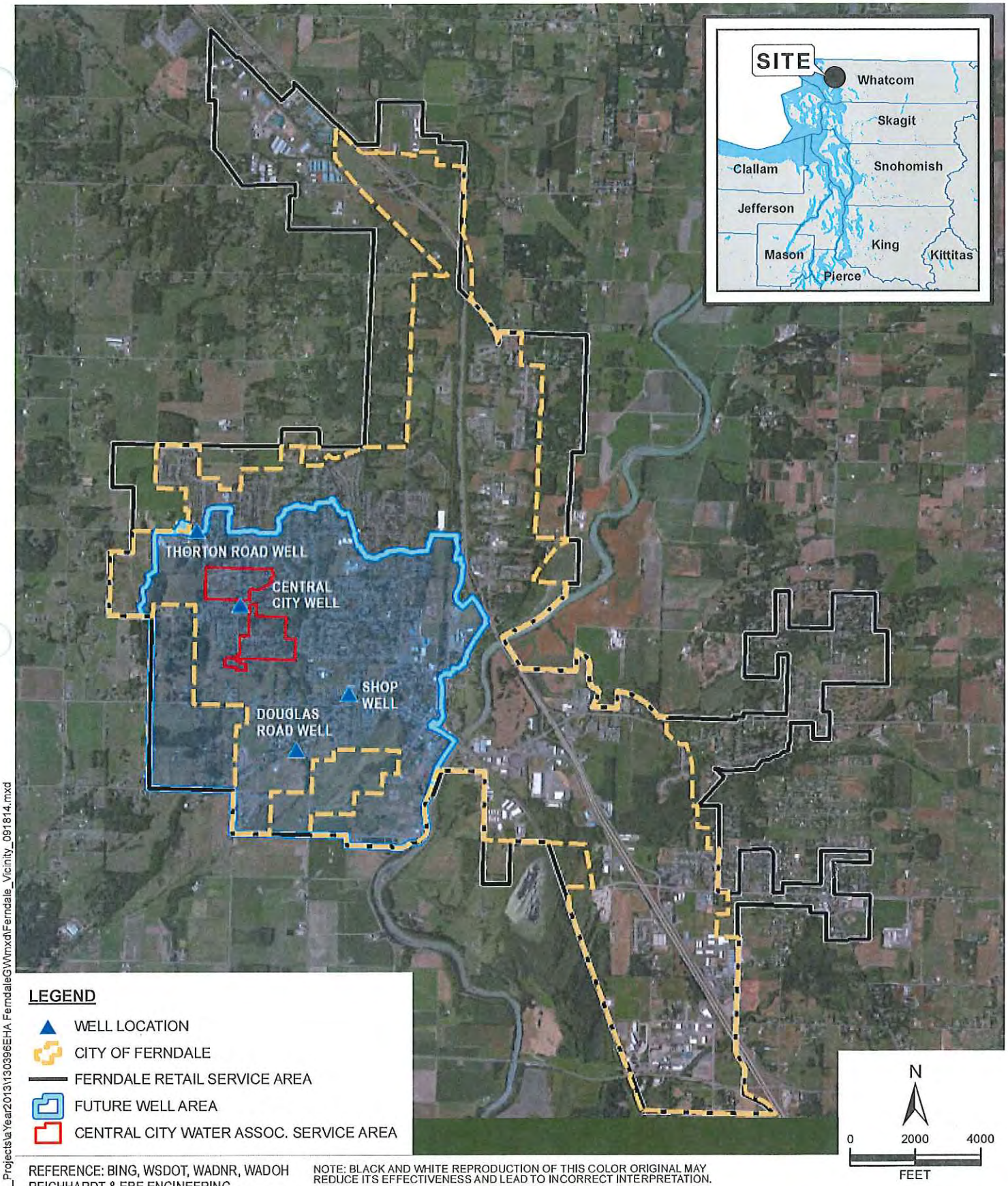
1. "Hydrogeologic Services Installation and Testing of Production Well No. 3" (Douglas Well), April 29, 1994 by GeoEngineers.

2. "Douglas and shop Wells Development Seawater Intrusion, Impairment and Hydrogeologic Issues, November 2007, by RH2 Engineering, Inc.

3. "Water Supply Feasibility Report" September 2009, by RH2 Engineering, Inc.

4. "Groundwater Feasibility Assessment", December 2013, by AESI

5. "Installation and Testing of the Thornton Road Well", December 2014, by AESI



REFERENCE: BING, WSDOT, WADNR, WADOH
REICHHARDT & EBE ENGINEERING

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

Document Path: H:\...\Projects\aYear2013\130396EHA FerndaleGW\mxd\Ferndale_Vicinity_091814.mxd

associated earth sciences incorporated

VICINITY MAP

WATER RIGHT CHANGE / TRANSFER APPLICATIONS
FERNDALE, WASHINGTON

FIGURE 1

DATE 9/14

PROJ. NO. EH130396A

EXHIBIT A.1

DOUGLAS WELL

39/2/30C

ENTER

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W39518

UNIQUE WELL I.D. #

Water Right Permit No.

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

(1) OWNER: Name City of Ferndale Address Ferndale

(2) LOCATION OF WELL: County Whatcom NE 1/4 NW 1/4 Sec 30 T. 39 N. R. 2 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) 5600 Imhoff

(3) PROPOSED USE: ☐ Domestic ☐ Industrial ☐ Municipal ☒ ☐ Irrigation ☐ Test Well ☐ Other ☐ ☐ DeWater

(4) TYPE OF WORK: Owner's number of well (if more than one)
Abandoned ☐ New well ☒ Method: Dug ☐ Bored ☐ Deepened ☐ Cable ☒ Driven ☐ Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 12 inches. Drilled 170 feet. Depth of completed well 170 ft.

(6) CONSTRUCTION DETAILS:
Casing Installed: 12 " Diam. from +1.5 ft. to 145 ft. Welded ☒
Liner Installed ☐ " Diam. from ft. to ft.
Threaded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Smith
Type SS Model No.
Diam. 12 Slot size 60 from 146 ft. to 149 ft.
Diam. 12 Slot size 230 from 149 ft. to 152 ft.

Gravel packed: Yes ☐ No ☒ Size of gravel
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level ft. below top of well Date
Artesian pressure +5 lbs. per square inch Date 2/28/94
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? B+C
Yield: 1000 gal./min. with 135 ft. drawdown after 24 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest gal./min. with stem set at ft. for hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Topsoil	0	2
Brown Clay	2	14
Gray Clay	14	68
Gravel w/Boulder Clay	68	79
Gravel Clay	79	122
Gravel H2O	122	131
Consolidated Gravel silt	131	135
Gravel/Sand H2O	135	167
Sand med-fine	167	170
Screen		
12" Slot 60	152 →	157
12" Slot 230	157 →	164
12" Slot 60	164 –	166
12" Blank	166 –	170

RECEIVED
JUN 13 1994
DEPT. OF ECOLOGY

Work Started 12/16/93 19. Completed 2/22/ 19 94

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME B+C Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 998 Kelly Bellingham
(Signed) (WELL DRILLER) License No. 0085
Contractor's Registration No. BCWELDP097K2 Date 2/24 19 94

(USE ADDITIONAL SHEETS IF NECESSARY)

ECL 050-1-20 (2/93)

DOUGLAS WELL
A. 2a

The Department of Ecology does NOT Warrant the Data and/or the Information on this Well Rep

Pumptech Inc
12020 SE 32nd Street, Bellevue, WA 98005
Mike Dunn mdunn@pumptechnw.com
Phone 425-644-8501
Fax 425-562-9213

Customer : Pumptech Inc
Pumptech Inc
12020 SE 32nd ST
Bellevue, WA
98005
USA

Contact : Mike Dunn Dunn
Phone : 425-562-9213 **Fax :** 425-562-9213
Date : Wednesday, May 18, 2011

Project : Ferndale Douglas, Shop Wells & WTP Back-Wash Pumps
Quote No. : US-2158-522 **Page No :** 22

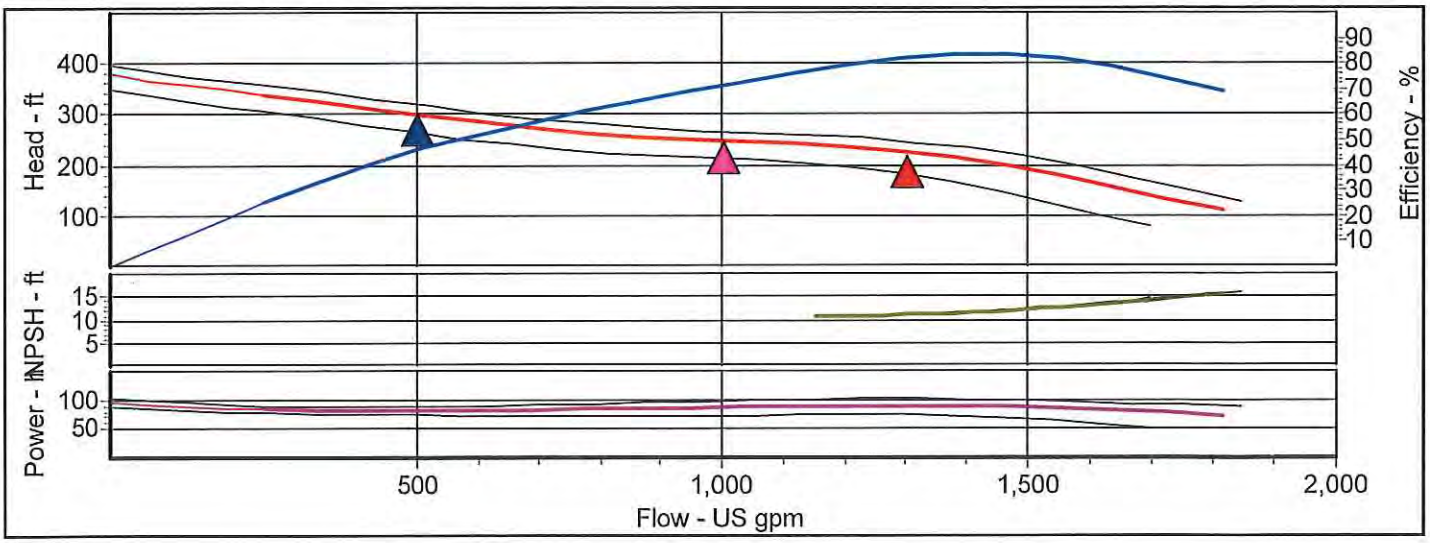
Pump Model: **Peerless Vertical - 10HH 8 Stages**
Nom. Speed: **1770 RPM, 60 Hz Electric**
Market : **Vertical Turbine Pump**
Impeller No.: **2626818 / HC**
Material Spec. Group: **A - B: CIE; I: Brz = Standard**
Item : **Douglas Well**
Your Ref. :

Fluid: **Water**
Temperature: **68** °F
Viscosity: **1.007** cSt
Sp. Gravity: **1.000** (base temp. 68 °F)

Stage No.	Trim Status		Imp. Dia. (inch) D2-in x D2-out
-----	**Full**		-----
-----	**Full**		**5.88 x 7.81**
1 - 8	**Trimmed**	**P**	**5.35 x 7.81**

Flow rate Q:	**1300**	US gpm
Bowl Total Head:	**220**	ft
Bowl Efficiency:	**82**	%
Bowl Power Required:	**90.31**	hp
NPSH Required	**10.996**	ft

Performance curve according to Hyd Inst-Peerless Std



Comments

Refer to factory for all single point bowl performance guarantees. Pumps must be selected with Hydraulic Institute-Peerless Std. See Std Hydraulic Performance document in RAPID for testing tolerances & contractual guarantees.

Flow (US gpm)	Head (ft)	Efficiency (%)	Power Required (hp)	NPSH Required (ft)	Thrust (lb)
0.0	379.6	0.0	96.6		4151.78
226.6	341.8	23.1	84.6		3632.41
453.3	307.0	42.6	82.5		3251.32
679.9	273.7	56.3	83.4		2896.38
906.5	252.2	67.0	86.2		2598.46
1133.2	239.4	76.6	89.5		2327.31
1359.8	217.7	83.1	90.0	11.3	1979.97
1586.4	170.5	80.9	84.4	12.9	1489.63
1813.1	109.7	68.7	73.1	15.7	936.73

DOUGLAS WELL
A.2b

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION AND DEVELOPMENT

WELL LOG No. Appli. 3899

Date May 18, 19

Record by City of Ferndale

Source Driller's Record

Location: State of WASHINGTON

County Whatcom

Area

Map

E½SE¼SW¼ SE. ¼ sec 19 T. 39 N., R. 2 E. W.

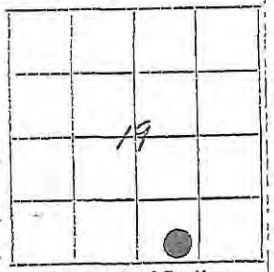


Diagram of Section

Drilling Co. G.A. Bezona

Address Ferndale, Washington

Method of Drilling Drilled Date May 20, 1955

Owner Town of Ferndale

Address Ferndale, Washington

Land surface, datum ..... ft. above / below

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses. If material water-bearing, so state and record static level if reported. Give depths in feet below land-surface datum unless otherwise indicated. Correlate with stratigraphic column, if feasible. Following log of materials, list all casings, perforations, screens, etc.)		
	Top Soil	12	12
	Blue Clay	14	26
	Sand & Gravel waterbearing	3	29
	Blue Clay with sand & Gravel	28	57
	Coarse sand & gravel water-bearing	2	59
	Clay sandy with gravel	27	86
	Fine sand & waterbearing	2	88
	Hard clay sandy	19	107
	coarse gravel waterbearing	3	110
	Clay & coarse rock	3	113
	Clay & fine gravel	6	119
	Gravel, sand & waterbearing	8	127
	Clay (12" pipe set in clay at 128')	3	130

SHOP WELL

SHOP WELL
A.3a

Sept 14 1955
File number

WELL LOG.—Continued No. ...../.....-.....

CORRELATION	MATERIAL	THICKNESS (feet)	DEPTH (feet)
	Depth forward	———	
	Coarse, gravel sand & water	30	160
	Pump Test:		
	Dia: 160' X 12"		
	SWL: 10'		
	DD: 20'		
	Yield: 868 g.p.m.		
	Casing: 16" conductor	0	16
	12" casing	0	128
	Perforations:		
	Silicon Bronz Cook Screen with #80 slot	160	130'
	10" to 12" bell reducer swedged to 12" pipe	125	160'

S. F. No. 7449—12-54—3M. 40108.

Pumptech Inc

12020 SE 32nd Street, Bellevue, WA 98005
Mike Dunn mdunn@pumptechnw.com
Phone 425-644-8501
Fax 425-562-9213

Customer : Pumptech Inc
Pumptech Inc
12020 SE 32nd ST
Bellevue, WA
98005
USA

Contact : Mike Dunn Dunn

Project : Ferndale Douglas, Shop Wells & WTP Back-Wash Pumps **Phone :** 425-562-9213 **Fax :** 425-562-9213

Quote No. : US-2158-522 **Page No :** 1 **Date :** Wednesday, May 18, 2011

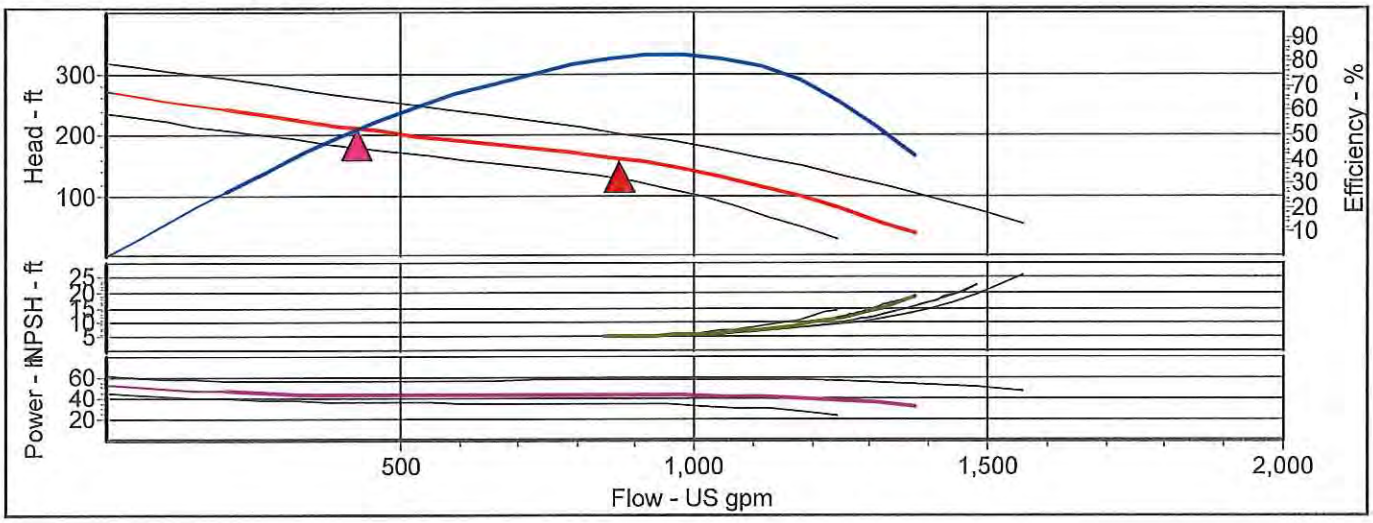
Pump Model: **Peerless Vertical - 10HH 7 Stages**
Nom. Speed: **1770 RPM, 60 Hz Electric**
Market : **Vertical Turbine Pump**
Impeller No.: **2622864 / MC**
Material Spec. Group: **A - B: CIE; I: Brz = Standard**
Item : **Shop Well**
Your Ref. :

Fluid: **Water**
Temperature: **68** °F
Viscosity: **1.007** cSt
Sp. Gravity: **1.000** (base temp. 68 °F)

Stage No.	Trim Status	Imp. Dia. (inch) D2-in x D2-out
-----	**Full**	-----
-----	**Full**	**5.56 x 7.25**
1 - 7	**Trimmed P**	**4.90 x 6.89**

Flow rate Q:	**870**	US gpm
Bowl Total Head:	**157**	ft
Bowl Efficiency:	**81.4**	%
Bowl Power Required:	**43.46**	hp
NPSH Required	**5.292**	ft

Performance curve according to Hyd Inst-Peerless Std



Comments

Refer to factory for all single point bowl performance guarantees. Pumps must be selected with Hydraulic Institute-Peerless Std. See Std Hydraulic Performance document in RAPID for testing tolerances & contractual guarantees.

Flow (US gpm)	Head (ft)	Efficiency (%)	Power Required (hp)	NPSH Required (ft)	Thrust (lb)
0.0	270.2	0.0	51.9		3889.52
171.8	245.1	22.4	47.5		3216.41
343.7	221.0	43.3	44.3		2714.26
515.5	198.9	60.3	43.0		2473.23
687.4	180.7	72.9	43.0		2279.95
859.2	162.3	81.0	43.5	5.3	1957.70
1031.1	134.5	81.8	42.8	6.3	1477.07
1202.9	90.5	69.4	39.6	9.9	954.38
1374.7	38.6	41.0	32.7		510.85

SHOP WELL
A.3b

STATE OF WASHINGTON
DEPARTMENT OF CONSERVATION
DIVISION OF WATER RESOURCES

WELL LOG

Record by: Driller

Source: Well Report

Location: State of WASHINGTON

County: Whatcom

Area:

Map:

SW¼ SW¼ sec. 19 T. 38 N., R. 2 E. W.

Diagram of Section

Drilling Co. Livermore & Son

Address 6053 Portal Way Ferndale, Wa

Method of Drilling Cable Date 10/27/70, 19

Owner Central City Water Assn 2471 Hilltop

Address Road Ferndale Wa.

Land surface, datum ft. above / below

SWL: 248' Date 10/27/70, 19 Dims.: 8" x 290'

Domestic

CORRELATION	MATERIAL	From (feet)	To (feet)
	Topsoil	0	1
	Hardpan	1	14
	Clay, blue, soft	14	114
	Clay, blue, soft w/boulders	114	116
	" " " w/sand, & gravel	116	165
	Sand, gravel w/clay blue	165	197
	" " " " " more clay	197	207
	Sand, gravel, clay, blue, mmmm	207	224
	Sand & gravel, dry	224	248
	" " " water-bearing	248	260
	Sand Clay, brown, (mix)	260	265
	Sand & Gravel, Coarse (W-B)	265	290
	Sand, fine (very)	290	

(Transcribe driller's terminology literally but paraphrase as necessary, in parentheses If material water-bearing, so state and record static level if reported Give depths in feet below land-surface datum unless otherwise indicated Correlate with stratigraphic column, if feasible. Following log of materials, but all casings, perforations, screens, etc.)

Turn up

Sheet ... of ... sheets

WELL LOG.—Continued No. 39/2E-19

CORRELATION	MATERIAL	From (feet)	To (feet)
	Depth forward	290	
	Casing:- 8"	0	280'
	Screens:- Johnson SS		
	8" Dia Slot Size -35	280'	285'
	8" " " " " -25	285'	290'
	Surface Seal:- Clay	0	60'
	Pump Test:- 140 gpm w/2½ hrs @ 24 hrs		

S. F. No. 7449—OS—12-65.

CENTRAL CITY WELL
A. 4a

THORNTON ROAD WELL

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

PROPOSED USE: ☐ Domestic ☐ Industrial ☒ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other _____

TYPE OF WORK: Owner's number of well (if more than one) _____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 450 ft. Depth of completed well 413 ft.

CONSTRUCTION DETAILS

Casing ☒ Welded 8" Diam. from +3 ft. to 393 ft.

Installed: ☐ Liner installed _____" Diam. from _____ ft. to _____ ft.

☐ Threaded _____" Diam. From _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

SIZE of perfs _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☒ Yes ☐ No ☐ K-Pac Location 388

Manufacturer's Name JOHNSON

Type STAINLESS Model No. _____

Diam. 6 Slot size 10 from 413 ft. to 408 ft.

Diam. 6 Slot size 20 from 408 ft. to 398 ft.

Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 60 ft.

Material used in seal BENTONITE GROUT

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.

Static level 314 ft. below top of well Date 10/24/14

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? AQUATECH

Yield: 310 gal./min. with 60 ft. drawdown after 24 hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 10/24/14

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 50+ gal./min. with stem set at 385 ft. for 6 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. WE19460

Unique Ecology Well ID Tag No. BHX510

Water Right Permit No. _____

Property Owner Name CITY OF FERNDALE

Well Street Address THORTON RD

City FERNDALE County WHATCOM

Location NW1/4-1/4 NW1/4 Sec 24 Twn 29 R 1 EWM ☒ Or WWM ☐

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 390124392440

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
BROWN FILL COBBLES	0	9
BROWN CLAY GRAVEL	9	25
GRAY CLAY	25	48
GRAY CLAY GRAVEL	48	96
GRAY SAND SILT	96	112
GRAY CLAY SAND GRAVE	112	198.5
GRAY COBBLE	198.5	200
GRAY SILT SAND GRAVEL	200	203
GRAY GRAVEL SAND SILT COBBLE	203	205
LT GRAY MED SAND GRAVEL	205	208
TAN MED SAND GRAVEL	208	222
BROWN COURSE SAND GRAVEL	222	245
TAN MED SAND GRAVEL	245	265
TAN MED SAND GRAVEL WOOD	265	270
TAN MED FINE SAND GRAVEL	270	273
GRAY SILT GRAVEL	273	282
GRAY COURSE SAND GRAVEL SILT	282	286
BROWN COURSE SAND GRAVEL SILT	286	330
BROWN MED SAND GRAVEL WATER	330	347
GRAY CLAY	347	353
GRAY SILT SAND FINE WATER	353	367
GRAY CLAY WOOD	367	375
GRAY FINE MED SAND WATER	375	417
GRAY CLAY	417	419
GRAY FINE SAND GRAVEL WATER	419	450
14361		

Start Date 10/14/14 Completed Date 10/24/14

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) BRANNON HOPKE

Driller/Engineer/Trainee Signature

Driller or trainee License No. 1825

IF TRAINEE: Driller's License No:

Driller's Signature:

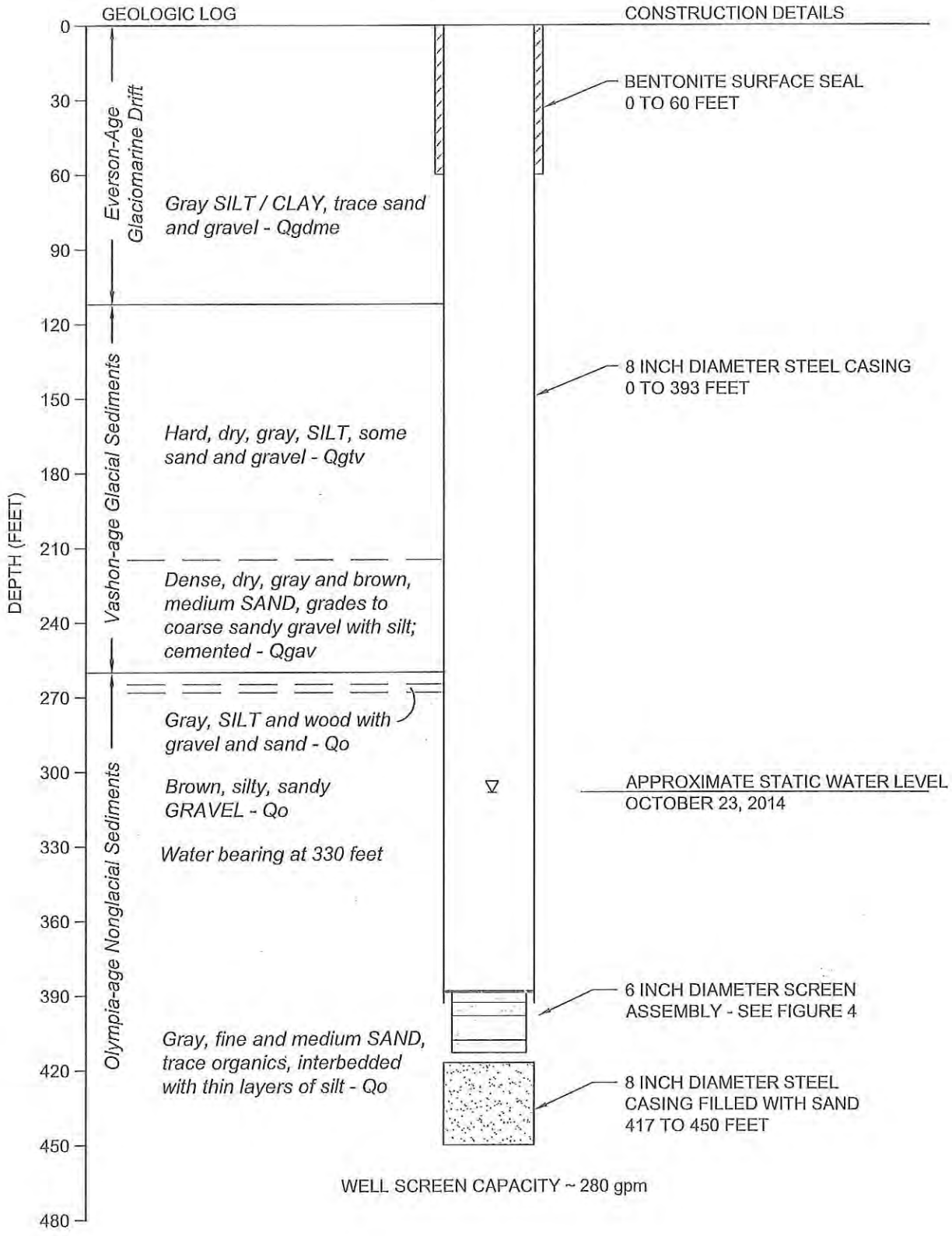
Drilling Company AQUATECH WELL DRILLING & PUMPS INC

Address 2675 BUTLER CREEK RD

City, State, Zip SEDROWOOLLEY , WA, 98284

Contractor's Registration No. AQUATWD040K4 Date 11/13/14

THORNTON WELL A.5a



130396 Ferndale \ 130396 const schem.dwg LAYOUT: Const Schem

associated earth sciences incorporated

CONSTRUCTION SCHEMATIC

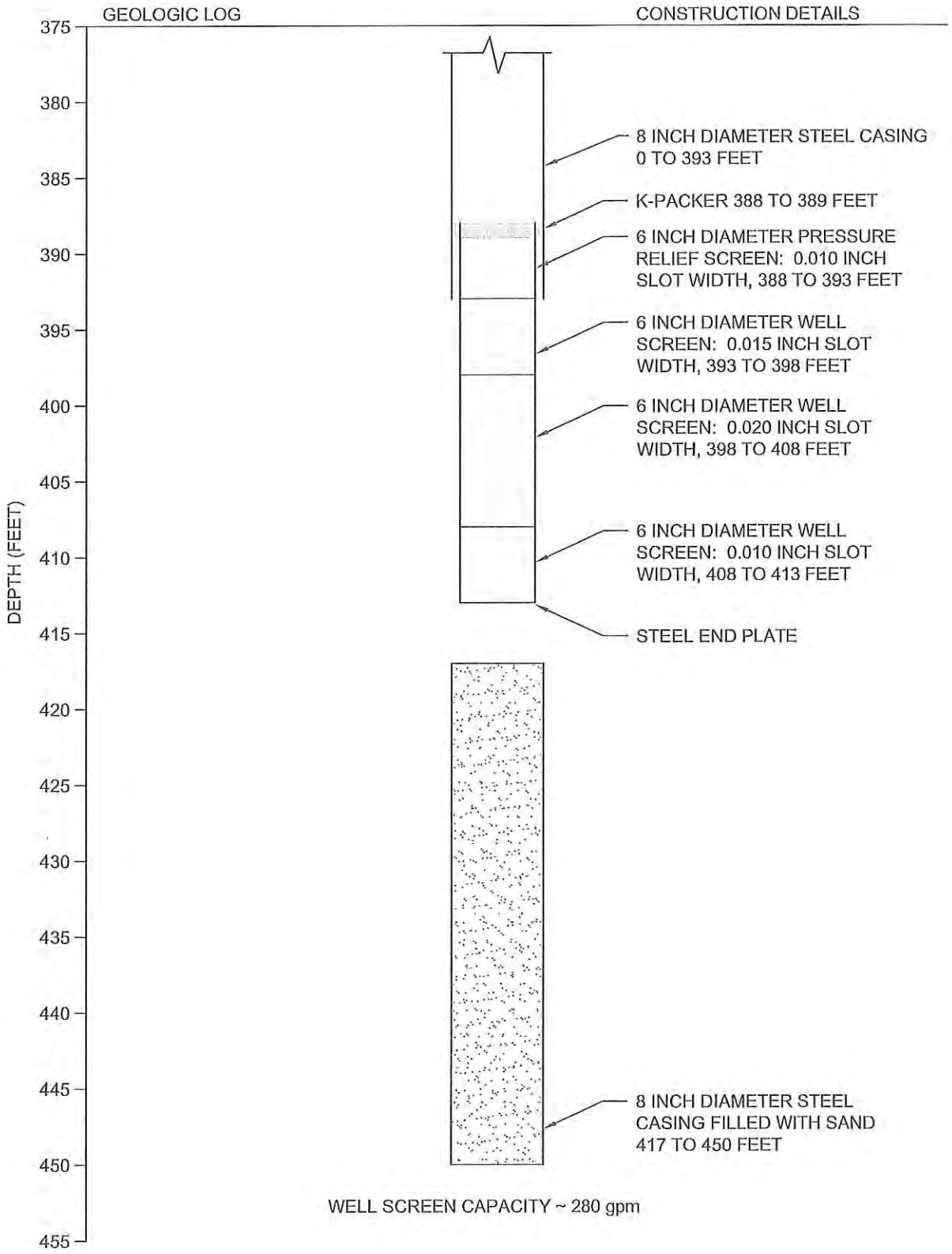
THORNTON ROAD WELL
FERNDALE, WASHINGTON

FIGURE 3

DATE 12/14

PROJECT NO. EH130396A

A.5b



WELL SCREEN CAPACITY ~ 280 gpm

130396 Ferndale \ 130396 const schem.dwg LAYOUT: Well Screen Assy

associated earth sciences incorporated

WELL SCREEN ASSEMBLY

THORNTON ROAD WELL
FERNDALE, WASHINGTON

FIGURE 4

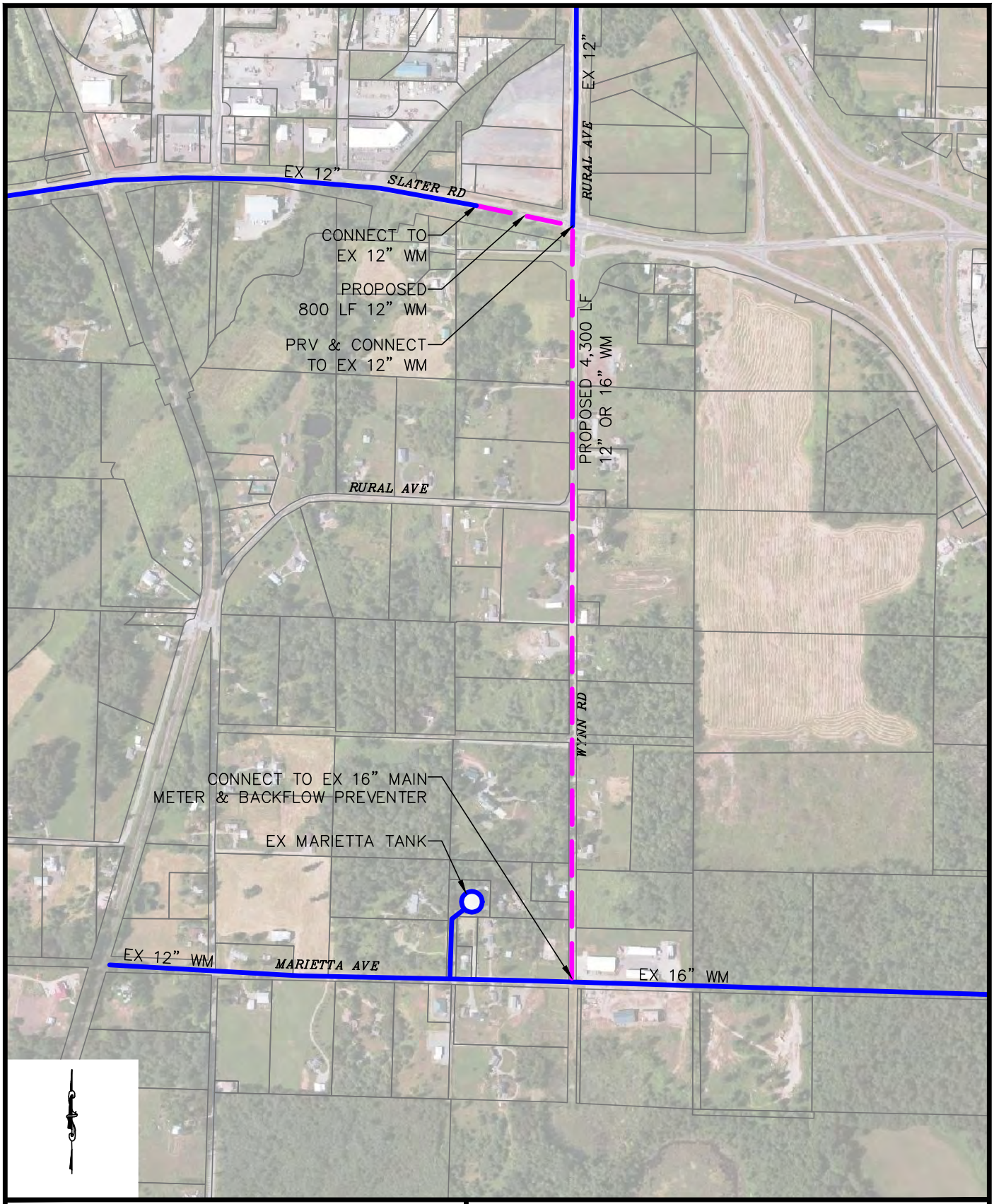
DATE 12/14

PROJECT NO. EH130396A

A.5b (CONTINUED)

Appendix B Intertie Exhibits

1. City of Bellingham Exhibit for Emergency Intertie at Marietta Ave.
2. Blaine/Birch Bay Exhibit for Intertie
3. Deer Creek Exhibit for Emergency Intertie



R&E Reichhardt & Ebe ENGINEERING INC

423 Front St., Lynden, WA 98264 (360) 354-3687

813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

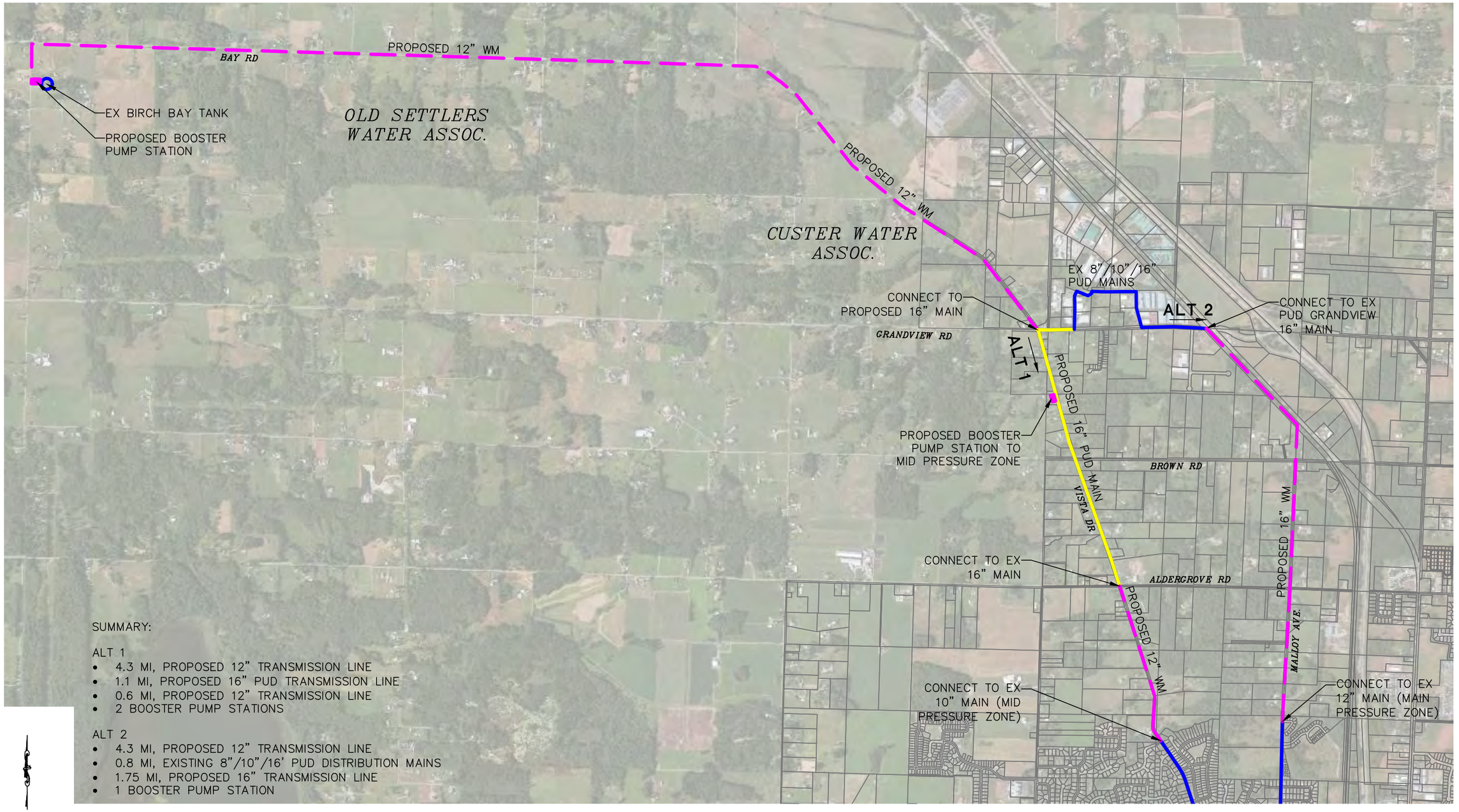
CITY OF FERNDALE

EMERGENCY INTERTIE SYSTEM

TO BELLINGHAM AT MARIETTA AVE

DATE: 11/10/16 DWG: 15027

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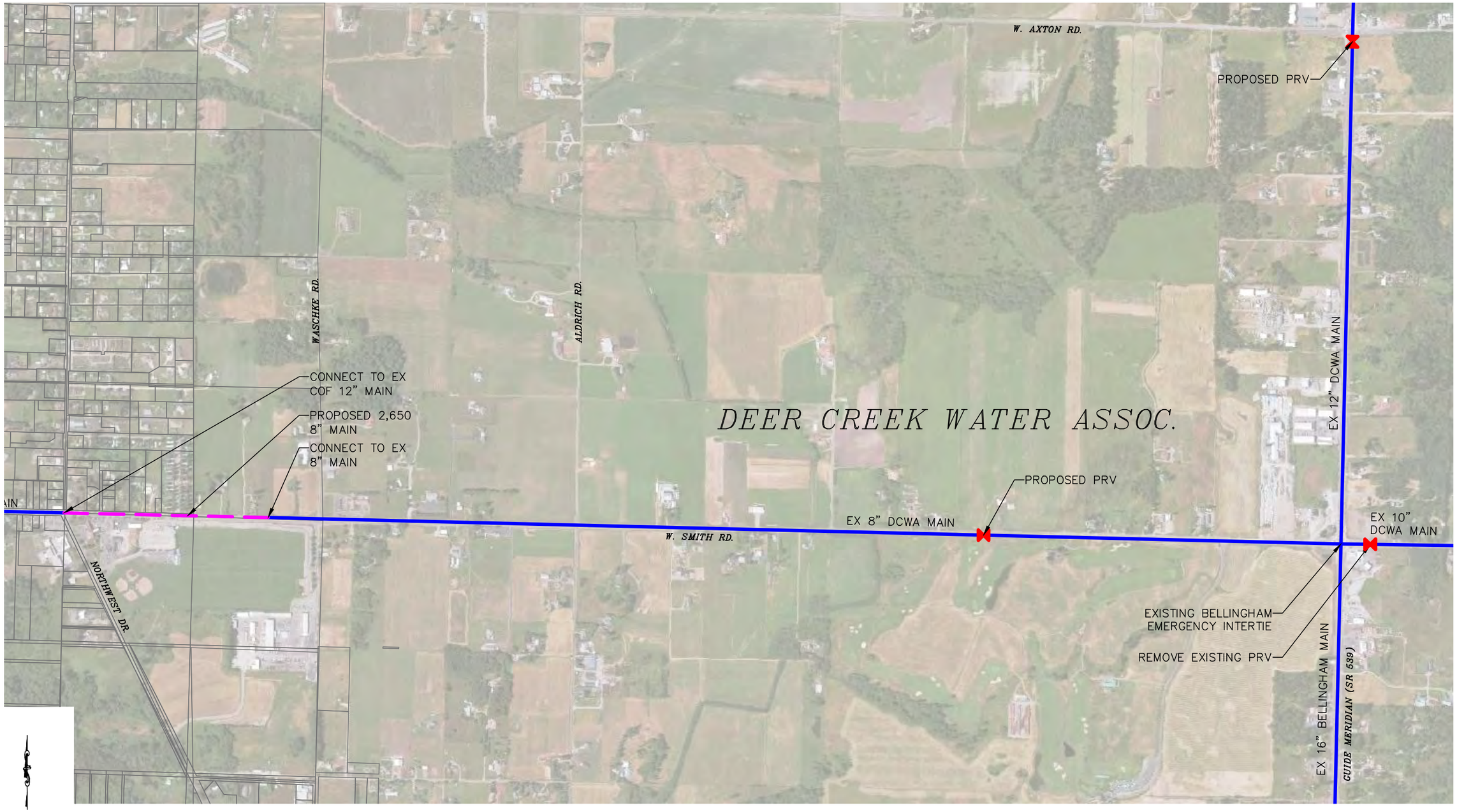
SUMMARY:

ALT 1
- 4.3 MI, PROPOSED 12" TRANSMISSION LINE
- 1.1 MI, PROPOSED 16" PUD TRANSMISSION LINE
- 0.6 MI, PROPOSED 12" TRANSMISSION LINE
- 2 BOOSTER PUMP STATIONS

ALT 2
- 4.3 MI, PROPOSED 12" TRANSMISSION LINE
- 0.8 MI, EXISTING 8"/10"/16' PUD DISTRIBUTION MAINS
- 1.75 MI, PROPOSED 16" TRANSMISSION LINE
- 1 BOOSTER PUMP STATION

DESIGNED BY CFR DRAWN BY IDH CHECKED BY CFR	R&E Reichhardt & Ebe ENGINEERING INC 423 Front St., Lynden, WA 98264 (360) 354-3687 813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713	CITY OF FERNDALE 2095 MAIN ST. FERNDALE, WA 98248	CITY OF FERNDALE EMERGENCY INTERTIE SYSTEM TO BLAINE AND BIRCH BAY	JOB# / DWG 15027 SCALE H: n/a V: n/a	DATE 11/10/16 SHEET 1 of 1

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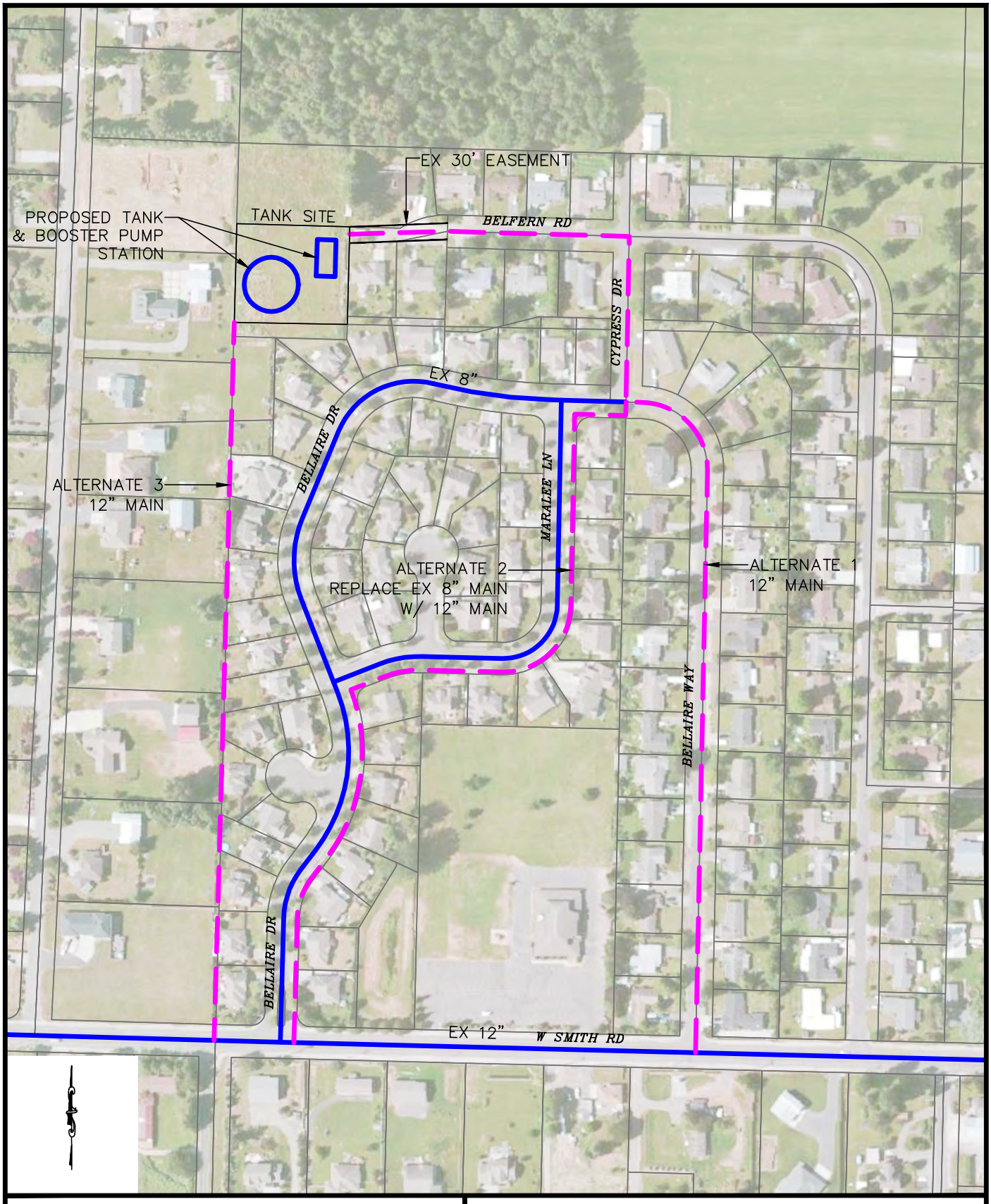


DESIGNED BY CFR DRAWN BY IDH CHECKED BY CFR	R&E Reichhardt & Ebe ENGINEERING INC 423 Front St., Lynden, WA 98264 (360) 354-3687 813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713	CITY OF FERNDALE 2095 MAIN ST. FERNDALE, WA 98248	CITY OF FERNDALE EMERGENCY INTERTIE SYSTEM TO DEER CREEK WATER ASSOC.	JOB# / DWG 15027 SCALE H: n/a V: n/a	DATE 11/10/16 SHEET 1 of 1

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Appendix C Storage Exhibits

1. Smith Road Storage
2. Bakerview Second Storage Tank
3. Bellingham Marietta Storage Tank
4. Brown Road Storage Tank



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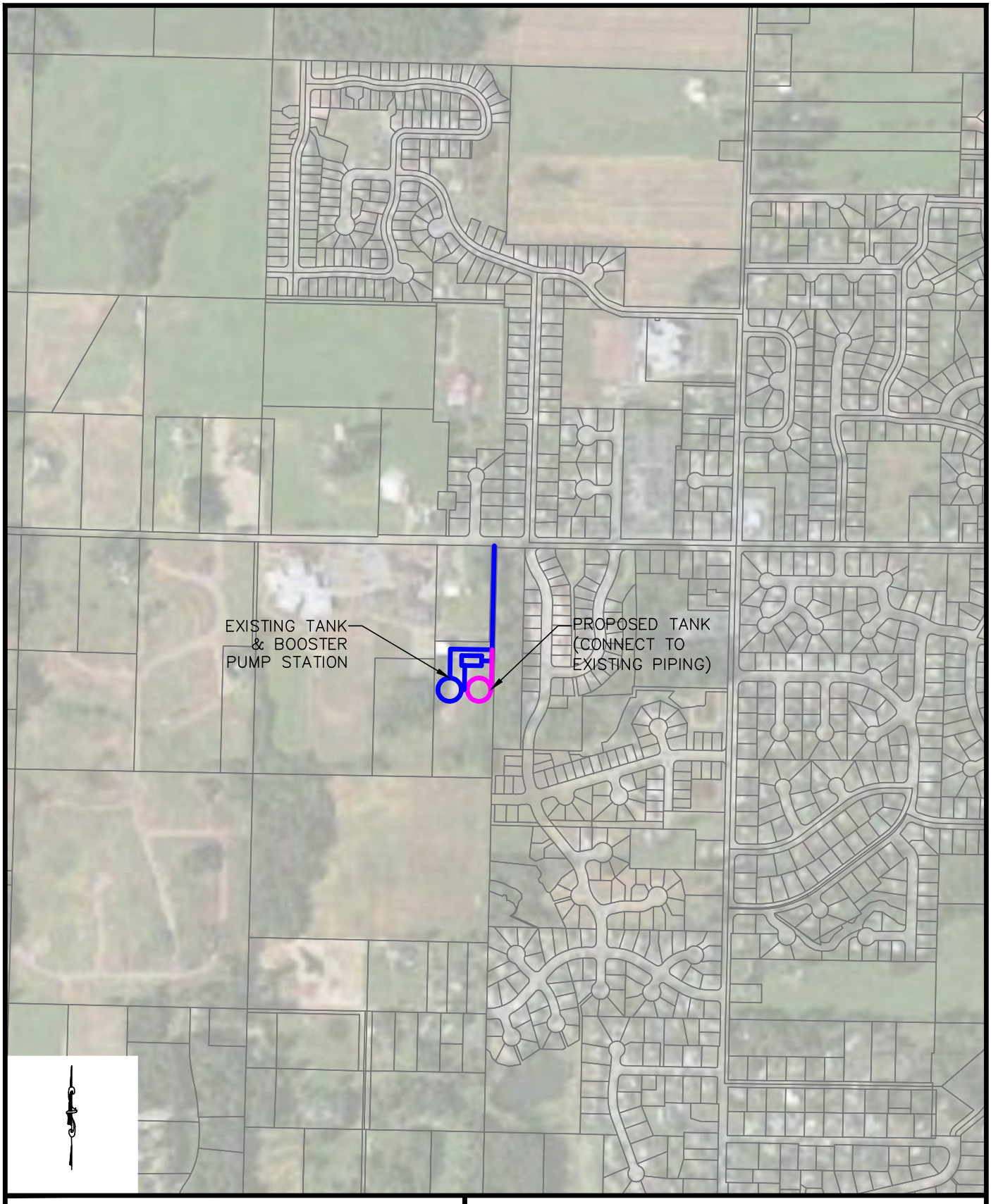
813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

CITY OF FERNDALE
SMITH RD. TANK SITE

DATE: 11/10/16

DWG: 15027

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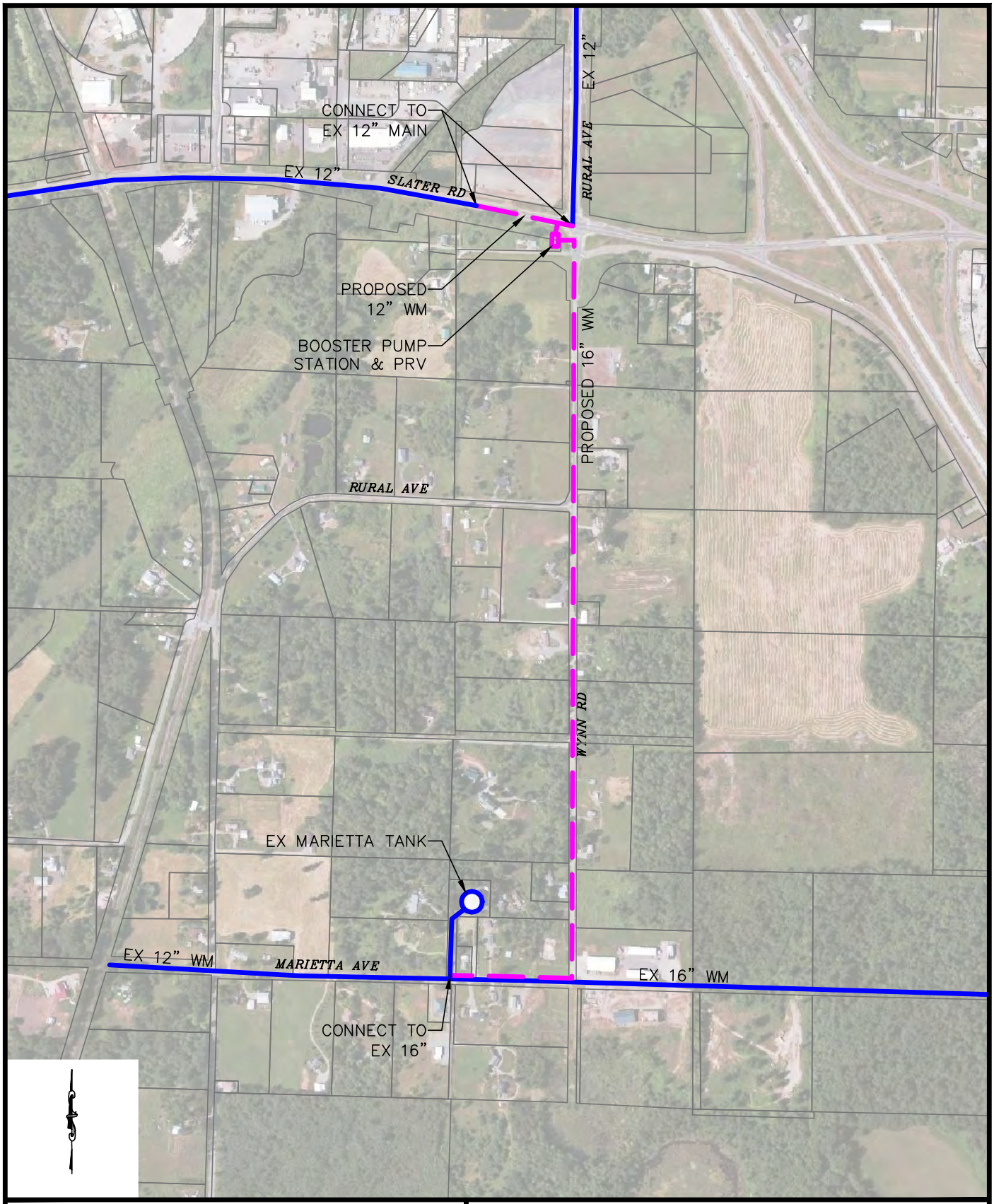
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ENGINEERING INC
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813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

CITY OF FERNDALE
BAKERVIEW TANK SITE

DATE: 11/10/16

DWG: 15027

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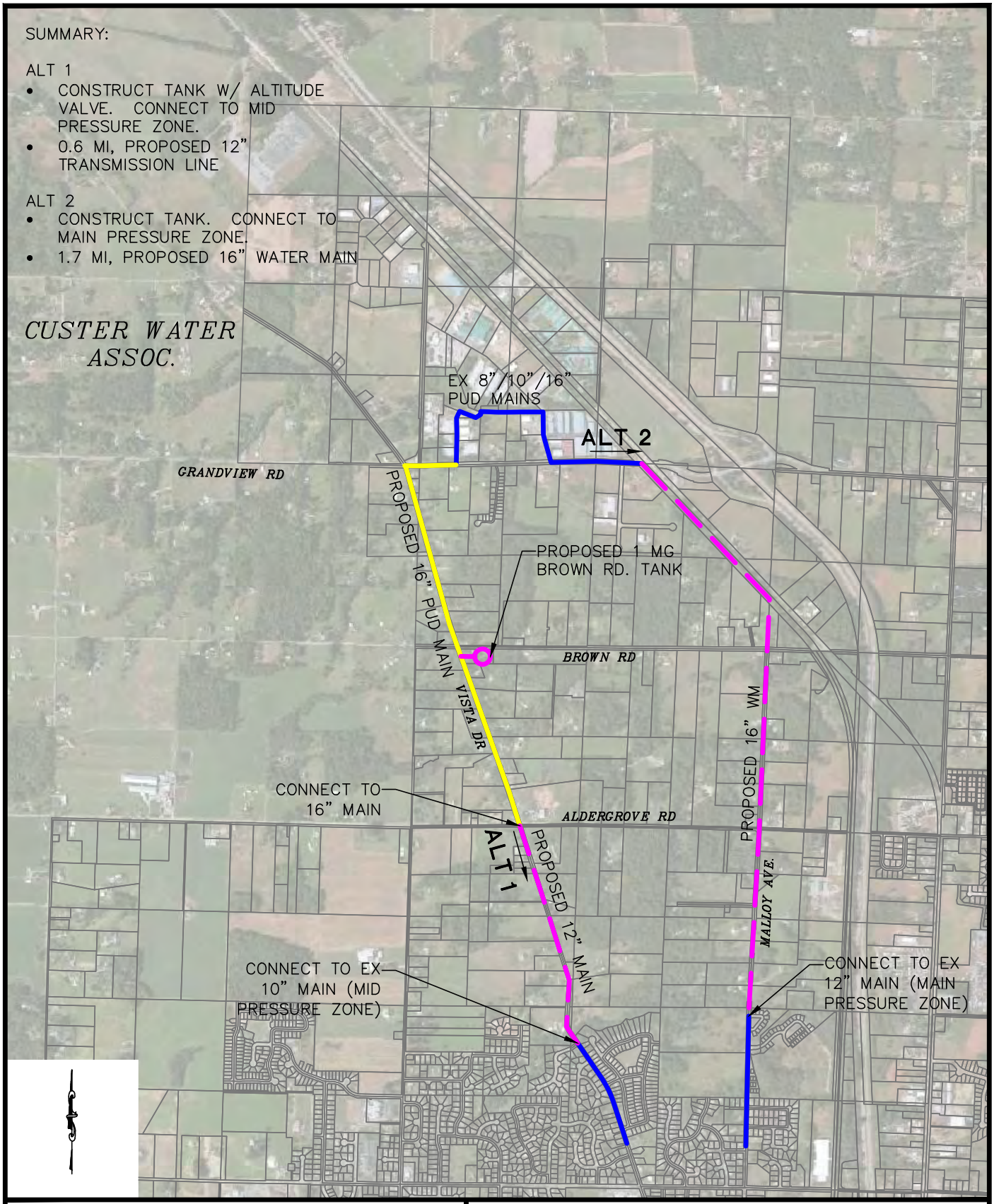
813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

CITY OF FERNDALE
MARIETTA TANK SITE

DATE: 11/10/16

DWG: 15027

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813 Metcalf St., Sedro-Woolley, WA 98284 (360) 855-1713

CITY OF FERNDALE
BROWN RD. TANK SITE

DATE: 11/10/16

DWG: 15027

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O. WELLHEAD PROTECTION PLAN

Table of Contents

List of Tables ii
List of Figures ii
List of Appendices ii
Summary 1
Introduction 2
Background 2
Description of Supply Wells 4
Susceptibility Assessment 5
Wellhead Protection Area Delineation 5
Potential Contamination Sources Inventory 6
Hazard analysis 6
Notification 7
Management Strategies 8
Contingency Plan 9
Emergency Response Plan 10
Limitations 10

List of Tables

Table 1 – Summary of Well Details ……..3

List of Figures

Figure 1 – Vicinity Map ……2

List of Appendices

A. Potential Contamination Sources
B. Susceptibility Assessment Forms
C. Well Logs
D. AESI – Delineation Report
E. Sample Notification Letters

Summary

This report summarizes the results of the work done to characterize the aquifer utilized by the City of Ferndale water supply wells. It also investigates and discusses risks of contamination to the water supply wells by delineating 1, 5, and 10 year time of travel (TOT) boundaries and creating an inventory of existing and potential contaminant sources within those boundaries (the Wellhead Protection Area, or WPA). The potential and known contamination sources at or near the ground surface will not be seen in the aquifer for several decades because the Regional Aquifer is separated from surface sources by a thick layer of low permeability sediments. Other public and private groundwater wells that are directly connected to the Regional Aquifer present more immediate risks if contamination is introduced into a well casing. This report also discusses management strategies to minimize risk of contamination of the aquifer.

Introduction

Background

The federal Safe Drinking Water Act requires all federally defined public water systems (Group A systems) that use groundwater as their source, to implement a wellhead protection program. The intent of this Wellhead Protection Plan is to keep the groundwater supply for the City of Ferndale (City) protected against potential contaminant sources, and provide contingency and emergency response plans in the event that contamination does occur. State authority implementing this requirement is contained in WAC 246-290-135(3).

The project area is located in and around the City of Ferndale, Washington. The approximate location of the City's production wells and supply wells are shown in Figure 1.

The City provides municipal water to a residential population of approximately 13,249 people with 5,099 service connections generally located within the city limits shown on Figure 1. Among these are farms, commercial businesses, and multi-family and single-family residential customers. The City maintains two supply wells (Shop and Douglas Road Wells) at the locations shown on Figure 1. The two City supply wells are the current points of withdrawal for three municipal ground water rights (G1-00720P, G1-*2509C, G1-*03889C), which have a total instantaneous quantity (Qi) of 2,870 gallons per minute (gpm) and total annual quantity (Qa) of 2,055 acre-feet (ac-ft/yr). Recently, the City acquired the Central City PWS well, water rights, and service area customers. That acquisition added approximately 245 people with 114 service connections. The Central City ground water right (G1-*10690C) has a Qi of 60 gpm and Qa of 85 ac-ft/yr. The process to consolidate all of the City's existing ground water rights is currently ongoing through the cost-reimbursement process with the Washington State Department of Ecology (Ecology).

Figure 1 – VICINITY MAP

Description of Supply Wells

The City of Ferndale maintains two supply wells (Douglas Well and Shop Well) and one exploration well (Thornton Road Well). The City also recently acquired the Central City Water Association production well and associated water rights. Table 1 below shows detailed information for each of the City's wells. Water well logs are included in Appendix B. For this report, the Douglas Road Well and the Shop Well are referred to as Supply Wells because they are typically used to supply water to the City's water system. The Thornton Road Well and the Central City Well are referred to as Production Wells because they can produce water for the system but are not used regularly.

In May 1955, Bezona Well Drilling installed the City of Ferndale Shop Well, a 12-inch diameter, 160-feet deep water well at the City Shop. The Shop Well site address is 5490 Legoe Ave. Ferndale, WA. The 2nd Supply Well, Douglas Road Well, is located at 2350 Douglas Road, Ferndale, WA. The Douglas Road Well is a 12-inch diameter well, 170-feet deep, and was installed in February 1994 by B&C Well Drilling. See Appendix C for descriptions of the geology and hydrogeology of the aquifer that feeds all the wells in this region.

Table 1 – Summary of Well Details

Well No.	Well Completion Depth (ft)	Water Right(s) Associated with Each Well	Maximum Pumping Rate (Qi) (gpm)	Aquifer Unit	Date of Construction	Size, Type
Douglas Road Well	170	G1-*02509C, G1-00720P	1,000[1] 300[1]	Regional Aquifer	Feb, 1994	12" Diam, Welded Casing
Shop Well	160	G1-*03899C	870[1]	Regional Aquifer	May, 1955	12" Diam, --
Central City Well	290	G1-*10690C	60[1]	Regional Aquifer	Oct, 1970	8" Diam, --
Thornton Road Well	413	TBD[2]	315-375[3]	Regional Aquifer	Oct, 2014	8" Diam, Welded Casing
Future Well[4]	TBD	G1-00720P	700[1]	Regional Aquifer	--	TBD

Notes:
(1) The maximum pumping rate allowed by existing water right for the individual well(s)
(2) The City is currently consolidating their water rights through the cost-reimbursement process with the Department of Ecology. Once complete, all of the City's water supply wells, including the Thornton Road Well, will be under a single water right.
(3) Pumping rate for Thornton Road Well based on pumping test analyses in AESI, 2014.
(4) Water right G1-00720P allows for a Qi of 700 gpm. The location of this well has yet to be determined.

Susceptibility Assessment

The susceptibility of the City of Ferndale Supply Wells (Douglas Road Well & Shop Well) to water quality impacts has been determined to be Low Susceptibility by the Department of Health. Susceptibility Assessment forms were completed for both Supply Wells and are included in Appendix A. Both supply wells and all of the City's production wells are within the permeable portions of the Vashon glacial deposits and within coarse-grained members of older non-glacial and glacial sediments, generally referred to as the Regional Aquifer. The Regional Aquifer has a confining layer as shown in the Well Logs – Appendix B. The aquifer is separated from the surface by a thick sequence of low permeability Everson glaciomarine drift.

The principal water quality concern to the aquifer is leaching septic tanks, a high population density (>1 house/acre), and abandoned ground water wells. The septic tanks and known abandoned ground water wells have been included in the Potential Contaminant Sources Inventory.

The deep hydraulic isolation of the Regional Aquifer, combined with the residential nature of the area, indicates there is a relatively low likelihood of water quality impact to the City's production wells.

Wellhead Protection Area Delineation

The Department of Health defines a Wellhead Protection Area (WPA) as the surface and subsurface area around a well or well field that contaminants are likely to pass through to reach the drinking water source and the area a community or water system manages to protect groundwater-based drinking water supplies from contamination. The WPAs for the City of Ferndale Production Wells has been determined by Associated Earth Sciences, Inc. in their Technical Report City of Ferndale Well Head Protection Zone Assessment, August 5, 2015. This report has been included as Appendix C.

The delineation method used by AESI to determine the WPAs was a calibrated numerical ground water flow model. This method is considered the most sophisticated approach. Individual WPAs for each production well have been delineated and are shown in Figure 6 of Appendix C. Typical operation of the Ferndale water system involves operation of both the Shop Well and the Douglas Road Well, and an overall WPA for both of these City Supply Wells in operation was delineated and is shown in Figure 7 of Appendix C.

Potential Contamination Sources Inventory

A review of Department of Ecology's Leaking Underground Storage Tank (LUST), Underground Storage Tanks (UST), Confirmed and Suspected Contaminated Sites (CSCS) and other potential contamination sources, was conducted for this Wellhead Protection Plan. A list of each site within the 1, 5, and 10 year time of travel zones for the two City Supply Wells (as delineated in Figure 7 of Appendix C) can be seen in Tables 2, 3, and 4, respectively. Potential contaminant sources within the maximum area of interest (described below) are shown in Table 5.

Figures 1 and 2 show the potential contaminant sources and the time of travel boundaries. Figure 2 is a larger map for clarity. They also show a max area of interest. This max area of interest includes the ten year time of travel boundary in the scenario in which the Douglas Road Well is operating and the Shop Well is not operating. This boundary can be seen at the South edge of the boundary. The second area included in the max area of interest is the area on the Northwest corner of the boundary, which shows the surface "watershed" boundary (the area that drains to the ten year time of travel boundary based on surface topography). This is also known as the Buffer Zone.

Tables 2, 3, 4, and 5 can be cross-referenced with Figures 3 and 4 using the ID on Map labels.

City of Ferndale public sewer mains also represent a potential contaminant source in the case of a sewer main break or leak (as quantified by Inflow and Infiltration quantities). Sewer mains are not shown on Figure 1 for clarity, but are shown on Figure 2. In general, where there are not on-site septic systems, there are sewer mains.

Hazard analysis

The hazards to the City of Ferndale's supply wells are best understood within the framework of the hydrogeology of the area. As the report in Appendix C discusses in its conclusions, the time of travel boundaries do not account for the vertical travel time of potential contaminants to the aquifer. The Regional Aquifer is separated from surface sources of potential contamination by a thick layer of low permeability sediments. The vertical ground water travel time from the ground surface to the Regional Aquifer beneath the wellhead protection area is likely in the range of several decades. Therefore, any contamination from sources at or near the ground surface will not be seen in the aquifer for several decades.

The exception to this travel time is any contamination introduced directly into the aquifer through a well that is drilled into the aquifer. Because of this, the most immediate potential hazards to the City's supply wells are the other public and private wells within the 1, 5, and 10 year time of travel zones. When the other wells are running, the risk of contamination is low, but if other wells are not running and contamination is introduced at the surface that gets into the well casing, this contamination will quickly be seen in the other nearby wells. Therefore, special care must be taken to keep hazardous materials from entering any of the wells within the aquifer. Some of the existing wells within the wellhead protection area are shown on Figure 1 and Figure 2, but many of the wells within the wellhead protection area do not have precise location coordinates and therefore are not shown on Figure 1 or Figure 2. A complete list of all well logs in the vicinity can be found at the Washington Department of Ecology (Ecology):

https://fortress.wa.gov/ecy/waterresources/map/WCLSWebMap/WellConstructionMapSearch.aspx

Some of these wells have been decommissioned. Proper decommissioning minimizes the risk of contamination to the aquifer. The database above does not list any improperly abandoned wells because Ecology takes appropriate action for any improperly abandoned wells that are brought to their attention. If any improperly abandoned wells are discovered, they should be brought to the attention of Noel Philip (NPHI461@ECY.WA.GOV) or Kasey Cykler (KIGN461@ECY.WA.GOV) at Ecology. In addition, some of the wells in the DOE database in the area do not appear to have been drilled deep enough to reach the Regional Aquifer and therefore pose less of a risk than wells that are hydraulically connected to the Regional Aquifer.

The other potential contamination sources discussed in this report are all sources that are at or near the ground surface. These contamination sources would take several decades to reach the Regional Aquifer, but special care must be taken to avoid future contamination.

The most obvious hazard to the City of Ferndale's supply wells is the known leaking underground storage tanks. There are two within the 5-year time of travel (Table 3), and one within the 10-year time of travel (Table 4). The DOE database shows that the status of the three leaking underground storage tanks are as follows. The 7 Eleven (ST1) is awaiting cleanup as of 10/31/2011. The Ferndale Mini Market (ST3) says cleanup had started as of 1/19/1990. The Ferndale Grain storage tank (ST2) was awaiting cleanup as of 7/1/2011. Renewed effort should be undertaken to get these sites cleaned up.

Another hazard to the groundwater quality is the presence of many on-site septic systems within the 1, 5, and 10 year time of travel boundaries. Because these near-surface hazards would take several decades to reach the Regional Aquifer through the vertical layer of low permeability sediments, the risk of bacteriological contamination is very low. Contamination from nitrates, nitrite, ammonia and chloride is possible in the long-term.

Stormwater facilities could also pose a hazard if there is contamination from a leak or spill of a hazardous chemical that gets into the stormwater facility and infiltrates into the groundwater. Primary risks of this would come from hazardous material transportation within the wellhead protection area. Again, this would take on the order of several decades to infiltrate down to the Regional Aquifer.

Non-point agricultural contamination could also pose a long-term risk for the City's groundwater supply in the infiltration of fertilizers, pesticides, or accidental leaks.

The commercial sites listed, in addition to the residential households throughout the time of travel boundaries, could represent potential contamination sources at or near the ground surface including, but not limited to, cleaning fluids, solvents, fuels, lubricants, paints, herbicides, insecticides, and fertilizers.

Notification

WAC 246-290-135(3) requires purveyors to notify all owners/operators of known or potential sources of contamination, which are described above. Example notification letters are provided in Appendix D. As part of the complete wellhead protection program, the City of Ferndale should notify all potential sources of contamination shown in Tables 2-5 as well as all owners/operators of wells not listed but as described above.

Management Strategies

Strategies for managing the risks to groundwater quality for the City of Ferndale include:

- Cooperation Strategies
    - Maintain a central point of contact for the City's Wellhead Protection Program
    - Provide current Wellhead Protection maps to City of Ferndale officials
    - Send notification and educational letters to owners identified in Tables 2, 3, 4, and 5 informing them of the risk identified and strategies to minimize the risk they pose
    - Encourage best management practices (BMPs) in land management activities
    - Communicate the findings of this report to operators of wells within the wellhead protection area and develop or update plans to avoid accidental contamination of the aquifer. Also, maintain communication with well operators to alert each other in the case of detected contamination. Consider inspection of wells to identify potential hazards.
    - Coordinate with government agencies
        - Whatcom County Health Department (for water quality, household hazardous waste collection)
        - Whatcom County Planning & Development Services (land use, building and permitting, Fire Marshal for permitting of above ground and underground fuel tanks)
        - Whatcom Conservation District (agricultural best management practices)
        - Washington Department of Ecology (water well information, environmental protection)
- Review land use permits for any new potential contamination sources
- Track and encourage cleanup of leaking underground storage tanks identified in the wellhead protection area
- Planning Strategies
    - Coordinate with local emergency responders (police and fire) to evaluate if any changes are needed to their incident/spill response measures based on the findings of this report
    - Obtain notifications of hazardous materials spills in the area
    - Develop detailed contingency plans for possible contamination problems
- Monitoring
    - Monitor groundwater quality – this may include development of a groundwater sampling plan and may require obtaining access to private water wells within the 1, 5, and 10 year time of travel boundaries
    - Investigate well logs and possibly perform well survey to inspect wells within wellhead protection area for potential hazards
    - Possibly track agricultural chemical use (fertilizers, pesticides, herbicides)
- Target public education programs within the wellhead protection area

Contingency Plan

A thorough contingency plan to supply water for the City of Ferndale in case of groundwater contamination should be developed. A first option in case of groundwater contamination is to switch back to the water from Whatcom County PUD #1, which comes from the Nooksack River. The possibility of this should be discussed with PUD #1 so that the specifics of switching over in case of emergency can be planned.

Any contingency plan will likely involve reduction of water system demand in the short and/or long term, so a key piece of a contingency plan will be methods for reducing demand. Short term conservation may be required when the contamination is detected so that there is time to implement a contingency plan. The contingency plan may also require long-term conservation until a more permanent solution is developed. Prioritizing water uses is a first step in conservation. For example, low-priority uses such as recreational or beautification would be the first to be curtailed in the event of a contamination problem.

The newly developed/acquired Thornton Rd. well and Central City well provide substantial flow and have wellhead protection areas with little overlap of those from the Shop Well and Douglas Road Well (Figure 6 of Appendix C), so if a contamination source was outside the time of travel boundaries for these alternate wells, they could be used to provide water supply. The City may need to implement policies to reduce water demand because of the lower capacity of these wells, as described above. The City should develop a specific operation plan for using these alternative sources that includes timing, sequencing, valve operations, flushing, etc.

The City currently has reverse osmosis (RO) treatment facilities for the groundwater source. Any contamination detected in the groundwater source should be investigated to determine if RO is an appropriate treatment technology for that specific type of contamination. Reverse osmosis will not remove all contaminants from water. Dissolved gases such as oxygen and carbon dioxide pass through RO membranes into the treated water. Hydrogen sulfide gas, with its notorious odor of rotten eggs, also passes through the RO membrane. RO in general is not a very effective treatment for trihalomethanes (THMs), some pesticides, solvents, TCE from drycleaner waste, and other volatile organic chemicals (VOCs).

If RO is an appropriate treatment technology for a specific contaminant, treatment operations should be adjusted accordingly to treat the contaminated water. This also may mean implementing measures to decrease water demand because the RO system is not intended to treat 100% of the City's water demand. Capacity would be limited to 1500 gpm. Also, pure RO water is too soft. It has to be hardened or there will be corrosion (lead and copper) problems. A chemical addition system would be needed to add lime to the treated RO water if 100% of the supply was being treated through the RO system.

Emergency Response Plan

It is recommended that the City coordinate with local emergency responders (police and fire departments), the Washington Department of Ecology, and Whatcom County Health to evaluate if any changes are necessary to incident/spill response measures to better protect groundwater within the wellhead protection area. This coordination effort may include submitting a copy of this report to these agencies for review. Incident/spill response measures should include notification to the City water department when incidents are within the wellhead protection area. Spill and incident response plans should be reviewed and updated at least every two years.

Limitations

This report has been prepared to attempt to delineate the wellhead protection area for the City of Ferndale water wells and qualify possible contamination sources that may present risks to the groundwater quality. Hydrogeologic and environmental conditions are subject to constant change and reinterpretation. Current conditions should not be assumed to represent conditions at some future time. Wilson Engineering, LLC does not guarantee that latent or undiscovered conditions will not become evident in the future. This report represents the professional opinions and judgements of Wilson Engineering, LLC and Associated Earth Sciences, Inc., prepared in accordance with commonly practiced hydrogeologic and environmental assessment procedures. No other warranties, representations, or certifications are made.

Wilson Engineering, LLC, obtained, reviewed, and evaluated information available from local and state agencies. Regulatory database searches are limited to those facilities which have been identified and listed in the referenced government environmental regulatory files. Wilson Engineering's conclusions, opinions, and recommendations are based, in part, on this information. Wilson Engineering, LLC, does not warrant the information contained in public records.

CITY OF FERNDALE, WA

WHATCOM COUNTY WASHINGTON

Potential Contamination Sources

SHEET 1 OF 1

DATE APR 2016 | SCALE AS SHOWN | JOB NUMBER 2015-083

Production Well - Thornton Road Well
Production Well - Central City Well
Supply Well - Shop Well
Supply Well - Douglas Road Well
MOUNTAIN VIEW WATER ASSOCIATION--WELL #1
LAMPLIGHTER MOBILE HOME COURT WELL # 1
LAMPLIGHTER MOBILE HOME COURT WELL # 2
LEVORSEN WATER ASSOCIATION--WELL #1
FERTILE MEADOWS WATER ASSN--WELL # 1
PS1 PS2 PS3 PS4 PS5 PS6 PS8
ST1 ST2 ST3
NA1 NA2
PVW1 PVW2 PVW3 PVW4 PVW5 PVW6
COM1 COM2 COM3 COM4 COM5 COM6 COM7 COM8 COM10 COM11
SW1 SW2 SW3 SW4 SW5 SW6 SW8 SW9 SW10 SW11 SW12 SW13 SW14 SW15 SW16 SW17 SW18 SW19 SW20 SW21 SW22 SW23 SW24 SW25 SW26 SW27
AG1 AG2 AG3 AG4 AG5 AG6 AG7 AG8 AG9 AG10 AG11 AG12 AG13 AG14 AG15 AG16 AG17 AG18 AG19 AG20 AG21 AG22 AG23 AG24 AG25 AG26 AG27 AG28 AG29 AG30 AG31 AG32 AG33 AG34 AG35 AG36 AG37 AG38 AG39 AG40 AG41 AG42 AG43 AG44 AG45 AG46 AG47 AG48 AG49 AG50
OSS1 OSS2 OSS3 OSS4 OSS5 OSS6 OSS7 OSS8 OSS9 OSS10 OSS11 OSS12 OSS13 OSS14 OSS15 OSS16 OSS17 OSS18 OSS19 OSS20 OSS21 OSS22 OSS23 OSS24 OSS25 OSS26 OSS27 OSS29 OSS30 OSS31 OSS32 OSS33 OSS34 OSS35 OSS36 OSS38 OSS39 OSS40 OSS41 OSS42 OSS43 OSS45 OSS46 OSS47 OSS48 OSS49 OSS50 OSS51 OSS52 OSS61 OSS64 OSS65 OSS66 OSS67 OSS68 OSS69 OSS70 OSS71 OSS72 OSS73 OSS74 OSS75 OSS76 OSS77 OSS78 OSS79 OSS80 OSS81 OSS82 OSS83 OSS84 OSS86 OSS87 OSS88 OSS89 OSS90 OSS91 OSS92 OSS93 OSS94 OSS95 OSS96 OSS97 OSS98 OSS99 OSS100 OSS101 OSS102 OSS103 OSS104 OSS105 OSS106 OSS107 OSS108 OSS109 OSS110 OSS111 OSS112 OSS113 OSS114 OSS115 OSS116 OSS117 OSS118 OSS120 OSS121 OSS122 OSS123 OSS124 OSS125 OSS126 OSS127 OSS128 OSS129 OSS130 OSS131 OSS132 OSS133 OSS134

N

Legend

- Ferndale Wells
- Public Wells
- Private Wells
- Leaking Underground Storage Tanks
- No Further Action Sites List
- Commercial Private Storm Facilities
- On-Site Septic

Potential Contaminant Source

- Agricultural
- Commercial
- Stormwater Retention
- Max Area of Interest
- Buffer Zone
- Ferndale City Limits

Time of Travel (years)

- 1
- 5
- 10

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0 410 820 1,230 1,640 2,050 Feet

1 inch = 1,041.666667 feet

Projection:
State Plane Washington North Feet
North American Datum 1983

Data Sources:
Whatcom County Planning/Assessor's,
City of Bellingham GIS, & Wilson Eng

WILSON ENGINEERING, LLC
805 DUPONT STREET
BELLINGHAM, WA 98225
(360)733-6100 FAX(360)647-9061
www.wilsonengineering.com

Wilson SURVEY/ENGINEERING

P. SANITARY SURVEY

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
NORTHWEST DRINKING WATER REGIONAL OPERATIONS
20425 72nd Avenue South, Suite 310, Kent Washington 98032-2388

May 20, 2015

MICHAEL OLINGER
FERNDALE
PO BOX 936
FERNDALE, WA 98248

City of Ferndale
Recieved on:
MAY 27 2015
By: _____
Public Works
Department

Subject: Ferndale Water System (ID #24850)
Whatcom County
Routine Sanitary Survey

Dear Mr. Olinger,

This letter is written in follow up to my routine sanitary survey of the Ferndale water system on May 5, 2015. Thank you for taking the time to meet with me and show me around the water system.

The purpose of a routine survey is to identify any immediate health concerns and to assess the operation, maintenance and management of the water system. Congratulations on the new treatment system; it looks great and appears to be working very well! In general, your water system is in fine sanitary condition and you should be commended for your efforts and diligence on the water system.

However, we have recently defined and are focusing on significant deficiencies. Please note, these findings may have been part of the original approved design and/or have been that way for many years without us requiring any changes.

The following findings have been determined to be significant deficiencies that must be addressed:

1. There were a few unprotected openings noted (both actual and potential) that need to either be documented as having the necessary protection or a fix applied. **Please provide us either a proposed schedule of when these deficiencies will be addressed or an update on the status <u>within 45 days</u> of the date of this letter/report.**
   - The Shop Well needs a finer screen on vent (should be 24-mesh)
   - All vehicles must be parked outside of the 100-ft SCA around the Shop Well – parked vehicles within the SCA is considered to be an unmitigated potential source of contamination
   - The Douglas Well – need to check the screen on tall vent to ensure it is 24-mesh
   - Both wells – check to see if valve is NO or NC on the well flush/surge control

- Reservoir 2 (Bakerview tank) – the overflow needs either a gasket seal or a 24-mesh screen (one or the other will work); the gasket seal on hatch needs to be replaced (or be scheduled to be replaced).
- **Reservoir 1 (Main tank) – the overflow needs to be modified to drain to daylight with an air gap.**

Enclosed is a copy of the sanitary survey report – you should review it for content and accuracy. I have noted below (and in the attached report) one area where some improvements could be made.

The Drinking Water Regulations require that all Group A public water systems have a sanitary survey every 5 years. In order to receive credit for the survey, a sanitary survey fee must be paid, as provided by WAC 246-290-990 (3)(iv). Enclosed is an invoice for $969.00. Please remit your complete payment in the form of a check or money order within thirty days of the date of this letter to: DOH, Revenue Section, P.O. Box 1099, Olympia, WA 98507-1099.

Please note that satisfying the conditions of this sanitary survey does not necessarily mean that your water system is fully compliant with other applicable requirements that may be found under other federal, state, or local statutes, ordinances, or regulations. These and other departmental requirements should be addressed separately from the sanitary survey process.

Please give me a call at 253/395-6762 if you have any questions or concerns. Let me know if there are any significant inaccuracies in the enclosed documents and I will make the necessary corrections.

Sincerely,

Jolyn Leslie
Regional Engineer
NW Drinking Water Operations

Enclosures

cc: Laurette Rasmussen – Whatcom County Health Department

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Office of Drinking Water
INVOICE
Engineering, Planning, and Sanitary Survey Review Form

TO: MICHAEL OLINGER
FERNDALE
PO BOX 936
FERNDALE WA 98248

ATTN: ACCOUNTS PAYABLE DEPT

Invoice Number	N01972
Invoice Date	May 20, 2015
Billing Period	30 days NW

DATE	DESCRIPTION	QTY	COST	AMOUNT
05/20/2015	SURVEY FEE FERNDALE WHATCOM COUNTY PWS ID 24850 DATE OF SURVEY: 5/5/2015 DOH STAFF	1	1	$969.00
	Total			**$969.00**
	Payment due within 30 days. Interest shall accrue at 1% per month after 30 days.			

Make Checks Payable to Department of Health
Return Lower Portion to:
Department of Health
PO Box 1099
Olympia, WA 98507-1099

Office of Drinking Water
Engineering, Planning, and Sanitary Survey Review Form

NAME	FERNDALE
INVOICE NUMBER	N01972
INVOICE DATE	May 20, 2015 NW
AMOUNT	**$969.00**

Return to:
Department of Health
Revenue Section
PO Box 1099
Olympia, WA 98507-1099

DOH Form #331-332

For persons with disabilities, this document is available on request in other formats. To submit a request, please call 1-800-525-0127 (TTY 1-800-833-6388).

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SANITARY SURVEY FEE WORKSHEET

Department of Health
Office of Drinking Water
Sanitary Survey Time Tracking

System Name Ferndale
County Whatcom
Surveyor Jolyn Leslie

PWS ID # 24850

Date of Survey:

System over 10,000 Connections? NO

	Quantity Hours/Miles				Cost
Department of Health Paid Costs					
Survey program RO Coordination	1	$	102	$	102.00
Survey Program Administrative Support	1	$	102	$	102.00
Travel expenses (Mileage)	150		(# Miles) x ($.337/Mile)	$	50.50
Technical Assistance	0.5	$	102	$	51.00
Travel Time <10,000	3		102	$	306.00
Total Department of Health Costs to Perform All Surveys				$	611.50
Water System Paid Costs	**Hours**				
Scheduling, research, prep	3	$	102	$	306.00
Survey Field Work	3.5	$	102	$	357.00
Survey documentation – preparation of survey report to the purveyor	3	$	102	$	306.00
Additional Water System Paid Costs for systems serving 10,000 or more connections	**Hours**				
		$	-	$	-
Total Cost of Survey				$	1,580.50
Total Department of Health Unreimbursed Costs				$	611.50
Water System Paid Costs (Less than 10,000 Connections)				$	969.00

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
NORTHWEST DRINKING WATER REGIONAL OPERATIONS
20425 72nd Avenue South, Suite 310, Kent Washington 98032-2388

SYSTEM INSPECTION / SANITARY SURVEY REPORT

Date: May 5, 2015

FERNDALE WATER SYSTEM Whatcom County (ID #24850)
Persons Attending:
Mike Olinger – Ferndale
Jolyn Leslie – DOH

Purpose: Routine Sanitary Survey

SYSTEM SUMMARY / FINDINGS
Last surveyed: November 3, 2010
Issues from last survey:

- The remaining technical work associated with the design, operation, and source approval of the City's new ground water supply and treatment facilities were outlined in a DOH letter dated November 16, 2010, which approved the feasibility study and design report for the new facilities. **Status: Resolved.**
- As also noted in the November 16th approval letter, it appears that some site work may be required at the existing shop well to mitigate the chance for contamination by vehicle traffic, buildings, and any materials that may be stored within and near the 100-foot well head protective zone around this well. Any site work or other improvements that may be necessary should be included in the final construction documents and the final mitigation measures should be identified in your well head protection plan. **Status: Ongoing – see notes below.**
- The tops of the storage tanks and the underside of the access covers should be inspected and cleaned on a regular basis. Verify that the vent and overflow pipes are fitted with tight mesh screens in good condition. Also verify that there is a tight fitting neoprene seal between the raised coaming and the underside of each access hatch. Spraying these areas with chlorine solution will help keep bugs away for these tank openings. **Status: Ongoing.**

Approval status:	Existing Connects	= 5099
	Eng Capacity	= Unspecified
System Type:	Group A – Community	

WATER QUALITY HISTORY:

Bacteriological	:	All satisfactory for past 2+ years
Nitrate	:	All ND
Exceed MCL?	:	None

GENERAL SYSTEM DESCRIPTION

This water system serves the City of Ferndale, portions of its urban growth area, and a large area to the east of its urban growth area from pipelines in Axton Road and Smith Road that extend to Northwest Drive. The distribution system is divided into five pressure zones that are supplied by two gravity reservoirs and three booster pump stations.

Source water now comes from two groundwater wells that are treated for removal of manganese and TDS reduction/softening.

SOURCES:

S02 – Shop Well: $Q_{observed}$ = not observed; Q_{design} = 900 gpm; WR = gpm

The well is located in a building in the middle of the city shop parking lot. **All vehicles should be parked outside of the 100-ft sanitary control area as this is a potential risk for fluids leaking and is considered to be a significant deficiency; it may also possibly a violation of the declaration of covenant.**

The well has a vertical turbine pump that pumps directly to the treatment plant. The well is under slight artesian pressure. There is a flow meter and sample tap at the well head. **There is a screened vent, but it needs a finer mesh screen (24-mesh). There is a flow control valve – the operator was not certain if this valve is normally open or normally closed.**

An emergency chlorination system is located at the well head, but not normally used.

S06 – Douglas Well: $Q_{observed}$ = gpm; Q_{design} = 1,300 gpm; WR = gpm

The well is located inside a building on a city-owned lot. The well has a vertical turbine pump that pumps directly to the treatment plant. The well is under slight artesian pressure and the vent extends to the top of the roof – **we were not able to view the vent up close to ensure that it has a screen.** There is a flow meter and sample tap at the well head. **There is a flow control valve – the operator was not certain if this valve is normally open or normally closed.**

An emergency chlorination system is located at the well head, but not normally used.

TREATMENT:

Total filtered/softened capacity is currently 2,050 gpm. Flow is split when it enters the plant with a portion being treated by the RO units and the remaining portion being treated by the greensand filters; total treated flow is re-combined in the clearwell. Caustic injection is no longer used.

Purpose: Water Softening – RO Treatment Plant

Facilities: Three (3) 3-stage RO units; 500 gpm each; target finished water hardness 80 mg/l

RO was added to the treatment process for TDS reduction/softening. Anti-scalant is injected prior to RO. Treatment process is working well.

Purpose: Manganese Removal – Manganese Greensand Filter

Facilities: The old surface water treatment facilities have been repurposed for manganese removal treatment. One of the sedimentation basins has been retained and is now used as a contact tank. The filter media has been replaced with manganese greensand.

STORAGE:

Reservoir 1, 1-MG Tank

Reservoir 1 has a dedicated inlet and separate outlet. The screened vent is built-in to the riser on the access hatch – the screen is currently in the process of being replaced (**there were openings in the screen at the time of the survey**). The overflow drains directly to a catch basin and does not daylight above ground. The operator thought that the tank was last cleaned in 2008.

Reservoir 2 (Bakerview Tank), 1.7-MG Tank

Reservoir 2 now has a dedicated inlet and separate outlet. The screened vent appears to be in good condition. The overflow terminates above ground but **the outlet has a rough screen and a flap valve, but it does not close tightly and needs to have a water-tight seal.**

DISTRIBUTION:

Five pressure zones (Main, Axton, Ferndale Terrace, Mid, Bakerview)

"Main Pressure Zone" Gravity from Reservoir 1

This zone is connected to the Ferndale Terrace Pressure Zone by a closed valve and also serves the Axton Pressure zone via PRV. Pump Station 1 pumps from Reservoir 1 up to Reservoir 2 and the Mid zone.

Reservoir 2 serves Mid Zone, Ferndale Terrace zone by PRV, and Bakerview Pressure zone via Bakerview BPS (new in 2010 – replaced the Thornton Road BPS).

The Church Road Pump Station moves water from the treatment plant and Reservoir 1 up to Reservoir 2.

MANAGEMENT & OPERATIONS:

Water System Plan	Approved 4/30/10 – need update by 4/30/2016
WFI Update	No changes needed
Water Quality Monitoring Schedule	OK
Coliform Monitoring Plan	Updated CMP submitted 5/10/12, 10 samples/month
DBP Monitoring Plan	4 samples/qtr – should be able to QFR at end of 2015 (2/yr)
Consumer Confidence Report	Mike prepares this
Operating Permit	Green
Overall Design Approval	Yes
Capital Improvements Planned?	Church Road BPS upgraded, main BPS to get generator
Certified Operator	WTPO2 required, Mike Olinger
O&M Manual	New tracking program to help schedule O&M
Flushing Program	About 5 years ago started flushing, no routine program set-up yet
Valve Exercise/PRV Maint.	Valve exercise during main flushing, GC systems rebuilds PRVs every 3 years
Routine practice for main repair	Shop crew does most repairs, city has vactor truck, positive pressure maintained – industry standards used

Water Use Efficiency Program	Mike in charge of this program
Individual Customer Meters	100%
Distribution System Leakage	3-year average 4.7%
Cross Connect Program	Mike is CCS, use TOKAY program
Wellhead Protection Program	Wellhead delineation is being done
Emergency Response Plan	Emergency response plan in WSP
e.Coli Response Plan	None yet, see recommendations below
Financial Viability Program	OK
Management Structure	City administrator, Chief operator – Mike, 3 other operators
Complaints	Mike handles complaints, we have no complaints on file since last survey

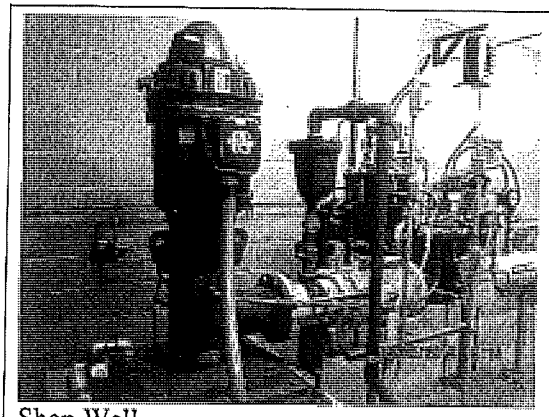
SIGNIFICANT DEFICIENCIES/FINDINGS

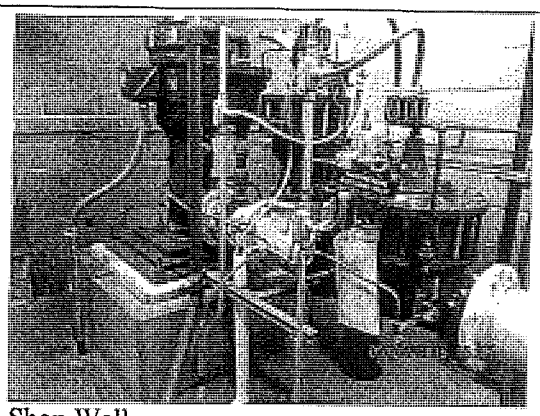
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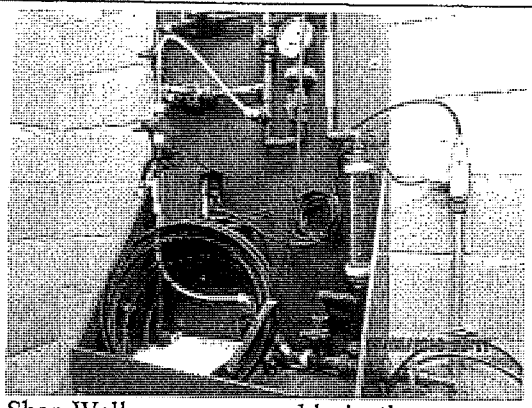
RECOMMENDATIONS AND OBSERVATIONS

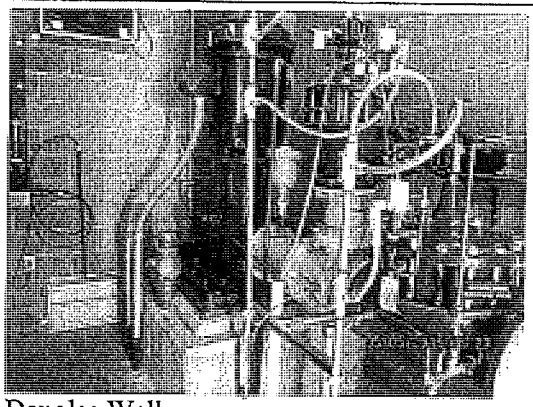
2. We also talked about developing an E.coli response plan. Enclosed is some information on developing your plan. This is also something that should be discussed with the mayor, city council, and city staff ahead of any potential emergency so that hopefully the response will go smoothly. While Ferndale is not quite the size of system that Mercer Island is, as you probably saw in the news last year, it can have quite an impact on the water system and customers.

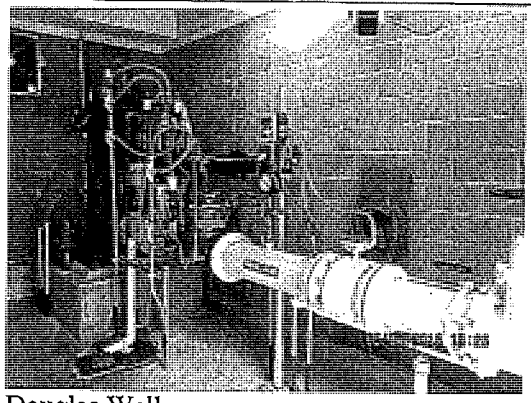
Ferndale Water System; ID #24850; May 5, 2015
Routine Sanitary Survey

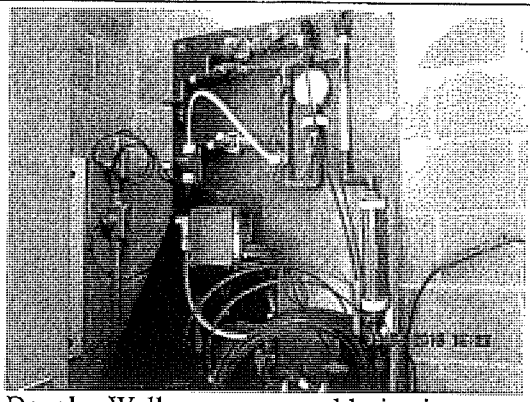

Shop Well


Shop Well

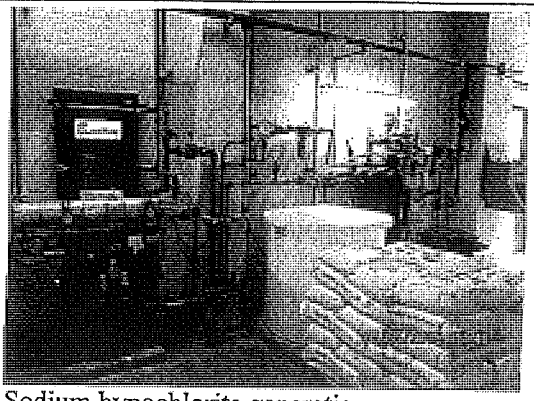

Shop Well – emergency chlorination


Douglas Well

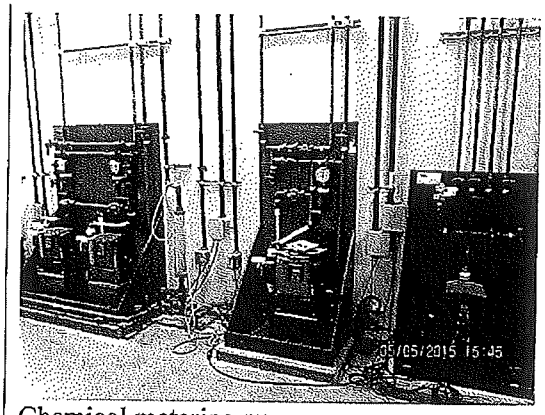

Douglas Well


Douglas Well – emergency chlorination

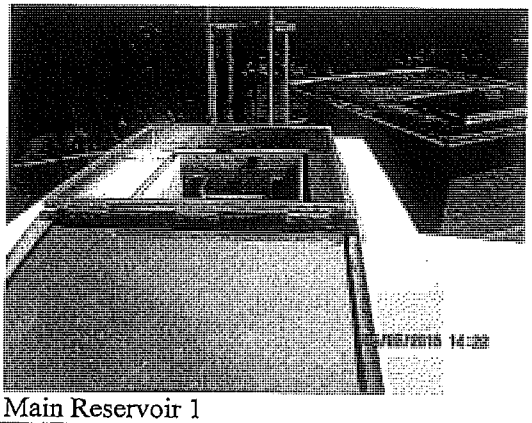

Manganese greensand filters in old filter beds

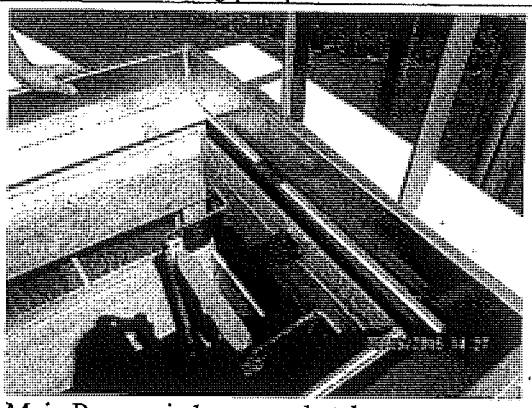

Sodium hypochlorite generation

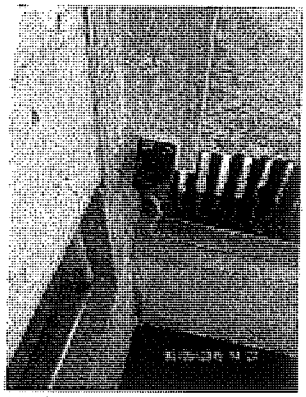
Ferndale Water System; ID #24850; May 5, 2015
Routine Sanitary Survey

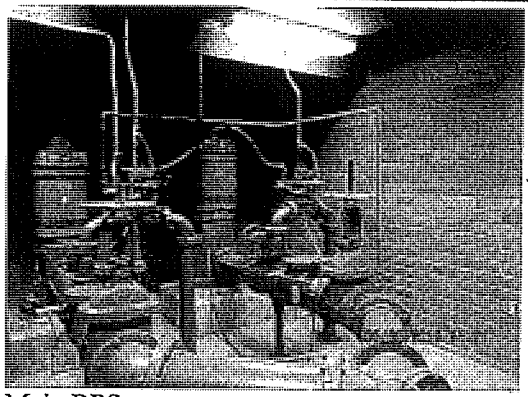


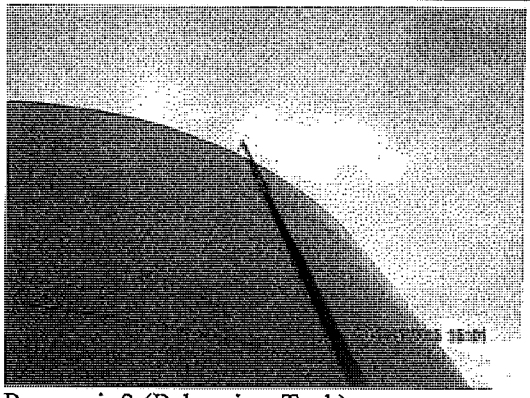
Chemical metering pumps

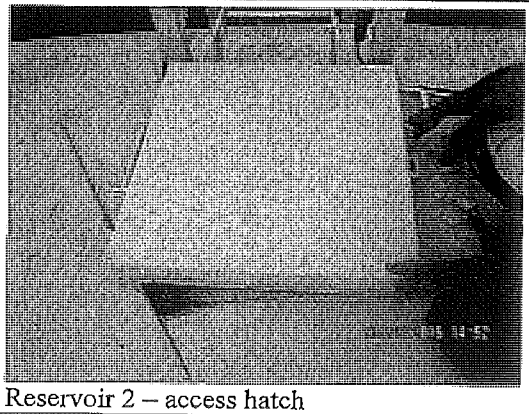

Main Reservoir 1

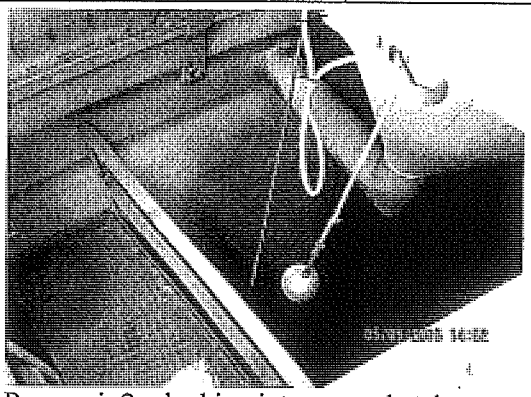

Main Reservoir 1 –access hatch


Main Reservoir 1 – screens to be replaced

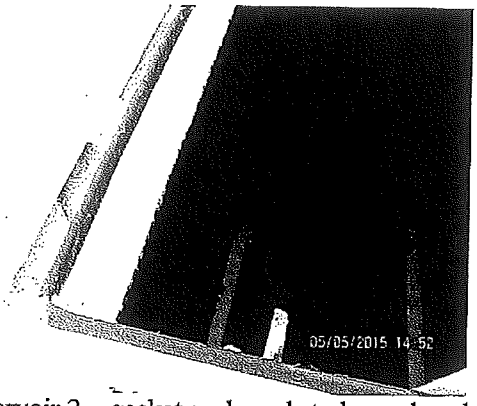

Main BPS


Reservoir 2 (Bakerview Tank)

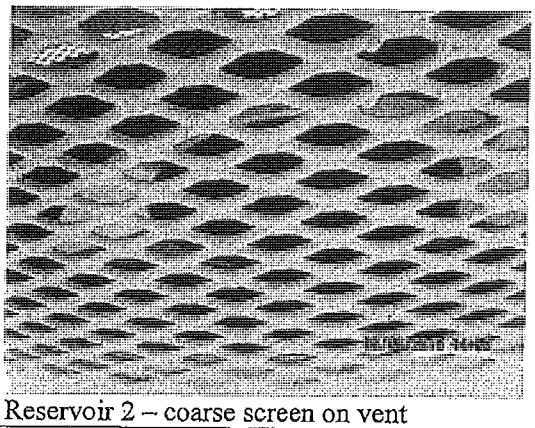

Reservoir 2 – access hatch

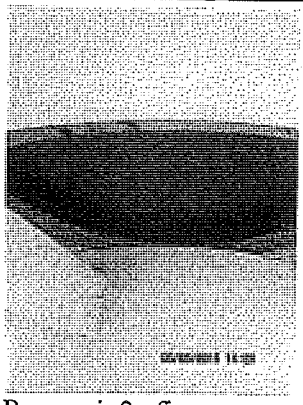

Reservoir 2 – looking into access hatch

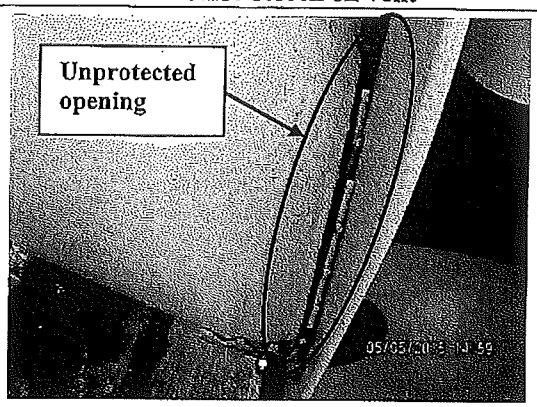
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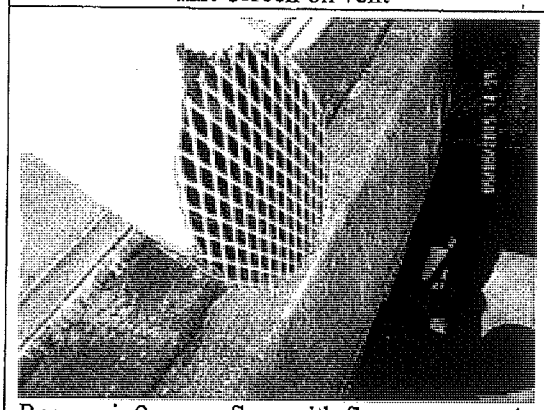
Reservoir 2 – gasket seal needs to be replaced

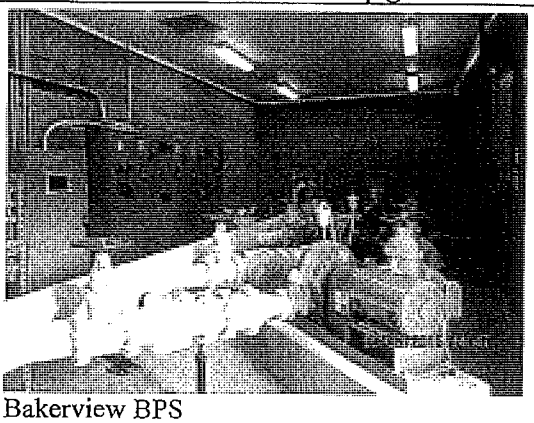

Reservoir 2 – coarse screen on vent


Reservoir 2 –fine screen on vent



Reservoir 2 – overflow with flap gate closed


Reservoir 2 – overflow with flap gate open (coarse screen)


Bakerview BPS

Q. WATER SYSTEM MAP

GRAPHIC SCALE

800 0 400 800

(IN FEET)

1 inch = 800 ft.

LEGEND

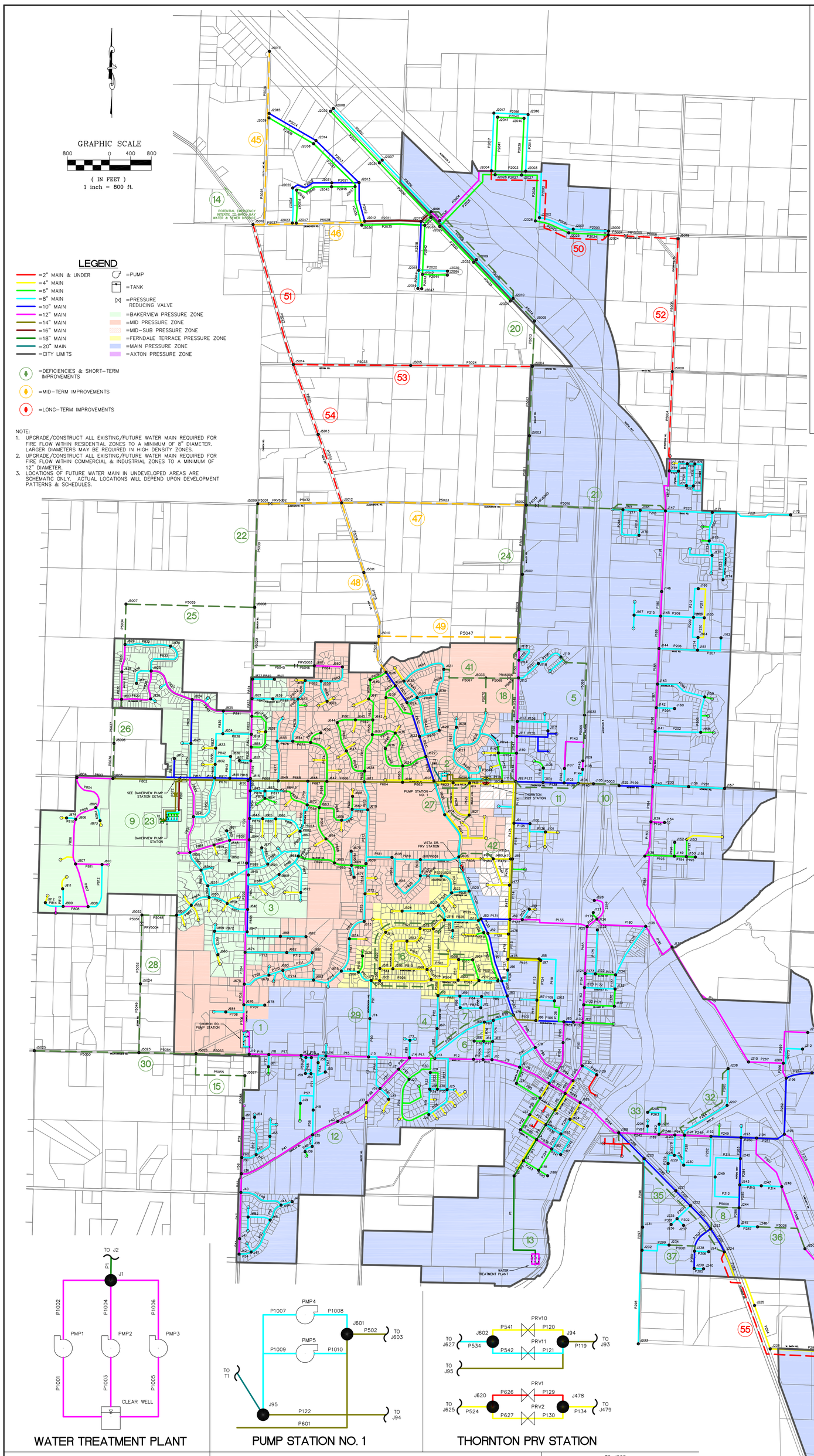
- =2" MAIN & UNDER
- =4" MAIN
- =6" MAIN
- =8" MAIN
- =10" MAIN
- =12" MAIN
- =14" MAIN
- =16" MAIN
- =18" MAIN
- =20" MAIN
- =CITY LIMITS
- =PUMP
- =TANK
- =PRESSURE REDUCING VALVE
- =BAKERVIEW PRESSURE ZONE
- =MID PRESSURE ZONE
- =MID-SUB PRESSURE ZONE
- =FERNDALE TERRACE PRESSURE ZONE
- =MAIN PRESSURE ZONE
- =AXTON PRESSURE ZONE

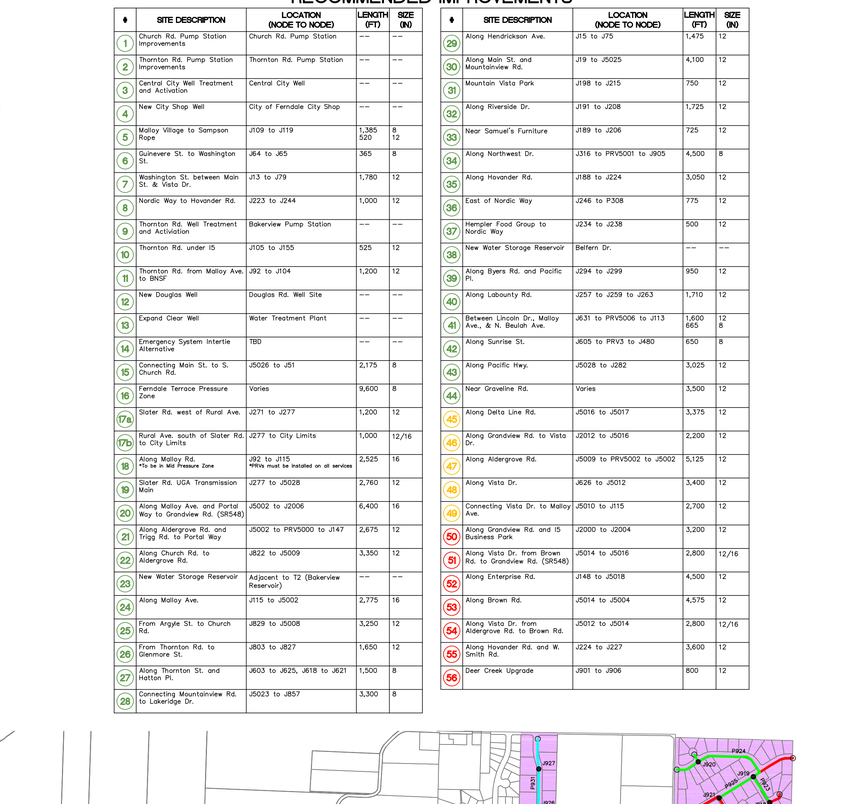
(#) =DEFICIENCIES & SHORT-TERM IMPROVEMENTS

(#) =MID-TERM IMPROVEMENTS

(#) =LONG-TERM IMPROVEMENTS

NOTE:
1. UPGRADE/CONSTRUCT ALL EXISTING/FUTURE WATER MAIN REQUIRED FOR FIRE FLOW WITHIN RESIDENTIAL ZONES TO A MINIMUM OF 8" DIAMETER. LARGER DIAMETERS MAY BE REQUIRED IN HIGH DENSITY ZONES.
2. UPGRADE/CONSTRUCT ALL EXISTING/FUTURE WATER MAIN REQUIRED FOR FIRE FLOW WITHIN COMMERCIAL & INDUSTRIAL ZONES TO A MINIMUM OF 12" DIAMETER.
3. LOCATIONS OF FUTURE WATER MAIN IN UNDEVELOPED AREAS ARE SCHEMATIC ONLY. ACTUAL LOCATIONS WILL DEPEND UPON DEVELOPMENT PATTERNS & SCHEDULES.





PRV#	LOCATION	SIZE	ELV.	SETTING HGL (FT)	SETTING PRESSURE (PSI)
1	THORNTON RD. (SOUTH)	1.5"	159.34	210	22
2	THORNTON RD. (SOUTH)	4"	159.34	199	17
3	SUNRISE ST.	3"	160.96	212	22
4	SNOWDEN DR.	6"	135.12	223	38
5	W. AXTON RD.	2"	42.28	181	60
6	W. AXTON RD.	8"	40.79	168	55
7	VISTA DR.	2"	164.65	262	42
8	VISTA DR.	6"	164.65	250	37
9	AUGUSTINE DR.	6"	159.60	259	43
10	THORNTON RD. (NORTH)	3"	155.86	228	31
11	THORNTON RD. (NORTH)	8"	155.86	216	26
12	PHEASANT WAY	6"	244.37	383	60
13	PINE DR.	6"	276.26	385	47
14	WESTVIEW DR.	8"	268.72	384	50
15	HEATHER DR.	6"	257.74	389	57
16	CHURCH RD. PUMP STA.	8"	147.70	240	40
17	BAKERVIEW PUMP STA.	8"	--	--	--

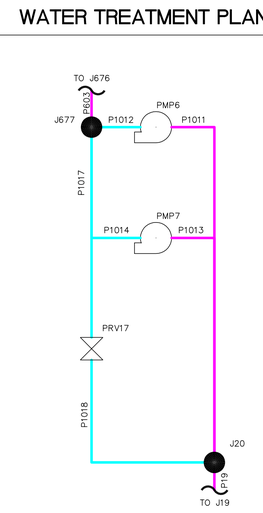
RECOMMENDED IMPROVEMENTS

#	SITE DESCRIPTION	LOCATION (NODE TO NODE)	LENGTH (FT)	SIZE (IN)
1	Church Rd. Pump Station Improvements	Church Rd. Pump Station	--	--
2	Thornton Rd. Pump Station Improvements	Thornton Rd. Pump Station	--	--
3	Central City Well Treatment and Activation	Central City Well	--	--
4	New City Shop Well	City of Ferndale City Shop	--	--
5	Malloy Village to Sampson Rope	J109 to J119	1,385 520	8 12
6	Guinevere St. to Washington St.	J64 to J65	365	8
7	Washington St. between Main St. & Vista Dr.	J13 to J79	1,780	12
8	Nordic Way to Hovander Rd.	J223 to J244	1,000	12
9	Thornton Rd. Well Treatment and Activation	Bakerview Pump Station	--	--
10	Thornton Rd. under I5	J105 to J155	525	12
11	Thornton Rd. from Malloy Ave. to BNSF	J92 to J104	1,200	12
12	New Douglas Well	Douglas Rd. Well Site	--	--
13	Expand Clear Well	Water Treatment Plant	--	--
14	Emergency System Intertie Alternative	TBD	--	--
15	Connecting Main St. to S. Church Rd.	J5026 to J51	2,175	8
16	Ferndale Terrace Pressure Zone	Varies	9,600	8
17a	Slater Rd. west of Rural Ave.	J271 to J277	1,200	12
17b	Rural Ave. south of Slater Rd. to City Limits	J277 to City Limits	1,000	12/16
18	Along Malloy Rd. *To be in Mid Pressure Zone	J92 to J115 **PRVs must be installed on all services	2,525	16
19	Slater Rd. UGA Transmission Main	J277 to J5028	2,760	12
20	Along Malloy Ave. and Portal Way to Grandview Rd. (SR548)	J5002 to J2006	6,400	16
21	Along Aldergrove Rd. and Trigg Rd. to Portal Way	J5002 to PRV5000 to J147	2,675	12
22	Along Church Rd. to Aldergrove Rd.	J822 to J5009	3,350	12
23	New Water Storage Reservoir	Adjacent to T2 (Bakerview Reservoir)	--	--
24	Along Malloy Ave.	J115 to J5002	2,775	16
25	From Argyle St. to Church Rd.	J829 to J5008	3,250	12
26	From Thornton Rd. to Glenmore St.	J803 to J827	1,650	12
27	Along Thornton St. and Hatton Pl.	J603 to J625, J618 to J621	1,500	8
28	Connecting Mountainview Rd. to Lakeridge Dr.	J5023 to J857	3,300	8
29	Along Hendrickson Ave.	J15 to J75	1,475	12
30	Along Main St. and Mountainview Rd.	J19 to J5025	4,100	12
31	Mountain Vista Park	J198 to J215	750	12
32	Along Riverside Dr.	J191 to J208	1,725	12
33	Near Samuel's Furniture	J189 to J206	725	12
34	Along Northwest Dr.	J316 to PRV5001 to J905	4,500	8
35	Along Hovander Rd.	J188 to J224	3,050	12
36	East of Nordic Way	J246 to P308	775	12
37	Nempler Food Group to Nordic Way	J234 to J238	500	12
38	New Water Storage Reservoir	Belfern Dr.	--	--
39	Along Byers Rd. and Pacific Pl.	J294 to J299	950	12
40	Along Labounty Rd.	J257 to J259 to J263	1,710	12
41	Between Lincoln Dr., Malloy Ave., & N. Beulah Ave.	J631 to PRV5006 to J113	1,600 665	12 8
42	Along Sunrise St.	J605 to PRV3 to J480	650	8
43	Along Pacific Hwy.	J5028 to J282	3,025	12
44	Near Graveline Rd.	Varies	3,500	12
45	Along Delta Line Rd.	J5016 to J5017	3,375	12
46	Along Grandview Rd. to Vista Dr.	J2012 to J5016	2,200	12
47	Along Aldergrove Rd.	J5009 to PRV5002 to J5002	5,125	12
48	Along Vista Dr.	J626 to J5012	3,400	12
49	Connecting Vista Dr. to Malloy Ave.	J5010 to J115	2,700	12
50	Along Grandview Rd. and I5 Business Park	J2000 to J2004	3,200	12
51	Along Vista Dr. from Brown Rd. to Grandview Rd. (SR548)	J5014 to J5016	2,800	12/16
52	Along Enterprise Rd.	J148 to J5018	4,500	12
53	Along Brown Rd.	J5014 to J5004	4,575	12
54	Along Vista Dr. from Aldergrove Rd. to Brown Rd.	J5012 to J5014	2,800	12/16
55	Along Hovander Rd. and W. Smith Rd.	J224 to J227	3,600	12
56	Deer Creek Upgrade	J901 to J906	800	12

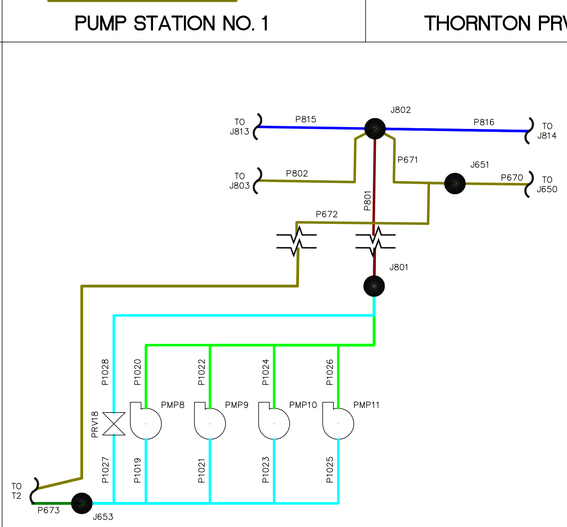
WATER TREATMENT PLANT

PUMP STATION NO. 1

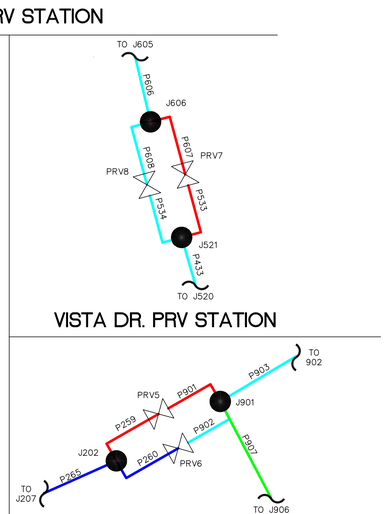
THORNTON PRV STATION



CHURCH RD. PUMP STATION



BAKERVIEW PUMP STATION



VISTA DR. PRV STATION

AXTON RD. PRV STATION

DESIGNED BY CFR/IDH DRAWN BY IDH CHECKED BY CFR	R&E Reichhardt & Ebe ENGINEERING INC 423 Front St, Lynden, WA 98264 (360) 354-3687 813 Metcalf St, Sedro-Woolley, WA 98284 (360) 855-1713	NO.	DATE	REVISION / BY
	CITY OF FERNDALE 2095 MAIN STREET FERNDALE, WA 98248	WATER SYSTEM MAP	JOB# / DWG 15027.1 WS2	DATE 12/29/16
			SCALE H:1"=800' V:N/A	SHEET 1

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