CABINET MOUNTAINS WATER DISTRICT

WATER SYSTEM FACILITY PLAN UPDATE

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TABLE OF CONTENTS

FACILITY PLAN BACKGROUND 1-1

1. PROJECT PLANNING 1-1

1.1. Location 1-1

1.2. Environmental Resources Present 1-1

A. Land Use/Important Farmland/Formally Classified Lands 1-1

B. Floodplains 1-2

C. Wetlands 1-2

D. Historic Properties 1-2

E. Biological Resources 1-2

F. Water Quality Issues 1-2

G. Coastal Resources 1-3

H. Socio-Economic/Environmental Justice Issues 1-3

I. Climate, Topography, Geology, and Soils 1-3

J. Wild and Scenic Rivers 1-3

K. Air Quality 1-4

1.3. Population/Connection Trends 1-4

1.4. Water Quality Requirements 1-4

1.5. Additional Design Considerations 1-5

A. Water Supply and Demands 1-5

B. Water Storage 1-5

C. IDAPA Rules for Public Drinking Water Systems 1-5

D. Planning and Zoning 1-6

1.6. Community Engagement 1-6

2. EXISTING FACILITIES EVALUATION AND RECOMMENDATIONS 2-1

2.1. General 2-1

A. History 2-3

B. Water, Energy and Waste Audits 2-3

C. Water Rights 2-3

D. Financial Status of Existing Facilities 2-3

2.2. Water Demands 2-3

A. Water Losses 2-4

2.3. Existing Storage Facilities and Storage Analysis 2-5

Parker Canyon Tank 2-5

Black Mountain Tank 2-6

Naples Tank 2-7

Storage Analysis 2-8

2.4. Supply and Distribution Facilities 2-10

Parker Canyon Booster Station Evaluation 2-10

Black Mountain Booster Pump Station Evaluation 2-11

Highland Flats Booster Pump Station Evaluation 2-1

Naples Booster Pump Station Evaluation 2-12

Paradise Valley (Four Corners) Booster Pump Station 2-13

Pleasant Valley Pressure Reducing Valve (PRV) Station 2-14

Crossport Well Facility 2-15

2.5. System SCADA/Controls 2-16

2.6. System Redundancy 2-16

2.7. Pipe Materials 2-16

2.8. Distribution System Hydraulic Evaluation 2-16

A. Distribution System Results and Recommendations 2-17

B. Maximum Day Demand plus Fire Demands 2-17

C. Peak Hour Demand 2-20

3. NEED FOR PROJECT 3-1

3.1. Public Health, Sanitation, and Security 3-1

3.2. Aging Infrastructure 3-1
3.3. Reasonable Growth 3-2
3.4. Compliance with State and Federal Regulations 3-2

4. ALTERNATIVES ANALYSIS 4-1

4.1. Description 4-1
A. Supply Alternatives 4-1
B. Storage Alternativities 4-3
C. Distribution System Alternatives 4-7
4.2. Design Criteria 4-10
4.3. Site Plan/Schematics 4-10
4.4. Environmental Impacts: Supply Alternatives 4-10
A. Alternative 1 – No Action 4-10
B. Alternative 2 – New Crossport Well 4-10
C. Alternative 3 – Cow Creek Well 4-10
D. Alternative 4 – Develop a New Well at Site to be Determined 4-11
4.5. Environmental Impacts: Storage Alternatives 4-12
A. No Action 4-12
B. New Parker Canyon Tank 4-12
C. New Paradise Tank 4-12
D. New Highland Flats Tank 4-12
E. Kootenai Trail Tank (Cow Creek) 4-12
4.6. Distribution System Recommendations 4-15
A. Alternative 1 – No Action 4-15
B. Alternative 2 – Replace Transmission Lines 4-15
C. Alternative 3 – Install New Transmission Lines 4-15
D. Alternative 4 – Upgrade Existing Booster Stations 4-15
E. Alternative 5 – Construct New Booster Stations 4-15
4.7. Land Requirements 4-18
A. Supply Alternatives 4-18

B. Storage Alternatives 4-18

C. Distribution Alternatives 4-18

4.8. Potential Construction Challenges 4-18

A. Supply Alternatives 4-18

B. Storage Alternatives 4-18

C. Distribution Alternatives 4-19

4.9. Sustainability Considerations 4-19

4.10. Cost Analysis 4-19

5. PROPOSED PROJECT (RECOMMENDED ALTERNATIVE) 5-1

5.1. Preliminary Project Design 5-3

Priority 1 Improvements 5-3

Project W1.1 – Additional Crossport Well 5-3

Project T1.1.2 – Parker Canyon Tank (260,000 gal) and Remove and Replace Booster Station 5-3

Project T1.2 – Highland Flats Tank (200,000 gal) 5-3

Project T1.3.2 – North Paradise Elevated Tank (300,000 gal) 5-3

Project 1.1 – Highland Booster Replacement 5-4

Project 1.2 –-Black Mountain Booster Improvements 5-4

Project 1.3 –Mountain Meadows Road Booster 5-4

Project 1.4 – Naples Pressure Reducing/Pressure Sustaining Valve 5-4

Project 1.5 – Kootenai Trail Booster 5-4

Project CI – Crossport Well Facility Improvements and Black Mountain Tank/Booster Improvements 5-4

Priority 2 and 3 Improvements 5-5

Project 2.1 through 2.4 – Priority 2 Water Distribution Projects 5-5

Project CI – Priority 2 – Existing Facilities Improvements 5-5

Project 3.1 through 3.11 – Various Transmission Improvements 5-5

5.2. Project Schedule 5-5

5.3. Permit Requirements 5-5

5.4. Sustainability Considerations 5-5

5.5. Organizational and Staffing Requirements 5-6

5.6. Total Project Cost Estimate 5-6

5.7. Annual Operating Budget 5-7

5.8. Financing Options 5-7

A. Idaho Department of Environmental Quality (Water State Revolving Fund [SRF]) 5-7

B. Department of Commerce (DOC) and Community Development Block Grants (CDBG) 5-7

C. United States Department of Agriculture-Rural Development (USDA-RD) 5-8

D. Idaho Bond Bank 5-8

E. Local and Private 5-8

5.9. Short Lived Assets 5-8

5.10. User Rate Impacts 5-9

6. CONCLUSION AND RECOMMENDATION 6-1

APPENDICES

Appendix A – Figures

Appendix B – Environmental

Appendix C – Water Data

Appendix D – Well Logs and Water Rights

Appendix E – Fire Flow

Appendix F – DEQ Sanitary Survey

Appendix G – Alternative Analysis

Appendix H – Capital Improvements Plan

Appendix I – 2018 Facility Plan

Appendix J – Tank Inspection Reports

Appendix K – Rates

Appendix L – Cow Creek Well Technical Memorandum

Appendix M – Storage Calculations

Appendix N – Short Lived Assets

LIST OF TABLES

Table 1.1: Projected Population and Connections 1.5% Growth........ 1-4
Table 2.1: Existing and Future Demands........ 2-4
Table 2.2: Unaccounted for Water........ 2-4
Table 2.3: Existing and Future Storage Needs........ 2-8
Table 2.4: Existing Storage by Pressure Zone Needs........ 2-9
Table 4.1: Supply Alternatives – Advantages and Disadvantages........ 4-3
Table 4.2: Storage Needs by Zone – Three Tanks Alternative........ 4-5
Table 4.3: Distribution System Alternatives – Advantages and Disadvantages........ 4-9
Table 4.4: Environmental Impacts Summary – Supply Alternatives........ 4-11
Table 4.5: Environmental Impact Summary – Storage Alternatives........ 4-13
Table 4.6: Environmental Impact Summary – Distribution System Recommendations........ 4-16
Table 4.7: Life-Cycle Cost Estimate – Supply Alternatives........ 4-20
Table 4.8: Life-Cycle Cost Estimate – Storage Alternatives........ 4-21
Table 5.1: Capital Improvement Plan........ 5-2

LIST OF FIGURES

Figure 2.1: Existing System........ 2-2
Figure 2.2: Available Fire Flows under Max Day Demands (Existing System)........ 2-19
Figure 2.3: Existing System Pressures Under Peak Hour Demands........ 2-21
Figure 2.4: Existing System Pressures Under Peak Hour Demands with Paradise Valley Booster in Operation........ 2-23
Figure 2.5: Existing System Fire Protection Coverage........ 2-25

FACILITY PLAN BACKGROUND

The Cabinet Mountains Water District (CMWD) previously completed a Water Facility Plan with Mike Klaus, PE in December 2018 that was submitted to IDEQ and USDA-RD for review. At the end of 2018 CMWD was also in the process of hiring a new engineer to help with the improvement projects that were determined in the previous study. Following comments from IDEQ and USDA-RD, additional items were identified that were needed to be included in the plan to meet Idaho Interagency Facility Plan Memorandum outline (November 2016) which is required to receive funding from these agencies.

Keller Associates, Inc. was retained to build on the previous facility plan, address DEQ review comments, and prepare a planning document consistent with the interagency outline. A copy of the 2018 CMWD facility plan can be found in Appendix I.

1. PROJECT PLANNING

CMWD is committed to maintaining a safe and reliable water system by providing adequate supply throughout its service area. This report evaluates the existing water distribution, storage and supply system and makes recommendations to address existing deficiencies and future needs.

1.1. LOCATION

CMWD is located in Boundary County, from Bonners Ferry south to the McArthur Lake wildlife management area. Figure 1.1 in Appendix A (where all full-size figures can be found) shows the general location of the District's service area. It is not anticipated that the District will expand significantly due to the bounds of the Kootenai River to the north, a wildlife management area to the south and steep mountain topography to the east and west. Population growth for the District is anticipated to be within the existing service area.

1.2. ENVIRONMENTAL RESOURCES PRESENT

The project area includes several unique natural resources, which are discussed in depth below. Important farmland, historical properties, and endangered/threatened plants and wildlife surround the planning area. These resources will need to be preserved during construction of improvements. A review of available resources did not reveal any floodplains, wetlands, coastal resources, water quality issues, wild/scenic rivers, or air quality problems. All recommended projects will be designed to minimize or mitigate any long-term impacts on the environmental resources present.

A. Land Use/Important Farmland/Formally Classified Lands

See Appendix B for a map showing important farmland throughout the state.

A review of resources from the Bureau of Land Management, the United States Fish and Wildlife Service, the National Park Service, and the United States Forest Service did not reveal any formally classified lands in the project vicinity.

B. Floodplains

A map showing the floodplain and floodway is included in Appendix B. The northern portion of CMWD along the Kootenai River is located in Flood Hazard Zone A and Zone AE. No existing infrastructure exists within the defined flood hazard zones or floodplains. No proposed new facilities are located within the defined flood hazard zones or floodplains.

C. Wetlands

The Idaho Department of Water Resources provides GIS data outlining Wetlands in Idaho. While the data shows wetlands within the planning area, proposed solutions will not be constructed in wetlands. A map showing the wetlands around CMWD is included in Appendix B.

D. Historic Properties

The National Register of Historic Places lists several buildings in Boundary County, which are included in Appendix B.

E. Biological Resources

The United States Department of Agriculture produces a database that lists endangered and threatened plants throughout the country. A database search for Idaho returns eight plants listed as endangered or threatened. The majority of priority improvements in the plan are proposed on previously-disturbed lands, in urbanized areas, or in roadways, impacts to threatened or endangered plant life are not anticipated.

The United States Fish and Wildlife Service (USFWS) produces a list of endangered species for each county in every state. Currently, Boundary County has seven species listed by the USFWS. Bull Trout, White Sturgeon, Canada Lynx, Grizzly bear and North American Wolverine are listed as endangered, threatened, or proposed threatened. Appendix B includes a report from the USFWS (as of June 10, 2019) showing endangered species in the District Service Area. Since the majority of the priority improvements in the plan are proposed on previously disturbed lands, in urbanized areas, or in roadways, impacts to threatened or endangered wildlife and/or fish are not anticipated.

F. Water Quality Issues

CMWD is a public drinking water system that provides potable water to the residents and businesses in the service area. The District's water is of sufficient quality that treatment is not necessary. The proposed improvements should not pose a threat to the existing groundwater quality. Best management practices should be employed during construction activities, which should also protect surface water quality in the surrounding area.

G. Coastal Resources

The Coastal Zone Management Act does not list any area in Idaho as a Coastal Resource; therefore, no area will be affected by the proposed improvements.

H. Socio-Economic/Environmental Justice Issues

There will be no socio-economic or environmental justice issues raised by this proposal. Nothing proposed will have an adverse effect on either of these categories. The proposed project improvement will have mutual benefit to all water customers and improve the overall economic vitality of the area.

I. Climate, Topography, Geology, and Soils

The climate summary (May 1907 through December 2005) for Bonners Ferry (Northern boundary of the district service area) shows minimum average monthly temperatures ranging from 18.9°F to 50°F, and maximum average monthly temperatures ranging from 32.2°F to 83.6°F. Over this same period, the total annual precipitation averaged about 22.20 inches with about 52 inches of snowfall. The coldest month was January and the hottest month was July.

Based on Western Regional Climate Center wind data (1996 to 2006) for Coeur d' Alene, Idaho, the prevailing wind direction is south from March through October, and north-northeast from November through February. The average wind speed for the area is 7.3 miles per hour.

The District planning area has moderate elevation change with elevations ranging from approximately 1,750 to 2,350 feet. The highest elevations in the planning area are the eastern and western bench area. Elevations generally drop as they move to the middle of the planning area.

The general soil types in the planning area are silt loams and sandy loams, with some rock. Further study would be required for a specific site to be properly evaluated (NRCS Boundary County Soil Survey).

The USGS reports that the District service area has a 5.1% chance of exceeding a peak horizontal acceleration of feet squared per second (% of gravity) over the next 50 years. See the USGS Earthquakes map in Appendix B for a detailed map.

J. Wild and Scenic Rivers

There are no wild and scenic rivers listed for the District area.

K. Air Quality

The District is not in an air non-attainment area, and no impacts are anticipated to air quality. See the Idaho Air Attainment Map in Appendix B.

1.3. POPULATION/CONNECTION TRENDS

The District currently serves approximately 745 active connections with a total of 921 total active and inactive connections. The District has indicated that the inactive connections are predominantly meters and service lines connected to empty lots, to be developed. The District is already committed to supplying water to these connections. Therefore, the District has decided to use the total connections (921) as existing conditions, as opposed to the current active connections. The District also has 30 "will serve" commitments with no expiration dates. The majority of these connections are residential with there being minimal commercial demands on the system besides Alta Mill. The District elected to continue to use 1.5% as their assumed future growth rate, consistent with what was selected in the 2018 Facility Plan. Table 1.1 shows the population projections.

Table 1.1: Projected Population and Connections 1.5% Growth

DESIGN POINT	TOTAL CONNECTIONS	POPULATION
2019	921	2,275
2039 (20-year growth)	1,252	3,092
2059 (40-year growth)	1,697	4,192

1.4. WATER QUALITY REQUIREMENTS

The Safe Drinking Water Act (created by the U.S. Government) establishes standards for drinking water quality in an effort to ensure public health. These standards limit concentrations of primary contaminants that pose a risk to life and health – such as total coliform, nitrates, and arsenic – and are monitored by the U.S. Environmental Protection Agency (EPA) and Idaho Department of Environmental Quality (DEQ). In planning for municipal water systems, sufficient elimination of these regulated contaminants is the chief concern – with regular testing and reporting required.

Other contaminants are sometimes found in water systems as well, referred to as nuisance, or secondary, contaminants. These include constituents such as hydrogen sulfide, ammonia, iron, and manganese. Where applicable, contaminants have been compared to the National Secondary Drinking Water Regulations as set by the EPA. These non-enforceable guidelines regulate aesthetic water quality parameters; no suggested guidelines exist (with the EPA) for hydrogen sulfide and ammonia.

The annual monitoring requirements for the District included in Appendix C. These generally include monitoring of coliform, arsenic, nitrite and nitrate, sodium, and miscellaneous other constituents.

1.5. ADDITIONAL DESIGN CONSIDERATIONS

The types of land use in a community, along with typical water usage patterns, determine requirements and demands placed on a water system. To effectively evaluate the District's immediate and future improvement needs, it is important to carefully evaluate both of these factors. This section discusses future considerations for land and water usage and their correlation with the District's water system requirements. In addition to the following, the Idaho Administrative Code (IDAPA) Rules for Public Drinking Water Systems outline further design criteria which must be met.

A. Water Supply and Demands

The District's existing water supply is summarized in Section 2.4.A of this report, and an evaluation of existing and future demands is presented in Section 2. The data indicates that improvements are needed in order to meet the firm capacity requirements set forth by DEQ.

B. Water Storage

CMWD was created to provide reliable and clean water for its customers. The system was not specifically designed to provide fire protection. In the development of CMWD, fire protection was deemed a non-critical objective. The District recognizes the value of including fire protection and desires to provide up to 1000 gpm for 2 hours of fire storage (consistent with International Fire Code requirements for residential dwellings under 3,600 s.f.), but wishes to prioritize projects that provide positive impacts on providing an ample supply of clean water to connections.

Alternative storage requirement for 8 hours of average day, 24 hours of average day and 48 hours of average day were evaluated with the CMWD. Given factors such as the remote nature of the system, the time it would take to make repairs, and the fact that the water sources are concentrated at one location, CMWD ultimately selected to plan for 48 hours of emergency storage. Given the amount of storage and emergency nature of fire storage, the CWMD elected to "nest" fire storage in the emergency storage, meaning that the fire storage would be a component of the emergency storage. Section 2.4.A summarizes the storage needs for the District.

C. IDAPA Rules for Public Drinking Water Systems

Per IDAPA standards the District's water system must be able to meet the following requirements:

- Minimum of 20 psi throughout the system during maximum day demands with fire flow.
- Minimum of 40 psi throughout the system during peak hour demands.
- System must be able to meet maximum day demands with the largest water source offline.

- System storage must provide adequate effective storage to cover operational, equalization, fire suppression and standby storage.
- Minimum pipe size for mains with fire hydrants is 6 inches in diameter. However, Keller Associates recommends that any new lines that provide fire hydrants should be at least 8 inches in diameter.

D. Planning and Zoning

The majority of the area within the District's service area is currently zoned as rural land use except for the northern end of the district, near Bonners Ferry. It is not anticipated that the rural areas will become residential. Additionally, the District anticipates that the ratio of commercial/industrial users to residential users will be maintained. This should be monitored as the District reviews and processes annexation requests.

1.6. COMMUNITY ENGAGEMENT

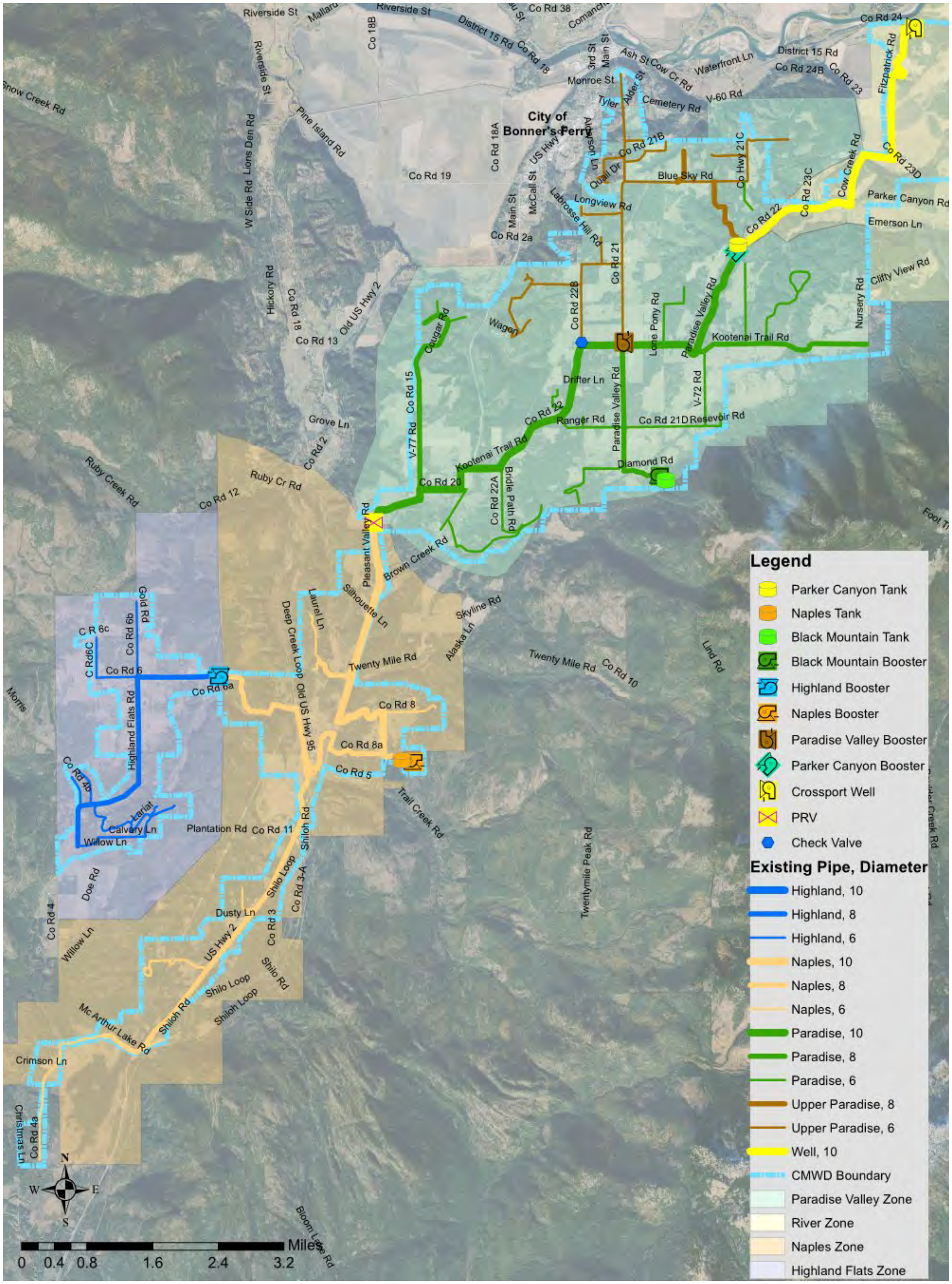
CMWD has been active in communicating and working with their constituents. CMWD has been informing users through their monthly bills of the ongoing study and future projects, posting meeting agendas and having open meetings for the facility plan. All project progress reports were provided the District Board representatives and operations staff. Additionally, public outreach open houses will be held prior to the fall 2019 bond to educate and inform the users of the need and impacts for the upcoming projects.

2. EXISTING FACILITIES EVALUATION AND RECOMMENDATIONS

2.1. GENERAL

CMWD is located in Boundary County, from Bonners Ferry south to the McArthur Lake wildlife management area. Figure 1.1 in Appendix A shows the general location of the District's service area. It is not anticipated that the District will expand significantly due to the bounds of the Kootenai River to the north, a wildlife management area to the south and steep mountain topography to the east and west. Population growth for the District is anticipated to be within the existing service area. See Figure 2.1 – Existing System on the following page.

Figure 2.1 – Existing System



A. History

The History of CMWD can be found in the 2018 Water System Facility Plan in Appendix I.

B. Water, Energy and Waste Audits

At present, no water or waste audits have been performed by the District. However, NLI has performed energy audits for the new high efficiency motors that were installed on the Crossport well and Parker Canyon pumps.

C. Water Rights

The District's current water rights are summarized in 2018 Water System Facility Plan.

D. Financial Status of Existing Facilities

The District reports that existing annual revenues are adequate to meet existing operating expenses with little extra reserve. A portion of the District's revenues is dedicated to paying off a $2 million dollar loan (approximately $16.70 per user per month is dedicated for debt service payment).

2.2. WATER DEMANDS

CMWD's well production data was analyzed from 2016-2018. The maximum day flow was based on the highest recorded well production day in the analysis period.

Within the service area, not all connections actively used water each month. As shown in Table 2.1 on the following page, there are 921 total accounts on the billing system in 2019. However, some of these accounts do not currently use any water (open, but not active). CMWD reported that all of these connections were expected to become fully active within the next several years. Therefore, the District elected to base future water usage on all open accounts (921), plus predicted growth.

There are several non-residential users, but the water usage for these commercial connections was not significantly higher than most of the residential connections. Alta Forest Products, LLC was the highest consumer, but did not use significantly more water than residential irrigation accounts. Therefore, all of the connections were deemed to be a single EDU.

As discussed in Chapter 1, over 300 new connections are anticipated to be added to the system within the 20-year planning period. These are anticipated to be located predominantly in the North Paradise Zone, and the Highland Flats Zone.

Table 2.1: Existing and Future Demands

	2019	2039 DESIGN	CURRENT WATER RIGHTS
Average Day (gal/day)	192,800	261,668	1,290,000
Max Day (gal/day)	900,700	1,224,500	
Projected EDU's	921	1,252	N/A
Average Water Usage (gal/day/ EDU)	209		
Max Day Water Usage per EDU	978		
Max Day (gpm)	625	850	897
Peak Hour (gpm)	1,212	1,649	

A. Water Losses

Relative to the size of the distribution system, unaccounted water is minimal. The District reported that actual unaccounted for water is less than what is represented in Table 2.2 below, based on free water provided to the Fire Department and County. CMWD mentioned in 2018, the County is estimated to have used nearly 400,000 gallons.

Table 2.2: Unaccounted for Water

YEAR	WATER CONSUMPTION, GAL	WATER PRODUCTION, GAL	UNACCOUNTED FOR WATER, %
2016	63,492,879	77,371,693	18%
2017	73,663,325	85,045,259	13%
2018	73,978,444	79,285,152	7%
Average	**70,378,216**	**80,567,368**	**13%**

2.3. EXISTING STORAGE FACILITIES AND STORAGE ANALYSIS

CMWD maintains and operates three storage reservoirs. The Naples and Black Mountain tanks are partially buried concrete tanks with identical dimensions. The Parker Canyon tank is a completely buried tank with a booster station built on top of the tank.

Parker Canyon Tank

This tank is a buried concrete tank with a designed storage capacity of 40,000 gallons, with a width of 21 feet, length of 31 feet and a depth of 9 feet. The actual usable storage of the tank is approximately 24,000 gallons because the pumps start cavitating when the water elevation in the tank drops below 4 feet. Cavitation occurs because the sump that the pumps sit in is inadequate. This tank is a critical piece of infrastructure to the CMWD system, because almost all water produced is routed through this tank. This tank site has good access and is secured by a fence.

The tank was built in 1996. An interior inspection of the tank was completed in August of 2019. The inspection indicated the tank was in good condition with only minor defects. See Appendix J. Based on the majority of the system water circulating into the tank there are no issues with turnover or water age. The overflow discharges to a drainage ditch. Currently the tank could not be easily taken offline for maintenance or work without significant modifications to piping and construction of another permanent/temporary tank and booster facility. Based on the inspection and observations made by Keller Associates, the following deficiencies were identified:

- The tank is undersized and does not have enough usable volume.
- Tank pumps cavitate when tank levels are below 4 feet; the pump sumps are inadequate for the existing pumps.
- There are not options to easily take the tank offline to clean or complete maintenance work.
- There is not sufficient land on site for additional storage.
- Pump intake needs to be lower than existing tank floor elevation to fully realize existing volume.

Recommendations are summarized below.

- Purchase adjacent land for an additional storage tank and build another tank for additional storage.
- As part of new on-site storage, look at ways to fully utilize existing storage.
- Install contamination protection around the tank hatch.

Black Mountain Tank

The Black Mountain Tank is a partially buried concrete tank that services the Paradise Pressure Zone. The tank was constructed in 1998. The tank has a total available storage of 179,000 gallons with the dimensions of 41 feet wide by 62 feet long by 10 feet deep. The tank is located on a remote site at the end of Diamond Road and is secured by a fence with a lock. In discussions with the operator, an intrusion alarm on the tank is warranted due to the remote location and potential for an intruder to cause damage or harm the water system.

The concrete is in fair condition with one visible location of tank leaking on the exterior and isolated cracking throughout the strucutre. There are no internal or external coatings on the tank. Water entering the tank is currently controlled by a SCADA system, housed in the nearby booster station. Levels are monitored using an ultrasonic level detection. Currently the ultrasonic is located in the ceiling of the tank and prevents the tank from completely filling. The operator indicated that the District intends to replace the ultrasonic level detraction with a pressure transducer.

When the tank is filling, water comes from the distribution system and has to “break head” to enter the tank. Currently, the District controls the back pressure in the system during tank fill cycles through a partially closed valve electrically operated valve. It is recomended that a pressure sustaining valve replace the electric valve to mitigate large pressure drops in the pressure zone when the tank is being filled.

It should also be noted that in the event of a fire, the existing automated controls could inhibit available fire flows if the tank were to call to “fill” during the event. There are no automated controls to override normal operations during a fire event.

In 2019, a dive inspection was conducted on the tank See Appendix J. The inspection noted the tank was in good condition, besides some interior and exterior cracking. Based on this inspection and observations made by Keller Associates, the following deficiencies were identified:

- The concrete tank is in need of minor rehabilitation to address observed cracks.
- The facility needs intrusion alarms.
- Existing valving and controls result in excessive pressure drops during tank fills.
- Operational control updates are needed.

Recommendations are summarized below.

- Repair observed cracks to extend its useful life.
- Install intrusion alarms.
- Add a pressure sustaining valve to the tank inlet. Complete additional operating control settings to allow tank to more effectively delivery emergency and fire demands from available storage.

Naples Tank

The Naples tank is a partially buried concrete tank with the same dimensions and volume as the Black Mountain Tank. The tank is uncoated, and in generally fair condition. The concrete is aged, with some cracks, with evidence of chipping and wear. As seen in the photo below there were two noticeable cracks where water appeared to be seeping from the tank. The site itself has fair accessibility on a gravel/dirt road with the tank access being locked. The site does not have a fence, though the access building to the pump has a locked door. The roadway in front of the tank serves as a driveway for several residences. There is a 7 KW propane generator on site that provides emergency power to tank for all operations (alarms, controls, lights, and pumps). A propane tank is stored on site. SCADA readouts include generator on/off and alarms for tank levels. The tank floats hydraulically on the system.

The tank inspection report from August 2019 indicated that the tank was in good condition with the exception of some bug holes, settling and cracks. See Appendix J.

Based on the inspection and observations made by Keller Associates, the following deficiencies were identified:

- The tank concrete is starting to see wear on the exterior with cracking in isolated locations.
- The site is not secure from the public and there are no intrusion alarms.

Recommendations are summarized below.

- Repair the existing cracks further preserve the life of the concrete tank.
- Install fencing around tank and install an intrusion alarm.
- Specifically repair existing cracks that are seeping water from the tank.

Storage Analysis

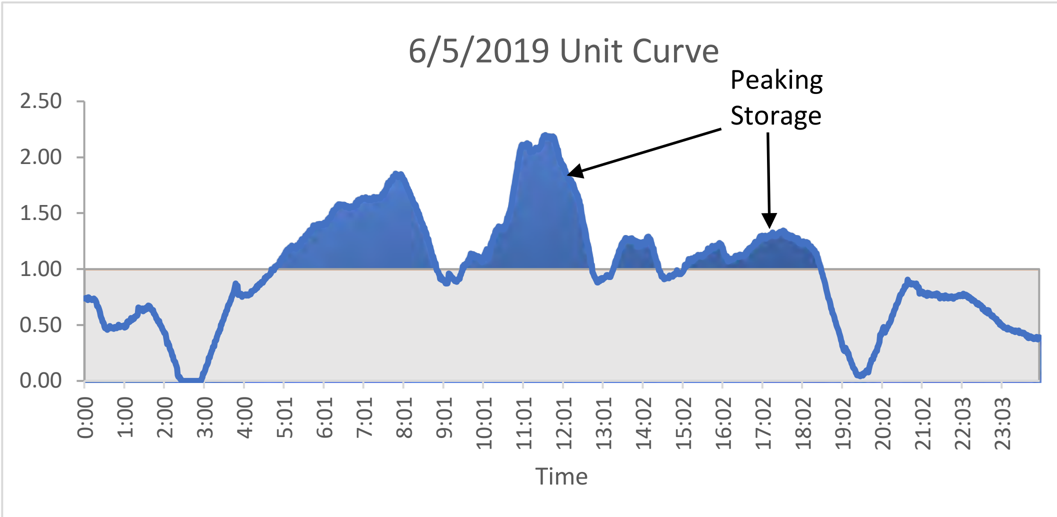
Existing and future storage capacity needs are presented in Table 2.3 below and are based on the planning criteria established in Chapter 1. Calculations for the complete system storage analysis can be found in Appendix M.

Table 2.3: Existing and Future Storage Needs

YEAR	2019	2039
Operational Storage, gal[1]	130,200	130,200
Peaking Storage, gal[2]	178,000	242,000
48-Hour Emergency Storage, gal	564,000	766,000
Fire Storage (1,000 gpm for 2 hours), gal	120,000 (nested in emergency storage)	120,000 (nested in emergency storage)
Total Storage Requirements, gal	872,200	1,138,200
Existing Storage Available, gal	382,300	382,300
Additional Storage Needed, gal (rounded)	**490,000**	**756,000**

[1] Existing operation storage currently in use by the District, which was assumed to remain the same for future conditions (requiring tighter operating points as the system demands and storage increase).
[2] Peaking Storage was calculated using 20% of the maximum day demand based off system SCADA trends (6/2/19-6/5/19).

Peaking storage unit curve can be seen in the below figure. Several days of SCADA data trends were evaluated and the most conservative day (6/5/2019) was utilized to determine peaking storage unit curve.



Beyond system storage, each existing pressure zone has individual storage requirements in order to appropriately meet operational storage, peaking storage, emergency storage, and fire storage for each zone. Table 2.4 below outlines the storage requirements by pressure zone. Storage calculations for each of the zones can be found in Appendix M. Storage needs for each pressure zone reflect the storage planning criteria. Future operating storage assumes 11.4% of the future tank volume. Which results in smaller operating storage than what currently exists in the existing tanks.

Table 2.4: Existing Storage by Pressure Zone Needs

PRESSURE ZONE	2019 EXISTING USABLE STORAGE (GAL)	STORAGE NEEDS (GAL)	
		2019 EXISTING	2039 PROJECTED
River (Well) Zone-Via Parker Canyon Tank (Less Volume Supplemented from Paradise Pressure Zone)[1]	24,300	146,200 (-91,000)	161,600 (-91,000)
Paradise Valley Zone	179,000	463,100	638,100
Naples Zone-Via Naples Tank[2]	179,000	252,600	240,400
Highland Zone	0	101,000	188,800
Existing Storage Available, gal	382,300	382,300	382,300
Total Storage Requirements, gal		962,900	1,228,900
Total Storage Adjustments, gal[1]		-91,000	-91,000
Additional Storage Needed, gal (rounded)		**490,000**	**756,000**

1. Storage adjustments based off of fire flows that will be supplemented by adjacent pressure zones. It is assumed that additional fire storage not covered by the River zone's emergency storage will be provided by Paradise zone.
2. Reduction in Naples storage volume reflect, a future lower operating storage recommendation of 11.4% of the tank volume.

2.4. SUPPLY AND DISTRIBUTION FACILITIES

Parker Canyon Booster Station Evaluation

The Parker Canyon Booster Station was completed in 1996 to connect the supply wells with the rest of the system. If this booster station were to fail, the majority of the system would not have water. The booster station is in fair condition with normal wear and tear from 20 years of operations. There is good access to a fenced and secure site, and the building is in good condition. The booster station includes two 75-hp, 500 gpm, 1780 rpm 480 volt, 3 phase pumps, a generator, an automatic transfer switch and associated controls and valves. The valves are in fair condition, the pipe supports are in great condition, and there is a pressure relief and a sample tap on the piping. The flow meters are old and need replacement. The operator noted that cavitation can occur if the Parker Canyon tank is drawn down below about 4 feet.

Under normal operating conditions, the pumps produce between 150 and 180 psi at the pump discharge. Currently, the pumps operate similar to constant speed pump, with periodic manual adjustments to the pump speed setting of the existing variable frequency drives (VFD). It is recommended with future improvements these pumps operate as true VFD pumps with local control settings to help maintain system pressures during high demand events (i.e. a fire).

Deficiencies noted during the site visit include the following:

- Flow meters in poor condition.
- There corrosion on some of the valves/fittings.
- The operator reported that the generator is unreliable during emergencies (power outages).

Recommendations include:

- Replace existing flow meters.
- Replace the existing generator. Note, a larger generator will be needed to accommodate proposed pumping capacity expansions presented later in this report.

Black Mountain Booster Pump Station Evaluation

The Black Mountain booster station increases system pressure in the paradise zone by pumping water from the Black Mountain tank. The booster station is adjacent to the Black Moutain Tank at the end of Diamond Road on the east side of the District. The booster station is comprised of three pumps (240 volt, single phase power). Two of the pumps are 7.5-hp (horsepower), 250 gpm. The other pump is a 5-hp pump, rated for 90 gpm. When the Black Mountain Tank is not filling, the smaller 5-hp pump runs almost all of the time, especially during the summer months. The booster station is controled by a local

pressure setting that dictates when the pumps are to run. The booster station controls prevent the pumps from operating when the tank is filling.

The pipe supports and valves are in fair condition. Much of the pipe coating is in poor condition with abundant rusting. There are sample taps, pressure relief provision, but no air relief provisions. The existing flow meters are old, and need to be replaced. There is a generator on site that provides single phase power (converted to 3 phase for the pumps) that is in fair condition.

Other deficiencies noted during the site visit include the following:

- The booster station cannot operate when the pump is filling.
- Flow meter has reached its useful life.
- Pump 1 is used almost constantly and needs replacement.
- Pipe coating is in poor condition.

Recommendations include:

- Replace Pump 1.
- Install new flow meter.
- Install air relief measures.
- Recoat exposed piping.

Highland Flats Booster Pump Station Evaluation

The Highland Flats booster station services the Highland Flats zone, located in the southwestern portion of the District service area. This booster station is located on a easement of the adjacent landowner. The District does not own the land and additional land will be needed if the booster station is replaced. The building is currently secured by a lock, but no fence around the site. The building is in fair condition. The booster station operates on a local pressure setting that dicates when the pumps operate. Generally, the facility has very little working room in the building to complete maintenace tasks. The booster station has radio telmentry to communicate to the main operations building via a repeater located at the Four Corners booster station.

The pumps in the booster station are 10-hp and 7.5-hp VFDs with the 10-hp being an agricultural irrigation pump that is in poor condition; these two pumps operate in rotation, switching daily at 8 AM, however, both can run at the same time if demand requires. The 7.5-hp pump was replaced in 2009 but the operator has noted operation and maintenance issues with upkeep of this pump. Currently, the 7.5-hp pump operates at 61 feet of total dynamic head. There is no backup generator onsite. There is pressure relief avaliable, but no air relief provisions within the house piping. The valves are in fair condition and the existing flow meter (paddle style) should be replaced with a magnetic flow meter. New pressure transducers are needed. Multiple segments and connections of piping were not plumbed vertically, straight horizontally or had appropriate support, which could result in leaking and issues in the future.

Other deficiencies noted during the site visit include the following:

- There are not enough pipe supports.

Recommendations include:

- Given the large number of deficiencies and overall age of the booster facility, plus the need for upgrades triggered by desired increased pressures and future flow conditions, we recommend replacing the booster station with a completely new booster station and building. In order to complete this improvement, an additional easement or property purchase is recommended.

Naples Booster Pump Station Evaluation

The Naples booster station serves three residential houses that are higher in elevation than the Naples Tank. The booster station is located on the same site as the Naples tank and delivers domestic flows only. The booster station is comprised of a single pump in one of two secure buildings (but not a secure site) adjacent to the tank. SCADA controls are in a separate building (north building).


The booster station consists of a single pump (in fair condition) pump operates on single phase power and appear to be in poor condition. Pipe supports and valving are also in fair condition. There are no pressure relief or air relief valves. The water meters are currently located in the booster station (three).

Other deficiencies noted during the site visit include the following:

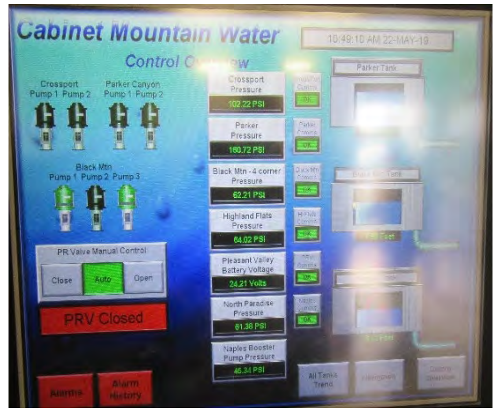
- The northern building is missing siding.
- Electrical components are functional but are reportedly outdated.
- A generator supplies power to the pump, but there is not a redundant pump.

Recommendations include:

- Add an additional pump.
- Install automatic transfer switch for pumps.
- Finish the northern building (add siding).
- Eventually, it would be advantageous to have the booster station further integrated into the District's SCADA system to notify the operator of additional alarm conditions.

Paradise Valley (Four Corners) Booster Pump Station

The Paradise Valley booster station, also known as the Four Corners Booster Station, is located just north of Kootenai Trail Road and Paradise Valley Road intersection. The booster facility is located within an easement. This booster station typically only runs during high demand seasons (summer). During high demands, the pumps (two) provide additional pressure to the upper paradise zone through an intertie. However, the pumps must be manually turned on to operate. The facility is capable of pumping water through an intertie to the Paradise Valley Water Association in case of emergency. During low demands, the pumps remain inactive.



The booster station pumps are set to maintain approximately 70 psi in the upper paradise valley zone. The pumps are rated for 230 gpm and 92 feet of head and are powered by 3 phase, 480 volt power. There are no air relief and pressure relief options in the facility. There is an existing 7 KW generator that provides single phase power. The generator is only used to keep controls operational and the lights on in the building.

The Four Corners facility is also the main control base for the entire system's SCADA and controls. The control system has auto dialer and texts for alarms that are reported within a few minutes when an alarm is triggered in the system.

Other deficiencies noted during the site visit include the following:

- The existing Grundfos controls are reported to be poor condition.
- No emergency power for the pumps.

As will be discussed later, the booster station was more of an interim fix for low pressures that result in system pressure swings caused by higher demands and system operations. Storage and delivery improvements discussed later will allow this facility to serve as strictly emergency use only.~~eventually be abandoned~~. As such, improvements at this site include only updating the SCADA system at this facility.

Pleasant Valley Pressure Reducing Valve (PRV) Station

Separating the Paradise Zone from the Naples is a pressure reducing valve station located just south of Julian Rd and Pleasant Valley Rd intersection. This pressure reducing station ensures that the southern zones, which are lower in elevation, are not over pressurized but also enables additional flow to the Naples/Highlands zones. The PRV station operates as a shutoff valve between the two zones, but currently does not open unless the Naples Tank calls for water. When the Naples tank draws down, a 3-inch PRV opens to allow the Naples tank to fill. A parallel 8-inch PRV is currently out of service.

The PRVs are in a concrete vault located off the east side of Pleasant Valley Road in the public right of way. Power is brought to the valve via solar power which charges a battery pack inside the vault. If solar power is not available (such as typically cloudy winter months), the operators must bring a generator to the site and hook it up so there is enough power for the PRV to operate.

All of the water serving the southern zones currently flows through the 3-inch PRV, which could be restricting in the case of a fire event in the Highlands or Naples pressure zones. The PRV station should be redesigned, and redundancy should be considered for this critical piece of infrastructure.

Recommendations include:

- Replace or upgrade the 8-inch PRV with an operating PRV equipped with pressure sustaining capabilities.
- Tie in power from nearby power pole.
- Remove and replace backup batteries.

Crossport Well Facility

The Crossport Well Facility consists of two active wells and one inactive well. The active wells provide all of the water for the entire District. The facility is located on the northeastern boundary of the District service area, just east of the Crossport Road and Fitzpatrick Road intersection. There is good access to the site on a paved road and a gravel driveway. The site is fenced and secured by lock. This building current serves as the shop and supply facility as well for the District. The facility is south of the Kootenai river a couple hundred feet.

The two active wells have 12-inch diameter casings with a screen.

The pumps consist of vertial line shaft turbines and are rated for 560-600 gpm with 370 feet of Total Dynamic Head. Both pumps are operated by 75-hp, 3 phase, 480-volt motors that produce approximately 119-130 psi. When the pumps run at the same time, they produce 850-950 gpm at 145-

150 psi. The pumps are in fair condition. Well #1's motor was replaced in 2012, and Well #2's motor replaced in 2014. Well #3 is unused and consists only of a casing and screen in unknown condition.

The pipe supports are in generally good condition, with some rust forming on some of lower portions of the support. The valves are in fair condition, with the check valves about 5 years old. There are sample taps, and the claval pump conrol valves provide air relief provisions on the start up of the pumps. There are chlorine injection points as well. Currently the chlorine solution tanks and pumps are not isolated in the facility and are adjacent to the pumps and electrical controls. However, there is an emergency drain pan to capture chlorine in the event of a leak. It is recommended that the tanks be isolated in a separate room for safety and protection of existing electrical components.

The well pumps are controlled by tank levels in the Parker Tank conveyed via radio communications. A 175 kW generator also provides auxiliary power to the existing wells.

Other deficiencies noted during the site visit include the following:

- The generator is old and is reportedly unreliable.

Recommendations include:

- Repaint the mechanical piping.
- Test pump Well #3 and evaluate if Well #3 is affected by pumping of Wells #1 & #2.
- Replace existing generator.

2.5. SYSTEM SCADA/CONTROLS

Currently the system communicates through radio frequency/towers to a central SCADA control building located at the Four Corners Booster Station. The four Corners Booster station was selected to be the main operation and control facility due to the location being convenient and easy access. In the event that an alarm is triggered, all operators will receive a text message. In the event that no acknowledgement of the text message occurs, the lead operator is then called. If the operator does not respond to the call, it will repeat the same notification process for each subsequent person on the call list.

2.6. SYSTEM REDUNDANCY

CMWD's system currently lacks redundancy at key junctions. The Parker Canyon booster station provides water delivery to much of the entire system. If this site is taken offline for an extended period, the District is unable to provide adequate water delivery to connections. The Naples Booster Station only features a single pump.

Additionally, due to the mountainous terrain, looping of water main is not always feasible. If a water main were to break in a non-looped main, downstream residents would lose access to potable water until the main was repaired. The PRV station is the sole link to water supply for the entire Naples and Highland Flats pressure zones.

2.7. PIPE MATERIALS

CMWD's system consists of polyvinyl chloride (PVC) and ductile iron (DI) pipelines ranging from 6 inches to 10 inches in diameter. There are no known pipe materials that typically cause severe operation and maintenance issues, such as asbestos concrete or steel. The majority of these pipelines are believed to still be within their useful life (80-100 years). As such, it is recommended that the District replace pipelines based on reported failures and size (ie undersized).

2.8. DISTRIBUTION SYSTEM HYDRAULIC EVALUATION

A hydraulic model of the existing distribution system was created in conjunction with this study, using distribution system data provided by the District and elevation and mapping data from Interactive Numeric & Spatial Information Data Engine (INSIDE) Idaho and Google EARTH. The hydraulic modeling software used for the analysis was Bentley's Water CAD v10. Figure 1.1 in Appendix A show the existing system layout, pipe sizes, pressure zones, pumps, and tanks. As stated, the existing distribution system primarily consists of ductile iron and PVC pipe ranging from 6 to 10 inches in diameter. As such, system pipes were modeled as ductile iron pipe with a C value of 130 to 140 (with a default of 138), indicating newer pipes. A lower C value of 120 was considered but resulted in poorer correlation to field results than when the higher C values were used.

Elevation information was added to the model through an automated terrain modeling process and manually checked for accuracy. Additional model input data from pump curves, operational controls, record drawings, and other data gathered by District staff was incorporated into the hydraulic model. Water consumption records from the District's billing database were used to inform the total demand for each zone, which were inputted into the hydraulic model. This allowed for a more accurate allocation of the existing system water demands.

The future water system demands were allocated in the water model using a District-provided map of anticipated future growth areas, presented in Figure 2.1 in Appendix A, and the estimated population increase for the 20-year planning period. For the 20-year planning evaluation, demands per EDU were allocated to the number of anticipated EDU in their respective areas of anticipated growth. This assumption was believed to provide a reasonable distribution of future demands.

Upon completion of the model construction process, Keller Associates collaborated with CMWD staff to calibrate the hydraulic model to actual field conditions. Several flow tests were performed in the field to measure pressure drops in the system. The field measurements were then compared with model results to check that the model accurately simulated field conditions. During calibration experiments, it was discovered the system is highly sensitive to general and localized demands. As such, field conditions could not be exactly replicated in the model but were generally within 5 to 10 psi of field conditions. Additional 12+ hour pressure tests were conducted at areas suspected of low pressure to further check that low pressure concerns calculated in the model existing in the field. A reasonable correlation of field test results to model results provides confidence in the analysis and recommendations presented in this report. Refer to Appendix C for calibration details.

A. Distribution System Results and Recommendations

With the calibrated model, the current distribution system was evaluated for compliance with the pressure and flow standards presented in Section 1.5.C. The following sections summarize the analysis results.

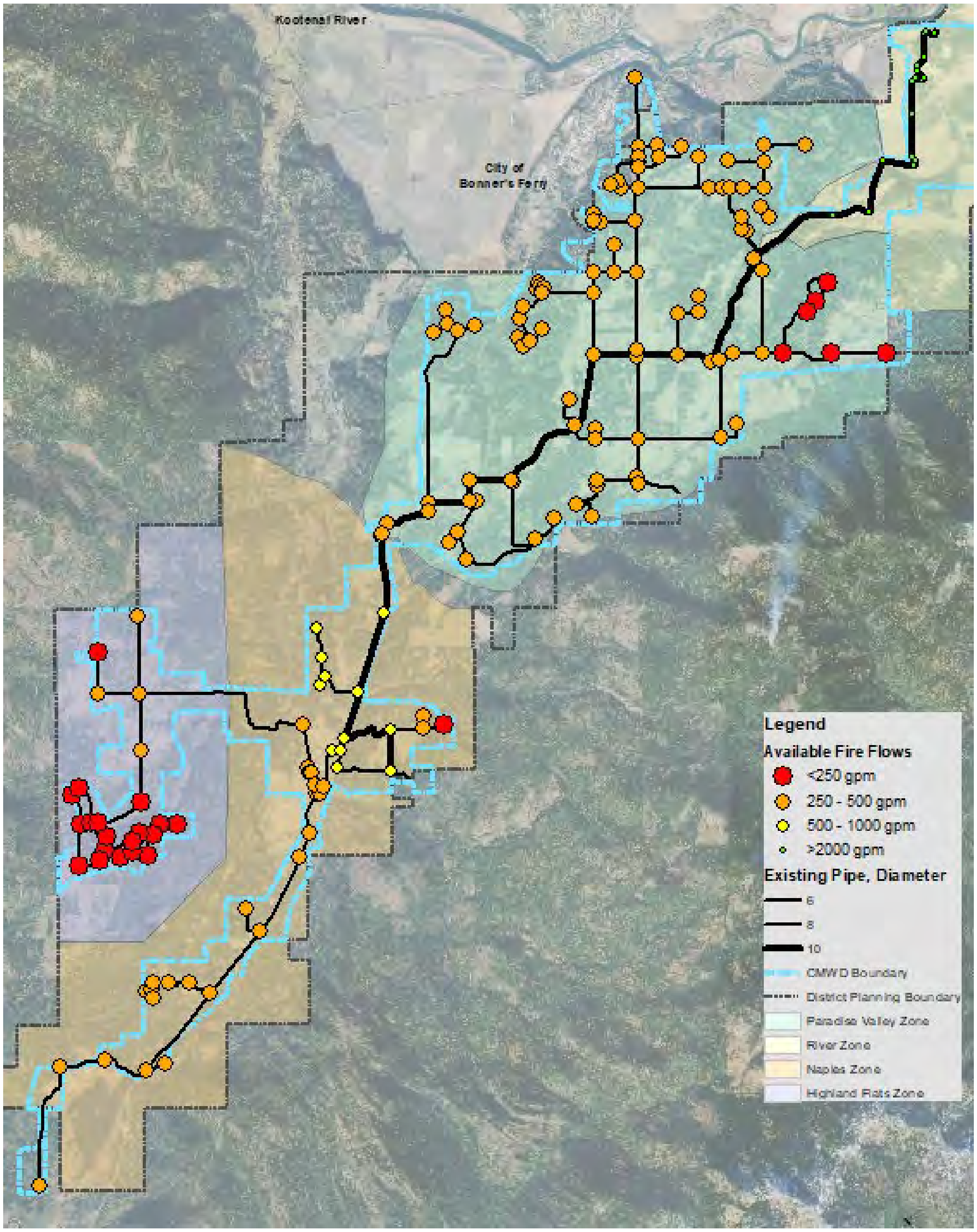
B. Maximum Day Demand plus Fire Demands

The model was populated with fire flow demands for areas with specific requirements identified by the local fire authority or the Idaho Insurance Rating Bureau. Structures and areas which require specific fire flows can be found in Appendix E. A minimum fire flow of 250 gpm at 20 psi was selected as the default for the model evaluation based on input from the local fire authority. This fire flow is consistent with previous planning efforts. CMWD has expressed interest in achieving a minimum fire flow under max day demand of 500 gpm throughout the system.

The model was run to simulate the system's "worst case scenario," where pressures and available fire flows are at their lowest. The boundary conditions for this scenario were the following: 1 booster pump at Parker Canyon running, the Black Mountain tank in fill mode, 1 pump at Highlands booster station running, and both the Crossport Well and Paradise Valley booster station are off.

Under maximum day demands with the largest pump offline, and the fire flow requirements stated, the system was tested with the criterion of system pressures not dropping below 20 psi. The water model evaluates each pipe junction individually under maximum day demands with the specific fire flow requirement for that node, while considering pressures at other nodes in the system. The analysis is steady state and assumes adequate fire storage is provided to support the design durations. Figure 2.2 on the following page highlights the modeled nodes in the water system. Nodes that do not meet Maximum Day Demand plus Fire requirements are labeled in red.

Figure 2.2: Available Fire Flows Under Max Day Demands (Existing System)



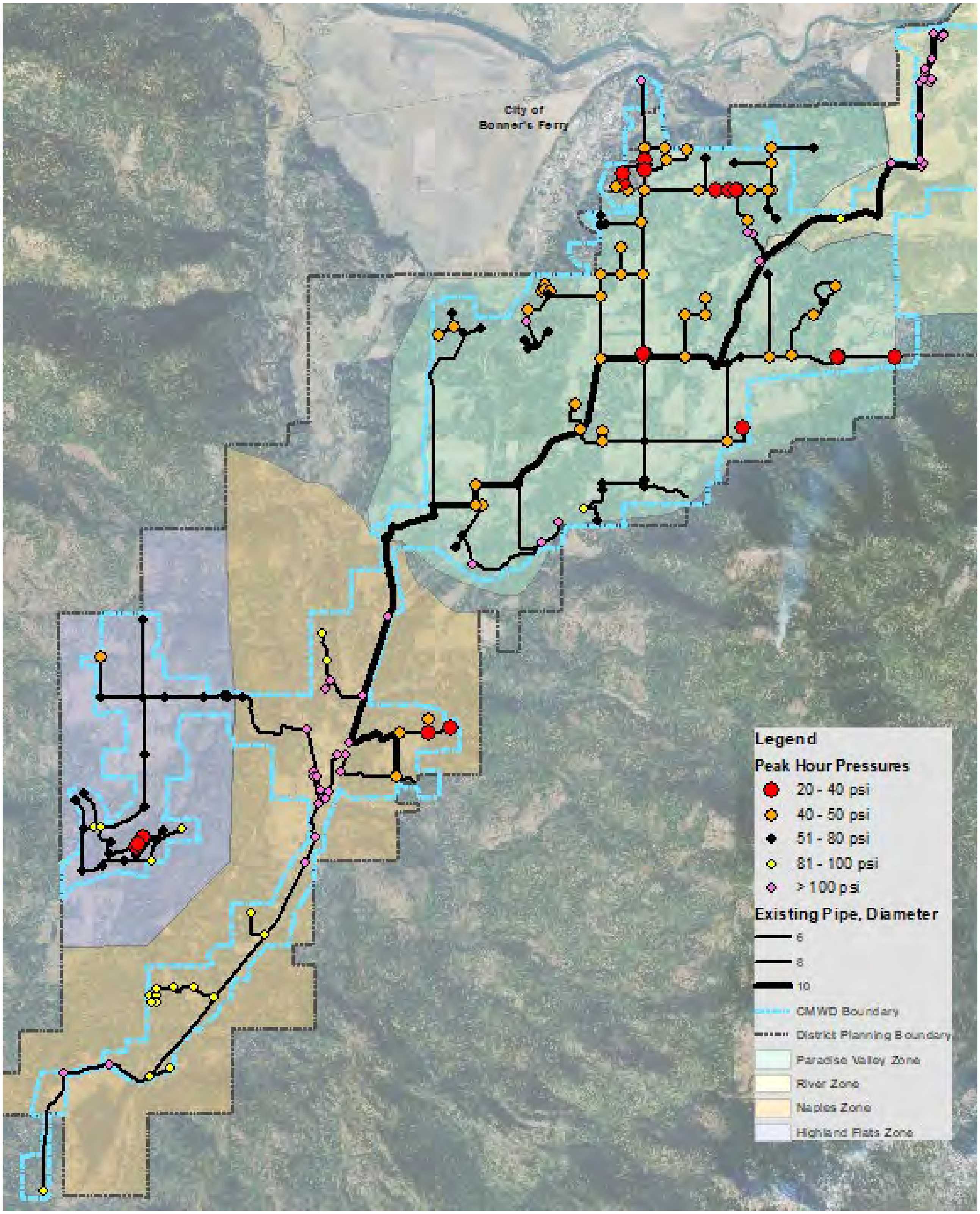
Areas of inadequate fire protection include the east Paradise Zone along Kootenai Trail Rd, in the Naples Zone along Mountain Meadows Rd, and in the extremities and southern portion of the Highlands Zone. The inadequate available fire flow in these areas is primarily a result of undersized lines, inadequate delivery capacity (ie transmission piping and pumping), and lack of system looping. In addition, most of the system experiences less than 500 gpm of available fire flow.

C. Peak Hour Demand

The system was also modeled under peak hour demands to check if the system could maintain greater than 40 psi.

Figure 2.3 on the following page highlights the system locations with various pressure ranges. The same “worst-case” boundary conditions presented in a previous section were replicated for this scenario.

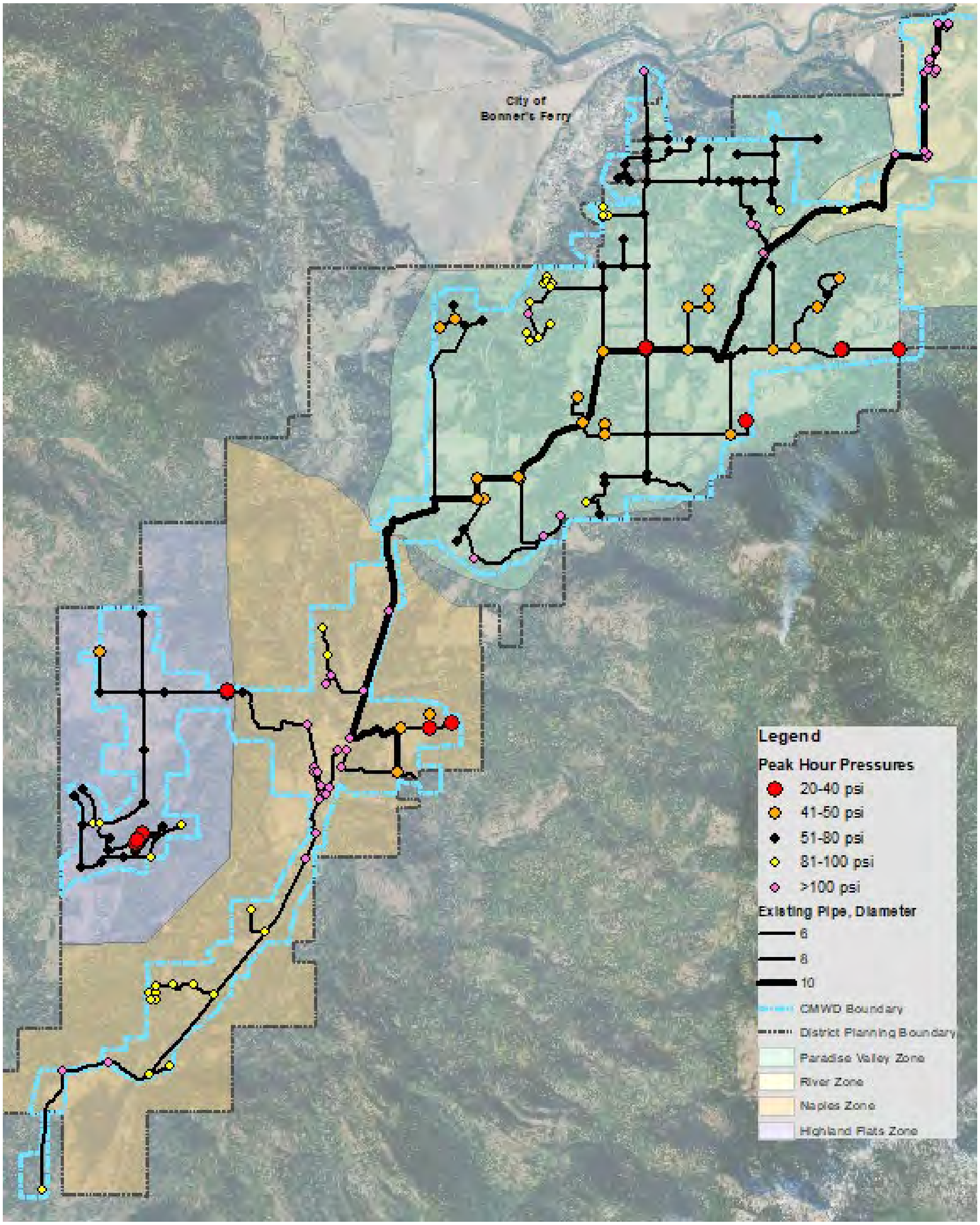
Figure 2.3: Existing System Pressures Under Peak Hour Demands



As shown, several areas do not meet the minimum 40 psi requirement for peak hour demand conditions. Several of these areas are overlap with the inadequate available fire flow areas presented previously. Additionally, much of the north portion of the Paradise Valley zone experiences less than 50 psi.

The Paradise Valley (Four Corners) booster station was constructed to combat the low pressures experienced by the northern portion of the Paradise Valley zone. With the Paradise Valley booster station active, the system experiences an increase in pressure, as depicted by Figure 2.4 on the following page. It should be noted that this pump station is manually operated and does not have standby power. If pressures dip unexpectedly, it is likely the northern Paradise zone will experience the pressures shown in Figure 2.4.

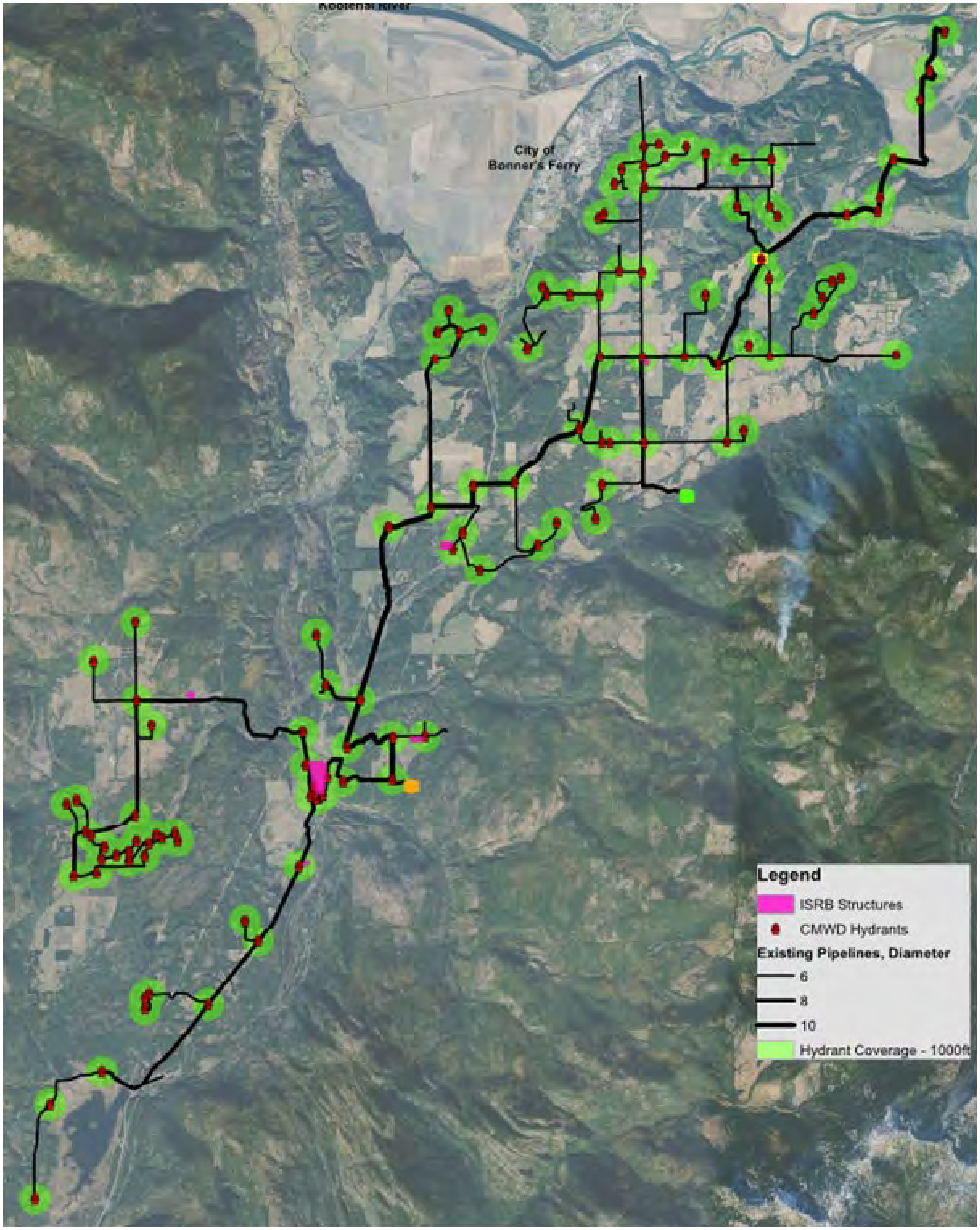
Figure 2.4: Existing System Pressures Under Peak Hour Demands with Paradise Valley Booster in Operation



There are reportedly 115 fire hydrants distributed throughout the water system. In conversations with the District and the local fire authority, hydrants are desired to be within 1000 feet due to the rural nature of the District.

Figure 2.5 on the following page illustrates the existing and future hydrant coverage based on a 1000-foot radius for each hydrant. As shown, the existing hydrants do not provide coverage to a large portion of the system. If the District desires to expand fire coverage to all of its users, then many additional hydrants would be required. However, the District's policy has historically placed the obligation of the development community to provide hydrants as required. Should the District decide to expand coverage by adding additional hydrants, Keller Associates would recommend that additional hydrants first target high-density areas and structures rated by the ISRB. Of the ISRB structures identified within the District's boundaries, only one (located at 1655 Highlands Flats Road) was outside of the 1000 ft radius from a working hydrant. At a minimum, Keller Associates recommends that adequate hydrant coverage be required for any new development.

Figure 2.5: Existing System Fire Protection Coverage



3. NEED FOR PROJECT

CMWD is currently under a suspension on additional water connections. An evaluation of the existing system identified the following deficiencies: inadequate water supply capacity, inadequate storage, low pressures during peak hour flow conditions, and inability to provide recommended minimum fire flows. A plan for mitigating these deficiencies and meeting future system requirements is needed.

3.1. PUBLIC HEALTH, SANITATION, AND SECURITY

CMWD system is relatively secure. All of the buildings are secured by locking doors, and the Crossport Well area is fenced in with locking gates. CMWD has not reported any problems with facility damage or water quality. Water quality grab samples taken by CMWD have historically met state standards; however, isolated low pressures, lack of redundancy, and inadequate fire flows put the system at risk. The CMWD has indicated that there is a lack of shut off valves in the system, but they do not have any issues with the current shut off valves. Additional shut off valves will be installed as future additions occur.

The most recent Sanitary Survey completed by DEQ in 2016 indicates that the CMWD's water system is in substantial compliance with the Idaho Rules for Public Drinking Water Systems. Additionally, no significant deficiencies were identified as a part of the Sanitary Survey. However, DEQ did identify a few items as deficiencies or requirements for the District to follow-up on:

- Provide pictures of the roof hatch interior for both tanks.
- Provide a copy of the District's cross connection control program.
- Dead end distribution mains must be flushed every six months.

A copy of this survey is included in Appendix F.

3.2. AGING INFRASTRUCTURE

Much of CMWD system appears to be in fair condition with normal wear and deterioration. CMWD operators have done a good job of extending the life of infrastructure through good maintenance and upkeep. Its anticipated that the three existing tanks will need coatings and substantial repair in the next 10 to 15 years. Additionally, the pumps installed in the wells and booster stations will need replaced/refurbished in the next 10 to 15 years as well. The distribution system is reported to be in fair to good shape. As pressure in the system rises, existing services, valves, and meters will need to be monitored to detect new leaks. A long-term distribution replacement plan is recommended to assist with the replacement of this aging structure such as piping, fire hydrants, meters, valves and pumping facilities.

3.3. REASONABLE GROWTH

New well and storage improvements should be sized to accommodate 20-year projected needs. Storage facilities will be sized for current and future 20-year projected needs. System pipelines should be sized to accommodate future needs – and be installed to provide necessary fire flow and transmission, or as needed for development.

3.4. COMPLIANCE WITH STATE AND FEDERAL REGULATIONS

CMWD existing water system does not have sufficient supply capacity to meet maximum day demands for existing commitments for active and inactive connections. Additionally, CMWD needs additional storage capacity to satisfy CMWD desired 48hour emergency storage volumes. Due to spread, size of water mains, and supply pressures the system specifically in the North Paradise Area is very sensitive to pressure swings based on operations and usage. These pressure swings have been observed to fluctuate approximately 10-20 PSI or more at specific locations. This currently results in pressures intermittently dropping below 40 PSI at specific isolated locations.

4. ALTERNATIVES ANALYSIS

All alternatives considered comply with the design criteria established in Section 1 of this report. Alternatives were evaluated on their ability to meet current and future demand requirements, maintain adequate pressures throughout the system, and provide sufficient redundancy to mitigate risk to the system.

4.1. DESCRIPTION

Several alternatives were considered for remediation of the existing system's deficiencies. The alternatives are grouped into three categories: supply, storage, and distribution with each category comprised of several options. A description of each alternative considered is presented below.

A. Supply Alternatives

Four alternatives were considered to correct the existing supply deficiency: Construct an additional well at the Crossport site, complete the Cow Creek Well facility, identify and develop a new well at an alternative site, and the no action alternative. A surface water treatment option was elected by CMWD to not be evaluated due to the high treatment and operation costs typically associated with these facilities. An evaluation of these alternatives can be found in a technical memorandum found in Appendix L. Life cycle costs can be found in Appendix G. Summary information is presented below.

ALTERNATIVE 1 – NO ACTION

Taking no action for increasing system supply could result in continuation of the current suspension on connections and prohibit future growth within the District. Finally, CMWD would remain at risk of having insufficient supply during peak events and mandatory restriction of water consumption could be required in the event of a pump failure during a peak summer demand period.

ALTERNATIVE 2 – NEW WELL AT CROSSPORT SITE

The District's current well field at the Crossport site likely has capacity for an additional adjacent well. The District's sole water supply source comes from the two existing Crossport wells. These wells are considered some of the most reliable sources of clean water in the area and produce large volumes of water with very little drawdown. Other wells drilled in the area reportedly struggle to provide more than 10 gpm.

ALTERNATIVE 3 – COW CREEK WELL

The District has expressed a desire to improve redundancy in their water source, as well as increase system capacity. The District recently drilled a well at a new location away from their existing supply wells in order to achieve this. Upon performing pump tests and water quality tests, the Cow Creek Well experienced iron and manganese levels that were above secondary drinking water standards. These two constituents would require a costly treatment process in order to use the Cow Creek Well for anything other than an emergency backup well. The well-produced approximately 250 gpm and additional pumping and capacity would be needed to ensure it would satisfy the future peak day pumping demands of 300+ gpm when combined with a Crossport wells. This well is about 2,000 feet away from existing District infrastructure and additional distribution piping would be needed to connect to the system.

ALTERNATIVE 4 – DEVELOP A NEW WELL AT A SITE TO BE DETERMINED

Another alternative would include drilling a new well at a location to be determined. Based on information from the District, the region has limited areas where higher producing wells can be found, and the distance to these and the potential water quality are unknown. The limited information from the test well near Cow Creek suggests that the water quality is also highly variable even within close proximity to known quality sources. One potential location for a new site could be near the Cow Creek test well which reportedly did not have elevated levels of manganese and iron. Additional production capacity and water quality testing of the existing test well may show this site has some promise. However, this alternative would still be considerably more costly than Alternative 2. Should an alternative site be investigated, a hydrogeologic evaluation would be needed.

ADVANTAGES AND DISADVANTAGES

Table 4.1 on the following page summarizes the advantages and disadvantages of each supply alternative.

Table 4.1: Supply Alternatives – Advantages and Disadvantages

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
1 – No Action	Lowest initial cost	System does not meet supply capacity for current max day demand and lacks adequate supply redundancy No redundant water sources
2 – New Crossport Well	Low initial cost Reliable water source Increase system capacity Substantial amount of Infrastructure already in place with existing adjacent well fields	No redundant water sources
3 – Cow Creek Well	Redundant water source	High in capital cost with need for a treatment facility for the iron and manganese Unpredictable/proven water source. Unknown well capacity since pumping was less than 250 gpm Additional distribution piping needed to connect to system
4 – Develop a New Well at a Site to be Determined	Potential for redundant, quality water source	Higher capital cost expected High degree of uncertainty

B. Storage Alternatives

Several alternatives were considered to provide sufficient emergency, operational, peaking and fire storage for the 20-year planning period. These alternatives included the number of tanks, type (elevated vs standpipe), and tank material. Additionally, alternative tank locations were examined based on pressure zones and available land.

NO ACTION ALTERNATIVE

Without additional storage facilities, the District would not meet the current and future storage needs and continue to be vulnerable, with little time to react to and remedy emergency situations (ie. water supply pump failures, break in transmission mains). Additionally, fire protection capabilities would continue would not meet desired levels and under certain conditions, low pressures would be exacerbated.

Alternative Number of Tanks: Three Tanks vs Four Tanks

In order to achieve the required storage volume, CMWD elected to evaluate an alternative with three new tanks and an alternative with four new tanks. Each alternative's storage summed to the required storage volume needed as identified in the planning criteria.

Based on design criteria, modeling and providing adequate storage in each pressure zone, tanks at the following four locations were evaluated:

- Parker Canyon
- Highland Flats
- North Paradise
- Kootenai Trail/Cow Creek (only considered for the four tanks alternative)

Parker Canyon is the most critical location for additional storage since most the District's water supply funnels through the Parker Canyon site. The existing tank on site is undersized without any redundancy and lacking the ability to take it offline for maintenance. Given the critical nature of this facility for overall system operations a parallel, larger tank is recommended at this location for both alternatives.

The Kootenai Trail/Cow Creek Tank was considered as a possible forth tank solution. Upon further evaluation utilizing the model and completing a sensitivity analysis, it was determined to have less of a system impact in improving supply and pressure in the paradise zone. Although this option potentially eliminates the need for a small booster station at the end of Cow Creek Road, existing distribution piping restrictions and costs of another storage facility significantly outweighed the benefits of this fourth tank.

The Highland Flats and North Paradise tank locations were selected to meet the storage requirements in their respective pressure zones while providing additional storage to other "downstream" pressure zones.

The three-tank alternative offers a lower capital cost per gallon of storage and less maintenance, while the four-tank alternative provides additional redundancy and more localized pressure advantages along Cow Creek Road compared to Alternative 2.1.

Table 4.2 on the following page reflects which tanks will provide the necessary storage to each of the pressure zones. Additionally, certain tanks can provide backup storage to other zones in the system. The Naples zone can draw from storage in the Paradise zone by opening the PRV between the two zones and can draw from the Highlands storage via the backflow valve that is to be installed in the upgraded Highlands booster station. The Parker Canyon tanks provide backup storage to the Paradise zone via the Parker Canyon booster station, which is supplied with backup power. All pressure zones will have adequate storage capacity independently or by drawing water from other storage facilities in the system.

Table 4.2: Storage Needs by Zone – Three Tanks Alternative

PRESSURE ZONE	STORAGE NEEDS (GAL)		THREE TANKS ALTERNATIVE STORAGE
	2019 Existing	2039 Future	
River (Well) Zone	55,200	70,600	Parker Canyon Tank - 24,300 gal New Parker Canyon Tank - 260,000 gal
Paradise Valley Zone	463,000	638,100	Black Mountain Tank - 179,000 gal (pumped) New Paradise Valley Tank - 300,000 gal New/Ex. Parker Canyon Tanks - 284,300 gal (pumped)
Naples Zone	252,500	240,400	Naples Tank - 179,000 gal New Highlands Tank - 200,000 gal Paradise Valley Zone Tanks (through control valves)
Highland Zone	101,000	188,800	New Highlands Tank - 200,000 gal
Storage Available, gal	382,300		1,142,300
Total Storage Requirements (rounded), gal	872,000	1,138,000	1,138,000
Additional Storage Needed, gal	**489,700**	**755,700**	**(4,300)**

PARADISE VALLEY TANK ALTERNATIVES – GROUND LEVEL TANK, ELEVATED TANK, AND STANDPIPE

To improve pressures and storage in the northern part of the CMWD system, a new tank is recommended. Three alternatives were considered, including a ground level tank, an elevated tank and a standpipe.

The ground level tank alternative requires that water “break head” to enter a ground level reservoir and be repumped through an additional pump station. While the capital cost for this alternative is less than an elevated tank, it has long-term operating costs and complexities that do not exist with other options. Additionally, the District expressed interest in having at least one tank be able to float on system pressure in the largest pressure zone in the event that pumping facilities were offline. An additional benefit of elevated storage is that the elevated tank serves as a pressure surge buffer for the system, reducing risk of overpressurization/underpressurization. Because of these factors, only the elevated and standpipe alternatives were considered in more depth.

Life cycle cost estimates can be found in Appendix G. In evaluating options that float on the system (standpipe and elevated tank), an elevated tank has the lowest life cycle cost. The standpipe alternative would require a small pump to improve circulation and increase usable volume, increasing capital cost and maintenance requirements. Given the height and volume requirements for this tank, the standpipe would be very narrow with very little storage volume in the targeted pressure range of the system. For this application, a standpipe is more expensive than an elevated storage facility and likely to have a larger variance in pressure swings.

TANK MATERIALS CONSIDERED

CMWD and Keller discussed advantages and disadvantages to each type of tank material for each location. CMWD generally prefers concrete tanks due to all of their existing tanks being concrete, lower maintenance and operations costs, reduced visibility, reduced vulnerability, and longer life expectancy.

Each proposed tank site has different considerations. In the Parker Canyon site, a concrete tank is more favorable because the existing storage tank is concrete, and the new tank is anticipated to be partially buried. Because of these constraints concrete material is the best application.

For the Highlands tank, either a steel or concrete tank could potentially work. However, given the remote nature and desired security provided by concrete, the District prefers concrete similar to their other tanks.

A life cycle analysis comparison was completed for the Parker Canyon and Highlands Tanks for concrete, steel and bolted steel options. As discussed with CMWD the initial costs of a bolted tank are significantly less than that of concrete tank, but over time the concrete tank option becomes the least expensive option around year 40. See Appendix G for the life cycle analysis.

For the additional Paradise Valley Tank, concrete is not practical option due to the required elevation of the tank. A steel elevated tank is recommended for the Paradise Valley Tank.

C. Distribution System Alternatives

The existing system currently has several locations that do not meet DEQ requirements for 40 psi minimum pressure (refer to Chapter 2 for locations). Generally, these low-pressure locations are more pronounced during peak hour events. Additionally, certain locations in each zone except the River Zone do not meet the minimum available fire flow of 250 gpm during max day events. Improvements to the distribution system would help increase fire flows throughout the water system and increase pressures above the minimum required. As identified in the previous chapter, a portion of the waterlines are less than 8-inch mains, making delivery of fire flows challenging. Additionally, the system has many dead-end lines. Achieving higher fire flows of 1000+ gpm throughout the distribution is not practical. Alternatives to address a more reasonable target of 500 gpm is explored here. Additionally, improvement alternatives to meet DEQ required minimum pressures of 40 psi during peak hour demands are also provide.

ALTERNATIVE 1 – NO ACTION

The existing system currently does not meet DEQ requirements for minimum pressures and would continue to have substandard pressures without needed actions. The no action alternative would also leave the District's system at risk during fire events, as insufficient flow would be available for fire suppression.

ALTERNATIVE 2 – REPLACE UNDERSIZED TRANSMISSION LINES

By replacing undersized transmission lines, system pressures and fire flows would improve. The lowest pressures generally occur at dead-end lines located at higher elevations near the system's boundaries. Although this will generally improve customers on the main transmission line, it does not result in pressures above 40 psi at critical locations within the District.

ALTERNATIVE 3 – INSTALL NEW TRANSMISSION LINES

Installing new transmission lines that provide looping throughout the system will likely result in improve flows and pressures. Additional looping stands to improve available fire flow and higher pressures under certain demand scenarios. This alternative would also increase the District's redundancy, as the transmission line looping in the system would have greater capacity. Due to the topography of the District, this option is only feasible in areas were easements can be acquired and the terrain does not prove cost-prohibitive for the installation of new pipes. Additionally, this option alone does not correct the low-pressure areas that currently experience pressures below 40 psi.

ALTERNATIVE 4 – UPGRADING EXISTING BOOSTER STATIONS

Installing new pumps or adjusting settings to allow for more flow through the booster stations will increase both system pressures and available fire flow. The system's hydraulic grades were evaluated to see which setting would achieve the recommended system pressures. Increasing the pressures in the Highlands Zone by approximately 10 psi, improved both fire flows and pressures to above their respective recommended minimums without over-pressuring the transmission lines. Additionally, improvements to the booster stations within the Paradise Zone are needed to address firm delivery capacity requirements and enhance controls that would stabilize pressures, reducing pressure swings and improving system pressures.

ALTERNATIVE 5 – CONSTRUCTING NEW BOOSTER STATIONS

For the Highlands pressure zone, a new booster stations would provide the similar benefits to upgrading existing booster stations, however, with the flexibility of a new facility, operational and maintenance improvements could be better integrated and the facility would have a longer useful life.

Certain areas within the District, not already equipped with a booster station, were found to greatly benefit from the addition of small, localized booster stations, as pipe replacements to these areas would not achieve the same benefits and elevations were high enough that even if extensive improvements were made, pressures would still be below 40 psi during peak hour conditions.

For the Parker and Highland Booster Stations, it was felt that replacing the existing booster stations with new facilities was in the District's best interest than rehabilitation. For other existing booster stations (Black Mountain), it was determined that rehabilitating existing facilities was more cost effective.

ADVANTAGES AND DISADVANTAGES

Table 4.3 on the following page summarizes the advantages and disadvantages of each distribution system alternative considered.

Table 4.3: Distribution System Alternatives – Advantages and Disadvantages

ALTERNATIVE	ADVANTAGES	DISADVANTAGES
1 – No Action	Lowest initial cost	Low system pressures (below DEQ requirements) Limited fire protection Increased frequency of disruption of service Wide system pressure swings and fluctuations
2 – Replace Transmission Lines	Lower maintenance costs Increased fire flows Less head loss in system	Generally, more costly Additional pumping still required for servicing some areas
3 – Install New Transmission Lines	Increased fire flows Less head loss in system	Generally highest initial cost Potential easement acquirement Increased maintenance Additional pumping still required for servicing some areas
4 – Upgrading Booster Station	Improved pressures Improved workability Lower initial cost	Limited to space already allotted Potential duplication of facilities (ie. Parker). Long-term added maintenance costs compared to new booster facilities. Increased system complexity
5 – Constructing New Booster Station	Improved pressures Design with space for future growth Implement energy efficient and cost-saving features	Increased maintenance Generally high initial cost

4.2. DESIGN CRITERIA

Design criteria used to develop and evaluate the alternatives presented above have been discussed throughout this report (e.g., Sections 1.3, 1.4, and 1.5).

4.3. SITE PLAN/SCHEMATICS

See Figure 4.1 in Appendix A for project locations for the supply and storage/pressure alternatives. Additional information on the preferred alternatives is summarized in Section 5 of this report. More detailed site plans will be developed during the pre-design and design phases of the project.

See Figure 5.1 in Appendix A for the locations of the distribution system upgrades recommended as a part of this Facility Plan Update.

4.4. ENVIRONMENTAL IMPACTS: SUPPLY ALTERNATIVES

The District's existing water supply wells do not have sufficient capacity to meet DEQ's firm capacity requirements resulting in a moratorium on future connections within the District. To mitigate this issue, four alternatives were evaluated. The first was the no action alternative. The other three alternatives were to develop another Crossport Well, proceed with the development of the Cow Creek Well or Develop a new well site at a new location. See Appendix G for preliminary cost estimates of these alternatives. See Table 4.4 on the following page for additional evaluations of the supply alternatives.

A. Alternative 1 – No Action

Without providing any supply upgrades the District would be left without sufficient redundant capacity during peak events. No impact would be passed along to the environment, but significant public health risks would be present.

B. Alternative 2 – New Crossport Well

The installation of a new well at the Crossport site would provide redundant capacity for the existing and future needs. The upgrades would be in a previously disturbed area that would have a minimal impact on any environmental issues.

C. Alternative 3 – Cow Creek Well

Utilizing the recently developed Cow Creek Well would provide the District with redundant capacity for some time. The existing site would need to be further developed, the land has already been cleared and grubbed and will likely not have an adverse environmental effect.

If the well was unable to produce more than what was originally pump tested, the system demand would exceed the systems supply capacity within the 20-year planning period. Under this scenario, an additional well supply would be required with potential additional environmental impacts.

D. Alternative 4 – Develop a New Well at Site to be Determined

Developing a new well at another location would likely have the largest environmental impact, depending on where it is sited.

Table 4.4: Environmental Impacts Summary – Supply Alternatives

ENVIRONMENTAL CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 NEW WELL AT CROSSPORT FACILITY	ALTERNATIVE 3 USE COW CREEK WELL	ALTERNATIVE 4 DEVELOPMENT OF NEW WELL AT TBD
Climate / Physical Aspects (topography/geology/and soils)	Limit new development potential	No permanent adverse impacts	No permanent adverse impacts	Unknown
Population, Economic, and Social Profile	Uncorrected deficiencies will jeopardize District's economic options in the future	Increased development potential through 20-year planning period	Increased development potential through 20-year planning period pending ability to meet firm capacity	Increased development potential through 20-year planning period
Land Use	No impact	No adverse impact	No adverse impact	Likely minimal impact
Floodplain Development	No impact	No impact	No impact	Unknown
Wetlands and Water Quality	No wetlands near the project area	No wetlands near the project area	No wetlands near the project area	Unknown
Wild & Scenic Rivers	No impact	No wild/scenic rivers within project or impact areas	No wild/scenic rivers within project or impact areas	Unknown
Cultural Resources	No impact	Impact unlikely because construction will be in previously disturbed area	Impact unlikely because construction will be in near disturbed areas	Unknown
Flora and Fauna	No impact	No adverse impact	No adverse impact	No adverse impact
Recreation/Open Space	No impact	No adverse impact	No adverse impact	No adverse impact
Agricultural Lands	No impact	No adverse impact	No adverse impact	No adverse impact
Air Quality	No impact	No adverse impact	No adverse impact	No adverse impact
Energy	No impact	No adverse impact	No adverse impact	No adverse impact
Public Health	Public health risk from existing supply deficiencies	Positive long-term impact on District's ability to provide firm capacity	Positive long-term impact on District's ability to provide firm capacity	Positive long-term impact on District's ability to provide firm capacity

4.5. ENVIRONMENTAL IMPACTS: STORAGE ALTERNATIVES

The storage alternatives presented are anticipated to have minimal environmental impacts. Each tank site's potential environmental impact is shown in Table 4.5 on the following page.

A. No Action

Without providing any additional storage, the District would be left without sufficient storage capacity during emergencies. No additional environmental impacts would directly result from constructing new storage facilities, but significant public health risks would be present. The regional would also be at higher risk to fire damage.

B. New Parker Canyon Tank

The proposed Parker Canyon Tank would be constructed adjacent to a previously disturbed site. Minimal impacts are expected due to the location of the tank.

C. New Paradise Tank

The proposed Paradise Tank location is separate from any existing District infrastructure, and would require an access road, as well as site development.

D. New Highland Flats Tank

The proposed Highland Flats Tank location is separate from any existing District infrastructure, and would require an access road, as well as site development.

E. Kootenai Trail Tank (Cow Creek)

The proposed Kootenai Trail Tank location is separate from any existing District infrastructure, and would require an access road, as well as site development.

Table 4.5: Environmental Impact Summary – Storage Alternatives

ENVIRONMENTAL CRITERIA	NO ACTION	PARKER CANYON TANK	HIGHLAND FLATS TANK	NORTH PARADISE TANK	KOOTENAI TRAIL TANK
Climate / Physical Aspects (topography/geology/and soils)	No impact	Modest site expansion to have minimal impact	Modest sized site expected to have minimal impacts	Modest sized site expected to have minimal impacts	Modest sized site expected to have minimal impacts
Population, Economic, and Social Profile	Uncorrected deficiencies will jeopardize District's economic options in the future	Increased potential through 20-year planning period	Increased potential through 20-year planning period	Increased potential through 20-year planning period	Increased potential through 20-year planning period
Land Use	Reduced capacity for future development	Minimal impact; slightly less available for other	Minimal impact; slightly less available for other	Minimal impact; slightly less available for other	Minimal impact; slightly less available for other
Floodplain Development	No impact	No Impact	No Impact	No Impact	No Impact
Wetlands and Water Quality	No impact	No Impact	No Impact	No Impact	No Impact
Wild & Scenic Rivers	No impact-No Wild & Scenic Rivers in area	No impact-No Wild & Scenic Rivers in area	No impact-No Wild & Scenic Rivers in area	No impact-No Wild & Scenic Rivers in area	No impact-No Wild & Scenic Rivers in area
Cultural Resources	No impact	Unlikely, but possible	Unlikely, but possible	Unlikely, but possible	Unlikely, but possible
Flora and Fauna	No impact	Minimal, due to previously disturbed site	Possible, but limited impacts to small site area	Possible, but limited impacts to small site area	Possible, but limited impacts to small site area
Recreation/Open Space	No impact	Minimal, due to previously disturbed site	Minimal impact; slightly less land available for other use	Minimal impact; slightly less land available for other use	Minimal impact; slightly less land available for other use
Agricultural Lands	No impact	Minimal, existing land unsuitable for agriculture	Minimal, existing land unsuitable for agriculture	Minimal, existing land unsuitable for agriculture	Minimal, existing land unsuitable for agriculture
Air Quality	No impact	No permanent impacts	No permanent impacts	No permanent impacts	No permanent impacts

Table 4.5: Environmental Impact Summary – Storage Alternatives *(Continued)*

ENVIRONMENTAL CRITERIA	NO ACTION	PARKER CANYON TANK	HIGHLAND FLATS TANK	NORTH PARADISE TANK	KOOTENAI TRAIL TANK
Energy	No impact	No impacts	Minimal impacts	Long-term benefit of providing tank service at system pressure and reducing existing "repumping"	Long-term benefit of providing tank service at system pressure and reducing existing "repumping"
Public Health	Public health risk from existing uncorrected deficiencies	Quality services	Quality services	Quality services	Quality services

4.6. DISTRIBUTION SYSTEM RECOMMENDATIONS

The existing distributions system currently struggles to provide adequate pressures and flows in certain locations throughout the District. These deficiencies will be remedied by the implementation of distribution improvements. Each recommended project has alternatives that could be used to correct the identified deficiencies. The environmental concerns associated with each of the alternatives are discussed below and in Table 4.6 on the following page.

A. Alternative 1 – No Action

By not making any improvements to the distribution system there would be no direct impact to the environment. The District would continue to see inadequate pressures, large head loss during peak flow events and substandard fire flows – all of which would have an indirect negative impact on public health and added environmental risk that results from poorer fire protection.

B. Alternative 2 – Replace Transmission Lines

Increasing size of substandard and inadequate transmission mains is anticipated to result in minimal disruption of the environment as most of the transmission mains are located in previously disturbed roadways and or roadside ditches. Upon completion, no long-term adverse impact is anticipated. Pressures and fire flows throughout the system would improve.

C. Alternative 3 – Install New Transmission Lines

Installing new transmission lines to improve system looping is anticipated to result in minimal disruption of the environment as most of the transmission line loops will follow previously disturbed roadways and or roadside ditches. Upon completion, no long-term adverse impact is anticipated. Pressures and fire flows throughout the system would improve.

D. Alternative 4 – Upgrade Existing Booster Stations

Constructing upgrades in existing structures is not anticipated to have significant impact on the environment. Pressures and fire flows throughout the system would improve.

E. Alternative 5 – Construct New Booster Stations

During construction of new booster facilities, minimal disruption of the environment is anticipated to occur as the majority of the booster stations would be located on existing sites or adjacent to previously disturbed roadways. Upon completion, no long-term adverse impact is anticipated. Pressures and fire flows throughout the system would improve.

Table 4.6: Environmental Impact Summary – Distribution System Recommendations

ENVIRONMENTAL CRITERIA	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5
	NO ACTION	REPLACE TRANSMISSION LINES	INSTALL NEW TRANSMISSION LINES	UPGRADE EXISTING BOOSTER STATIONS	CONSTRUCT NEW BOOSTER STATIONS
Climate / Physical Aspects (topography/geology/and soils)	No impact	No permanent adverse impacts	No permanent adverse impacts	No permanent adverse impacts	No permanent adverse impacts
Population, Economic, and Social Profile	Uncorrected deficiencies will jeopardize District's economic options in the future	Will provide additional system capacity to support development	Will provide additional system capacity to support development	Will provide additional system capacity to support development	Will provide additional system capacity to support development
Land Use	Reduced capacity and service area for future development	Will increase land use opportunities	Will increase land use opportunities	Will increase land use opportunities	Will increase land use opportunities
Floodplain Development	No impact	No development is expected to occur within floodplains	No development is expected to occur within floodplains	No development is expected to occur within floodplains	No development is expected to occur within floodplains
Wetlands and Water Quality	No adverse impact	No development is expected to occur within wetlands. No impact to water quality expected	No development is expected to occur within wetlands. No impact to water quality expected	No development is expected to occur within wetlands. No impact to water quality expected	No development is expected to occur within wetlands. No impact to water quality expected
Wild & Scenic Rivers	No impact	No impact to the Kootenai River anticipated	No impact to the Kootenai River anticipated	No impact to the Kootenai River anticipated	No impact to the Kootenai River anticipated
Cultural Resources	No impact	Impact unlikely because construction will be in previously disturbed area	Impact unlikely because construction will be in previously disturbed area	Impact unlikely because construction will be in previously disturbed area	Impact unlikely because construction will be in previously disturbed area
Flora and Fauna	No impact	No adverse impact	No adverse impact	No adverse impact	No adverse impact

Table 4.6: Environmental Impact Summary – Distribution System Recommendations *(Continued)*

ENVIRONMENTAL CRITERIA	ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 REPLACE TRANSMISSION LINES	ALTERNATIVE 3 INSTALL NEW TRANSMISSION LINES	ALTERNATIVE 4 UPGRADE EXISTING BOOSTER STATIONS	ALTERNATIVE 5 CONSTRUCT NEW BOOSTER STATIONS
Recreation/Open Space	No impact	No adverse impact	No adverse impact	No adverse impact	No adverse impact
Agricultural Lands	No impact	No adverse impact	No adverse impact	No adverse impact	No adverse impact
Air Quality	No impact	No adverse impact	No adverse impact	No adverse impact	No adverse impact
Energy	Increased energy used for pumping	No adverse impact	No adverse impact	No adverse impact	No adverse impact
Public Health	Public health risk from existing uncorrected deficiencies	Positive long-term impact on District's ability to provide water service	Positive long-term impact on District's ability to provide water service	Positive long-term impact on District's ability to provide water service	Positive long-term impact on District's ability to provide water service

4.7. LAND REQUIREMENTS

The following is a brief discussion of land requirements for the District. In general, roughly half of the projects need either an easement or purchased land. Those projects requiring easement/land acquisition are discussed below. The cost of acquiring the easements or additional land has also been included in the project costs summarized in Appendix H.

A. Supply Alternatives

Two of the three supply alternatives do not require additional land. The Cow Creek Well, and Crossport Well alternatives are located on District owned land. The new well developed at site to be determined alternative may require the purchase of additional land.

B. Storage Alternatives

Out of the four potential tank sites, all will require additional land and some will require access easements. The District has indicated that acquiring additional land is attainable and has already begun conversations with property owners.

C. Distribution Alternatives

Roughly half of the distribution projects would require an easement or dedicated right-of-way. The proposed new booster stations would also require the District to purchase additional land or secure a permanent easement.

4.8. POTENTIAL CONSTRUCTION CHALLENGES

Below is a summary of the anticipated potential construction challenges associated with the supply, storage, and distribution alternatives considered.

A. Supply Alternatives

Utilizing a new well would likely exceed the District's existing water rights. The District would need to secure additional water rights to meet total pumping capacity or relegate one well to be a dedicated backup well. Keller Associates recommends that the District begin applying for additional water rights.

When drilling a new well (Crossport Well and new well alternatives), adequate well capacity, water quality, and depth of wells are not always guaranteed due to uncertainty associated with underground drilling. The Cow Creek Well already has several know challenges such as high levels of iron and manganese.

B. Storage Alternatives

All of the storage alternatives considered (with exception to no action) would involve construction of additional storage tanks. Constructing near the existing tank could prove to be difficult with the proposed parallel Parker Canyon Tank. All tanks will need to meet appropriate setbacks, excavation limits, embankment construction, and potential for substantial site disturbance. Additionally, appropriate drainage for overflows on new tank sites needs to be incorporated during construction. Adverse geotechnical conditions may increase foundation requirements and delay the project schedule.

C. Distribution Alternatives

Any challenges associated with the distribution alternatives are centered around the nature of underground infrastructure projects. Unmarked utilities, tight corridors, poor soils, or groundwater can cause delays and cost increases.

4.9. SUSTAINABILITY CONSIDERATIONS

All water system improvements considered would improve the sustainability of the existing water system. Selection of storage alternatives that enables the water storage to float on the system would improve operations, reduce "repumping", and increase system resiliency. Additionally, minimizing the number of booster stations and avoiding water sources with contaminants reduces energy required to operate the system and treat the water. The proposed projects seek to be environmentally conscience, economically feasible, and socially beneficial.

4.10. COST ANALYSIS

Life-cycle costs were prepared for the major supply alternatives, as well as two storage alternatives. See Tables 4.7 and 4.8 on the following pages. Factors contributing to the life-cycle cost include the capital cost and the operation and maintenance (O&M) cost for the 20-year life cycle evaluation. The O&M costs presented reflect power, replacement, and estimated expenses for site visits at each facility (e.g., travel time, visual inspection, and cleaning).

Table 4.7: Life-Cycle Cost Estimate – Supply Alternatives

	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
	ADDITIONAL CROSSPORT WELL	COW CREEK WELL	NEW WELL AT SITE TBD
Capital Cost Estimate			
Total Capital Cost[1]	$877,000	$2,051,000	$1,405,000
Operation and Maintenance Cost Estimate			
Annual Electrical	$17,000	$17,100	$17,000
Annual Maintenance	$19,900	$66,500	$26,600
Replacement[2]	$2,900	$8,600	$1,200
Total Annual O&M Cost	*$39,800*	*$92,000*	*$45,000*
20-Year O&M Cost	$796,000	$1,840,000	$900,000
20 Year Total Cost			
Total Cost	$1,673,000	$3,891,000	$2,305,000

All costs are in 2019 dollars.

1. Capital cost includes contractor overhead, contingency, and engineering.
2. Replacement costs include pumps, generators, filter media

CMWD elected to compare the life-cycle costs for the following two water storage scenarios. The first alternative involves three tanks and a small booster station. The second alternative includes four tanks. Note that each of the Parker Canyon improvements include a booster station replacement. Storage materials were selected based on District preferences and site constraints. The District also preferred to have an elevated storage tank in the Paradise Zone over a standpipe because of its lower capital cost and operational benefits. More detail can be found in Appendix G:

- **Alternative 1 – Three Tanks and Small Booster Station**
  - 260,000 gallon Parker Canyon Tank (buried concrete)
  - 200,000 gallon Highland Flats Tank (ground level concrete)
  - 300,000 gallon North Paradise Tank (elevated steel)
  - Kootenai Trail Booster Station
- **Alternative 2 – Four Tanks**
  - 210,000 gallon Parker Canyon Tank (buried concrete)
  - 200,000 gallon Highland Flats Tank (ground level concrete)
  - 200,000 gallon North Paradise Tank (elevated steel)
  - 150,000 gallon Kootenai Trail Tank (ground level concrete)

Table 4.8: Life-Cycle Cost Estimate – Storage Alternatives

	ALTERNATIVE 1 THREE TANKS AND SMALL BOOSTER STATION[2]	ALTERNATIVE 2 FOUR TANKS
Capital Cost Estimate		
Total Capital Cost[1]	$5,954,000	$6,686,000
Operation and Maintenance Cost Estimate		
Annual Electrical	$750	$250
Annual Labor	$17,000	$16,000
Replacement[2]	$3,500	$3,500
Total Annual O&M Cost	$21,250	$19,750
20-Year O&M Cost	$425,000	$395,000
20 Year Total Cost		
Total Cost	$6,379,000	$7,081,000

All costs are in 2019 dollars.

1. Capital cost includes contractor overhead, contingency, and engineering.
2. Replacement costs include coatings, pump replacement

Life-cycle cost estimates were not developed for the distribution system alternatives. Keller Associates recommends that pipe improvement alternatives and costs be further vetted as part of future pipeline predesign efforts.

5. PROPOSED PROJECT (RECOMMENDED ALTERNATIVE)

This section of the report includes a summary of the recommended improvement projects. After reviewing the various alternatives, the District has elected to pursue all of the recommended priority 1 improvement projects as described below:

- Develop a new well at the Crossport site to meet current and future supply requirements. Complete additional improvements at the existing Crossport Well facility.
- Construct three new storage tanks (Parker Canyon, Highland Flats, North Paradise) for a total of 760,000 gallons of storage to meet current and future storage needs.
- Replace the Highland Booster Station; replace the Parker Canyon Booster Station; add Mountain Meadows Booster Station; add Cow Creek Booster Station; and complete improvements at Black Mountain Booster Station.
- Upgrade the Naples pressure reducing valve station.

These Priority 1 projects, along with other future improvements, have been organized into a Capital Improvement Plan (CIP). Priority 1 improvements address the existing storage deficiency, improve pressures above the required 40 psi minimum during peak hour events, and increase the available fire flow in the system to above 250 gpm. The improvements are prioritized by need and displayed in Table 5.1 on the following page. Appendix H contains a breakdown of planning level cost estimates for each improvement project; Figure 5.1 in Appendix A shows the locations of these improvements.

Also included in the CIP are Priority 2 and 3 projects, which are intended to provide additional redundancy/reliability, improved pipe looping, transmission, and fire protection. These improvements are primarily geared towards increasing fire flows to greater than 500 gpm. Based on model results, the Priority 3 projects yield lower benefits compared to the cost, and as such are given a lower priority. Priority 2 and 3 improvements should be coordinated with future development, pipeline extensions, and pipeline replacement needs where practical.

In addition to the recommended capital projects, Keller Associates developed annual replacement budget recommendations for the District's pipelines, booster stations, wells, storage facilities, hydrants, and meters. A summary of these costs is also presented in Table 5.1. We recommend that the District begin setting aside funds for these replacements and recognize that fully funding the replacement program may take many years. Given the remaining life of the existing assets, priority should be given to short-lived assets (i.e. pumps) as well as preventative maintenance activities at pumping and storage facilities. Pipeline replacements may not be needed for many years and could initially focus on areas where undersized pipelines could be replaced with a coordinated road reconstruction project. Once the District retires the existing debt, we recommend funds currently committed toward existing debt be dedicated toward a long-term annual replacement budget.

Table 5.1: Capital Improvement Plan

ID	Project	Est. Cost (2019 Dollars)
	Priority 1 Improvements	
W1.1	Alternative 1: Additional Crossport Well	$877,000
T1.1.2	Parker Canyon Tank (260,000 gal) and Remove and Replace Booster Station	$2,107,000
T1.2	Highland Flats Tank (200,000 gal)	$1,370,000
T1.3	North Paradise Elevated Tank (300,000 gal)	$2,192,000
1.1	Highland Booster Replacement	$586,000
1.2	Black Mountain Booster Improvements	$179,000
1.3	Mountain Meadows Rd. Booster	$285,000
1.4	Naples Pressure Reducing / Pressure Sustaining Valve	$62,000
1.5	Kootenai Trail Booster	$285,000
CI	Crossport Well Facility Improvements	$168,000
CI	Black Mountain Facility Improvements	$103,000
	Total Priority 1 (rounded)	***$8,214,000***
	Priority 2 Improvements	
2.1	Brown Creek Road Distribution Improvements	$490,000
2.2	Naples Zone US-2 Loop	$698,000
2.3	Quail Drive Distribution Improvements	$220,000
2.4	Blue Sky Distribution Improvements	$1,315,000
CI	Priority 2 - Existing Facilities Improvements	$460,000
	Total Priority 2 (rounded)	***$3,183,000***
	Priority 3 Improvements	
3.1	Highland Flats Road and McArthur Lake Road Distribution Improvements	$2,083,000
3.2	South Highlands Distribution Improvements	$68,000
3.3	Roman Nose Dr Distribution Improvements	$483,000
3.4	South Naples Distribution Improvements	$2,796,000
3.5	Frontier Village Distribution Improvements	$423,000
3.6	Northeast Paradise Distribution Improvements	$1,498,000
3.7	Coyote Way Distribution Improvements	$450,000
3.8	Pinnacle Circle Distribution Improvements	$695,000
3.9	Cottage Lane Distribution Improvements	$293,000
3.10	Grumpy Lane Distribution Improvements	$291,000
3.11	Northeast Paradise Distribution Improvements	$594,000
	Total Priority 3 (rounded)	***$9,674,000***
	Total Priority 1, 2 & 3 Improvement Costs	**$21,071,000**
	Annual Replacement Budget	
	Water Distribution Lines	$286,000
	Fire Hydrants	$25,000
	Water Meters	$13,000
	Well Facilities	$21,000
	Booster Facilities	$26,000
	Storage Facilities	$12,000
	Total Annual Replacement Budget Costs	**$383,000**

Notes
1) Timing depends on when growth occurs. Development participation anticipated.
2) The cost estimate herein is based on our perception of current conditions at the project location. This planning level estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures.

5.1. PRELIMINARY PROJECT DESIGN

Each project identified in the CIP will help create a more reliable District water system. Preliminary plans for each improvement were discussed in Section 4 of this report, with locations shown in the facility plan Figure 5.1, in Appendix A. Brief descriptions of additional design considerations follow. Refer to Figures 5.2 and 5.3 in Appendix A to see these recommended improvements provide target pressures and fire flows.

Priority 1 Improvements:

Project W1.1 – Additional Crossport Well

An additional well at the Crossport site will be developed. Pending the results of the existing well casing investigation, this may include redrilling the existing Well # 3 well casing (budget for redrilling is included in the CIP). The well will be connected to the existing system, and the existing building will be expanded to accommodate the new well. The well is expected to be capable of supplying 500 gpm with minimal drawdown, similar to the existing Crossport wells. The proposed well will have access to standby power and will be connected to the District's existing controls system.

Project T1.1.2 – Parker Canyon Tank (260,000 gal) and Remove and Replace Booster Station

A new partially buried, concrete water storage tank will be constructed adjacent to the existing Parker Canyon Tank. The two tanks will be interconnected and will essentially operate as a single tank under normal operations. Isolation valves will allow one of the tanks to be taken offline for maintenance purposes. The existing Parker Canyon Booster station will be abandoned in favor of a new booster station. The new Parker Canyon Booster Station will be constructed near the proposed tank and be capable of operating with one or both of the existing tanks supplying the pumps. The new booster station will have twice the capacity of the existing Parker Canyon booster station. The new pump station will be equipped with standby power and variable frequency drives with the ability to operate based on local pressures. Additional land will need to be purchased adjacent to the existing Parker Canyon Facility.

Project T1.2 – Highland Flats Tank (200,000 gal)

Currently, there is no storage in the Highland Flats Pressure Zone. A Partially Buried Concrete Tank will be installed on a nearby hill at the hydraulic grade of the pressure zone. The project will consist of the partially buried concrete tank, an access road, overflow protection measures, yard piping and valving, and electrical and controls. Additional land will need to be purchased.

Project T1.3.2 – North Paradise Elevated Tank (300,000 gal)

The North Paradise Elevated Tank is intended to provide additional systemwide storage, with an emphasis specifically in the north portion of the Paradise pressure zone. This project will consist of an access road, yard piping, an elevated steel tank, valving, and controls. The District has already acquired property at this location, but additional land may need to be purchased.

Project 1.1 – Highland Booster Replacement

The existing Highland Flats Booster Station will be replaced with a new booster station. The replacement booster station will have duty pumps and larger pumps to meet average and maximum demands. This project will include installation of the new pumps, a new CMU building, instrumentation, generator, mechanical and yard piping, controls, and demolition of the existing booster station. Additional land or easement will need to be acquired.

Project 1.2 – Black Mountain Booster Improvements

This project includes upgrades to the existing Black Mountain Booster Station. Air relief and pressure relief provisions will be installed, as well as installation of a pressure sustaining valve to maintain pressure in the Paradise Zone when the tank is filling. The existing primary duty pump will be replaced.

Project 1.3 – Mountain Meadows Road Booster

The goal of this project is to improve pressure to comply with DEQ minimum pressure requirements. The project will include a new small booster station with two pumps, mechanical piping/valving, instrumentation, and a generator. Pumps will be sized to deliver peak hour demands. This project requires an easement.

Project 1.4 – Naples Pressure Reducing/Pressure Sustaining Valve

This project consists of replacing the existing pressure sustaining valve with a combination pressure sustaining/reducing valve. SCADA integration, and power supply upgrades will also be included in the project.

Project 1.5 – Kootenai Trail Booster

The goal of this project is to improve pressure to comply with DEQ minimum pressure requirements. The project will include a new small booster station with two pumps, mechanical piping/valving, instrumentation, and a generator. Pumps will be sized to deliver peak hour demands. This project requires an easement.

Project CI – Crossport Well Facility Improvements and Black Mountain Tank/Booster Improvements

This project involves additional improvements to the existing Crossport and Black Mountain facilities that are needed based on on-site evaluations. At the Crossport Site, this includes a replaced generator, pressure and air relief provisions, and new flowmeters. At the Black Mountain Facility, flowmeter replacement and tank rehabilitation are included.

Priority 2 and 3 Improvements:

Project 2.1 through 2.4 – Priority 2 Water Distribution Projects

These projects are intended to improve pressure, and fire flow capabilities of the system by installing new 10-inch diameter water mains along key portions of the water distribution system. Pipe installation, road repair, traffic control, and connection to existing system are included with these projects.

Project CI – Priority 2 – Existing Facilities Improvements

This project involves installing intrusion alarms, controls and pump upgrades, tank rehabilitation, pipe repainting, and valve replacement at various existing facilities within the District. These improvements are not considered as urgent as Priority 1 conditions improvements. Funding for these improvements could come from the annual replacement program.

Project 3.1 through 3.11 – Various Transmission Improvements

These projects are intended to improve pressure and fire flow capabilities of the system by installing new 8 to 12-inch diameter water main along critical segments of the water distribution system. These improvements include both replacement of undersized lines as well as new pipeline extensions / looping. Pipe installation, road repair, traffic control, and connection to existing system are included with these projects.

5.2. PROJECT SCHEDULE

Priority 1 improvements should be implemented within the next 1-5 years, Priority 2 improvements should be completed within 5-10 years, and Priority 3 and Future improvements should be completed as needed to accommodate development and improve fire flows.

5.3. PERMIT REQUIREMENTS

Each project will have its own permitting requirements that will be handled as the projects are implemented. Priority 1 improvements are anticipated to require highway permits, water rights permitting, and DEQ approvals. Other permits (e.g., SWPPP, traffic, plumbing, and electrical) will be required to be obtained by the contractor.

5.4. SUSTAINABILITY CONSIDERATIONS

Projects included in the CIP will improve the sustainability of the District's water system by increasing redundancy and reliability in supply and distribution, increasing pressures to meet recommended minimums, and increasing available fire flows. The additional supply redundancy will help enable the District to provide peak demands with one of their wells offline. Increased pressures throughout the District will reduce the number of low-pressure complaints and help to increase fire flow availability. Abandoning certain inadequate facilities (such as the existing Highland Flats Booster Station) and constructing a new booster station will also improve system reliability. The addition of new tanks will booster stations will provide additional redundancy, which will assist the District in emergency situations. Improvements to the distribution system will enable the District to move toward recommended fire flow. New capital improvements will also improve system operations by employing energy efficient pumps and an operating approach that reduces the total energy consumption (i.e. less water will need to break head and be repumped from Black Mountain).

Keller Associates anticipates that the operations and maintenance budget implications will be fairly minimal, with the most notable added O&M cost being associated with the maintenance of additional booster stations (between removals and replacements of booster stations, the District will add a single booster station) and added maintenance associated with the new storage tanks. However, as the system continues to age, system replacement needs – particularly for short-lived assets such as pumps, electrical, etc. – will require that the District's user rates be sufficient to meet these needs. This may require modest increases in user rates each year. As mentioned previously, we recommend that revenues currently dedicated to existing debt service be dedicated to a system replacement fund once the debt is retired in 2027.

5.5. ORGANIZATIONAL AND STAFFING REQUIREMENTS

Existing District personnel will be able to operate and maintain the system upgrades. No new treatment or chemicals are anticipated to be added as a part of these projects. The District's existing operators and their certifications are included below:

- Jeremy Davy, Responsible Charge Operator -Distribution and Treatment Level 1 Certifications, working towards Distribution Level 2 Certification
- Chris Lewandowski, associate operator-Working towards Level 1 Certification

The proposed upgrades are not adding a water treatment facility and it is anticipated that current staff will be able to maintain the existing and new facilities. Improvements to the existing facilities are expected to reduce operation and maintenance requirements, and add minimal costs. Added replacement costs associated with short-lived assets should be addressed with increased available funding that will result when the existing debt service retires.

- Existing system: three (3) tanks, five (5) booster stations, and one (1) supply facility complex comprised of 2 wells
- Proposed System: five (5) tanks, six (6) booster stations, and one (1) supply facility complex comprised of 3 wells

5.6. TOTAL PROJECT COST ESTIMATE

A planning level opinion of probable cost for each recommended improvement were summarized in the CIP, in Appendix H, with a breakdown of how these costs were developed provided in Appendix H. As the project progresses through predesign and design, these estimates should be updated.

5.7. ANNUAL OPERATING BUDGET

The District reports that their annual income is essentially equal to the existing annual expenses. Funding new projects will require additional debt service. Once the existing debt service is retired in 2027, the current annual payment of approximately $180,000 per year should be dedicated to replacement of District assets.

5.8. FINANCING OPTIONS

Recommended improvements identified above will be necessary in order to accommodate demands created by future growth, as well as address existing deficiencies. Consequently, adequate funds generated by hook-up fees from future connections, user rates from existing customers, grants, and long-term financing options will all be needed to fund these recommended improvements.

A variety of funding sources exist in both the private and public sectors, contingent on a project meeting certain criteria. The following paragraphs give a brief description of several grant and loan resources available.

A. Idaho Department of Environmental Quality (Water State Revolving Fund [SRF])

The SRF program has experienced significant changes over the last few years. It is funded by a combination of repayment of loans previously made by DEQ and grant money supplied by EPA. Owners of public water systems can apply for SRF funds annually through a competitive application process, which generally has an application deadline around January of each year. Applications are ranked by State officials based on need, sustainability, water quality improvements, and other criteria. Davis-Bacon wages are required. Currently, loan terms can range from 20-30 years, and interest rates from 0-2%, depending on applicant’s user rates and median household income. Applicants may even qualify for principal forgiveness. DEQ is required to commit a significant percentage of available loan funds to sustainable, energy-efficient, and “green” infrastructure improvements. Consequently, elements that meet the “green” infrastructure qualifications may receive priority for funding. Voter approval in a bond election, or judicial confirmation, is required for this funding source. Letters of interest are typically due in January and qualifying public utilities may receive funding as soon as July of the same year.

B. Department of Commerce (DOC) and Community Development Block Grants (CDBG)

The Department of Commerce offers a number of grant programs for public water system improvements. Eligibility for these funds is dependent on economic development. Grants up to $500,000 are available through community programs. Applicants must secure the services of a certified grant administrator to administer grant money and follow other grant requirements. There is an annual application window for applying for these funds, which generally has a deadline around November.

C. United States Department of Agriculture-Rural Development (USDA-RD)

USDA-RD offers a grant and loan program for improvements to water systems that serve rural communities, which is defined as systems that serve less than 10,000 people. Grants up to 45% (typically closer to 25%) of the project cost are eligible, depending on user rates. Applicants can apply for USDA-RD funds at any time during the year. Funds include several program requirements – including but not limited to the completion of a short-lived asset inventory and approved engineering report; and limited funding for fire-protection water storage volumes. Voter approval in a bond election and interim financing are required with this funding source.

D. Idaho Bond Bank

A bond bank is a state-level entity which lends money to local governments within the state, with the goal of providing funds for their infrastructure needs and access to capital markets at competitive interest rates. Under the Idaho Bond Bank program, a municipality obtains a loan from the Bond Bank secured by either the municipality's bond or a loan agreement with the Bond Bank. The Bond Bank pools several loans to municipalities into one bond issue. The municipalities then make loan payments, which are used to repay the revenue bonds. The Bond Bank can obtain better credit ratings, more attractive interest rates, and lower underwriting costs than municipalities could achieve individually. Funds administered through the Bond Bank are not subject to Davis-Bacon wages or American Iron and Steel requirements found in other funding sources.

The Bond Bank is able to pledge certain state funds as additional security for its bonds, further reducing interest costs. The Idaho Bond Bank Authority can open doors to municipalities that were previously barred from the capital markets due to high costs of financing or challenging credit situations. The current underlying rating from Moody's Rating Agency is Aa1. Rates are typically higher than USDA or DEQ options.

E. Local and Private

In addition to federal and state funding programs, local and private funding sources are available to communities as well. These include a local improvement district (LID), the municipal bond market with voter approval, a business improvement district (BID), urban renewal district, connection fees, and development agreements with developers. Due to CMWD's size, some of these options would likely not be feasible.

5.9. SHORT LIVED ASSETS

System costs for short-lived assets (SLA) should be for reserves to replace/repair components of the facility which is being financed "… which have a useful life significantly less than the repayment period of the loan." For example, if the project is only construction of water distribution mains there will likely be no SLAs, but if the project and/or facility being financed include well pumping improvements or a water storage tank, there will be SLAs. SLA items are equipment/assets which are not daily/weekly/monthly O&M type items. The time frame for these items has been established in three periods: 0-5 years, 6-10 years, and 11-15 years. The priority SLA costs identified as part of the conditions assessment have been included in the Priority 1 improvement costs. Additional short-lived assets are anticipated to be fully funded once the existing debt service is retired. Eventually, Keller Associates recommends that the short-lived asset replacement budget be expanded to fully fund long-term asset replacement needs. Summary of the SLA can be found in Appendix N.

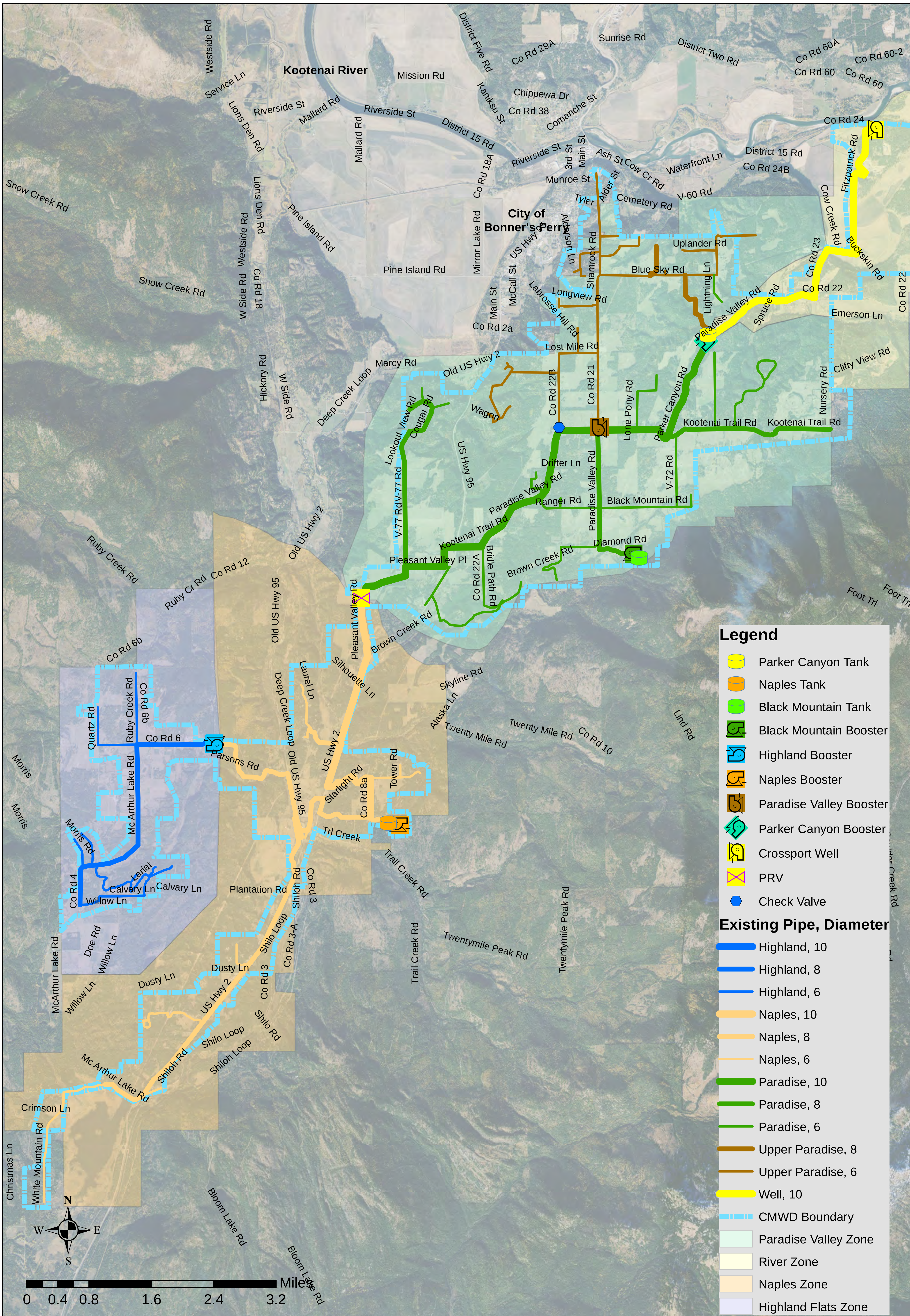
5.10. USER RATE IMPACTS

DEQ, CDBG, and USDA-RD appear to be the most favorable funding sources for the District to pursue. All three options could potentially provide assistance in the form of low interest loans, grant money, or principal forgiveness to lessen the impact on CMWD's user rates. Appendix K presents several potential funding scenarios from DEQ and USDA-RD to complete Priority 1 improvements. Additional sources of funding may decrease the anticipated rate increase associated with these projects. Rates are expected to increase by $30 and $50 per connection per month, pending final funding sources. With existing rates of $45 per month per connection, the new rates could be $75 - $95 per month.

6. CONCLUSION AND RECOMMENDATION

Keller Associates recommends that the District proceed with Priority 1 improvements. A promising funding strategy may include using DEQ funding for interim financing, pursuing the CDBG grant, providing a portion as local match, and then pursuing USDA-RD funding for final financing for all Priority 1 improvements. This scenario appears to maximize the grant/principal forgiveness potential for this project. It is anticipated that these improvements will improve fire protection and provide sufficient supply and storage capacity for the District's water system throughout the 20-year planning period. The District already submitted a letter of interest to DEQ in January 2019 and is planning to submit CDBG and USDA-RD funding applications. Remaining funding steps for the District will be to pass a bond, submit funding application documentation to DEQ, and apply for CDBG and USDA-RD funding.

APPENDIX A
FIGURES



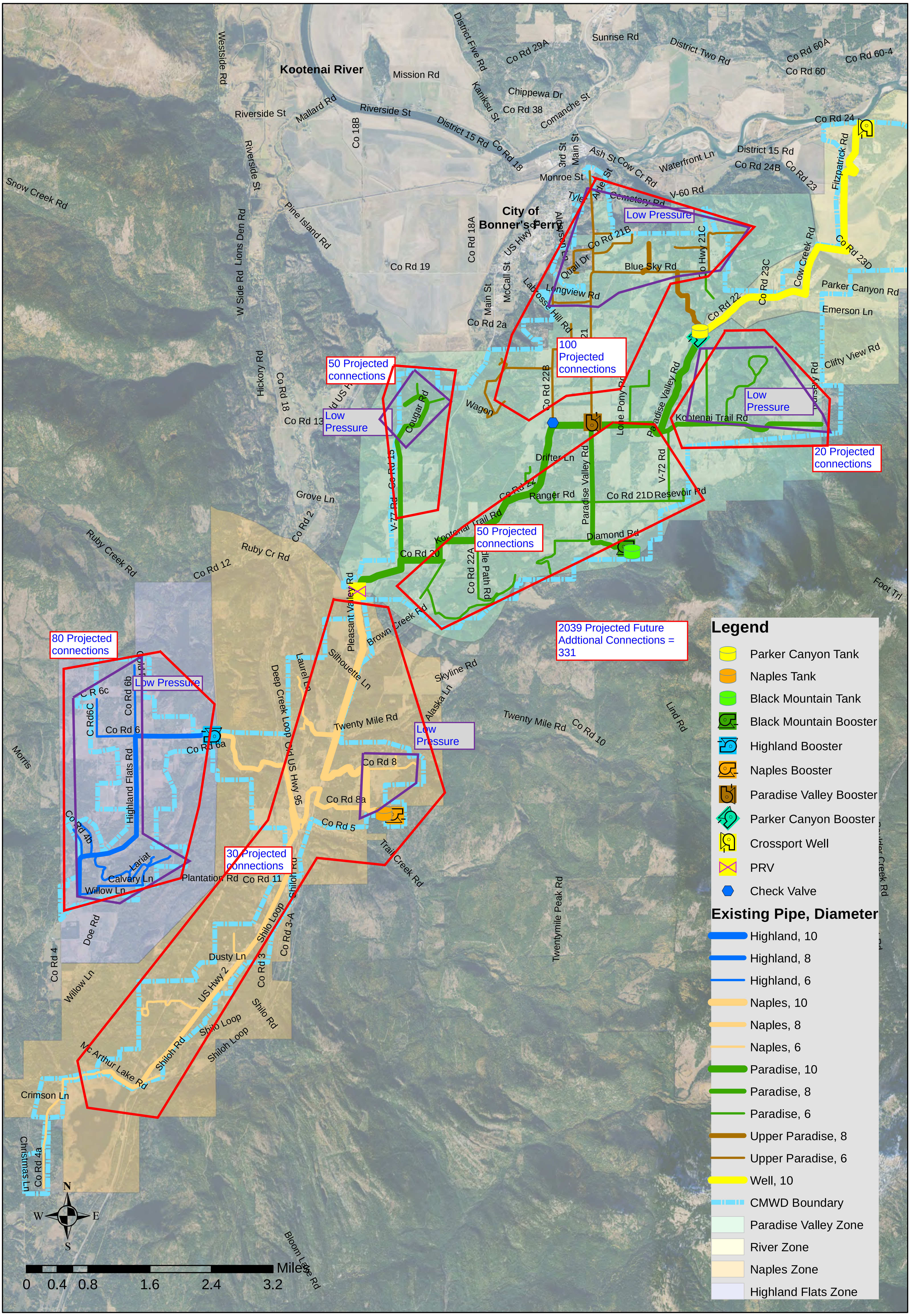
KELLER ASSOCIATES

Existing System

Facility Plan Update

Figure 1.1

CMWD, ID
September 2019



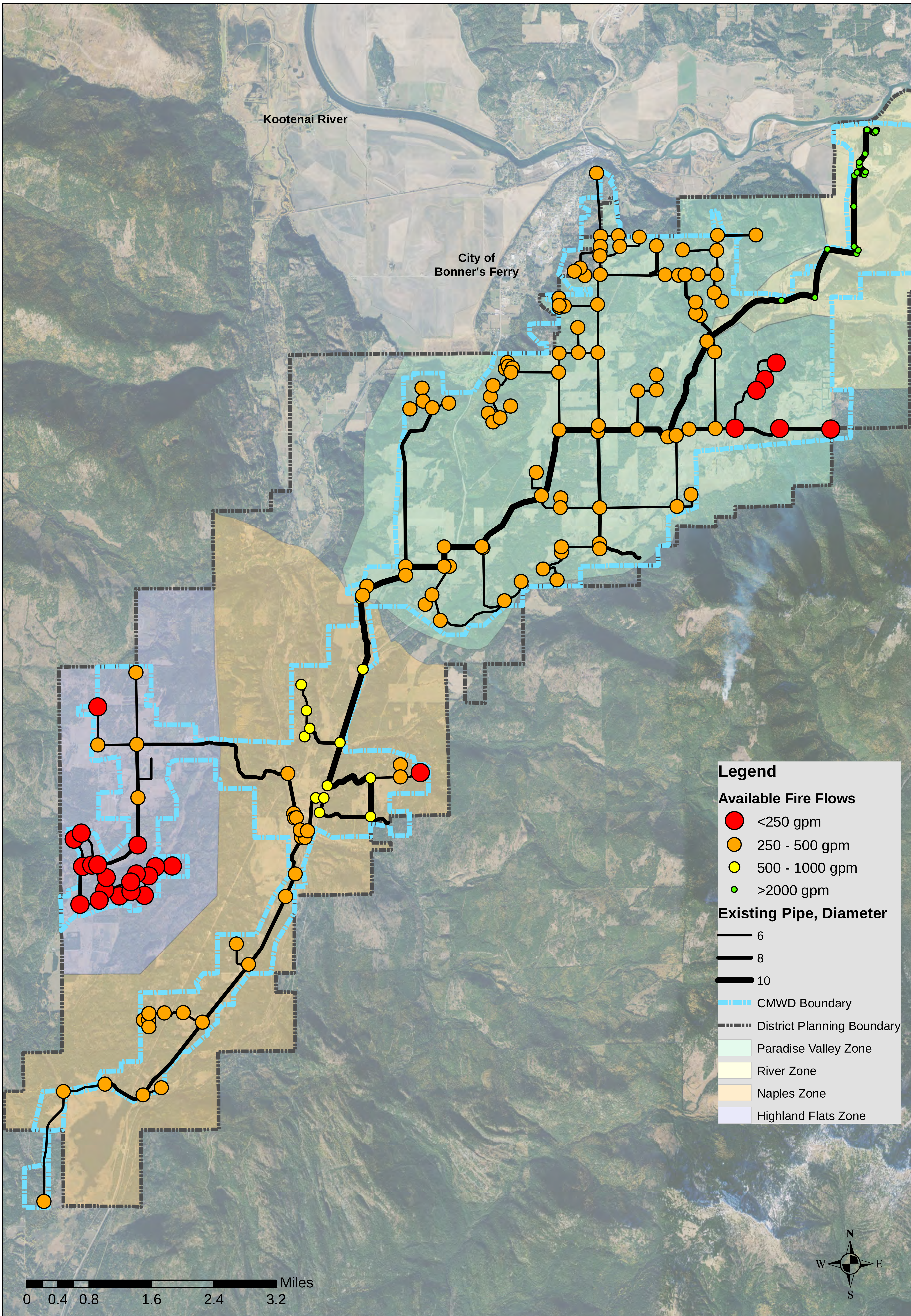
KELLER ASSOCIATES

Anticipated Growth Areas

Facility Plan Update

F Figure 2

CMWD, ID
September 2019



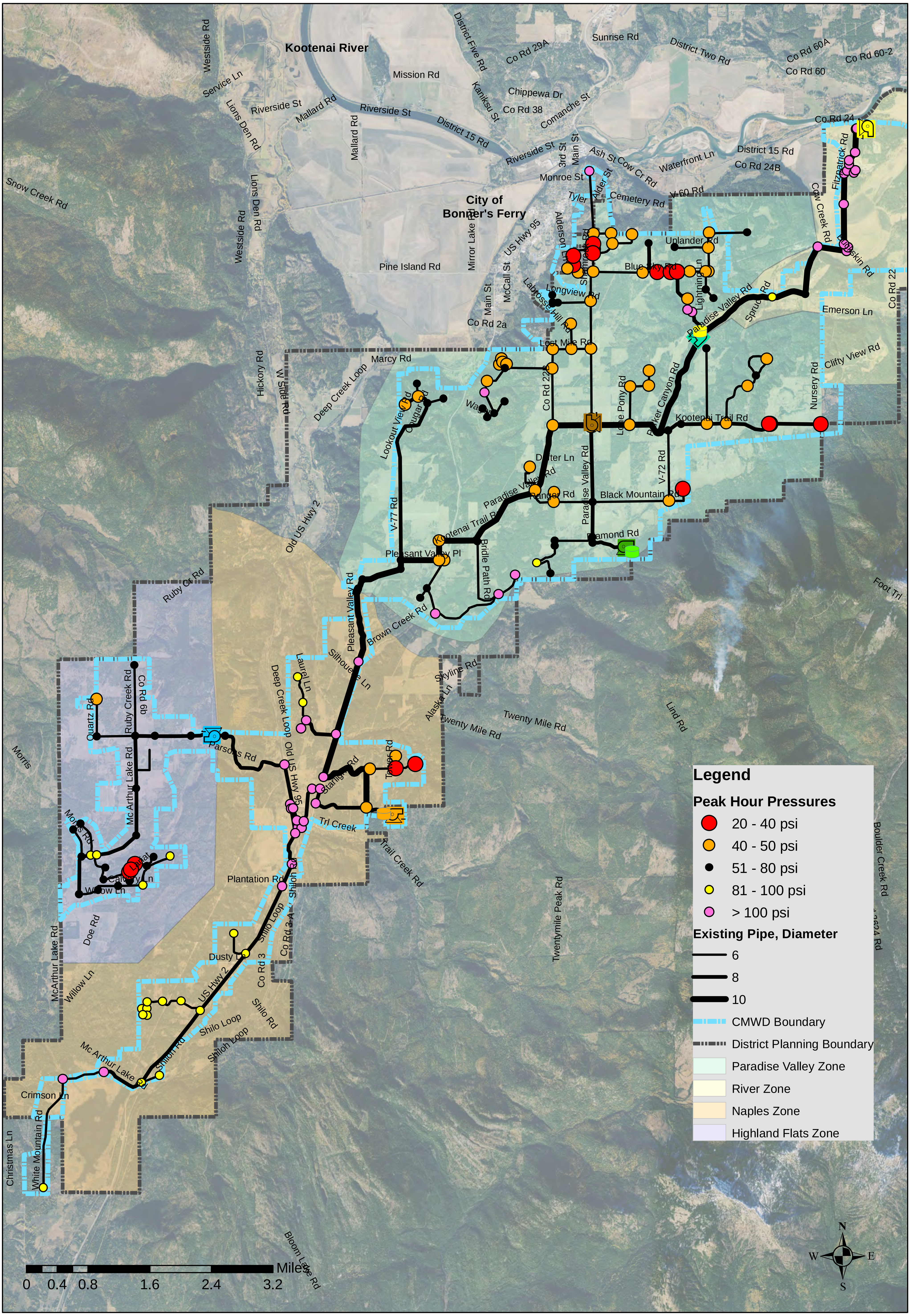
KELLER ASSOCIATES

Exisiting Fire Flow Deficiencies

Facility Plan Update

Figure 2.2

CMWD, ID
September 2019



KELLER ASSOCIATES

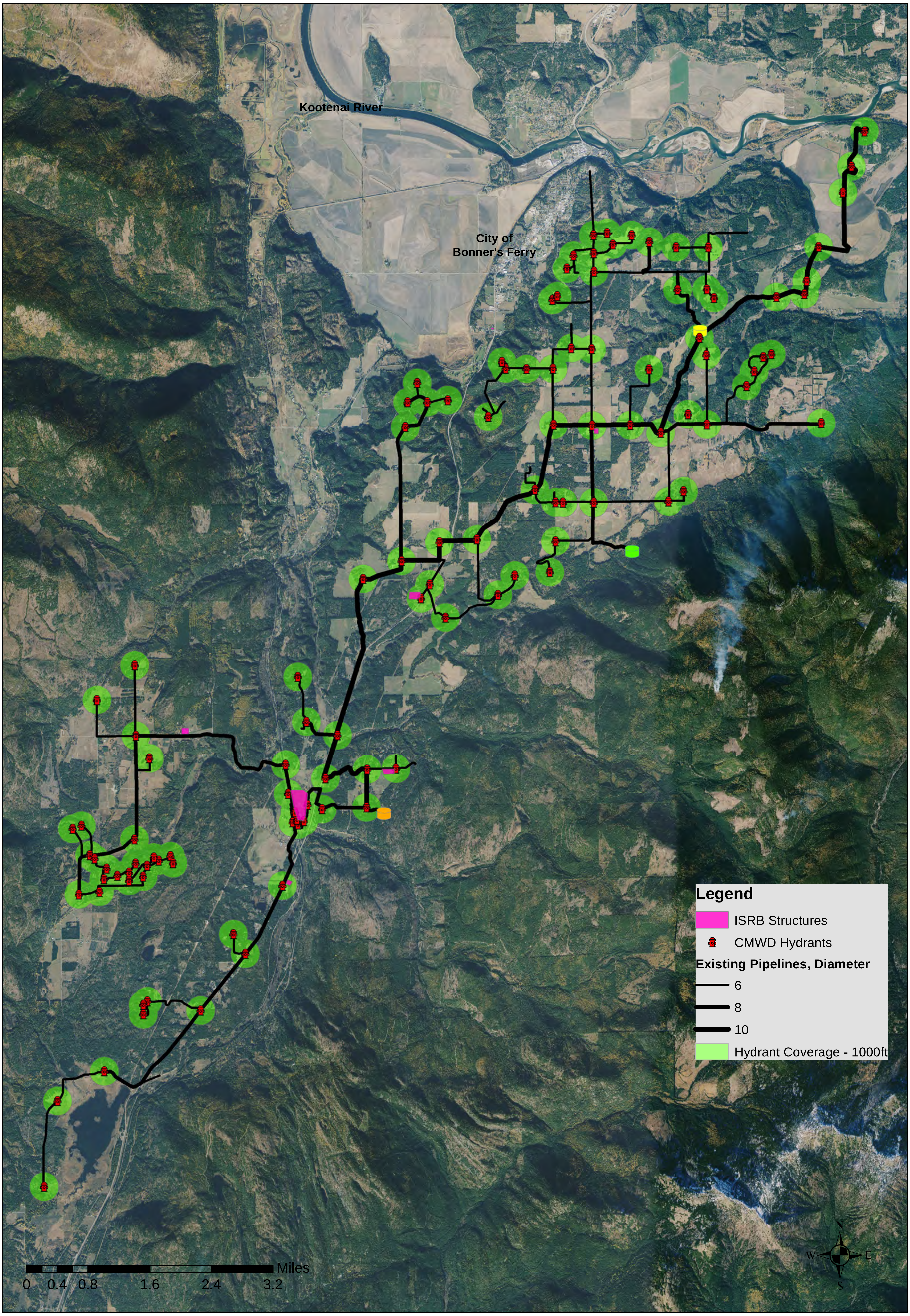
Existing Peak Hour Pressures

Facility Plan Update

Figure 2.3

CMWD, ID

September 2019



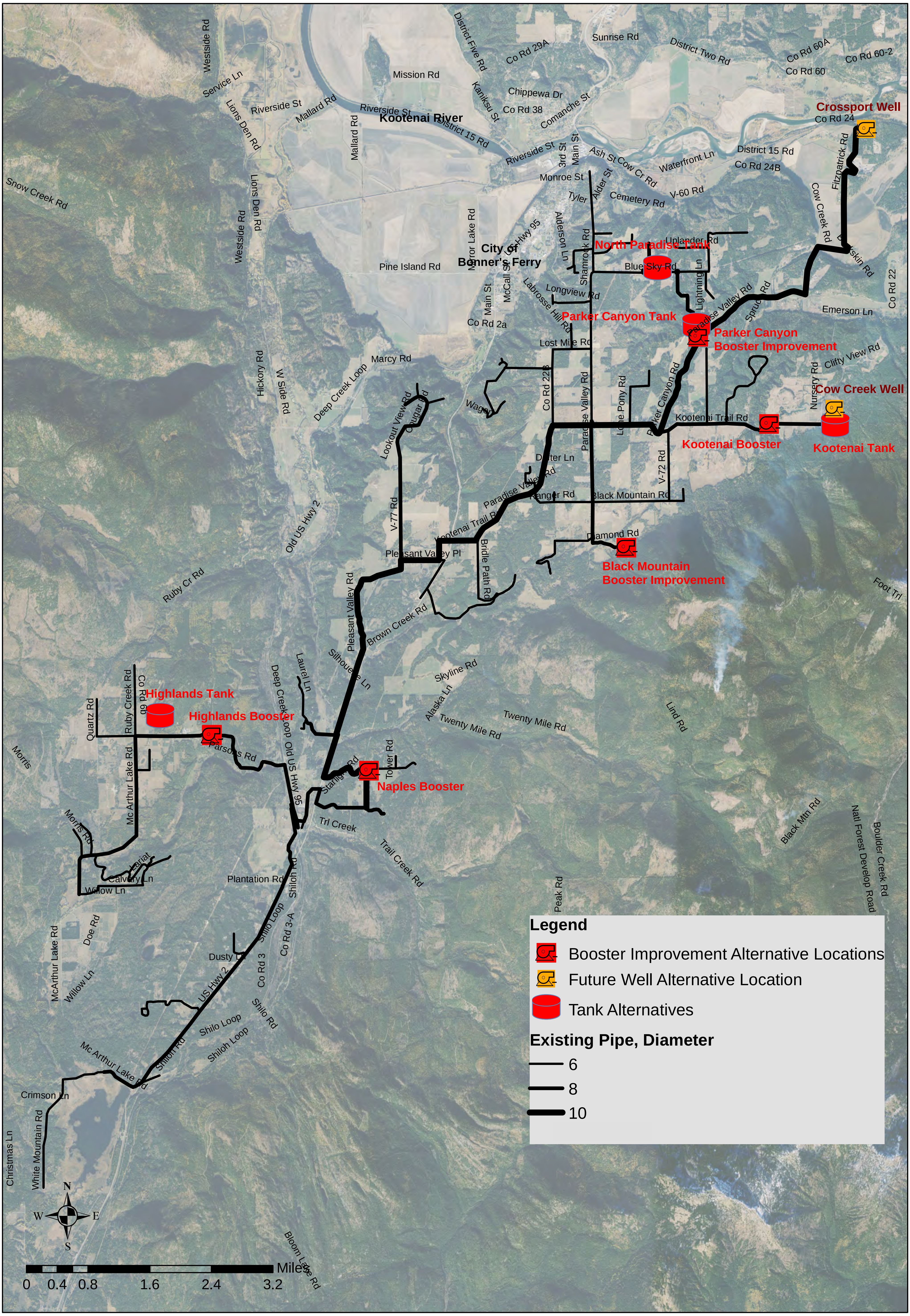
KELLER ASSOCIATES

Hydrant Coverage Locations

Facility Plan Update

Figure 2.4

CMWD, ID
September 2019



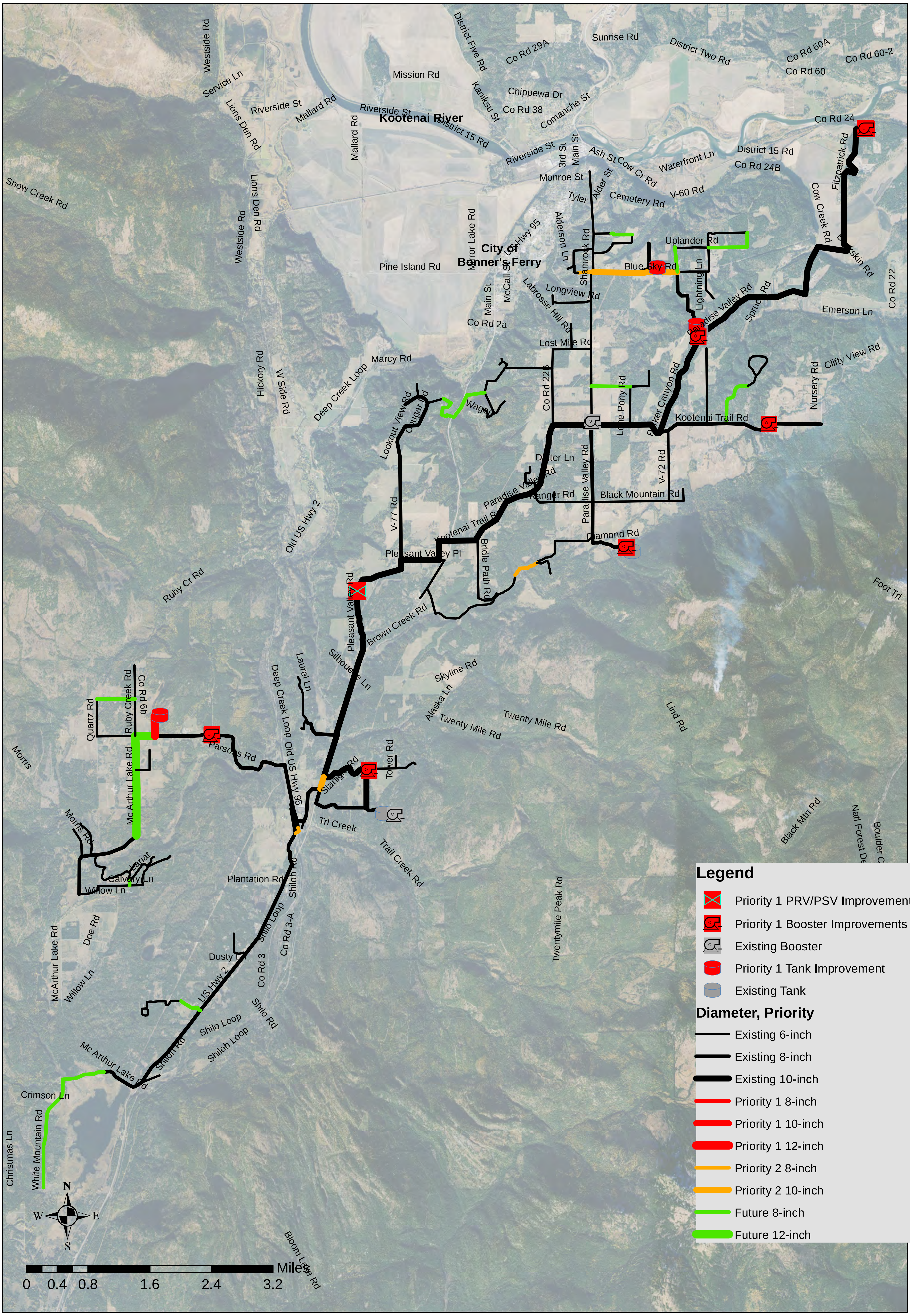
KELLER ASSOCIATES

Improvement Alternatives Locations

Facility Plan Update

Figure 4.1

CMWD, ID
September 2019



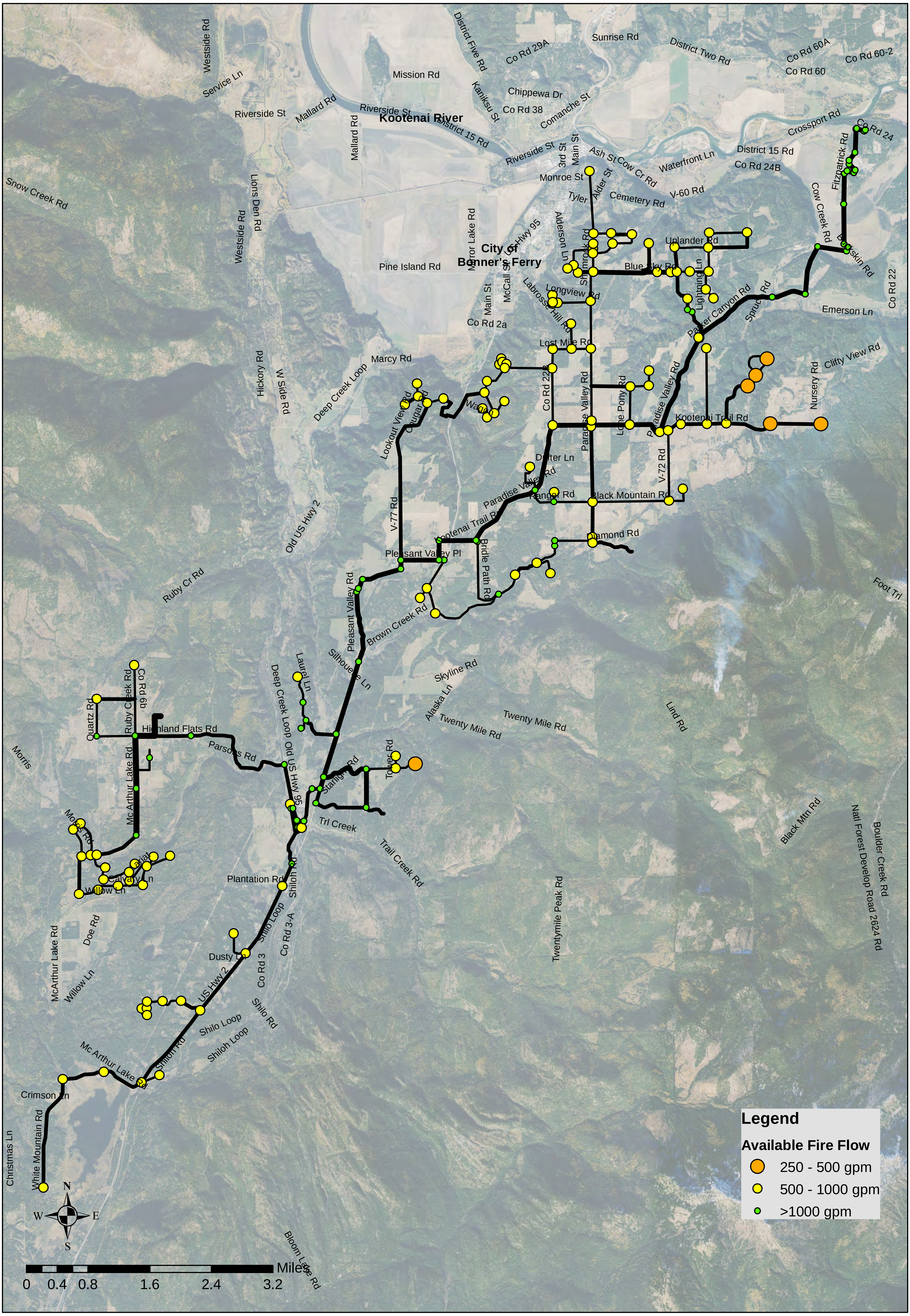
KELLER ASSOCIATES

CIP Improvements

Facility Plan Update

Figure 5.1

CMWD, ID
September 2019



KELLER ASSOCIATES

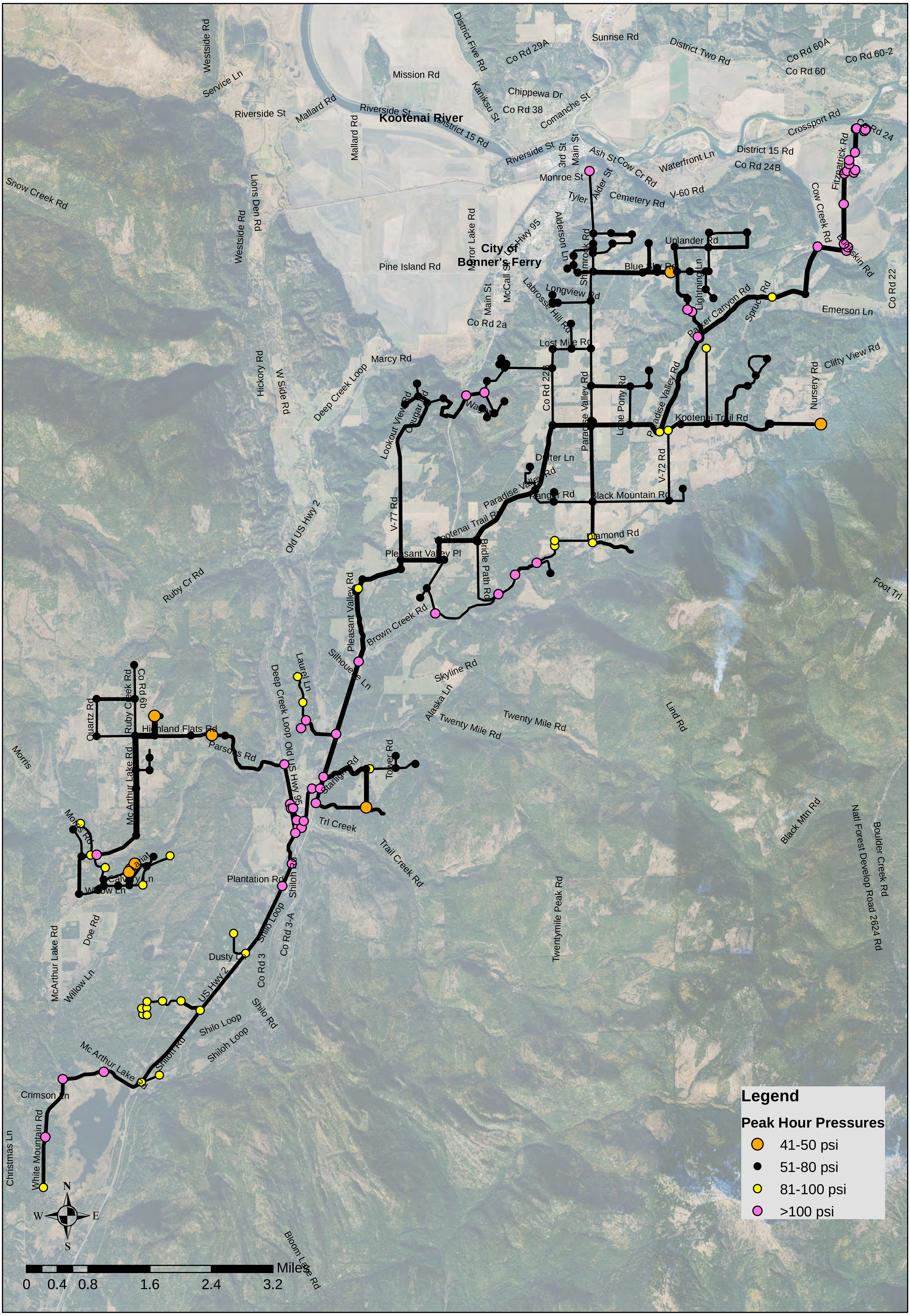
Future Max Day Available Fire Flow

All Priority Improvements

Figure 5.2

CMWD, ID

September 2019



Future Peak Hour Pressure

All Priority Improvements

KELLER ASSOCIATES

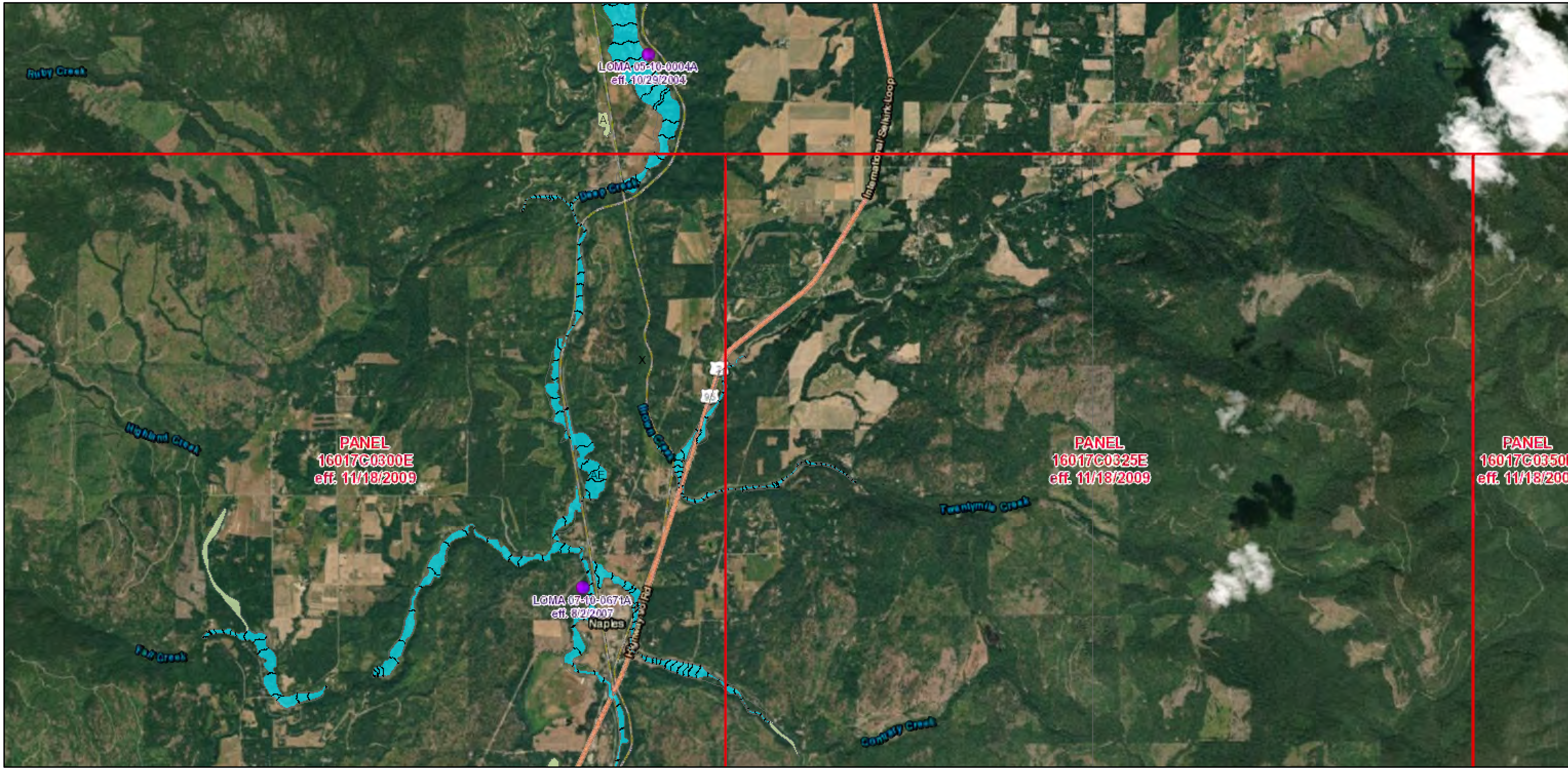
Figure 5.3

CMWD, ID

September 2019

APPENDIX B
ENVIRONMENTAL

Flood Hazard Map-Middle



6/10/2019, 11:04:44 AM

1:72,224

0 0.5 1 2 mi

0 0.75 1.5 3 km

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee

Special Flood Hazard Area

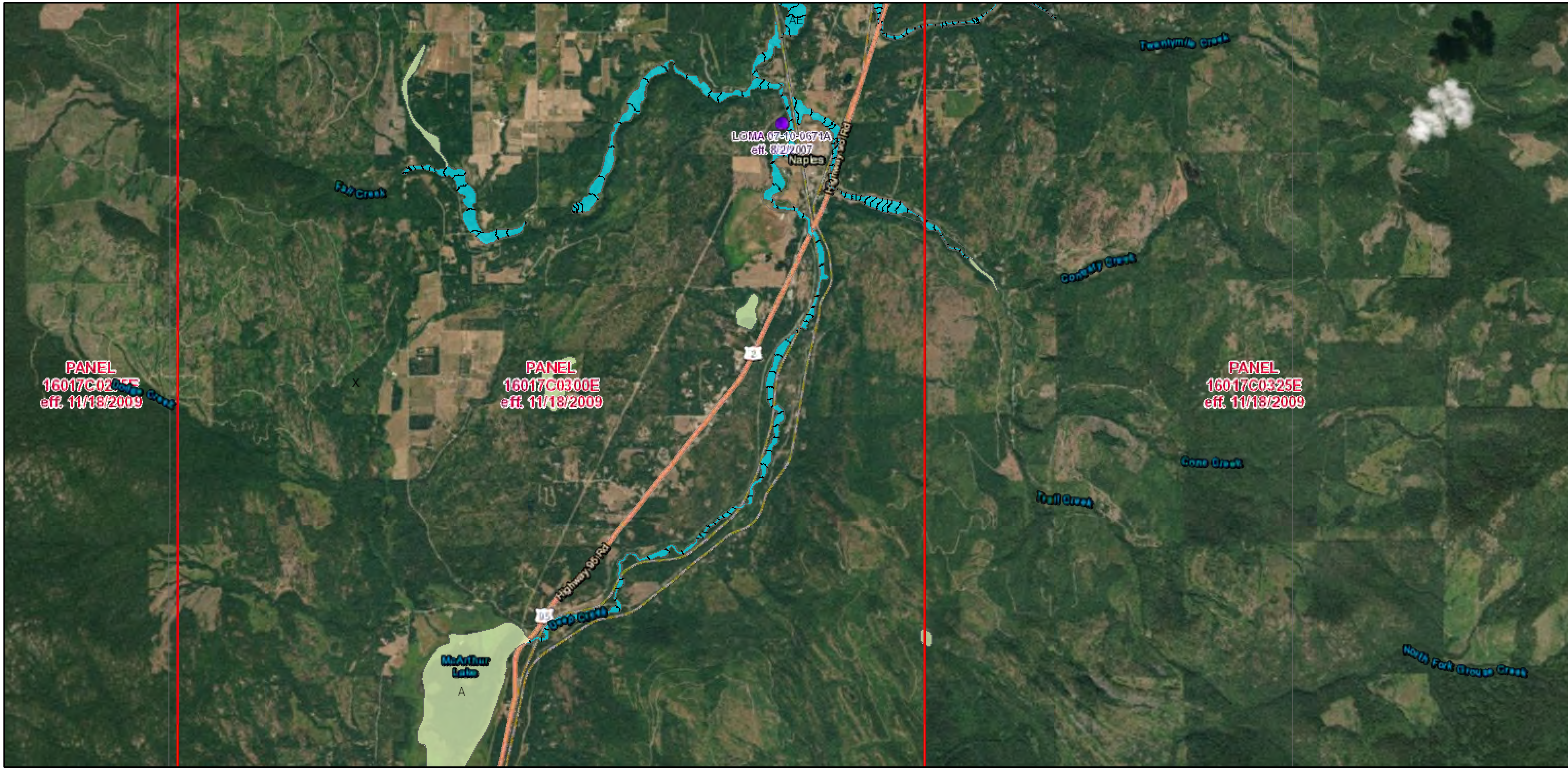
- Zone A
- Zone AE
- Zone AH
- Zone AO
- Zone D (Unknown)
- X
- Base Flood Elevation (Merged)

Esri, HERE, Garmin, (c) OpenStreetMap contributors, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and

Idaho Department of Water Resources

USDA FSA, DigitalGlobe, GeoEye, Earthstar Geographics | Idaho Department of Water Resources | Esri, HERE | Esri, HERE, Garmin |

Flood Hazard Map-South



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Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee

Special Flood Hazard Area

- Zone A
- Zone AE
- Zone AH
- Zone AO
- Zone D (Unknown)
- X
- Base Flood Elevation (Merged)

1:72,224

0 0.5 1 2 mi

0 0.75 1.5 3 km

Esri, HERE, Garmin, (c) OpenStreetMap contributors, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and

Idaho Department of Water Resources

USDA FSA, DigitalGlobe, GeoEye, Earthstar Geographics | Idaho Department of Water Resources | Esri, HERE | Esri, HERE, Garmin |

Flood Hazard Map-Upper

6/10/2019, 11:06:17 AM

Flood Hazard Zones

- 1% Annual Chance Flood Hazard
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee

Special Flood Hazard Area

- Zone A
- Zone AE
- Zone AH
- Zone AO
- Zone D (Unknown)
- X
- Base Flood Elevation (Merged)

1:72,224

0 0.5 1 2 mi

0 0.75 1.5 3 km

Esri, HERE, Garmin, (c) OpenStreetMap contributors, Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and

Idaho Department of Water Resources

USDA FSA, DigitalGlobe, GeoEye, Earthstar Geographics | Idaho Department of Water Resources | Esri, HERE | Esri, HERE, Garmin |

IDAHO - Boundary County

Boundary County Courthouse (added 1987 - - #87001581)
Also known as **001316**
Kootenai St. , Bonners Ferry

Historic Significance:	Event, Architecture/Engineering
Architect, builder, or engineer:	Martin,Fletcher
Architectural Style:	Art Deco
Area of Significance:	Politics/Government, Art, Architecture
Period of Significance:	1925-1949
Owner:	**Local**
Historic Function:	Government
Historic Sub-function:	Courthouse
Current Function:	Government
Current Sub-function:	Courthouse

Fry's Trading Post (added 1984 - - #84001104)
Also known as **Bonner-Fry Trading Post**
Off US 95 , Bonners Ferry

Historic Significance:	Event
Area of Significance:	Commerce
Period of Significance:	1900-1924, 1875-1899
Owner:	**Private**
Historic Function:	Commerce/Trade
Historic Sub-function:	Specialty Store
Current Function:	Vacant/Not In Use

Harvey Mountain Quarry (added 1978 - - #78001053)
Address Restricted , Bonners Ferry

Historic Significance:	Information Potential
Area of Significance:	Historic - Aboriginal, Prehistoric
Cultural Affiliation:	Native American
Period of Significance:	5000-6999 BC, 3000-4999 BC, 1800-1824, 1750-1799, 1749-1500 AD, 1700-1749, 1499-1000 AD, 1000-2999 BC, 1000 AD-999 BC
Owner:	**Federal**
Historic Function:	Industry/Processing/Extraction
Historic Sub-function:	Extractive Facility
Current Function:	Landscape
Current Sub-function:	Unoccupied Land

North Side School (added 1992 - - #92000417)
Also known as **Burkholder,Jim and Ruth,House;006259**
218 W. Commanche , Bonners Ferry

Historic Significance:	Architecture/Engineering, Event
Architect, builder, or engineer:	Cox,J.G., Keith & Whitehouse

Architectural Style: Classical Revival
Area of Significance: Education, Architecture
Period of Significance: 1925-1949, 1900-1924
Owner: **Private**
Historic Function: Education
Historic Sub-function: School
Current Function: Work In Progress

Snyder Guard Station Historical District (added 1983 - - #83000283)
Also known as **Snyder Guard Station**
S of Eastport on Forest Service Rd. 211 , Eastport

Historic Significance: Architecture/Engineering, Event
Architectural Style: No Style Listed
Area of Significance: Conservation, Architecture
Period of Significance: 1950-1974, 1925-1949, 1900-1924
Owner: **Federal**
Historic Function: Domestic, Landscape
Historic Sub-function: Camp, Conservation Area, Secondary Structure
Current Function: Domestic, Landscape
Current Sub-function: Camp, Conservation Area, Secondary Structure

Soderling, Russell and Pearl, House (added 1998 - - #97001650)
Also known as **21-17876**
217 W. Madison St. , Bonners Ferry

Historic Significance: Architecture/Engineering
Architect, builder, or engineer: Solderling, Russell
Architectural Style: Other
Area of Significance: Architecture
Period of Significance: 1925-1949
Owner: **Private**
Historic Function: Domestic
Historic Sub-function: Single Dwelling
Current Function: Domestic
Current Sub-function: Single Dwelling

Spokane & International Railroad Construction Camp (added 1994 - - #94000630)
Also known as **Chinese Ovens site;10-BY-372;IHSI 21-15699**
E of US 95 along the Spokane & International RR tracks, 2 mi. S of the US--Canadian border , Eastport

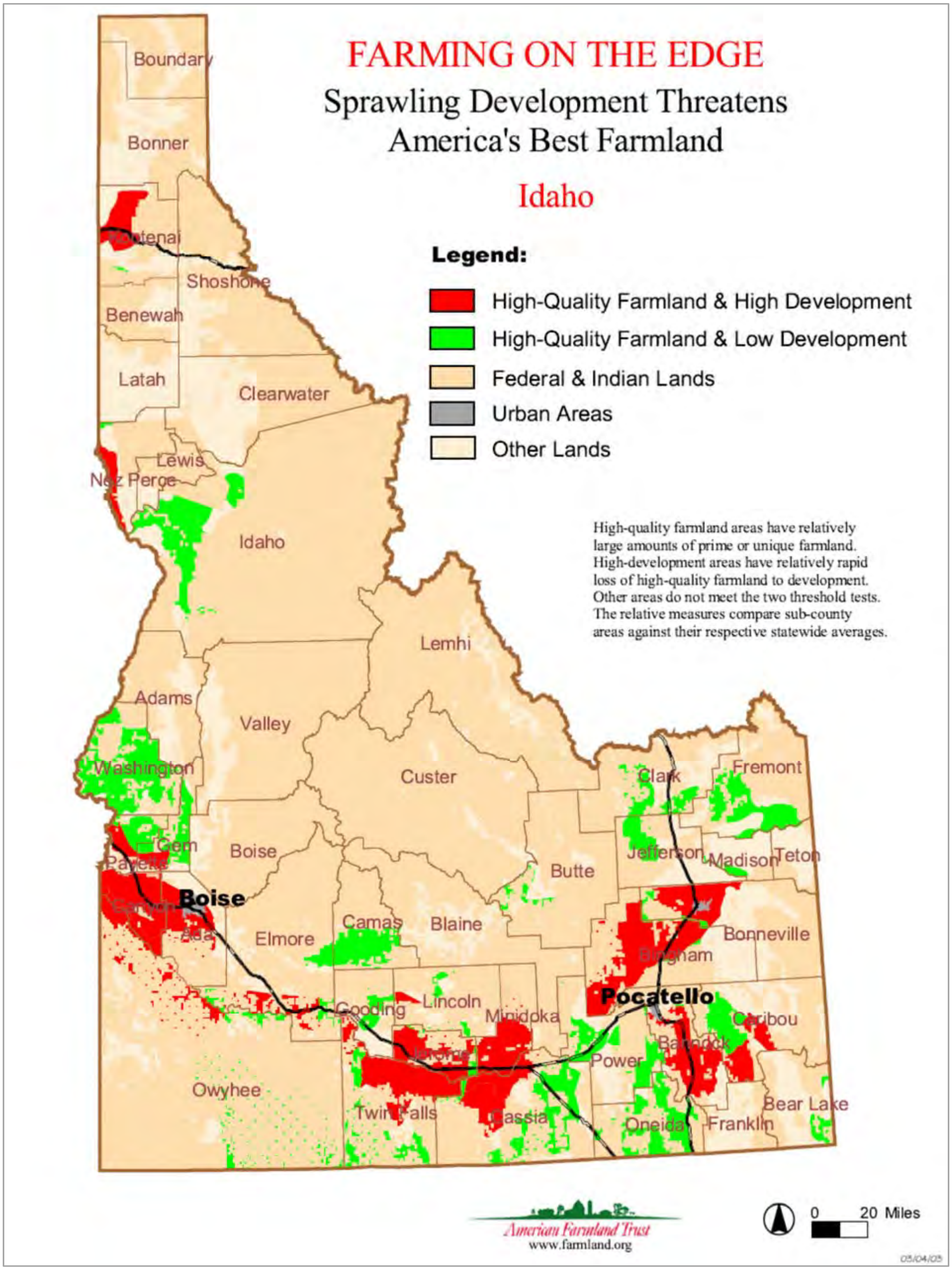
Historic Significance: Architecture/Engineering, Information Potential
Architectural Style: No Style Listed
Area of Significance: Historic - Non-Aboriginal, European, Architecture
Cultural Affiliation: American
Period of Significance: 1900-1924
Owner: **Private**

Historic Function:	Domestic
Historic Sub-function:	Institutional Housing
Current Function:	Vacant/Not In Use

US Post Office--Bonners Ferry Main (added 1989 - - #89000129)
Also known as **Bonners Ferry Main Post Office**
215 First , Bonners Ferry

Historic Significance:	Architecture/Engineering, Event
Architect, builder, or engineer:	Simon,Louis A.
Architectural Style:	Classical Revival
Area of Significance:	Politics/Government, Architecture
Period of Significance:	1925-1949
Owner:	**Federal**
Historic Function:	Government
Historic Sub-function:	Post Office
Current Function:	Government
Current Sub-function:	Post Office

Important Farmland throughout the State



IPaC **U.S. Fish & Wildlife Service**

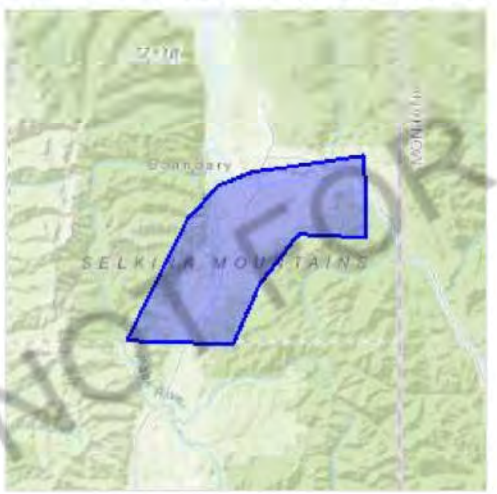
IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Bonner and Boundary counties, Idaho



Local office

Idaho Fish And Wildlife Office

(208) 378-5243
(208) 378-5262

1387 South Vinnell Way, Suite 368
Boise, ID 83709-1657

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Canada Lynx *Lynx canadensis* There is **final** critical habitat for this species. Your location is outside the critical habitat. https://ecos.fws.gov/ecp/species/3652	Threatened
Grizzly Bear *Ursus arctos horribilis* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/7642	Threatened
North American Wolverine *Gulo gulo luscus* No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/5123	Proposed Threatened

Fishes

NAME	STATUS
Bull Trout *Salvelinus confluentus* There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/8212	Threatened
White Sturgeon *Acipenser transmontanus* There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/8241	Endangered

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Bull Trout *Salvelinus confluentus* https://ecos.fws.gov/ecp/species/8212#crithab	Final
White Sturgeon *Acipenser transmontanus* https://ecos.fws.gov/ecp/species/8241#crithab	Final

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES

THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)

Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Cassin's Finch Carpodacus cassinii This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9462	Breeds May 15 to Jul 15
Golden Eagle Aquila chrysaetos This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31
Lesser Yellowlegs Tringa flavipes This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere
Olive-sided Flycatcher Contopus cooperi This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31
Rufous Hummingbird selasphorus rufus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8002	Breeds Apr 15 to Jul 15

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ “Proper Interpretation and Use of Your Migratory Bird Report” before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season ( )
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

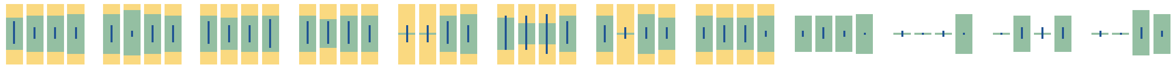
No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

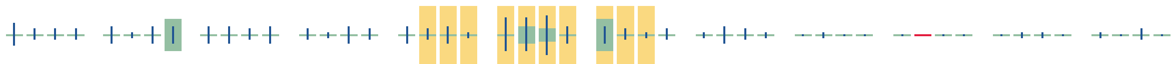
■ probability of presence ■ breeding season | survey effort – no data

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Bald Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



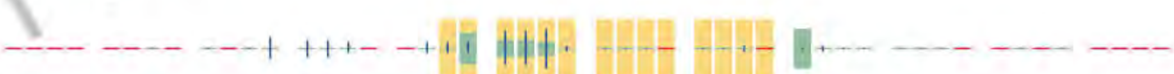
Cassin's Finch
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



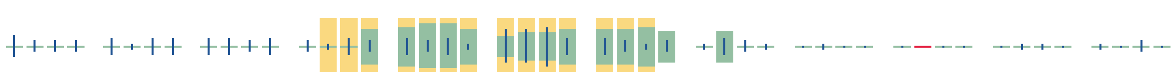
Golden Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Lesser Yellowlegs
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Olive-sided Flycatcher
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Rufous Hummingbird
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

This location overlaps the following National Wildlife Refuge lands:

LAND	ACRES
Kootenai National Wildlife Refuge	2,764.2 acres

(208) 267-3888
(208) 267-5570

287 Westside Road
Bonners Ferry, ID 83805-5172

https://www.fws.gov/refuges/profiles/index.cfm?id=14580

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER EMERGENT WETLAND

- PEM1C
- PEM1A
- PEM1Fh
- PEM1F
- PEM1Ad
- PEM1Cx
- PEM1Cd
- PEM1B

FRESHWATER FORESTED/SHRUB WETLAND

- PSS1C
- PFO1C
- PFO1A

- PSS1A
- PFO4C
- PSS4B
- PSS1F
- PFO5Hb

FRESHWATER POND

- PUBH
- PAB3H
- PUBHh
- PUBHx
- PAB4Hh
- PAB4H
- PUBHb
- PABF
- PUB/AB4H
- PABHx
- PAB4Hx

LAKE

- L1UBHh
- L1UBH
- L2AB4H

RIVERINE

- R3UBH
- R4SBC
- R3USC
- R5UBH
- R3USA
- R4SBA
- R5UBFx
- R2UBHx
- R4SBCx
- R3UBHx

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

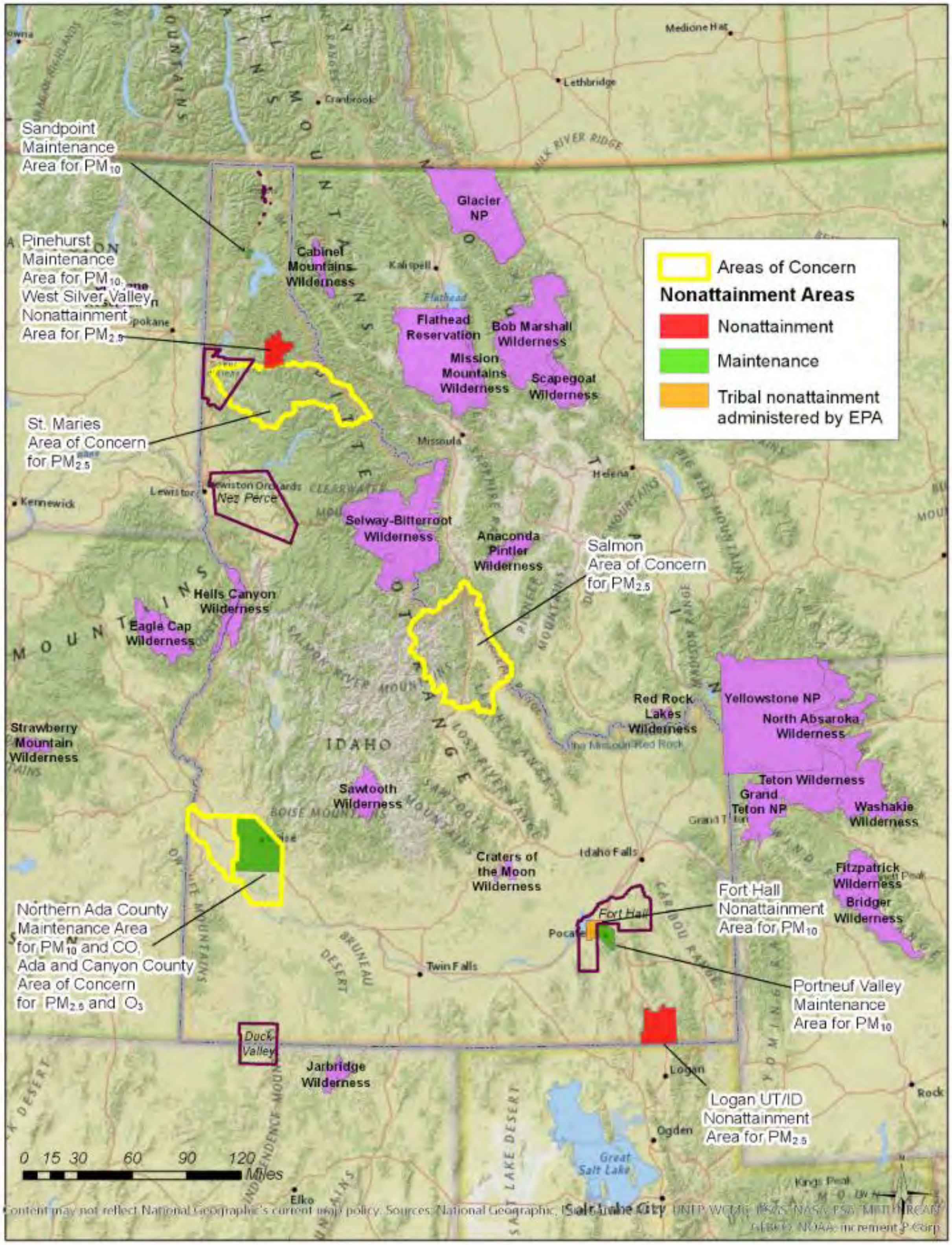
Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.


Areas of Concern
Nonattainment Areas
Nonattainment
Maintenance
Tribal nonattainment administered by EPA
Sandpoint Maintenance Area for PM_{10}
Pinehurst Maintenance Area for PM_{10}, West Silver Valley Nonattainment Area for $PM_{2.5}$
St. Maries Area of Concern for $PM_{2.5}$
Salmon Area of Concern for $PM_{2.5}$
Northern Ada County Maintenance Area for PM_{10} and CO, Ada and Canyon County Area of Concern for $PM_{2.5}$ and O_3
Fort Hall Nonattainment Area for PM_{10}
Portneuf Valley Maintenance Area for PM_{10}
Logan UT/ID Nonattainment Area for $PM_{2.5}$
Glacier NP
Cabinet Mountains Wilderness
Flathead Reservation
Bob Marshall Wilderness
Mission Mountains Wilderness
Scapegoat Wilderness
Selway-Bitterroot Wilderness
Anaconda Pintler Wilderness
Hells Canyon Wilderness
Eagle Cap Wilderness
Strawberry Mountain Wilderness
Red Rock Lakes Wilderness
Yellowstone NP
North Absaroka Wilderness
Teton Wilderness
Grand Teton NP
Washakie Wilderness
Sawtooth Wilderness
Craters of the Moon Wilderness
Fitzpatrick Wilderness
Bridger Wilderness
Jarbidge Wilderness
Duck Valley
Nez Perce
Fort Hall
IDAHO
Medicine Hat
Lethbridge
Cranbrook
Kalispell
Missoula
Helena
Lewiston
Kennewick
Idaho Falls
Twin Falls
Pocatello
Logan
Ogden
Elko
Salt Lake City
Great Salt Lake
0 15 30 60 90 120 Miles
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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Boundary County Area, Idaho, and Idaho Panhandle National Forest, Idaho-Washington-Montana

June 10, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Preface........ 2
How Soil Surveys Are Made........ 7
Soil Map........ 10
Soil Map........ 11
Legend........ 12
Map Unit Legend........ 14
Map Unit Descriptions........ 18
Boundary County Area, Idaho........ 21
2lg1v—Pearsoncreek-Highfalls families, complex, dissected steep glaciated mountain slopes, belt geology, north aspects........ 21
101—Dufort-Rock outcrop-Kriest complex, 35 to 65 percent slopes........ 22
102—Caboose-Wishbone complex, 15 to 35 percent slopes........ 24
103—Artnoc silt loam, 35 to 75 percent slopes........ 26
105—Bane loamy fine sand, 2 to 8 percent slopes........ 27
106—Caribouridge ashy silt loam, 0 to 15 percent slopes........ 28
107—Caribouridge ashy silt loam, 15 to 35 percent slopes........ 29
108—Caribouridge ashy silt loam, 35 to 65 percent slopes........ 30
110—Crash silt loam, 35 to 75 percent slopes........ 31
112—Crash-Artnoc complex, 35 to 75 percent slopes........ 32
114—Dufort ashy silt loam, 35 to 65 percent slopes........ 34
115—DeVoignes mucky silt loam, protected, drained, 0 to 1 percent slopes........ 35
116—Dufort ashy silt loam, 15 to 35 percent slopes........ 36
117—Dodgecreek ashy silt loam, 2 to 12 percent slopes........ 37
118—Farnhamton silt loam, protected, drained, 2 to 5 percent slopes........ 38
119—Farnhamton silt loam, unprotected, undrained, 0 to 4 percent slopes........ 40
120—Dufort ashy silt loam, 5 to 15 percent slopes........ 41
123—Jaypeak gravelly ashy silt loam, 35 to 75 percent slopes........ 42
124—McArthur, very stony-Rock outcrop complex, 35 to 75 percent slopes........ 43
125—Idamont ashy silt loam, 5 to 15 percent slopes........ 44
126—Idamont ashy silt loam, 15 to 35 percent slopes........ 45
127—Idamont ashy silt loam, 35 to 65 percent slopes........ 46
128—Myrtlecreek ashy sandy loam, 15 to 35 percent slopes........ 47
129—Myrtlecreek ashy sandy loam, 35 to 75 percent slopes........ 48
131—Pearsoncreek ashy loam, 15 to 35 percent slopes........ 49
132—Pearsoncreek ashy silt loam, 35 to 65 percent slopes........ 50
133—Pearsoncreek-Rock outcrop complex, 15 to 35 percent slopes........ 51
134—Elmira loamy fine sand, 15 to 35 percent slopes........ 53
135—Pend Oreille ashy silt loam, 5 to 15 percent slopes........ 54
136—Pend Oreille ashy silt loam, 15 to 35 percent slopes........ 55
137—Pend Oreille ashy silt loam, 35 to 65 percent slopes........ 56
138—Pend Oreille-Rock outcrop complex, 15 to 35 percent slopes........ 57

139—Highfalls gravelly ashy silt loam, 15 to 35 percent slopes................. 58
140—Frycanyon ashy silt loam, 2 to 8 percent slopes................................59
141—Farnhamton silt loam, unprotected, drained, 0 to 4 percent slopes...60
142—Ritz silt loam, unprotected, undrained, 0 to 2 percent slopes............61
143—Ritz-Farnhamton complex, protected, drained, 0 to 5 percent slopes..........63
144—Rock outcrop-Jaypeak, very stony complex, 65 to 100 percent slopes..........65
148—Riverwash..........66
150—Pywell muck, protected, drained, 0 to 1 percent slopes.................... 67
151—Pywell-DeVoignes complex, unprotected, undrained, 0 to 1 percent slopes..........68
153—Ritz-Farnhamton complex, unprotected, drained, 0 to 5 percent slopes..........70
156—Ritz silt loam, protected, drained, 0 to 2 percent slopes....................72
157—Ritz-Schnoorson complex, protected, drained, 0 to 2 percent slopes..........73
162—Rock outcrop-Treble, very stony complex, 5 to 35 percent slopes.... 75
165—Rubson ashy silt loam, 0 to 2 percent slopes.................................. 76
166—Rubson ashy silt loam, 2 to 8 percent slopes.................................. 77
167—Rubson ashy silt loam, 8 to 15 percent slopes................................. 78
170—Schnoorson silt loam, protected, drained, 0 to 2 percent slopes....... 79
171—Seelovers silt loam, 0 to 2 percent slopes.. 80
172—Seelovers silt loam, drained, 0 to 2 percent slopes........................... 82
173—Schnoorson silty clay loam, protected, drained, 0 to 2 percent slopes..........83
174—Selle ashy fine sandy loam, 0 to 7 percent slopes.............................84
175—Selle-Elmira complex, 0 to 20 percent slopes...................................85
176—Snowlake ashy sandy loam, 12 to 35 percent slopes........................87
177—Snowlake ashy sandy loam, 35 to 65 percent slopes........................88
179—Stien gravelly ashy silt loam, 2 to 8 percent slopes...........................89
182—Stien cobbly ashy silt loam, 2 to 8 percent slopes.............................90
184—Treble, very bouldery-Rock outcrop complex, 35 to 65 percent slopes..........91
185—Treble gravelly ashy sandy loam, 35 to 65 percent slopes................93
186—Treble gravelly ashy sandy loam, 15 to 35 percent slopes................94
189—Flemingcreek silt loam, 35 to 65 percent slopes...............................95
190—Wishbone-Caboose complex, 35 to 75 percent slopes..................... 96
191—Dufort-Rock outcrop-Kriest complex, 15 to 35 percent slopes.......... 98
197—Pend Oreille-Stien, moist complex, 2 to 8 percent slopes............... 100
199—Seelovers-Typic Fluvaquents-Aquic Udifluvents complex, 0 to 4 percent slopes..........101
200—Pywell-DeVoignes complex, partially drained, 0 to 2 percent slopes..........104
201—Pywell muck, unprotected, undrained, 0 to 1 percent slopes.......... 106
202—Water.......... 107
Idaho Panhandle National Forest, Idaho-Washington-Montana................... 109
2x6t9—Pend Oreille-Rock outcrop complex 15 to 35 percent slopes....... 109
261—Pearsoncreek-Highfalls families, complex, glaciated mountain slopes, belt geology, north aspects, 30 to 60 percent slopes.............110
262—Pearsoncreek-Highfalls families, complex, steep glaciated mountain slopes, belt geology, north aspects, 40 to 75 percent slopes.......... 111

265—Pearsoncreek-Highfalls families, complex, dissected steep glaciated mountain slopes, belt geology, north aspects......................113
353—Andic Humudepts-Humic Udivitrands-Pearsoncreek families, dense substratum complex, shallow incised glaciated mountain slopes, granitic geology, south aspects..115
370—Eloika-Humic Lithic Dystroxerepts families-Rock outcrop complex, glaciated scoured ridges and upper mountain slopes, granitic geology, south aspects...118
540h—Caribouridge ashy silt loam, 35 to 65 percent slopes....................120
540n—Dufort ashy silt loam, 35 to 65 percent slopes...............................121
540x—Jaypeak gravelly ashy silt loam, 35 to 75 percent slopes..............122
541b—Pend Oreille ashy silt loam, 35 to 65 percent slopes.....................123
541x—Rock outcrop-Treble, very stony complex, 35 to 65 percent slopes...124
542k—Treble, very bouldery-Rock outcrop complex, 35 to 65 percent slopes...125
542z—Dufort-Rock outcrop-Kriest complex, 35 to 65 percent slopes.......126
5417—Pearsoncreek-Rock outcrop complex, 15 to 35 percent slopes.... 129
5418—Pend Oreille ashy silt loam, 5 to 15 percent slopes.......................130
5419—Pend Oreille ashy silt loam, 15 to 35 percent slopes.....................131
5428—Selle-Elmira complex, 0 to 20 percent slopes................................132
5436—Dufort-Rock outcrop-Kriest complex, 15 to 35 percent slopes...... 134
References...137

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

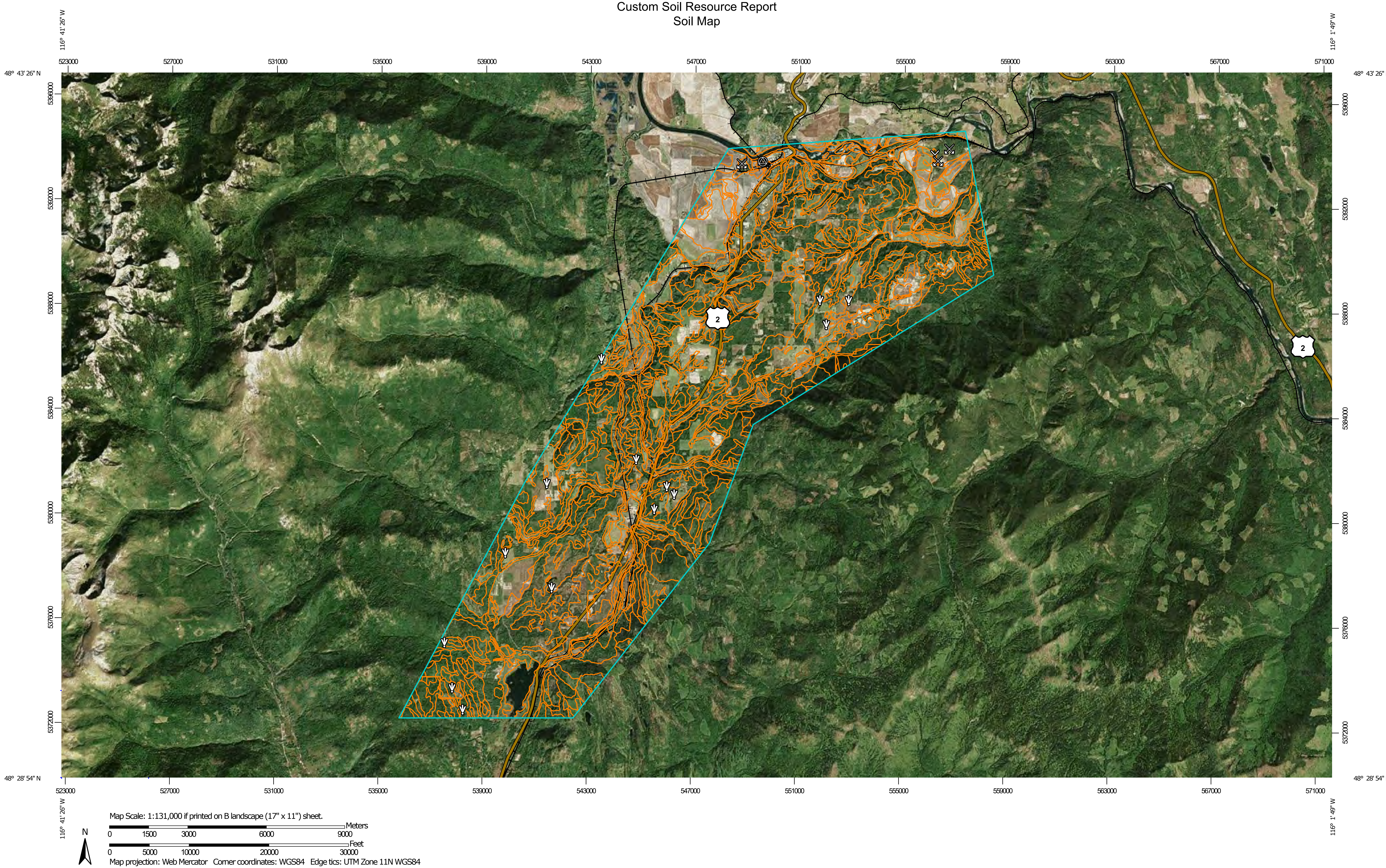
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boundary County Area, Idaho
Survey Area Data: Version 13, Sep 13, 2018

Soil Survey Area: Idaho Panhandle National Forest, Idaho-Washington-Montana
Survey Area Data: Version 5, Sep 14, 2018

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jan 1, 1999—Dec 31, 2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2lg1v	Pearsoncreek-Highfalls families, complex, dissected steep glaciated mountain slopes, belt geology, north aspects	2.8	0.0%
101	Dufort-Rock outcrop-Kriest complex, 35 to 65 percent slopes	724.9	1.5%
102	Caboose-Wishbone complex, 15 to 35 percent slopes	33.2	0.1%
103	Artnoc silt loam, 35 to 75 percent slopes	2,473.9	5.0%
105	Bane loamy fine sand, 2 to 8 percent slopes	30.0	0.1%
106	Caribouridge ashy silt loam, 0 to 15 percent slopes	26.7	0.1%
107	Caribouridge ashy silt loam, 15 to 35 percent slopes	91.8	0.2%
108	Caribouridge ashy silt loam, 35 to 65 percent slopes	84.2	0.2%
110	Crash silt loam, 35 to 75 percent slopes	2,424.9	4.9%
112	Crash-Artnoc complex, 35 to 75 percent slopes	887.2	1.8%
114	Dufort ashy silt loam, 35 to 65 percent slopes	656.9	1.3%
115	DeVoignes mucky silt loam, protected, drained, 0 to 1 percent slopes	101.7	0.2%
116	Dufort ashy silt loam, 15 to 35 percent slopes	57.1	0.1%
117	Dodgecreek ashy silt loam, 2 to 12 percent slopes	26.6	0.1%
118	Farnhamton silt loam, protected, drained, 2 to 5 percent slopes	437.2	0.9%
119	Farnhamton silt loam, unprotected, undrained, 0 to 4 percent slopes	139.3	0.3%
120	Dufort ashy silt loam, 5 to 15 percent slopes	47.4	0.1%
123	Jaypeak gravelly ashy silt loam, 35 to 75 percent slopes	299.5	0.6%
124	McArthur, very stony-Rock outcrop complex, 35 to 75 percent slopes	107.8	0.2%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
125	Idamont ashy silt loam, 5 to 15 percent slopes	160.6	0.3%
126	Idamont ashy silt loam, 15 to 35 percent slopes	647.2	1.3%
127	Idamont ashy silt loam, 35 to 65 percent slopes	156.7	0.3%
128	Myrtlecreek ashy sandy loam, 15 to 35 percent slopes	82.2	0.2%
129	Myrtlecreek ashy sandy loam, 35 to 75 percent slopes	50.3	0.1%
131	Pearsoncreek ashy loam, 15 to 35 percent slopes	93.9	0.2%
132	Pearsoncreek ashy silt loam, 35 to 65 percent slopes	73.0	0.1%
133	Pearsoncreek-Rock outcrop complex, 15 to 35 percent slopes	131.1	0.3%
134	Elmira loamy fine sand, 15 to 35 percent slopes	1,863.6	3.7%
135	Pend Oreille ashy silt loam, 5 to 15 percent slopes	1,023.1	2.1%
136	Pend Oreille ashy silt loam, 15 to 35 percent slopes	1,952.2	3.9%
137	Pend Oreille ashy silt loam, 35 to 65 percent slopes	1,660.5	3.3%
138	Pend Oreille-Rock outcrop complex, 15 to 35 percent slopes	131.0	0.3%
139	Highfalls gravelly ashy silt loam, 15 to 35 percent slopes	2.5	0.0%
140	Frycanyon ashy silt loam, 2 to 8 percent slopes	199.8	0.4%
141	Farnhamton silt loam, unprotected, drained, 0 to 4 percent slopes	22.4	0.0%
142	Ritz silt loam, unprotected, undrained, 0 to 2 percent slopes	158.9	0.3%
143	Ritz-Farnhamton complex, protected, drained, 0 to 5 percent slopes	199.0	0.4%
144	Rock outcrop-Jaypeak, very stony complex, 65 to 100 percent slopes	18.6	0.0%
148	Riverwash	124.0	0.2%
150	Pywell muck, protected, drained, 0 to 1 percent slopes	310.2	0.6%
151	Pywell-DeVoignes complex, unprotected, undrained, 0 to 1 percent slopes	250.4	0.5%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
153	Ritz-Farnhamton complex, unprotected, drained, 0 to 5 percent slopes	161.0	0.3%
156	Ritz silt loam, protected, drained, 0 to 2 percent slopes	293.6	0.6%
157	Ritz-Schnoorson complex, protected, drained, 0 to 2 percent slopes	480.5	1.0%
162	Rock outcrop-Treble, very stony complex, 5 to 35 percent slopes	43.2	0.1%
165	Rubson ashy silt loam, 0 to 2 percent slopes	1,318.2	2.6%
166	Rubson ashy silt loam, 2 to 8 percent slopes	9,765.2	19.6%
167	Rubson ashy silt loam, 8 to 15 percent slopes	2,318.5	4.6%
170	Schnoorson silt loam, protected, drained, 0 to 2 percent slopes	958.0	1.9%
171	Seelovers silt loam, 0 to 2 percent slopes	100.3	0.2%
172	Seelovers silt loam, drained, 0 to 2 percent slopes	742.5	1.5%
173	Schnoorson silty clay loam, protected, drained, 0 to 2 percent slopes	289.9	0.6%
174	Selle ashy fine sandy loam, 0 to 7 percent slopes	2,578.4	5.2%
175	Selle-Elmira complex, 0 to 20 percent slopes	5,352.5	10.7%
176	Snowlake ashy sandy loam, 12 to 35 percent slopes	31.9	0.1%
177	Snowlake ashy sandy loam, 35 to 65 percent slopes	0.0	0.0%
179	Stien gravelly ashy silt loam, 2 to 8 percent slopes	943.4	1.9%
182	Stien cobbly ashy silt loam, 2 to 8 percent slopes	11.9	0.0%
184	Treble, very bouldery-Rock outcrop complex, 35 to 65 percent slopes	1,083.3	2.2%
185	Treble gravelly ashy sandy loam, 35 to 65 percent slopes	259.7	0.5%
186	Treble gravelly ashy sandy loam, 15 to 35 percent slopes	27.1	0.1%
189	Flemingcreek silt loam, 35 to 65 percent slopes	258.2	0.5%
190	Wishbone-Caboose complex, 35 to 75 percent slopes	1,716.0	3.4%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
191	Dufort-Rock outcrop-Kriest complex, 15 to 35 percent slopes	499.3	1.0%
197	Pend Oreille-Stien, moist complex, 2 to 8 percent slopes	13.9	0.0%
199	Seelovers-Typic Fluvaquents-Aquic Udifluvents complex, 0 to 4 percent slopes	793.2	1.6%
200	Pywell-DeVoignes complex, partially drained, 0 to 2 percent slopes	71.2	0.1%
201	Pywell muck, unprotected, undrained, 0 to 1 percent slopes	264.2	0.5%
202	Water	805.2	1.6%
Subtotals for Soil Survey Area		**49,144.6**	**98.5%**
Totals for Area of Interest		**49,908.9**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2x6t9	Pend Oreille-Rock outcrop complex 15 to 35 percent slopes	163.1	0.3%
261	Pearsoncreek-Highfalls families, complex, glaciated mountain slopes, belt geology, north aspects, 30 to 60 percent slopes	8.1	0.0%
262	Pearsoncreek-Highfalls families, complex, steep glaciated mountain slopes, belt geology, north aspects, 40 to 75 percent slopes	47.1	0.1%
265	Pearsoncreek-Highfalls families, complex, dissected steep glaciated mountain slopes, belt geology, north aspects	38.6	0.1%
353	Andic Humudepts-Humic Udivitrands-Pearsoncreek families, dense substratum complex, shallow incised glaciated mountain slopes, granitic geology, south aspects	40.4	0.1%
370	Eloika-Humic Lithic Dystroxerepts families-Rock outcrop complex, glaciated scoured ridges and upper mountain slopes, granitic geology, south aspects	47.6	0.1%
540h	Caribouridge ashy silt loam, 35 to 65 percent slopes	5.5	0.0%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
540n	Dufort ashy silt loam, 35 to 65 percent slopes	0.0	0.0%
540x	Jaypeak gravelly ashy silt loam, 35 to 75 percent slopes	3.4	0.0%
541b	Pend Oreille ashy silt loam, 35 to 65 percent slopes	50.8	0.1%
541x	Rock outcrop-Treble, very stony complex, 35 to 65 percent slopes	8.9	0.0%
542k	Treble, very bouldery-Rock outcrop complex, 35 to 65 percent slopes	6.5	0.0%
542z	Dufort-Rock outcrop-Kriest complex, 35 to 65 percent slopes	142.4	0.3%
5417	Pearsoncreek-Rock outcrop complex, 15 to 35 percent slopes	71.0	0.1%
5418	Pend Oreille ashy silt loam, 5 to 15 percent slopes	33.6	0.1%
5419	Pend Oreille ashy silt loam, 15 to 35 percent slopes	38.5	0.1%
5428	Selle-Elmira complex, 0 to 20 percent slopes	6.5	0.0%
5436	Dufort-Rock outcrop-Kriest complex, 15 to 35 percent slopes	52.3	0.1%
Subtotals for Soil Survey Area		**764.3**	**1.5%**
Totals for Area of Interest		**49,908.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boundary County Area, Idaho

2lg1v—Pearsoncreek-Highfalls families, complex, dissected steep glaciated mountain slopes, belt geology, north aspects

Map Unit Setting

National map unit symbol: 2lg1v
Elevation: 3,350 to 4,580 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 40 to 46 degrees F
Frost-free period: 60 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 45 percent
Highfalls and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A1 - 2 to 4 inches: gravelly ashy silt loam
A2 - 4 to 11 inches: extremely cobbly ashy silt loam
2Bw1 - 11 to 26 inches: extremely gravelly silt loam
2Bw2 - 26 to 36 inches: extremely gravelly silt loam
2Bw3 - 36 to 62 inches: extremely gravelly silt loam

Properties and qualities

Slope: 30 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530), western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Description of Highfalls

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Bw1 - 1 to 11 inches: ashy silt loam
Bw2 - 11 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 32 inches: very gravelly sandy loam
2C - 32 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 30 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530), western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

101—Dufort-Rock outcrop-Kriest complex, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 542z
Elevation: 1,800 to 3,800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Dufort and similar soils: 45 percent
Rock outcrop: 25 percent
Kriest and similar soils: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam
2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Kriest

Setting

Landform: Mountains, ridges
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and loess over till over residuum weathered from granite and/or schist and/or gneiss

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 18 inches: gravelly ashy sandy loam
Bt1 - 18 to 27 inches: gravelly sandy loam
Bt2 - 27 to 34 inches: gravelly sandy loam
BC - 34 to 43 inches: gravelly loamy sand
2Cr - 43 to 53 inches: bedrock

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

102—Caboose-Wishbone complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5430
Elevation: 1,800 to 2,400 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 49 degrees F
Frost-free period: 100 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Caboose and similar soils: 50 percent
Wishbone and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caboose

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 5 inches: silt loam
AB1 - 5 to 9 inches: silt loam
AB2 - 9 to 21 inches: silt loam
Bt1 - 21 to 35 inches: silt loam
Bt2 - 35 to 57 inches: silt loam
Bk - 57 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

Description of Wishbone

Setting

Landform: Escarpments
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Calcareous glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 7 inches: silt loam
Bt - 7 to 20 inches: silt loam

Btk - 20 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/common snowberry (CN310)
Hydric soil rating: No

103—Artnoc silt loam, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 540b
Elevation: 1,800 to 2,700 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Artnoc and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Artnoc

Setting

Landform: Escarpments
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Silty glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: silt loam

AB - 4 to 8 inches: silt loam
Bt1 - 8 to 18 inches: silt loam
Bt2 - 18 to 33 inches: silt loam
C - 33 to 60 inches: silt loam

Properties and qualities
Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Very high (about 12.5 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: C
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

105—Bane loamy fine sand, 2 to 8 percent slopes

Map Unit Setting
National map unit symbol: 540d
Elevation: 1,750 to 2,000 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 42 to 44 degrees F
Frost-free period: 90 to 110 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Bane and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bane

Setting
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 6 inches: loamy fine sand
C1 - 6 to 25 inches: gravelly sand
2C2 - 25 to 39 inches: fine sand
3Ab - 39 to 43 inches: gravelly loamy fine sand

4C3 - 43 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

106—Caribouridge ashy silt loam, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 540f
Elevation: 2,400 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Caribouridge and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caribouridge

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Volcanic ash over outwash and/or till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: ashy silt loam
2BC - 18 to 23 inches: very cobbly loamy coarse sand
2C1 - 23 to 44 inches: extremely cobbly coarse sand
2C2 - 44 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

107—Caribouridge ashy silt loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 540g
Elevation: 2,400 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Caribouridge and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caribouridge

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over outwash and/or till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: ashy silt loam
2BC - 18 to 23 inches: very cobbly loamy coarse sand
2C1 - 23 to 44 inches: extremely cobbly coarse sand
2C2 - 44 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

108—Caribouridge ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 540h
Elevation: 2,400 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Caribouridge and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caribouridge

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over outwash and/or till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: ashy silt loam
2BC - 18 to 23 inches: very cobbly loamy coarse sand
2C1 - 23 to 44 inches: extremely cobbly coarse sand
2C2 - 44 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

110—Crash silt loam, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 540k
Elevation: 1,800 to 2,700 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 42 to 44 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Crash and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Crash

Setting

Landform: Escarpments
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous silty glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A1 - 2 to 3 inches: silt loam
A2 - 3 to 5 inches: silt loam
AB - 5 to 9 inches: silt loam
Bt1 - 9 to 13 inches: silt loam
Bt2 - 13 to 20 inches: silt loam
Bt3 - 20 to 29 inches: silt loam
Bk - 29 to 60 inches: silt loam

Properties and qualities

Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: C
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

112—Crash-Artnoc complex, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 540l
Elevation: 1,800 to 2,700 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 80 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Crash and similar soils: 50 percent
Artnoc and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Crash

Setting

Landform: Escarpments
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous silty glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A1 - 2 to 3 inches: silt loam
A2 - 3 to 5 inches: silt loam
AB - 5 to 9 inches: silt loam
Bt1 - 9 to 13 inches: silt loam

Bt2 - 13 to 20 inches: silt loam
Bt3 - 20 to 29 inches: silt loam
Bk - 29 to 60 inches: silt loam

Properties and qualities
Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.5 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: C
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Description of Artnoc

Setting
Landform: Escarpments
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Silty glaciolacustrine deposits

Typical profile
Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: silt loam
AB - 4 to 8 inches: silt loam
Bt1 - 8 to 18 inches: silt loam
Bt2 - 18 to 33 inches: silt loam
C - 33 to 60 inches: silt loam

Properties and qualities
Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Very high (about 12.5 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8

Hydrologic Soil Group: C
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

114—Dufort ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 540n
Elevation: 2,400 to 3,800 feet
Mean annual precipitation: 30 to 35 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Dufort and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam
2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

115—DeVoignes mucky silt loam, protected, drained, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 540p
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Devoignes, protected, drained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Devoignes, Protected, Drained

Setting

Landform: Swales, flood plains, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Stratified herbaceous organic material over mixed alluvium

Typical profile

Ap - 0 to 9 inches: mucky silt loam
Oa/C - 9 to 19 inches: stratified muck to silty clay loam
Oa/Cg - 19 to 24 inches: stratified muck to silty clay loam
2Cg1 - 24 to 28 inches: silty clay loam
2Cg2 - 28 to 41 inches: silty clay loam
2Cg3 - 41 to 65 inches: stratified silty clay loam to silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.9 inches)

Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Schnoorson, protected, drained
Percent of map unit: 5 percent
Landform: Flood plains, swales, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Ritz, protected, drained
Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: Yes

Pywell, protected, drained
Percent of map unit: 5 percent
Landform: Flood plains, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

116—Dufort ashy silt loam, 15 to 35 percent slopes

Map Unit Setting
National map unit symbol: 540q
Elevation: 2,300 to 3,800 feet
Mean annual precipitation: 30 to 35 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition
Dufort and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting
Landform: Mountains, hills

Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam
2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

117—Dodgecreek ashy silt loam, 2 to 12 percent slopes

Map Unit Setting

National map unit symbol: 540r
Elevation: 3,000 to 4,900 feet
Mean annual precipitation: 35 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Dodgecreek and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dodgecreek

Setting

Landform: Outwash terraces
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over sandy outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 7 inches: ashy silt loam
Bw2 - 7 to 10 inches: ashy loam
2BC1 - 10 to 14 inches: sandy loam
2BC2 - 14 to 19 inches: loamy sand
2C1 - 19 to 47 inches: coarse sand
2C2 - 47 to 62 inches: coarse sand

Properties and qualities

Slope: 2 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

118—Farnhamton silt loam, protected, drained, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 540s
Elevation: 1,750 to 1,800 feet
Mean annual precipitation: 23 to 28 inches
Mean annual air temperature: 43 to 47 degrees F
Frost-free period: 120 to 140 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Farnhamton, protected, drained, and similar soils: 90 percent
Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Farnhamton, Protected, Drained

Setting

Landform: Natural levees, flood plains
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous alluvium

Typical profile

Ap - 0 to 7 inches: silt loam
AC - 7 to 11 inches: silt loam
C1 - 11 to 22 inches: silt loam
C2 - 22 to 40 inches: silt loam
C3 - 40 to 60 inches: silt loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Ritz, protected, drained

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: Yes

Schnoorson, protected, drained

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

119—Farnhamton silt loam, unprotected, undrained, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 540t
Elevation: 1,750 to 1,800 feet
Mean annual precipitation: 23 to 28 inches
Mean annual air temperature: 43 to 47 degrees F
Frost-free period: 120 to 140 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Farnhamton, unprotected, undrained, and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Farnhamton, Unprotected, Undrained

Setting

Landform: Natural levees, flood plains
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous alluvium

Typical profile

Ap - 0 to 7 inches: silt loam
AC - 7 to 11 inches: silt loam
C1 - 11 to 22 inches: silt loam
C2 - 22 to 40 inches: silt loam
C3 - 40 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 36 to 48 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/ladyfern (CN540)

Hydric soil rating: No

Minor Components

Ritz, unprotected, undrained

Percent of map unit: 5 percent
Landform: Flood plains
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Schnoorson, unprotected, undrained

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

120—Dufort ashy silt loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 542t
Elevation: 2,300 to 3,200 feet
Mean annual precipitation: 30 to 35 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Dufort and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam

2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

123—Jaypeak gravelly ashy silt loam, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 540x
Elevation: 2,400 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Jaypeak and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jaypeak

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over colluvium derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: gravelly ashy silt loam
Bw1 - 3 to 9 inches: gravelly ashy silt loam
Bw2 - 9 to 19 inches: gravelly ashy silt loam
2BC - 19 to 26 inches: extremely gravelly loam

2C1 - 26 to 41 inches: extremely stony loam
2C2 - 41 to 53 inches: extremely gravelly loam
2C3 - 53 to 60 inches: extremely stony loam

Properties and qualities

Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

124—McArthur, very stony-Rock outcrop complex, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 540y
Elevation: 2,600 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Mcarthur, very stony surface, and similar soils: 55 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcarthur, Very Stony Surface

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or colluvium derived from schist and/or gneiss and/or granite

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: gravelly ashy very fine sandy loam

AB - 3 to 9 inches: very cobbly ashy very fine sandy loam
Bw - 9 to 17 inches: very cobbly ashy very fine sandy loam
C1 - 17 to 31 inches: very cobbly very fine sandy loam
C2 - 31 to 45 inches: very cobbly very fine sandy loam
C3 - 45 to 57 inches: extremely cobbly very fine sandy loam
C4 - 57 to 60 inches: very cobbly very fine sandy loam

Properties and qualities

Slope: 35 to 75 percent
Percent of area covered with surface fragments: 1.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 35 to 75 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

125—Idamont ashy silt loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 540z
Elevation: 2,400 to 4,900 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Idamont and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Idamont

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 3 inches: moderately decomposed plant material
A - 3 to 4 inches: ashy silt loam
Bw1 - 4 to 10 inches: ashy silt loam
Bw2 - 10 to 21 inches: ashy silt loam
2Bw3 - 21 to 31 inches: gravelly loam
2Bt - 31 to 55 inches: gravelly sandy loam
3C - 55 to 60 inches: extremely cobbly sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

126—Idamont ashy silt loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5410
Elevation: 2,400 to 4,900 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Idamont and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Idamont

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 3 inches: moderately decomposed plant material
A - 3 to 4 inches: ashy silt loam
Bw1 - 4 to 10 inches: ashy silt loam
Bw2 - 10 to 21 inches: ashy silt loam
2Bw3 - 21 to 31 inches: gravelly loam
2Bt - 31 to 55 inches: gravelly sandy loam
3C - 55 to 60 inches: extremely cobbly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

127—Idamont ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 5411
Elevation: 2,400 to 4,900 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 80 to 110 days

Farmland classification: Not prime farmland

Map Unit Composition

Idamont and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Idamont

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 3 inches: moderately decomposed plant material
A - 3 to 4 inches: ashy silt loam
Bw1 - 4 to 10 inches: ashy silt loam
Bw2 - 10 to 21 inches: ashy silt loam
2Bw3 - 21 to 31 inches: gravelly loam
2Bt - 31 to 55 inches: gravelly sandy loam
3C - 55 to 60 inches: extremely cobbly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

128—Myrtlecreek ashy sandy loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5412
Elevation: 2,300 to 4,500 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F

Frost-free period: 80 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Myrtlecreek and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Myrtlecreek

Setting

Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and sandy outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: ashy sandy loam
Bw1 - 2 to 8 inches: ashy sandy loam
Bw2 - 8 to 14 inches: ashy sandy loam
C1 - 14 to 19 inches: loamy sand
C2 - 19 to 33 inches: sand
C3 - 33 to 41 inches: coarse sand
C4 - 41 to 49 inches: coarse sand
C5 - 49 to 60 inches: sand

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

129—Myrtlecreek ashy sandy loam, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 5413
Elevation: 2,300 to 4,500 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 80 to 110 days

Farmland classification: Not prime farmland

Map Unit Composition

Myrtlecreek and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Myrtlecreek

Setting

Landform: Escarpments, canyons
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and sandy outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: ashy sandy loam
Bw1 - 2 to 8 inches: ashy sandy loam
Bw2 - 8 to 14 inches: ashy sandy loam
C1 - 14 to 19 inches: loamy sand
C2 - 19 to 33 inches: sand
C3 - 33 to 41 inches: coarse sand
C4 - 41 to 49 inches: coarse sand
C5 - 49 to 60 inches: sand

Properties and qualities

Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

131—Pearsoncreek ashy loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5415
Elevation: 2,800 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days

Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from gneiss and/or schist and/or granite

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy loam
Bw1 - 3 to 9 inches: ashy loam
Bw2 - 9 to 12 inches: ashy loam
2Bw3 - 12 to 17 inches: gravelly sandy loam
2BC - 17 to 29 inches: very cobbly sandy loam
2C1 - 29 to 50 inches: very gravelly sandy loam
2C2 - 50 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/queencup beadlily (CN520)
Hydric soil rating: No

132—Pearsoncreek ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 5416
Elevation: 2,800 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 43 to 46 degrees F

Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from gneiss and/or schist and/or granite

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 12 inches: ashy silt loam
2Bw3 - 12 to 17 inches: gravelly sandy loam
2BC - 17 to 29 inches: very cobbly sandy loam
2C1 - 29 to 50 inches: very gravelly sandy loam
2C2 - 50 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/queencup beadlily (CN520)
Hydric soil rating: No

133—Pearsoncreek-Rock outcrop complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5417
Elevation: 2,800 to 4,800 feet
Mean annual precipitation: 30 to 45 inches

Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 55 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from gneiss and/or schist and/or granite

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 12 inches: ashy silt loam
2Bw3 - 12 to 17 inches: gravelly sandy loam
2BC - 17 to 29 inches: very cobbly sandy loam
2C1 - 29 to 50 inches: very gravelly sandy loam
2C2 - 50 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/queencup beadlily (CN520)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

134—Elmira loamy fine sand, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 542v
Elevation: 1,800 to 2,500 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 47 degrees F
Frost-free period: 110 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Elmira and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elmira

Setting

Landform: Dunes
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and loess over sandy glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 6 inches: loamy fine sand
Bw1 - 6 to 14 inches: loamy fine sand
Bw2 - 14 to 26 inches: fine sand
E&Bt - 26 to 60 inches: fine sand

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A

Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/common snowberry (CN310)
Hydric soil rating: No

135—Pend Oreille ashy silt loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 5418
Elevation: 2,200 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pend oreille and similar soils: 85 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam
2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Minor Components

Seelovers

Percent of map unit: 1 percent
Landform: Valley floors, flood plains
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

136—Pend Oreille ashy silt loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5419
Elevation: 2,200 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Pend oreille and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam
2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

137—Pend Oreille ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 541b
Elevation: 2,200 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Pend oreille and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam
2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

138—Pend Oreille-Rock outcrop complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 541c
Elevation: 2,800 to 3,500 feet
Mean annual precipitation: 30 to 35 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Pend oreille and similar soils: 55 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam
2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

139—Highfalls gravelly ashy silt loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5406
Elevation: 2,800 to 4,900 feet
Mean annual precipitation: 35 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Highfalls and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Highfalls

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: gravelly ashy silt loam
Bw1 - 3 to 8 inches: gravelly ashy silt loam
Bw2 - 8 to 18 inches: gravelly ashy silt loam
2Bt - 18 to 29 inches: very gravelly sandy loam
2C - 29 to 60 inches: extremely cobbly fine sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/queencup beadlily (CN520)
Hydric soil rating: No

140—Frycanyon ashy silt loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 542r
Elevation: 2,200 to 2,400 feet
Mean annual precipitation: 28 to 32 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 100 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Frycanyon and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Frycanyon

Setting

Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash and glaciolacustrine deposits

Typical profile

Ap1 - 0 to 6 inches: ashy silt loam
Ap2 - 6 to 11 inches: ashy silt loam

BA - 11 to 17 inches: silt loam
Bt1 - 17 to 27 inches: silt loam
Bt2 - 27 to 34 inches: silt loam
Bt3 - 34 to 42 inches: silt loam
Bt4 - 42 to 46 inches: silt loam
Bk - 46 to 52 inches: silt loam
BC - 52 to 60 inches: silt loam
C - 60 to 62 inches: loamy very fine sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

141—Farnhamton silt loam, unprotected, drained, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 5431
Elevation: 1,750 to 1,800 feet
Mean annual precipitation: 23 to 28 inches
Mean annual air temperature: 43 to 47 degrees F
Frost-free period: 120 to 140 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Farnhamton, unprotected, drained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Farnhamton, Unprotected, Drained

Setting

Landform: Natural levees, flood plains
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous alluvium

Typical profile

Ap - 0 to 7 inches: silt loam
AC - 7 to 11 inches: silt loam
C1 - 11 to 22 inches: silt loam
C2 - 22 to 40 inches: silt loam
C3 - 40 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Ritz, unprotected, drained

Percent of map unit: 10 percent
Landform: Flood plains
Hydric soil rating: Yes

Schnoorson, unprotected, drained

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

142—Ritz silt loam, unprotected, undrained, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 5434
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 90 to 140 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Ritz, unprotected, undrained, and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritz, Unprotected, Undrained

Setting

Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Calcareous silty alluvium

Typical profile

A - 0 to 8 inches: silt loam
Cg1 - 8 to 18 inches: silt loam
Cg2 - 18 to 24 inches: silt loam
Cg3 - 24 to 32 inches: silt loam
Cg4 - 32 to 46 inches: silt loam
Cg5 - 46 to 60 inches: stratified silt loam to very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 5w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Minor Components

Schnoorson, unprotected, undrained

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Devoignes, unprotected, undrained

Percent of map unit: 2 percent
Landform: Flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Concave

Hydric soil rating: Yes

Typic fluvaquents, unprotected, undrained

Percent of map unit: 1 percent
Landform: Flood plains, valley floors
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

143—Ritz-Farnhamton complex, protected, drained, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 5433
Elevation: 1,750 to 1,800 feet
Mean annual precipitation: 23 to 28 inches
Mean annual air temperature: 43 to 47 degrees F
Frost-free period: 120 to 140 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Ritz, protected, drained, and similar soils: 50 percent
Farnhamton, protected, drained, and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritz, Protected, Drained

Setting

Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Calcareous silty alluvium

Typical profile

Ap - 0 to 8 inches: silt loam
Cg1 - 8 to 18 inches: silt loam
Cg2 - 18 to 24 inches: silt loam
Cg3 - 24 to 32 inches: silt loam
Cg4 - 32 to 46 inches: silt loam
Cg5 - 46 to 60 inches: stratified silt loam to very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 24 to 48 inches

Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: Yes

Description of Farnhamton, Protected, Drained

Setting

Landform: Flood plains, natural levees
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous alluvium

Typical profile

Ap - 0 to 7 inches: silt loam
AC - 7 to 11 inches: silt loam
C1 - 11 to 22 inches: silt loam
C2 - 22 to 40 inches: silt loam
C3 - 40 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Schnoorson, protected, drained

Percent of map unit: 10 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

144—Rock outcrop-Jaypeak, very stony complex, 65 to 100 percent slopes

Map Unit Setting

National map unit symbol: 5432
Elevation: 1,800 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 50 percent
Jaypeak, very stony surface, and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 65 to 100 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Description of Jaypeak, Very Stony Surface

Setting

Landform: Escarpments, mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over colluvium derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: gravelly ashy silt loam
Bw1 - 3 to 9 inches: gravelly ashy silt loam
Bw2 - 9 to 19 inches: gravelly ashy silt loam
2BC - 19 to 26 inches: extremely gravelly loam
2C1 - 26 to 41 inches: extremely stony loam
2C2 - 41 to 53 inches: extremely gravelly loam

2C3 - 53 to 60 inches: extremely stony loam

Properties and qualities

Slope: 65 to 85 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

148—Riverwash

Map Unit Setting

National map unit symbol: 5407
Elevation: 1,750 to 1,800 feet
Mean annual precipitation: 23 to 28 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 120 to 140 days

Map Unit Composition

Riverwash: 95 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Point bars

Typical profile

C - 0 to 60 inches: stratified sand to gravel

Properties and qualities

Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Ritz, unprotected, undrained

Percent of map unit: 3 percent
Landform: Flood plains
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

150—Pywell muck, protected, drained, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2x6t2
Elevation: 1,750 to 1,920 feet
Mean annual precipitation: 20 to 25 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 90 to 130 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Pywell, protected, drained, and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pywell, Protected, Drained

Setting

Landform: Flood plains, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material

Typical profile

Oap - 0 to 10 inches: muck
Oa1 - 10 to 14 inches: muck
Oa2 - 14 to 22 inches: muck
Oa3 - 22 to 33 inches: muck
Oa4 - 33 to 70 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 7.09 in/hr)
Depth to water table: About 12 to 39 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Very high (about 26.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: sedge plant associations (meadow series) - wetland (MW)
Hydric soil rating: Yes

151—Pywell-DeVoignes complex, unprotected, undrained, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 541j
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 80 to 120 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Pywell, unprotected, undrained, and similar soils: 55 percent
Devoignes, unprotected, undrained, and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pywell, Unprotected, Undrained

Setting

Landform: Drainageways, depressions, flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous and/or woody organic material

Typical profile

Oa1 - 0 to 10 inches: muck
Oa2 - 10 to 14 inches: muck
Oa3 - 14 to 22 inches: muck
Oa4 - 22 to 33 inches: muck
Oa5 - 33 to 70 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Very high (about 26.9 inches)

Interpretive groups

Land capability classification (irrigated): 5w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Other vegetative classification: sedge plant associations (meadow series) - wetland (MW)
Hydric soil rating: Yes

Description of Devoignes, Unprotected, Undrained

Setting

Landform: Flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Stratified herbaceous organic material over mixed alluvium

Typical profile

Ap - 0 to 9 inches: mucky silt loam
Oa/C - 9 to 19 inches: stratified muck to silty clay loam
Oa/Cg - 19 to 24 inches: stratified muck to silty clay loam
2Cg1 - 24 to 28 inches: silty clay loam
2Cg2 - 28 to 41 inches: silty clay loam
2Cg3 - 41 to 65 inches: stratified silty clay loam to silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C/D
Other vegetative classification: beaked sedge h.t. (HP500)
Hydric soil rating: Yes

Minor Components

Schnoorson, unprotected, undrained

Percent of map unit: 10 percent
Landform: Swales, depressions, flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Ritz, unprotected, undrained

Percent of map unit: 5 percent
Landform: Flood plains

Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

153—Ritz-Farnhamton complex, unprotected, drained, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 541l
Elevation: 1,750 to 1,800 feet
Mean annual precipitation: 23 to 28 inches
Mean annual air temperature: 43 to 47 degrees F
Frost-free period: 120 to 140 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Ritz, unprotected, drained, and similar soils: 45 percent
Farnhamton, unprotected, drained, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritz, Unprotected, Drained

Setting

Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Calcareous silty alluvium

Typical profile

Ap - 0 to 8 inches: silt loam
Cg1 - 8 to 18 inches: silt loam
Cg2 - 18 to 24 inches: silt loam
Cg3 - 24 to 32 inches: silt loam
Cg4 - 32 to 46 inches: silt loam
Cg5 - 46 to 60 inches: stratified silt loam to very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: Yes

Description of Farnhamton, Unprotected, Drained

Setting

Landform: Natural levees, flood plains
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Calcareous alluvium

Typical profile

Ap - 0 to 7 inches: silt loam
AC - 7 to 11 inches: silt loam
C1 - 11 to 22 inches: silt loam
C2 - 22 to 40 inches: silt loam
C3 - 40 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 48 to 60 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Schnoorson, unprotected, drained

Percent of map unit: 15 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

156—Ritz silt loam, protected, drained, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 541p
Elevation: 1,750 to 1,800 feet
Mean annual precipitation: 23 to 28 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 120 to 140 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Ritz, protected, drained, and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritz, Protected, Drained

Setting

Landform: Flood plains
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous silty alluvium

Typical profile

Ap - 0 to 8 inches: silt loam
Cg1 - 8 to 18 inches: silt loam
Cg2 - 18 to 24 inches: silt loam
Cg3 - 24 to 32 inches: silt loam
Cg4 - 32 to 46 inches: silt loam
Cg5 - 46 to 60 inches: stratified silt loam to very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Schnoorson, protected, drained

Percent of map unit: 10 percent
Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

157—Ritz-Schnoorson complex, protected, drained, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 541q
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 140 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Ritz, protected, drained, and similar soils: 45 percent
Schnoorson, protected, drained, and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ritz, Protected, Drained

Setting

Landform: Flood plains
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous silty alluvium

Typical profile

Ap - 0 to 8 inches: silt loam
Cg1 - 8 to 18 inches: silt loam
Cg2 - 18 to 24 inches: silt loam
Cg3 - 24 to 32 inches: silt loam
Cg4 - 32 to 46 inches: silt loam
Cg5 - 46 to 60 inches: stratified silt loam to very fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 24 to 48 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: Yes

Description of Schnoorson, Protected, Drained

Setting
Landform: Flood plains, depressions, swales
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Silty and clayey alluvium

Typical profile
Ap - 0 to 6 inches: silty clay loam
Cg1 - 6 to 20 inches: silty clay loam
Cg2 - 20 to 31 inches: silty clay loam
Cg3 - 31 to 40 inches: silty clay loam
Cg4 - 40 to 65 inches: silty clay

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Devoignes, protected, drained
Percent of map unit: 5 percent
Landform: Depressions, swales, flood plains
Down-slope shape: Concave

Across-slope shape: Concave
Hydric soil rating: Yes

162—Rock outcrop-Treble, very stony complex, 5 to 35 percent slopes

Map Unit Setting

National map unit symbol: 541w
Elevation: 1,800 to 3,800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 55 percent
Treble, very stony surface, and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 5 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Description of Treble, Very Stony Surface

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash and loess over till derived from gneiss and/or granite and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 14 inches: gravelly ashy sandy loam
Bt1 - 14 to 24 inches: very gravelly sandy loam
Bt2 - 24 to 34 inches: very gravelly sandy loam

Bt3 - 34 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 5 to 35 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

165—Rubson ashy silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 541z
Elevation: 2,100 to 2,700 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 100 to 135 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rubson and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rubson

Setting

Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Volcanic ash and/or loess over glaciolacustrine deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 5 inches: ashy silt loam
Bw1 - 5 to 11 inches: ashy silt loam
Bw2 - 11 to 17 inches: ashy silt loam

Bt1 - 17 to 26 inches: silt loam
Bt2 - 26 to 32 inches: silt loam
Bt3 - 32 to 35 inches: silt loam
Bt4 - 35 to 53 inches: very fine sandy loam
Bt5 - 53 to 58 inches: very fine sandy loam
C - 58 to 68 inches: loamy very fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

166—Rubson ashy silt loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2x1zn
Elevation: 1,740 to 2,720 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 45 to 46 degrees F
Frost-free period: 105 to 130 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rubson and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rubson

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed volcanic ash, loess and glaciolacustrine deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 5 inches: ashy silt loam

Bw - 5 to 17 inches: ashy silt loam
Bt1 - 17 to 35 inches: silt loam
Bt2 - 35 to 58 inches: very fine sandy loam
C - 58 to 68 inches: loamy very fine sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 7.09 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

167—Rubson ashy silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 5421
Elevation: 2,100 to 2,700 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 100 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Rubson and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rubson

Setting

Landform: Terraces
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash and/or loess over glaciolacustrine deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 5 inches: ashy silt loam
Bw1 - 5 to 11 inches: ashy silt loam
Bw2 - 11 to 17 inches: ashy silt loam
Bt1 - 17 to 26 inches: silt loam

Bt2 - 26 to 32 inches: silt loam
Bt3 - 32 to 35 inches: silt loam
Bt4 - 35 to 53 inches: very fine sandy loam
Bt5 - 53 to 58 inches: very fine sandy loam
C - 58 to 68 inches: loamy very fine sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

170—Schnoorson silt loam, protected, drained, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 5424
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 140 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Schnoorson, protected, drained, and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Schnoorson, Protected, Drained

Setting

Landform: Flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Silty and clayey alluvium

Typical profile

Ap - 0 to 6 inches: silt loam
Cg1 - 6 to 20 inches: silt loam
Cg2 - 20 to 31 inches: silt loam

Cg3 - 31 to 40 inches: silty clay loam
Cg4 - 40 to 65 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Ritz, protected, drained

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: Yes

Devoignes, protected, drained

Percent of map unit: 5 percent
Landform: Flood plains, depressions, swales
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

171—Seelovers silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 5425
Elevation: 1,750 to 3,000 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 80 to 120 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Seelovers and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Seelovers

Setting

Landform: Valley floors, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed fine-silty alluvium

Typical profile

A1 - 0 to 6 inches: silt loam
A2 - 6 to 12 inches: silt loam
Bg1 - 12 to 17 inches: silt loam
Bg2 - 17 to 29 inches: silt loam
Cg - 29 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Minor Components

Typic fluvaquents

Percent of map unit: 5 percent
Landform: Flood plains, valley floors
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Devoignes

Percent of map unit: 3 percent
Landform: Flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Pywell

Percent of map unit: 2 percent

Landform: Drainageways, depressions, flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

172—Seelovers silt loam, drained, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 5426
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 80 to 120 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Seelovers, drained, and similar soils: 85 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Seelovers, Drained

Setting

Landform: Valley floors, flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Mixed fine-silty alluvium

Typical profile

A1 - 0 to 6 inches: silt loam
A2 - 6 to 12 inches: silt loam
Bg1 - 12 to 17 inches: silt loam
Bg2 - 17 to 29 inches: silt loam
Cg - 29 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C
Other vegetative classification: western redcedar/devil's club (CN550)

Hydric soil rating: Yes

Minor Components

Typic fluvaquents, drained

Percent of map unit: 5 percent
Landform: Valley floors, flood plains
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Devoignes, drained

Percent of map unit: 2 percent
Landform: Flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Pywell, drained

Percent of map unit: 2 percent
Landform: Drainageways, depressions, flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

173—Schnoorson silty clay loam, protected, drained, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 542x
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 140 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Schnoorson, protected, drained, and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Schnoorson, Protected, Drained

Setting

Landform: Swales, depressions, flood plains
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Silty and clayey alluvium

Typical profile

Ap - 0 to 6 inches: silty clay loam
Cg1 - 6 to 20 inches: silty clay loam
Cg2 - 20 to 31 inches: silty clay loam
Cg3 - 31 to 40 inches: silty clay loam
Cg4 - 40 to 65 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: Yes

Minor Components

Ritz, protected, drained

Percent of map unit: 5 percent
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: Yes

Devoignes, protected, drained

Percent of map unit: 5 percent
Landform: Flood plains, depressions, swales
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

174—Selle ashy fine sandy loam, 0 to 7 percent slopes

Map Unit Setting

National map unit symbol: 5427
Elevation: 2,000 to 2,500 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 45 degrees F

Frost-free period: 100 to 130 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Selle and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Selle

Setting

Landform: Terraces
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash and/or loess over sandy glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy fine sandy loam
Bw1 - 3 to 6 inches: ashy fine sandy loam
Bw2 - 6 to 17 inches: ashy fine sandy loam
Bw3 - 17 to 33 inches: loamy fine sand
E&Bt - 33 to 42 inches: fine sand
C - 42 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

175—Selle-Elmira complex, 0 to 20 percent slopes

Map Unit Setting

National map unit symbol: 2x6t5
Elevation: 1,970 to 2,530 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 110 to 140 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Selle and similar soils: 50 percent
Elmira and similar soils: 35 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Selle

Setting

Landform: Dunes
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash and/or loess over sandy glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 6 inches: ashy fine sandy loam
Bw - 6 to 21 inches: fine sandy loam
E/Bt - 21 to 61 inches: loamy fine sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 7.09 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

Description of Elmira

Setting

Landform: Dunes
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Very minor amounts of volcanic ash and/or loess over sandy glaciolacustrine deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: loamy sand
Bw - 5 to 26 inches: loamy sand
E and Bt - 26 to 60 inches: sand

Properties and qualities

Slope: 3 to 20 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (7.09 to 42.51 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/common snowberry (CN310)
Hydric soil rating: No

Minor Components

Pywell, somewhat poorly drained

Percent of map unit: 1 percent
Landform: Flood plains, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: WET MEADOW 16-24 PZ (R044XY601WA)
Hydric soil rating: Yes

176—Snowlake ashy sandy loam, 12 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5429
Elevation: 3,000 to 4,800 feet
Mean annual precipitation: 35 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Snowlake and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Snowlake

Setting

Landform: Terraces
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over sandy outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy sandy loam
Bw1 - 3 to 7 inches: ashy sandy loam
Bw2 - 7 to 14 inches: ashy sandy loam
BC - 14 to 25 inches: loamy sand
C1 - 25 to 39 inches: fine gravelly loamy coarse sand
C2 - 39 to 52 inches: fine gravelly coarse sand
C3 - 52 to 62 inches: gravelly coarse sand

Properties and qualities

Slope: 12 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Other vegetative classification: grand fir/queencup beadlily (CN520)
Hydric soil rating: No

177—Snowlake ashy sandy loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 542b
Elevation: 3,000 to 4,800 feet
Mean annual precipitation: 35 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Snowlake and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Snowlake

Setting

Landform: Canyons, escarpments
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over sandy outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy sandy loam
Bw1 - 3 to 7 inches: ashy sandy loam
Bw2 - 7 to 14 inches: ashy sandy loam
BC - 14 to 25 inches: loamy sand
C1 - 25 to 39 inches: fine gravelly loamy coarse sand
C2 - 39 to 52 inches: fine gravelly coarse sand
C3 - 52 to 62 inches: gravelly coarse sand

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Other vegetative classification: grand fir/queencup beadlily (CN520)
Hydric soil rating: No

179—Stien gravelly ashy silt loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 542d
Elevation: 1,800 to 2,800 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 90 to 110 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Stien and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stien

Setting

Landform: Outwash terraces, lateral moraines
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Volcanic ash over drift and/or outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: gravelly ashy silt loam
Bw1 - 3 to 6 inches: gravelly ashy silt loam
Bw2 - 6 to 17 inches: extremely gravelly ashy silt loam
2BC - 17 to 27 inches: extremely cobbly sandy loam
3C - 27 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/common snowberry (CN310)
Hydric soil rating: No

182—Stien cobbly ashy silt loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 542h
Elevation: 2,200 to 2,800 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 90 to 110 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Stien and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stien

Setting

Landform: Lateral moraines
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over drift and/or outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: cobbly ashy silt loam
Bw1 - 3 to 6 inches: cobbly ashy silt loam
Bw2 - 6 to 17 inches: very cobbly ashy silt loam
2BC - 17 to 27 inches: extremely cobbly sandy loam
3C - 27 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/common snowberry (CN310)
Hydric soil rating: No

184—Treble, very bouldery-Rock outcrop complex, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 542k
Elevation: 1,800 to 3,800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Treble, very bouldery surface, and similar soils: 55 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Treble, Very Bouldery Surface

Setting

Landform: Mountains, escarpments
Landform position (two-dimensional): Backslope
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Volcanic ash and loess over till derived from gneiss and/or granite and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 14 inches: gravelly ashy sandy loam
Bt1 - 14 to 24 inches: very gravelly sandy loam
Bt2 - 24 to 34 inches: very gravelly sandy loam
Bt3 - 34 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

185—Treble gravelly ashy sandy loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 542l
Elevation: 1,800 to 3,800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Treble and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Treble

Setting

Landform: Escarpments, mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash and loess over till derived from gneiss and/or granite and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 14 inches: gravelly ashy sandy loam
Bt1 - 14 to 24 inches: very gravelly sandy loam
Bt2 - 24 to 34 inches: very gravelly sandy loam
Bt3 - 34 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A

Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

186—Treble gravelly ashy sandy loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 542m
Elevation: 2,000 to 3,700 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Treble and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Treble

Setting

Landform: Hills, mountains, escarpments
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and loess over till derived from gneiss and/or granite and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 14 inches: gravelly ashy sandy loam
Bt1 - 14 to 24 inches: very gravelly sandy loam
Bt2 - 24 to 34 inches: very gravelly sandy loam
Bt3 - 34 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

189—Flemingcreek silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 5435
Elevation: 1,800 to 2,400 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 100 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Flemingcreek and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Flemingcreek

Setting

Landform: Escarpments
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: silt loam
BA - 3 to 11 inches: silt loam
Bt1 - 11 to 18 inches: silty clay loam
Bt2 - 18 to 32 inches: silty clay loam
Bk1 - 32 to 48 inches: silt loam
Bk2 - 48 to 60 inches: silt loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Other vegetative classification: grand fir/twinflower (CN590)
Hydric soil rating: No

190—Wishbone-Caboose complex, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 542n
Elevation: 1,800 to 2,700 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 49 degrees F
Frost-free period: 100 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Wishbone and similar soils: 60 percent
Caboose and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wishbone

Setting

Landform: Escarpments
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 7 inches: silt loam
Bt - 7 to 20 inches: silt loam
Btk - 20 to 60 inches: silt loam

Properties and qualities

Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/common snowberry (CN310)
Hydric soil rating: No

Description of Caboose

Setting

Landform: Escarpments
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Calcareous glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 5 inches: very fine sandy loam
AB1 - 5 to 9 inches: very fine sandy loam
AB2 - 9 to 21 inches: very fine sandy loam
Bt1 - 21 to 35 inches: silt loam
Bt2 - 35 to 57 inches: silt loam
Bk - 57 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

191—Dufort-Rock outcrop-Kriest complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5436
Elevation: 1,800 to 3,600 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Dufort and similar soils: 45 percent
Rock outcrop: 25 percent
Kriest and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam
2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Kriest

Setting

Landform: Mountains, ridges
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and loess over till over residuum weathered from granite and/or schist and/or gneiss

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 18 inches: gravelly ashy sandy loam
Bt1 - 18 to 27 inches: gravelly sandy loam
Bt2 - 27 to 34 inches: gravelly sandy loam
BC - 34 to 43 inches: gravelly loamy sand
2Cr - 43 to 53 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A

Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

197—Pend Oreille-Stien, moist complex, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 5439
Elevation: 2,300 to 2,800 feet
Mean annual precipitation: 30 to 32 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 110 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Pend oreille and similar soils: 45 percent
Stien, moist, and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Outwash terraces, lateral moraines
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 4 inches: ashy silt loam
Bw1 - 4 to 8 inches: ashy silt loam
Bw2 - 8 to 20 inches: gravelly ashy silt loam
2Bt1 - 20 to 27 inches: cobbly sandy loam
2Bt2 - 27 to 38 inches: cobbly sandy loam
2C - 38 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Description of Stien, Moist

Setting

Landform: Lateral moraines
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over drift and/or outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: gravelly ashy silt loam
Bw1 - 3 to 6 inches: gravelly ashy silt loam
Bw2 - 6 to 17 inches: extremely gravelly ashy silt loam
2BC - 17 to 27 inches: extremely cobbly sandy loam
3C - 27 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: B
Other vegetative classification: grand fir/twinflower (CN590)
Hydric soil rating: No

199—Seelovers-Typic Fluvaquents-Aquic Udifluvents complex, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 543c
Elevation: 1,750 to 3,000 feet
Mean annual precipitation: 23 to 35 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 80 to 120 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Aquic udifluvents and similar soils: 30 percent
Seelovers and similar soils: 30 percent
Typic fluvaquents and similar soils: 30 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aquic Udifluvents

Setting

Landform: Valley floors, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 4 inches: silt loam
AC - 4 to 9 inches: silt loam
C - 9 to 24 inches: stratified very fine sandy loam to loamy fine sand
Cg1 - 24 to 44 inches: stratified very fine sandy loam to coarse sand
Cg2 - 44 to 60 inches: stratified loamy sand to very cobbly coarse sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 35 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C
Other vegetative classification: western redcedar/oakfern (CN555)
Hydric soil rating: No

Description of Seelovers

Setting

Landform: Valley floors, flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Mixed fine-silty alluvium

Typical profile

A1 - 0 to 6 inches: silt loam
A2 - 6 to 12 inches: silt loam
Bg1 - 12 to 17 inches: silt loam
Bg2 - 17 to 29 inches: silt loam
Cg - 29 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Description of Typic Fluvaquents

Setting

Landform: Valley floors, flood plains
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 4 inches: silt loam
AC - 4 to 12 inches: silt loam
Cg1 - 12 to 27 inches: stratified very fine sandy loam to loamy fine sand
Cg2 - 27 to 42 inches: stratified very fine sandy loam to sand
Cg3 - 42 to 60 inches: stratified loamy sand to very cobbly coarse sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Minor Components

Pywell

Percent of map unit: 3 percent
Landform: Depressions, flood plains, drainageways

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Devoignes
Percent of map unit: 3 percent
Landform: Flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

200—Pywell-DeVoignes complex, partially drained, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 543d
Elevation: 1,750 to 2,800 feet
Mean annual precipitation: 23 to 30 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 80 to 120 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Pywell, partially drained, and similar soils: 45 percent
Devoignes, partially drained, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pywell, Partially Drained

Setting
Landform: Flood plains, valley floors, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous and/or woody organic material

Typical profile
Oa1 - 0 to 10 inches: muck
Oa2 - 10 to 14 inches: muck
Oa3 - 14 to 22 inches: muck
Oa4 - 22 to 33 inches: muck
Oa5 - 33 to 70 inches: muck

Properties and qualities
Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Very high (about 26.9 inches)

Interpretive groups

Land capability classification (irrigated): 5w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Other vegetative classification: sedge plant associations (meadow series) - wetland (MW)
Hydric soil rating: Yes

Description of Devoignes, Partially Drained

Setting

Landform: Flood plains, valley floors, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Stratified herbaceous organic material over mixed alluvium

Typical profile

Ap - 0 to 9 inches: mucky silt loam
Oa/C - 9 to 19 inches: stratified muck to silty clay loam
Oa/Cg - 19 to 24 inches: stratified muck to silty clay loam
2Cg1 - 24 to 28 inches: silty clay loam
2Cg2 - 28 to 41 inches: silty clay loam
2Cg3 - 41 to 65 inches: stratified silty clay loam to silty clay

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 20 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: beaked sedge h.t. (HP500)
Hydric soil rating: Yes

Minor Components

Schnoorson, partially drained

Percent of map unit: 5 percent
Landform: Swales, depressions, flood plains

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Seelovers, partially drained
Percent of map unit: 5 percent
Landform: Flood plains, valley floors
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Typic fluvaquents, partially drained
Percent of map unit: 5 percent
Landform: Valley floors, flood plains
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

201—Pywell muck, unprotected, undrained, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2x6t4
Elevation: 1,770 to 3,170 feet
Mean annual precipitation: 23 to 33 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 100 to 125 days
Farmland classification: Not prime farmland

Map Unit Composition

Pywell, unprotected, undrained, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pywell, Unprotected, Undrained

Setting

Landform: Flood plains, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material

Typical profile

Oa1 - 0 to 10 inches: muck
Oa1 - 10 to 14 inches: muck
Oa2 - 14 to 22 inches: muck
Oa3 - 22 to 33 inches: muck
Oa4 - 33 to 70 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 7.09 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Very high (about 26.9 inches)

Interpretive groups

Land capability classification (irrigated): 5w
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Other vegetative classification: sedge plant associations (meadow series) - wetland (MW)
Hydric soil rating: Yes

Minor Components

Schnoorson, unprotected, undrained

Percent of map unit: 5 percent
Landform: Flood plains, swales, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: reed canarygrass h.t. (HP618)
Hydric soil rating: Yes

Seelovers, unprotected, undrained

Percent of map unit: 5 percent
Landform: Flood plains, valley floors
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

Devoignes, poorly drained

Percent of map unit: 5 percent
Landform: Flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: beaked sedge h.t. (HP500)
Hydric soil rating: Yes

202—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Idaho Panhandle National Forest, Idaho-Washington-Montana

2x6t9—Pend Oreille-Rock outcrop complex 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2x6t9
Elevation: 2,800 to 3,500 feet
Mean annual precipitation: 30 to 35 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pend oreille and similar soils: 55 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam
2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

261—Pearsoncreek-Highfalls families, complex, glaciated mountain slopes, belt geology, north aspects, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2lg1s
Elevation: 3,300 to 4,500 feet
Mean annual precipitation: 40 to 54 inches
Mean annual air temperature: 40 to 46 degrees F
Frost-free period: 60 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 45 percent
Highfalls and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountain slopes
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A1 - 2 to 4 inches: gravelly ashy silt loam
A2 - 4 to 11 inches: extremely cobbly ashy silt loam
2Bw1 - 11 to 26 inches: extremely gravelly silt loam
2Bw2 - 26 to 36 inches: extremely gravelly silt loam
2Bw3 - 36 to 62 inches: extremely gravelly silt loam

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Highfalls

Setting

Landform: Mountain slopes
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Bw1 - 1 to 11 inches: ashy silt loam
Bw2 - 11 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 32 inches: very gravelly sandy loam
2C - 32 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

262—Pearsoncreek-Highfalls families, complex, steep glaciated mountain slopes, belt geology, north aspects, 40 to 75 percent slopes

Map Unit Setting

National map unit symbol: 2lg1t

Elevation: 3,010 to 4,480 feet
Mean annual precipitation: 39 to 52 inches
Mean annual air temperature: 40 to 46 degrees F
Frost-free period: 60 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 45 percent
Highfalls and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A1 - 2 to 4 inches: gravelly ashy silt loam
A2 - 4 to 11 inches: extremely cobbly ashy silt loam
2Bw1 - 11 to 26 inches: extremely gravelly silt loam
2Bw2 - 26 to 36 inches: extremely gravelly silt loam
2Bw3 - 36 to 62 inches: extremely gravelly silt loam

Properties and qualities

Slope: 40 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530), western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Description of Highfalls

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Bw1 - 1 to 11 inches: ashy silt loam
Bw2 - 11 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 32 inches: very gravelly sandy loam
2C - 32 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 40 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530), western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

265—Pearsoncreek-Highfalls families, complex, dissected steep glaciated mountain slopes, belt geology, north aspects

Map Unit Setting

National map unit symbol: 2lg1v
Elevation: 3,350 to 4,580 feet
Mean annual precipitation: 40 to 55 inches
Mean annual air temperature: 40 to 46 degrees F
Frost-free period: 60 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 45 percent
Highfalls and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Convex
Across-slope shape: Linear

Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A1 - 2 to 4 inches: gravelly ashy silt loam
A2 - 4 to 11 inches: extremely cobbly ashy silt loam
2Bw1 - 11 to 26 inches: extremely gravelly silt loam
2Bw2 - 26 to 36 inches: extremely gravelly silt loam
2Bw3 - 36 to 62 inches: extremely gravelly silt loam

Properties and qualities

Slope: 30 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530), western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Description of Highfalls

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Bw1 - 1 to 11 inches: ashy silt loam
Bw2 - 11 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 32 inches: very gravelly sandy loam
2C - 32 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 30 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western redcedar/queencup beadlily (CN530), western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

353—Andic Humudepts-Humic Udivitrands-Pearsoncreek families, dense substratum complex, shallow incised glaciated mountain slopes, granitic geology, south aspects

Map Unit Setting

National map unit symbol: 2lg3b
Elevation: 3,090 to 4,680 feet
Mean annual precipitation: 40 to 52 inches
Mean annual air temperature: 40 to 46 degrees F
Frost-free period: 60 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Andic humudepts and similar soils: 25 percent
Humic udivitrands and similar soils: 25 percent
Pearsoncreek, shallow, and similar soils: 20 percent
Pearsoncreek, dense subsoil, and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Andic Humudepts

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 13 inches: gravelly ashy silt loam
2Bw - 13 to 60 inches: extremely cobbly silt loam

Properties and qualities

Slope: 10 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Humic Udivitrands

Setting

Landform: Mountain slopes
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A1 - 1 to 3 inches: gravelly ashy silt loam
A2 - 3 to 16 inches: extremely gravelly ashy silt loam
2Bw - 16 to 33 inches: extremely gravelly silt loam
3C - 33 to 60 inches: extremely gravelly coarse sand

Properties and qualities

Slope: 10 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Pearsoncreek, Shallow

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Volcanic ash over dense till

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: ashy silt loam
Bs - 7 to 14 inches: ashy silt loam
2Bw - 14 to 18 inches: very gravelly very fine sandy loam
2Bd - 18 to 60 inches: very gravelly very fine sandy loam

Properties and qualities

Slope: 10 to 40 percent
Depth to restrictive feature: 10 to 20 inches to densic material
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.01 in/hr)
Depth to water table: About 13 to 25 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Pearsoncreek, Dense Subsoil

Setting

Landform: Mountain slopes
Landform position (two-dimensional): Toeslope, footslope, backslope
Landform position (three-dimensional): Lower third of mountainflank
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till

Typical profile

Oi - 0 to 3 inches: slightly decomposed plant material
A - 3 to 8 inches: gravelly ashy silt loam
AB - 8 to 11 inches: extremely cobbly ashy silt loam
2Bw - 11 to 16 inches: extremely gravelly silt loam
2Bd - 16 to 23 inches: extremely gravelly silt loam
2BC - 23 to 60 inches: extremely gravelly silt loam

Properties and qualities

Slope: 10 to 40 percent
Depth to restrictive feature: 10 to 20 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.07 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Hydric soil rating: No

370—Eloika-Humic Lithic Dystroxerepts families-Rock outcrop complex, glaciated scoured ridges and upper mountain slopes, granitic geology, south aspects

Map Unit Setting

National map unit symbol: 2lg3k
Elevation: 2,840 to 4,130 feet
Mean annual precipitation: 35 to 47 inches
Mean annual air temperature: 40 to 46 degrees F
Frost-free period: 60 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Eloika and similar soils: 35 percent
Humic lithic dystroxerepts and similar soils: 30 percent
Rock outcrop: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Eloika

Setting

Landform: Mountain slopes
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash over till

Typical profile

A - 0 to 3 inches: ashy silt loam
Bw1 - 3 to 13 inches: ashy silt loam
Bw2 - 13 to 23 inches: cobbly ashy silt loam
2Bw3 - 23 to 34 inches: cobbly silt loam
2Bw4 - 34 to 42 inches: cobbly silt loam
2BC - 42 to 60 inches: extremely cobbly silt loam

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Humic Lithic Dystroxerepts

Setting

Landform: Mountain slopes on ridges
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Mountainflank, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Till derived from granite

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 11 inches: very cobbly sandy loam
AB - 11 to 16 inches: very cobbly sandy loam
R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 15 to 40 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

540h—Caribouridge ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 540h
Elevation: 2,400 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Caribouridge and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caribouridge

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over outwash and/or till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: ashy silt loam
2BC - 18 to 23 inches: very cobbly loamy coarse sand
2C1 - 23 to 44 inches: extremely cobbly coarse sand
2C2 - 44 to 60 inches: extremely cobbly coarse sand

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B

Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

540n—Dufort ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 540n
Elevation: 2,400 to 3,800 feet
Mean annual precipitation: 30 to 35 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Dufort and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam
2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

540x—Jaypeak gravelly ashy silt loam, 35 to 75 percent slopes

Map Unit Setting

National map unit symbol: 540x
Elevation: 2,400 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 80 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Jaypeak and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jaypeak

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over colluvium derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: gravelly ashy silt loam
Bw1 - 3 to 9 inches: gravelly ashy silt loam
Bw2 - 9 to 19 inches: gravelly ashy silt loam
2BC - 19 to 26 inches: extremely gravelly loam
2C1 - 26 to 41 inches: extremely stony loam
2C2 - 41 to 53 inches: extremely gravelly loam
2C3 - 53 to 60 inches: extremely stony loam

Properties and qualities

Slope: 35 to 75 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

541b—Pend Oreille ashy silt loam, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 541b
Elevation: 2,200 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Pend oreille and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam
2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

541x—Rock outcrop-Treble, very stony complex, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 541x
Elevation: 1,800 to 3,800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 55 percent
Treble, very stony surface, and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Description of Treble, Very Stony Surface

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash and loess over till derived from gneiss and/or granite and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 14 inches: gravelly ashy sandy loam

Bt1 - 14 to 24 inches: very gravelly sandy loam
Bt2 - 24 to 34 inches: very gravelly sandy loam
Bt3 - 34 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

542k—Treble, very bouldery-Rock outcrop complex, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 542k
Elevation: 1,800 to 3,800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Treble, very bouldery surface, and similar soils: 55 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Treble, Very Bouldery Surface

Setting

Landform: Escarpments, mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and loess over till derived from gneiss and/or granite and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 14 inches: gravelly ashy sandy loam
Bt1 - 14 to 24 inches: very gravelly sandy loam
Bt2 - 24 to 34 inches: very gravelly sandy loam
Bt3 - 34 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 35 to 65 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/ninebark (CN260)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

542z—Dufort-Rock outcrop-Kriest complex, 35 to 65 percent slopes

Map Unit Setting

National map unit symbol: 542z
Elevation: 1,800 to 3,800 feet
Mean annual precipitation: 25 to 35 inches

Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Dufort and similar soils: 45 percent
Rock outcrop: 25 percent
Kriest and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam
2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Kriest

Setting

Landform: Mountains, ridges
Landform position (two-dimensional): Backslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and loess over till over residuum weathered from granite and/or schist and/or gneiss

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 18 inches: gravelly ashy sandy loam
Bt1 - 18 to 27 inches: gravelly sandy loam
Bt2 - 27 to 34 inches: gravelly sandy loam
BC - 34 to 43 inches: gravelly loamy sand
2Cr - 43 to 53 inches: bedrock

Properties and qualities

Slope: 35 to 65 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: A
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

5417—Pearsoncreek-Rock outcrop complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5417
Elevation: 2,800 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Pearsoncreek and similar soils: 55 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pearsoncreek

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash over till derived from gneiss and/or schist and/or granite

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 12 inches: ashy silt loam
2Bw3 - 12 to 17 inches: gravelly sandy loam
2BC - 17 to 29 inches: very cobbly sandy loam
2C1 - 29 to 50 inches: very gravelly sandy loam
2C2 - 50 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/queencup beadlily (CN520)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

5418—Pend Oreille ashy silt loam, 5 to 15 percent slopes

Map Unit Setting

National map unit symbol: 5418
Elevation: 2,200 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Pend oreille and similar soils: 85 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam

2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Minor Components

Seelovers

Percent of map unit: 1 percent
Landform: Valley floors, flood plains
Other vegetative classification: western redcedar/devil's club (CN550)
Hydric soil rating: Yes

5419—Pend Oreille ashy silt loam, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5419
Elevation: 2,200 to 4,800 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 42 to 45 degrees F
Frost-free period: 70 to 100 days
Farmland classification: Not prime farmland

Map Unit Composition

Pend oreille and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: ashy silt loam
Bw1 - 7 to 17 inches: ashy silt loam
Bw2 - 17 to 20 inches: gravelly ashy silt loam
2Bt - 20 to 30 inches: cobbly sandy loam
2BC - 30 to 60 inches: cobbly sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

5428—Selle-Elmira complex, 0 to 20 percent slopes

Map Unit Setting

National map unit symbol: 5428
Elevation: 2,000 to 2,500 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 47 degrees F
Frost-free period: 100 to 140 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Selle and similar soils: 45 percent
Elmira and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Selle

Setting

Landform: Terraces
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Volcanic ash and/or loess over sandy glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material

Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy fine sandy loam
Bw1 - 3 to 6 inches: ashy fine sandy loam
Bw2 - 6 to 17 inches: ashy fine sandy loam
Bw3 - 17 to 33 inches: loamy fine sand
E&Bt - 33 to 42 inches: fine sand
C - 42 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

Description of Elmira

Setting

Landform: Dunes
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Volcanic ash and loess over sandy glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 6 inches: loamy fine sand
Bw1 - 6 to 14 inches: loamy fine sand
Bw2 - 14 to 26 inches: fine sand
E&Bt - 26 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 20 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A

Ecological site: Warm Frigid Xeric Ashy Slopes (Douglas-Fir Warm Dry Shrub) (F043AY002WA)
Other vegetative classification: Douglas-fir/common snowberry (CN310)
Hydric soil rating: No

5436—Dufort-Rock outcrop-Kriest complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 5436
Elevation: 1,800 to 3,600 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 43 to 46 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Dufort and similar soils: 45 percent
Rock outcrop: 25 percent
Kriest and similar soils: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 3 inches: ashy silt loam
Bw1 - 3 to 9 inches: ashy silt loam
Bw2 - 9 to 18 inches: gravelly ashy silt loam
2Bt1 - 18 to 25 inches: very gravelly sandy loam
2Bt2 - 25 to 36 inches: extremely cobbly sandy loam
2Bt3 - 36 to 47 inches: extremely cobbly sandy loam
2Bt4 - 47 to 52 inches: very gravelly fine sandy loam
2C - 52 to 60 inches: extremely bouldery sandy loam

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile
R - 0 to 60 inches: bedrock

Properties and qualities
Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Kriest

Setting
Landform: Mountains, ridges
Landform position (two-dimensional): Backslope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Volcanic ash and loess over till over residuum weathered from granite and/or schist and/or gneiss

Typical profile
Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: gravelly ashy sandy loam
Bw1 - 4 to 8 inches: gravelly ashy sandy loam
Bw2 - 8 to 18 inches: gravelly ashy sandy loam
Bt1 - 18 to 27 inches: gravelly sandy loam
Bt2 - 27 to 34 inches: gravelly sandy loam
BC - 34 to 43 inches: gravelly loamy sand
2Cr - 43 to 53 inches: bedrock

Properties and qualities
Slope: 15 to 35 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

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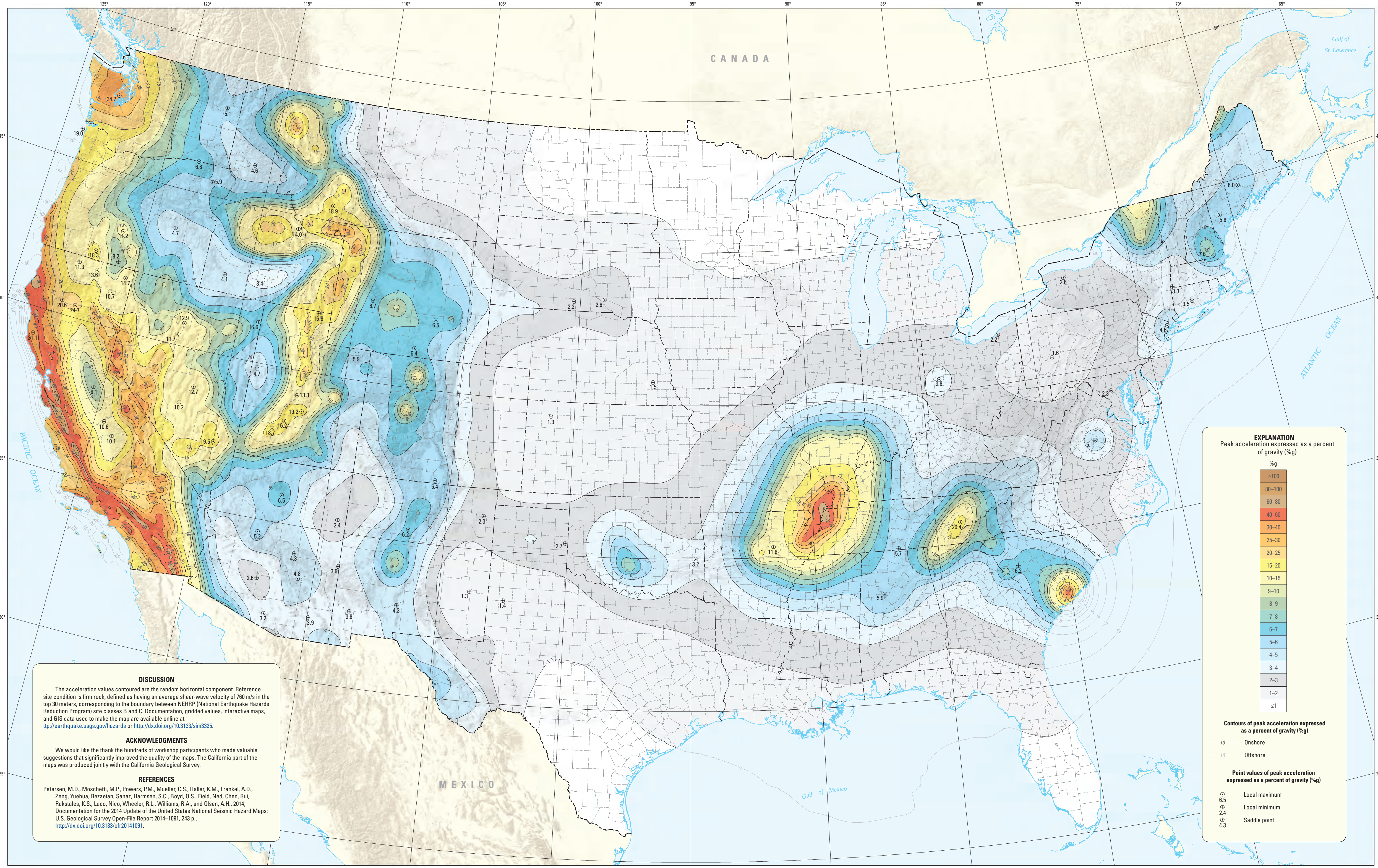

DISCUSSION

The acceleration values contoured are the random horizontal component. Reference site condition is firm rock, defined as having an average shear-wave velocity of 760 m/s in the top 30 meters, corresponding to the boundary between NEHRP (National Earthquake Hazards Reduction Program) site classes B and C. Documentation, gridded values, interactive maps, and GIS data used to make the map are available online at http://earthquake.usgs.gov/hazards or http://dx.doi.org/10.3133/sim3325.

ACKNOWLEDGMENTS

We would like the thank the hundreds of workshop participants who made valuable suggestions that significantly improved the quality of the maps. The California part of the maps was produced jointly with the California Geological Survey.

REFERENCES

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Shaded relief base from Esri Inc., 2008, Data and Maps
All other base map data from Esri Inc., 1993, Digital Chart of the World
United States County base map from the U.S. Geological Survey National Atlas, available at http://nationalatlas.gov/

Projection: Albers equal-area conic
Standard parallels 29.5°N. and 45.5°N., central meridian 95°W

SCALE 1:7 000 000

Digital data prepared with ArcGIS 10.1 running under Windows 7

Seismic-Hazard Maps for the Conterminous United States, 2014

Peak Horizontal Acceleration with 10 Percent Probability of Exceedance in 50 Years

By

Mark D. Petersen,[1] Morgan P. Moschetti,[1] Peter M. Powers,[1] Charles S. Mueller,[1] Kathleen M. Haller,[1] Arthur D. Frankel,[1] Yuehua Zeng,[1] Sanaz Rezaeian,[1] Stephen C. Harmsen,[1] Oliver S. Boyd,[1] Edward H. Field,[1] Rui Chen,[2] Nicolas Luco,[1] Russell L. Wheeler,[1] Robert A. Williams,[1] Anna H. Olsen,[1] and Kenneth S. Rukstales[1]

2015

[1]U.S. Geological Survey
[2]California Geological Survey, Sacramento, Calif.

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Box 25046, Mail Stop 966
Denver, CO 80225
(303) 273-8579

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http://geohazards.cr.usgs.gov/.

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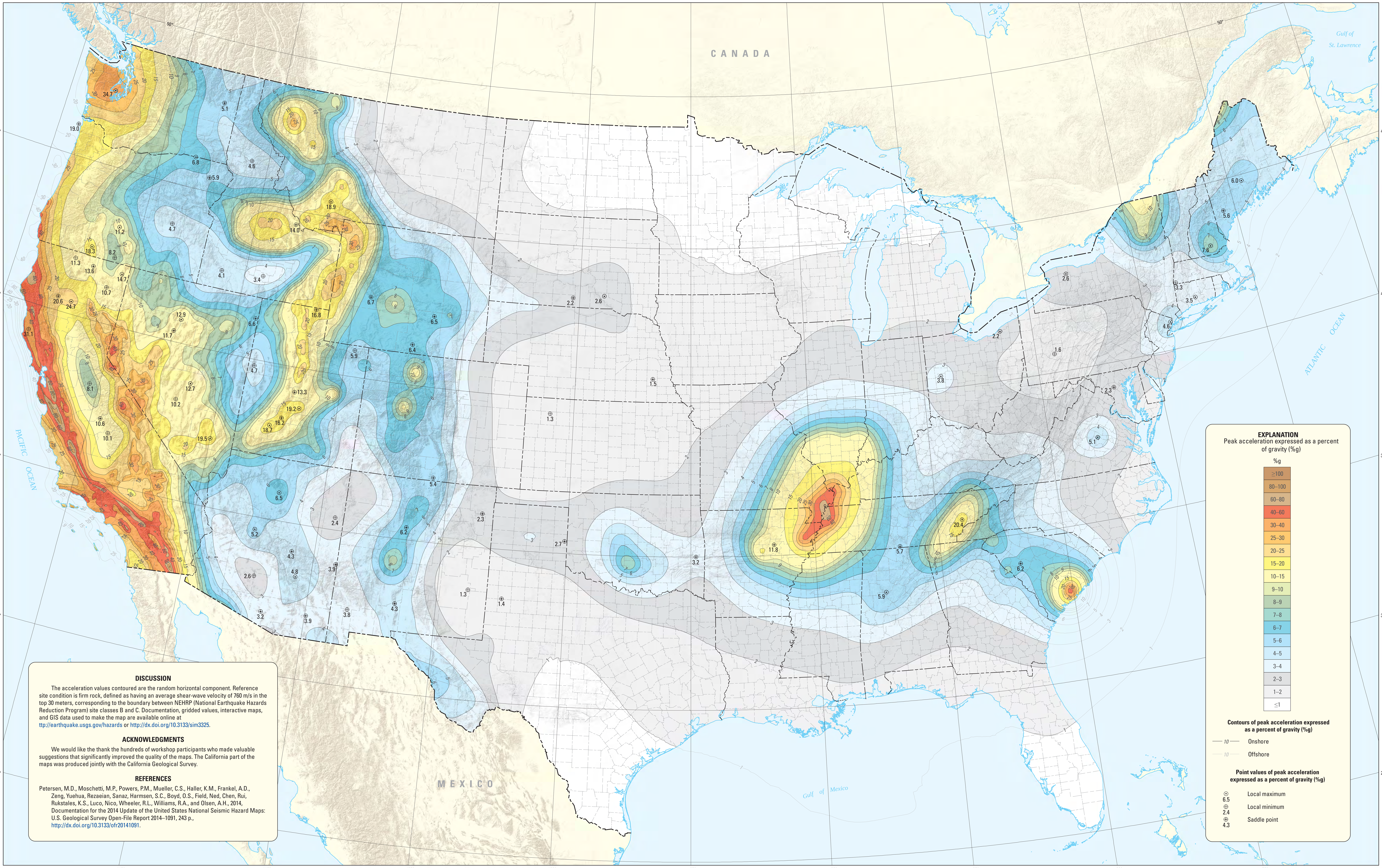

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EXPLANATION

Peak acceleration expressed as a percent of gravity (%g)

%g
≥100
80–100
60–80
40–60
30–40
25–30
20–25
15–20
10–15
9–10
8–9
7–8
6–7
5–6
4–5
3–4
2–3
1–2
≤1

Contours of peak acceleration expressed as a percent of gravity (%g)

10 Onshore

10 Offshore

Point values of peak acceleration expressed as a percent of gravity (%g)

6.5 Local maximum

2.4 Local minimum

4.3 Saddle point

Shaded relief base from Esri Inc., 2008, Data and Maps
All other base map data from Esri Inc., 1993, Digital Chart of the World
United States County base map from the U.S. Geological Survey National Atlas, available at http://nationalatlas.gov/

Projection: Albers equal-area conic
Standard parallels 29.5°N. and 45.5°N., central meridian 95°W

SCALE 1:7 000 000

100 0 100 200 300 400 500 600 700 800 900 1000 MILES

100 0 100 200 300 400 500 600 700 800 900 1000 KILOMETERS

Digital data prepared with ArcGIS 10.1 running under Windows 7

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DEQ Public Drinking Water System
Monitoring Schedule Report

Print Date: June 10, 2019

ID1110042 - CABINET MOUNTAINS WATER DIST

Community water system serving 2100 people and 914 connections.

Regulated by: COEUR D ALENE REGIONAL OFFICE

The following schedules include monitoring periods between 1-1-2019 and 12-31-2019

Schedules for Distribution System(s)

Code	Group/Analyte Name	Monitoring Frequency	Season Begin Date	Season End Date	Satisfied
3100	COLIFORM (TCR)	2 per MN	1/1	12/31	Monthly
2456	TOTAL HALOACETIC ACID (HAA5)	1 per YR collected in 2019 taken 7/1 through 9/30 2001 WHITE MOUNTAIN ROAD (DBP2A)	7/1	9/30	*FUTURE
2950	TTHM	1 per YR collected in 2019 taken 7/1 through 9/30 2001 WHITE MOUNTAIN ROAD (DBP2A)	7/1	9/30	*FUTURE

Schedules for Distribution Systems(s) Lead and Copper

Code	Group/Analyte Name	Monitoring Frequency	Season Begin Date	Season End Date	Satisfied
PBCU	LCR - LEAD COPPER	10 per 3Y collected in 2019 taken 6/1 through 9/30	6/1	9/30	NO

Note: Consumer notice of lead tap results, regardless of lead level, is required within 30 days after receiving results. For templates and more information, please visit: http://www.deq.idaho.gov/water-quality/drinking-water/pws-monitoring-reporting/public-notifications

Schedules for ID1110042WF

Please Label these samples as: "WELLFIELD 1 & 2"

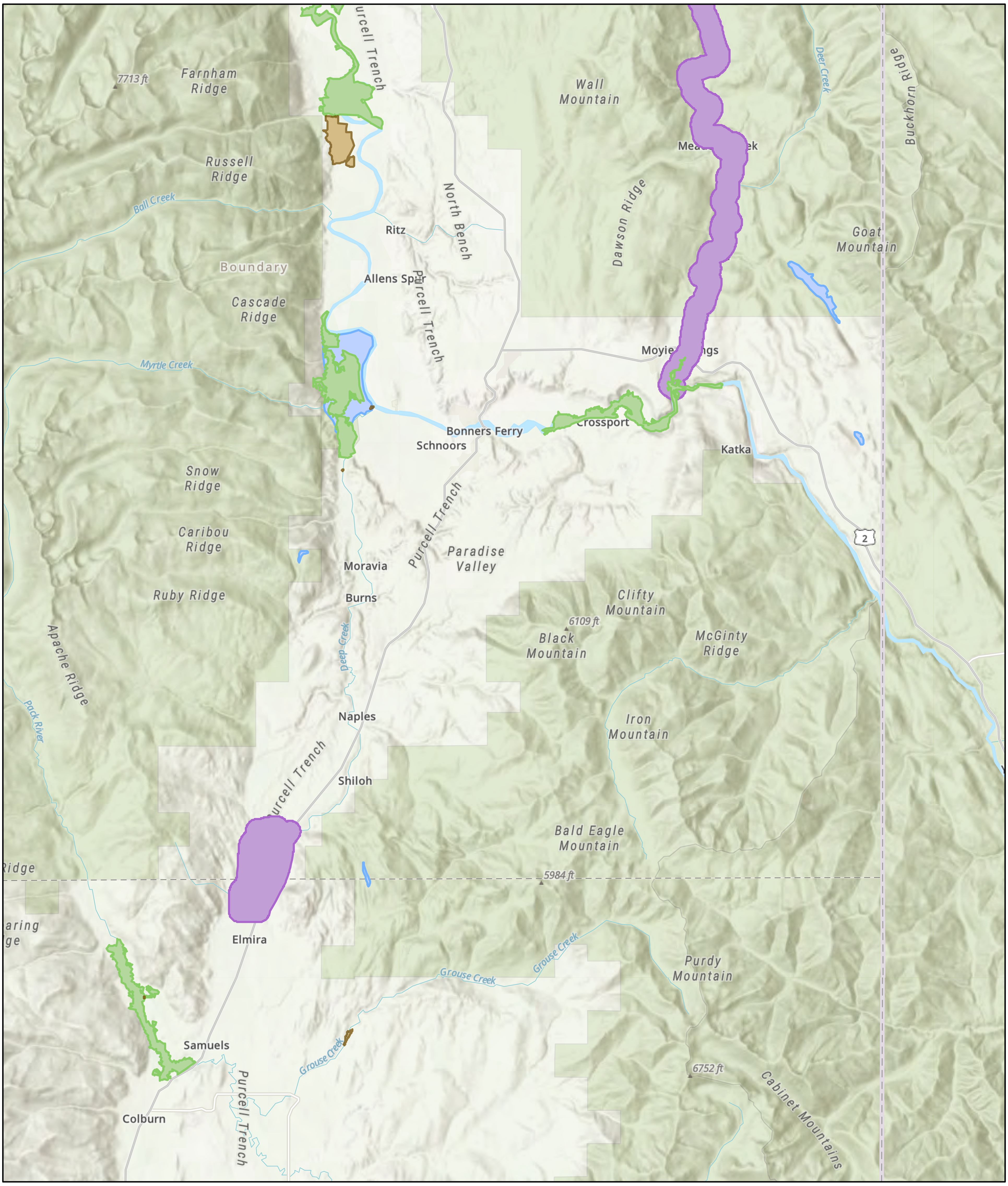
Code	Group/Analyte Name	Monitoring Frequency	Season Begin Date	Season End Date	Satisfied
ZARS	ARSENIC (1005)	1 per 9Y due between 01/01/2011 and 12/31/2019	n/a	n/a	YES
ZFLU	IOC - FLUORIDE	1 per 9Y due between 01/01/2011 and 12/31/2019	n/a	n/a	YES
ZIOC	IOCS - PHASE 2 AND 5	1 per 9Y due between 01/01/2011 and 12/31/2019	n/a	n/a	YES
ZNO2	NITRITE	1 per 9Y due between 01/01/2011 and 12/31/2019	n/a	n/a	YES
VOCS	VOCS - GROUP	1 per 6Y due between 01/01/2014 and 12/31/2019	n/a	n/a	NO
SODI	IOC - SODIUM	1 per 3Y due between 01/01/2017 and 12/31/2019	n/a	n/a	YES
ZNO3	NITRATE	1 per YR due between 01/01/2019 and 12/31/2019	n/a	n/a	YES

"*FUTURE" in the "Satisfied" column indicates the sampling requirement begins sometime in the future. Sampling before the monitoring period begin date will not satisfy the requirement for the monitoring period.

"*See CO" in the "Satisfied" column indicates the operator needs to contact his or her compliance officer (CO) to verify that samples have been taken and the schedule has been satisfied.

IMPORTANT NOTICE: This monitoring schedule is provided to you as a courtesy and is current as of June 10, 2019 Surface water systems and systems that are disinfecting have additional sampling that is not reflected in this monitoring schedule report. This monitoring schedule may be changed or modified as needed. This monitoring schedule does not show past unfulfilled schedules for which violations may exist. Please revisit the monitoring schedule tool and review the system's monitoring schedule prior to sampling to ensure compliance with the most current monitoring requirements. Contact your public water system regulating agency if you have any questions.

Wetlands



6/10/2019, 12:37:33 PM

- Wetland Assessment Areas
- Wetland Prioritization SCORTP 2012 (Top 60)
- Wetland Prioritization SCORTP 2005 (Top 25)
- Wetland Prioritization SCORTP 1998

1:288,895

0 2 4 8 mi

0 3.5 7 14 km

Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
Idaho Fish and Game

Web AppBuilder for ArcGIS

APPENDIX C
WATER DATA

Water System Name: Cabinet Mtns Water District		PWS ID No.: 1110042 RE
Collector: Luke Reach	Date Collected: 01/17/2018	County: Boundary
Report Results to: Cabinet Mtns Water District Mike Klaus P.O. Box 1223 Bonners Ferry, ID 83805		
Phone: (208) 946-9488	Fax: (208) 267-3515	
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com		

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018010244**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

Laboratory Name:
Accurate Testing Labs, LLC
7950 Meadowlark Way
Coeur d'Alene, ID 83815
Phone (208) 762 8378 Fax (208) 762 9082
Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
190070	RS-Routine Sample	Parker Canyon	13:00	0.23		Absent	Absent
190071	RS-Routine Sample	Black Mountain	13:15	0.18		Absent	Absent

Sample Transportation by (Name):	Luke Reach	Date/Time:	01/17/2018 15:10	Analyst: WM Date Analyzed: 01/18/2018
Sample Received by (Name):	JM	Date/Time:	01/17/2018 15:10	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 01/18/18

Water System Name: Cabinet Mtns Water District	PWS ID No.: 1110042 RE
Collector: Luke Reach	Date Collected: 02/15/2018
County: Boundary	
Report Results to: Cabinet Mtns Water District, Mike Klaus, P.O. Box 1223, Bonners Ferry, ID 83805	
Phone: (208) 946-9488	Fax: (208) 267-3515
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com	

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018020221**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

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Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
190768	RS-Routine Sample	4 Corners	07:30	0.15		Absent	Absent
190769	RS-Routine Sample	Highland Flats	08:15	0.14		Absent	Absent

Sample Transportation by (Name):	Luke Reach	Date/Time:	02/15/2018 09:47	Analyst: WM Date Analyzed: 02/16/2018
Sample Received by (Name):	JM	Date/Time:	02/15/2018 09:47	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 02/16/18

Water System Name: Cabinet Mtns Water District	PWS ID No.: 1110042 RE
Collector: Jeremy Davy	Date Collected: 03/14/2018
County: Boundary	
Report Results to: Cabinet Mtns Water District Mike Klaus P.O. Box 1223 Bonners Ferry, ID 83805	
Phone: (208) 946-9488	Fax: (208) 267-3515
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com	

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018030241**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

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Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
191470	RS-Routine Sample	Parker Canyon	10:15	0.22		Absent	Absent
191471	RS-Routine Sample	Black Mountain	10:45	0.12		Absent	Absent

Sample Transportation by (Name):	Jeremy Davy	Date/Time:	03/14/2018 12:45	Analyst: WM Date Analyzed: 03/15/2018
Sample Received by (Name):	JM	Date/Time:	03/14/2018 12:45	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 03/15/18

Water System Name: Cabinet Mtns Water District	PWS ID No.: 1110042 RE
Collector: Luke Reach	Date Collected: 04/17/2018
County: Boundary	
Report Results to: Cabinet Mtns Water District, Mike Klaus, P.O. Box 1223, Bonners Ferry, ID 83805	
Phone: (208) 946-9488	Fax: (208) 267-3515
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com	

COLIFORM BACTERIA

ANALYSIS REPORT

CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018040281**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

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E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
192381	RS-Routine Sample	4 Corners	10:50	0.21		Absent	Absent
192382	RS-Routine Sample	Highland Flats	11:50	0.16		Absent	Absent

Sample Transportation by (Name):	Luke Reach	Date/Time:	04/17/2018 13:12	Analyst: WM Date Analyzed: 04/18/2018
Sample Received by (Name):	JM	Date/Time:	04/17/2018 13:12	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 04/18/18

Water System Name: Cabinet Mtns Water District	PWS ID No.: 1110042 RE
Collector: Luke Reach	Date Collected: 05/17/2018 / County: Boundary
Report Results to: Cabinet Mtns Water District, Mike Klaus, P.O. Box 1223, Bonners Ferry, ID 83805	
Phone: (208) 946-9488	Fax: (208) 267-3515
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com	

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018050357**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

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Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
193391	RS-Routine Sample	Parker Canyon	12:45	0.19		Absent	Absent
193392	RS-Routine Sample	Black Mountain	13:15	0.24		Absent	Absent

Sample Transportation by (Name):	Luke Reach	Date/Time:	05/17/2018 15:47	Analyst: TR Date Analyzed: 05/18/2018
Sample Received by (Name):	JM	Date/Time:	05/17/2018 15:47	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 05/18/18

Water System Name: Cabinet Mtns Water District	PWS ID No.: 1110042 RE
Collector: Luke Reach	Date Collected: 06/14/2018
County: Boundary	
Report Results to: Cabinet Mtns Water District, Mike Klaus, P.O. Box 1223, Bonners Ferry, ID 83805	
Phone: (208) 946-9488	Fax: (208) 267-3515
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com	

COLIFORM BACTERIA

ANALYSIS REPORT

CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018060293**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

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E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
194273	RS-Routine Sample	Highland Flats	12:00	0.23		Absent	Absent
194274	RS-Routine Sample	4 Corners	12:30	0.23		Absent	Absent

Sample Transportation by (Name):	Luke Reach	Date/Time:	06/14/2018 14:28	Analyst: WM Date Analyzed: 06/15/2018
Sample Received by (Name):	JM	Date/Time:	06/14/2018 14:28	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 06/15/18

Water System Name: Cabinet Mtns Water District		PWS ID No.: 1110042 RE
Collector: Luke Reach	Date Collected: 07/20/2018	County: Boundary
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E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com		

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018070423**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

Laboratory Name:
Accurate Testing Labs, LLC
7950 Meadowlark Way
Coeur d'Alene, ID 83815
Phone (208) 762 8378 Fax (208) 762 9082
Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
195542	RS-Routine Sample	Parker Canyon	13:45	0.10		Absent	Absent
195543	RS-Routine Sample	Black Mountain	14:00	0.12		Absent	Absent

Sample Transportation by (Name):	Luke Reach	Date/Time:	07/20/2018 15:35	Analyst: WM Date Analyzed: 07/21/2018
Sample Received by (Name):	JM	Date/Time:	07/20/2018 15:35	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 07/23/18

Water System Name: Cabinet Mtns Water District	PWS ID No.: 1110042 RE
Collector: Luke Reach	Date Collected: 08/15/2018
County: Boundary	

Report Results to:
Cabinet Mtns Water District
Mike Klaus
P.O. Box 1223
Bonners Ferry, ID 83805

Phone: (208) 946-9488 | Fax: (208) 267-3515

E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018080301**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

Laboratory Name:
Accurate Testing Labs, LLC
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Phone (208) 762 8378 Fax (208) 762 9082
Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
196389	RS-Routine Sample	4 Corners	12:45	0.11		Absent	Absent
196390	RS-Routine Sample	Highland Flats	13:15	0.11		Absent	Absent

Sample Transportation by (Name):	Luke Reach	Date/Time:	08/15/2018 15:05	Analyst: TR Date Analyzed: 08/16/2018
Sample Received by (Name):	JM	Date/Time:	08/15/2018 15:05	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 08/16/18

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Lab EPA ID No.: ID00912	Lab Sample#: 196951
Date Received: 08/31/2018	Date Reported by Lab: 09/04/18
Compliance or Replacement Sample: Compliance	
Date Collected: 08/31/2018	Time Collected: 08:15
Sample Type: Plant Tap	
PWS No.: 1110042 RE	PWS Name: Cabinet Mtns Water District
Sampling Location: Wellfield 1 & 2	Tag#
Collector: Luke Reach	Phone: (208) 946-9488

Laboratory Name:
Accurate Testing Labs, LLC
7950 Meadowlark Way
Coeur d'Alene, ID 83815
Phone (208) 762 8378
Fax (208) 762 9082
Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab Order No.:	2018080643	2

Public Drinking Water System INORGANIC CHEMICAL (IOC) ANALYSIS REPORT:

Phase II								*Phase V*							
FRDS	Analytes	Results	MCL*	MDL*	Method	Analysis Date	Analyst	FRDS	Analytes	Results	MCL*	MDL*	Method	Analysis Date	Analyst
1010	Barium							1036	Nickel						
1015	Cadmium							1074	Antimony						
1020	Chromium							1075	Beryllium						
1035	Mercury							1085	Thallium						
1038	NO2/NO3							*Other IOCs*							
1040	Nitrate-N	1.04	10.0	0.1	EPA 300.0	08/31/18	WM	1005	Arsenic						
1041	Nitrite-N							1025	Fluoride						
1045	Selenium							1052	Sodium						
1024	Cyanide														
Secondary IOCs (optional)															
1002	Aluminum							1055	Sulfate						
1003	Ammonia							1095	Zinc						
1016	Calcium							1905	Color						
1017	Chloride							1915	Hardness						
1022	Copper							1920	Odor						
1027	Hyd. Sulfide							1925	pH						
1028	Iron							1926	Conductivity						
1031	Magnesium							1927	Alkalinity						
1032	Manganese							1930	Diss. Solids						
1042	Postassium							1997	Langlier Indx						
1049	Silica SiO2							2905	Surfactants						
1050	Silver							1030	Lead						

*Reported in mg/L unless otherwise noted, units differ for secondary MCLs depending on contaminant
ND = Not detected within sensitivity of instrument
Empty = No analysis performed for this contaminant
MDL = Method detection limit
MCL - Maximum Contaminant Level

Comments:

Walter Mueller

09/04/18

Cabinet Mtns Water District

P.O. Box 1223
Bonners Ferry , ID 83805

Laboratory Supervisor,
Digitally signed by:
Walter Mueller

Lab EPA ID No.: ID00912	Lab Sample#: 196952
Date Received: 08/31/2018	Date Reported by Lab: 09/21/18
Compliance or Replacement Sample: Compliance	
Date Collected: 08/31/2018	Time Collected: 10:08
Sample Type: Distribution	
PWS No.: 1110042 RE	PWS Name: Cabinet Mtns Water District
Sample Location: 2001 White Mtn Rd	
Collector: Luke Reach	Phone: (208) 946-9488

Laboratory Name:
Accurate Testing Labs, LLC
7950 Meadowlark Way
Coeur d'Alene, ID 83815
Phone (208) 762 8378 Fax (208) 762 9082
Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab Order No.:	**2018080644**

Public Drinking Water System DISINFECTION BYPRODUCT (DBP) ANALYSIS REPORT:

FRDS	Contaminant	Results ug/L	Method:	MCL*	MDL*	Analysis Date	Analyst:
2454	Dibromoacetic Acid	ND	SM6251B		1.0	09/13/18	ANA
2451	Dichloroacetic Acid	ND	SM6251B		1.0	09/13/18	ANA
2453	Monobromoacetic Acid	ND	SM6251B		1.0	09/13/18	ANA
2450	Monochloroacetic Acid	ND	SM6251B		2.0	09/13/18	ANA
2452	Trichloroacetic Acid	ND	SM6251B		1.0	09/13/18	ANA
2943	Bromodichloromethane	0.74	EPA 524.2		0.5	09/11/18	ANA
2942	Bromoform	0.99	EPA 524.2		0.5	09/11/18	ANA
2941	Chloroform	ND	EPA 524.2		0.5	09/11/18	ANA
2944	Dibromochloromethane	1.59	EPA 524.2		0.5	09/11/18	ANA
2950	Total Trihalomethanes	3.32	EPA 524.2	80	0.5	09/11/18	ANA
2456	Total Haloacetic acids	ND	SM 6251B	60	1.0	09/13/18	ANA

ND = Not detected within sensitivity of instrument
MDL = Method detection limit
MCL - Maximum Contaminant Level

Comments:

Cabinet Mtns Water District

P.O. Box 1223
Bonners Ferry , ID 83805

Walter Mueller

09/21/18

Laboratory Supervisor, Digitally signed by: *Walter Mueller*

Water System Name: Cabinet Mtns Water District	PWS ID No.: 1110042 RE
Collector: Jeremy Davy	Date Collected: 10/25/2018
County: Boundary	
Report Results to: Cabinet Mtns Water District, Mike Klaus, P.O. Box 1223, Bonners Ferry, ID 83805	
Phone: (208) 946-9488	Fax: (208) 267-3515
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com	

COLIFORM BACTERIA

ANALYSIS REPORT

CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018100432**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

Laboratory Name:

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Coeur d'Alene, ID 83815
Phone (208) 762 8378 Fax (208) 762 9082
Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
198886	RS-Routine Sample	Parker	09:30	0.13		Absent	Absent
198887	RS-Routine Sample	Black Mtn	10:45	0.10		Absent	Absent

Sample Transportation by (Name):	Jeremy Davy	Date/Time:	10/25/2018 12:10	Analyst: TR Date Analyzed: 10/26/2018
Sample Received by (Name):	JM	Date/Time:	10/25/2018 12:10	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 10/26/18

DocuSign Envelope ID: B37C3CE7-53FA-4B94-B7EF-498B517DCAB2

Water System Name: Cabinet Mtns Water District		PWS ID No.: 1110042 RE
Collector: Jeremy Davy	Date Collected: 11/14/2018	County: Boundary
Report Results to: Cabinet Mtns Water District, Jeremy Davy, P.O. Box 1223, Bonners Ferry, ID 83805		
Phone: (208) 946-9488	Fax: (208) 267-3515	
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com		

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018110189**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

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Accurate Testing Labs, LLC
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Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
199422	RS-Routine Sample	Four Corners	10:33	0.22		Absent	Absent
199423	RS-Routine Sample	Highland Flats	11:19	0.07		Absent	Absent

Sample Transportation by (Name):	Jeremy Davy	Date/Time:	11/14/2018 12:48	Analyst: WM Date Analyzed: 11/15/2018
Sample Received by (Name):	JM	Date/Time:	11/14/2018 12:48	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 11/15/18

Water System Name: Cabinet Mtns Water District		PWS ID No.: 1110042 RE
Collector: Chris Lewandowski	Date Collected: 12/13/2018	County: Boundary
Report Results to: Cabinet Mtns Water District Jeremy Davy P.O. Box 1223 Bonners Ferry, ID 83805		
Phone: (208) 946-9488	Fax: (208) 267-3515	
E-Mail: pwsreports@deq.idaho.gov, jeremy@cmwd.org, northcnc@hotmail.com		

COLIFORM BACTERIA
ANALYSIS REPORT
CONTAMINANT ID# 3100

Type of System:	**Public**
Type of Sample:	**Compliance Sample**
Lab Order No.:	**2018120213**

Water system info must be fully filled out or samples will not be run. Private samples do not need PWS# or Chlorine residual. Your sample will be analyzed for TOTAL COLIFORMS unless you specify analysis under Remarks.

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Web site: www.accuratetesting.com
E-mail: info@accuratetesting.com

Lab EPA ID No: ID00912

For PWS only, if this is a repeat sample, mark the date of the ORIGINAL POSITIVE SAMPLE.

Sample Number	Sample Type	Sample Location	Time Collected	Chlorine Residual ppm	Original Sample Date	Total Coliform Method: 9223B-PA	E. Coli Method: 9223B-PA
200191	RS-Routine Sample	Parker	09:10	0.18		Absent	Absent
200192	RS-Routine Sample	Black Mountain	09:40	0.14		Absent	Absent

Sample Transportation by (Name):	Chris Lewandowski	Date/Time:	12/13/2018 12:15	Analyst: WM Date Analyzed: 12/14/2018
Sample Received by (Name):	JM	Date/Time:	12/13/2018 12:15	Supervisor: Rhena Cooper
Remarks:				Date Reviewed and Printed: 12/14/18

2017 Cabinet Mountains Water District CCR

Is my water safe?

We are pleased to present this year's Annual Water Quality Report (Consumer Confidence Report) as required by the Safe Drinking Water Act (SDWA). This report is designed to provide details about where your water comes from, what it contains, and how it compares to standards set by regulatory agencies. This report is a snapshot of last year's water quality. We are committed to providing you with information because informed customers are our best allies.

Do I need to take special precautions?

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/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by Cryptosporidium and other microbial contaminants are available from the Safe Water Drinking Hotline (800-426-4791).

Where does my water come from?

Your water is provided by a ground water source located on an aquifer recharged by the Cabinet Mountains basin.

Source water assessment and its availability

The Idaho DEQ completed the source water assessment for Cabinet Mountains Water District in February 2003. For additional information or a copy of the assessment report, please contact CMWD office at (208)267-3616

Why are there contaminants in my drinking water?

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 Environmental Protection Agency's (EPA) Safe Drinking Water Hotline (800-426-4791). 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:
microbial contaminants, such as viruses and bacteria, that 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 by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems; and 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 that limit the amount of certain contaminants in water provided by public water systems. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water which must provide the same protection for public health.

How can I get involved?

Fixing any leaks on your service line and making sure there are no cross-connections to your drinking water are great ways to be involved in the safety and efficiency of your water system.

Description of Water Treatment Process

Your water is treated by disinfection. Disinfection involves the addition of chlorine or other disinfectant to kill dangerous bacteria and microorganisms that may be in the water. Disinfection is considered to be one of the major public health advances of the 20th century.

Water Conservation Tips

Did you know that the average U.S. household uses approximately 400 gallons of water per day or 100 gallons per person per day? Luckily, there are many low-cost and no-cost ways to conserve water. Small changes can make a big difference - try one today and soon it will become second nature.

- Take short showers - a 5 minute shower uses 4 to 5 gallons of water compared to up to 50 gallons for a bath.
- Shut off water while brushing your teeth, washing your hair and shaving and save up to 500 gallons a month.
- Use a water-efficient showerhead. They're inexpensive, easy to install, and can save you up to 750 gallons a month.
- Run your clothes washer and dishwasher only when they are full. You can save up to 1,000 gallons a month.
- Water plants only when necessary.
- Fix leaky toilets and faucets. Faucet washers are inexpensive and take only a few minutes to replace. To check your toilet for a leak, place a few drops of food coloring in the tank and wait. If it seeps into the toilet bowl without flushing, you have a leak. Fixing it or replacing it with a new, more efficient model can save up to 1,000 gallons a month.
- Adjust sprinklers so only your lawn is watered. Apply water only as fast as the soil can absorb it and during the cooler parts of the day to reduce evaporation.
- Teach your kids about water conservation to ensure a future generation that uses water wisely. Make it a family effort to reduce next month's water bill!
- Visit www.epa.gov/watersense for more information.

Cross Connection Control Survey

The purpose of this survey is to determine whether a cross-connection may exist at your home or business. A cross connection is an unprotected or improper connection to a public water distribution system that may cause contamination or pollution to enter the system. We are responsible for enforcing cross-connection control regulations and insuring that no contaminants can, under any flow conditions, enter the distribution system. If you have any of the devices listed below please contact us so that we can discuss the issue, and if needed, survey your connection and assist you in isolating it if that is necessary.

- Boiler/ Radiant heater (water heaters not included)
- Underground lawn sprinkler system
- Pool or hot tub (whirlpool tubs not included)
- Additional source(s) of water on the property
- Decorative pond
- Watering trough

Source Water Protection Tips

Protection of drinking water is everyone's responsibility. You can help protect your community's drinking water source in several ways:

- Eliminate excess use of lawn and garden fertilizers and pesticides - they contain hazardous chemicals that can reach your drinking water source.
- Pick up after your pets.
- If you have your own septic system, properly maintain your system to reduce leaching to water sources or consider connecting to a public water system.
- Dispose of chemicals properly; take used motor oil to a recycling center.
- Volunteer in your community. Find a watershed or wellhead protection organization in your community and volunteer to help. If there are no active groups, consider starting one. Use EPA's Adopt Your Watershed to locate groups in your community, or visit the Watershed Information Network's How to Start a Watershed Team.
- Organize a storm drain stenciling project with your local government or water supplier. Stencil a message next to the street drain reminding people "Dump No Waste - Drains to River" or "Protect Your Water." Produce and distribute a flyer for households to remind residents that storm drains dump directly into your local water body.

Additional Information for Lead

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. Cabinet Mountains Water District is 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 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.

Water Quality Data Table

In order to ensure that tap water is safe to drink, EPA prescribes regulations which limit the amount of contaminants in water provided by public water systems. The table below lists all of the drinking water contaminants that we detected during the calendar year of this report. Although many more contaminants were tested, only those substances listed below were found in your water. All sources of drinking water contain some naturally occurring contaminants. At low levels, these substances are generally not harmful in our drinking water. Removing all contaminants would be extremely expensive, and in most cases, would not provide increased protection of public health. A few naturally occurring minerals may actually improve the taste of drinking water and have nutritional value at low levels. Unless otherwise noted, the data presented in this table is from testing done in the calendar year of the report. The EPA or the State requires us to monitor for certain contaminants less than once per year because the concentrations of these contaminants do not vary significantly from year to year, or the system is not considered vulnerable to this type of contamination. As such, some of our data, though representative, may be more than one year old. In this table you will find terms and abbreviations that might not be familiar to you. To help you better understand these terms, we have provided the definitions below the table.

Contaminants	MCLG or MRDLG	MCL, TT, or MRDL	Detect In Your Water	Range		Sample Date	Violation	Typical Source
				Low	High			
Disinfectants & Disinfection By-Products								
(There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants)								
Chlorine (as Cl2) (ppm)	4	4	.35	NA	NA	2017	No	Water additive used to control microbes
Haloacetic Acids (HAA5) (ppb)	NA	60	2.46	NA	NA	2017	No	By-product of drinking water chlorination
TTHMs [Total Trihalomethanes] (ppb)	NA	80	4.59	NA	NA	2017	No	By-product of drinking water disinfection
Inorganic Contaminants								
Nitrate [measured as Nitrogen] (ppm)	10	10	.8	NA	NA	2017	No	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits
Microbiological Contaminants								
E. coli (RTCR) - in the distribution system	0	Routine and repeat samples are total coliform positive and either is E. coli - positive or system fails to take repeat samples following E. coli positive routine sample or system fails to analyze total coliform positive repeat sample for E. coli.	0	NA	NA	2017	No	Human and animal fecal waste
Total Coliform	NA	TT	NA	NA	NA	2017	No	Naturally present

Contaminants	MCLG or MRDLG	MCL, TT, or MRDL	Detect In Your Water	Range		Sample Date	Violation	Typical Source
				Low	High			
(RTCR)								in the environment

Contaminants	MCLG	AL	Your Water	Sample Date	# Samples Exceeding AL	Exceeds AL	Typical Source
Inorganic Contaminants							
Copper - action level at consumer taps (ppm)	1.3	1.3	.0886	2016	0	No	Corrosion of household plumbing systems; Erosion of natural deposits
Inorganic Contaminants							
Lead - action level at consumer taps (ppb)	0	15	3.2	2016	0	No	Corrosion of household plumbing systems; Erosion of natural deposits

Violations and Exceedances

Unit Descriptions

Term	Definition
ppm	ppm: parts per million, or milligrams per liter (mg/L)
ppb	ppb: parts per billion, or micrograms per liter (µg/L)
% positive samples/month	% positive samples/month: Percent of samples taken monthly that were positive
NA	NA: not applicable
ND	ND: Not detected
NR	NR: Monitoring not required, but recommended.
positive samples	positive samples/yr: The number of positive samples taken that year

Important Drinking Water Definitions

Term	Definition
MCLG	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	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.
TT	TT: Treatment Technique: A required process intended to reduce the level of a contaminant in drinking water.
AL	AL: Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.
Variances and Exemptions	Variances and Exemptions: State or EPA permission not to meet an MCL or a treatment technique under certain conditions.

Important Drinking Water Definitions	
MRDLG	MRDLG: Maximum residual disinfection 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	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 microbial contaminants.
MNR	MNR: Monitored Not Regulated
MPL	MPL: State Assigned Maximum Permissible Level

For more information please contact:

Contact Name: Jeremy Davy
Address: PO Box 1223
Bonners Ferry, ID 83805
Phone: (208)946-1985

Calibration Data: Model vs Field Results of Hydrant Testing
Cabinet Mountain Water District - Water Master Plan Update

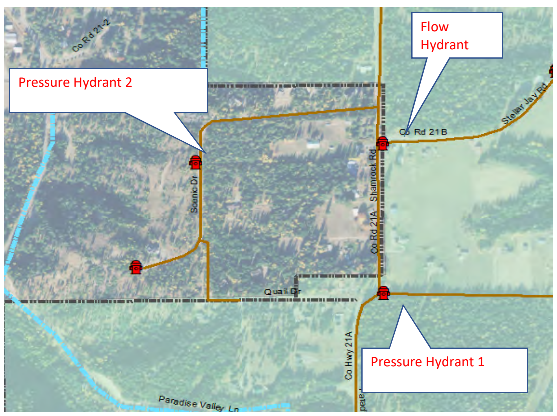
Calibration 1: Using a reservior at 2452 elev for calibration. Pressure sustaining valve on Black Mountain set to 10 psi. System flow = 376			Pressure Hydrant 1							Pressure Hydrant 2							Parker Canyon Booster						
			Field			Model				Field			Model				Field				Model		
Test No.	Date and Time	Flow Hydrant flow (gpm)	Static Pressure	Residual Pressure	Drop	Static Pressure	Residual Pressure	Drop	Difference	Static Pressure	Residual Pressure	Drop	Static Pressure	Residual Pressure	Drop	Difference	Flow	Pressure	Pump running	Hz	Flow	Pressure	HZ
1	6/4/2019 1502 hrs	360	70	40	30	64	39	25	5	53	25	28	53	21	32	4	553	136.7	# 1	57.5	593	140	57.5
1A	6/4/2019 1537 hrs	370	70	50	20	69	43	26	6	55	36	19	58	25	33	14	0	147.3	none		0	142	0
2	6/4/2019 1405 hrs	325	85	70	15	82	61	21	6	170	158	12	167	147	20	8	0	153.1	none		0	146	0
3	6/4/2019 1308 hrs	240	95	85	10	94	74	20	10	104	84	20	98	69	29	9	480	168.24	# 2	57.5	456	164	57.5
Static	6/4/2019 1523 hrs	0															0	160.3	none		0	159	0

	Black Mountain Booster									4 Corners		Naples PRV	Naples Tank	Black Tank
	Field					Model				Field	Model			
	Flow	Pressure	Tank in Fill Mode?	Pump running	Hz	Flow	Pump running	Pressure	HZ	Pressure	Pressure	Open/Close	Tank Level	Tank Level
1	0	0	yes	none	0	0	none	0	0	33.2	38	closed	7.4	6.85
1A	550.7	32.1	no	# 1,2,3	55	568	#1,2,3	35	0	46.7	45	closed	7.26	6.68
2	555.7	33.4	no	# 1,2,3	54	523	#1, 2, 3	35	0	52.8	48	closed	7.88	6.06
3	22.6	34.3	no	# 1,2	45	145	#1,2	35	0	66	62	open	7.4	6.38
Static	197.8	33.6	no	#1,2,3	46.7	198	#1,2	34		59.4	60	closed	7.36	6.89

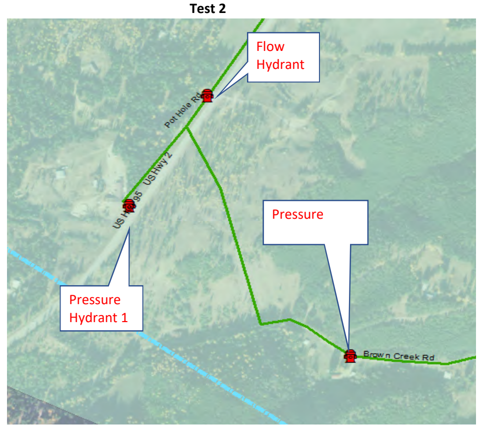
Calibration 2: Model Results if flow during the hydrant tests was 188 gpm, 10 psi at Black Mtn Booster			Pressure Hydrant 1							Pressure Hydrant 2							Parker Canyon Booster						
			Field			Model				Field			Model				Field				Model		
Test No.	Date and Time	Flow Hydrant flow (gpm)	Static Pressure	Residual Pressure	Drop	Static Pressure	Residual Pressure	Drop	Difference	Static Pressure	Residual Pressure	Drop	Static Pressure	Residual Pressure	Drop	Difference	Flow	Pressure	Pump running	Hz	Flow	Pressure	HZ
1	6/4/2019 1502 hrs	360	70	40	30	69	45	24	6	55	25	30	58	28	30	-	553	136.7	# 1	57.5	568	146	57.5
1A	6/4/2019 1537 hrs	370	70	50	20	71	49	22	2	55	36	19	60	31	29	10	0	147.3	none		0	147	0
2	6/4/2019 1405 hrs	325	85	70	15	84	66	18	3	170	158	12	169	152	17	5	0	153.1	none		0	151	0
3	6/4/2019 1308 hrs	240	95	85	10	95	78	17	7	104	84	20	99	73	26	6	480	168.24	# 2	57.5	443	166	57.5

	Black Mountain Booster									4 Corners		Naples PRV	Naples Tank	Black Tank
	Field					Model				Field	Model			
Test No.	Flow	Pressure	Tank in Fill Mode?	Pump running	Hz	Flow	Pump running	Pressure	HZ	Pressure	Pressure	Open/Close	Tank Level	Tank Level
1	0	0	yes	none	0	0	none	0	0	33.2	44	closed	7.4	6.85
1A	550.7	32.1	no	# 1,2,3	55	469	#1,2,3	35	0	46.7	50	closed	7.26	6.68
2	555.7	33.4	no	# 1,2,3	54	424	#1, 2, 3	35	0	52.8	53	closed	7.88	6.06
3	22.6	34.3	no	# 1,2	45	53	#2	35	0	66	63	open	7.4	6.38

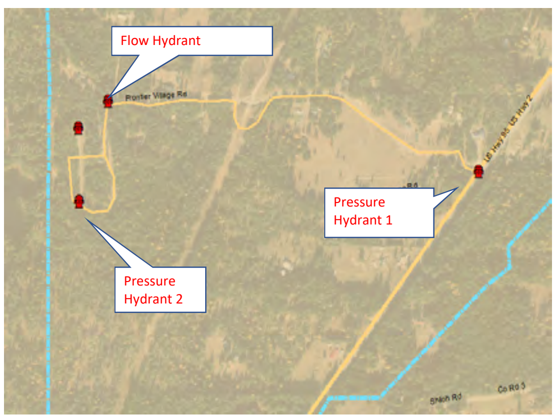
Test 1



Test 2



Test 3



APPENDIX D
WELL LOGS AND WATER RIGHTS

State of Idaho
DEPARTMENT OF WATER RESOURCES
Northern Region • 7600 N. Mineral Drive, Suite 100 • Coeur d'Alene, Idaho 83815-7763
Phone: (208) 762-2800 • Fax: (208) 762-2819 • Website: www.idwr.idaho.gov

C.L. "BUTCH" OTTER
Governor

GARY SPACKMAN
Director

September 4, 2018

CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY ID 83805-1223

Re: Transfer No: 82305
Water Right No(s).: 98-7750
Transfer Approval Notice

Dear Water Right Holder:

The Department of Water Resources has issued the enclosed approved Transfer of Water Right(s). Please be sure to thoroughly review the conditions of approval and remarks listed on the approval document.

The Transfer of Water Right(s) is a PRELIMINARY ORDER issued by the Department pursuant to section 67-5243, Idaho Code. It can and will become a final order without further action by the Department unless the APPLICANT petitions for reconsideration or files an exception and/or brief within fourteen (14) days of the service date as described in the enclosed information sheet.

ANY PERSON aggrieved by any decision, determination, order or action of the Department and who has not previously been afforded an opportunity for a hearing on the matter may request a hearing pursuant to section 42-1701A(3), Idaho Code. A written petition contesting the action of the Department and requesting a hearing shall be filed within fifteen (15) days after receipt of the denial or conditional approval.

If the transfer approval includes a condition requiring measuring and recording devices, such devices shall comply with specifications established by the Department Detailed specifications are available on the Department's home page on the Internet, or you can request a copy by contacting any office of the Department. Please be sure to thoroughly review the specifications to avoid unnecessary costs for reinstallation or modification due to non-conforming or improperly installed devices.

Please note that water right owners are required to report any change of water right ownership and/or mailing address to the Department within 120 days of the change. Failure to report these changes could result in a $100 late filing fee. Contact any office of the Department or visit the Department's homepage on the Internet to obtain the proper forms and instructions.

If you have any questions, please contact the Northern Region Office at (208) 762-2800.

Sincerely,

Douglas Jones

Douglas Jones, P.E.
Northern Regional Manager

Enclosure

CERTIFICATE OF SERVICE

I hereby certify that on September 4, 2018 I mailed a true and correct copy, postage prepaid, of the foregoing PRELIMINARY ORDER (Approved Transfer) to the person(s) listed below:

Re: Transfer No.: 82305
Water Right No(s).: 98-7750

CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY ID 83805-1223

Tammy Alleman

Tammy Alleman
Administrative Assistant

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

TRANSFER OF WATER RIGHT
TRANSFER NO. 82305

This is to certify that: CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY, ID 83805-1223

has requested a change to the water right(s) listed below. This change in water right(s) is authorized pursuant to the provisions of Section 42-222, Idaho Code. A summary of the changes is also listed below. The authorized change for each affected water right, including conditions of approval, is shown on the following pages of this document.

Summary of Water Rights Before the Proposed Changes

Water Right	Origin/Basis	Priority Date	Diversion Rate	Diversion Volume	Acre Limit	Total Acres	Source
98-7750	WR/LICENSE	3/24/1995	2.000 cfs	1314.6 af	N/A	N/A	GROUND WATER

Purpose of Transfer (Changes Proposed)

Current Number	Split	POD	POU	Add POD	Period of Use	Nature of Use
98-7750	NO	NO	NO	YES	NO	NO

Summary Of Water Rights After the Approved Change

Existing Right	New No. (Changed Portion)	Transfer Rate	Transfer Volume	Acre Limit	Total Acres	New No. (remaining portion)	Remaining Rate	Remaining Volume	Remaining Acre Limit	Remaining Total Acres
98-7750	98-7750	2.000 cfs	1314.6 af	N/A	N/A	N/A	N/A	N/A	N/A	N/A
COMBINED TOTALS		**2.000 cfs**	**1314.6 af**	**N/A**	**N/A**		**N/A**	**N/A**	**N/A**	**N/A**

This water right(s) is subject to all prior water rights and shall be administered in accordance with Idaho law and applicable rules of the Department of Water Resources. Detailed Water Right Description(s) attached.

Dated this 4th day of September, 2018.

Douglas Jones

Douglas Jones, Northern Regional Manager

WATER RIGHT NO. 98-7750

As Modified by Transfer No. 82305

In accordance with the approval of Transfer No. 82305, Water Right No. 98-7750 is now described as follows:

Right Holder: CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY, ID 83805-1223

Priority Date: 3/24/1995

Source: GROUND WATER

BENEFICIAL USE	From		To	Diversion Rate	Diversion Volume
MUNICIPAL	01/01	to	12/31	2.000 cfs	1314.6 af
				2.000 cfs	1314.6 af

LOCATION OF POINT(S) OF DIVERSION

GROUND WATER	SWSW	Sec 8 Twp 61N Rge 02E	BOUNDARY County
GROUND WATER	L1 (NWNE)	Sec 29 Twp 62N Rge 02E	BOUNDARY County
GROUND WATER	L1 (NWNE)	Sec 29 Twp 62N Rge 02E	BOUNDARY County
GROUND WATER	L1 (NWNE)	Sec 29 Twp 62N Rge 02E	BOUNDARY County

CONDITIONS OF APPROVAL

1. The right holder shall accomplish the change authorized by this transfer within one year of the date of this approval.
2. Failure of the right holder to comply with the conditions of this transfer is cause for the Director to rescind approval of the transfer.
3. Right holder shall comply with the drilling permit requirements of Idaho Code § 42-235 and applicable Well Construction Rules of the Department.
4. After specific notification by the department, the right holder shall install a suitable measuring device or shall enter into an agreement with the department to determine the amount of water diverted from power records and shall annually report the information to the department.
5. A map depicting the place of use boundary for this water right at the time of this approval is attached to this document for illustration purposes.
6. Place of use is within the area served by the public water supply system ID 1110042 of Cabinet Mountains Water District. The place of use is generally located within Township 60N, 61N, and 62N, and Range 01W, 01E, and 02E.
7. The rate of diversion of water for irrigation under this right and all other water rights on the same land shall not exceed 0.02 cubic feet per second for each acre of land.

WATER RIGHT NO. 98-7750

As Modified by Transfer No. 82305

CONDITIONS OF APPROVAL

8. The right holder shall not provide water diverted under this right for the irrigation of land having appurtenant surface water rights as a primary source of irrigation water except when the surface water rights are not available for use. This condition applies to all land with appurtenant surface water rights, including land converted from irrigated agricultural use to other land uses but still requiring water to irrigate lawns and landscaping.

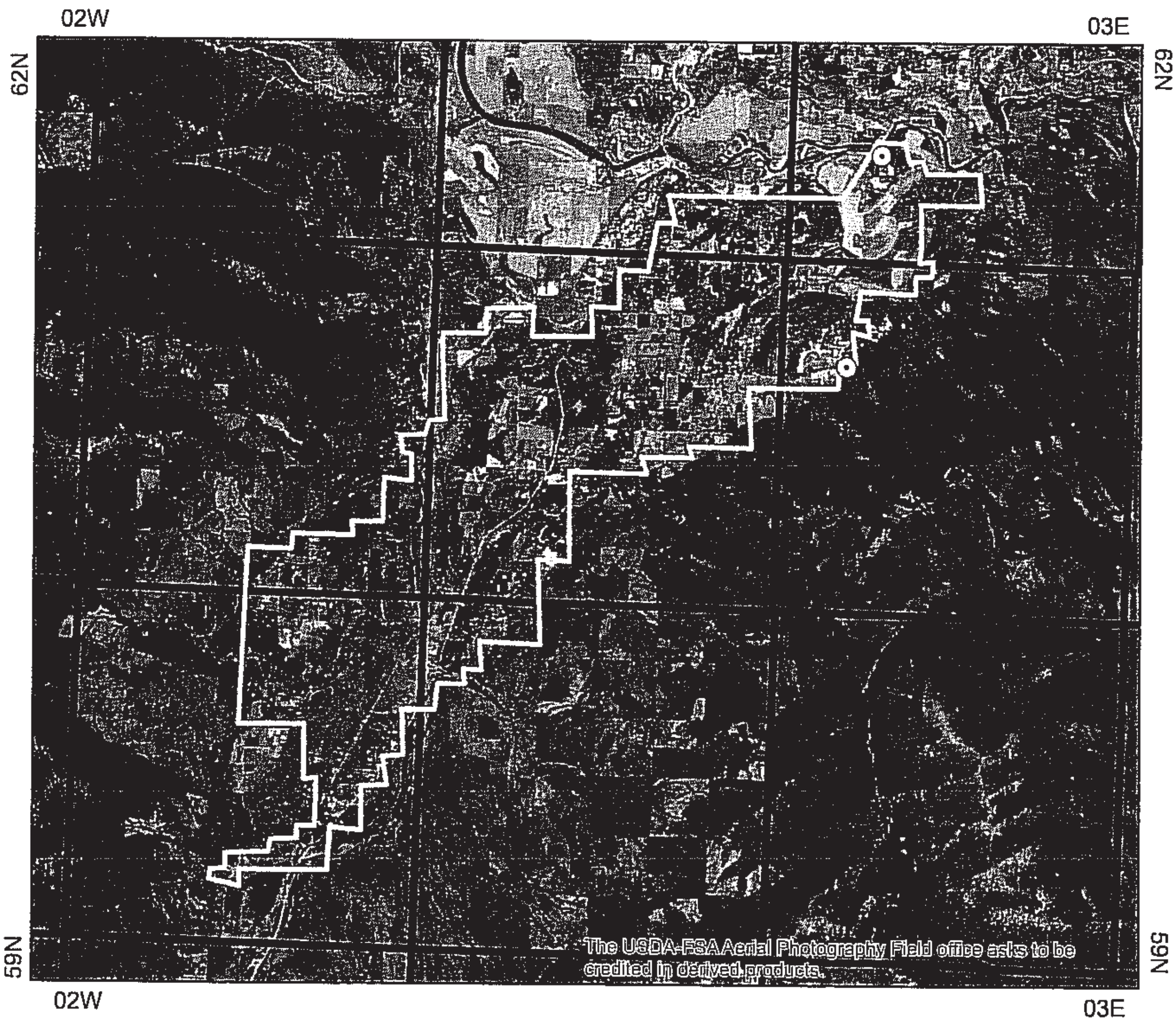
9. The issuance of this right does not grant any right-of-way or easement across the land of another.

Cabinet Mountains Water District

Attachment to Transfer # 82305

98-7750

This map depicts the MUNICIPAL place of use boundary for this water right at the time of this approval and is attached to the approval document solely for illustrative purposes.



0 2 4 8 Miles

Point of Diversion

Water Service Area Boundary

Townships

N

State of Idaho
DEPARTMENT OF WATER RESOURCES
Northern Region • 7600 N. Mineral Drive, Suite 100 • Coeur d'Alene, Idaho 83815-7763
Phone: (208) 762-2800 • Fax: (208) 762-2819 • Website: www.idwr.idaho.gov

C.L. "BUTCH" OTTER
Governor

GARY SPACKMAN
Director

September 4, 2018

CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY ID 83805-1223

Re: Transfer No: 82305
Water Right No(s).: 98-7750
Transfer Approval Notice

Dear Water Right Holder:

The Department of Water Resources has issued the enclosed approved Transfer of Water Right(s). Please be sure to thoroughly review the conditions of approval and remarks listed on the approval document.

The Transfer of Water Right(s) is a PRELIMINARY ORDER issued by the Department pursuant to section 67-5243, Idaho Code. It can and will become a final order without further action by the Department unless the APPLICANT petitions for reconsideration or files an exception and/or brief within fourteen (14) days of the service date as described in the enclosed information sheet.

ANY PERSON aggrieved by any decision, determination, order or action of the Department and who has not previously been afforded an opportunity for a hearing on the matter may request a hearing pursuant to section 42-1701A(3), Idaho Code. A written petition contesting the action of the Department and requesting a hearing shall be filed within fifteen (15) days after receipt of the denial or conditional approval.

If the transfer approval includes a condition requiring measuring and recording devices, such devices shall comply with specifications established by the Department Detailed specifications are available on the Department's home page on the Internet, or you can request a copy by contacting any office of the Department. Please be sure to thoroughly review the specifications to avoid unnecessary costs for reinstallation or modification due to non-conforming or improperly installed devices.

Please note that water right owners are required to report any change of water right ownership and/or mailing address to the Department within 120 days of the change. Failure to report these changes could result in a $100 late filing fee. Contact any office of the Department or visit the Department's homepage on the Internet to obtain the proper forms and instructions.

If you have any questions, please contact the Northern Region Office at (208) 762-2800.

Sincerely,

Douglas Jones, P.E.
Northern Regional Manager

Enclosure

CERTIFICATE OF SERVICE

I hereby certify that on September 4, 2018 I mailed a true and correct copy, postage prepaid, of the foregoing PRELIMINARY ORDER (Approved Transfer) to the person(s) listed below:

Re: Transfer No.: 82305
Water Right No(s).: 98-7750

CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY ID 83805-1223

Tammy Alleman

Tammy Alleman
Administrative Assistant

STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES

TRANSFER OF WATER RIGHT
TRANSFER NO. 82305

This is to certify that: CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY, ID 83805-1223

has requested a change to the water right(s) listed below. This change in water right(s) is authorized pursuant to the provisions of Section 42-222, Idaho Code. A summary of the changes is also listed below. The authorized change for each affected water right, including conditions of approval, is shown on the following pages of this document.

Summary of Water Rights Before the Proposed Changes

Water Right	Origin/Basis	Priority Date	Diversion Rate	Diversion Volume	Acre Limit	Total Acres	Source
98-7750	WR/LICENSE	3/24/1995	2.000 cfs	1314.6 af	N/A	N/A	GROUND WATER

Purpose of Transfer (Changes Proposed)

Current Number	Split	POD	POU	Add POD	Period of Use	Nature of Use
98-7750	NO	NO	NO	YES	NO	NO

Summary Of Water Rights After the Approved Change

Existing Right	New No. (Changed Portion)	Transfer Rate	Transfer Volume	Acre Limit	Total Acres	New No. (remaining portion)	Remaining Rate	Remaining Volume	Remaining Acre Limit	Remaining Total Acres
98-7750	98-7750	2.000 cfs	1314.6 af	N/A	N/A	N/A	N/A	N/A	N/A	N/A
COMBINED TOTALS		**2.000 cfs**	**1314.6 af**	**N/A**	**N/A**		**N/A**	**N/A**	**N/A**	**N/A**

This water right(s) is subject to all prior water rights and shall be administered in accordance with Idaho law and applicable rules of the Department of Water Resources. Detailed Water Right Description(s) attached.

Dated this 4th day of September, 2018.

Douglas Jones

Douglas Jones, Northern Regional Manager

WATER RIGHT NO. 98-7750

As Modified by Transfer No. 82305

In accordance with the approval of Transfer No. 82305, Water Right No. 98-7750 is now described as follows:

Right Holder: CABINET MOUNTAINS WATER DISTRICT
PO BOX 1223
BONNERS FERRY, ID 83805-1223

Priority Date: 3/24/1995

Source: GROUND WATER

BENEFICIAL USE	From		To	Diversion Rate	Diversion Volume
MUNICIPAL	01/01	to	12/31	2.000 cfs	1314.6 af
				2.000 cfs	1314.6 af

LOCATION OF POINT(S) OF DIVERSION

GROUND WATER	SWSW	Sec 8	Twp 61N	Rge 02E	BOUNDARY County
GROUND WATER	L1 (NWNE)	Sec 29	Twp 62N	Rge 02E	BOUNDARY County
GROUND WATER	L1 (NWNE)	Sec 29	Twp 62N	Rge 02E	BOUNDARY County
GROUND WATER	L1 (NWNE)	Sec 29	Twp 62N	Rge 02E	BOUNDARY County

CONDITIONS OF APPROVAL

1. The right holder shall accomplish the change authorized by this transfer within one year of the date of this approval.
2. Failure of the right holder to comply with the conditions of this transfer is cause for the Director to rescind approval of the transfer.
3. Right holder shall comply with the drilling permit requirements of Idaho Code § 42-235 and applicable Well Construction Rules of the Department.
4. After specific notification by the department, the right holder shall install a suitable measuring device or shall enter into an agreement with the department to determine the amount of water diverted from power records and shall annually report the information to the department.
5. A map depicting the place of use boundary for this water right at the time of this approval is attached to this document for illustration purposes.
6. Place of use is within the area served by the public water supply system ID 1110042 of Cabinet Mountains Water District. The place of use is generally located within Township 60N, 61N, and 62N, and Range 01W, 01E, and 02E.
7. The rate of diversion of water for irrigation under this right and all other water rights on the same land shall not exceed 0.02 cubic feet per second for each acre of land.

WATER RIGHT NO. 98-7750

As Modified by Transfer No. 82305

CONDITIONS OF APPROVAL

8. The right holder shall not provide water diverted under this right for the irrigation of land having appurtenant surface water rights as a primary source of irrigation water except when the surface water rights are not available for use. This condition applies to all land with appurtenant surface water rights, including land converted from irrigated agricultural use to other land uses but still requiring water to irrigate lawns and landscaping.

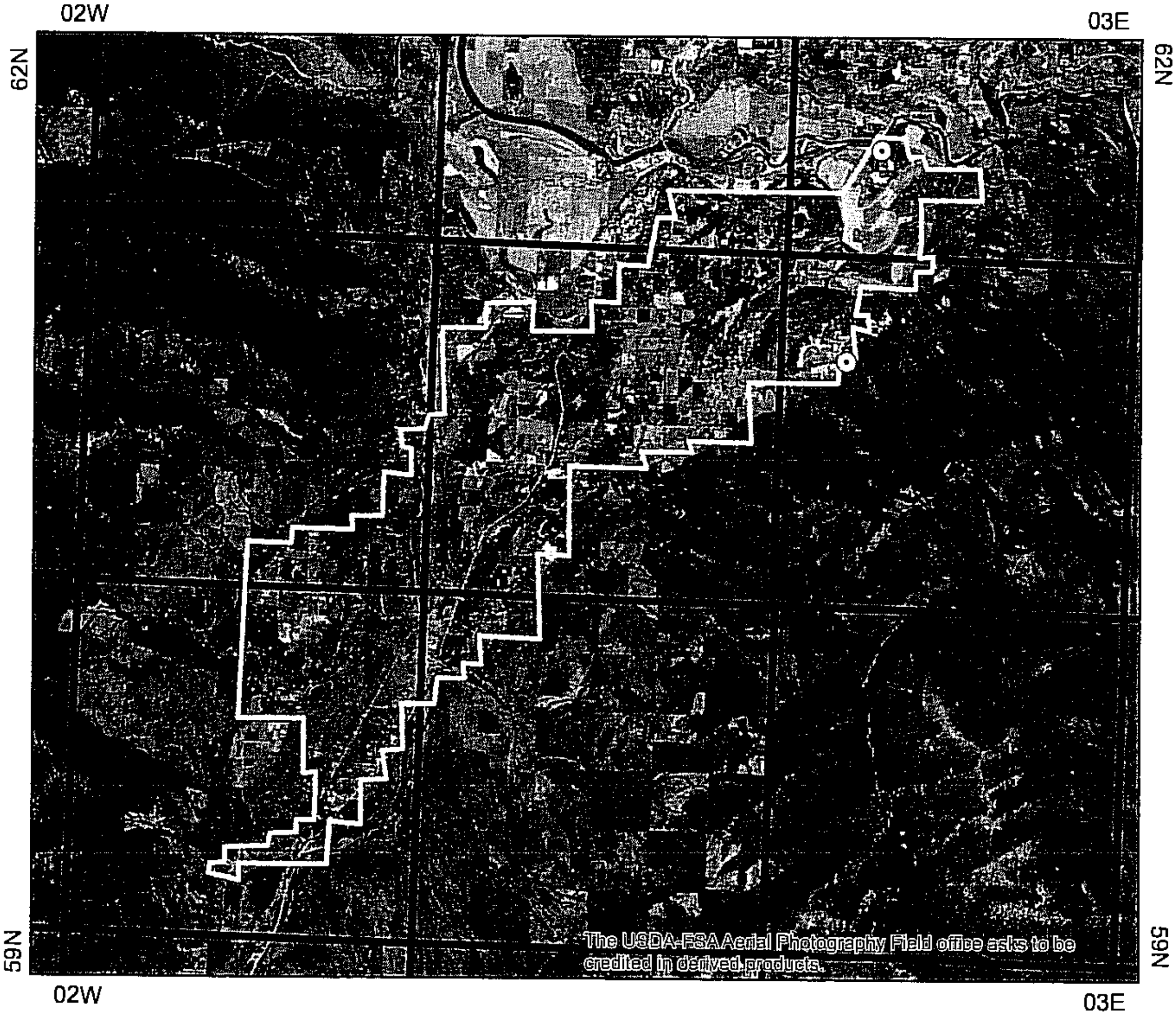
9. The issuance of this right does not grant any right-of-way or easement across the land of another.

Cabinet Mountains Water District

Attachment to Transfer # 82305

98-7750

This map depicts the MUNICIPAL place of use boundary for this water right at the time of this approval and is attached to the approval document solely for illustrative purposes.



0 2 4 8 Miles

Point of Diversion

Water Service Area Boundary

Townships

N

Form 238-7
6/07

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

1. WELL TAG NO. D D0076086
Drilling Permit No. 883137
Water right or injection well #

2. OWNER: Cabinet Water
Name Cabinet Water - Carl Unruh
Address PO Box 1223
City Bonners Ferry State Id Zip 83805

3. WELL LOCATION:
Twp. 61 North ☒ or South ☐ Rge. 02 East ☒ or West ☐
Sec. 8 ____ 1/4 (10 acres) SW 1/4 (40 acres) SW 1/4 (160 acres)
Gov't Lot ____ County Boundary
Lat. 48 ° 38.862 (Deg. and Decimal minutes)
Long. -116 ° 14.514 (Deg. and Decimal minutes)
Address of Well Site Cow Creek Road - Just North Of Kootenai Trail (Give at least name of road + Distance to Road or Landmark) City Bonners Ferry
Lot. ____ Blk. ____ Sub. Name ____

4. USE:
☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation ☐ Thermal ☐ Injection
☐ Other

5. TYPE OF WORK:
☒ New well ☐ Replacement well ☐ Modify existing well
☐ Abandonment ☐ Other

6. DRILL METHOD:
☒ Air Rotary ☐ Mud Rotary ☐ Cable ☐ Other

7. SEALING PROCEDURES:

Seal material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method/procedure
Bentonite	0	58	29 Bags	Pour

8. CASING/LINER:

Diameter (nominal)	From (ft)	To (ft)	Gauge/ Schedule	Material	Casing	Liner	Threaded	Welded
6	-2	260	.25	Steel	☒	☐	☐	☒
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 260

9. PERFORATIONS/SCREENS:
Perforations ☐ Y ☐ N Method
Manufactured screen ☒ Y ☐ N Type Johnson
Method of installation

From (ft)	To (ft)	Slot size	Number/ft	Diameter (nominal)	Material	Gauge or Schedule
260	300	.50		5 in	Stainless	

Length of Headpipe 2 feet Length of Tailpipe 0
Packer ☒ Y ☐ N Type K

10. FILTER PACK:

Filter Material	From (ft)	To (ft)	Quantity (lbs or ft³)	Placement method

11. FLOWING ARTESIAN:
Flowing Artesian? ☐ Y ☒ N Artesian Pressure (PSIG)
Describe control device Well cap

12. STATIC WATER LEVEL and WELL TESTS:
Depth first water encountered (ft) 110 Static water level (ft) 180
Water temp. (°F) cold Bottom hole temp. (°F) cold
Describe access port Well Cap
Well test:

Drawdown (feet)	Discharge or yield (gpm)	Test duration (minutes)

Test method: Pump ☐ ☐ Bailer ☐ ☐ Air ☐ ☐ Flowing artesian ☐ ☐

Water quality test or comments:

13. LITHOLOGIC LOG and/or repairs or abandonment:

Bore Dia. (in)	From (ft)	To (ft)	Remarks, lithology or description of repairs or abandonment, water temp.	Water Y	Water N
10	0	58	Seal		X
6	0	65	Clay Silt Brown Dry		X
6	65	100	Gravel Clay Silt Wet	X	
6	100	110	Gravel Sand water 20 gpm	X	
6	110	180	Gravel, Cobble, Clay, Silt		X
6	180	260	Gravel, Cobble, Silt clay, wet	X	
6	260	300	Gravel Sand, Water	X	

RECEIVED
OCT 03 2017
IDWR / NORTH

Completed Depth (Measurable): 300
Date Started: July 31-17 Date Completed: Aug 3-17

14. DRILLER'S CERTIFICATION:
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Company Name Universal Drilling Co. No. 650
*Principal Driller Scott Hittle Date Aug 26-17
*Driller Scott H. Httle Date Aug 26-17
*Operator II Austin Hittle Date Aug 26-17
Operator I ____ Date ____

* Signature of Principal Driller and rig operator are required.

https://idwr.idaho.gov/apps/ExtSearch/RightReportAJ.asp?BasinNumber=98&SequenceNumber=7750&SplitSuffix=%20%20&TypeWaterRight=True

WATER RIGHT REPORT

8/20/2019

IDAHO DEPARTMENT OF WATER RESOURCES

Water Right Report

WATER RIGHT NO. 98-7750

Owner Type Name and Address

Current Owner CABINET MOUNTAINS WATER DISTRICT

PO BOX 1223

BONNERS FERRY, ID 83805-1223

2089461985

Priority Date: 03/24/1995

Basis: License

Status: Active

Source Tributary

GROUND WATER

Beneficial Use	From	To	Diversion Rate	Volume
MUNICIPAL	01/01	12/31	2 CFS	1314.6 AFA
Total Diversion			2 CFS	1314.6 AFA

Location of Point(s) of Diversion:

GROUND WATER	SWSW	Sec. 08	Township 61N	Range 02E	BOUNDARY County
GROUND WATER	NWNE Lt 1	Sec. 29	Township 62N	Range 02E	BOUNDARY County
GROUND WATER	NWNE Lt 1	Sec. 29	Township 62N	Range 02E	BOUNDARY County

GROUND WATER NWNE Lt 1 Sec. 29 Township 62N Range 02E BOUNDARY County

Place(s) of use: Large POU Info

Conditions of Approval:

1. T07 The right holder shall accomplish the change authorized by this transfer within one year of the date of this approval.

2. T08 Failure of the right holder to comply with the conditions of this transfer is cause for the Director to rescind approval of the transfer.

3. 046 Right holder shall comply with the drilling permit requirements of Idaho Code § 42-235 and applicable Well Construction Rules of the Department.

4. 01M After specific notification by the department, the right holder shall install a suitable measuring device or shall enter into an agreement with the department to determine the amount of water diverted from power records and shall annually report the information to the department.

5. 180 A map depicting the place of use boundary for this water right at the time of this approval is attached to this document for illustration purposes.

6. 128 Place of use is within the area served by the public water supply system ID 1110042 of Cabinet Mountains Water District. The place of use is generally located within Township 60N, 61N, and 62N, and Range 01W, 01E, and 02E.

7. 03A The rate of diversion of water for irrigation under this right and all other water rights on the same land shall not exceed 0.02 cubic feet per second for each acre of land.

8. 102 The right holder shall not provide water diverted under this right for the irrigation of land having appurtenant surface water rights as a primary source of irrigation water except when the surface water rights are not available for use. This condition applies to all land with appurtenant surface water rights, including land converted from irrigated agricultural use to other land uses but still requiring water to irrigate lawns and landscaping.

9. 004 The issuance of this right does not grant any right-of-way or easement across the land of another.

Dates:

Licensed Date: 01/27/2009

Decreed Date:

Permit Proof Due Date: 11/1/2000

Permit Proof Made Date: 12/15/2000

Permit Approved Date: 10/19/1995

Permit Moratorium Expiration Date:

Enlargement Use Priority Date:

Enlargement Statute Priority Date:

Water Supply Bank Enrollment Date Accepted:

Water Supply Bank Enrollment Date Removed:

Application Received Date: 02/08/1995

Protest Deadline Date:

Number of Protests: 0

Other Information:

State or Federal:

Owner Name Connector:

Water District Number: NWD

Generic Max Rate per Acre:

Generic Max Volume per Acre:

Civil Case Number:

Old Case Number:

Decree Plantiff:

Decree Defendant:

Swan Falls Trust or Nontrust:

Swan Falls Dismissed:

DLE Act Number:

Cary Act Number:

Mitigation Plan: False

Form 238-7
3/95
Starships Consulting and Management Services

NOV 15 1995

IDAHO DEPARTMENT OF WATER RESOURCES
WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

Office Use Only
Inspected by______
Twp____ Rge____ Sec____
____1/4 ____1/4 ____1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 98-95-N-0054-000
Other IDWR No. 98-07750

2. OWNER
Name CABINET MOUNTAIN WATER #3
Address FEDERAL BLDG. #212
City BONNERS FERRY State ID Zip 83805

3. LOCATION OF WELL by legal description
sketch map location must agree with written location

Twp. 62 [X] North or [ ] South
Rge. 02 [X] East or [ ] West
Sec. 29 ____ 1/4 NW 1/4 NW 1/4
Gov't Lot ____ County BOUNDARY
Lat: : : Long: : :
Address of Well Site DOBSON ROAD
City ____
(Give at least name of road + Distance to Road or Landmark)
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
[X] Domestic [ ] Municipal [ ] Monitor [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Other ____

5. TYPE OF WORK check all that apply (Replacement, etc.)
[X] New Well [ ] Modify [ ] Abandonment [ ] Other ____

6. DRILL METHOD
[X] Air Rotary [ ] Cable [ ] Mud Rotary [ ] Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
CEMENT	0	18	1 YARD	OVERBORE
BENTONITE	18	30	GALLO	FOLLOW/ SHOE

Was drive shoe used? [X] Y [ ] N Shoe Depth(s) 128
Was drive shoe seal tested? [ ] Y [ ] N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
12	+2.5	128	.250	STEEL	[X]	[ ]	[X]	[ ]

Length of Headpipe ____ Length of Tailpipe ____

9. PERFORATIONS/SCREENS
[ ] Perforations Method ____
[X] Screens Screen Type JOHNSON

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
128	148	100	210	12	ainless St	[X]	[ ]

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
60 ft. below ground Artesian pressure ____ lb.
Depth flow encountered ____ ft. Describe access port or control devices:
NWNW 29 62N 2E

11. WELL TESTS:
[ ] Pump [ ] Bailer [X] Air [ ] Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
1000+		148	6 hours

Water Temp. ____ Bottom Hole Temp ____
Water Quality test or comments: ____
____ Depth first Water encountered ____

12. LITHOLOGIC LOG:(Describe repairs or abandonment)

Bore Diam	From	To	Remarks: Lithology, Water Quality, Temperature	Water Y	Water N
18	0	18	SOIL COBBLE & BOULDERS	[ ]	[X]
14	18	43	SAND & GRAVEL W/ COBBLES	[ ]	[X]
14	43	66	STACKED BOULDERS W/ GRAVE	[ ]	[X]
14	66	87	SAND & GRAVEL W/ COBBLES	[X]	[ ]
14	87	89	BOULDER	[X]	[ ]
14	89	131	SAND & GRAVEL W/ COBBLES G	[X]	[ ]
14	131	141	STACKED BOULDERS W/ COBBL	[X]	[ ]
14	141	150	SAND & GRAVEL 3 /IN MINIS	[X]	[ ]
	0	0	WELD ON 12" CAP	[ ]	[ ]

MICROFILMED MAR 03 1999

Completed Depth 150 (Measurable)
Date: Started 10/28/95 Completed 11/01/95

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name H20 WellService, Inc. Firm No. 448
Firm Official [signature] Date 11-13-95
and
Supervisor or Operator [signature] Date 11-13-95
(Sign Once if Firm Offical and Operator)

Form 238-7
3/95
Starships Consulting Management Services

NOV 15 1995

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

Office Use Only
Inspected by ______
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 98-95-N-0054-000
Other IDWR No. 98-07750

2. OWNER
Name CABINET MOUNTAIN WATER #3
Address FEDERAL BLDG. #212
City BONNERS FERRY State ID Zip 83805

3. LOCATION OF WELL by legal description
sketch map location must agree with written location

N / W / E / S — X

Twp. 62 ☒ North or ☐ South
Rge. 02 ☒ East or ☐ West
Sec. 29 ____ 1/4 NW 1/4 NW 1/4
Gov't Lot ____ County BOUNDARY
Lat: : : Long: : :
Address of Well Site DOBSON ROAD
City ____
(Give at least name of road + Distance to Road or Landmark)
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other ____

5. TYPE OF WORK check all that apply (Replacement, etc.)
☒ New Well ☐ Modify ☐ Abandonment ☐ Other ____

6. DRILL METHOD
☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK			AMOUNT	METHOD
Material	From	To	Sacks or Pounds	
CEMENT	0	18	1 YARD	OVERBORE
BENTONITE	18	30	GALLO	FOLLOW/ SHOE

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 128
Was drive shoe seal tested? ☐ Y ☐ N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
12	+2.5	128	.250	STEEL	☒	☐	☒	☐

Length of Headpipe ____ Length of Tailpipe ____

9. PERFORATIONS/SCREENS
☐ Perforations Method ____
☒ Screens Screen Type JOHNSON

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
128	148	100	210	12	ainless St	☒	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
60 ft. below ground Artesian pressure ____ lb.
Depth flow encountered ____ ft. Describe access port or control devices: ____

NWNW 29 62N 2E

11. WELL TESTS:
☐ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
1000+		148	6 hours

Water Temp. ____ Bottom Hole Temp ____
Water Quality test or comments: ____
____ Depth first Water encountered ____

12. LITHOLOGIC LOG:(Describe repairs or abandonment)

Bore Diam	From	To	Remarks: Lithology, Water Quality, Temperature	Water Y	Water N
18	0	18	SOIL COBBLE & BOULDERS	☐	☒
14	18	43	SAND & GRAVEL W/ COBBLES	☐	☒
14	43	66	STACKED BOULDERS W/ GRAVE	☐	☒
14	66	87	SAND & GRAVEL W/ COBBLES	☒	☐
14	87	89	BOULDER	☒	☐
14	89	131	SAND & GRAVEL W/ COBBLES G	☒	☐
14	131	141	STACKED BOULDERS W/ COBBL	☒	☐
14	141	150	SAND & GRAVEL 3 /IN MINIS	☒	☐
	0	0	WELD ON 12" CAP	☐	☐

MICROFILMED
MAR 03 1999

Completed Depth 150 (Measurable)
Date: Started 10/28/95 Completed 11/01/95

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I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name H20 WellService, Inc. Firm No. 448
Firm Official [signature] Date 11-13-95
and
Supervisor or Operator [signature] Date 11-13-95
(Sign Once if Firm Offical and Operator)

APPENDIX E

FIRE FLOW

Kyle Meschko

From: Tony Rohrwasser <chief@southboundaryfire.com>
Sent: Wednesday, May 15, 2019 9:34 AM
To: Kyle Meschko
Subject: RE: CMWD - Fire Planning

Hi Kyle,

Looking at the recommended flows, we would recommend the same as yours. The 250 GPM is what we allowed the system to use as a minimum flow so we could have hydrants installed which allowed us to use a hydrant instead of having to set up a draft site on one of the creeks in our jurisdiction. This was also the minimum flow rate that Idaho Surveying and rating Bureau needed to give the homeowner a discount on insurance costs.

I am not sure where the needed fire flow chart came from but I will address each location to the best of my knowledge.

#1 – Connie Bremer Deep Creek Loop. Connie was the owner the Deep Creek Trailer Park and the Deep Creek Restaurant. I am guessing they are addressing the restaurant which would fall under commercial which by your recommendation of 2,500 gpm would work. This location is approx.. 4 miles from the closest Cabinet Mountain water line.

#2 O&S Naples LLC @ 1655 Highland Flats Rd. This is the location of Idaho Granite Works which is owned by Oscar and Shirley Anderson (O&S). This is industrial and to my knowledge does not have a hydrant close by. Being Industrial would put it at 3,500gpm on your recommendations which would work. The other O&S at the same address in my mind would probably be their house which is at the same location making that residential 1,000 gpm.

#3 JJ Cookshack is a restaurant which is currently closed. It would fall under commercial which would qualify for 2,500ppm.

#4 Brenda Lierman is the owner of the “Great Northwest Territories Event Center” which would fall under commercial requiring 2,500gpm according to your requirements. There is a hydrant within 1,00 feet but it must cross Hwy 95 which is unacceptable for operations.

With all of these locations, they seem to meet what you are shooting for in flows. There are other commercial and industrial sites that need improved flows also within the South Boundary Fire District.

As I mentioned before one of the most important pieces of trying to save a residential structure from fire is the ability to get water flowing within minutes of arriving on scene, and to keep that flow going uninterrupted. With ISRB’s rating system our home owners receive a discount on their insurance costs if they have a hydrant on the Cabinet Mountain Water System within 1,000 feet from their home as the road travels. This allows us a substantial advantage in getting water on scene and fast since we must carry 1,200’ of supply hose to meet NFPA 1901 standard for equipment carried on pumper engines. In these situations we can drop our line at the hydrant and drive to the home and within minutes have a continual water flow.

Without a hydrant within 1,00’ we must bring in water tenders which come and dump water into a portable tank that the engine can draw from. To be successful there must be very quick turnaround times for tenders meaning close hydrants, ample pressure and many tenders to facilitate this process. This process is very difficult to achieve and uses many personnel which is hard for volunteer companies to do effectively.

Thanks for the ability to give some of our input. I have been on the department since before the watersystem was installed, it only covers a small portion of our fire district but we are so thankful for the ability to use the system to help save lives and properties.

Thanks Kyle let me know if there is anything we can do to assist in your process.

APPENDIX F
DEQ SANITARY SURVEY

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

2110 Ironwood Parkway, Coeur d'Alene, ID 83814 (208) 769-1422

C. L. "Butch" Otter, Governor
John H. Tippets, Director

August 29, 2018

Jeremy Davy
Cabinet Mountains Water District
PO Box 1223
Bonners Ferry, ID 83805
Jeremy@cmwd.org

Subject: Report of Sanitary Survey, Cabinet Mountains Water District, ID1110042

Dear Jeremy:

I would like to thank you and Luke Reoch for participating in the survey of the Cabinet Mountains Water District public drinking water system (system) on July 31, 2018.

The system was inspected and determined to be operating mostly in compliance with the Idaho Rules for Public Drinking Water Systems (Rules). At the time an air gap or other approved mechanism for backflow protection is provided on well discharge to waste (evaluated as a significant deficiency), the system will be considered operating in full compliance with the Rules.

Requirements and recommendations are also included at the conclusion of the enclosed report.

I may be reached at 208-666-4624 if you wish to discuss the findings of the survey.

Sincerely,

Suzanne Scheidt Miller

Suzanne Scheidt Miller
Senior Drinking Water Analyst
suzanne.scheidtmiller@deq.idaho.gov

Enclosures: Cabinet Mountains Water District System Report and Photo Log

c: Anna Moody, Drinking Water Program Supervisor – Anna.Moody@deq.idaho.gov
Ed Katz, Board President, PO Box 1223, Bonners Ferry, ID 83805
EDMS File: ID1110042 / 2018ACA6920 / 2018ACA6922 / 2018ACA6923

2018 Drinking Water Supply Report

Idaho Department of Environmental Quality

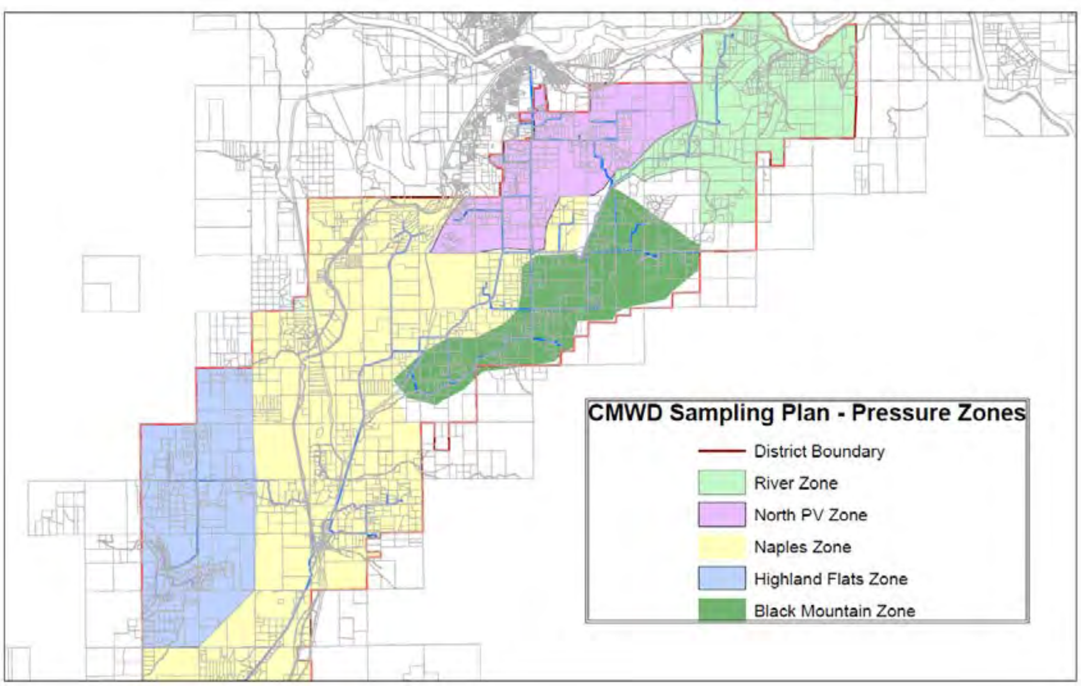
System: Cabinet Mountains Water District
PWS#: ID1110042 **County:** Boundary **Date of Survey:** July 31, 2018
System Representatives Present at Survey: Jeremy Davy, Designated Operator in Charge
Surveyed by: Suzanne Scheidt, Senior Drinking Water Analyst
Sources: Wells 1 and 2
Water System Type: Community
Population: 2100 **Service Connections:** 900 residential and commercial

A photographic log is enclosed with the narrative report.

System Overview

The Cabinet Mountains community public drinking water system (system) is owned and operated by Cabinet Mountains Water District (District). The system is supplied by two wells situated within the River pressure zone (north east service area). A well site has been approved for a third well to be situated within the south east service area zone with drilling planned for later this year. District service area extends approximately 25 miles between the Kootenai River and McArthur Lake along east and west sides of Highway 95 as depicted within the red border below. Four pressure zones are served: the River zone, the combined North Paradise Valley and Black Mountain Zone, the Naples Zone and the Highland Flats zone.

Cabinet Mountains Service Area



System Overview

Seventy-six miles of water main distributes water from the system's two wells over a span of 25 miles to supply service connections. Three reservoirs and four booster stations maintain adequate system pressure.

Vertical turbine line shaft (VTLS) wells equipped with variable frequency drive (VFD) motors are actuated in alternating lead/lag to maintain set point levels in the 40,000 gallon Parker Canyon tank housed below the Parker Canyon booster station. Two VTLS pumps (also equipped with VFDs) lift water from the Parker Canyon tank to supply Black Mountain and Naples Tanks. Four Corners booster station boosts pressure when Parker Canyon booster station is not actuated.

A pressure reducing valve (PRV) vault between northern and southern zones is auto-actuated via operator set points programmed into on-site PLC equipped with SCADA relay. The PRV is opened to gravity supply the Naples tank from the northern zone. When the tank is not calling for water, the PRV is closed. PRV components are energized via 12V AGM glass matt batteries charged via solar panel. If necessary, back-up power may be provided via portable generator through on-site pigtail receptacle.

The Naples booster station lifts water from the Naples tank to pressurize three residential connections via individual service meters. The Highland Flats booster station boosts pressure from the Naples zone to the Highland Flats zone.

Back-up power to wells, Parker Canyon booster station and Black Mountain booster station is supplied via diesel generators equipped with 110% secondary containment. Back- up propane generators supplies Four Corners and Naples (Mountain Meadows) booster station. Diesel generator at wells and Parker Canyon booster station are manually tested, while other generators are auto-tested weekly. A mechanism for back-up power is recommended at Highland Flats booster station and further discussed on page 7 of this report.

The District supplies a one-way intertie to the City of Bonners Ferry via the City's Hoover Booster Station.

Voluntary chlorination of distribution system components is provided via flow proportional injection on individual well discharge points.

Remote monitoring of all systems components is implemented through a supervisory control and data acquisition (SCADA) system. Remote SCADA oversight allows operators to respond in a timely manner to system concerns and significantly increases the level of service and public health protection to water users. SCADA programming sends autodialer alarms to operators and District office staff in the event of system conditions such as: power loss or surge, pump failure, communication failure, and low and high reservoir level. Due to remote locations of some system components, intrusion alarms are recommended to protect system infrastructure such as Black Mountain and Naples tanks.

Source Water Assessment Reports for wells serving the system were updated by DEQ in August 2016 and available on line at http://www2.deq.idaho.gov/water/swaOnline/Search . The report is scheduled to be updated in 2018 to include a large gravel pit within the well field zone of influence.

The District shares a mutual aid agreement with the City of Bonners Ferry; it is recommended the agreement is updated to reflect current configuration and capacity of both systems.

Sources

Wells 1 and 2 meet all required setback distances and are housed within a well building located at 1347 Crossport Road on a property enclosed with eight-foot hurricane fence. Wells are 16 feet apart and previously evaluated as a well field. Analyses of well 1 and 2 pump testing (conducted in October 1995) by Jim De Smet, P.G. indicates "both wells are extremely productive and likely to be capable of pumping 1500 gpm or more."

Wells operate in alternating lead/lag and are equipped with 75 hp VTLS pumps actuated to maintain levels in the 40,000 gallon Parker Canyon tank. Tank levels are determined via level transducer with a back-up float system. Pumps are equipped with VFD motors modulated to maintain operator assigned hertz settings. Combined well discharge is restricted to 1000 gpm to accommodate distribution main capacity. At the time of the survey combined well discharge was 885 gallons per minute.

Water lube to vertical turbine line shaft pumps is regulated through solenoid valves via distribution back pressure and routed through a flow restrictor prior to well start up. In the event flow is not detected, the PLC will preclude well start-up and an auto-dialer alarm will be generated to the on-duty operator. Control valves route air and water to a dry well during pump actuation and shut down. As per Idaho Rules for Public Drinking Water Systems, IDAPA 58.01.08.511.02.g: "The pump to waste discharge piping shall be valved to ensure that other system components that could be negatively affected by the quality of the discharged water are not pressurized by the water that is being pumped to waste. The existing well discharge to waste is required to be valved to ensure potable system components are protected." This is evaluated as a significant deficiency requiring correction. A plan for correction has been determined through consultation between DEQ and system operator following the survey and the significant deficiency is scheduled for correction within 120 days of receipt of the survey report. A floor drain will be installed in conjunction with correction of the significant deficiency.

Individual well discharge appurtenances include: raw water sample tap, flow meter, check valve, pressure relief valve, sodium hypochlorite injection quill, isolation (gate valves) and flow to waste. Each well pedestal was found to be sealed, and well casing vents protected with 24-mesh screen.

Well 1(E0005601) and Well 2 (E0005602)

Wells 1 and 2 were drilled concurrently and of similar construction characteristics: 12-inch cased wells were drilled in 1995 to a depth of 150 feet through layers of cemented cobble, sand and boulders. Wells were constructed with a cement surface seal to a depth of 18 feet. Well casings extend to a depth of 128 feet, with stainless steel telescoping screens installed from 128 to 148 feet.

Voluntary Chlorination of Distribution Components

Voluntary chlorination of distribution components is provided by components housed in the well building. One 35 gallon day tank, situated on secondary containment and vented to atmosphere contains 12.5% (Hasachlor) diluted sodium hypochlorite (one gallon sodium hypochlorite to two gallons water). Two Walchem electronic (diaphragm) metering pumps under flooded suction draw from the tank and inject sodium hypochlorite injection via quills installed on individual well discharge within the well building. Each metering pump is rated to discharge against 160 psi at a maximum feed rate of 0.6 gallons per hour; pumps are set at 90 stroke. Well discharge rates are not subject to fluctuation. Metering pumps are tied to individual flow meter discharge to provide automatic flow cut off via the PLC.

Raw and chlorinated sample taps are provided on individual well discharge.

District operators monitor for free chlorine residual daily from the Parker Canyon and Highland booster stations. Parker Canyon daily residuals are compiled on a monthly report provided to DEQ. Reports are consistently provided to DEQ within 10 days following the end of each month.

Distribution System

Distribution main consists of seventy-six miles of 6- to 10-inch ductile iron and PVC, primarily constructed between 1995 and 1999. Water main is partially looped and all dead end mains are equipped with a mechanism to flush. Flushing is conducted at a minimum basis of twice per year as required by the Rules.

Service connections at locations where main pressure exceeds 100 psi are equipped with individual pressure reducing valves. Valves are regularly maintained and protected from freezing.

The location of air vacuum relief valves have been identified in distribution. Valves subject to malfunction or otherwise requiring repair are valved off from the system until repair is complete. Repair of air vacuum relief valves is required. Valve outlets are required to be raised above the ground water table, downturned and equipped with 24-mesh screen.

The system is within the South Boundary and Paradise Valley Fire Districts and does not meet minimum fire flow requirements of 1100 gpm, however strives to achieve 250 gpm.

Booster Stations

Primary logic controllers (PLC) are installed at all booster pumping stations. PLC information is relayed to SCADA to allow for operator remote oversight. All booster pumps are equipped with low flow cut off to prevent pump damage in the event water supply to pumps is compromised. All booster stations are locked and equipped with adequate heating and ventilation systems. All stations with the exception of Four Corners booster station are equipped with floor drains.

Parker Canyon Booster Station and Tank

The Parker Canyon booster station lifts water from the River zone to supply remaining gravity and pressure zones. Parker Canyon booster pumps are actuated to maintain levels in the Black Mountain and Naples Tanks. Booster pumps consist of two 75 VTLS hp pumps equipped with VFDs modulating to maintain operator hertz settings and discharge up to 500 gpm each.

Pumps are equipped with adequate isolation valves and flow meters. A pressure relief valve on boosted discharge is plumbed to return to the Parker Canyon tank. Pressure gages are provided on inlet and outlet piping, with pump discharge pressure transducer readings relayed via PLC to SCADA. At the time of the survey, pump one was discharging at 466 gpm with pump two at 358 gpm.

The 50,000 gallon rectangular ground-level concrete tank has a total storage capacity of 40,000 gallons. The tank access hatch is housed within the booster station building and equipped with an internal watertight seal. The reservoir overflow discharges over a rip rap bank; the outlet is equipped with 24-mesh screen and flapper valve. Tank interior was in excellent condition with no evidence of sedimentation on tank floor.

Four Corners Booster Station

Four Corners booster station pressurizes the North Paradise Valley zone during periods when Parker Canyon boosters are off and the Black Mountain booster station is pressurizing the zone. The booster station is typically actuated during summer months only. Boosted pressure is supplied via two 10 hp pumps discharging up to 250 gpm each and equipped with Grundfos drives to modulate at a discharge pressure of 70 psi.

Pumps are equipped with individual upstream and downstream isolation valves and flow meters. Pump curves indicate discharge pressure cannot exceed 90 psi; therefore, a pressure relief valve on boosted discharge is not required. Pressure gages are provided on inlet and outlet piping, with pump discharge pressure transducer readings relayed via PLC to SCADA.

Black Mountain Booster Station and Tank

The Black Mountain tank supplies the Black Mountain booster station pressurizing the North Paradise Valley pressure zone. Pressurized water from Parker Canyon enters through the booster pump station and routes to the tank via automatic control valve actuators.
Black Mountain Booster pumps consist of three in-line pumps equipped with VFD. Two 7.5 hp pumps with discharge capacity of 235 gpm each and one 5 hp pump with discharge capacity of 90 gpm modulate to maintain 35 psi to distribution during summer periods and 30 psi during winter. Booster pumps are equipped to be auto-energized via diesel generator.

Pumps are equipped with individual upstream and downstream isolation valves and combined discharge flow meters. A pressure relief valve on boosted discharge is plumbed to return to the Black Mountain tank. Pressure gages are provided on inlet and outlet piping, with pressure transducer, actuator valves and flow meter tied to the PLC and relayed to SCADA.

The Black Mountain tank has a total storage capacity of 175,000 gallons. The tank was inspected in 2016 by a third party contractor. While the corner leak was evaluated as not requiring immediate attention, future maintenance will be required in order to preserve tank service life. However, the tank cannot be taken off line for maintenance without disruption of service. It is strongly recommended the District carefully evaluate additional storage, such as the proposed 600,000 gallon North Paradise Valley standpipe under consideration, in order to also allow for maintenance of system components without extended disruption of service.

The tank access hatch is equipped with an internal seal and adequately screened vent. Reservoir overflow discharges over a rip rap bank; the outlet is equipped with 24-mesh screen and flapper valve. Tank interior was in excellent condition with no evidence of sedimentation on tank floor.

Naples Booster Station and Tank (Mountain Meadows Road)

The Naples Tank gravity supplies the Naples pressure zone and Highland Flats booster station. The Naples booster station lifts water from the tank to boost pressure to three service connections. Pressurized water enters directly to the tank gravity supplying the pressure zone. A pressure reducing valve station (detail included on page 2) in distribution opens when the tank is filling and closes when the tank gravity supplies the pressure zone.

One 5 hp booster pump actuated via pressure switch pressurizes three individual metered service connections. Pressure gages are installed on influent and boosted pressure. The pump is equipped with one upstream and three downstream valves (corp stops) on metered services in building. The booster station building is equipped with adequate heat, ventilation and floor drain. The Naples tank PLC was tied into the Naples booster station immediately following the survey to allow for remote monitoring of pump operation via SCADA relay.

The Naples (aka Mountain Meadows) tank also has a total storage capacity of 175,000 gallons. The tank was inspected in 2016 by a third party contractor and found to be clean. The tank cannot currently be taken off line for maintenance without disruption of service.

The tank access hatch is equipped with an internal watertight seal and adequately screened vent. The reservoir overflow discharges over a rip rap bank; the outlet is equipped with 24-mesh screen and flapper valve. Tank interior was in excellent condition with no evidence of sedimentation on tank floor.

Highland Flats Booster Station

As previously indicated, the Naples Tank gravity supplies the Highland Flats booster station which in turn pressurizes the Highland Flats pressure zone. Booster pumps (5 hp and 10 hp equipped with VFDs) are actuated to maintain boosted pressure of 65 psi. Typical pump discharge is 30 gpm; however the boosted pressure flow meter has become unreliable with replacement recommended. Pumps are equipped with individual upstream and downstream isolation valves. A pressure relief valve on boosted discharge is installed; however the outlet is isolated by a ball valve until relief discharge is routed away from electrical controls and to atmosphere. This is evaluated as a deficiency requiring correction. Pressure gages are provided on inlet and outlet piping, with a pressure transducer, actuator valves and flow meter tied to PLC and relayed to SCADA.

Booster station upgrades and future storage to serve the Highland Flats pressure zone are currently under evaluation. It is recommended the booster station be equipped with back-up power following determination of future booster station improvements.

Cross Connection Control Implementation

The 2012 survey indicated the District Board was to adopt a Cross Connection Control resolution by February 2, 2013. Please provide a copy of documentation to DEQ demonstrating system authority to implement their program. High risk service connections have been inspected for potential cross connections with residential service connection inspections on going. The system is implementing a tracking system to ensure annual backflow assembly testing is completed as required. The District is required to continue moving toward full program implementation.

The Idaho Rules for Public Drinking Water Systems require that community public drinking water systems implement a cross connection control program that includes at minimum the following five elements as per IDAPA 58.01.08.552.06 a-e:

a. An inspection program to locate cross connections and determine required suitable protection. For new connections, suitable protection must be installed prior to providing water service.
b. Required installation and operation of adequate backflow prevention assemblies. Appropriate and adequate backflow prevention assembly types for various facilities, fixtures, equipment, and uses of water should be selected from the AWWA Pacific Northwest Section Cross Connection Control Manual, the Uniform Plumbing Code, the AWWA Recommended Practice for Backflow Prevention and Cross Connection Control (M14), the USC Foundation Manual of Cross Connection Control, or other sources deemed acceptable by the Department. The assemblies must meet the requirements of Section 543 and comply with local ordinances.
c. Annual inspections and testing of all installed backflow prevention assemblies by a tester licensed by a licensing authority recognized by the Department. Testing shall be done in accordance with the test procedures published by the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research. See the USC Foundation Manual of Cross-Connection Control referenced in Subsection 002.02.
d. Discontinuance of service to any structure, facility, or premises where suitable backflow protection has not been provided for a cross connection.
e. Assemblies that cannot pass annual tests or those found to be defective shall be repaired, replaced, or isolated within ten (10) business days. If the failed assembly cannot be repaired, replaced, or isolated within ten (10) business days, water service to the failed assembly shall be discontinued.

Monitoring Summary

The system is in compliance with all current monitoring requirements. The District actively participates in DEQ's Monitoring Waiver Program. The table below summarizes current monitoring requirements. Current monitoring schedule information may also be accessed at: http://www. deq. idaho. gov/water-quality/drinking-water/pws-switchboard. aspx

Sample Type	Frequency	Sample Location
Distribution		
Total coliform	2 samples per month	In accordance with coliform sampling
Lead and Copper	10 samples every 3 years	Assigned sampling locations
Total Trihalomethane	1 sample every year	2001 White Mountain Road
Haloacetic Acids Group 5	1 sample every year	2001 White Mountain Road
Sample Location: Wellfield (Wells 1 & 2)	**Frequency**	
Nitrate	1 sample per year	
Nitrite	1 sample per 9 years	
Alpha	1 sample per 9 years	
Fluoride	1 sample per 9 years	
Sodium	1 sample per 3 years	
Uranium	1 sample per 9 years	
VOCs	1 sample per 6 years	
Arsenic	1 sample per 9 years	
Radium 226	1 sample per 9 years	
Radium 228	1 sample per 9 years	
Regulated IOC	1 sample per 9 years	

Source Water Quality

Source water quality meets all regulatory standards. Nitrate levels (1995-present) range consistently between minimum detection limits to 1.47 mg/L with a decreasing trend from samples collected from the well field. The maximum contaminant level (MCL) for nitrate in drinking water is 10 mg/L.

Arsenic levels (1998-2015) consistently range below minimum detection limits from the well field and Finucane well. The MCL for arsenic in drinking water is 0.010 mg/L.

Distribution Water Quality

Disinfection by product results drawn from the designated sampling location in August 2017. Haloacetic acid group 5 results were 2.16 ug/L; the MCL for haloacetic acids in drinking water is 60 ug/L. Total trihalomethane results were 4.25 ug/L; the MCL for total trihalomethanes in drinking water is 80.0 ug/L. Results are indicative of low organic compounds in the source supply.

Lead and copper monitoring results from the most recent round of ten samples collected in September 2016 indicate levels of lead in drinking water supply range between 0.0017 to 0.0070 mg/L. The action level for lead in drinking water is 0.015 mg/L. Copper levels ranged from 0.0115 to 0.0896 mg/L. The action level for copper in drinking water is 1.3 mg/L.

The District is required to collect two coliform samples per month from rotating locations throughout distribution. A total coliform sampling plan is referenced to collect samples on a rotating basis from the four pressure zones: Highland Flats, 4 Corners, Parker Canyon, and Black Mountain.

Operator Certification

The Cabinet Mountains Water District is classified as a distribution two water system and is under designated oversight of Responsible Charge Operator Charlie Dreschel. Mr. Drechsel holds Distribution Level 2 (DWD2-16686) and Treatment Level 1 (DWT1-16687) licenses, renewal due 8/10/2019. Jeremy Davy is operator of record and holds Distribution Level 1 (DWD1-21598) and Treatment Level 1 (DWT1-21599) licenses, renewal due 05/25/2019. Luke Reoch is also an operator of record and holds Distribution Level 1 (DWD1-22429) and Treatment Level 1 (DWT1-22430) licenses, renewal due 3/16/20. As per Idaho Statute, the licensed operator is responsible for all decisions impacting water quality or quantity.

Administration

The District is administered by a five member Board meeting on the second Tuesday of each month at the District Office. Ed Katz serves as District President, John Martling as Vice President, and Karen Glazier, Michael Stephens and Rick Staats as Board Members.

Rate Structure

All District service connections are metered. A monthly basis rate of $43 is charged for up to 12,000 gallons with overages as indicated below:

12,000-24,000 gallons	$4 per 1,000 gallons
24,000-48,000 gallons	$6 per 1,000 gallons
Greater than 48,000 gallons	$8 per 1,000 gallons

Conclusion

The system was found to be operating mostly in compliance with the Idaho Rules for Public Drinking Water Systems and will be considered operating in full compliance upon correction of the significant deficiency noted below:

Significant Deficiency

1. As per Idaho Rules for Public Drinking Water Systems, IDAPA 58.01.08.511.02.g: "The pump to waste discharge piping shall be valved to ensure that other system components that could be negatively affected by the quality of the discharged water are not pressurized by the water that is being pumped to waste." Well discharge to waste is required to be valved to ensure potable system components are protected within 120 days of receipt of this report.

Deficiency – A plan of correction is requested within 120 days describing the District's timeline to address the deficiency below:

1. A pressure relief valve on Highland Flats boosted discharge is installed; however the outlet is isolated by a ball valve until the relief may be routed away from electrical controls and outside the building. The pressure relief valve outlet is required to be exhausted to atmosphere.

Requirements

1. Maintenance of the Black Mountain Tank will be required in the future to preserve tank service period.
2. The location of air vacuum relief valves have been identified in distribution. Valves subject to malfunction or requiring repair have been valved from the system until repair is completed. Repair of air vacuum relief valves is required.
3. The 2012 survey indicated the District Board were to adopt a Cross Connection Control resolution by February 2, 2018. Please provide a copy of documentation demonstrating system implementation authority. The District is required to continue to implement their program.

Recommendations

1. It is strongly recommended the system consider additional storage, such as the proposed 600,000 gallon North Paradise Valley standpipe under consideration.
2. A mechanism for back-up power is recommended at the Highland Flats booster station.
3. Due to the remote locations of some system components, intrusion alarms are recommended to protect system infrastructure such as the Black Mountain and Naples tanks.
4. The District shares a mutual aid agreement with the City of Bonners Ferry; it is recommended the agreement is updated to reflect current system configurations and capacities.
5. A flow meter on Highland Flats boosted pressure has become unreliable; replacement is recommended.

Photographic Documentation

Name of Facility: Cabinet Mountains Water District

Inspector(s): Suzanne Scheidt Miller

Inspection Date: Tuesday, July 31, 2018

Purpose of Inspection: Sanitary Survey Inspection

Publish Date: Wednesday 1 August 2018

Table of Photographs:

Photograph 1: Well discharge appurtenances.......... 5
Photograph 2: Well 1 5
Photograph 3: Well 1 sample tap 5
Photograph 4: Well 1 screened vent 5
Photograph 5: Well 1 discharge to waste control valve 6
Photograph 6: Test well (capped) 6
Photograph 7: Well 2 6
Photograph 8: Well 2 6
Photograph 9: Well 2 electronic metering pump and calibration cylinder 7
Photograph 10: Sodium hypochlorite day tank 7
Photograph 11: Well 1 electronic metering pump 8
Photograph 12: Electronic metering pump placard 8
Photograph 13: Sodium hypochlorite injection quill 9
Photograph 14: Pressure gage well discharge 9
Photograph 15: Pressure transducer on combined well discharge 9
Photograph 16: Individual flow meter tied to electronic chlorine metering pump 9
Photograph 17: Finished (chlorinated) sample tap 10
Photograph 18: Well 2 discharge to waste control valve 10
Photograph 19: Well electrical switches.......... 11
Photograph 20: Well electrical switches.......... 11
Photograph 21: Well flow rates 12
Photograph 22: Well discharge to waste dry well (requries air gap/backflow protection) 12
Photograph 23: Well 1 and 2 building 12
Photograph 24: Parker Canyon booster station 12
Photograph 25: Parker Canyon diesel generator.......... 13
Photograph 26: Parker Canyon tank.......... 13
Photograph 27: Parker Canyon level controls (well actuation) 13
Photograph 28: Parker Canyon tank water tight access hatch.......... 13
Photograph 29: Parker Canyon booster pump 14
Photograph 30: Parker Canyon booster pump 14
Photograph 31: Parker Canyon boosted discharge appurtenances 14
Photograph 32: Parker Canyon boosted discharge appurtenances 14
Photograph 33: Parker Canyon booster pump controls.......... 15
Photograph 34: Parker Canyon pump controls 15
Photograph 35: Parker Canyon tank screened overflow w metal flapper valve 15
Photograph 36: Parker Canyon tank screened overflow w metal flapper valve 15
Photograph 37: Four Corners booster station SCADA display.......... 16
Photograph 38: Four Corners booster station autodialer 16

Photograph 39: Four Corners booster station 16
Photograph 40: Four Corners booster pumps and discharge appurtenances 16
Photograph 41: Four Corners booster pumps and discharge appurtenances 17
Photograph 42: Four Corners sample tap 17
Photograph 43: Four Corners sample tap 17
Photograph 44: Four Corners combined boosted flow meter 17
Photograph 45: Four Corners boosted discharge appurtenances 18
Photograph 46: Four Corners inlet pressure 18
Photograph 47: Four Corners booster station 18
Photograph 48: Four Corners propane generator 18
Photograph 49: Black Mountain reservoir (leak) 19
Photograph 50: Black Mountain reservoir interior 19
Photograph 51: Black Mountain reservoir interior 19
Photograph 52: Black Mountain interior reservoir hatch water tight seal 19
Photograph 53: Black Mountain reservoir interior overflow 20
Photograph 54: Black Mountain reservoir interior overflow 20
Photograph 55: Black Mountain reservoir vent w 24-mesh screen 20
Photograph 56: Black Mountain reservoir lid 20
Photograph 57: Black Mountain reservoir 21
Photograph 58: Black Mountain booster station diesel generator 21
Photograph 59: Black Mountain booster pumps and discharge appurtenances 21
Photograph 60: Black Mountain operators daily record log 21
Photograph 61: Black Mountain reservoir fill line and boosted discharge appurtenances 22
Photograph 62: Black Mountain boosted discharge flow meter 22
Photograph 63: Black Mountain boosted discharge appurtenances flow meter 22
Photograph 64: Black Mountain booster station, thermostatically controlled heater 22
Photograph 65: Black Mountain booster station, thermostatically controlled louvre vent 23
Photograph 66: Black Mountain booster station, thermostatically controlled louvre vent 23
Photograph 67: Black Mountain booster pump controls 23
Photograph 68: Black Mountain reservoir screened drain 23
Photograph 69: Black Mountain reservoir screened overflow 24
Photograph 70: Pressure reducing valve vault w pigtail 24
Photograph 71: Pressure reducing valve vault 24
Photograph 72: Pressure reducing valve solar panel to charge batteries 24
Photograph 73: Naples tank and booster station 25
Photograph 74: Naples booster station propane generator 25
Photograph 75: Naples tank booster pump 25
Photograph 76: Naples tank booster station, 3 residential connections 25
Photograph 77: Naples tank boosted discharge, 3 residential connections 26
Photograph 78: Metered residential connection w corp stop 26
Photograph 79: Naples tank overflow outlet screened with metal flapper valve 26
Photograph 80: Naples tank overflow outlet screened with metal flapper valve 26
Photograph 81: Naples tank roof 27
Photograph 82: Naples tank interior 27

Photograph 83: Naples tank ultra sonic level transducer 28
Photograph 84: Naples tank interior 28
Photograph 85: Naples tank overflow 29
Photograph 86: Naples tank lid w water tight seal 29
Photograph 87: Naples tank lid w screened vent 30
Photograph 88: Naples tank 30
Photograph 89: Naples tank 30
Photograph 90: Naples tank 30
Photograph 91: Highland Flats booster pump controls 31
Photograph 92: Highland Flats flow meter (malfunctioning) 31
Photograph 93: Highland Flats pressure relief (requires reconfiguration of discharge) 32
Photograph 94: Highland Flats combined boosted discharge flow meter 32
Photograph 95: Highland Flats boosted discharge appurtenances 32
Photograph 96: Highland Flats inlet pressure 32
Photograph 97: Highland Flats pressure transducer and sample tap 33
Photograph 98: Highland Flats booster pump 33
Photograph 99: Highland Flats booster station building 33

Idaho Department of Environmental Quality
Photographic Documentation For Cabinet Mountains Water District

Photograph 1: Well discharge appurtenances

Photograph 2: Well 1

Photograph 3: Well 1 sample tap

Photograph 4: Well 1 screened vent

Idaho Department of Environmental Quality
Photographic Documentation For Cabinet Mountains Water District

Photograph 5: Well 1 discharge to waste control valve

Photograph 6: Test well (capped)

Photograph 7: Well 2

Photograph 8: Well 2

Photograph 9: Well 2 electronic metering pump and calibration cylinder

Photograph 10: Sodium hypochlorite day tank

Photograph 11: Well 1 electronic metering pump

Photograph 12: Electronic metering pump placard

Photograph 13: Sodium hypochlorite injection quill

Photograph 14: Pressure gage well discharge

Photograph 15: Pressure transducer on combined well discharge

Photograph 16: Individual flow meter tied to electronic chlorine metering pump

Photograph 17: Finished (chlorinated) sample tap

Photograph 18: Well 2 discharge to waste control valve

Photograph 19: Well electrical switches

Photograph 20: Well electrical switches

Photograph 21: Well flow rates

Photograph 22: Well discharge to waste dry well (requires air gap/backflow protection)

Photograph 23: Well 1 and 2 building

Photograph 24: Parker Canyon booster station

Photograph 25: Parker Canyon diesel generator

Photograph 26: Parker Canyon tank

Photograph 27: Parker Canyon level controls (well actuation)

Photograph 28: Parker Canyon tank water tight access hatch

Photograph 29: Parker Canyon booster pump

Photograph 30: Parker Canyon booster pump

Photograph 31: Parker Canyon boosted discharge appurtenances

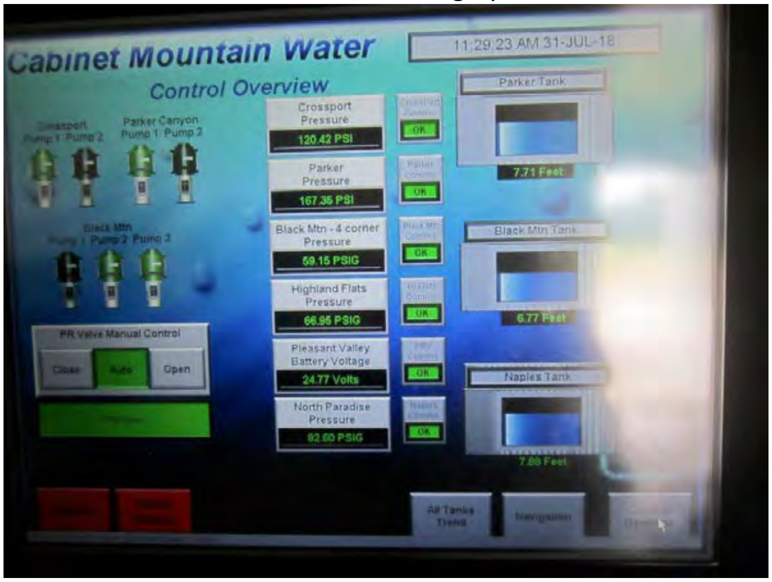
Photograph 32: Parker Canyon boosted discharge appurtenances

Photograph 33: Parker Canyon booster pump controls

Photograph 34: Parker Canyon pump controls

Photograph 35: Parker Canyon tank screened overflow w metal flapper valve

Photograph 36: Parker Canyon tank screened overflow w metal flapper valve



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Photograph 39: Four Corners booster station

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Idaho Department of Environmental Quality
Photographic Documentation For Cabinet Mountains Water District

Photograph 41: Four Corners booster pumps and discharge appurtenances

Photograph 42: Four Corners sample tap

Photograph 43: Four Corners sample tap

Photograph 44: Four Corners combined boosted flow meter

Photograph 45: Four Corners boosted discharge appurtenances

Photograph 46: Four Corners inlet pressure

Photograph 47: Four Corners booster station

Photograph 48: Four Corners propane generator

Photograph 49: Black Mountain reservoir (leak)

Photograph 50: Black Mountain reservoir interior

Photograph 51: Black Mountain reservoir interior

Photograph 52: Black Mountain interior reservoir hatch water tight seal


Photograph 53: Black Mountain reservoir interior overflow


Photograph 54: Black Mountain reservoir interior overflow

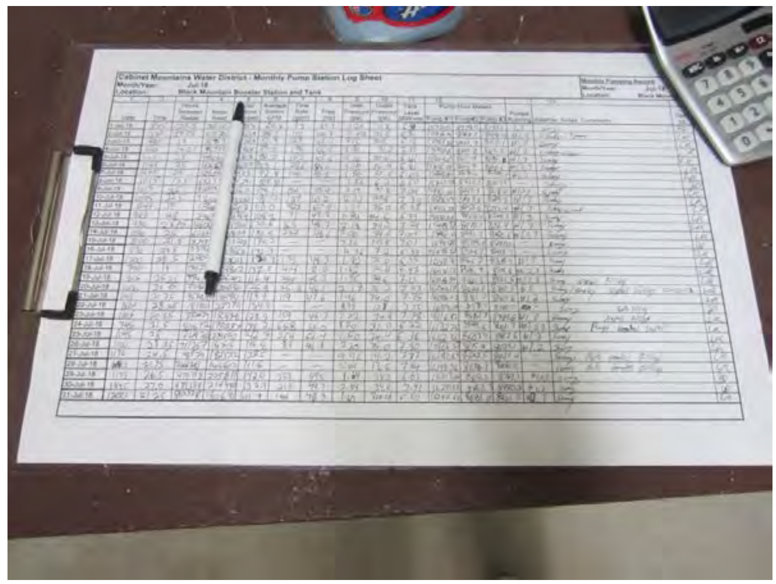

Photograph 55: Black Mountain reservoir vent w 24-mesh screen


Photograph 56: Black Mountain reservoir lid

Photograph 57: Black Mountain reservoir

Photograph 58: Black Mountain booster station diesel generator

Photograph 59: Black Mountain booster pumps and discharge appurtenances



Photograph 60: Black Mountain operators daily record log

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Photograph 67: Black Mountain booster pump controls

Photograph 68: Black Mountain reservoir screened drain

Photograph 69: Black Mountain reservoir screened overflow

Photograph 70: Pressure reducing valve vault w pigtail

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Photograph 73: Naples tank and booster station

Photograph 74: Naples booster station propane generator

Photograph 75: Naples tank booster pump

Photograph 76: Naples tank booster station, 3 residential connections

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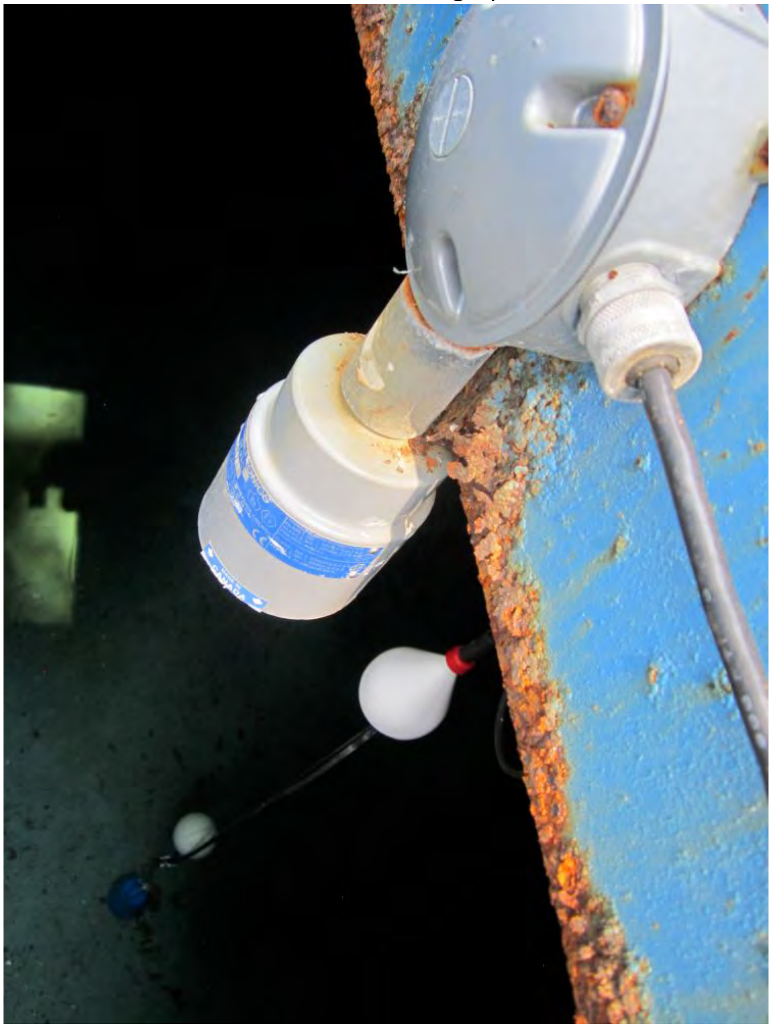

Photograph 83: Naples tank ultra-sonic level transducer

Photograph 84: Naples tank interior

Photograph 85: Naples tank overflow

Photograph 86: Naples tank lid w water tight seal

Photograph 87: Naples tank lid w screened vent

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Photograph 89: Naples tank

Photograph 90: Naples tank

Photograph 91: Highland Flats booster pump controls

Photograph 92: Highland Flats flow meter (malfunctioning)

Idaho Department of Environmental Quality
Photographic Documentation For Cabinet Mountains Water District

Photograph 93: Highland Flats pressure relief (requires reconfiguration of discharge)

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Photograph 7: Well 2 6
Photograph 8: Well 2 6
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Photograph 11: Well 1 electronic metering pump 8
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Photograph 14: Pressure gage well discharge 9
Photograph 15: Pressure transducer on combined well discharge 9
Photograph 16: Individual flow meter tied to electronic chlorine metering pump 9
Photograph 17: Finished (chlorinated) sample tap 10
Photograph 18: Well 2 discharge to waste control valve 10
Photograph 19: Well electrical switches....11
Photograph 20: Well electrical switches....11
Photograph 21: Well flow rates 12
Photograph 22: Well discharge to waste dry well (requries air gap/backflow protection) 12
Photograph 23: Well 1 and 2 building 12
Photograph 24: Parker Canyon booster station 12
Photograph 25: Parker Canyon diesel generator....13
Photograph 26: Parker Canyon tank....13
Photograph 27: Parker Canyon level controls (well actuation) 13
Photograph 28: Parker Canyon tank water tight access hatch....13
Photograph 29: Parker Canyon booster pump 14
Photograph 30: Parker Canyon booster pump 14
Photograph 31: Parker Canyon boosted discharge appurtenances 14
Photograph 32: Parker Canyon boosted discharge appurtenances 14
Photograph 33: Parker Canyon booster pump controls....15
Photograph 34: Parker Canyon pump controls 15
Photograph 35: Parker Canyon tank screened overflow w metal flapper valve 15
Photograph 36: Parker Canyon tank screened overflow w metal flapper valve 15
Photograph 37: Four Corners booster station SCADA display....16
Photograph 38: Four Corners booster station autodialer 16

Photograph 39: Four Corners booster station 16
Photograph 40: Four Corners booster pumps and discharge appurtenances 16
Photograph 41: Four Corners booster pumps and discharge appurtenances 17
Photograph 42: Four Corners sample tap 17
Photograph 43: Four Corners sample tap 17
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Photograph 68: Black Mountain reservoir screened drain 23
Photograph 69: Black Mountain reservoir screened overflow 24
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Photograph 71: Pressure reducing valve vault 24
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Photograph 73: Naples tank and booster station 25
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Idaho Department of Environmental Quality
Photographic Documentation For Cabinet Mountains Water District

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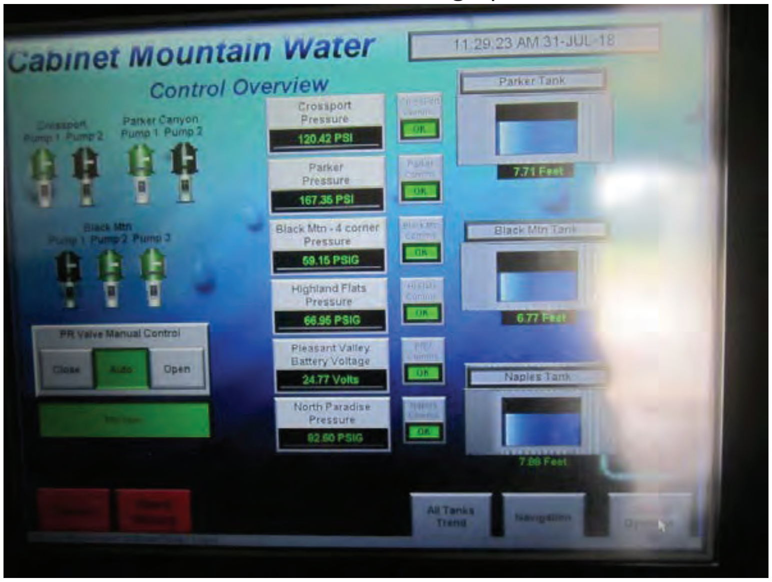

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Photograph 47: Four Corners booster station

Photograph 48: Four Corners propane generator

Photograph 49: Black Mountain reservoir (leak)

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Photograph 83: Naples tank ultra-sonic level transducer


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Photograph 85: Naples tank overflow

Photograph 86: Naples tank lid w water tight seal

Photograph 87: Naples tank lid w screened vent

Photograph 88: Naples tank

Photograph 89: Naples tank

Photograph 90: Naples tank

Photograph 91: Highland Flats booster pump controls

Photograph 92: Highland Flats flow meter (malfunctioning)

Photograph 93: Highland Flats pressure relief (requires reconfiguration of discharge)

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Photograph 98: Highland Flats booster pump

Photograph 99: Highland Flats booster station building

From: Jeremy Davy
To: Suzanne Scheidt
Subject: Cabinet Mtns Water Dist. Drain Repair
Date: Friday, December 28, 2018 8:44:09 AM

Good Morning Suzanne,

I have attached some photos of the new drain system we got finished last night, please let me know if you need anything else.

Have a Happy New Year,

Jeremy Davy
System Operator
Cabinet Mountains Water District
(208)946-1985
Jeremy@cmwd.org


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4"


MCP
MCC-1
DANGER


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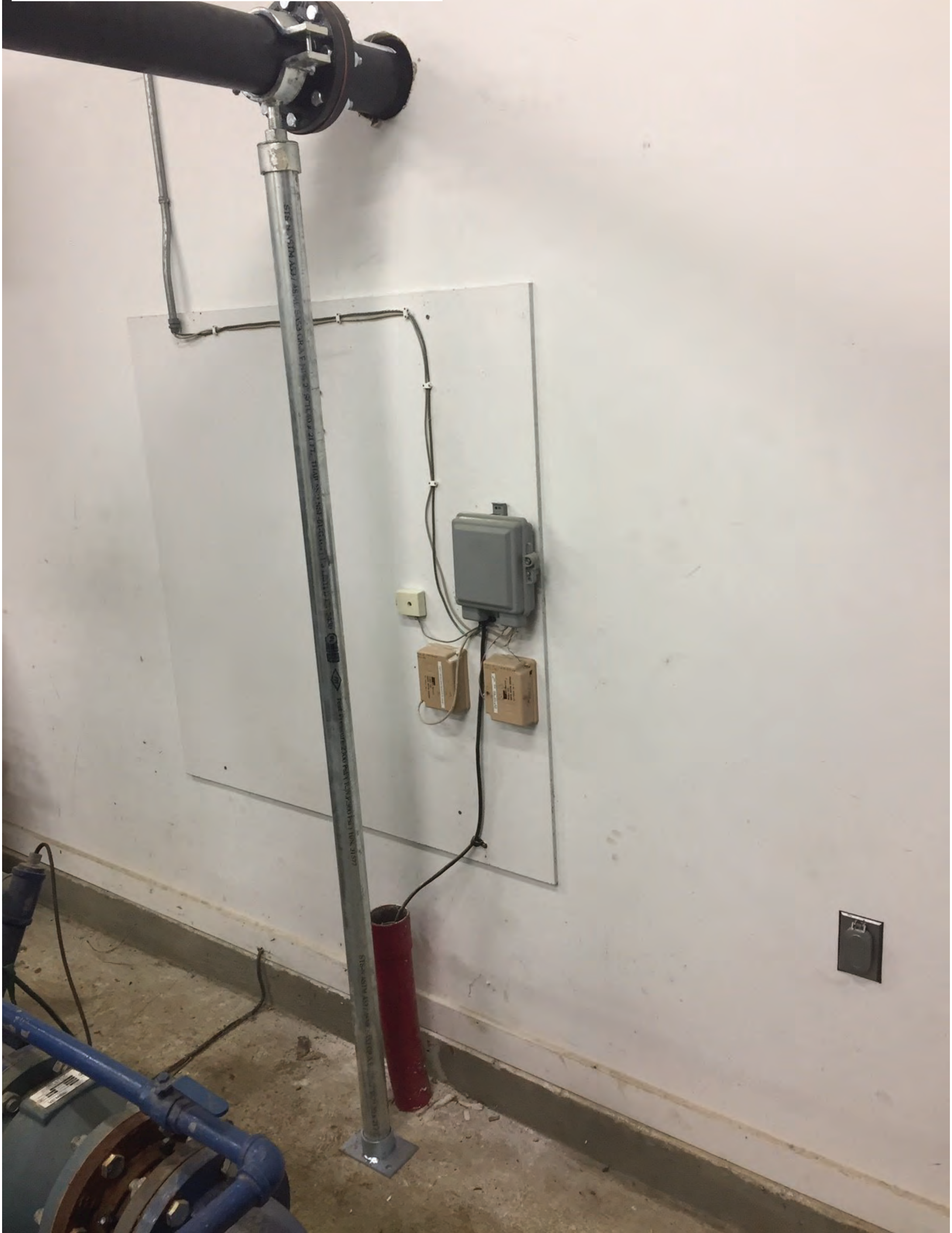


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APPENDIX G
ALTERNATIVE ANALYSIS

Water System Capital Improvement Plan - Priority 1 Improvements		
ID	**Project**	**Est. Cost (2019 Dollars)**
	Priority 1 Improvements	
W1.1	Alternative 1: Additional Crossport Well	$877,000
T1.1.2	Parker Canyon Tank (260,000 gal)	$952,000
T1.2	Highland Flats Tank (200,000 gal)	$1,370,000
T1.3	North Paradise Elevated Tank (300,000 gal)	$2,192,000
1.1	Highland Booster Replacement	$586,000
1.2	Pump Station Improvements - Black Mountain Booster	$179,000
1.3	Mountain Meadows Rd. Booster	$285,000
1.4	Naples Pressure Reducing / Pressure Sustaining Valve	$62,000
1.5	Kootenai Trail Booster	$285,000
CI	Crossport Well Facility Improvements	$168,000
CI	Black Mountain Tank/Booster Improvements	$103,000
	Total Priority 1 (rounded)	***$7,059,000***

Notes*
1) Timing depends on when growth occurs. Development participation anticipated.
2) The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor’s methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.

Water System Capital Improvement Plan - Priority 1 Improvements		
ID	**Project**	**Est. Cost (2019 Dollars)**
	Priority 1 Improvements	
W1.1	Alternative 1: Additional Crossport Well	$877,000
T1.1.4	Parker Canyon Tank (260,000 gal) and Parallel Booster Station	$1,642,000
T1.2	Highland Flats Tank (200,000 gal)	$1,370,000
T1.3	North Paradise Elevated Tank (300,000 gal)	$2,192,000
1.1A	Highland Booster Minor Upgrades	$211,000
1.3	Mountain Meadows Rd. Booster	$285,000
1.4	Naples Pressure Reducing / Pressure Sustaining Valve	$62,000
1.5	Kootenai Trail Booster	$285,000
	Total Priority 1 (rounded)	***$6,924,000***

Notes*
1) Timing depends on when growth occurs. Development participation anticipated.
2) The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.

Water System Capital Improvement Plan - Priority Improvements & Replacement Budget		
ID	**Project**	**Est. Cost (2019 Dollars)**
	Priority 1 Improvements	
W1.1	Alternative 1: Additional Crossport Well	$877,000
T1.1.2	Parker Canyon Tank (260,000 gal)	$952,000
T1.2	Highland Flats Tank (200,000 gal)	$1,370,000
T1.3	North Paradise Elevated Tank (300,000 gal)	$2,192,000
1.1	Highland Booster Replacement	$586,000
1.2	Pump Station Improvements - Black Mountain Booster	$179,000
1.3	Mountain Meadows Rd. Booster	$285,000
1.4	Naples Pressure Reducing / Pressure Sustaining Valve	$62,000
1.5	Kootenai Trail Booster	$285,000
CI	Crossport Well Facility Improvements	$168,000
CI	Black Mountain Tank/Booster Improvements	$103,000
	Total Priority 1 (rounded)	***$7,059,000***
	Priority 2 Improvements	
2.1	Brown Creek Road Distribution Improvements	$490,000
2.2	Naples Zone US-2 Loop	$698,000
2.3	Quail Drive Distribution Improvements	$220,000
2.4	Blue Sky Distribution Improvements	$1,315,000
CI	Priority 2 - Existing Facilities Improvements	$460,000
	Total Priority 2 (rounded)	***$3,183,000***
	Priority 3 Improvements	
3.1	Highland Flats Road and McArthur Lake Road Distribution Improvements	$2,083,000
3.2	South Highlands Distribution Improvements	$68,000
3.3	Roman Nose Dr Distribution Improvements	$483,000
3.4	South Naples Distribution Improvements	$2,796,000
3.5	Frontier Village Distribution Improvements	$423,000
3.6	Northeast Paradise Distribution Improvements	$1,498,000
3.7	Coyote Way Distribution Improvements	$450,000
3.8	Pinnacle Circle Distribution Improvements	$695,000
3.9	Cottage Lane Distribution Improvements	$293,000
3.10	Grumpy Lane Distribution Improvements	$291,000
3.11	Northeast Paradise Distribution Improvements	$594,000
	Total Priority 3 (rounded)	***$9,674,000***
	Total Priority 1, 2 & 3 Improvement Costs	**$19,916,000**
	Annual Replacement Budget	
	Water Distribution Lines	$286,000
	Fire Hydrants	$25,000
	Water Meters	$13,000
	Well Facilities	$21,000
	Booster Facilities	$26,000
	Storage Facilities	$12,000
	Total Annual Replacement Budget Costs	**$383,000**

Notes*
1) Timing depends on when growth occurs. Development participation anticipated.
2) The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.

Storage Alternatives

Alternative 1 : 3 tanks and Small Booster

Description	**Cost**	
Parker Canyon Tank (260,000 gal)	$	952,000
Highland Flats Tank (200,000 gal)	$	1,370,000
North Paradise Elevated Tank (300,000 gal)	$	2,192,000
Kootenai Trail Booster	$	285,000
Total Cost	$	4,799,000

Alternative 2 : 4 tanks

Description	**Cost**	
Parker Canyon Tank (210,000 gal)	$	883,000
Highland Flats Tank (200,000 gal)	$	1,370,000
North Paradise Elevated Tank (2(	$	1,935,000
Cow Creek Tank (150,000 gal)	$	1,343,000
Total Cost	$	5,531,000

Parker Canyon Tank Alternatives

Description	**Capital Cost**
Parker Canyon Tank (210,000 gal) and Parallel Booster Station	$ 1,573,000
Parker Canyon Tank (210,000 gal)	$ 883,000
Parker Canyon Tank (260,000 gal) and Parallel Booster Station	$ 1,642,000
Parker Canyon Tank (260,000 gal)	$ 952,000

Supply Alternatives

Description	**Capital Cost**	**20 Year O&M**	**Total Cost Life Cycle Analsysis Cost**
Alternative 1: Additional Crossport Well	$ 877,000	$ 796,000	$ 1,673,000
Alternative 2: Cow Creek Well	$ 2,051,000	$ 1,840,000	$ 3,891,000
Alternative 3: New Well at Site TBD	$ 1,405,000	$ 900,000	$ 2,305,000

Non-Elevated Tank
Steel
Concrete

CMWD - Water Facility Plan
Annual Replacement Budgets

Infrastructure	Annual Budget	Comments
Water Distribution Lines	$ 286,000	0.5% of distribution piping replaced per year (all inclusive cost)
Fire Hydrants	$ 25,000	5 hydrants per year
Water Meters	$ 13,000	46 meter replacements per year based on a 20 year life
Well Facilities	$ 21,000	Includes typical well facility components needing replacement
Booster Facilities	$ 26,000	Includes booster facility components
Storage Facilities	$ 12,000	Includes minor repairs, cleaning and inspection
Total Annual Replacement Budget	**$ 383,000**	

Annual Pipeline Replacement Budget

Pipeline Replacement Costs			
Total Syste		411,840	
Pipe Repla		2,059	
Cost per Fo	$	139	includes valves, pavement, fittings, engineerin
			assumes most pipe is 8-inches
Cost/year	**$**	**286,000**	

Fire Hydrant Replacement

# Hydrants		5
Cost /Hydr	$	5,000
Cost/year	**$**	**25,000**

pipe detail
RS Means (Dec 2013)

Item	Cost/foot (8inch)		
Excavation	$ 6.57		
Backfill	$ 9.00		
Pipe	$ 44.26		
Fittings	$ 1.80	assumes 1 every 500 feet	
Valves	$ 1.18	assumes 1 every 1000 feet	
Paving	$ 11.80		
Water Serv	$ 15.00		
Testing	$ 3.00		
Sub-total	$ 92.61	$ 106.50	
Contingenc	$ 13.89		README
Engineerin	$ 13.89		
Total	$ 120.39		
Rounded	$ 120		

ENR Index	9668
ENR Index	11186

Meter Replacement Budget

# Meters	921
Typical life (years)	20
# replace/year	46.05
Typical cost/meter	$ 275
Annual budget (rounded)	**$ 13,000**

Well Facility Improvements
75 ± HP Pump and Motors (Wells 1,2)

Typical Replacement Activities	Frequency (ye	Unit Cost	Cost/year
Roof replacement	25	$ 25,000	$ 1,000
Electrical	20	$ 35,000	$ 1,750
Pump and motor	15	$ 40,000	$ 2,667
SCADA	15	$ 20,000	$ 1,333
Building	50	$120,000	$ 2,400
Chlorination / treatment	20	$ 15,000	$ 750
Valves / meter /piping	30	$ 25,000	$ 833
Total per Facility			$ 10,733
# Wells On line			2
Recommended Annual Budget (rounded)			**$ 21,000**

Booster Facility Improvements
Typical for All Booster Stations > 100 gpm

Typical Replacement Activities	Frequency (ye	Unit Cost	Cost/year
Roof replacement	25	$ 15,000	$ 600
Electrical	20	$ 30,000	$ 1,500
Door, HVAC, Siding	30	$ 15,000	$ 500
Pump and motor	20	$ 57,000	$ 2,850
SCADA	15	$ 20,000	$ 1,333
Building	50	$100,000	$ 2,000
Site paving, fencing, etc.	30	$ 5,000	$ 167
Valves / meter	30	$ 35,000	$ 1,167
Total per Facility			$ 10,117
Total with 2 Facilities (Black Mtn/Parker)			$ 20,233

Minor Booster Stations < 100 gpm

Typical Replacement Activities	Frequency (ye	Unit Cost	Cost/year
Roof replacement	25	$ 5,000	$ 200
Electrical	20	$ 55,000	$ 2,750
Pump and motor	20	$ 10,000	$ 500
SCADA	15	$ 20,000	$ 1,333
Building	50	$ 15,000	$ 300
Site paving, fencing, etc.	30	$ -	$ -
Valves / meter	30	$ 10,000	$ 333
Total per Facility			$ 5,417
Recommended Annual Budget (rounded)			**$ 26,000**

assume 1 for now at Naples. two more will be added on Kootenai trail and upper Naples

Typical Tank Rehabilitation Projects

Typical Replacement Activities	Frequency (ye	Unit Cost	Cost/year
Misc. Vent, Hatch, Equip.	25	$ 5,500	$ 220
Crack/Leak Repair	10	$ 5,000	$ 500
Site paving, fencing, etc.	30	$ 8,000	$ 267
Inspection	7	$ 3,500	$ 500
Paint/Coating	25	$ 30,000	$ 1,200
Clean	7	$ 9,500	$ 1,357
Annual Cost (rounded)			$ 4,000
Total Number of Tanks 3 (Parker, Naples, Black Mtn			$ 12,000
Total Annual Tank Costs (rounded)			**$ 12,000**

Water Facility Plan Improvements
Summary
Capital Improvement Cost Estimate

Site	Recommended Improvement	Recommended Completion Time	2019 Costs		
			Priority 1	Priority 2	Priority 3
Crossport Well Facility Improvements	Replace Existing Generator (175 kW)	1-5 Years	$ 50,000		
	Repaint Mechanical Piping	5-10 years		$ 10,000	
	Separate Chlorine storage/room	1-5 Years	$ 8,000		
	Install Pressure and Air Relief	1-5 Years	$ 15,000		
	Replace Existing Flowmeters(2)	1-5 Years	$ 8,000		
	Separate Storage Room other than Pumping Facility	5-10 years		$ 45,000	
	SCADA Controls at Crossport Facility	1-5 years	$ 25,000		
		Subtotal	$ 106,000	$ 55,000	$ -
		Contingency (30%)	$ 31,800	$ 16,500	$ -
		Engineering (20%)	$ 27,560	$ 14,300	$ -
		Administration (2%)	$ 2,756	$ 1,430	$ -
		Total	**$ 168,000**	**$ 87,000**	**$ -**

Site	Recommended Improvement	Recommended Completion Time	2019 Costs		
			Priority 1	Priority 2	Priority 3
Parker Canyon Tank/Booster Station	See T1.1 for new improvements	1-5 Years			
	Replace/Refurbish Corroded Valves	5-10 years		$ 20,000	
	Preform Tank Inspection	5-10 years		$ 10,000	
	Hatch Contamination Protection	1-5 Years	$ 5,000		
		Subtotal	$ 5,000	$ 30,000	$ -
		Contingency (30%)	$ 1,500	$ 9,000	$ -
		Engineering (20%)	$ 1,300	$ 7,800	$ -
		Administration (2%)	$ 130	$ 780	$ -
		Total	**$ 8,000**	**$ 48,000**	**$ -**

Site	Recommended Improvement	Recommended Completion Time	2019 Costs		
			Priority 1	Priority 2	Priority 3
Black Mountain Tank/Booster Station	Replace Flowmeters	1-10 years	$ 10,000		
	Repaint Pipe	5-10 years		$ 10,000	
	Tank Rehabilitation/Leak Repair, Paint Inside and Out	5-10 years	$ 55,000		
	Intrusion Alarms	5-10 years		$ 10,000	
		Subtotal	$ 65,000	$ 20,000	$ -
		Contingency (30%)	$ 19,500	$ 6,000	$ -
		Engineering (20%)	$ 16,900	$ 5,200	$ -
		Administration (2%)	$ 1,690	$ 520	$ -
		Total	**$ 103,000**	**$ 32,000**	**$ -**

Site	Recommended Improvement	Recommended Completion Time	2019 Costs		
			Priority 1	Priority 2	Priority 3
Naples Tank/Booster Station	Replace Existing Pump with two pumps (one active, one standby)	5-10 years		$ 25,000	
	Replace Generator with Diesel (50kW)	5-10 years	$ 15,000		
	Expand Northern Building to Consolidate Booster and Controls	5-10 years		$ 50,000	
	Controls Integration/PLC/Electrical Upgrades	5-10 years		$ 30,000	
	Tank Rehabilitation	5-10 years		$ 50,000	
	Install Site Fencing and Intrusion Alarms	5-10 years		$ 30,000	
		Subtotal	$ 15,000	$ 185,000	$ -
		Contingency (30%)	$ 4,500	$ 55,500	$ -
		Engineering (20%)	$ 3,900	$ 48,100	$ -
		Administration (2%)	$ 390	$ 4,810	$ -
		Total	**$ 24,000**	**$ 293,000**	**$ -**

Site	Recommended Improvement	Recommended Completion Time	2019 Costs		
			Priority 1	Priority 2	Priority 3
Highland Flats Booster Station	Replace the Booster Station	1-5 Years	See CIP 1.1		
		Subtotal	$ -	$ -	$ -
		Contingency (30%)	$ -	$ -	$ -
		Engineering (20%)	$ -	$ -	$ -
		Administration (2%)	$ -	$ -	$ -
		Total	$ -	$ -	$ -

Site	Recommended Improvement	Recommended Completion Time	2019 Costs		
			Priority 1	Priority 2	Priority 3
Paradise Valley (Four Corners) Booster Station	Demolish Existing Booster Station	1-5 years	See CIP T1.3		
		Subtotal	$ -	$ -	$ -
		Contingency (30%)	$ -	$ -	$ -
		Engineering (20%)	$ -	$ -	$ -
		Administration (2%)	$ -	$ -	$ -
		Total	$ -	$ -	$ -

Site	Recommended Improvement	Recommended Completion Time	2019 Costs		
			Priority 1	Priority 2	Priority 3
Pressure Reducing Valve (PRV)	Replace Existing Valve	1-5 years	See CIP 1.4		
		Subtotal	$ -	$ -	$ -
		Contingency (30%)	$ -	$ -	$ -
		Engineering (20%)	$ -	$ -	$ -
		Administration (2%)	$ -	$ -	$ -
		Total	$ -	$ -	$ -

	Priority 1	Priority 2	Priority 3
	$ 303,000	$ 460,000	$ -
Average Annual Maintenance Budget	$ 60,600		

Distribution Project Title:

Parker Canyon Tank (260,000 gal)

Location:

Parker Canyon Road, Existing Site (Booster Station and Tank)

Project Identifier:

T1.1.2

Objective:
- Provide additional 260,000 gallons of storage at the Parker Canyon site, in the form of a parallel tank

Design Considerations:
- Space considerations and land/parcel acquisition
- Maintain operation during construction
- Enables existing Parker Canyon Tank to be taken offline

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$20,000	$20,000
Yard Piping (tank connection, overflow line)	1	LS	$35,000	$35,000
12"Pipe to connect to system	140	LF	$70	$9,800
New Buried Concrete Tank	1	LS	$455,000	$455,000
Transducer	1	LS	$6,000	$6,000
Site Fencing	400	LF	$50	$20,000
Access Road Improvements	1	LS	$2,500	$2,500
Additional land for tank	1	LS	$20,000	$20,000
Tank Cost Subtotal				$568,300
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$56,830
Contingency			25%	$142,075
Total Construction Costs				*$767,205*
Engineering and CMS - % of total construction costs			20%	$153,441
Legal, Admin, and Permitting			4%	$30,688
Construction Costs (rounded)				**$952,000**

Operations and Maintenance

Electrical (Power)	$	*100*
Maintenance	$	*1,800*
Replacement	$	*1,000*
Yearly O&M Subtotal	$	*2,900*
20 Year O&M Total		58,000
20 Year Total Cost		**$1,010,000**

Distribution Project Title:

Parker Canyon Tank (210,000 gal)

Location:

Parker Canyon Road, Existing Site (Booster Station and Tank)

Project Identifier:

T1.1.3

Objective:
- Provide additional 210,000 gallons of storage at the Parker Canyon site, in the form of a parallel tank
- Remove existing pumps (2) at Parker Canyon Booster station and replace with new booster station above new parallel buried tank (four pumps)
- Set VFD of Parker Canyon booster to target a specific hydraulic grade

Design Considerations:
- Space considerations and land/parcel acquisition
- Maintain operation during construction

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$20,000	$20,000
Yard Piping (tank connection, overflow line)	1	LS	$35,000	$35,000
12"Pipe to connect to system	140	LF	$70	$9,800
New Buried Concrete Tank	1	LS	$414,000	$414,000
Transducer	1	LS	$6,000	$6,000
Site Fencing	400	LF	$50	$20,000
Access Road Improvements	1	LS	$2,500	$2,500
Additional land for tank	1	LS	$20,000	$20,000
Tank Cost Subtotal				$527,300
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$52,730
Contingency			25%	$131,825
Total Construction Costs				*$711,855*
Engineering and CMS - % of total construction costs			20%	$142,371
Legal, Admin, and Permitting			4%	$28,474
Total Project Costs (rounded)				**$883,000**

Operations and Maintenance

Electrical (Power)	$	*100*
Maintenance	$	*1,700*
Replacement	$	*900*
Yearly O&M Subtotal	$	*2,700*
20 Year O&M Total		54,000
20 Year Total Cost		**$937,000**

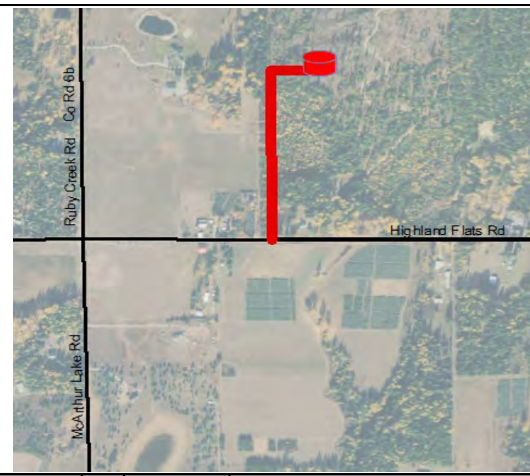
Distribution Project Title:	Location:
Highland Flats Tank (200,000 gal)	**North of Highland Flats Rd**

Project Identifier:

T1.2

Objective:
- Provide additional storage within the Highland Zone
- Partially 200,000 gal Partial Buried Concrete Tank

Design Considerations:
- Space considerations and parcel acquisition
- Steep terrain
- Easements
- Connection to system



General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$20,000	$20,000
Site Fencing	400	LF	$50	$20,000
Access Road (gravel)	1,800	LF	$35	$63,000
200,000 Gallon Concrete Tank	1	LS	$414,000	$414,000
12" PVC Pipe to Tank from Road	2,150	LF	$70	$150,500
Yard Piping (Includes overflow line)	1	LS	$10,000	$10,000
Overflow Pond	1	LS	$5,000	$5,000
Inlet/Outlet Valves	2	EA	$8,500	$17,000
Isolation Valves	1	EA	$8,500	$8,500
Controls/Electrical/Solar Power	1	LS	$55,000	$55,000
Transducer	1	EA	$6,000	$6,000
Additional land for tank	1	LS	$20,000	$20,000
Subtotal				*$789,000*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$78,900
Contingency			30%	$236,700
Total Construction Costs				*$1,104,600*
Engineering and CMS - % of total construction costs			20%	$220,920
Legal, Admin, and Permitting			4%	$44,184
Total Project Costs (rounded)				**$1,370,000**

Electrical (Power)	$	*100*
Maintenance	$	*1,500*
Replacement	$	*800*
Yearly O&M Subtotal	$	*2,400*
20 Year O&M Total		48,000
20 Year Total Cost		**$1,418,000**

Distribution Project Title:

North Paradise Elevated Tank (200,000 gal)

Location:

North of Blue Sky Rd

Project Identifier:

T1.3.1

Objective:
- 120' Elevated legged water tank
- Provide additional storage within the Paradise Zone
- Target hydraulic grade of Parker Canyon Booster station
- Elminates need for four corners

Design Considerations:
- Space considerations and parcel acquisition
- Easements

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$50,000	$50,000
Site Fencing	500	LF	$50	$25,000
Access Road (gravel)	200	LF	$15	$3,000
200,000 Gallon Elevated Steel Tank	1	LS	$940,000	$940,000
12" PVC Pipe to Tank from Road	350	LF	$70	$24,500
Yard Piping	1	LS	$15,000	$15,000
Inlet/Outlet Valves	2	EA	$8,500	$17,000
Four Corners Modifications/ Isolation Valves	1	EA	$8,500	$8,500
30,000 Gallon Overflow Pond and Piping	1	LS	$40,000	$40,000
Controls/Electrical/Solar Power	1	LS	$55,000	$55,000
Transducer	1	EA	$6,000	$6,000
Additional land for tank	1	LS	$20,000	$20,000
Subtotal				*$1,204,000*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$120,400
Contingency			25%	$301,000
Total Construction Costs				*$1,625,400*
Engineering and CMS - % of total construction costs			15%	$243,810
Legal, Admin, and Permitting			4%	$65,016.00
Total Project Costs (rounded)				**$1,935,000**

Electrical (Power)	$	*100*
Maintenance	$	*1,500*
Replacement	$	*12,500*
Yearly O&M Subtotal	$	*14,100*
20 Year O&M Total		282,000
20 Year Total Cost		**$347,000**

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Distribution Project Title:

North Paradise Elevated Tank (300,000 gal)

Location:

North of Blue Sky Rd

Project Identifier:

T1.3.2

Objective:
- 120' Elevated legged water tank
- Provide additional storage within the Paradise Zone
- Target hydraulic grade of Parker Canyon Booster station
- Elminates need for four corners

Design Considerations:
- Space considerations and parcel acquisition
- Easements

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$50,000	$50,000
Site Fencing	500	LF	$50	$25,000
Access Road (gravel)	200	LF	$15	$3,000
300,000 Gallon Elevated Steel Tank	1	LS	$1,100,000	$1,100,000
12" PVC Pipe to Tank from Road	350	LF	$70	$24,500
Yard Piping	1	LS	$15,000	$15,000
Inlet/Outlet Valves	2	EA	$8,500	$17,000
Four Corners Modifications/ Isolation Valves	1	EA	$8,500	$8,500
30,000 Gallon Overflow Pond and Piping	1	LS	$40,000	$40,000
Controls/Electrical/Power	1	LS	$55,000	$55,000
Transducer	1	EA	$6,000	$6,000
Additional land for tank	1	LS	$20,000	$20,000
Subtotal				*$1,364,000*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$136,400
Contingency			25%	$341,000
Total Construction Costs				*$1,841,400*
Engineering and CMS - % of total construction costs			15%	$276,210
Legal, Admin, and Permitting			4%	$73,656.00
Total Project Costs (rounded)				**$2,192,000**
Electrical (Power)				*$ 100*
Maintenance				*$ 1,750*
Replacement				*$ 1,800*
Yearly O&M Subtotal				*$ 3,650*
20 Year O&M Total				73,000
20 Year Total Cost				**$2,265,000**

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Distribution Project Title:

North Paradise Standpipe (23'x120')

Location:

North of Blue Sky Rd

Project Identifier:

T1.3.3

Objective:
- 120' Standpipe
- Provide additional storage within the Paradise Zone
- add small booster station to add addtional useable elevation

Design Considerations:
- Space considerations and parcel acquisition
- Easements

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$50,000	$50,000
Site Fencing	500	LF	$50	$25,000
Access Road (gravel)	200	LF	$15	$3,000
120' Standpipe 23' diameter	1	LS	$1,200,000	$1,200,000
12" PVC Pipe to Tank from Road	350	LF	$70	$24,500
Yard Piping	1	LS	$15,000	$15,000
Inlet/Outlet Valves	2	EA	$8,500	$17,000
Isolation Valves	1	EA	$8,500	$8,500
30,000 Gallon Overflow Pond and Piping	1	LS	$40,000	$40,000
Controls/Electrical/Power	1	LS	$55,000	$55,000
Transducer	1	EA	$6,000	$6,000
Additional land for tank	1	LS	$20,000	$20,000
Small Booster Station	1	LS	$250,000	$250,000
Subtotal				*$1,714,000*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$171,400
Contingency			25%	$428,500
Total Construction Costs				*$2,313,900*
Engineering and CMS - % of total construction costs			15%	$347,085
Legal, Admin, and Permitting			4%	$92,556.00
Total Project Costs (rounded)				**$2,754,000**

Electrical (Power)	$	*1,000*
Maintenance	$	*1,100*
Replacement	$	*1,250*
Yearly O&M Subtotal	$	*3,350*
20 Year O&M Total		67,000
20 Year Total Cost		**$2,821,000**

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Distribution Project Title:

North Paradise Concrete Tank

Location:

North of Blue Sky Rd

Project Identifier:

T1.3.4

Objective:
- 120' Standpipe
- Provide additional storage within the Paradise Zone
- add small booster station to add addtional useable elevation

Design Considerations:
- Space considerations and parcel acquisition
- Easements

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$50,000	$50,000
Site Fencing	500	LF	$50	$25,000
Access Road (gravel)	200	LF	$15	$3,000
Concrete Tank	1	LS	$500,000	$500,000
12" PVC Pipe to Tank from Road	350	LF	$70	$24,500
Yard Piping	1	LS	$15,000	$15,000
Inlet/Outlet Valves	2	EA	$8,500	$17,000
Isolation Valves	1	EA	$8,500	$8,500
30,000 Gallon Overflow Pond and Piping	1	LS	$40,000	$40,000
Controls/Electrical/Power	1	LS	$55,000	$55,000
Transducer	1	EA	$6,000	$6,000
Additional land for tank	1	LS	$20,000	$20,000
Moderate sized Booster Station	1	LS	$625,000	$625,000
Subtotal				*$1,389,000*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$138,900
Contingency			25%	$347,250
Total Construction Costs				*$1,875,150*
Engineering and CMS - % of total construction costs			15%	$281,273
Legal, Admin, and Permitting			4%	$75,006.00
Total Project Costs (rounded)				**$2,232,000**

Electrical (Power)	$	5,000
Maintenance	$	3,000
Replacement	$	3,500
Yearly O&M Subtotal	$	11,500
20 Year O&M Total		230,000
20 Year Total Cost		**$2,462,000**

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the cost presented herein.

Distribution Project Title:

Kootenai Trail Tank (150,000 GAL)

Location:

Kootenai Trail Rd

Project Identifier:

T1.4

Objective:
- Provide additional storage within the Paradise Zone
- Target hydraulic grade of Parker Canyon Booster station

Design Considerations:
- Space considerations and parcel acquisition
- Steep terrain
- Connection to main system

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$40,000	$40,000
Site Fencing	400	LF	$50	$20,000
Access Road (gravel)	1,300	LF	$35	$45,500
150,000 Gallon Tank Concete Tank	1	LS	$367,000	$367,000
12" PVC Pipe to tank from Road	1,300	LF	$70	$91,000
Yard Piping	1	LS	$15,000	$15,000
Inlet/Outlet Valves	2	EA	$8,500	$17,000
Isolation Valves	2	EA	$8,500	$17,000
Controls/Electrical/SCADA	1	LS	$55,000	$55,000
Transducer	1	EA	$6,000	$6,000
12" Overflow Line	150	LF	$65	$9,750
Additional Land for Tank	1	LS	$20,000	$20,000
Subtotal				*$703,250*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$70,325
Contingency			30%	$210,975
Total Construction Costs				*$984,550*
Engineering and CMS - % of total construction costs			20%	$196,910
Legal, Admin, and Permitting			4%	$39,382
Total Project Costs (rounded)				**$1,221,000**

Electrical (Power)	$ -
Maintenance	$ -
Replacement	$ -
Yearly O&M Subtotal	$ -
20 Year O&M Total	0

The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to

Alternative 1:	Location:
Alternative 1: Additional Crossport Well	**Crossport Site**

Project Identifier:

Objective:
Increase the District's firm capacity to meet 2039 requirements ands current max day demand potential.

Design Considerations:
- Meet District's need for standby power
- Incorporate into existing well house
- Potential for Cost Savings if existing casing in usable condition
- Need additional water rights to meet total pumping capacity
- Maintain continuous operation during construction

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2019 Dollars)
Drill Well, (Quality testing, casing, screen)	150	LF	$700	$105,000	
Pump Test	1	LS	$15,000	$15,000	
New Well Pump (500 gpm @ 420' TDH)	1	LS	$75,000	$75,000	
Site work and yard Piping	1	LS	$40,000	$40,000	
Standby Power Generator	1	LS	$55,000	$55,000	
Electrical/Controls	1	LS	$55,000	$55,000	
Metering and Mechanical Piping	1	LS	$45,000	$45,000	
Building addition	1	LS	$75,000	$75,000	
CCTV - already completed	1	LS	-		
Alignment and Mandrel Testing	1	LS	$20,000	$20,000	
Subtotal					*$485,000*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$49,000	
Contingency			30%	$146,000	
Total Construction Costs					*$680,000*
Engineering and CMS - % of total construction costs			25%	$170,000	
Legal, Admin, and Permitting			4%	$27,000	
Construction Costs (rounded)					**$877,000**

Operations and Maintenance

Electrical (Power)	$	*17,000*
Maintenance	$	*19,900*
Replacement	$	*2,900*
Yearly O&M Subtotal	$	*39,800*
20 Year O&M Total		796,000
20 Year Total Cost		**$1,673,000**

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Alternative 2:

Alternative 2: Cow Creek Well

Location:

Cow Creek

Project Identifier:

Objective:

Increase the District's firm capacity to meet 2039 requirements

Design Considerations:

- Meet District's need for standby power
- Target hydraulic grade of Parker Canyon Booster Station
- Need to better define well capacity
- Need additional water rights
- Connect to future tank
- Space considerations and parcel acquisition
- Water Treatment

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2019 Dollars)
New Iron/Manganese Treatment Facility	1	LS	$400,000	$400,000	
Backwash Water Lagoon	1	LS	$200,000	$200,000	
Pump Test	1	LS	$10,000	$10,000	
Site work and yard Piping	1	LS	$80,000	$80,000	
Standby Power Generator	1	LS	$50,000	$50,000	
Access Road	1	LS	$8,000	$8,000	
Electrical/Controls	1	LS	$85,000	$85,000	
Metering and Mechanical Piping	1	LS	$60,000	$60,000	
Building	1	LS	$125,000	$125,000	
8-inch PVC waterline to connect to District	2,000	LF	$50	$100,000	
1/2 Lane Gravel Road Repair	1,650	LF	$15	$24,750	
Subtotal					*$1,142,750*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$114,000	
Contingency			30%	$343,000	
Total Construction Costs					*$1,599,750*
Engineering and CMS - % of total construction costs			22%	$352,000	
Pilot Testing, and additional engineering	1	LS	$35,000	$35,000	
Legal, Admin, and Permitting			4%	$64,000	
Total Project Costs (rounded)					**$2,051,000**
Electrical (Power)				$	17,100
Maintenance				$	66,500
Replacement				$	8,600
Yearly O&M Subtotal				$	92,000
20 Year O&M Total				$	1,840,000
20 Year Total Cost					**$3,891,000**

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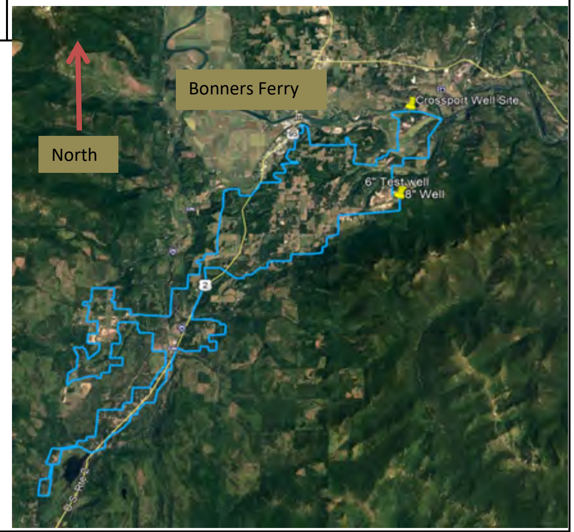
Alternative 3

Alternative 3: New Well at Site TBD

Location:

District Service Area



Project Identifier:

Objective:
Find separate water source to improve redundancy and improve supply capacity of District

Design Considerations:
- Budget assumes location in service zone-Assume 2000 ft from existing line
- Budget assumes no significant primary or secondary contaminants requiring treatment in source water
- Budget assume alternative aquifer available
- Water Rights acquisition

General Line Item	Estimated Quantity	Unit	Unit Price	Item Cost (Rounded)	Total Cost (2019 Dollars)
Drill Well, (Quality testing, casing, screen)	300	LF	$700	$210,000	
Pump Test	1	LS	$15,000	$15,000	
New Well Pump (500gpm, 300' TDH)	1	LS	$75,000	$75,000	
Site work and yard Piping	1	LS	$40,000	$40,000	
Standby Power Generator	1	LS	$50,000	$50,000	
Electrical/Controls	1	LS	$50,000	$50,000	
Metering and Mechanical Piping	1	LS	$45,000	$45,000	
New Building	1	LS	$150,000	$150,000	
8-inch PVC waterline to connect to District	2000	LF	$50	$100,000	
1/2 Lane Pavement Repair	2000	LF	$25	$50,000	
Subtotal					*$785,000*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$78,500	
Contingency			30%	$235,500	
Total Construction Costs					*$1,099,000*
Hydrogeologic and water right study	1	LS	$20,000	$20,000	
Engineering and CMS - % of total construction costs			22%	$241,780	
Legal, Admin, and Permitting			4%	$43,960	
Total Project Costs (rounded)					**$1,405,000**

Electrical (Power)	$	17,000
Maintenance	$	26,600
Replacement	$	1,200
Yearly O&M Subtotal	$	45,000
20 Year O&M Total	$	900,000
20 Year Total Cost		**$2,305,000**

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APPENDIX H
CAPITAL IMPROVEMENTS PLAN

Water System Capital Improvement Plan - Priority Improvements & Replacement Budget		
ID	Project	Est. Cost (2019 Dollars)
Priority 1 Improvements		
W1.1	Alternative 1: Additional Crossport Well	$877,000
T1.1.2	Parker Canyon Tank (260,000 gal) and Remove and Replace Booster Station	$2,107,000
T1.2	Highland Flats Tank (200,000 gal)	$1,370,000
T1.3	North Paradise Elevated Tank (300,000 gal)	$2,192,000
1.1	Highland Booster Replacement	$586,000
1.2	Pump Station Improvements - Black Mountain Booster	$179,000
1.3	Mountain Meadows Rd. Booster	$285,000
1.4	Naples Pressure Reducing / Pressure Sustaining Valve	$62,000
1.5	Kootenai Trail Booster	$285,000
CI	Crossport Well Facility Improvements	$168,000
CI	Black Mountain Facility Improvements	$103,000
	Total Priority 1 (rounded)	***$8,214,000***
Priority 2 Improvements		
2.1	Brown Creek Road Distribution Improvements	$490,000
2.2	Naples Zone US-2 Loop	$698,000
2.3	Quail Drive Distribution Improvements	$220,000
2.4	Blue Sky Distribution Improvements	$1,315,000
CI	Priority 2 - Existing Facilities Improvements	$460,000
	Total Priority 2 (rounded)	***$3,183,000***
Priority 3 Improvements		
3.1	Highland Flats Road and McArthur Lake Road Distribution Improvements	$2,083,000
3.2	South Highlands Distribution Improvements	$68,000
3.3	Roman Nose Dr Distribution Improvements	$483,000
3.4	South Naples Distribution Improvements	$2,796,000
3.5	Frontier Village Distribution Improvements	$423,000
3.6	Northeast Paradise Distribution Improvements	$1,498,000
3.7	Coyote Way Distribution Improvements	$450,000
3.8	Pinnacle Circle Distribution Improvements	$695,000
3.9	Cottage Lane Distribution Improvements	$293,000
3.10	Grumpy Lane Distribution Improvements	$291,000
3.11	Northeast Paradise Distribution Improvements	$594,000
	Total Priority 3 (rounded)	***$9,674,000***
	Total Priority 1, 2 & 3 Improvement Costs	**$21,071,000**
Annual Replacement Budget		
	Water Distribution Lines	$286,000
	Fire Hydrants	$25,000
	Water Meters	$13,000
	Well Facilities	$21,000
	Booster Facilities	$26,000
	Storage Facilities	$12,000
	Total Annual Replacement Budget Costs	**$383,000**

Notes*

1) Timing depends on when growth occurs. Development participation anticipated.
2) The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our opinion of probable costs at this time and is subject to change as the project design matures. Keller Associates has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices or bidding strategies. Keller Associates cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented herein.

Distribution Project Title:	Location:
Parker Canyon Tank (260,000 gal) and Remove and Replace Booster Station	**Parker Canyon Road, Existing Site (Booster Station and Tank)**

Project Identifier:

T1.1.2

Objective:
- Provide additional 260,000 gallons of storage at the Parker Canyon site, in the form of a parallel tank
- Remove existing pumps (2) at Parker Canyon Booster station and replace with new booster station above new parallel buried tank (four pumps)

Design Considerations:
- Space considerations and land/parcel acquisition
- Maintain operation during construction
- Enables existing Parker Canyon Tank to be taken offline

General Line Item	Estimated Quantity	Unit	Unit Price	Total Cost (2019 Dollars)
Site Work	1	LS	$20,000	$20,000
Yard Piping (tank connection, overflow line)	1	LS	$35,000	$35,000
12"Pipe to connect to system	140	LF	$70	$9,800
New Buried Concrete Tank	1	LS	$455,000	$455,000
Transducer	1	LS	$6,000	$6,000
Site Fencing	400	LF	$50	$20,000
Access Road Improvements	1	LS	$2,500	$2,500
Additional land for tank	1	LS	$20,000	$20,000
Tank Cost Subtotal				$568,300
New Building (for 4 new pumps)	1	LS	$180,000	$180,000
Generator (175 kW)	1	LS	$60,000	$60,000
Instrumentation (on new pumps)-Flowmeter, Pressure Transducer, Cl Analyzer	1	LS	$20,000	$20,000
Mechnical Piping and Valves	1	LS	$65,000	$65,000
Controls/Electrical/HVAC/SCADA	1	LS	$140,000	$140,000
500 GPM, 400 TDH Booster Pumps	4	EA	$55,000	$220,000
Abandon Existing Booster Station	1	LS	$5,000	$5,000
Booster Cost Subtotal				$690,000
Construction Cost Subtotal				*$1,258,300*
Mobilization, Bonding & Insurance - Percent of Item Cost Sum			10%	$125,830
Contingency			25%	$314,575
Total Construction Costs				*$1,698,705*
Engineering and CMS - % of total construction costs			20%	$339,741
Legal, Admin, and Permitting			4%	$67,948
Total Project Costs (rounded)				**$2,107,000**

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APPENDIX I
2018 FACILITY PLAN

CABINET MOUNTAINS WATER DISTRICT
WATER SYSTEM FACILITY PLAN

December 2018

PROFESSIONAL ENGINEER
REGISTERED
10385
12-15-2018
STATE OF IDAHO
MICHAEL B. KLAUS

TABLE OF CONTENTS

1. WATER SYSTEM OVERVIEW....3
   1.1 Introduction....3
   1.2 System Description....3
   1.3 Water System Components....6
   1.4 Master Planning Criteria....11
   1.5 Definitions....12
2. POPULATION AND WATER DEMANDS....14
   2.1 Population Trends....14
   2.2 County Zoning....19
   2.3 Existing Water Demands....20
   2.4 Water Demand Projections....20
   2.5 Water Supply Limitations....22
   2.6 Customer Water Use Characteristics....22
3. WATER SUPPLY ANALYSIS....24
   3.1 Existing Wells....24
   3.2 Existing Water Quality....25
   3.3 Existing Well Pumps....25
   3.4 Future Supply Options....26
4. WATER STORAGE ANALYSIS....30
   4.1 Components of Finished Water Storage....30
   4.2 Existing Storage Needs....32
   4.3 Future Storage Needs....34
5. DISTRIBUTION SYSTEM ANALYSIS....37
6. PUMP STATION ANALYSIS....50
7. RECOMMENDED IMPROVEMENTS....54
8. CAPITAL IMPROVEMENT PLAN....56
9. WATER RATES....58
10. DISTRICT STAFFING....59
APPENDIX A – WELL LOGS....60

1. WATER SYSTEM OVERVIEW

1.1 Introduction

This document is intended to provide an overview of the existing Cabinet Mountains Water District (CMWD) system and an analysis of existing deficiencies and future needs. The water system serves a large area, from the Kootenai River extending as far south as the Bonner County line, adjacent to Mc Arthur Reservoir (Figure 1-1).

The CMWD system was first organized in 1994, with by-laws being promulgated and adopted in accordance with Idaho Code Section 42-3212, on November 2, 1994. The goal of the original Board was to create a system that provided water to a large number of county residents who were without a reliable water source.

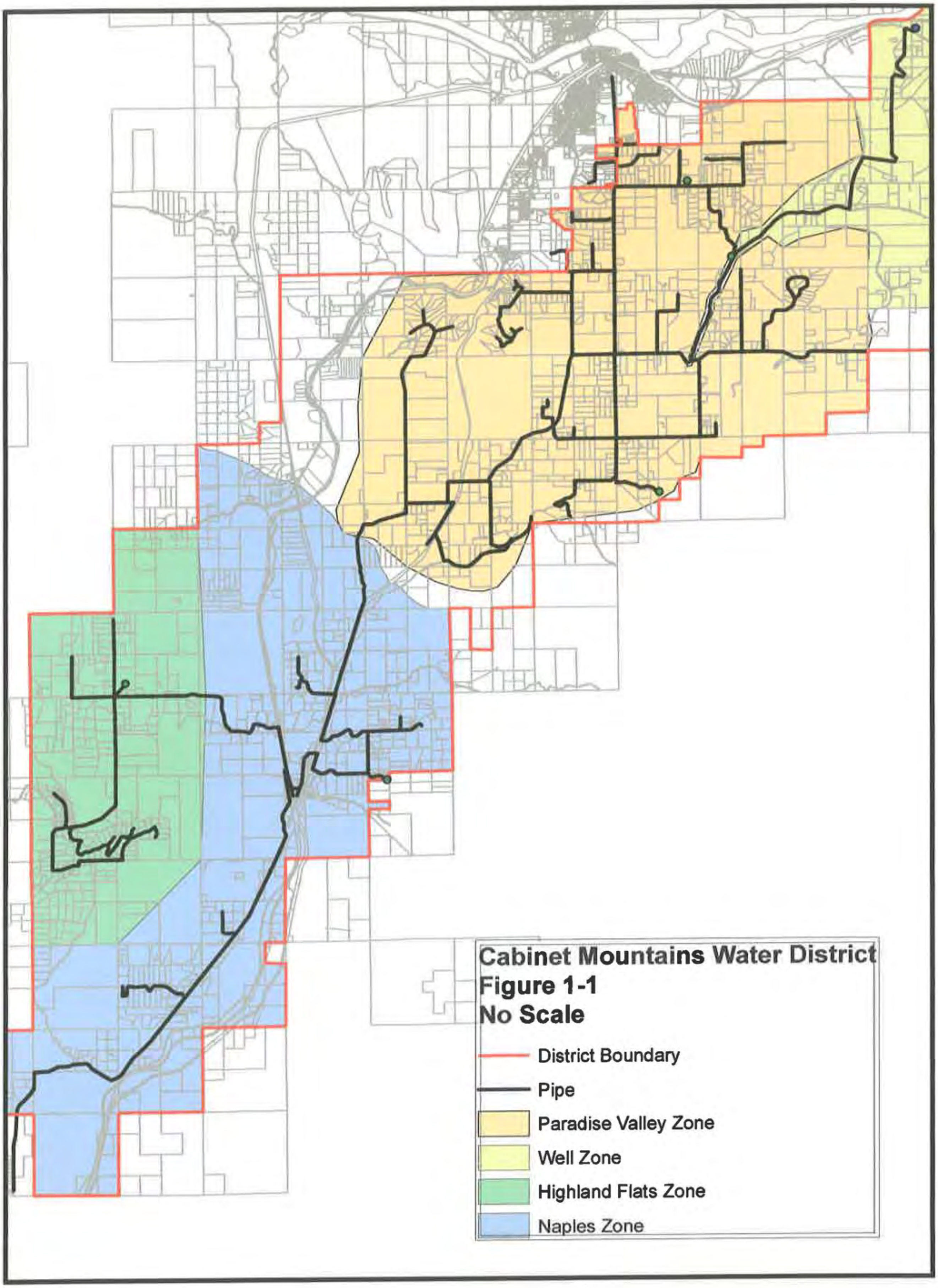
Many people in the current service area were either connected to an inadequate source or were hauling water to their residence. The new system helped many people substantially by providing them with safe drinking water. The system was not designed or constructed with the intention of providing fire flow.

This master plan focuses a 20-year planning period from 2018 to 2038.

1.2 System Description

The system is served with two groundwater wells near the Kootenai River, three storage tanks, five booster stations, and over 75 miles of water main. Currently, the system serves 898 accounts with approximately 759 active connections.

The most challenging features of the system are topography and small distribution main sizes. The elevation of the well house adjacent to the Kootenai River is approximately 1830, while the Paradise Valley bench exists at the 2300 foot level. In addition, from Paradise Valley to McArthur Reservoir, the service area drops and rises 300-400 hundred feet several times. The operational challenge lies in providing adequate pressure in the higher elevations of the system, while keeping the lower areas from being over-pressurized. Many services in the lower elevations of the system have individual pressure reducing valves installed adjacent to their meters to maintain pressures below State maximums. Additionally, the water system is challenged by miles of mains that are too small to provide the flow necessary to particular service areas.


Cabinet Mountains Water District
Figure 1-1
No Scale
District Boundary
Pipe
Paradise Valley Zone
Well Zone
Highland Flats Zone
Naples Zone

The water system is separated into four different pressure zones that are also shown in Figure 1-1. Below is a description of each zone:

Well Zone:

This zone exists between the wells and the Parker Canyon booster station. The pressure in this zone is sustained by the static level in the reservoir below the Parker Canyon booster station. However, significant variations in pressure occur in this zone when the well pumps cycle on and off. The Parker Canyon booster station provides water to each zone since it is the sole link between the wells and the remainder of the system.

Paradise Valley Zone:

The Black Mountain area, Paradise Valley, and Pleasant Valley are provided water from the Black Mountain tank and booster station. Upgrades to this zone in 2008 increased the pressure significantly. The zone is fed directly by the Parker Canyon booster station when the Naples tank or Black Mountain tank is filling. When the Black Mountain tank level controls call for water, two functions occur simultaneously; an automated valve at the Black Mountain booster station opens and a pump at Parker Canyon is energized to fill the tank.

Once the Black Mountain tank is filled, the automated fill valve in the black Mountain Booster station closes and the Parker Canyon pump shuts off if the Naples Zone is not also calling for water. After tank filling, the Black Mountain booster station begins operation by pumping water back into the zone producing an additional 30 - 35 psi, depending on the season. This operation provides at least 40 psi at locations near Black Mountain, south Paradise Valley, and Pleasant Valley, where pressures were previously inadequate.

Naples Zone:

The Naples zone covers the largest land area within the District and is fed from the Parker Canyon station through the Paradise Valley zone. An automated Pressure Regulating Valve (PRV) station in south Pleasant Valley opens when the Naples tank controls provide a signal to the telemetry system, indicating a low tank level. When the control valve in the PRV station opens to fill the Naples tank, one of the pumps at Parker Canyon is energized and operates until the tank is full. The PRV also serves the Paradise Valley zone by providing back pressure within that zone to sustain the additional 30-35 psi developed by the Black Mountain booster station. It is important to note that CMWD serves the Naples Elementary School within the Naples zone. Providing water to Naples school was a very important aspect of the original water system construction in the mid-1990's, since the project supplied a safe and reliable source of water to the school.

Highland Flats Zone:

Highland Flats is an elevated area to the west of Naples that is fed by the Naples zone. An 8-inch main from Naples provides service the Highland Flats area. A booster station is located on the Highland Flats bench after the main reaches the top of the hill.

Emergency Connections to CMWD:

Cabinet Mountains Water District maintains a connection to the City of Bonners Ferry that can currently provide up to 300-gpm to the City, depending on the season and demands in Paradise Valley. This connection is 10-inches in diameter at the City where it enters the City property. The City connection is provided through the Paradise Valley zone, at the northernmost point along Cottage Lane. Emergency flow available to the City is directly dependent upon demands within that zone at the time and is typically delivered through the Parker Canyon Booster Station.

CMWD also provides water to Paradise Valley Water Association (PVWA) during emergencies. The District provides emergency flow through a connection to the Paradise Valley Booster Station. The pumps at the Paradise Valley Booster Station have the ability to deliver water to PVWA through a 4-inch main, and also to pump water to CMWD's north part of Paradise Valley.

1.3 Water System Components

This section is intended to provide a brief overview of the existing system components that are used to deliver water to District customers. Greater detail for these systems will be provided specifically in later chapters.

Wells

The Districts two existing wells are drilled into fairly porous material adjacent to the Kootenai River at Crossport. Both wells are capable of delivering 575-gpm individually. The combined simultaneous discharge of the both wells is approximately 900-gpm.

Storage Systems

Three storage tanks exist within the CMWD water system. The first storage tank is located below the Parker Canyon booster station. The 40,000 gallon tank has two purposes; it provides a location for the booster pumps to draw from and it also serves as storage to the Well Zone located between the wells and Parker Canyon.

The Black Mountain tank is a rectangular concrete tank with a maximum volume of 180,000 gallons that is partially buried. As discussed earlier, the tank also has a booster station located directly adjacent to it that boosts the pressure to the Paradise valley zone.

The Naples Zone is served by another 180,000 gallon tank, at maximum volume, that is identical in size and construction to that of the Black Mountain tank. The total storage volume of the system is 400,000 gallons, if the tanks are operated to their fullest possible levels.

Booster Stations

Parker Canyon booster station is a pivotal facility that transfers water to most of the water system. The station includes two pumps that are individually capable of delivering over 575-gpm individually. The two pumps deliver approximately 700-gpm when operating together. Each pump is driven by a 75-hp motor equipped with a variable frequency drive (VFD). The Parker Canyon station is also equipped with a back-up generator to provide power to the pumps in the event of a power outage. This station is equipped with a back-up generator.

The *Paradise Valley* booster station was constructed in 2005 to increase pressure in the Paradise Valley area prior to construction of the Black Mountain booster station. The pumps in the Paradise Valley station are primarily used to deliver water to the Paradise Valley Water Association when that system experiences high turbidity events. Paradise Valley Booster Station also provides the District staff with a central location to view system operations on the computer. This station is equipped with a back-up generator, that only provides power to the computer and control system, not the pumps.

The *Black Mountain* booster station, located adjacent to the Black Mountain tank, has three variable frequency pumps. The pumps were designed to deliver water to customers in south Paradise Valley and Pleasant Valley. This station is also equipped with a back-up generator.

A small booster station is located adjacent to the *Naples* tank. This station has a single pump with two pressure tanks that provide service to three customers that are located close to the tank, at nearly the same elevation.

The *Highland Flats* booster station contains two variable frequency drive pumps that deliver water at a steady pressure of 67 psi.

Most of the pumps in each of the stations provide adequate flow and pressure to each zone, with the exception of the Paradise Valley station. The north Paradise Valley area is more limited by distribution hydraulic friction than pumping capacity. The bulk of the connections in north Paradise Valley are located three to four miles north of the pump station, with delivery through a single 6-inch main. Once demands exceed 300-gpm in north Paradise Valley, the delivery pressure deteriorates rapidly because of excessive pipe friction.

Distribution System

The main trunk line for the Cabinet Mountains system is a 10-inch main that extends from the well house to Parker Canyon, through the Paradise Valley zone, continuing to the Naples tank. Figure 1-2 shows the current District's distribution system.

Table 1-1 summarizes the approximate length of distribution piping for CMWD:

TABLE 1-1 – CMWD Water Main Lengths	
Water Main Diameter	**Water Main Lengths (miles)**
2-inch	0.59
4-inch	0.04
6-inch	36.82
8-inch	21.86
10-inch	16.33
Total	**75.64**

The District has had pressure and flow problems that have been attributed to inadequate main sizing, unexpected growth in specific locations, and the lack of water main looping. A hydraulic model was assembled for the District to identify solutions to several flow and pressure problems. The model can also be used to estimate the flows and pressures that can be expected in proposed mains installed by developers or the District.

Water System Controls

The hydraulic grade line (HGL) for most water systems is driven by a tank level within the system. The HGL determines the pressure for any given location within a system and is directly related to the difference in elevation between the tank level and the elevation any location within the service area. However, CMWD provides water to several areas that utilize booster pumps instead of tank level to deliver adequate pressure. Providing service pressure in this manner requires a greater level of monitoring and control than a system that is served directly by a storage tank.

The primary control components of the CMWD system are Programmed Logic Controllers (PLC's) at each of the systems main pumping facilities. The District installed Rugid 9 Remote Telemetry Units (RTU'S) for system controls when the water system was first constructed. The District found the Rugid equipment to be difficult and expensive to work with; for District staff as well as experienced programmers. For this reason, the District has upgraded their controls by replacing PLC's at each of the District's stations to Allen-Bradley Compact Logix or MicroLogix. The PLC upgrades were completed in 2011.

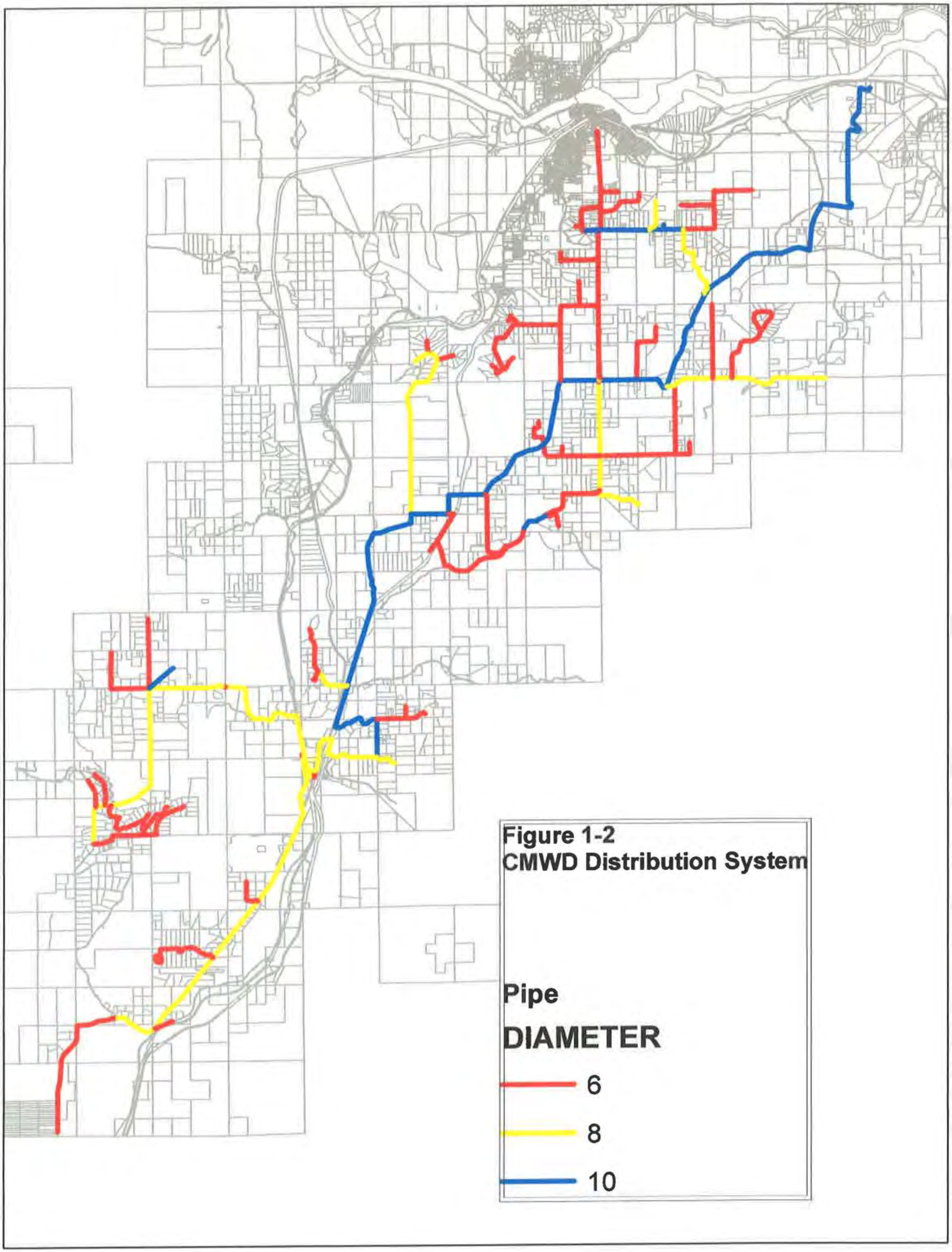


Figure 1-2
CMWD Distribution System
Pipe
DIAMETER
6
8
10

1.4 Master Planning Criteria

Water system operating criteria must be established to provide benchmarks that reflect the Districts goals for service. Some criteria must also be met in order to meet State requirements established by the Idaho Department of Environmental Quality and the Idaho Department of Water Resources. Table 1-2 shows a list of water system criteria that will be used in evaluating existing levels of service as well as making recommendations for improvements.

TABLE 1-2: Water System Operating/Design Criteria

Component	Criteria
Water Supply	Provide Maximum Day Demand (MDD) with largest source out of service
Pump Stations	Provide MDD with largest pump out of service
Minimum Main Size	8-inch diameter
Minimum Design Pressure	40 psi measured at main
Fireflow	250-gpm (existing goal)
Storage	Two average day volumes for emergencies, equalization, and fire flow volume.

This master plan will utilize the basis that emergency storage is equal to two average days demand volume, as selected by the District Board. The assumed fire flow volume will be equal to a two-hour event at 250-gpm, or 30,000 gallons in each zone.

The Idaho Department of Environmental Quality has several other operational requirements for public water systems, with a few of the applicable standards for CMWD listed below:

- Minimum Capacity. The capacity of a public drinking water system shall be at least eight hundred (800) gallons per day per residence.

- Minimum Pressure. Public water systems or service areas of public water systems, constructed after July 1, 1985 shall maintain a minimum pressure of forty (40) psi throughout the distribution system, during peak hour demand conditions, excluding fire flow, measured at the service connection or along the property line adjacent to the consumer's premises.

- Maximum Pressure. Any public water system shall keep static pressure within the distribution system below one hundred (100) psi and should ordinarily keep static pressure below eighty (80) psi. Pressures above one hundred (100) psi shall be controlled by pressure reducing valve stations installed in the distribution main. In areas where failure of installed pressure reducing valve stations would result in extremely high pressure, pressure relief valves may be required. The Department may approve the use of pressure reducing devices at individual service connections on a case by case basis, if it can be demonstrated that higher pressures in portions of the distribution system are required for efficient system operation. If system modification will cause pressure to routinely exceed eighty (80) psi, or if a check valve or an individual pressure reducing device is added to the service line, the water system owner shall notify affected customers. Notification may include reasons for the elevated pressure, problems or damage that elevated pressure can inflict on appliances or plumbing systems, and suggested procedures or mitigation efforts affected property owners may initiate to minimize problems or damage.

- Individual Booster Pumps. The Department may allow the installation of booster pump systems at individual service connections on a case by case basis. However, such an installation may only occur with the full knowledge and agreement of the public water system, including assurance by the water system that the individual booster pump will cause no adverse effects on system operation or public health.

1.5 Definitions

Several terms and acronyms will be used throughout the remainder of this document, and warrant definition. Below are some of the terms that will be used:

Equivalent Residential Unit (ERU), an ERU is a unit of measure equivalent to the water usage of a typical single-family residential connection within a particular system. All other non-residential usages are attributed an equivalent number of ERU's based on its usage relative to a typical single-family connection.

Average Day Demand (ADD), typically expressed in gallons per average day per ERU (gpd/ERU).

Maximum Day Demand (MDD), typically expressed in gallons per peak day per ERU (gpd/ERU).

Peak Hour Demand (PHD), typically expressed in gallons per minute for the total system, or for specifically defined pressure zones within a system (gpm)

Hydraulic Grade Line (HGL), is the water level in an unpressurized tank or the level that water would rise to in a small vertical tube connected to a pressurized pipe

Gallons Per Minute – GPM

Gallons Per Day - GPD

Idaho Department of Environmental Quality- IDEQ, the state agency that has primacy over the drinking water program in Idaho, as delegated by the Environmental Protection Agency.

2. POPULATION AND WATER DEMANDS

2.1 Population Trends

The growth rate of Cabinet Mountains Water District has been steady since District formation. Table 2-1 shows the number of connections for the beginning of 2005 through the beginning of 2018. A forecast of water demands throughout a distribution system is dependent on an estimation of three key parameters – the number of water users, the type of water use, and the amount of water each member of a particular water user group is likely to consume. This section describes the projection of water use and population projections that will become the basis for developing the water demand projections and directly affects Capital Improvement Plan later in this document.

TABLE 2-1: District Accounts 2005-2018	
Date	**# of Accounts**
January 1, 2005	682
January 1, 2006	705
January 1, 2007	800
January 1, 2008	833
January 1, 2009	853
January 1, 2010	857
January 1, 2011	858 [1]
January 1, 2012	861
January 1, 2013	865
January 1, 2014	872 [2]
January 1, 2015	879 [2]
January 1, 2016	885 [2]
January 1, 2017	891
January 1, 2018	895

1. Four new connections were installed in 2010; however, three existing accounts were abandoned in that same period.
2. Estimated numbers.

As the table indicates, 95 connections were purchased in 2006. It is important to note that several subdivisions were applied for in 2006. Many of the lots subdivided at that time are not actively using water today. Based on available data it is difficult to determine exactly how many of the purchased connections were active during each of the years listed above. However, the District currently has approximately 759 active connections at this time (July 2018).

Table 2-2 shows the number of active and total connections to the CMWD system in each hydraulic zone, in 2017. It is important to note that 139 paying customers exist that are not currently using water. This creates some planning difficulty since it is not known when these customers will become active water users.

TABLE 2-2: 2017 Service Connections			
Zone	Active Connections	Total Accounts	Difference (Currently Unused)
Well Zone	23	23	0
Paradise Valley Zone	421	527	106
Naples Zone	215	237	22
Highland Flats Zone	100	111	11
Paying/Unconnected		15	15 [1]
Totals	**759**	**898**	**139**

[1]These numbers are included in the Paradise Valley zone since they will be connected in that zone. These numbers were updated in July 2018.

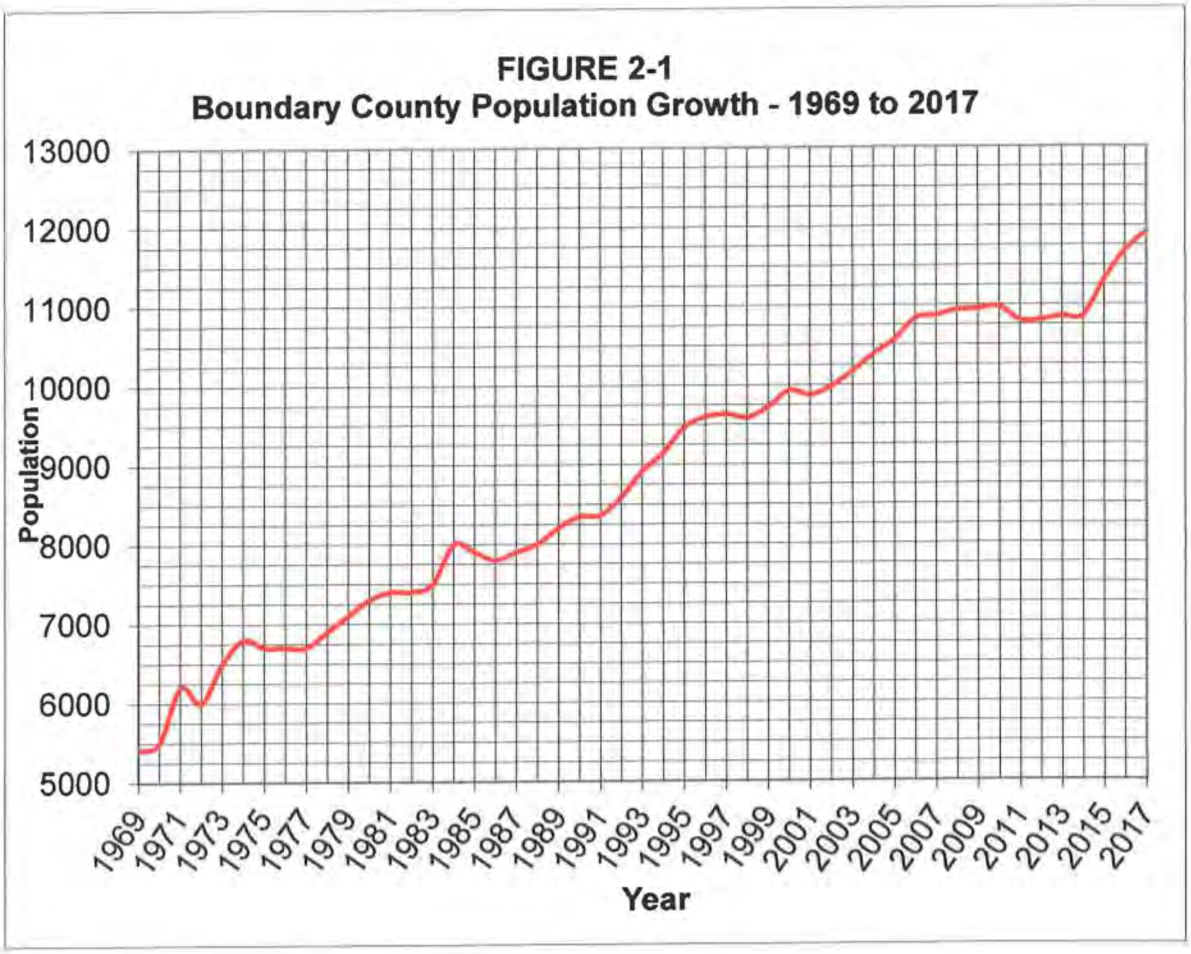
Table 2-2 illustrates which zones in the system that has the greatest potential for putting further demands on the system. The Paradise Valley Zone has the greatest number of accounts that do not currently use water at 106, while the Well Zone has no inactive accounts. Considering the large area served in the Naples Zone, there are relatively few inactive accounts at 22.

Highland Flats shows a small number of accounts not using water, however, the Meadow's at Fall Creek subdivision has the potential for serving up to 42 connections. The subdivision was constructed with water stubs under the roads so that water meters could be installed easily.

For planning purposes it is important to know the current number of active water connections, and an accurate growth rate. The growth rate for Boundary County was used in determining the growth rate for future active connections for CMWD. Data collected from *City-Data and the US Census Bureau*, provided a list of population values for the years 1969 to 2016. Figure 2-1 shows the population growth for Boundary County based on the collected data, while Figure 2-2 shows an algebraic trend line for growth. The average number of people per household in Boundary County is 2.47, based on 2010 US Census data.

The goal of identifying the County growth rate trend is to establish a correlation between population growth and water service growth. The County growth rate was utilized by creating a trend line that could be extended into the future. Figure 2-3 shows the expected connection growth trend for CMWD, based on three possible growth rate projections; linear, 1.5%, and 2.0%. The CMWD board has recently adopted a projected growth rate of 1.5%.

Boundary County's current comprehensive plan states that from 1969 to 2003, the county experienced an average annual growth rate of 1.91%. From 2003 to 2006, Boundary County experienced substantial growth that far exceeded the previous trend. The equation developed in Figure 2-2 was used in Figure 2-3 to estimate connection growth rate based on a linear function.



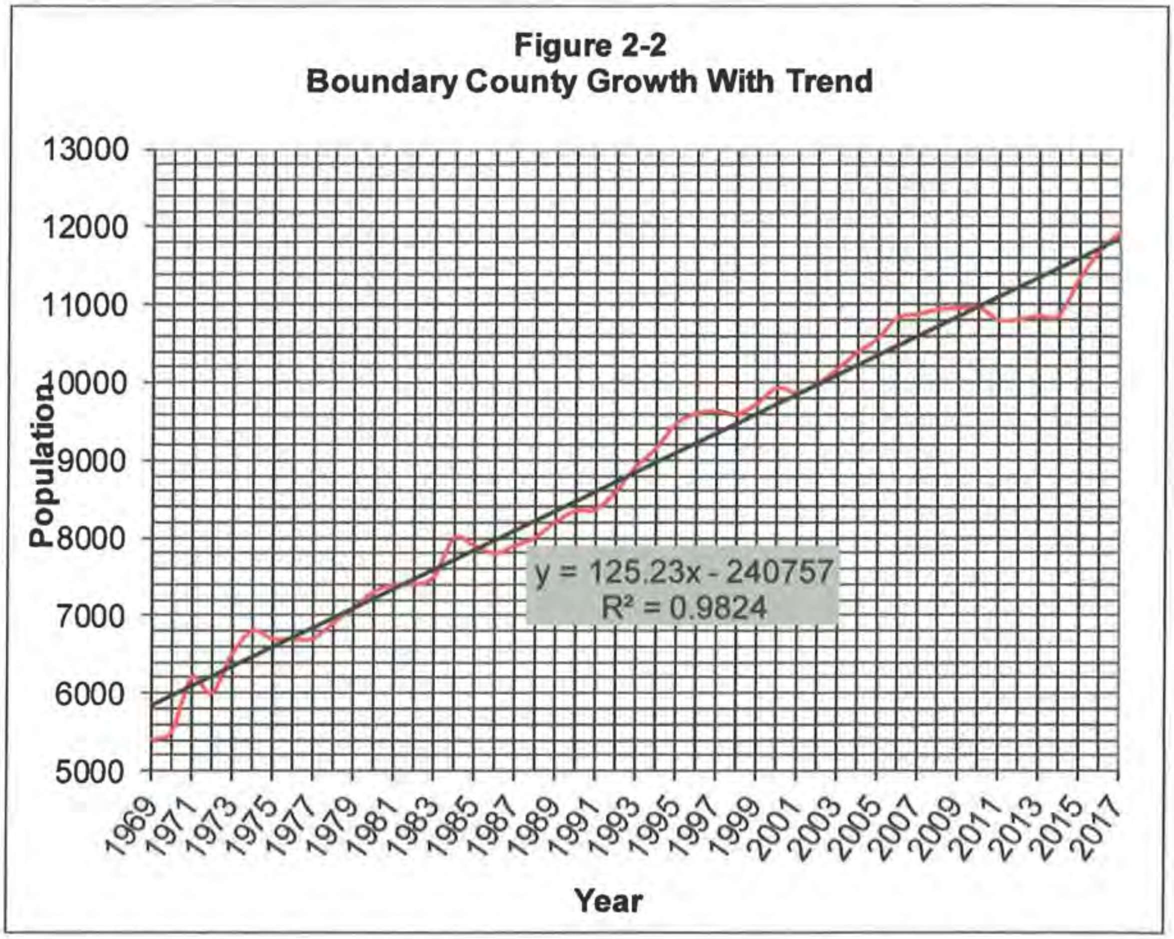


Figure 2-2
Boundary County Growth With Trend
13000
12000
11000
10000
9000
8000
7000
6000
5000
Population
y = 125.23x - 240757
R² = 0.9824
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
2017
Year

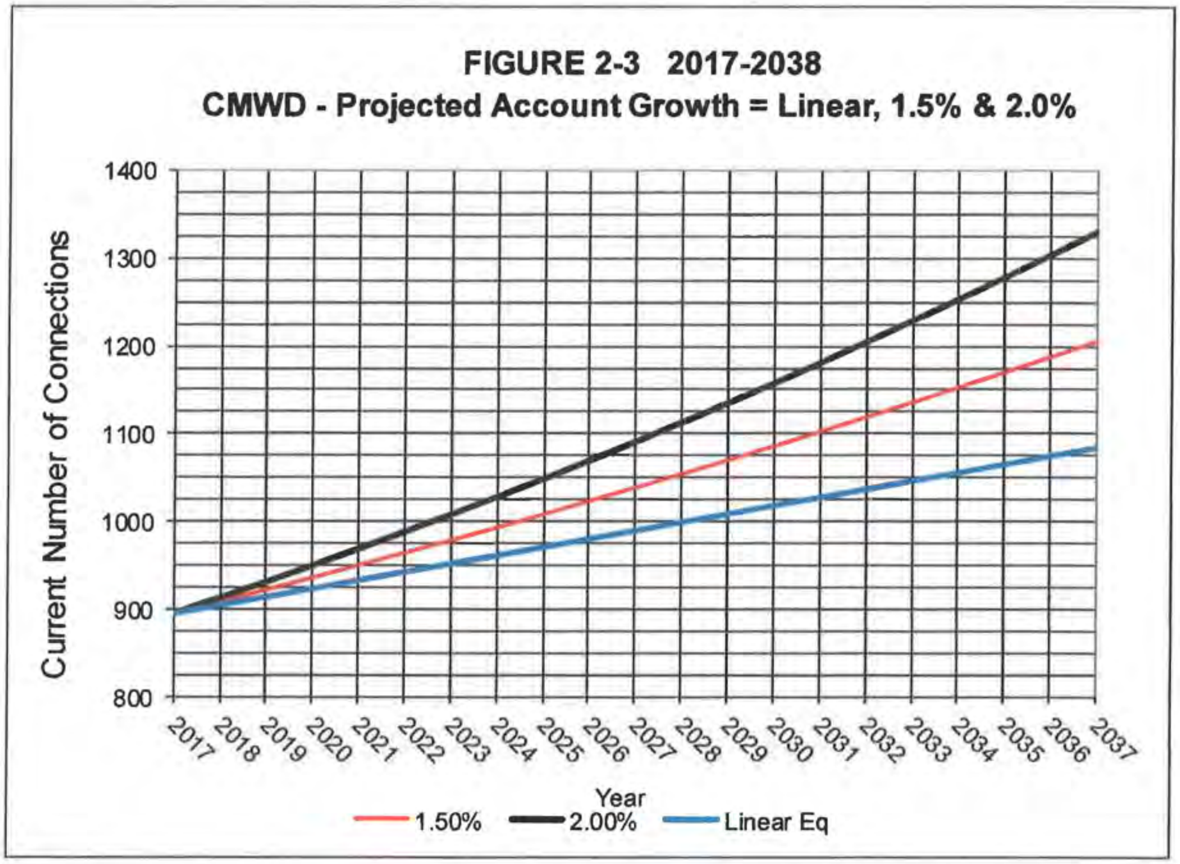


Table 2-3 shows the anticipated growth of the numbers of total purchased accounts and the number of anticipated active users, based on a 1.5% growth rate between 2018 and 2038. The lowest trend line (blue) indicates the linear growth rate estimate based on the equation in Figure 2-2, while the middle line (red) shows the 1.5% growth trend. The top trend line (black) illustrates the 2.0% growth projection.

Table 2-3 Anticipated Account Growth at 1.5%		
Year	Anticipated Total Accounts (1)	Anticipated Active Accounts
2018	908	759
2019	922	773
2020	936	786
2021	950	800
2022	964	815
2023	979	829
2024	993	844
2025	1008	859
2026	1023	874
2027	1039	889
2028	1054	905
2029	1070	921
2030	1086	937

2031	1102	953
2032	1119	970
2033	1136	986
2034	1153	1003
2035	1170	1021
2036	1188	1038
2037	1205	1056
2038	1224	1074

Note (1): Some of the numbers for 2018 are estimated, end of year expectations.

It is difficult to forecast how many inactive accounts will become active during the planning period. It is recommended that the District monitor active account growth closely since only the active accounts use water.

2.2 County Zoning

It is important for planning purposes to recognize and understand what the current and future County Zoning is within the District. Table 2-4 shows the current zones within the District boundaries and what that zoning allows for growth density. The list below is related to the County's zoning map update of 1/24/2018, and the current zoning designations found on the Boundary County website as of September of 2018.

TABLE 2-4: Existing Zoning within District	
Zone	**Allowed Density**
Rural Community Commercial	4 businesses or residences per acre
Rural Residential	1 single family residence per 5 acres
Agriculture/Forestry	1 single family residence per 10 acres

Other County zoning categories exist, but the three listed above are predominantly within the District's service area. The zoning within most of Paradise Valley is Rural Residential, which allows for 1 residence per 5 acres. Much of the service area south of the Paradise/Pleasant Valley area is shown as Agriculture/Forestry which allows for 1 residence per 10 acres. Naples also includes a zone called Rural Community Commercial.

For planning purposes, each single family residence list in Table 2-4 is assumed to be equal to one Equivalent Residential Unit (ERU), as discussed in Chapter 1. Each business needs to be evaluated on a case-by-case basis to determine how many ERU's need to be attributed to that particular use.

It is not recommended to use County zoning as a sole basis for determining how demands should be allocated across the system. Boundary County subdivision approvals can happen almost anywhere within the District's service area, creating much larger demands per unit area, than would be produced if the current zoning densities were followed.

2.3 Existing Water Demands

Water demands are typically expressed in three ways; average day demand (ADD), maximum day demand (MDD), and peak hour demand (PHD). Data were obtained from District staff to determine the current ADD and MDD values. The peak hour demand was calculated from Equation 5-3 taken from the Washington Department of Health Water System Design Manual, using applicable values in that manual.

The maximum water use recorded for the CMWD was in 2017, between July 6th at 7:15 am and July 7th at 11:15 am. The total volume produced at the well house in that timeframe was 821,000 gallons, or an average production rate of 488 gpm. When the flow rate of 488 gpm is applied to a 24-hour day the current maximum day is 703,000 for CMWD.

With 759 current connections, each connection uses an average of 926 gallons per day (GPD) on a maximum day. The total number of current accounts is 898, which means the District has 139 accounts sold that are not yet using water. If all of the current accounts were using water, and the average of 926 GPD/Connection was applied, 832,000 gallons would be needed to meet system demands on a maximum day. The District's current firm capacity is 828,000 gallons per day, based on removing the largest source from service.

It is important to note that the District temporarily stopped selling new connections to the water system, beginning on August 14, 2018, because all of the existing source capacity has been allocated, as shown above.

Table 2-5 shows the 2017 values for ADD, MDD, and PHD values for Cabinet Mountains Water District.

Table 2-5: Existing CMWD Demands		
Average Day Demand (gal/day/ERU)	Maximum Day Demand (gal/day/ERU)	Peak Hour Demand (gpm)
395	926	944

2.4 Water Demand Projections

Table 2-6 shows the projected values for anticipated service connection growth, average day demand, and maximum day demand, from 2018 to 2038. Values in the table indicate the expected volumes of water that will be used system-wide based on a 1.5% growth rate for active connections. Table 2-7 shows the projected demands on a gallons per minute basis.

Table 2-6: Projected CMWD Demands

Year	Active Service Connections	Average Day Demand (gal/day)	Maximum Day Demand (gal/day)
2018	759	300,000	703,000
2019	773	305,386	715,621
2020	786	310,853	728,431
2021	800	316,401	741,434
2022	815	322,033	754,631
2023	829	327,750	768,027
2024	844	333,552	781,623
2025	859	339,441	795,424
2026	874	345,419	809,431
2027	889	351,486	823,648
2028	905	357,644	838,079
2029	921	363,895	852,726
2030	937	370,239	867,593
2031	953	376,678	882,683
2032	970	383,215	897,999
2033	986	389,849	913,545
2034	1003	396,582	929,325
2035	1021	403,417	945,340
2036	1038	410,354	961,596
2037	1056	417,395	978,096
2038	1074	424,542	994,844

Table 2-7: Projected CMWD Demands (GPM)

Year	Average Day Demand (GPM)	Maximum Day Demand (GPM)	Peak Hour Demand (GPM)
2018	208	488	944
2019	212	497	958
2020	216	506	972
2021	220	515	987
2022	224	524	1001
2023	228	533	1016
2024	232	543	1031
2025	236	552	1047
2026	240	562	1062
2027	244	572	1078
2028	248	582	1094

2029	253	592	1110
2030	257	602	1127
2031	262	613	1143
2032	266	624	1160
2033	271	634	1178
2034	275	645	1195
2035	280	656	1213
2036	285	668	1231
2037	290	679	1249
2038	295	691	1268

2.5 Water Supply Limitations

Standard practice for evaluating source capacity includes calculating the production of the pumping system with one source out of service. Both well pumps are capable of 575-gpm individually. Assuming a 24-hour operational day, both wells are capable of providing 828,000 gallons per day (GPD).

The well house is located at approximately 1830 feet elevation, while most customers are located at elevations ranging from 2000 to 2300 feet in elevation. The Parker Canyon pump station is an intermediate station located at approximately 2100 feet in elevation that receives water from the wells and re-pumps it to the larger part of the system. Twenty-three customers are located between the well house and the Parker Canyon station and make up just 3% of the systems active users. Flow and pressure is provided to those customers from a 40,000-gallon storage tank located directly below the Parker Canyon station.

The same pumping criteria used for the well supply capacity will be used for determining the Parker Canyon capacity. Both of the two pumps at Parker Canyon are capable of delivering 575-gpm, or 828,000 gallons per day each. With one pump out of service, the firm capacity of the station is 828,000 gallons per day. The District has worked to add pumping capacity at Parker Canyon to match the capacity of the well house.

2.6 Customer Water Use Characteristics

Estimating future water use is a straight-forward analysis if water user behavior is consistent. While this report shows anticipated water use for the next 20 years, projections are based on water statistics of the past. If the behavior of a typical water user changes significantly demands on the system could change drastically. The CMWD rate structure charges on a tiered rate above 12,000 gallons of use. The tiered rate structure likely provides the greatest incentive for keeping most customer demands from climbing at a greater rate.

Noteworthy, is the change in customer water use in a relatively short period of time. Prior to 2015, the maximum water use day totaled approximately 500,000 gallons in one day. At that time, the approximate number of active customers was 700. At 500,000 gallons per day and an estimated 700 active users, the maximum day use per account is 714 gallons per day (500000/700=714). The water use on a maximum day has increased over 200 gallons per day per customer. This is a substantial change in water use.

3. WATER SUPPLY ANALYSIS

3.1 Existing Wells

The District's well sources are located near Crossport, approximately 800 feet south of the Kootenai River. Three wells were drilled at this location in 1995 by H2O well service.

All three wells were constructed with 12-inch casings. Wells #1 and #2 are currently used by the District, while the Well #3 casing was apparently damaged during drilling, but may possibly be used in the future. Wells #1 and #2 are approximately 16 feet apart and located in the well house at Crossport, while well #3 is located approximately 10 feet south of the other two wells. Table 3-1 lists the well data for the District's wells.

TABLE 3-1: CMWD Well Information

Well #	1	2	3
Completed Well Depth	150 feet	150 feet	150 feet
Casing Diameter	12-inch	12-inch	12-inch
Well Seal Depth	18 feet	18 feet	18 feet
Well Seal Diameter	18-inch	18-inch	18-inch
Well Seal Material	cement	cement	Cement
Screen Diameter	12-inch	12-inch	12-inch
Screen Length	20 feet	20 feet	20 feet
Screen Location	128-148 feet	128-148 feet	128-148 feet
Screen Slot Size	80	80	100
Static Water Level (below ground)	60 feet	60 feet	60 feet
Pump Test Rate	800-gpm	500-gpm	1000-gpm
Pump Test Duration	6-hours	Data not available	Data not available
Drawdown	0.2 feet	Data not available	Data not available

According to the well logs and testing information provided by H2O Well Service, wells #2 and #3 were air tested for flow, but not actually pumped to determine production and drawdown. If well #3 is to be considered for future use, it will be necessary to camera the well to look at the condition of the casing and the screen, to verify that it is acceptable for use. **Appendix A** contains the well logs for all three of the District's wells, as well as the District's water rights information.

Table 3-2 summarizes the District's Water Right information:

Table 3-2: CMWD Water Right Information	
Water Right Number	98-7750
Priority Date	3/24/1995
Permit Proof Date	12/15/2000
Licensed Date	1/27/2009
Diversion Rate	2.0 Cubic Feet per Second (897-gpm)
Water Right Type	Municipal

The District's water right allows them to pump 897-gpm to the system, or up to 1.29 MGD (million gallons per day).

3.2 Existing Water Quality

The District is required to perform several water tests each year to monitor the quality of water pumped from the wells. Each month the District takes two coliform bacteria samples within the distribution system. Coliform bacteria is considered an indicator organism that , if present, warrants further testing to determine if E.coli or fecal coliform is also present. Water which contains either total or fecal coliform, or E.coli are more likely to contain disease causing organisms, and should not be used for drinking, personal hygiene, or in the preparation of food.

Sampling in 2009 from the District's wells show that the calcium hardness levels are approximately 186 mg/L, or 186 parts per million. The hardness levels cause customer complaints regarding calcium deposition in household pipes and fixtures. Test results for nitrates in 2017 yielded results of 0.80 mg/L, which is much lower than the maximum contaminant level (MCL) of 10.0 mg/L.

3.3 Existing Well Pumps

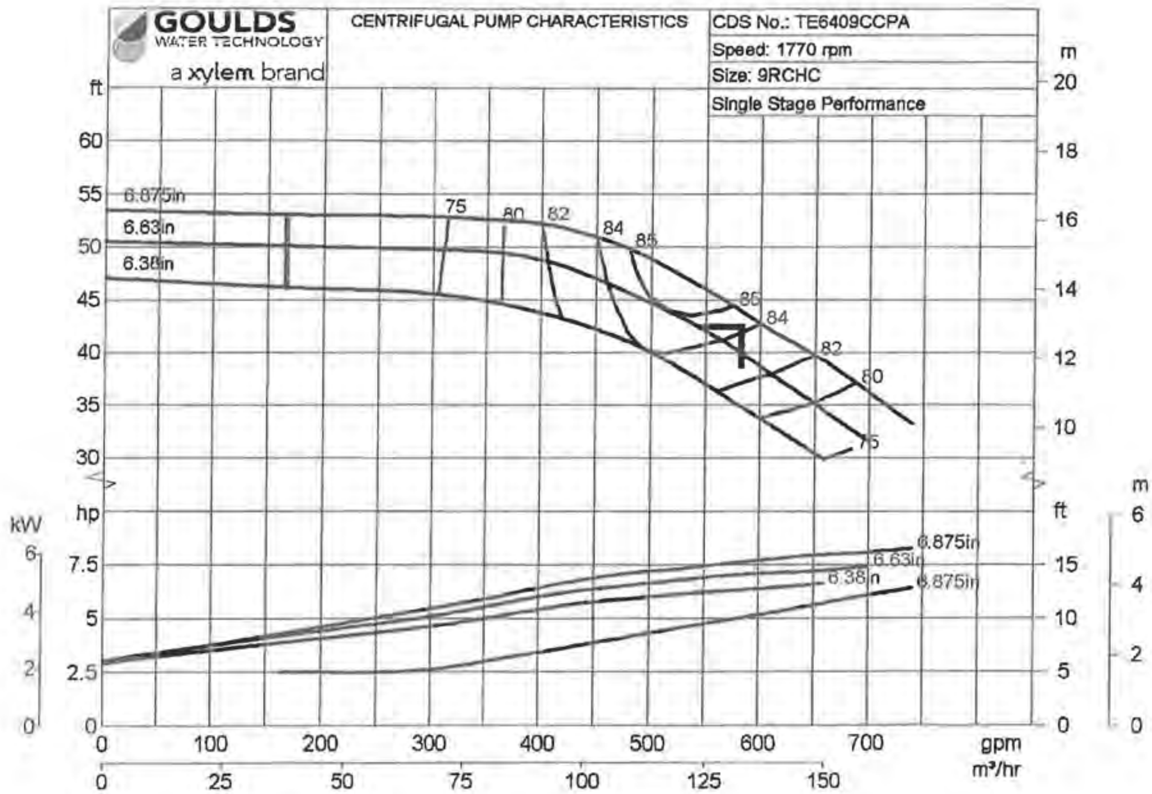
The well house contains two vertical line shaft turbine pumps that are located in each of the District's current wells. Table 3-1 summarizes the construction of each well, while this section describes the well pump systems.

In November 2012, well pump #2 was replaced, while well pump #1 was replaced in 2015. The following components were included in the new pump installation:

1. 6-inch column piping.
2. Pump shaft
3. Stuffing box and packing
4. Motor
5. Top shaft and motor coupling.

Figure 3-1 shows the pump curve for both well pumps. **Appendix B** includes more detailed information about the new well pumping systems.

FIGURE 3-1: Pump Curves for Existing Well Pumps #1 & 2



3.4 Future Supply Options

One of the district's goals is to provide additional water sources outside of the Well Zone. Currently, the District is planning to drill a new well in the Paradise Valley

Zone on the northeastern edge of the system near the intersection of Kootenai Trail Road and Cow Creek Road as shown in Figure 3-2.

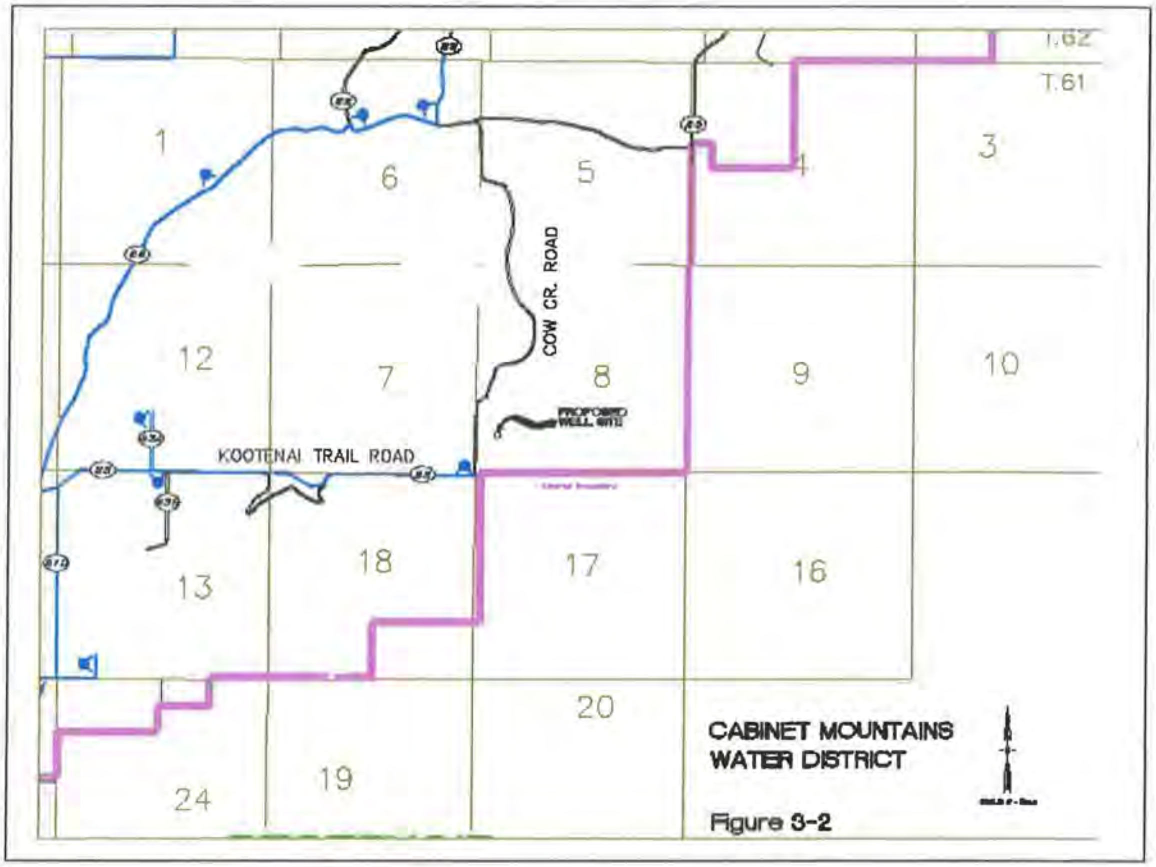


Figure 3-2

New well

The District recognizes the current need for additional source water based on the following:

1. The District often needs to utilize its entire water right (2.0 CFS) instantaneously, when pumping on peak days in the summer. An additional source and water right would help attenuate peak hour demands.
2. The District's current wells are in the same aquifer and are located only 10 feet apart. If the aquifer were contaminated, the District would be completely without water. The Burlington Northern Railway operates directly north of the District's well site (approx. 500-feet away), and ships several loads of crude oil past the site every day. A derailment could easily contaminate the aquifer.
3. The City of Bonners Ferry is the only feasible alternative source that CMWD could utilize, with the addition of a booster station adjacent to the City's Hoover tank.

The District has been approved for an *Application for Transfer of Water Right*, with the Idaho Department of Water Resources, to add an additional *Point of Diversion*. With that approval, the District is now allowed to drill a new well and be able to use part of the existing water right of 2.0 CFS from the new well, but will not be allowed to exceed that rate from any combination of the wells instantaneously. The District has also been given IDEQ approval to drill the proposed well.

The District purchased the well site parcel in 2017, and anticipates drilling additional wells on the lot in the future. Any wells drilled on this site will deliver water to the Black Mountain tank, which also has the ability to provide water to the Naples tank, if programmed to do so.

If additional groundwater is available at the new well site, the only hindrance to developing more than one well at this location is the availability of three-phase power. Currently, single-phase power is available to the newly purchased well lot. Northern Lights service power to the site can be upgraded to three phase power in the future, which would help provide the power needed to additional wells.

Crossport Well Expansion

The option of adding a submersible pump to the third existing well at Crossport is also a potential solution for providing additional source water to the system. While that option would not give the District an alternate source in another aquifer, it would provide additional supply to the system.

Using the Crossport option would also require an additional pump at the Parker Canyon booster station, in order to provide the entire system with the benefit of additional water. With an additional well in use, the well house could produce a total of 700 gpm with the largest pump out of service. This pump rate equates to approximately 1,000,000 gallons of daily production, which would be a capacity increase of 172,000 gallons per day.

A smaller pump at the well house and Parker Canyon could also provide a more economical pumping strategy in the winter months, potentially reducing power demand costs and pump starts. The new well and the capacity upgrades to the well house and Parker Canyon provide good options for increasing water supply to the system. The new well is the preferred option to providing additional source water.

City Intertie

The City has a connection to CMWD that currently allows water delivery to the City through Paradise Valley. The City's Hoover tank was constructed approximately 10 years ago, and has discharge piping that allows for connection to a booster station. The Hoover tank is approximately 200 feet below the elevation of Paradise Valley, and a booster station would be required in order to pump water from the tank to the CMWD distribution. The option of pumping from the City to CMWD is certainly possible, but the volume of excess water available from the City is not known at this time. It recommended that the District work with the City to construct a booster station to serve CMWD in emergencies. This option is included in the capital improvement plan in Chapter 8.

3.5 Source Back-up Power Generation

The District has two 175-KW generators that provide back-up power at the well house and Parker Canyon stations. Both of these generators have aided the system greatly during power outages that have lasted up to 5 days. Both of the generators were provided by Aptech, and the motor and generator combination is not common. It is recommended that both generator systems be replaced in the 20 year planning cycle.

4. WATER STORAGE ANALYSIS

4.1 Components of Finished Water Storage

Storage is available to serve the system if the storage structure or facility is elevated sufficiently or is equipped with sufficient booster pumping capability to pressurize the system. Components of finished water storage are further defined as:

- Dead Storage. Storage that is either not available for use in the system or can provide only substandard flows and pressures.
- Effective Storage. Effective storage is all storage other than dead storage and is made up of the additive components described
- Operational Storage. Operational storage supplies water when, under normal conditions, the sources are off. The volume required to prevent excess pump cycling and ensure that the following volume components are full and ready for use when needed. The operational storage represents the current volume of water between ON and OFF tank set points for the well house and Parker Canyon pumps.
- Equalization Storage. Storage of finished water in sufficient quantity to compensate for the difference between a water system's maximum pumping capacity and peak hour demand. Figure 4-1 below illustrates the water use peaks throughout the day.

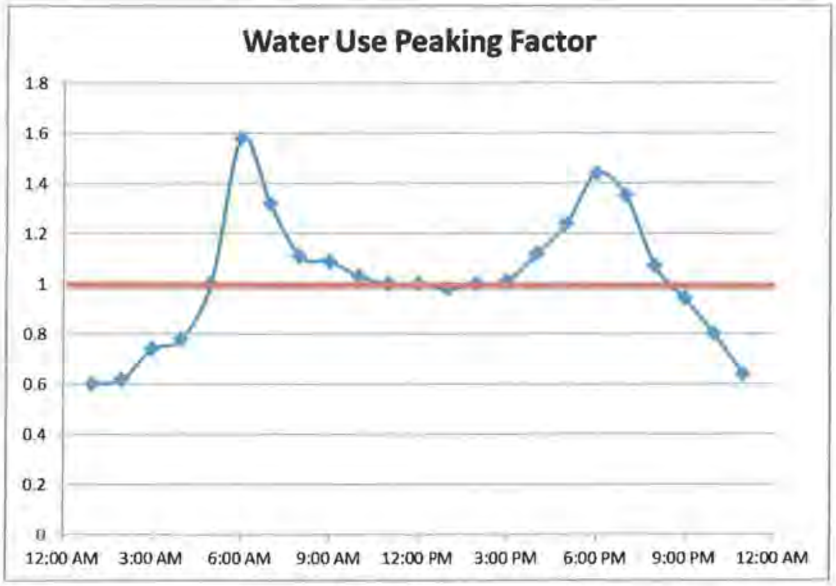


Figure 4-1

The red line in Figure 4-1 represents a steady pumping rate from a source, while the blue trend line represents the demand that customers exert on a system. The area above the red line, and below the blue line, represents a volume of water that must be available in storage to meet peak hour demand. Equalization storage need was determined using the IDEQ Guidance for Equalization Storage.

- Fire Suppression Storage. The water needed to support fire flow in those systems that provide it. While the CMWD system was not designed to provide fire flow, the District allocates 30,000 gallons of fire flow storage in each zone based on a flow of 250-gpm for 120 minutes.

- Standby Storage. Standby storage provides a measure of reliability or safety factor should sources fail or when unusual conditions impose higher than anticipated demands. Normally used for emergency operation, if standby power is not provided. The district has selected to use two days of average day demand (ADD) volume as the standard for standby storage. At a current ADD of 300,000 gallons, that total for standby storage volume is 600,000 gallons.

As discussed in Chapter 2, CMWD has three water storage structures at the following locations; Parker Canyon Booster Station, Black Mountain, and Naples. The current system storage of approximately 400,000 gallons provides enough water to meet the current operational and equalization needs, and some volume for emergency, or standby storage. It is not known what original criterion was used in sizing the current tanks. However, the criterion of this plan includes providing two days of ADD volume. Figure 4-2 shows the current breakdown of the District's storage volume, with the effective storage being the total of the other four columns.

Table 4-1 Current CMWD Storage Volumes (gallons)

Effective (Total if Full)	Operational	Fire Flow	Equalization	Standby
400,000	90,000	30,000	79,000	201,000

As Table 4-1 shows, the District only has 201,000 gallons of standby storage, which falls short of the new criteria of 600,000 gallons by nearly 400,000 gallons. To determine future storage needs, the growth rate of 1.5% was applied to the current need and extrapolated from 2018 to 2038.

4.2 Existing Storage Needs

Table 4-2 shows the anticipated storage need assuming that an additional 100-gpm source will be added in 2018-2019. The additional source will offset some equalization storage need. The operational storage is estimated 150,000 gallons for total system, and is largely based on the operational levels selected by the operator for the tanks in each zone.

Table 4-2 Anticipated Future Storage Needs in Gallons

Year	Equalization Storage	Fire Storage	Emergency Storage	Operational Storage	Total Effective Storage
2018	29,292	30,000	600,000	150,000	809,292
2019	32,799	30,000	610,772	150,000	823,571
2020	39,457	30,000	621,705	150,000	841,162
2021	43,250	30,000	632,803	150,000	856,053
2022	50,309	30,000	644,067	150,000	874,375
2023	60,802	30,000	655,499	150,000	896,302
2024	71,649	30,000	667,104	150,000	918,753
2025	82,857	30,000	678,882	150,000	941,739
2026	87,688	30,000	690,837	150,000	958,526
2027	96,092	30,000	702,972	150,000	979,064
2028	111,744	30,000	715,288	150,000	1,007,032
2029	120,803	30,000	727,789	150,000	1,028,592
2030	137,369	30,000	740,478	150,000	1,057,847
2031	147,114	30,000	753,357	150,000	1,080,471
2032	160,892	30,000	766,429	150,000	1,107,321
2033	175,096	30,000	779,697	150,000	1,134,793
2034	181,993	30,000	793,165	150,000	1,155,157
2035	193,007	30,000	806,834	150,000	1,179,841
2036	212,353	30,000	820,708	150,000	1,213,061
2037	220,072	30,000	834,791	150,000	1,234,862
2038	223,840	30,000	849,084	150,000	1,252,924

As Tables 4-1 and 4-2 show, CMWD has a current and future need for additional storage, especially in light of new criterion for standby storage. Of the four pressure zones, the Paradise Valley zone has the greatest current and future storage needs. Since the zone is so large, the hydraulic model was used to help determine the most effective location for the new required storage.

The Paradise Valley zone is hampered by relatively small water mains that make it difficult to effectively deliver water from any single storage location. The Black Mountain tank is nearly 4 miles away from north Paradise Valley (Blue Sky rd.), and over 7 miles away from Wilderness Ridge, a subdivision in north Pleasant Valley.

Three miles of the piping between the Black Mountain tank and Blue Sky road is 6" PVC, which is adequate in most cases for rural distribution needs. However, effective water transmission within a zone as large as Paradise Valley requires greater main sizes, or strategic tank placement in order to maintain acceptable pressure during higher demand periods. Considering the miles between the Black Mountain tank and the north end of the Paradise Valley pressure zone, a tank was installed in the hydraulic model to determine its effect on the zone. The modeled tank yielded favorable results that significantly increased operational pressures on peak demand days. A tank in north Paradise Valley is recommended with this facility plan based on the following:

- It provides needed storage for current and future needs in the Paradise Valley zone.

- It eliminates the need to immediately increase the size of miles of pipe between the Black Mountain tank and the north end of the zone.

- The hydraulic grade line (HGL) is significantly improved in the Paradise Valley zone.

In 2008, CMWD purchased a future tank site in north Paradise Valley adjacent to Blue Sky road. The approximate elevation of the tank site is 2330 feet, while the approximate hydraulic grade line in the Paradise Valley zone is 2440 feet. The tank needs to be 110 to 120 feet tall in order to provide the pressure required for the zone. Planning-level calculations indicate that the tank should be 30 feet in diameter, with an overall tank volume of 600,000 gallons. The final design of the tank will include exact sizing. Design of the tank will require a foundation that is approximately 60-80 feet in diameter, depending upon final tank size and soil bearing strength.

The recommended tank of 600,000 gallons would have an estimated 250,000 gallons of operational storage above 40 psi. Approximately 230,000 gallons would be available between 20 psi and 40psi that could be considered emergency storage. The lower 120,000 gallons of the tank would be dead storage. The following features are recommended with the new tank:

- An altitude valve (with two-way function). This feature will keep the tank from overfilling in lower-demand periods while the Black Mountain booster station is pumping into the zone.

- Piping provision for installing a booster station at the base of the tank so that the entire tank volume could be fully utilized as operational storage.

It is also possible that the Paradise Valley zone could be split into two zones with the Black Mountain tank operating independently of the proposed north tank.

Independent zone function in the Paradise Valley zone could be implemented for little or no cost, since this could simply occur with valve closures.

When the Paradise Valley Booster Station was constructed in 2005, it was designed to pump water from the 10" main on Kootenai Trail Road to deliver water to north Paradise Valley. At that time the north Paradise Valley zone was delineated by two check valves at the intersection of Kootenai Trail Road and Lost Mile, and the intersection of Kootenai Trail Road and Paradise Valley Road. This effectively created the zone that could be used again, only with a tank instead of pumps.

4.3 Future Storage Needs

Table 4-3 summarizes the recommended storage improvements for CMWD. The summary below is based on the anticipated storage needs shown in Table 4-2, which shows a total storage need at the end of the planning period of 1,252,924 gallons. The intention of the prescribed timing of constructing additional storage shown in Table 4-3 is to provide a plan for meeting the new storage criteria of this plan with a phased approach.

However, since the projects below are large, the District will likely need to borrow money to construct these tanks. With that in mind, it may be advantageous to build all of the recommended storage in a relatively short period of time and only bond for the improvements one time. This approach may also lend itself to procuring more potential grant money.

Table 4-3 Recommended Storage Improvements

Year	Storage Improvement Description	Additional Storage (Gallons)
2020	North Paradise Valley Standpipe - Steel	600,000
2024	Expansion of Naples Tank Volume - Concrete	120,000[1]
2028	New Tank In Highland Flats – Concrete or Steel	150,000
2035	New Tank at Black Mountain – Concrete or Steel	200,000[2]

[1] Before final design of the Naples tank expansion, the current and future needs of Alta Mill need to considered or negotiated.

[2] This volume should be reviewed in a facility plan update recommended in 2028.

North Paradise Valley Standpipe

Earlier in this chapter the need was shown for a 600,000 gallon standpipe in the north end of Paradise Valley. It is recommended that design and financial planning begin for the new tank so that it can be constructed as soon as possible.

Naples Tank Expansion

The number of active water accounts in the Naples zone only account for approximately 28% of the total in the system. The Naples zone only has 22 inactive accounts, or 16% of the total, system wide. Currently, the Naples tank operates as a source for the Highland Flats zone, while the Highland Flats zone has no storage of its own.

If operations continue with the current delivery approach, the Naples tank would need an additional 270,000 gallons (180,000 gallons existing) by 2024. The wildcard in sizing the Naples tank is the Alta Mill water usage. At the time of publishing this report, Alta is known to be investigating the feasibility of finding and developing another source of water for log watering. Before finalizing the design volume of the Naples tank, the needs of the mill should be discussed and considered with Alta.

It has been noted by the system operator that the PRV that feeds the Naples zone is open for several consecutive hours per day when the Mill is watering logs. When the PRV is open, one of the pumps at Parker Canyon is operating and will continue to run until the Naples tank is full. It is recommended that the District discuss the future mill plans with Alta to determine exact current and future storage needs and also their plans to procure an alternate source of water for log watering.

Since this plan recommends constructing independent storage in Highland Flats, the recommendation of this study is to expand the Naples tank an additional 120,000 gallons in 2024. The Naples tank was originally constructed with expandability in mind. While the prescribed expansion of this storage is shown in 2024, it may make sense to include the financing for this tank with the north Paradise Valley tank funding and expand the Naples tank earlier.

Highland Flats Tank

As mentioned in the previous section, the Highland Flats is fed by the Naples tank by an 8" main. The main extends up Highland Flats Road to Round Mountain Road where the pressure is boosted to the zone, since the maximum static pressure available from the Naples tank is approximately 30 psi. It is recommended that 150,000 gallon tank be constructed in the Highland Flats zone at a base elevation of 2455'. A tank at this elevation will provide 40 psi to the zone, with some pressures being much higher in the Fall Creek area, because of its lower elevation.

Black Mountain Tank

The District has a perpetual lease from Boundary County for approximately two acres above the existing Black Mountain tank. The purpose of the lease was to provide the District with another tank site that would allow for gravity delivery at an elevation of 2440'. The current 180,000 tank is not capable of supplying water to the system at 40 psi or greater by gravity.

In 2008, the District constructed a booster station directly adjacent to the tank to boost the pressure in the Paradise Valley zone to approximately 60 psi. It is recommended that the District construct a tank at 2440' to provide gravity storage to the south side of the Paradise Valley zone.

The existing 180,000 gallon tank has been included as part of the existing storage available even though it will require that the pumps remain at Black Mountain in order to provide water at an adequate pressure. It is recommended that the existing tank be piped to the new tank, so that water is delivered to customers by gravity instead of pumped directly into the distribution system.

5. DISTRIBUTION SYSTEM ANALYSIS

5.1 Existing Distribution System

The District has an extensive distribution system that extends from the well house at Crossport to the Bonner County line adjacent to McArthur Reservoir. Table 1-1 shows the breakdown of pipe lengths for each diameter of pipe used in the system.

Figure 5-1 shows the CMWD distribution system. The main trunk line of the distribution system is a 10-inch main that begins at the well house and extends south to the Naples area at the intersection of Green Pasture Road and Stoney Trail Road. This intersection is near the existing Naples water tank. This 10-inch line provides a means to deliver water from the Parker Canyon booster station to the Naples tank, and the southern parts of the water system.

Several 8-inch mains exist in places where the system designer may have anticipated future system growth. Notably, the 8-inch main that extends from the south end of Parker Canyon Road to the very east end of Kootenai Trail Road, will provide ample capacity to deliver water from the proposed new well to the rest of the system. The 8-inch main on Lookout View Road, north of Pleasant Valley Road, also appears to have been sized for growth, possibly in the Moravia/Deep Creek area.

Some areas of the system, such as North Paradise Valley, are predominantly served by 6-inch mains that are proving to be too small for the growth that has taken place. Two booster stations have been constructed in Paradise Valley to help mitigate the pressure issues over time. In 2005, the booster station at the intersection of Paradise Valley Road and Kootenai Trail Road (Four Corners) was constructed. And in 2008, the booster station adjacent to the Black Mountain tank was constructed.

5.2 Distribution System Challenges

It is likely that the original designer of the CMWD system was unable to know exactly what area of the District would grow the most over time. When the District began, mains were planned in areas where customers originally bought into the system, which was likely the largest driver for the original locations and sizes of mains. Over time, several subdivisions have been approved within the District that created large burdens on the system. In the mid-2000's several of these subdivisions were created, many of them in areas where only 6-inch mains were available.

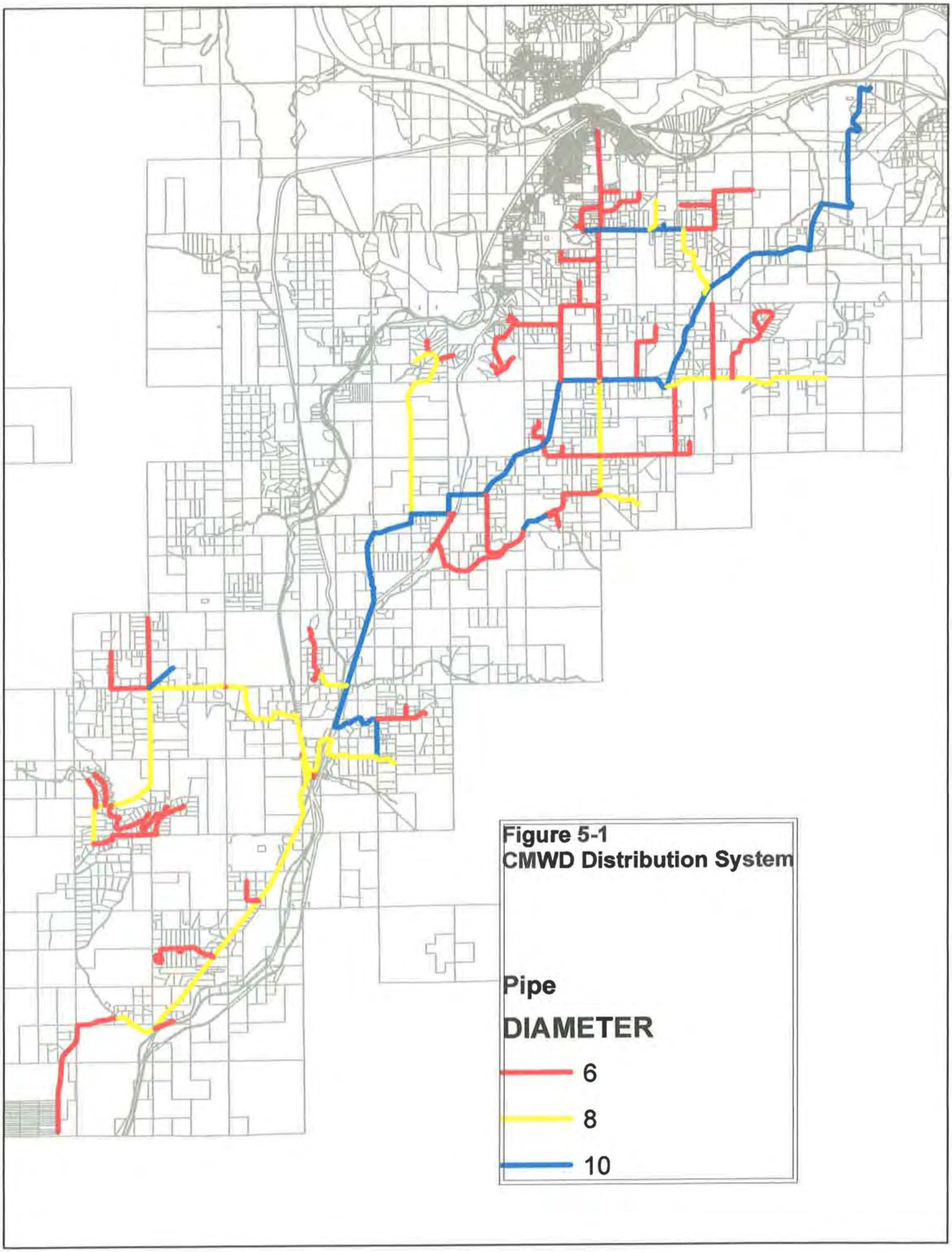


Figure 5-1
CMWD Distribution System
Pipe
DIAMETER
6
8
10

Subdivisions

North Paradise Valley, as an example, has several subdivisions, in an area that only had a delivery system of 6-inch pipe. High growth in this area led to a moratorium in 2007 on new connections in North Paradise Valley until a solution was constructed. In 2008, a new 8-inch main from the Parker Canyon booster station to North Paradise Valley was constructed, connecting to the 8-inch main on Hidden place road.

It is still possible for developers to propose new subdivisions in any area of the District that could create a large unanticipated burden on the system. Future burdens on the system will be difficult to predict, and will require the District to ensure that reasonable requirements are placed on developers, to provide adequate water infrastructure is built prior to serving future subdivision. Future subdivisions will likely require on-site as well as offsite improvements in order to serve them.

High Pressures

Because of topography, significant areas of the District have pressures that exceed 100 psi. In those areas, the District installs individual pressure reducing valves (PRV's) for customers so the pressure can be lowered to an acceptable level. The District has approximately 150 PRV's installed on individual services.

Low Pressures and Fluctuations

In areas, such as the Paradise Valley (PV) zone, pressures can fluctuate quickly from high to low. Part of the reason for the low pressures and fluctuations is that the entire PV zone is provided delivery pressure solely by booster pumps. The booster pump systems rely on pressure transmitters to deliver a signal to the pump so that the variable frequency motors can ramp up and down to achieve an operator-selected pressure value.

The closer a customer is to the pump, the better the pressure delivery. However, the existing pumps are trying to deliver pressure to customers that are several miles away in some cases. It is difficult for pumps to be controlled to react to demands at great distances, especially if the mains are relatively small. Customers in the Paradise Valley area suffer from pressure fluctuations that are significant at times, because of the scenario described above.

5.2 Hydraulic Model

A hydraulic model of the CMWD system was performed to determine the existing limitations of the distribution system, as well as determine efficient and strategic locations for storage improvements.

The model was assembled using record drawing information from construction of the original system. The platform of the model is ArcView 10.1 GIS software. The hydraulic modeling software works in tandem with ArcView, and operates like a layer on top of the GIS mapping. The hydraulic modeling software used with ArcView is InfoWater by the Innovyze Company.

Development of the hydraulic model includes installing junctions, or nodes, where demands can be applied to the model. Accurate junction elevations are critically important for model accuracy. Demand allocation is also critical for creating a model that correlates closely with actual system operations. Demands for the model were developed by establishing overall system demands from District production records and allocating those demands to individual junctions.

The process of calibrating the model included the following steps:

1. Performing hydrant flow tests throughout the water system, and correlating the observed results with those of the model.
2. Adjusting demands in the model to correlate with the demands within the system, as closely as possible, at the time of flow testing.
3. Adjust pipe friction values within the model to match observed results as closely as possible.

Calibration was challenging in some locations because of unsteady pressures observed during the flow tests. In some cases, the pressures observed at the hydrant would vary as much as 10 psi during the test. The observed pressure variation is likely due to pump operations in the zone where the testing took place.

Once calibration was complete, modeling of the existing system was broken up into three categories:

1. Current average day demand
2. Current maximum day demand
3. Current peak hour demand

Demands for each scenario were based on values derived for Chapter 2 of this document for current and future water demands. The demand distribution in the model was also related to the concentration of demands based on existing meter locations as well as where future connections have been purchased.

Figure 5-2 shows pressure contours based on current maximum day demand in the system, while Figure 5-3 illustrates the pressures observed during current peak hour demands.

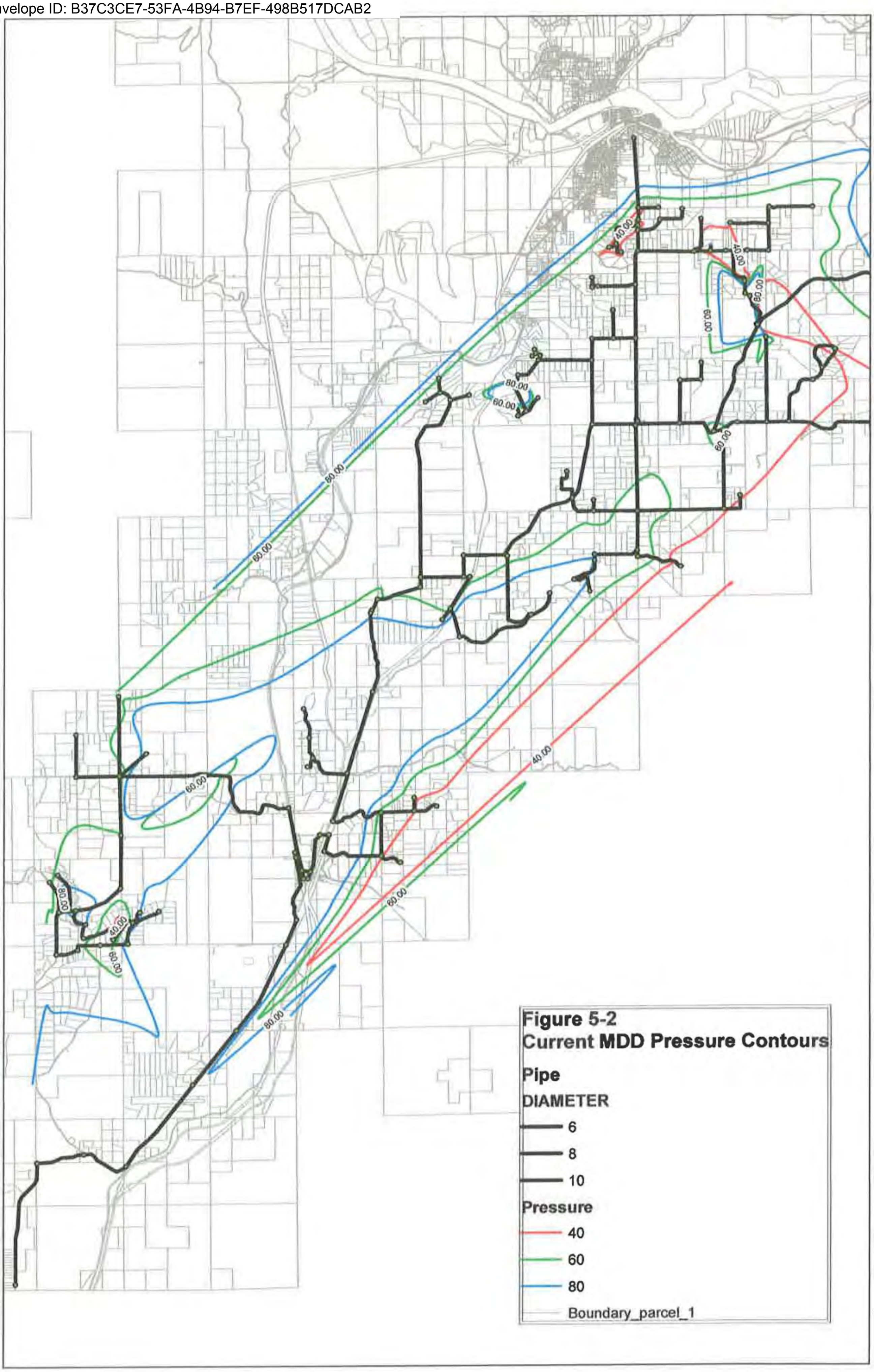
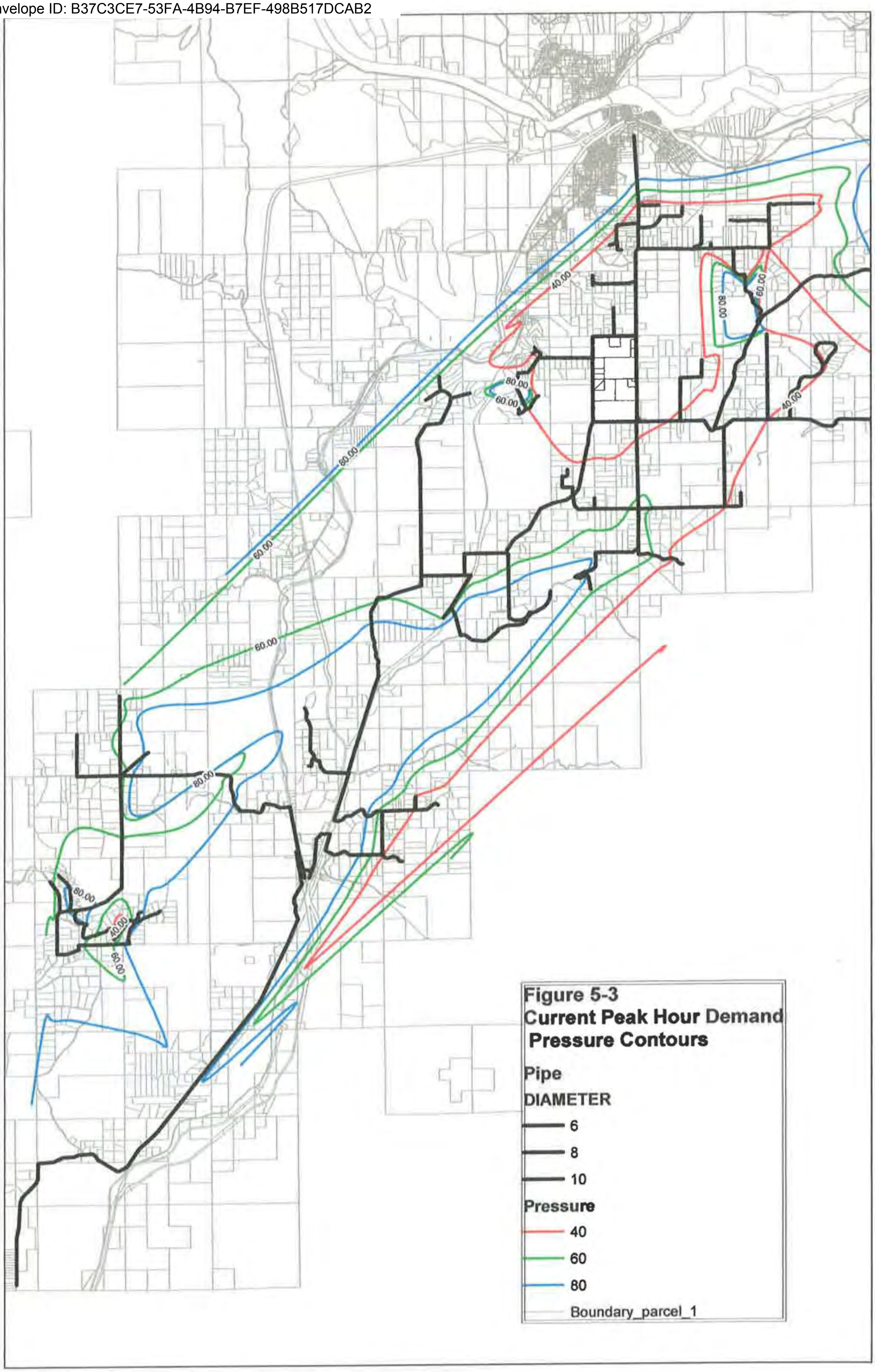


Figure 5-2
Current MDD Pressure Contours



40.00
80.00
60.00
Figure 5-3
Current Peak Hour Demand
Pressure Contours
Pipe
DIAMETER
6
8
10
Pressure
40
60
80
Boundary_parcel_1

The future scenarios featured in the model included average day demand, maximum day demand, and peak hour demand, based on the anticipated demands for year 2038, as listed in Figure 2-7. Those scenarios were modeled with the incorporation of the recommended storage and distribution improvements outlined in this plan. The future pressure contours for the 2038 maximum day and 2038 peak hour demand are illustrated in Figures 5-4 and 5-5. Figure 5-6 shows the anticipated pressures during peak hour demand in 2038, with the City using water at 300-gpm. The focus of that figure is north Paradise Valley since that is the zone most affected by City water purchasing.

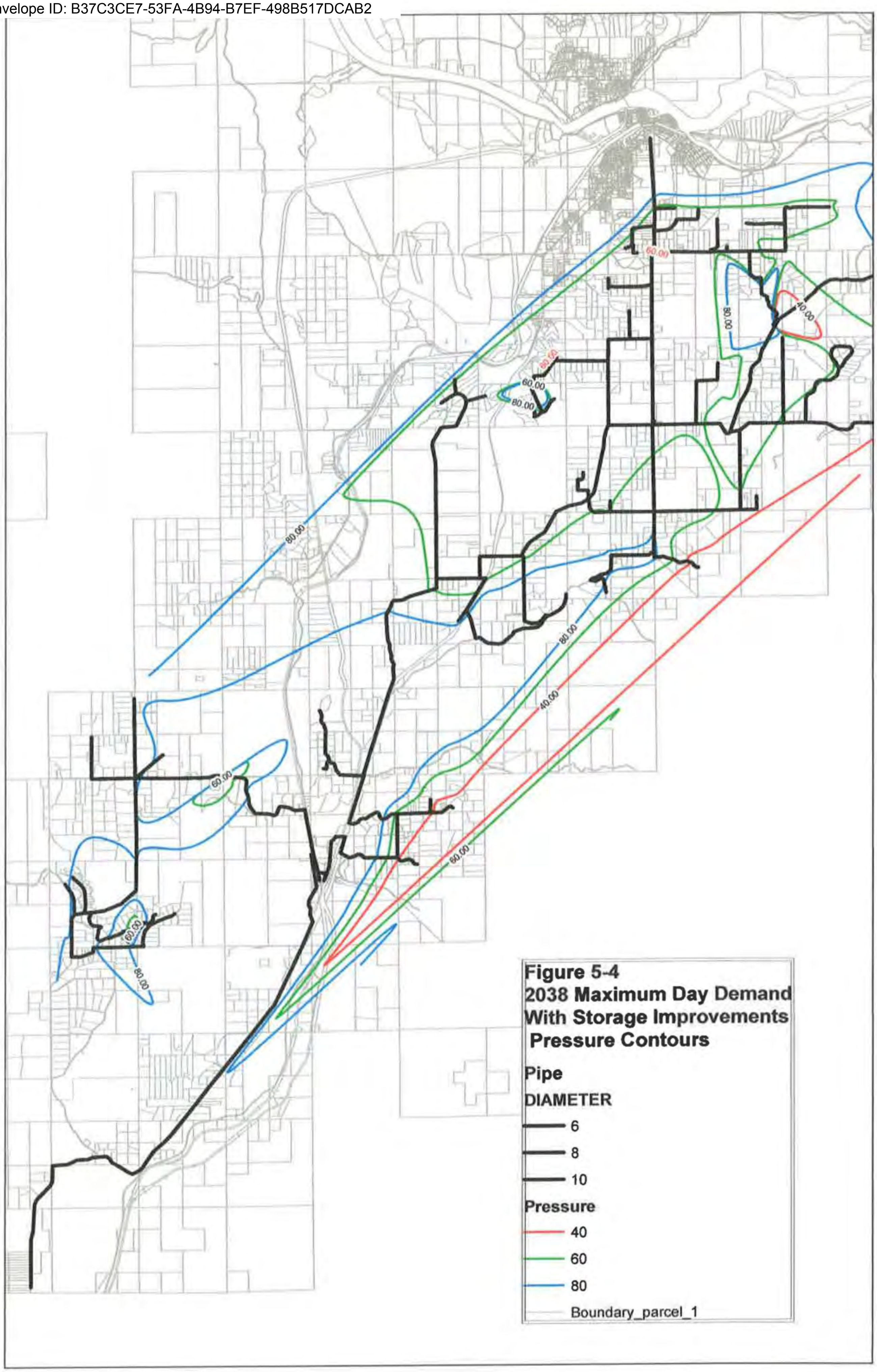


Figure 5-4
2038 Maximum Day Demand
With Storage Improvements
Pressure Contours
Pipe
DIAMETER
6
8
10
Pressure
40
60
80
Boundary_parcel_1
80.00
60.00
40.00

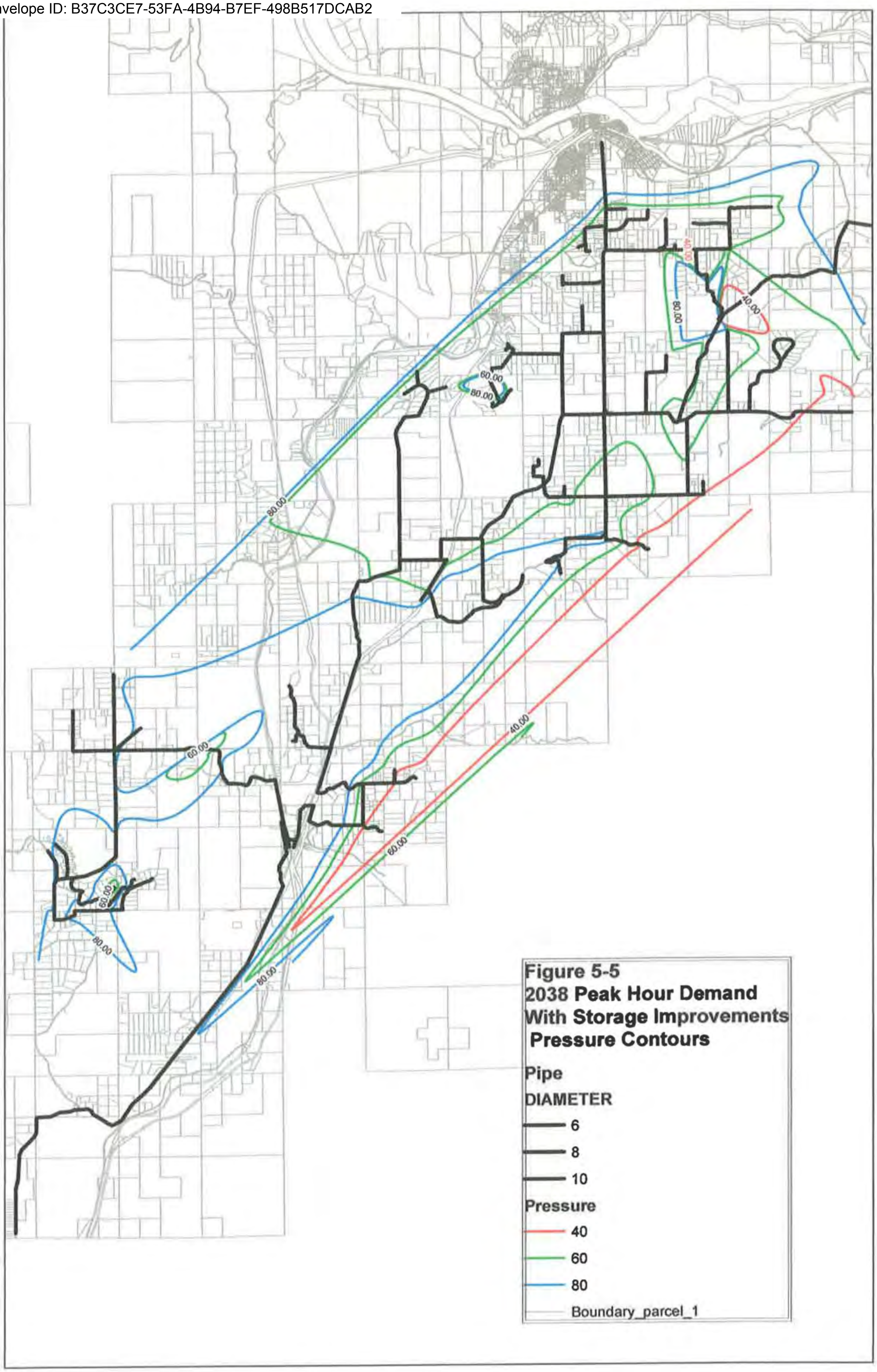
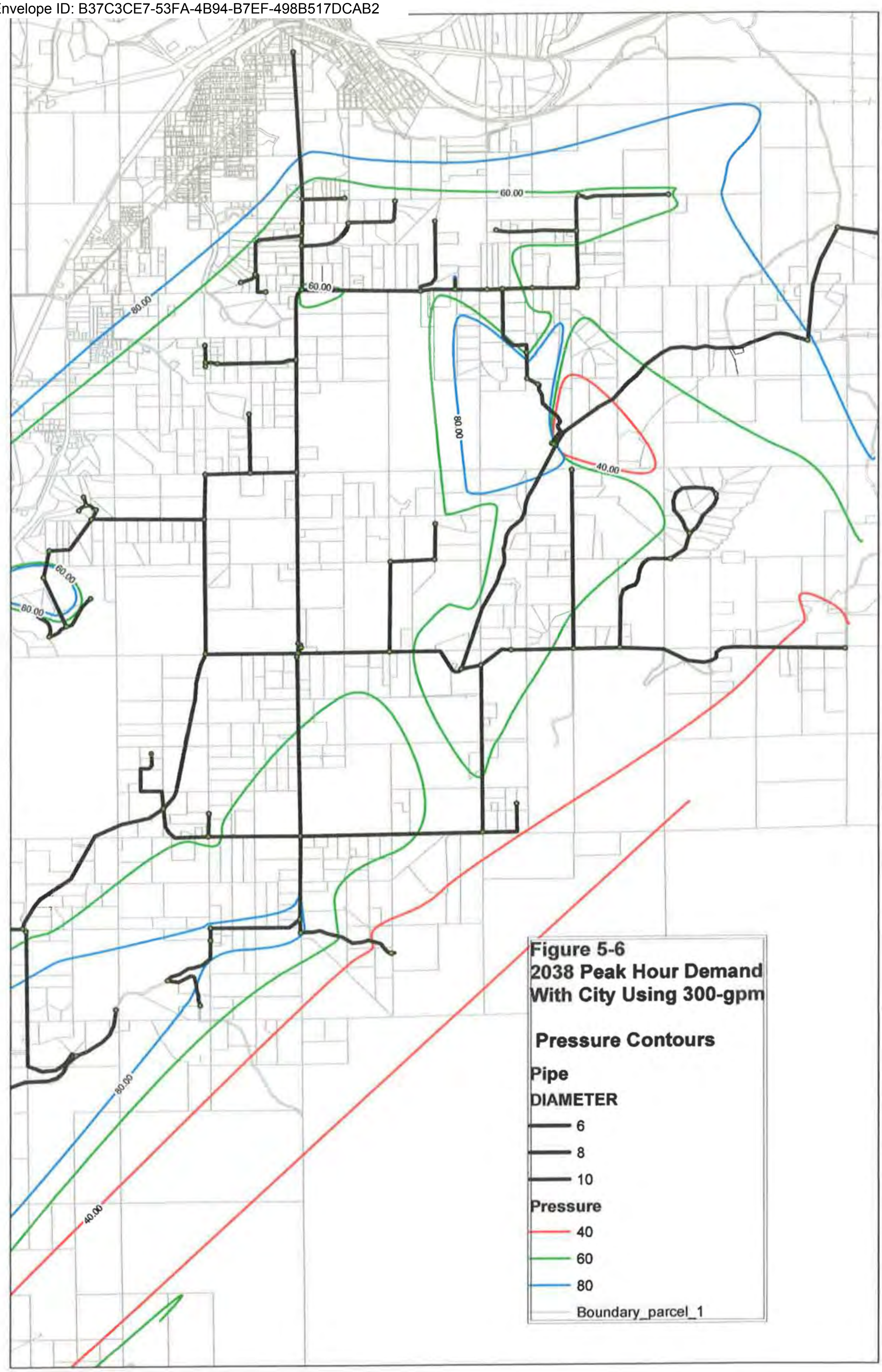


Figure 5-5
2038 Peak Hour Demand
With Storage Improvements
Pressure Contours
Pipe
DIAMETER
6
8
10
Pressure
40
60
80
Boundary_parcel_1
80.00
60.00
40.00


60.00
60.00
80.00
80.00
40.00
60.00
80.00
80.00
40.00
Figure 5-6
2038 Peak Hour Demand
With City Using 300-gpm
Pressure Contours
Pipe
DIAMETER
6
8
10
Pressure
40
60
80
Boundary_parcel_1

5.3 Distribution System Improvements

System growth has created the need to upgrade several mains within the CMWD system. It is also important to provide adequate connections to new and existing storage tanks with mains that will deliver water efficiently from those facilities. The CMWD distribution system has several dead end mains, which is typical of rural water systems of this size. Below are some important distribution issues that the District contends with.

Water Main Looping

For some of the dead end mains, easy solutions exist for connecting them to other mains to create a loop. Water main looping has the following advantages:

1. Reliability; it provides two paths of service to a customer.
2. It can help minimize the number of affected customers during a water main repair, assuming adequate valving for isolation is available.
3. It increases water flow available to an area.
4. It enhances fire flow capacity.

While several dead end mains exist within the CMWD system, some looping would be very expensive because of extreme topography or distance. The recommendations for looping in this plan are intended to provide the greatest benefit for the cost, but don't attempt to loop every dead end main. It is recommended that an analysis of looping be considered with every new main that is installed.

Subdivisions

When new subdivisions are proposed in the future, it is recommended that the District investigate closely whether or not connecting the subdivision at two points of the existing distribution system is feasible. Subdivisions in Boundary County don't usually create large demands at first, but will grow into a larger demand for the District that a single connection to the distribution system may not be capable of serving adequately.

Lot Splits

Lot splits happen often in Boundary County, and the District is often unaware that they have occurred. This can create problems for the District if a water customer splits their lot, since the account is tied to the original parcel number.

Recommended Improvements

Figure 5-7 shows the location of the recommended distribution system improvements in north Paradise Valley. The existing mains are shown in black, while the main upgrades are shown in red. The new main shown on Blue Sky Road from the end of Scenic Drive to Shamrock Road is a proposed 6-inch main that is approximately 1,250 feet in length. The new main shown on Blue Sky Road from Shamrock to Hidden Place is a proposed 10-inch main that is approximately 6,200 feet in length. Figure 5-8 shows a 6-inch water main loop that connects a main at Brown Creek Road, providing an alternate route for water on the south end of Paradise Valley.

The recommendations do not attempt to address every possibility with respect to where new subdivisions may be built, since those locations are not yet known.

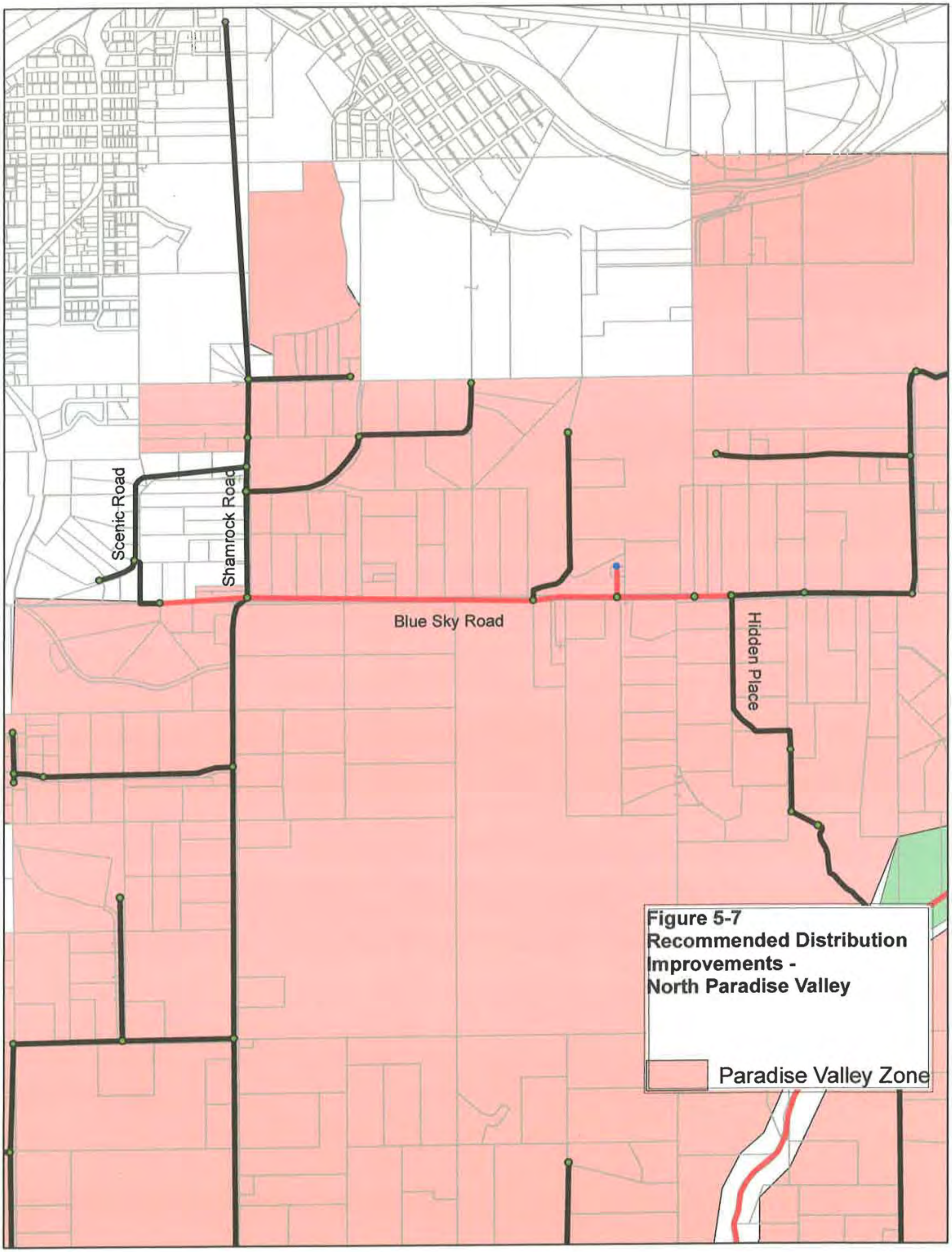


**Figure 5-7
Recommended Distribution Improvements -
North Paradise Valley**

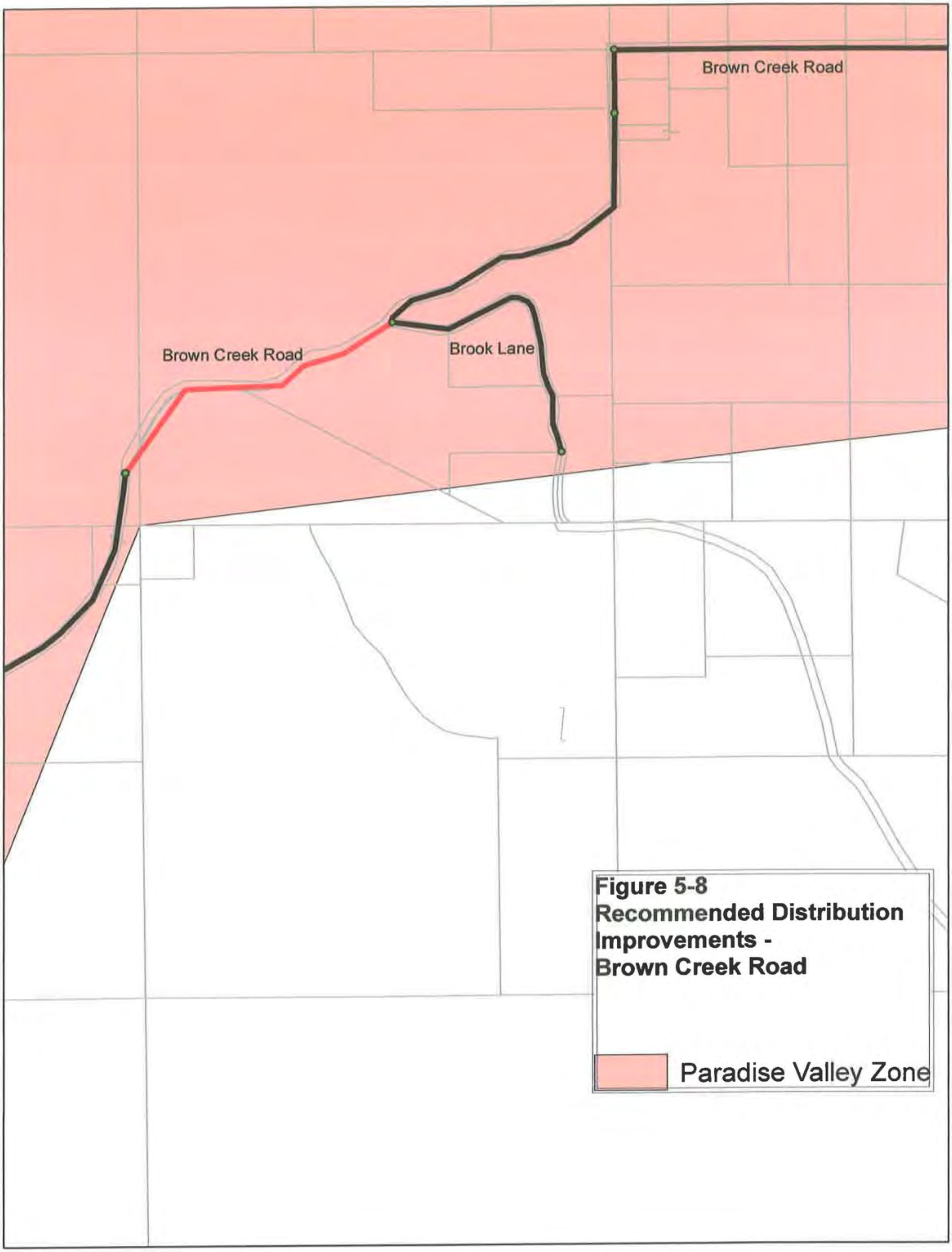


Figure 5-8
Recommended Distribution Improvements -
Brown Creek Road

6. PUMP STATION ANALYSIS

6.1 Existing Pump Stations

As discussed in Chapter 1, the District operates the following pump stations:

- The Crossport Well House
- Parker Canyon Booster Station
- Black Mountain Booster Station
- Paradise Valley Booster Station
- Highland Flats Booster Station
- Naples Booster Station

The purpose of this section is to describe each pump station listed above and provide recommended improvements for each station. While the well house at Crossport was also discussed in Chapter 3, it is also discussed in this chapter as a pump station with recommended improvements.

Crossport Well House

As discussed earlier, the well house has a net pumping capacity of 575-gpm using the capacity criteria while assuming the largest pump is out of service. The current District Board and engineer are both in favor of constructing a new well as discussed in section 3.4, as opposed to increasing the capacity of existing well house.

However, if the proposed new well is unable to produce the supply necessary for District needs, it is recommended that the District move forward to increase the capacity of the well house and the Parker Canyon booster station. To increase the capacity of the well house, it is recommended to install a third pump into the unused casing, that is referred to as well #3 in the well logs found in **Appendix A.**

The drillers report for well #3 indicates that a #100-slot screen was installed between 128 and 148 feet below ground surface. It is believed that this well was not used because of a bent casing. It is recommended that this well be investigated by extending a camera for the entire length of the well to determine if it is in useable condition, and if the screen section appears as described in the well log.

In order to use the third well, significant upgrades to the well house would be required, such as;

- Determine whether a vertical line shaft or submersible pump would be most appropriate for the casing condition.
- Provide connective piping necessary for the new pump.
- Install all of the electrical equipment necessary to operate the new pump and controls.
- Expand the building to accommodate the new well, piping, and electrical.

It is recommended that the new third pump be sized to provide a total of 700-gpm from the well house, when operated in conjunction with one of the existing pumps. It is also recommended that the pump be capable of delivering 300-gpm while operating alone, so that average day demands could be provided through the 20-year planning period, with this single, smaller pump (refer to Table 2-7). The pump and motor combination would require a VFD in order to work in the two operating scenarios described above.

Parker Canyon Booster Station

The Parker Canyon booster station has approximately the same pumping capacity as the well house. In order to deliver water at approximately the same rate as the well house, the station would need another pump also that has the same capabilities as the recommended well house pump. The installation of a 300-gpm pump at Parker Canyon is possible, but would be difficult without significant modifications to the station.

It is possible that either a submersible or vertical line shaft pump could be installed in the existing station, but would take modifications that are not advised. It is recommended that the station be expanded to include the following:

- Additional floor space so that the pump, motor, electrical equipment and piping can facilitate additional capacity.
- Install a more flexible piping/valving system that would allow for delivering water to a new Paradise Valley tank independently.

- Provide additional tank volume below the floor to accommodate the requirements of an additional pump.

Because the Parker Canyon booster station site is so small, it may be required to acquire more property in order to expand and still have enough area to park, and access to all of the station components.

Black Mountain Booster Station

With the storage recommendations of this plan in mind, there are no recommendations to expand or improve that Black Mountain booster station. If the District moves forward with the north Paradise Valley storage recommendation, the current Black Mountain booster station will be serving a much smaller area. The pumps will then be more responsive to the needs of customers in south Paradise Valley and Pleasant Valley.

Once the future Black Mountain tank is constructed, the current Black Mountain booster station could then be piped to the new tank so that it can fill the new tank, effectively continuing to utilize the existing tank. The current pumps at Black Mountain are sized to provide flow to a new tank above the existing facility.

It is also recommended that the station be piped to provide a means of delivering directly to the distribution system with the existing pumps to provide for a means to take the new tank out of service if needed. These upgrades are intended to take place during the construction of the proposed Black Mountain tank, so no upgrades to this station are recommended at this time.

Paradise Valley Booster Station

The *Paradise Valley* booster station was constructed in 2005 to increase pressure in the Paradise Valley area prior to construction of the Black Mountain booster station being constructed. The pumps in the Paradise Valley station are used to deliver water to the Paradise Valley Water Association during emergencies or when CMWD has a need to energize the pumps to attempt to provide greater pressure to north Paradise Valley. Paradise Valley Booster Station also provides the District staff with a central location to view system operations on the computer. With the storage recommendations of this plan, no significant improvements to this station are recommended.

Naples Tank Booster Station

A small booster station is located adjacent to the *Naples* tank. This station has a single pump with two pressure tanks that provide service to three customers that are located close to the tank, at nearly the same elevation. Within the small station, there is accommodation for one more service. It is not anticipated that significant growth will be served through this station, and therefore no significant improvements are recommended at this time.

Highland Flats Booster Station

The Highland Flats booster station has the greatest current need. The station contains two variable frequency drive pumps that are programmed to deliver water at a steady pressure of 67 psi. The station was originally constructed without adequate room for electrical equipment, pumps, or a flow meter.

This plan recommends the following improvements at the Highland Flats Booster Station:

- Expanding the footprint of the existing station.
- Installing three new pumps in the station with new VFD's.
- Installing a back-up power generator.
- Ensuring that piping will allow for a flow meter that can provide accurate instantaneous and totalized flow readings.
- Ensure that building design provides adequate separation between electrical panels and piping.
- Installing suction-side transmitter to monitor suction pressure.

The Highland Flats booster station has the greatest current need because it lacks enough space to work safely, and lacks some of the basic features of a municipal pump station. The booster station upgrades need to include designing the new pumps to not only provide immediate service, but also to ensure the capability to pump to the recommended tank.

7. RECOMMENDED IMPROVEMENTS

This section is intended to summarize the recommended improvements discussed in previous chapters in the following categories:

- Supply
- Storage
- Pump Stations
- Distribution

7.1 Supply Improvements

Table 7-1 lists the recommended supply improvements to the CMWD system.

Table 7-1 Recommended Supply Improvements		
Priority	Storage Improvement Description	Estimated Cost
1	Drill Cow Creek Basin Well (2018)	$76,000
2	Cow Ck. Basin Wellhouse & Piping (2019)	$225,000
3	Cow Ck Basin Well #2	$200,000[1]
4	City Intertie	$250,000
Future	Develop Surface Water Source in Naples or HF Zone	$500,000

[1] Upgrade to 3-phase power required for second well, cost estimated at $100,000, requires quotes from NLI, while $90,000 is anticipated to get 2nd new well connected to well house with electrical and controls.

It is important to note that improvements included in the pump station recommendations also have a great impact on supply improvements; specifically with respect to including the additional well at Crossport.

7.2 Storage Improvements

Table 7-2 Recommended Storage Improvements		
Priority	Storage Improvement Description	Estimated Cost
1	North Paradise Valley Standpipe – Steel (600,000 gal)	$1,600,000
2	Expansion of Naples Tank Volume – Concrete (120,000 gal)	$425,000
3	New Tank In Highland Flats – Concrete or Steel (150,000 gal)	$600,000
4	New Tank at Black Mountain – Concrete or Steel (200,000 gal)	$650,000

[1] Before final design of the Naples tank expansion, the current and future needs of Alta Mill need to considered or negotiated.

7.3 Pump Station Improvements

Table 7-3 Recommended Pump Station Improvements		
Priority	Pump Station Improvement Description	Estimated Cost
1	Highland Flats Booster Station	$175,000
2	Additional Well Pump at Crossport Well House	$250,000
3	Additional Pump, Piping and Building Extension at Parker Canyon	$500,000

7.3 Distribution Improvements

Table 7-3 Recommended Distribution Improvements		
Improvement	Distribution Improvement Description	Estimated Cost
1	Scenic Road to Shamrock/Blue Sky Loop	$40,000
2	Blue Sky Road – Shamrock to Hidden Place	$310,000
3	Brown Creek Loop	$50,000

8. CAPITAL IMPROVEMENT PLAN

This section provides a phasing plan for implementation of the improvements recommended in the plan. The District should consider phasing at the times recommended, but should also monitor the usage of water system components and construct improvements earlier if system flows, storage, and pressures warrant. The tables for supply and storage should be utilized to monitor actual use versus anticipated use, and move forward sooner with improvements if needed. A 5-year check of this facility plan would provide an indication of how well actual improvements are tracking with estimated growth.

8.1 Project Phasing Plan

System growth obviously creates the need for greater amounts of water supply, storage, and distribution improvements from one year to the next. And typically, the key is to stagger improvements to water system components to keep ahead of the need. However, sometimes it makes sense to lump future improvements with current needs, since large improvements will likely require borrowing money to complete.

For Idaho water districts, borrowing money requires a vote of people in the District boundaries for approval. With that in mind, it may make sense to borrow money one time in the planning period for the larger improvements that are recommended. The phasing recommendation for this plan includes grouping all of the storage and larger pump station improvements into one financial package. Table 8-1 lists the improvements recommended that are anticipated to require financing.

Table 8-1 Recommended Initial Capital Improvements

Project Type	Improvement Description	Estimated Cost
Storage	North Paradise Valley (600,000 gal)	$1,600,000
Storage	Naples (120,000 gal)	$425,000
Storage	Highland Flats (150,000 gal)	$600,000
Storage	Black Mountain (200,000 gal)	$650,000
Pumping	Additional Crossport Pump	$250,000

Pumping	Additional Parker Canyon Pump	$500,000
Distribution	Blue Sky Upgrade	$310,000
	Total	**$4,310,000**

Table 8-2 Recommended Future Capital Improvements

Project Type	Year Projected	Improvement Description	Estimated Cost
Supply	2019	Drill Cow Creek Basin Well	$76,000
Supply	2019	Cow Ck. Basin Wellhouse & Piping (2019)	$225,000
Pumping	2020	Highland Flats Booster Station	$175,000
Distribution	2021	Brown Creek Loop	$50,000
Distribution	2022	Scenic Road to Shamrock/Blue Sky Loop	$40,000
Supply	2024	City Intertie	$225,000
Supply	2026	Cow Ck Basin Well #2	$190,000
		Total	**$860,000**

8.2 Implementation

It is anticipated that all of the improvements listed in Table 8-1 could take three to four years to complete, with the expectation that the highest priority projects would be designed and constructed first. The capital improvement list in Table 8-2 shows the improvements that can be staggered. The anticipation is that these projects will be financed from the District's budget, and not from borrowed money. The projected years of construction are estimated, and could be adjusted by the District as the budget allows.

9. WATER RATES

The current base water rate is $43.00 per month, per equivalent residential unit (ERU). The District also has a tiered water rate after the base volume of 12,000 gallons has been exceeded. The tiered water rate has been effective, in most cases, at keeping overall system demands most systems of similar size. The current rate adequately funds the operation, maintenance, and debt service of the District, prior to the proposed improvements.

With the improvements recommended in this plan, and the likelihood of borrowing money to complete those improvements, water rates will need to increase to satisfy increased debt service. Several opportunities exist for borrowing money, and some opportunities exist for grant funding of the improvements.

This section will attempt to provide an estimation of what the water rates may be after borrowing money for the recommended improvements. To be conservative, the prospect of grant funds should be kept out of the calculation of increased rates, so that in the worst case, the District will bond for enough money to cover the anticipated debt service. The amount needed to complete the improvements in Table 8-1 is $4,310,000. The District still owes approximately $2,000,000 for the original construction bond for the water system. That debt service equates to approximately $16.70 per account, out of the $43.00 base charge for water.

The estimated rate increase will include the assumption that the District can borrow $4,310,000 at 3.5% for 40 years. Table 9-1 shows the estimated rate based on the assumptions above.

Table 9-1 Possible Water Rate Scenario Per ERU

Scenario	Current Base Rate	Base W/O Debt	Total Debt (Old +New)	Total New Monthly Base Rate[1]
Borrow $4,310,000 3.5%, 40-yr Term	$43.00	$26.30	$36.88	$63.18

Notes:

1. The monthly rates do not take into account any grant funding that could offset the final monthly rate.

10. DISTRICT STAFFING

The District is adequately staffed with two full time operators, and one part-time operator. The District may need, from time to time, an additional person to assist with operations during the busy summer months.

APPENDIX A

WELL LOGS

Form 238
3/95

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

Office Use Only
Inspected by
Twp Rge Sec
1/4 1/4 1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 98-95-N-0043-000

Other IDWR No. 98-07750

2. OWNER

Name CABINET MOUNTAIN WATER #1

Address FED BLD. 212

City BONNERS FERRY State ID Zip 83805

3. LOCATION OF WELL by legal description

sketch map location must agree with written location

N / W / E / S — X

Twp. 62 ☒ North or ☐ South

Rge. 02 ☒ East or ☐ West

Sec. 29 1/4 NW 1/4 NW 1/4

Gov't Lot ____ County BOUNDARY

Lat: : : Long: : :

Address of Well Site DOBSON ROAD

City

(Give at least name of road + Distance to Road or Landmark)

Lt. ____ Blk. ____ Sub. Name ____

4. USE:

☒ Domestic ☐ Municipal ☐ Monitor ☐ Irrigation
☐ Thermal ☐ Injection ☐ Other

5. TYPE OF WORK check all that apply (Replacement, etc.)

☒ New Well ☐ Modify ☐ Abandonment ☐ Other

6. DRILL METHOD

☒ Air Rotary ☐ Cable ☐ Mud Rotary ☐ Other

7. SEALING PROCEDURES

SEAL/FILTER PACK			AMOUNT	METHOD
Material	From	To	Sacks or Pounds	
CEMENT	0	18		ERBORE 18" CA

Was drive shoe used? ☒ Y ☐ N Shoe Depth(s) 122

Was drive shoe seal tested? ☐ Y ☐ N How?

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
12	+2	128	.250	STEEL	☒	☐	☒	☐

Length of Headpipe 3' Length of Tailpipe 2'

9. PERFORATIONS/SCREENS

☐ Perforations Method

☒ Screens Screen Type JOHNSON

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
128	148	80	0	12	ainless ste	☒	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

60 ft. below ground Artesian pressure ____ lb.

Depth flow encountered ____ ft. Describe access port or control devices:

NW NW 29 62N 2E

11. WELL TESTS:

☒ Pump ☐ Bailer ☒ Air ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
800 Pump Test			6 HRS
500+			

Water Temp. ____ Bottom Hole Temp ____

Water Quality test or comments:

Depth first Water encountered

12. LITHOLOGIC LOG:(Describe repairs or abandonment)

Bore Diam	From	To	Remarks: Lithology, Water Quality, Temperature	Water Y	Water N
18	0	18	CEMENTED COBBLE & BOULDER	☐	☒
14	18	64	SAND & GRAVEL W/BOULDERS	☐	☒
14	64	150	COBBLE & SAND W/ BOULDERS	☒	☐

Completed Depth 150' (Measurable)

Date: Started 09/19/95 Completed 10/15/95

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name H20 WellService, Inc. Firm No. 448

Firm Official [signature] Date 11-13-95

and

Supervisor or Operator [signature] Date 11-13-95

(Sign once if Firm Official and Operator)

Form 238-7
3/95

POSTED
Stapleton Consulting and Management Services

NOV 15 1995
NORTHERN REGION
IDWR

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

Office Use Only
Inspected by ____
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. ~~98-95-N-0044-000~~

Other IDWR No. 98-07750

2. OWNER

Name CABINET MOUNTAIN WATER #2

Address FEDERAL BLDG. ROOM 212

City BONNERS FERRY State ID Zip 83805

3. LOCATION OF WELL by legal description

sketch map location must agree with written location

N / W / E / S — X

Twp. 62 [✓ North] or ☐ South

Rge. 02 [✓ East] or ☐ West

Sec. 29 ____ 1/4 NW 1/4 NW 1/4

Gov't Lot ____ County BOUNDARY

Lat: : : Long: : :

Address of Well Site DOBSON ROAD

____ City ____

(Give at least name of road + Distance to Road or Landmark)

Lt. ____ Blk. ____ Sub. Name ____

4. USE:

[✓ Domestic] ☐ Municipal ☐ Monitor ☐ Irrigation

☐ Thermal ☐ Injection ☐ Other ____

5. TYPE OF WORK check all that apply (Replacement, etc.)

[✓ New Well] ☐ Modify ☐ Abandonment ☐ Other ____

6. DRILL METHOD

[✓ Air Rotary] ☐ Cable ☐ Mud Rotary ☐ Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK Material	From	To	AMOUNT Sacks or Pounds	METHOD
GROUT				
CEMENT	0	30		ERBORE 18"CAS

Was drive shoe used? ☐ Y ☐ N Shoe Depth(s) 0

Was drive shoe seal tested? ☐ Y ☐ N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
12	+2	128	.250	STEEL	☒	☐	☒	☐

Length of Headpipe 3' Length of Tailpipe 2'

9. PERFORATIONS/SCREENS

☐ Perforations Method ____

[✓ Screens] Screen Type JOHNSON

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
128	148	80		12	ainless St	☒	☐

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:

60 ft. below ground Artesian pressure ____ lb.

Depth flow encountered ____ ft. Describe access port or control devices:

NWNW 29 62N 2E

11. WELL TESTS:

☐ Pump ☐ Bailer [✓ Air] ☐ Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
500+			

Water Temp. ____ Bottom Hole Temp ____

Water Quality test or comments: ____

____ Depth first Water encountered ____

12. LITHOLOGIC LOG:(Describe repairs or abandonment)

Bore Diam	From	To	Remarks: Lithology, Water Quality, Temperature	Water Y	Water N
18	0	30	CEMENTED COBBLE & BOULDER	☐	☒
14	30	44	SAND & COBBLE W/ BOULDER	☐	☒
14	44	48	BOULDER	☐	☒
14	48	150	SAND & GRAVEL W/BOULDERS	☒	☐

MICROFILMED

APR 2 ? 2001

Completed Depth 150' (Measurable)

Date: Started 09/24/95 Completed 10/15/95

13. DRILLER'S CERTIFICATION

I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name H20 WellService, Inc. Firm No. 448

Firm Official [illegible] Date 11-13-95

and

Supervisor or Operator [illegible] Date 11-13-95

(Sign Once if Firm Offical and Operator)

Form 238-7
3/95
Starships Consulting and Management Services

NOV 15 1995

IDAHO DEPARTMENT OF WATER RESOURCES

WELL DRILLER'S REPORT

Use Typewriter or Ballpoint Pen

Office Use Only
Inspected by ____
Twp ____ Rge ____ Sec ____
____ 1/4 ____ 1/4 ____ 1/4
Lat: : : Long: : :

1. DRILLING PERMIT NO. 98-95-N-0054-000
Other IDWR No. 98-07750

2. OWNER
Name CABINET MOUNTAIN WATER #3
Address FEDERAL BLDG. #212
City BONNERS FERRY State ID Zip 83805

3. LOCATION OF WELL by legal description
sketch map location must agree with written location

N / W / E / S — X (NW quarter)

Twp. 62 [X] North or [ ] South
Rge. 02 [X] East or [ ] West
Sec. 29 ____ 1/4 NW 1/4 NW 1/4
Gov't Lot ____ County BOUNDARY
Lat: : : Long: : :
Address of Well Site DOBSON ROAD
City ____
(Give at least name of road + Distance to Road or Landmark)
Lt. ____ Blk. ____ Sub. Name ____

4. USE:
[X] Domestic [ ] Municipal [ ] Monitor [ ] Irrigation
[ ] Thermal [ ] Injection [ ] Other ____

5. TYPE OF WORK check all that apply (Replacement, etc.)
[X] New Well [ ] Modify [ ] Abandonment [ ] Other ____

6. DRILL METHOD
[X] Air Rotary [ ] Cable [ ] Mud Rotary [ ] Other ____

7. SEALING PROCEDURES

SEAL/FILTER PACK			AMOUNT	METHOD
Material	From	To	Sacks or Pounds	
CEMENT	0	18	1 YARD	OVERBORE
BENTONITE	18	30	GALLO	FOLLOW/ SHOE

Was drive shoe used? [X] Y [ ] N Shoe Depth(s) 128
Was drive shoe seal tested? [ ] Y [ ] N How? ____

8. CASING/LINER:

Diameter	From	To	Gauge	Material	Casing	Liner	Welded	Threaded
12	+2.5	128	.250	STEEL	[X]	[ ]	[X]	[ ]

Length of Headpipe ____ Length of Tailpipe ____

9. PERFORATIONS/SCREENS
[ ] Perforations Method ____
[X] Screens Screen Type JOHNSON

From	To	Slot Size	Number	Diameter	Material	Casing	Liner
128	148	100	210	12	ainless St	[X]	[ ]

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:
60 ft. below ground Artesian pressure ____ lb.
Depth flow encountered ____ ft. Describe access port or control devices:
NWNW 29 62N 2E

11. WELL TESTS:
[ ] Pump [ ] Bailer [X] Air [ ] Flowing Artesian

Yield gal./min.	Drawdown	Pumping Level	Time
1000+		148	6 hours

Water Temp. ____ Bottom Hole Temp ____
Water Quality test or comments: ____
____ Depth first Water encountered ____

12. LITHOLOGIC LOG:(Describe repairs or abandonment)

Bore Diam	From	To	Remarks: Lithology, Water Quality, Temperature	Water Y	Water N
18	0	18	SOIL COBBLE & BOULDERS	[ ]	[X]
14	18	43	SAND & GRAVEL W/ COBBLES	[ ]	[X]
14	43	66	STACKED BOULDERS W/ GRAVE	[ ]	[X]
14	66	87	SAND & GRAVEL W/ COBBLES	[X]	[ ]
14	87	89	BOULDER	[X]	[ ]
14	89	131	SAND & GRAVEL W/ COBBLES G	[X]	[ ]
14	131	141	STACKED BOULDERS W/ COBBL	[X]	[ ]
14	141	150	SAND & GRAVEL 3 /IN MINIS	[X]	[ ]
	0	0	WELD ON 12" CAP	[ ]	[ ]

MICROFILMED
APR 1 1 2001

Completed Depth 150 (Measurable)
Date: Started 10/28/95 Completed 11/01/95

13. DRILLER'S CERTIFICATION
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

Firm Name H20 WellService, Inc. Firm No. 448
Firm Official John Wehrer Date 11-13-95
and
Supervisor or Operator John Wehrer Date 11-13-95
(Sign Once if Firm Offical and Operator)

APPENDIX J

TANK INSPECTION REPORTS

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 Utility: Cabinet Mountains Water Tank: Tank1 Date: 8/2/2019

Inspector: Calhoun Dive Controller: Lombardi Capacity: 250kg Dimentions: 64'x42'

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	QC, B, R	QC, B, R	QC, B, R	QC, B, R
~~Expansion Joint(s)~~				
~~Support Beam(s)~~				
~~Beam Joint(s)~~				

General Appearance: Good Coating: N/A

~~All expansion Joints~~: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

INTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	B,R,	B,R,	B,R,	B,R,
Wall Structure	B,R, QC	B,R, QC	B,R, QC	B,R, QC

General Appearance: Good Coating: N/A Leaking: Possible leaking

INTERIOR RESERVOIR SUPPORT COLUMNS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Columns	B,R,E	B,R,E	B,R,E	B,R,E
Column Capitals	B,R,E	B,R,E	B,R,E	B,R,E
Column Bases	B,R,E	B,R,E	B,R,E	B,R,E

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	R, B	R, B	R, B	R, B
Floor Slabs	R, B	R, B	R, B	R, B

General Appearance: Good Coating: N/A Sump System: Good Leaking: None observed

~~All expansion Joints~~ Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Tank1

Inspector: Calhoun | Dive Controller: Lombardi | Date: 8/2/2019

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1 SSPC Rating	QUADRANT 1 Corrosion	QUADRANT 2 SSPC Rating	QUADRANT 2 Corrosion	QUADRANT 3 SSPC Rating	QUADRANT 3 Corrosion	QUADRANT 4 SSPC Rating	QUADRANT 4 Corrosion
Inlet Plumbing	8	Minor	N/A	------	N/A	------	N/A	------
Outlet Plumbing	N/A	------	N/A	------	N/A	------	7	Minor
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
Interior Overflow	N/A	------	N/A	------	N/A	------	8	Minor
~~Other Plumbing~~	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☑ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Good | Average Blister Size 1"

Over All Structural Condition Good | Weld Condition ---- | Average Pit Depth

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R,B,QC	R,B,QC	R,B,QC	R,B,QC
~~Expansion Joint(s)~~				

General Appearance: Good | Coating: N/A | Vents: Good | Level Indicator: ------

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	R,B,QC	R,B,QC	R,B,QC	R,B,QC
Wall Structure	R,B,QC	R,B,QC	R,B,QC	R,B,QC

General Appearance: Good | Coating: N/A | Leaking: Possible leaking

Overflow Structure: Good

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

~~EXTERIOR RESERVOIR FOOTINGS / FOUNDATION~~

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	Below Ground	unable to evaluate		
Footing Ring	Below Ground	unable to evaluate		

~~General Appearance:~~ ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

~~All expansion Joints~~ Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

DISCLAIMER

Liquid Engineering does not provide consulting engineering services. Unless otherwise noted, the findings contained in this report were neither prepared nor reviewed by a licensed Professional Engineer, but are based on experience, training and visual examination of the Dive Maintenance Technician

Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 53615	Utility: Cabinet Mountains Water	Tank: Tank1
Inspector: Calhoun	Dive Controller: Lombardi	Date: 8/2/2019

FACILITY SAFETY & HEALTH

Primary Air Vent	Type: J-Tube	Screen : Good	Frost Proof: No	Vac. Press Proof: No
Exterior Overflow	Flapper: No	Screen: Yes	Gasket: No	Condition: Good
~~Cathodic Protection~~	System Installed: ----	**Cathodic Access Covers**	#: ----	Properly Sealed: ----
Water Level Indicator	Type: Electronic	Condition: Good	**Pennetration Points**	Properly Sealed: Yes
~~Heater System~~	Installed: ----	Type: ------		
1st Access Hatch	Type: Square	Size: 25"x50"	in. (24" - 24" x 15" min)	Properly Sealed: Yes
Hatch Height: 9"	in. (min 4")	Lid Height: 2"	in (min 2")	Properly Secured: Yes
~~2nd Access Hatch~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size:	in (24" - 18"x22")		
Support Structure	Type: -------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

Primary Exterior Ladder

Location	Wall: Q3	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: Good	Height: 10'	Offset Landing: No			
Vandal Guard	Present: No	Locked: ----				
Ladder Rails & Rungs	Condition: Good	Anti-Skid Rungs: No	Missing/Damaged Rungs: No			
Rung Spacing & Depth	Spacing: 12"	in. (max 12")	Toe Depth: 9"	in. (min 7")		
Rail Spacing & Size	Width: 2"	in. (min 2")	Thickness: 1/4"	in. (min 1/4")	Rail to Rail: 18"	in. (min 16")
Safety Climb System	Type: None	Condition: ----				

~~Primary Balcony & Railing~~

Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width: na	in. (min 24")	
Top Rails	Condition: ----	Height: na	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height: na	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height: na	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: Yes	Standing Water: No	Other:		
Wall Integrity:	Holes: No	Cracking: Yes	Leaks: Yes	Other:		
Safety Tie-Off Points	Type: Integrated	#: 5+	Condition: Good			
Antennas	Type: Receiving	#: 1	Location(s): Roof: Q3	Bowl:	Leg:	Other:
Water Clarity	General Appearance: Good	Odor: None	Surface Debris: none			
~~Hypalon Floating Cover~~	Condition: ----	Holes: ----	Tears: ----			
~~Grounding System~~	Present: ----					

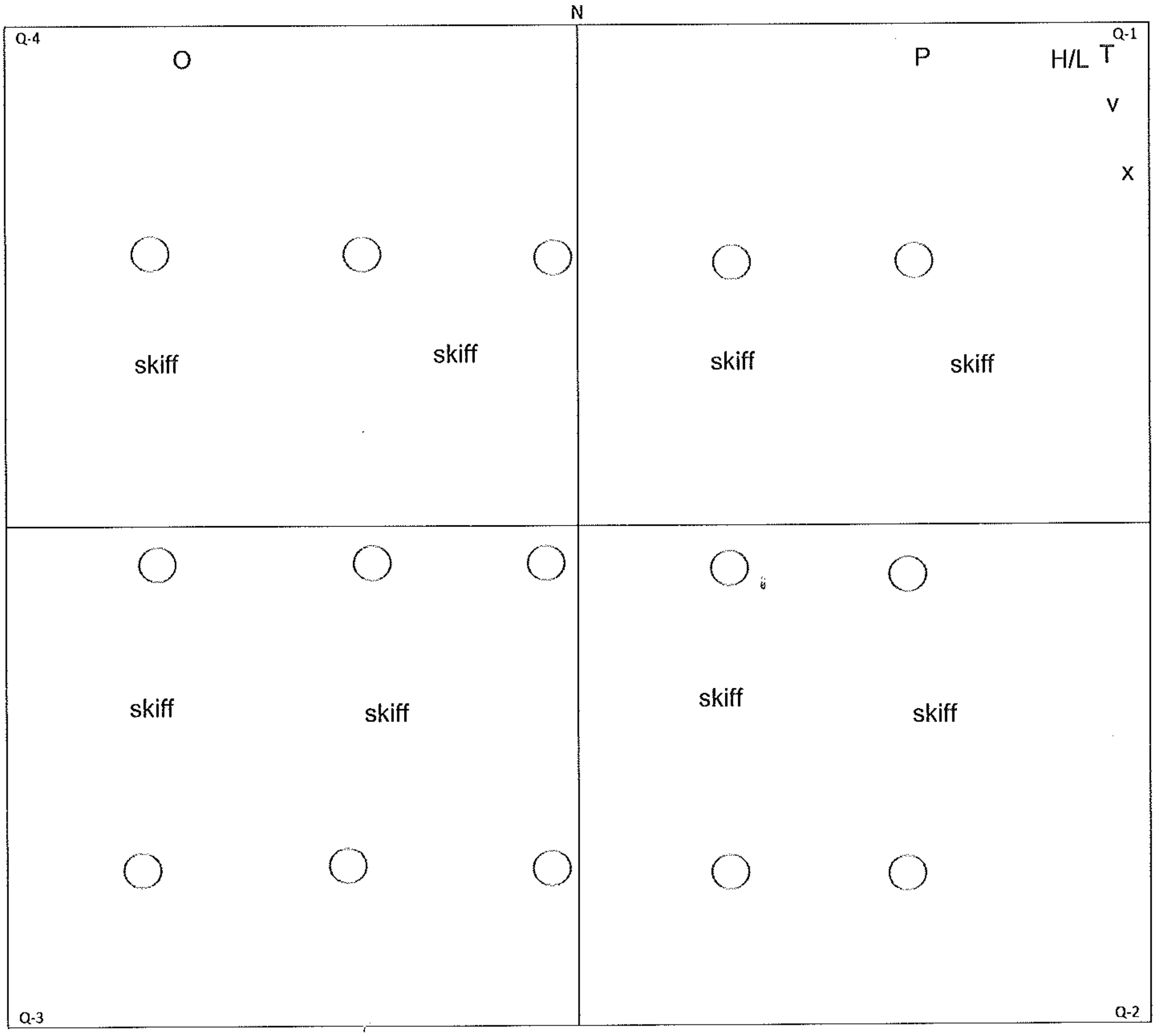
DISCLAIMER

Unless otherwise noted, the findings contained in this report were neither prepared nor reviewed by a licensed Professional Engineer, but are based on experience, training and visual examination of the Dive Maintenance Technician

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 53615   Utility Name Cabinet Mountains Water   Tank Name Tank1



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth skiff   **Cubic Yardage** na   **Sediment Type** Iron manganese

Plumbing & Structure location

Plumbing and structure codes

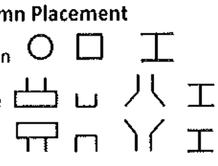
O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

Column Placement

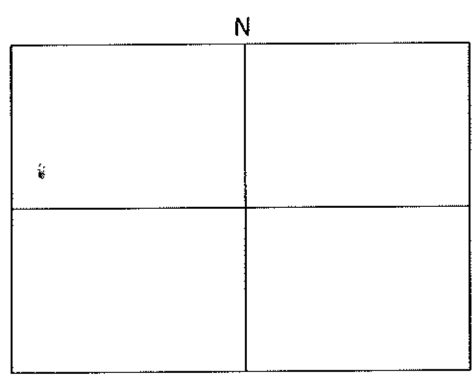
Type of Column

Base Structure

Top Structure



Column Construction ------



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Liquid Engineering Corporation

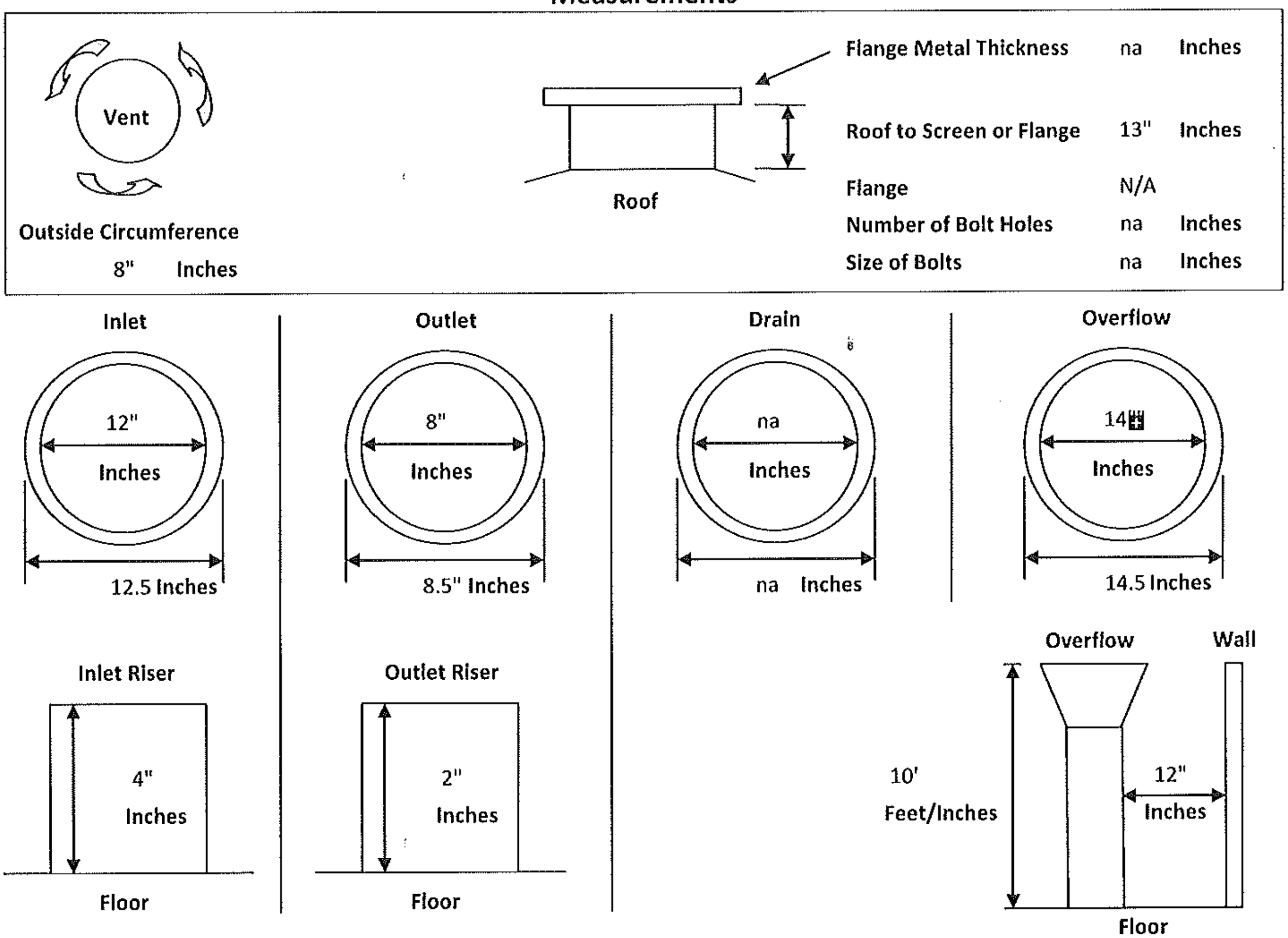
Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 53615 Utility Name Cabinet Mountains Water Tank Name Tank1

Security

Is the area surrounding the tank well lit?	No
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

Measurements



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Liquid Engineering Corporation

Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Tank1

Inspector: Calhoun | Dive Controller: Lombardi | Date: 8/2/2019

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Below are the notables for the : Tank 1 Reservoir
The reservoir was in good over all condition There was an estimated (skiff) of sediment.
Inlet- Had concentration cell formations beginning to form.
Hatch- The outside of the hatch had slight peeling.
Vent- Was mounted into the top of the hatch which still had good seals keeping outside objects out.
Walls- Consisted of large areas of settling cracks. With one area on the outside seeping water.
Floor- There was a noted 1/16in of sediment and staining.
Overflow-Was unobstructed however below the water level there was concentration cells beginning to form.
Outlet- Had rust modules beginning to form around the outside.
Roof- There was settling cracks throughout the roof as well as bug holes and staining.
Liquid Engineering Corporation recommends another clean and inspect in three to five years.

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Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 Utility: Cabinet Mountains Water Tank: Tank1 Date: 8/2/2019

Inspector: Calhoun Dive Controller: Lombardi Capacity: 250kg Dimentions: 64'x42'

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s) ~~Expansion Joint(s)~~ ~~Support Beam(s)~~ ~~Beam Joint(s)~~	QC, B, R	QC, B, R	QC, B, R	QC, B, R

General Appearance: Good Coating: N/A

~~All expansion Joints~~: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

INTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	B,R,	B,R,	B,R,	B,R,
Wall Structure	B,R, QC	B,R, QC	B,R, QC	B,R, QC

General Appearance: Good Coating: N/A Leaking: Possible leaking

INTERIOR RESERVOIR SUPPORT COLUMNS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Columns	B,R,E	B,R,E	B,R,E	B,R,E
Column Capitals	B,R,E	B,R,E	B,R,E	B,R,E
Column Bases	B,R,E	B,R,E	B,R,E	B,R,E

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	R, B	R, B	R, B	R, B
Floor Slabs	R, B	R, B	R, B	R, B

General Appearance: Good Coating: N/A Sump System: Good Leaking: None observed

~~All expansion Joints~~ Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

Additional Comments:

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Tank1

Inspector: Calhoun | Dive Controller: Lombardi | Date: 8/2/2019

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1 SSPC Rating	QUADRANT 1 Corrosion	QUADRANT 2 SSPC Rating	QUADRANT 2 Corrosion	QUADRANT 3 SSPC Rating	QUADRANT 3 Corrosion	QUADRANT 4 SSPC Rating	QUADRANT 4 Corrosion
Inlet Plumbing	8	Minor	N/A	------	N/A	------	N/A	------
Outlet Plumbing	N/A	------	N/A	------	N/A	------	7	Minor
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
Interior Overflow	N/A	------	N/A	------	N/A	------	8	Minor
~~Other Plumbing~~	N/A	------	N/A	------	N/A	------	N/A	------

Coating Deficiencies: ☑ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Good   Average Blister Size 1"

Over All Structural Condition Good   Weld Condition ----   Average Pit Depth

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R,B,QC	R,B,QC	R,B,QC	R,B,QC
~~Expansion Joint(s)~~				

General Appearance: Good   Coating: N/A   Vents: Good   Level Indicator: ------

~~All expansion Joints~~ Uniform width: ------   Uniform Level: ------   Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	R,B,QC	R,B,QC	R,B,QC	R,B,QC
Wall Structure	R,B,QC	R,B,QC	R,B,QC	R,B,QC

General Appearance: Good   Coating: N/A   Leaking: Possible leaking

Overflow Structure: Good

~~All expansion Joints~~ Uniform width: ------   Uniform Level: ------   Gaskets Intact: ------

~~EXTERIOR RESERVOIR FOOTINGS / FOUNDATION~~

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	Below Ground	unable to evaluate		
Footing Ring	Below Ground	unable to evaluate		

~~General Appearance:~~ ------   Coating: N/A   Leaking: ------   Ground Subsidence: ------

~~All expansion Joints~~ Uniform Width: ------   Uniform Level: ------   Gaskets Intact: ------

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Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Tank1
Inspector: Calhoun | Dive Controller: Lombardi | Date: 8/2/2019

FACILITY SAFETY & HEALTH

Primary Air Vent	Type: J-Tube	Screen : Good	Frost Proof: No	Vac. Press Proof: No
Exterior Overflow	Flapper: No	Screen: Yes	Gasket: No	Condition: Good
~~**Cathodic Protection**~~	System Installed: ----	**Cathodic Access Covers**	#: ----	Properly Sealed: ----
Water Level Indicator	Type: Electronic	Condition: Good	**Pennetration Points**	Properly Sealed: Yes
~~**Heater System**~~	Installed: ----	Type: ------		
1st Access Hatch	Type: Square	Size: 25"x50"	in. (24" - 24" x 15" min)	Properly Sealed: Yes
Hatch Height: 9"	in. (min 4")	Lid Height: 2"	in (min 2")	Properly Secured: Yes
~~**2nd Access Hatch**~~	Type: ------	Size:	in. (24" - 24" x 15" min)	Properly Sealed: ----
Hatch Height:	in. (min 4")	Lid Height:	in (min 2")	Properly Secured: ----

~~**Primary Manway**~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size:	in (24" - 18"x22")		
Support Structure	Type: -------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

Primary Exterior Ladder

Location	Wall: Q3	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: Good	Height: 10'	Offset Landing: No			
Vandal Guard	Present: No	Locked: ----				
Ladder Rails & Rungs	Condition: Good	Anti-Skid Rungs: No	Missing/Damaged Rungs: No			
Rung Spacing & Depth	Spacing: 12"	in. (max 12")	Toe Depth: 9"	in. (min 7")		
Rail Spacing & Size	Width: 2"	in. (min 2")	Thickness: 1/4"	in. (min 1/4")	Rail to Rail: 18"	in. (min 16")
Safety Climb System	Type: None	Condition: ----				

~~**Primary Balcony & Railing**~~

Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width: na	in. (min 24")	
Top Rails	Condition: ----	Height: na	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height: na	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height: na	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: Yes	Standing Water: No	Other:
Wall Integrity:	Holes: No	Cracking: Yes	Leaks: Yes	Other:
Safety Tie-Off Points	Type: Integrated	#: 5+		Condition: Good
Antennas	Type: Receiving	#: 1	Location(s): Roof: Q3 Bowl: Leg:	Other:
Water Clarity	General Appearance: Good	Odor: None		Surface Debris: none
~~**Hypalon Floating Cover**~~	Condition: ----	Holes: ----		Tears: ----
~~**Grounding System**~~	Present: ----			

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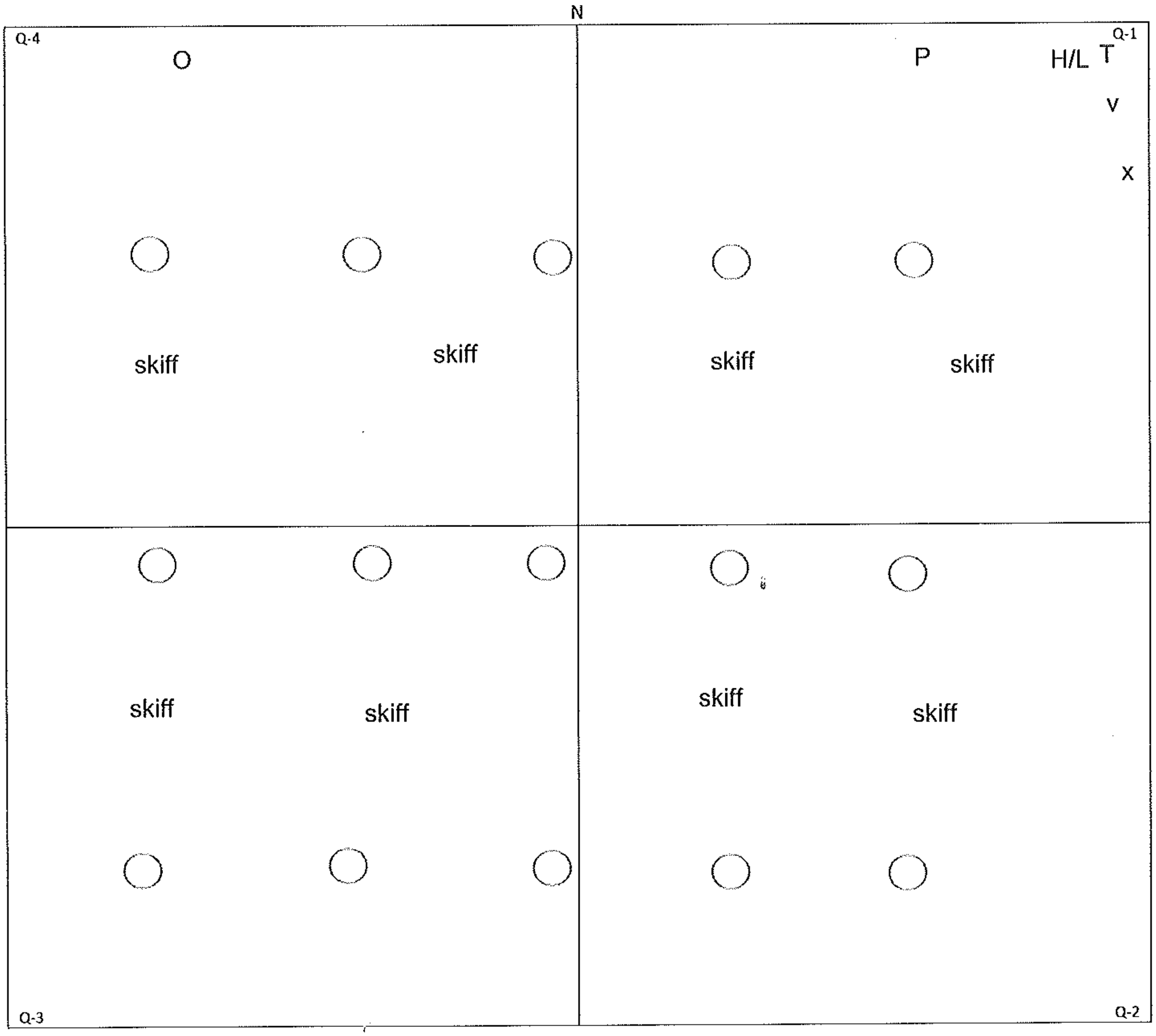
Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

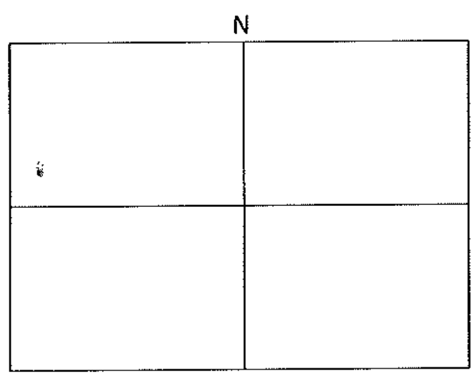
Job Number 53615 Utility Name Cabinet Mountains Water Tank Name Tank1



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth skiff **Cubic Yardage** na **Sediment Type** Iron manganese



Plumbing & Structure location

Plumbing and structure codes

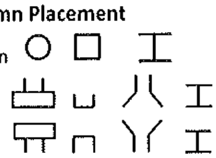
O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

Column Placement

Type of Column

Base Structure

Top Structure



Column Construction ------

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Liquid Engineering Corporation

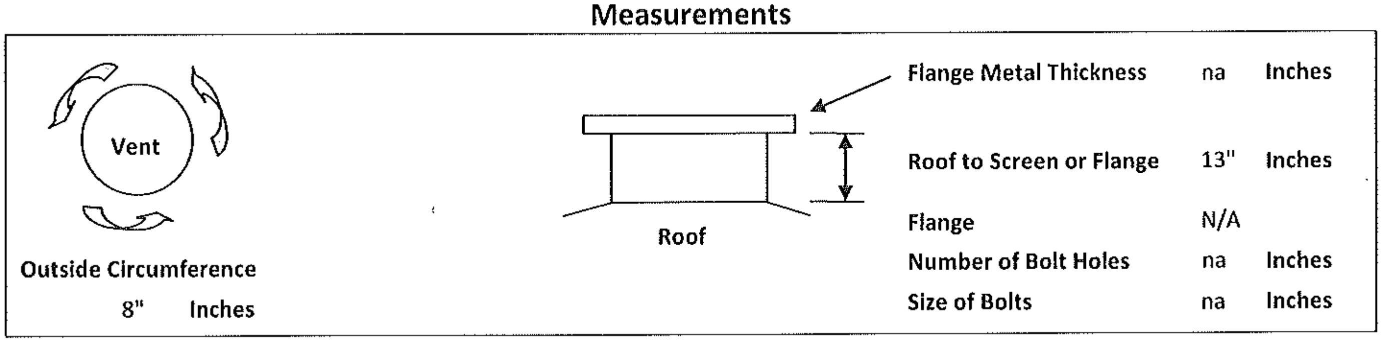
Steel Potable Water Reservoir Security / Measurement Worksheet

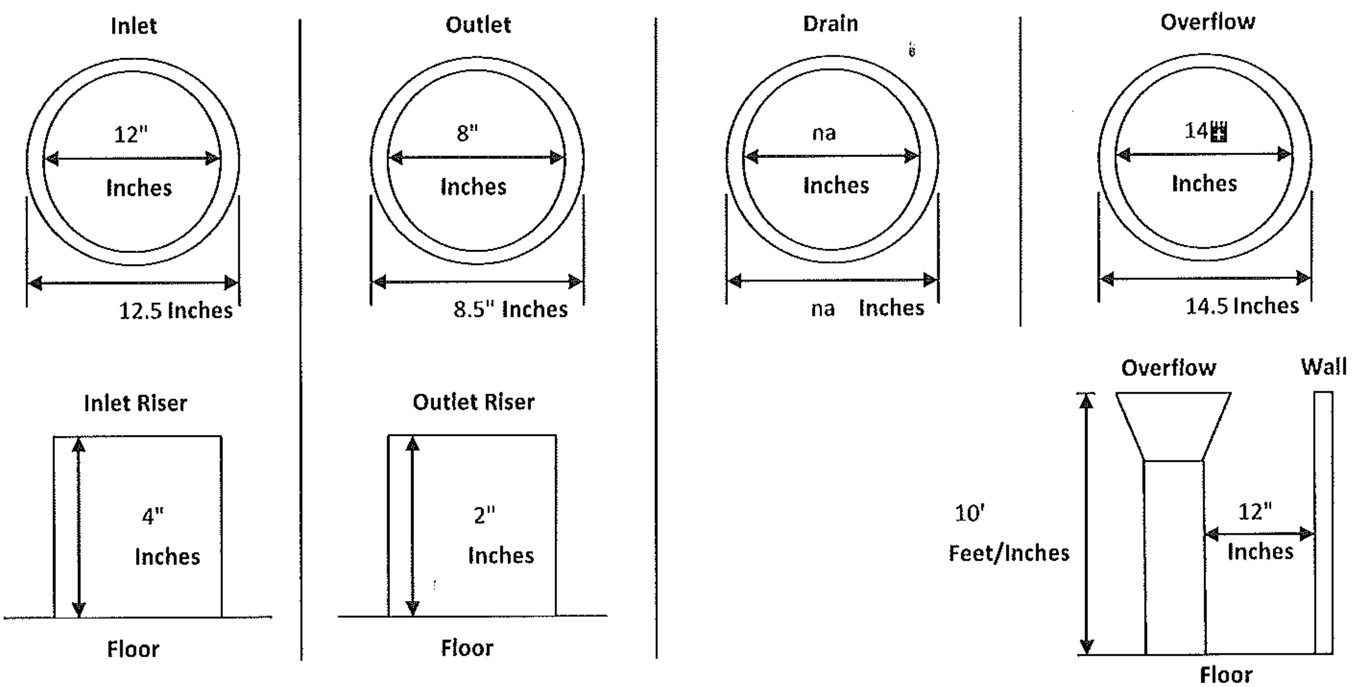
Job Number 53615   Utility Name Cabinet Mountains Water   Tank Name Tank1

Security

Is the area surrounding the tank well lit?	No
Is the tank surrounded by a Security Fence?	Yes
Are the access gates locked?	Yes
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	Yes
Does the exterior of the tank show signs of trespass?	No

Measurements





Liquid Engineering Corporation

Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 53615 Utility: Cabinet Mountains Water Tank: Tank1

Inspector: Calhoun Dive Controller: Lombardi Date: 8/2/2019

1. **Health and Safety Items**
   - [ ] Safety Climb System Installation:
   - [ ] Vent Screen Repairs:

2. **Testing Items**
   - [ ] Dye Testing for Leak Evaluation:
   - [ ] Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - [ ] Epoxy Coating Repairs:
   - [ ] Temporary Leak Repairs:
   - [ ] Float Operated Level Indicator Repairs / Maintenance:
   - [ ] Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - [ ] Tank vents are not equipped with a security vent shroud:
   - [ ] Tank hatches are not equipped with a security hatch locking device:
   - [ ] Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Below are the notables for the : Tank 1 Reservoir
The reservoir was in good over all condition There was an estimated (skiff) of sediment.
Inlet- Had concentration cell formations beginning to form.
Hatch- The outside of the hatch had slight peeling.
Vent- Was mounted into the top of the hatch which still had good seals keeping outside objects out.
Walls- Consisted of large areas of settling cracks. With one area on the outside seeping water.
Floor- There was a noted 1/16in of sediment and staining.
Overflow-Was unobstructed however below the water level there was concentration cells beginning to form.
Outlet- Had rust modules beginning to form around the outside.
Roof- There was settling cracks throughout the roof as well as bug holes and staining.
Liquid Engineering Corporation recommends another clean and inspect in three to five years.

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Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 Utility: Cabinet Mountains Tank: Tank 2 Date: 8/2/2019

Inspector: Joe Lombardi Dive Controller: Jacob Calhoun Capacity: 250kg Dimentions: 64'x42'

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	B, R,QC	B, R,QC	B, R,QC	B, R,QC
~~Expansion Joint(s)~~				
~~Support Beam(s)~~				
~~Beam Joint(s)~~				

General Appearance: Good Coating: N/A

~~All expansion Joints:~~ Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

INTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	R,B	R,B	R,B	R,B
Wall Structure	R,B,QC,E	R,B,QC,E	R,B,QC,E	R,B,QC,E

General Appearance: Good Coating: N/A Leaking: None observed

INTERIOR RESERVOIR SUPPORT COLUMNS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Columns	R,B,QC,E	R,B,QC,E	R,B,QC,E	R,B,QC,E
Column Capitals	R,B	R,B	R,B	R,B
Column Bases	R,B	R,B	R,B	R,B

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A Sump System: ------ Leaking: None observed

~~All expansion Joints~~ Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

Additional Comments:

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Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 | Utility: Cabinet Mountains | Tank: Tank 2

Inspector: Joe Lombardi | Dive Controller: Jacob Calhoun | Date: 8/2/2019

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	N/A	------	N/A	------	7	Minor
Outlet Plumbing	N/A	------	N/A	------	N/A	------	7	Minor
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
Interior Overflow	N/A	------	N/A	------	N/A	------	8	None Noted
Other Plumbing	N/A	------	8	Minor	N/A	------	N/A	------

Coating Deficiencies: ☑ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Fair | Average Blister Size 1"

Over All Structural Condition Good | Weld Condition Good | Average Pit Depth na

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s) / ~~Expansion Joint(s)~~	B, R,QC	B, R,QC	B, R,QC	B, R,QC

General Appearance: Good | Coating: N/A | Vents: Good | Level Indicator: N/A

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	B, R	B, R	B, R	B, R
Wall Structure	B, R,QC	B, R,QC	B, R,QC	B, R,QC

General Appearance: Good | Coating: N/A | Leaking: Possible leaking

Overflow Structure: Good

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

~~EXTERIOR RESERVOIR FOOTINGS / FOUNDATION~~

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	Below Ground	unable to evaluate		
Footing Ring	Below Ground	unable to evaluate		

General Appearance: ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

All expansion Joints Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

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Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 53615	Utility: Cabinet Mountains	Tank: Tank 2
Inspector: Joe Lombardi	Dive Controller: Jacob Calhoun	Date: 8/2/2019

FACILITY SAFETY & HEALTH

Primary Air Vent	Type: Mushroom	Screen : Good		Frost Proof: No		Vac. Press Proof: No
Exterior Overflow	Flapper: No	Screen: Yes		Gasket: No		Condition: Good
~~**Cathodic Protection**~~	System Installed: No	**Cathodic Access Covers**		#: ----		Properly Sealed: ----
Water Level Indicator	Type: Electronic	Condition: Good		**Pennetration Points**		Properly Sealed: Yes
~~**Heater System**~~	Installed: ----	Type: ------				
1st Access Hatch	Type: Square	Size: 24"x47"	in. (24" - 24" x 15" min)			Properly Sealed: Yes
Hatch Height: 8"	in. (min 4")	Lid Height: 1.5"	in (min 2")			Properly Secured: Yes
~~**2nd Access Hatch**~~	Type: ------	Size: NA	in. (24" - 24" x 15" min)			Properly Sealed: ----
Hatch Height: NA	in. (min 4")	Lid Height: NA	in (min 2")			Properly Secured: ----

~~**Primary Manway**~~

Locations	Wall: na	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size: na	in (24" - 18"x22")		
Support Structure	Type: -------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

Primary Exterior Ladder

Location	Wall: Q4	Leg:	Roof:	Riser Pipe:		Other:	
Overall Ladder	Condition: Good	Height: 10'	Offset Landing: No				
Vandal Guard	Present: No	Locked: ----					
Ladder Rails & Rungs	Condition: Good	Anti-Skid Rungs: No		Missing/Damaged Rungs: No			
Rung Spacing & Depth	Spacing: 18	in. (max 12")	Toe Depth: 13"	in. (min 7")			
Rail Spacing & Size	Width: 2"	in. (min 2")	Thickness: 1/2"	in. (min 1/4")	Rail to Rail: 12"	in. (min 16")	
~~**Safety Climb System**~~	Type: None	Condition: ----					

~~**Primary Balcony & Railing**~~

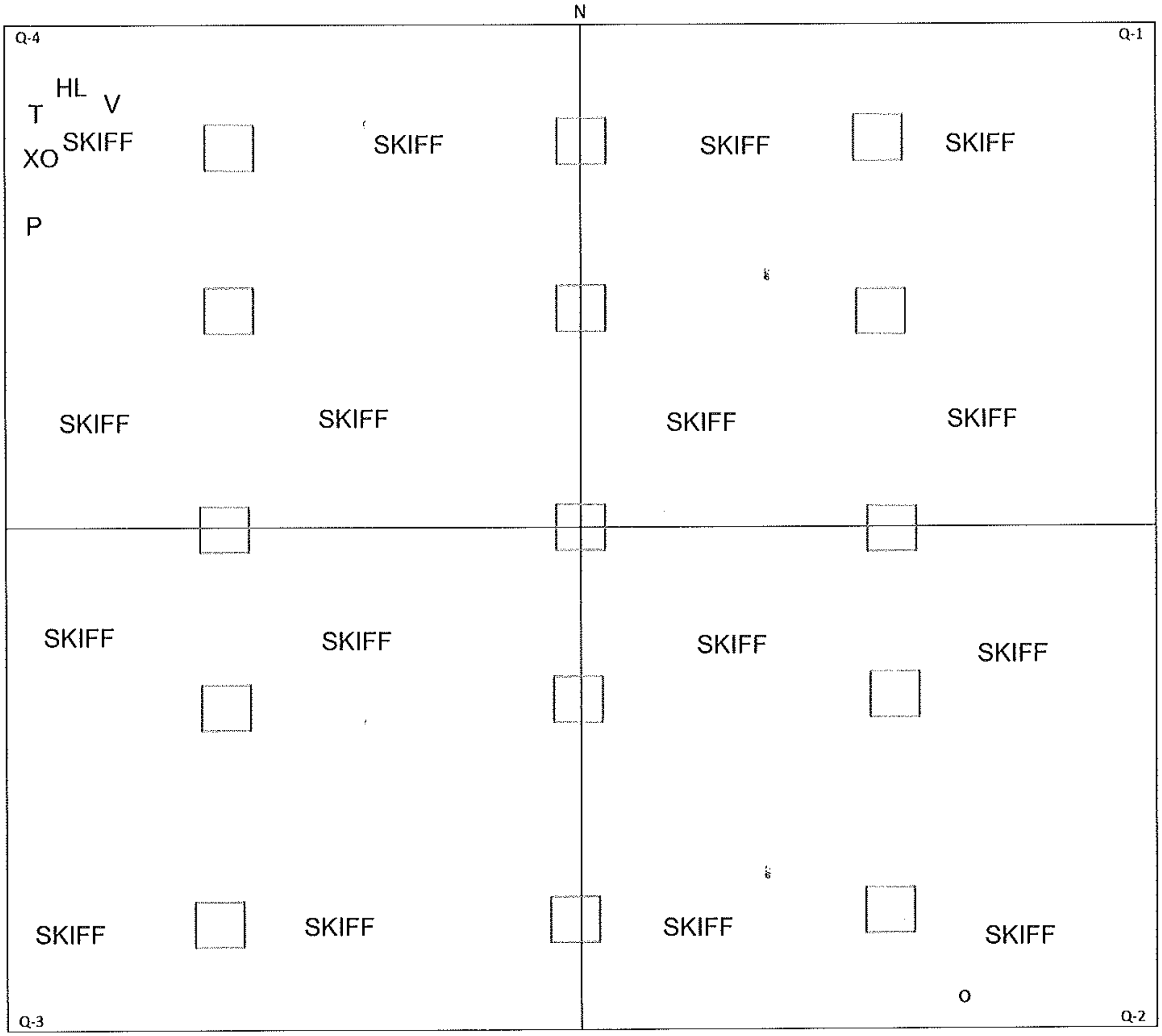
Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width: na	in. (min 24")	
Top Rails	Condition: ----	Height: na	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height: na	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height: na	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: No	Standing Water: No	Other:			
Wall Integrity:	Holes: No	Cracking: Yes	Leaks: No	Other:			
Safety Tie-Off Points	Type: Structural		#: 2	Condition: Good			
~~**Antennas**~~	Type: ----		#:	Location(s): Roof:	Bowl:	Leg:	Other:
Water Clarity	General Appearance: Good		Odor: None	Surface Debris: None			
~~**Hypalon Floating Cover**~~	Condition: ----		Holes: ----	Tears: ----			
~~**Grounding System**~~	Present: ----						

Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

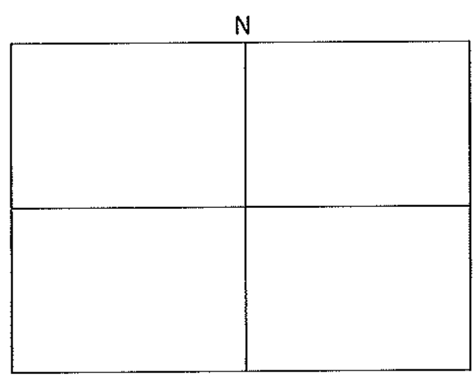
Job Number 53615 Utility Name Cabinet Mountains Tank Name Tank 2



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth SKIFF **Cubic Yardage** Na **Sediment Type** Iron Manganize



Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway

V=Vent D=Drain S=Sump

L=Ladder H=Hatch P=Overflow

F=Float Level Indicator

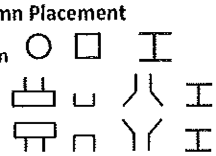
T=Telemetry

Column Placement

Type of Column

Base Structure

Top Structure



Column Construction Concrete

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Liquid Engineering Corporation

Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 53615 | Utility Name Cabinet Mountains | Tank Name Tank 2

Security

Is the area surrounding the tank well lit?	No
Is the tank surrounded by a Security Fence?	No
Are the access gates locked?	No
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	No
Does the exterior of the tank show signs of trespass?	No

Measurements

Vent

Outside Circumference
8" Inches

Roof

Flange Metal Thickness	NA	Inches
Roof to Screen or Flange	16"	Inches
Flange	No	
Number of Bolt Holes	NA	Inches
Size of Bolts	NA	Inches

Inlet
12" Inches
12.5 Inches

Outlet
8" Inches
8.5 Inches

Drain
NA Inches
NA Inches

Overflow
12" Inches
12 Inches

Inlet Riser
NA Inches
Floor

Outlet Riser
7" Inches
Floor

Overflow | Wall
10' Feet/Inches
24" Inches
Floor

Liquid Engineering Corporation

Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 53615 | Utility: Cabinet Mountains | Tank: Tank 2

Inspector: Joe Lombardi | Dive Controller: Jacob Calhoun | Date: 8/2/2019

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Below are the notables for the : Tank 2 Reservoir
The reservoir was in good overall condition there was an estimated (SKIFF) of iron manganese sediment.
Inlet/ Outlet- Had light staining with light rust nodules forming mainly on the edges.
Hatch- Was in good repair with delamination of coating but could be locked and sealed properly.
Vent- Mushroom type attached to the top of hatch, the screen was in good repair.
Walls- The walls had a build up of efflorescence as well as bug holes, staining, and settling cracks.
Floor- The floor had a skiff of iron manganese and light staining in all four quadrants.
Overflow- The overflow was in good repair but had staining around the pipe and concentration cell formations on the flanges.
Outlet #2- The outlet had light staining and uniform corrosion.
Roof- There were bug holes and staining found during inspection.
Liquid Engineering Corporation recommends another clean and inspect in three to five years.

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Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 Utility: Cabinet Mountains Tank: Tank 2 Date: 8/2/2019

Inspector: Joe Lombardi Dive Controller: Jacob Calhoun Capacity: 250kg Dimentions: 64'x42'

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	B, R,QC	B, R,QC	B, R,QC	B, R,QC
~~Expansion Joint(s)~~				
~~Support Beam(s)~~				
~~Beam Joint(s)~~				

General Appearance: Good Coating: N/A

~~All expansion Joints~~: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

INTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	R,B	R,B	R,B	R,B
Wall Structure	R,B,QC,E	R,B,QC,E	R,B,QC,E	R,B,QC,E

General Appearance: Good Coating: N/A Leaking: None observed

INTERIOR RESERVOIR SUPPORT COLUMNS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Columns	R,B,QC,E	R,B,QC,E	R,B,QC,E	R,B,QC,E
Column Capitals	R,B	R,B	R,B	R,B
Column Bases	R,B	R,B	R,B	R,B

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	R	R	R	R
Floor Slabs	R	R	R	R

General Appearance: Good Coating: N/A Sump System: ------ Leaking: None observed

~~All expansion Joints~~ Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

Additional Comments:

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Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 | Utility: Cabinet Mountains | Tank: Tank 2

Inspector: Joe Lombardi | Dive Controller: Jacob Calhoun | Date: 8/2/2019

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1		QUADRANT 2		QUADRANT 3		QUADRANT 4	
	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion	SSPC Rating	Corrosion
Inlet Plumbing	N/A	------	N/A	------	N/A	------	7	Minor
Outlet Plumbing	N/A	------	N/A	------	N/A	------	7	Minor
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
Interior Overflow	N/A	------	N/A	------	N/A	------	8	None Noted
Other Plumbing	N/A	------	8	Minor	N/A	------	N/A	------

Coating Deficiencies: ☑ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Fair | Average Blister Size 1"

Over All Structural Condition Good | Weld Condition Good | Average Pit Depth na

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s) / ~~Expansion Joint(s)~~	B, R,QC	B, R,QC	B, R,QC	B, R,QC

General Appearance: Good | Coating: N/A | Vents: Good | Level Indicator: N/A

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	B, R	B, R	B, R	B, R
Wall Structure	B, R,QC	B, R,QC	B, R,QC	B, R,QC

General Appearance: Good | Coating: N/A | Leaking: Possible leaking

Overflow Structure: Good

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

~~EXTERIOR RESERVOIR FOOTINGS / FOUNDATION~~

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	Below Ground	unable to evaluate		
Footing Ring	Below Ground	unable to evaluate		

General Appearance: ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

All expansion Joints Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

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Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 53615 | Utility: Cabinet Mountains | Tank: Tank 2

Inspector: Joe Lombardi | Dive Controller: Jacob Calhoun | Date: 8/2/2019

FACILITY SAFETY & HEALTH

Primary Air Vent	Type: Mushroom	Screen : Good	Frost Proof: No	Vac. Press Proof: No
Exterior Overflow	Flapper: No	Screen: Yes	Gasket: No	Condition: Good
~~**Cathodic Protection**~~	System Installed: No	**Cathodic Access Covers**	#: ----	Properly Sealed: ----
Water Level Indicator	Type: Electronic	Condition: Good	**Pennetration Points**	Properly Sealed: Yes
~~**Heater System**~~	Installed: ----	Type: ------		
1st Access Hatch	Type: Square	Size: 24"x47"	in. (24" - 24" x 15" min)	Properly Sealed: Yes
Hatch Height: 8"	in. (min 4")	Lid Height: 1.5"	in (min 2")	Properly Secured: Yes
~~**2nd Access Hatch**~~	Type: ------	Size: NA	in. (24" - 24" x 15" min)	Properly Sealed: ----
Hatch Height: NA	in. (min 4")	Lid Height: NA	in (min 2")	Properly Secured: ----

~~**Primary Manway**~~

Locations	Wall: na	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size: na	in (24" - 18"x22")		
Support Structure	Type: -------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

Primary Exterior Ladder

Location	Wall: Q4	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: Good	Height: 10'	Offset Landing: No			
Vandal Guard	Present: No	Locked: ----				
Ladder Rails & Rungs	Condition: Good	Anti-Skid Rungs: No	Missing/Damaged Rungs: No			
Rung Spacing & Depth	Spacing: 18	in. (max 12")	Toe Depth: 13"	in. (min 7")		
Rail Spacing & Size	Width: 2"	in. (min 2")	Thickness: 1/2"	in. (min 1/4")	Rail to Rail: 12"	in. (min 16")
~~**Safety Climb System**~~	Type: None	Condition: ----				

~~**Primary Balcony & Railing**~~

Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width: na	in. (min 24")	
Top Rails	Condition: ----	Height: na	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height: na	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height: na	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: No	Standing Water: No	Other:		
Wall Integrity:	Holes: No	Cracking: Yes	Leaks: No	Other:		
Safety Tie-Off Points	Type: Structural	#: 2	Condition: Good			
~~**Antennas**~~	Type: ----	#:	Location(s): Roof:	Bowl:	Leg:	Other:
Water Clarity	General Appearance: Good	Odor: None	Surface Debris: None			
~~**Hypalon Floating Cover**~~	Condition: ----	Holes: ----	Tears: ----			
~~**Grounding System**~~	Present: ----					

DISCLAIMER

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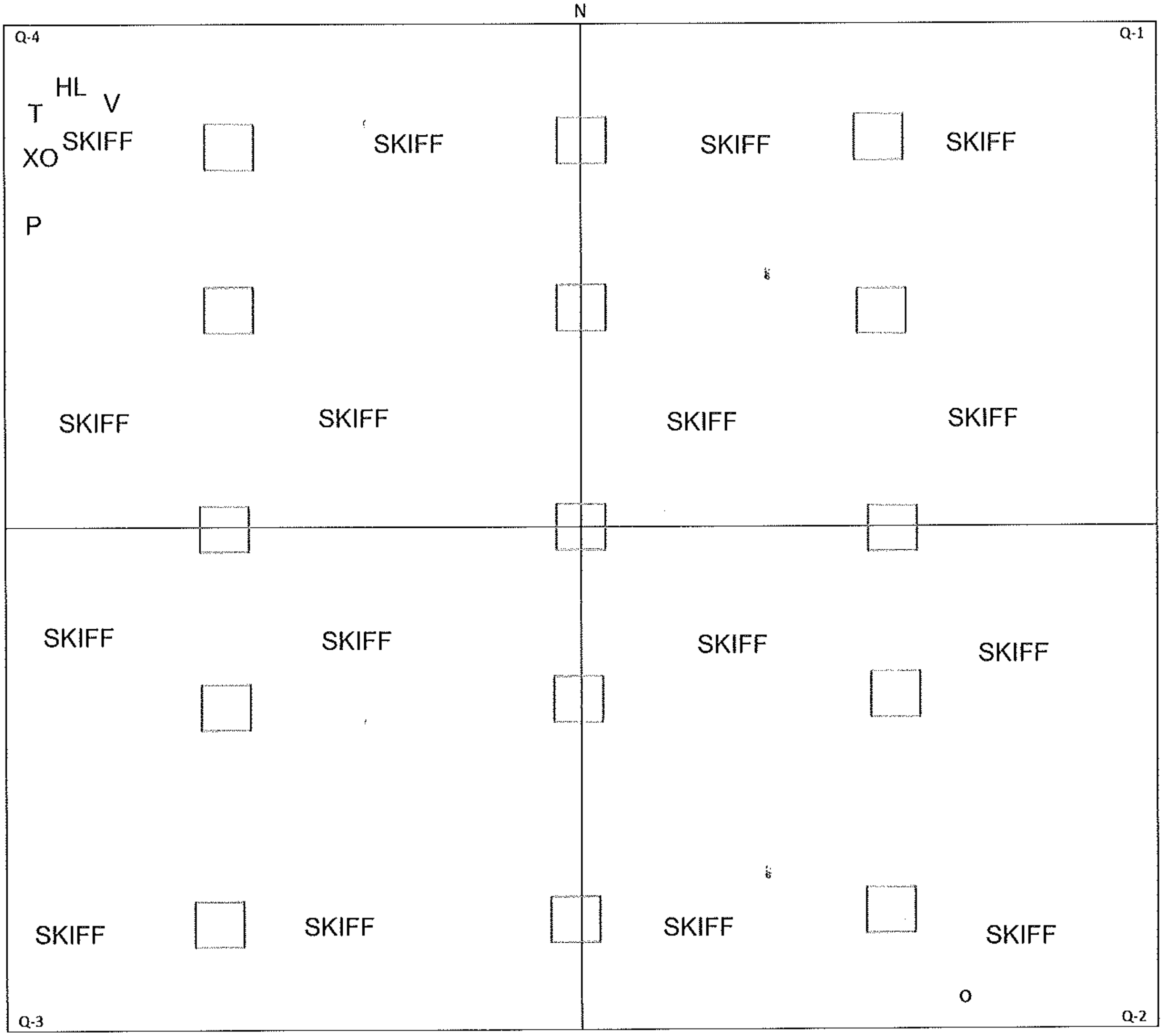
Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 53615 Utility Name Cabinet Mountains Tank Name Tank 2

N

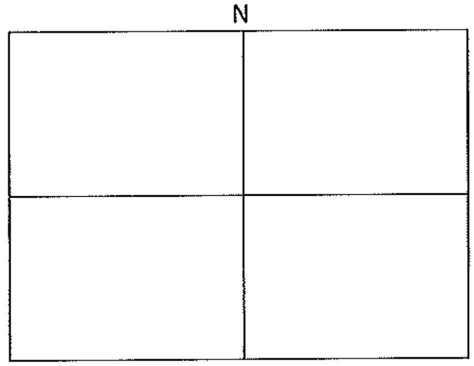


Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth SKIFF **Cubic Yardage** Na **Sediment Type** Iron Manganize

N



Plumbing & Structure location

Plumbing and structure codes

O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

Column Placement

Type of Column

Base Structure

Top Structure

Column Construction Concrete

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Liquid Engineering Corporation

Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 53615 | Utility Name Cabinet Mountains | Tank Name Tank 2

Security

Is the area surrounding the tank well lit?	No
Is the tank surrounded by a Security Fence?	No
Are the access gates locked?	No
Is the tank equipped with a Vandal Guard on the primary access ladder?	No
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	No
Does the exterior of the tank show signs of trespass?	No

Measurements

Vent

Outside Circumference
8" Inches

Roof

Flange Metal Thickness NA Inches

Roof to Screen or Flange 16" Inches

Flange No

Number of Bolt Holes NA Inches

Size of Bolts NA Inches

Inlet
12" Inches
12.5 Inches

Outlet
8" Inches
8.5 Inches

Drain
NA Inches
NA Inches

Overflow
12" Inches
12 Inches

Inlet Riser
NA Inches
Floor

Outlet Riser
7" Inches
Floor

Overflow | Wall
10' Feet/Inches
24" Inches
Floor

Liquid Engineering Corporation

Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 53615 | Utility: Cabinet Mountains | Tank: Tank 2

Inspector: Joe Lombardi | Dive Controller: Jacob Calhoun | Date: 8/2/2019

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Below are the notables for the : Tank 2 Reservoir
The reservoir was in good overall condition there was an estimated (SKIFF) of iron manganese sediment.
Inlet/ Outlet- Had light staining with light rust nodules forming mainly on the edges.
Hatch- Was in good repair with delamination of coating but could be locked and sealed properly.
Vent- Mushroom type attached to the top of hatch, the screen was in good repair.
Walls- The walls had a build up of efflorescence as well as bug holes, staining, and settling cracks.
Floor- The floor had a skiff of iron manganese and light staining in all four quadrants.
Overflow- The overflow was in good repair but had staining around the pipe and concentration cell formations on the flanges.
Outlet #2- The outlet had light staining and uniform corrosion.
Roof- There were bug holes and staining found during inspection.
Liquid Engineering Corporation recommends another clean and inspect in three to five years.

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 Utility: Cabinet Mountains Water Tank: Booster Station Date: 8/3/2019

Inspector: J.Visser Dive Controller: J. Lombardi Capacity: 50kg Dimentions: 32'x20'

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R	R	R	R
~~Expansion Joint(s)~~				
~~Support Beam(s)~~				
~~Beam Joint(s)~~				

General Appearance: Good Coating: Good

~~All expansion Joints~~: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

INTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
~~Wall-Roof Joint~~				
Wall Structure	B,R,Q	B,R	B,R	B,R

General Appearance: Good Coating: Good Leaking: None observed

INTERIOR RESERVOIR SUPPORT COLUMNS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Columns	B,R			
~~Column Capitals~~				
Column Bases	B,R			

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
~~Perimeter Joint~~				
Floor Slabs	B,R	B,R	B,R	B,R

General Appearance: Good Coating: N/A Sump System: Good Leaking: None observed

~~All expansion Joints~~ Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

Additional Comments:

The interior of the tank saw light staining and bugholes throughout. The seams were in good repair and the floor to wall joint was solid throughout. The floor was covered in the light skiff of iron manganese sediment in all four quadrants and had light staining. The internal roof of the tank had light staining but was otherwise pristine. In quadrant 2 there was a notable settling crack but it was the only one located throughout the tank and would not cause any structural integrity loss.

Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Booster Station

Inspector: J.Visser | Dive Controller: J. Lombardi | Date: 8/3/2019

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1 SSPC Rating	QUADRANT 1 Corrosion	QUADRANT 2 SSPC Rating	QUADRANT 2 Corrosion	QUADRANT 3 SSPC Rating	QUADRANT 3 Corrosion	QUADRANT 4 SSPC Rating	QUADRANT 4 Corrosion
Inlet Plumbing	N/A	------	N/A	------	N/A	------	9	Minor
Outlet Plumbing	N/A	------	N/A	------	8	Minor	8	Minor
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
Interior Overflow	N/A	------	7	Minor	N/A	------	N/A	------
Other Plumbing	N/A	------	N/A	------	N/A	------	8	Minor

Coating Deficiencies: ☑ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Good   Average Blister Size 2"

Over All Structural Condition Good   Weld Condition Good   Average Pit Depth

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R,B	R,B	R,B	R,B
~~Expansion Joint(s)~~				

General Appearance: Good   Coating: N/A   Vents: Good   Level Indicator: Good

~~All expansion Joints~~   Uniform width: ------   Uniform Level: ------   Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	Below ground	unable to evaluate		
Wall Structure	Below ground	unable to evaluate		

General Appearance: ------   Coating: N/A   Leaking: ------

Overflow Structure: ------

All expansion Joints   Uniform width: ------   Uniform Level: ------   Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	Below ground	unable to evaluate		
Footing Ring	Below ground	unable to evaluate		

General Appearance: ------   Coating: N/A   Leaking: ------   Ground Subsidence: ------

All expansion Joints   Uniform Width: ------   Uniform Level: ------   Gaskets Intact: ------

DISCLAIMER

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Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Booster Station

Inspector: J.Visser | Dive Controller: J. Lombardi | Date: 8/3/2019

FACILITY SAFETY & HEALTH

Primary Air Vent	Type: Mushroom	Screen : Good	Frost Proof: No	Vac. Press Proof: No
~~**Exterior Overflow**~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----
~~**Cathodic Protection**~~	System Installed: ----	**Cathodic Access Covers**	#: ----	Properly Sealed: ----
Water Level Indicator	Type: Electronic	Condition: Good	**Pennetration Points**	Properly Sealed: Yes
~~**Heater System**~~	Installed: ----	Type: ------		
1st Access Hatch	Type: Square	Size: 23 1/2"x48"	in. (24" - 24" x 15" min)	Properly Sealed: Yes
Hatch Height: 8 1/2"	in. (min 4")	Lid Height: 2"	in (min 2")	Properly Secured: Yes
~~**2nd Access Hatch**~~	Type: ------	Size: na	in. (24" - 24" x 15" min)	Properly Sealed: ----
Hatch Height: na	in. (min 4")	Lid Height: na	in (min 2")	Properly Secured: ----

~~**Primary Manway**~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size:	in (24" - 18"x22")		
Support Structure	Type: -------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

~~**Primary Exterior Ladder**~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~**Primary Balcony & Railing**~~

Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width: na	in. (min 24")	
Top Rails	Condition: ----	Height: na	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height: na	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height: na	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: No	Standing Water: No	Other:
Wall Integrity:	Holes: No	Cracking: No	Leaks: No	Other:
Safety Tie-Off Points	Type: ----	#: na		Condition: ----
Antennas	Type: ----	#:	Location(s): Roof:	Bowl: Leg: Other:
Water Clarity	General Appearance: good	Odor: n/a		Surface Debris: n/a
Hypalon Floating Cover	Condition: ----	Holes: ----		Tears: ----
Grounding System	Present: ----			

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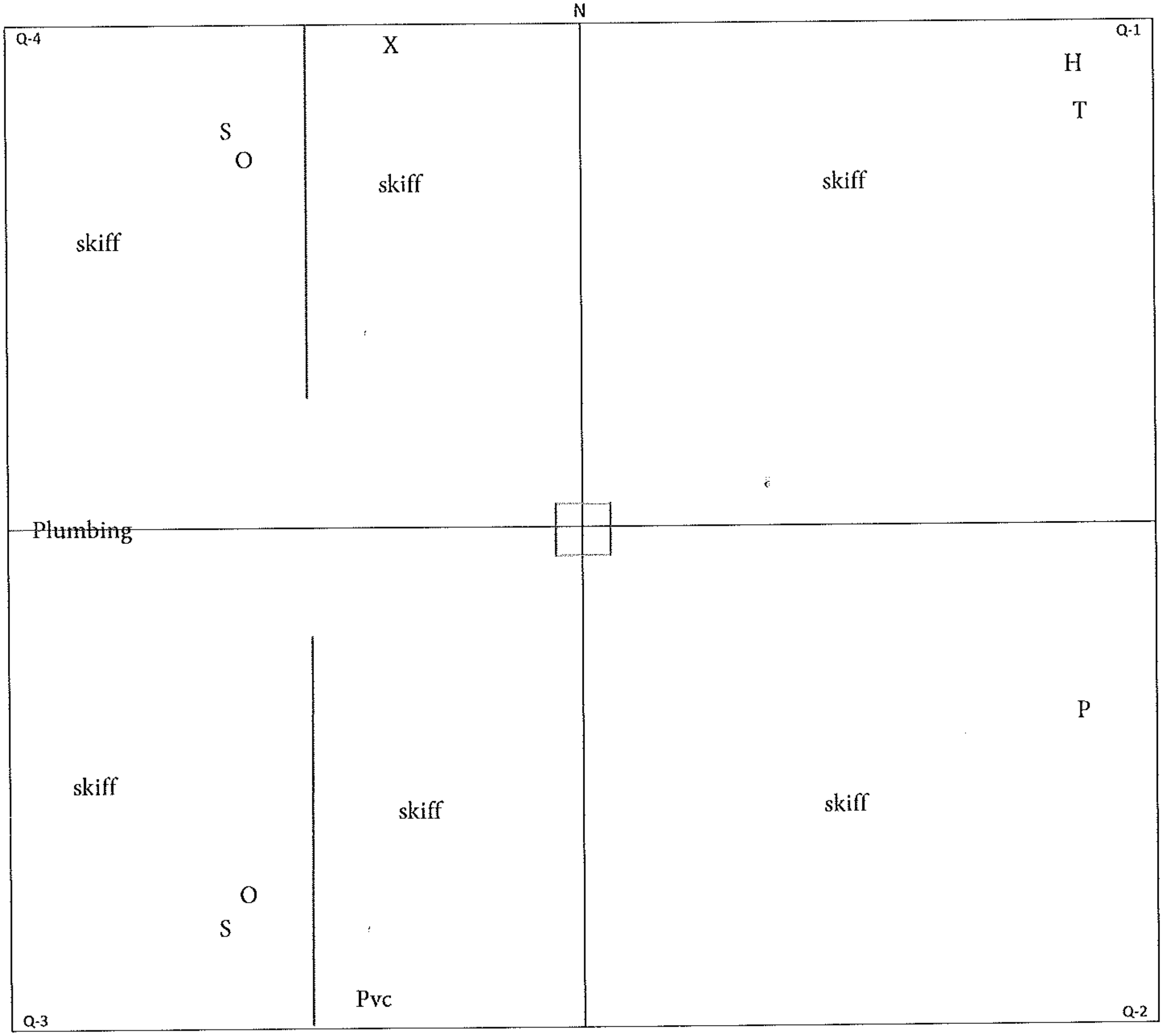
Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

Job Number 53615 Utility Name Cabinet Mountains Water Tank Name Booster Station



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth Skiff **Cubic Yardage** na **Sediment Type** Iron manganese

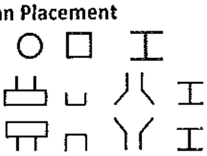
Plumbing & Structure location

Plumbing and structure codes

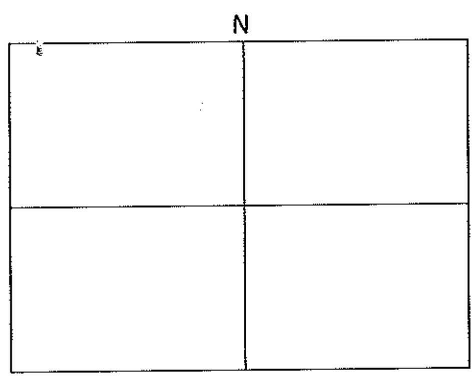
O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

Column Placement

Type of Column
Base Structure
Top Structure



Column Construction ------



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Liquid Engineering Corporation

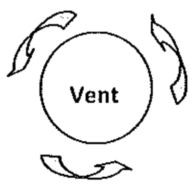
Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 53615 Utility Name Cabinet Mountains Water Tank Name Booster Station

Security

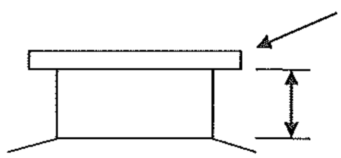
Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	No
Are the access gates locked?	N/A
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	No
Does the exterior of the tank show signs of trespass?	No

Measurements



Outside Circumference

6.5" Inches



Roof

Flange Metal Thickness na Inches

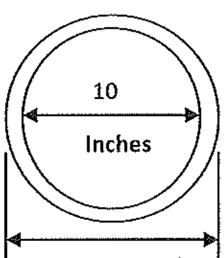
Roof to Screen or Flange 23" Inches

Flange N/A

Number of Bolt Holes na Inches

Size of Bolts na Inches

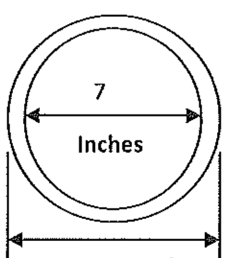
Inlet



10 Inches

10.5 Inches

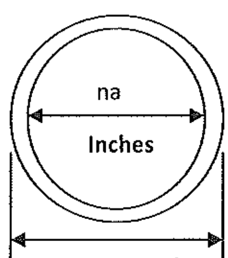
Outlet



7 Inches

7 Inches

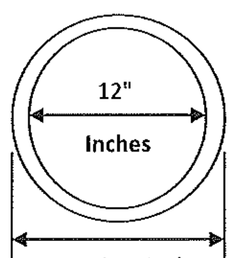
Drain



na Inches

na Inches

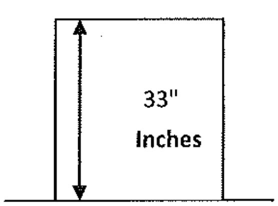
Overflow



12" Inches

12.5 Inches

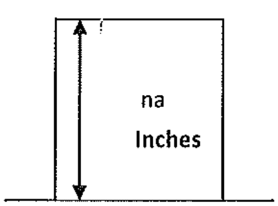
Inlet Riser



33" Inches

Floor

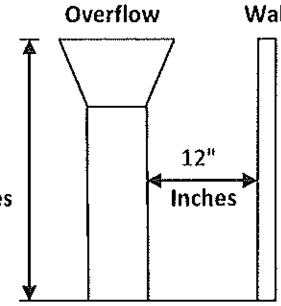
Outlet Riser



na Inches

Floor

Overflow Wall



10' Feet/Inches

12" Inches

Floor

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Liquid Engineering Corporation

Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 53615 Utility: Cabinet Mountains Water Tank: Booster Station

Inspector: J.Visser Dive Controller: J. Lombardi Date: 8/3/2019

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Below are the notables for the : Booster Station Reservoir
The reservoir was in good condition there was estimated (1/16) of sediment.
Inlet- Consisted of concentration cell buildup around the bolts of the flange.
Hatch- The hatch was in good condition and met minimum requirements for size.
Vent- The vent was built into hatch and in good condition there was no screen it was a mushroom type vent.
Walls- There were small bugholes throughout, minor settling cracks in quadrant 2 south wall and light staining in all four quadrants.
Floor- Bugholes throughout entirety of the tank there was light iron manganese sediment (skiff) less than 1/16"and staining in the tank.
Overflow-Concentration cell formations were forming around first flange approx. 2" in diameter.
Outlet- The two pumps were housed in the floor which was 60" deep they both had slight corrosion / rust but were in good working order.
Roof-The roof had light staining but was in otherwise pristine condition.
Liquid Engineering Corporation recommends another clean and inspect in three to five years.

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Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 Utility: Cabinet Mountains Water Tank: Booster Station Date: 8/3/2019

Inspector: J.Visser Dive Controller: J. Lombardi Capacity: 50kg Dimentions: 32'x20'

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

INTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R	R	R	R
~~Expansion Joint(s)~~				
~~Support Beam(s)~~				
~~Beam Joint(s)~~				

General Appearance: Good Coating: Good

~~All expansion Joints~~: Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

INTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
~~Wall-Roof Joint~~				
Wall Structure	B,R,Q	B,R	B,R	B,R

General Appearance: Good Coating: Good Leaking: None observed

INTERIOR RESERVOIR SUPPORT COLUMNS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Columns	B,R			
~~Column Capitals~~				
Column Bases	B,R			

General Appearance: Good Coating: N/A

INTERIOR RESERVOIR FLOOR

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
~~Perimeter Joint~~				
Floor Slabs	B,R	B,R	B,R	B,R

General Appearance: Good Coating: N/A Sump System: Good Leaking: None observed

~~All expansion Joints~~ Uniform width: ------ Uniform Level: ------ Gaskets Intact: ------

Additional Comments:

The interior of the tank saw light staining and bugholes throughout. The seams were in good repair and the floor to wall joint was solid throughout. The floor was covered in the light skiff of iron manganese sediment in all four quadrants and had light staining. The internal roof of the tank had light staining but was otherwise pristine. In quadrant 2 there was a notable settling crack but it was the only one located throughout the tank and would not cause any structural integrity loss.

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Liquid Engineering Corporation

Concrete Water Reservoir Inspection Report

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Booster Station

Inspector: J.Visser | Dive Controller: J. Lombardi | Date: 8/3/2019

SSPC Rating

Grade	Description - Good Condition
10	No Rusting, or <0.01% of surface is rusted
9	Minor rusting, or <0.03% of surface is rusted
8	Isolated rust, <.01% of surface is rusted

SSPC Rating

Grade	Description - Fair Condition
7	Isolated rust, <.03% of surface is rusted
6	Extensive rusting, <1% of surface is rusted
5	Approximately 3% of the surface is rusted

SSPC Rating

Grade	Description - Poor Condition
4	Approximately 10% of the surface is rusted
3	Approximately 17% of the surface is rusted
2	Approximately 33% of the surface is rusted
1	Approximately 50% of the surface is rusted
0	Approximately 100% of the surface is rusted

INTERIOR RESERVOIR PLUMBING COMPONENTS

	QUADRANT 1 SSPC Rating	QUADRANT 1 Corrosion	QUADRANT 2 SSPC Rating	QUADRANT 2 Corrosion	QUADRANT 3 SSPC Rating	QUADRANT 3 Corrosion	QUADRANT 4 SSPC Rating	QUADRANT 4 Corrosion
Inlet Plumbing	N/A	------	N/A	------	N/A	------	9	Minor
Outlet Plumbing	N/A	------	N/A	------	8	Minor	8	Minor
~~Manways~~	N/A	------	N/A	------	N/A	------	N/A	------
~~Floor Drains~~	N/A	------	N/A	------	N/A	------	N/A	------
Interior Overflow	N/A	------	7	Minor	N/A	------	N/A	------
Other Plumbing	N/A	------	N/A	------	N/A	------	8	Minor

Coating Deficiencies: ☑ Blistering ☐ Delamination ☐ Chalking ☐ Checking ☐ Cracking ☐ Cratering ☐ Pinholes ☑ Staining ☐ Sags/Runs

Over All Coating Condition Good | Average Blister Size 2"

Over All Structural Condition Good | Weld Condition Good | Average Pit Depth

CONCRETE CONDITION CODE

A - Abrasion	D - Deformation	G - Contraction	J - Chalking	M - Erosion	P - Popouts	S - Spalling	V - Void
B - Bug Holes	E - Efflorescence	H - Deflection	K - Checking	N - Peeling	Q - Settling	T - Exposed Aggregate	X - Exposed Reinforcement
C - Cracking	F - Fissure	I - Delamination	L - Expansion	O - Curling	R - Stains		

EXTERIOR RESERVOIR ROOF

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Roof Slab(s)	R,B	R,B	R,B	R,B
~~Expansion Joint(s)~~				

General Appearance: Good | Coating: N/A | Vents: Good | Level Indicator: Good

~~All expansion Joints~~ Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR WALLS

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Wall-Roof Joint	Below ground	unable to evaluate		
Wall Structure	Below ground	unable to evaluate		

General Appearance: ------ | Coating: N/A | Leaking: ------

Overflow Structure: ------

All expansion Joints Uniform width: ------ | Uniform Level: ------ | Gaskets Intact: ------

EXTERIOR RESERVOIR FOOTINGS / FOUNDATION

	QUADRANT 1	QUADRANT 2	QUADRANT 3	QUADRANT 4
Perimeter Joint	Below ground	unable to evaluate		
Footing Ring	Below ground	unable to evaluate		

General Appearance: ------ | Coating: N/A | Leaking: ------ | Ground Subsidence: ------

All expansion Joints Uniform Width: ------ | Uniform Level: ------ | Gaskets Intact: ------

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Liquid Engineering Corporation

Potable Water Reservoir Contamination, Health and Safety Report (Primary)

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Booster Station

Inspector: J.Visser | Dive Controller: J. Lombardi | Date: 8/3/2019

FACILITY SAFETY & HEALTH

Primary Air Vent	Type: Mushroom	Screen : Good	Frost Proof: No	Vac. Press Proof: No
~~Exterior Overflow~~	Flapper: ----	Screen: ----	Gasket: ----	Condition: ----
~~Cathodic Protection~~	System Installed: ----	**Cathodic Access Covers**	#: ----	Properly Sealed: ----
Water Level Indicator	Type: Electronic	Condition: Good	**Pennetration Points**	Properly Sealed: Yes
~~Heater System~~	Installed: ----	Type: ------		
1st Access Hatch	Type: Square	Size: 23 1/2"x48"	in. (24" - 24" x 15" min)	Properly Sealed: Yes
Hatch Height: 8 1/2"	in. (min 4")	Lid Height: 2"	in (min 2")	Properly Secured: Yes
~~2nd Access Hatch~~	Type: ------	Size: na	in. (24" - 24" x 15" min)	Properly Sealed: ----
Hatch Height: na	in. (min 4")	Lid Height: na	in (min 2")	Properly Secured: ----

~~Primary Manway~~

Locations	Wall:	Leg:	Roof:	Riser Pipe:	Other:
Type and Size	Type: ------	Size:	in (24" - 18"x22")		
Support Structure	Type: -------	Condition: ----			
WT Integrity	Leaks: ----	Condition: ----			

~~Primary Exterior Ladder~~

Location	Wall:	Leg:	Roof:	Riser Pipe:	Other:	
Overall Ladder	Condition: ----	Height:	Offset Landing: ----			
Vandal Guard	Present: ----	Locked: ----				
Ladder Rails & Rungs	Condition: ----	Anti-Skid Rungs: ----	Missing/Damaged Rungs: ----			
Rung Spacing & Depth	Spacing:	in. (max 12")	Toe Depth:	in. (min 7")		
Rail Spacing & Size	Width:	in. (min 2")	Thickness:	in. (min 1/4")	Rail to Rail:	in. (min 16")
Safety Climb System	Type: ------	Condition: ----				

~~Primary Balcony & Railing~~

Location	On Roof:	Around Bowl:	At Interior Landing:	Other:
Deck / Walkways	Condition: ----	Width: na	in. (min 24")	
Top Rails	Condition: ----	Height: na	in. (min 42" +/- 3")	Swing Gate Present: ----
Mid Rails	Condition: ----	Height: na	in. (half the distance between top rail and floor)	
Toe Boards	Condition: ----	Height: na	in. (min 4")	

Roof Integrity:	Holes: No	Cracking: No	Standing Water: No	Other:
Wall Integrity:	Holes: No	Cracking: No	Leaks: No	Other:
Safety Tie-Off Points	Type: ----	#: na		Condition: ----
Antennas	Type: ----	#:	Location(s): Roof:	Bowl: Leg: Other:
Water Clarity	General Appearance: good	Odor: n/a		Surface Debris: n/a
Hypalon Floating Cover	Condition: ----	Holes: ----		Tears: ----
Grounding System	Present: ----			

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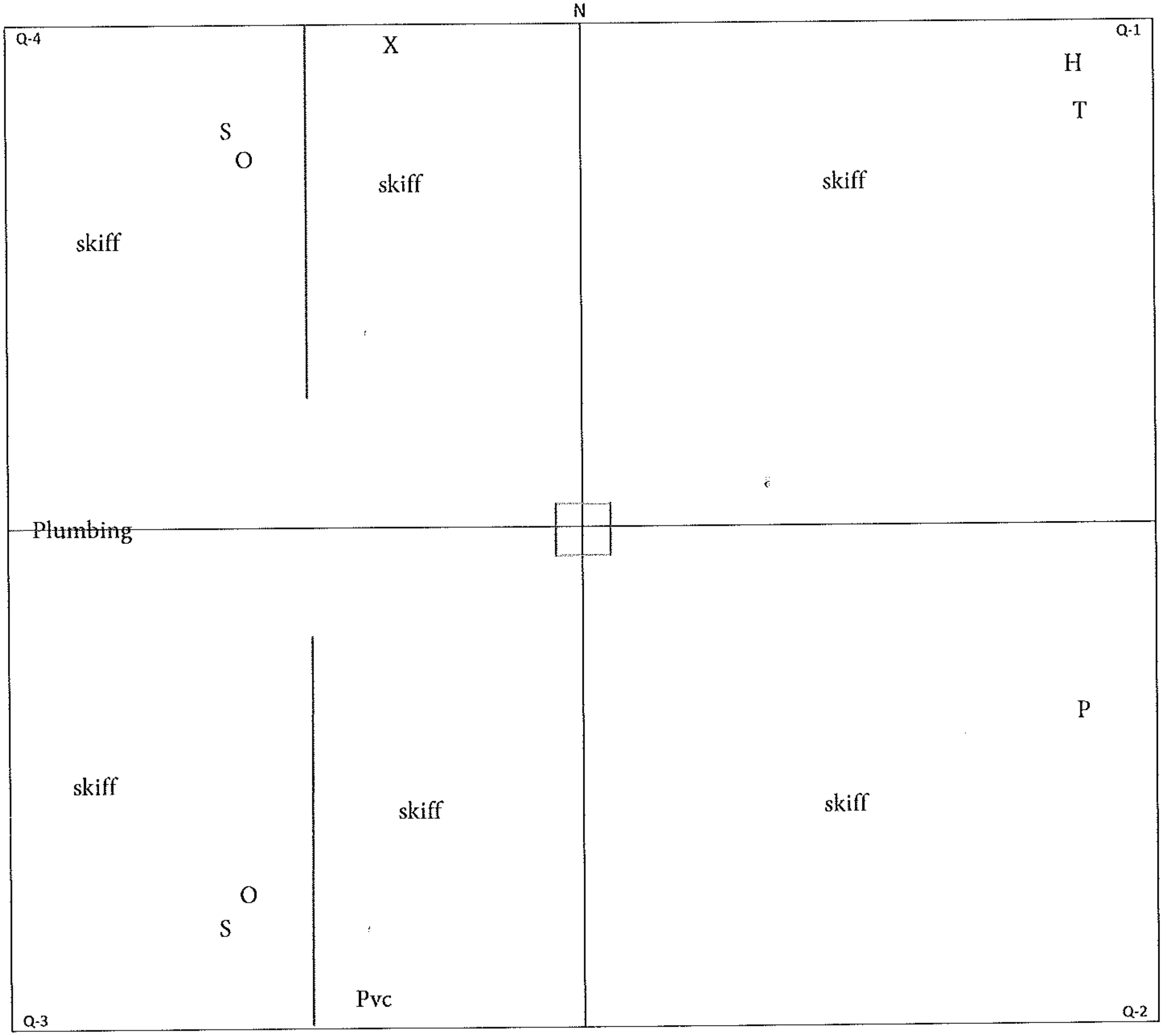
Liquid Engineering Corporation

Rectangular Tank Diagram / Information Worksheet

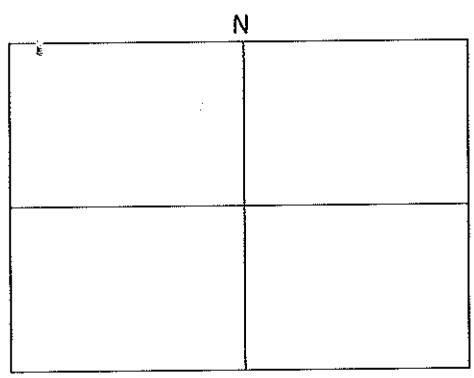
Job Number 53615 Utility Name Cabinet Mountains Water Tank Name Booster Station



Sediment Depth Measurements

Average Sediment Depth = The sum of all measurements taken, divided by the number of measurements taken

Avg. Depth Skiff **Cubic Yardage** na **Sediment Type** Iron manganese



Plumbing & Structure location

Plumbing and structure codes

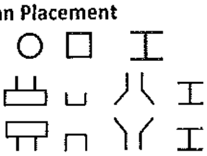
O=Outlet X=Inlet Z=Manway
V=Vent D=Drain S=Sump
L=Ladder H=Hatch P=Overflow
F=Float Level Indicator
T=Telemetry

Column Placement

Type of Column

Base Structure

Top Structure



Column Construction ------

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Liquid Engineering Corporation

Steel Potable Water Reservoir Security / Measurement Worksheet

Job Number 53615 Utility Name Cabinet Mountains Water Tank Name Booster Station

Security

Is the area surrounding the tank well lit?	Yes
Is the tank surrounded by a Security Fence?	No
Are the access gates locked?	N/A
Is the tank equipped with a Vandal Guard on the primary access ladder?	N/A
If so, is the Vandal Guard locked?	N/A
Are the access roads in good repair?	Yes
Are all of the hatches equipped with electronic monitoring devices?	No
Are the external plumbing components housed in a secure vault or out-building?	Yes
Does the surrounding geography of the tank obscure it from public view?	No
Does the exterior of the tank show signs of trespass?	No

Measurements

Vent

Outside Circumference

6.5" Inches

Roof

Flange Metal Thickness na Inches

Roof to Screen or Flange 23" Inches

Flange N/A

Number of Bolt Holes na Inches

Size of Bolts na Inches

Inlet

10 Inches

10.5 Inches

Outlet

7 Inches

7 Inches

Drain

na Inches

na Inches

Overflow

12" Inches

12.5 Inches

Inlet Riser

33" Inches

Floor

Outlet Riser

na Inches

Floor

Overflow Wall

10' Feet/Inches

12" Inches

Floor

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Liquid Engineering Corporation

Steel Potable Water Reservoir Immediate Needs Assessment

Job Number: 53615 | Utility: Cabinet Mountains Water | Tank: Booster Station

Inspector: J.Visser | Dive Controller: J. Lombardi | Date: 8/3/2019

1. **Health and Safety Items**
   - ☐ Safety Climb System Installation:
   - ☐ Vent Screen Repairs:

2. **Testing Items**
   - ☐ Dye Testing for Leak Evaluation:
   - ☐ Presence of Lead Test (Interior/Exterior):

3. **Repair Items**
   - ☐ Epoxy Coating Repairs:
   - ☐ Temporary Leak Repairs:
   - ☐ Float Operated Level Indicator Repairs / Maintenance:
   - ☐ Hypalon Repairs:

4. **Security Related Items** *(Critical security upgrade information is immediately available)*
   - ☐ Tank vents are not equipped with a security vent shroud:
   - ☐ Tank hatches are not equipped with a security hatch locking device:
   - ☐ Tank perimeter not adequately secured:

The above mentioned additional work is considered immediately necessary and is recommended to be completed. Some items may be completed in conjunction with work currently being performed while the crew is on site.

Reservoir Inspection Condition Supplemental

Below are the notables for the : Booster Station Reservoir
The reservoir was in good condition there was estimated (1/16) of sediment.
Inlet- Consisted of concentration cell buildup around the bolts of the flange.
Hatch- The hatch was in good condition and met minimum requirements for size.
Vent- The vent was built into hatch and in good condition there was no screen it was a mushroom type vent.
Walls- There were small bugholes throughout, minor settling cracks in quadrant 2 south wall and light staining in all four quadrants.
Floor- Bugholes throughout entirety of the tank there was light iron manganese sediment (skiff) less than 1/16"and staining in the tank.
Overflow-Concentration cell formations were forming around first flange approx. 2" in diameter.
Outlet- The two pumps were housed in the floor which was 60" deep they both had slight corrosion / rust but were in good working order.
Roof-The roof had light staining but was in otherwise pristine condition.
Liquid Engineering Corporation recommends another clean and inspect in three to five years.

DISCLAIMER
Liquid Engineering does not provide consulting enginrering services. Unless otherwise noted, the findings contained in this report were neither prepared nor reviewed by a licensed Professional Engineer, but are based on experience, training and visual examination of the Dive Maintenance Technician

APPENDIX K
RATES

CMWD

Budget for O&M and SLA and Estimated Rates

CURRENT BUDGET (BASED ON 2018 EXPENDITURES)		
Operation and Maintenance (O&M) Spending		
Salaries and Benefits	$	154,000
Accounting/Legal/Prof. Fees	$	55,000
Bonding and Insurances	$	6,000
Bond Interest Exspense	$	51,000
Utility Power and Telephone	$	60,000
Water Testing	$	1,000
Maintenance and Repair	$	40,000
Misc. Costs	$	33,000
Total O&M Spending	**$**	**400,000**
Short Lived Assests (SLA) Spending		
Short Lived Assest	$	75,000
Total O&M and SLA Spending	**$**	**475,000**
AFTER COMPLETION OF IMPROVEMENT PROJECTS		
O&M Budget		
Part-Time Hire	$	30,000
O&M Existing plus Future	$	465,000
SLA	$	227,000
Total O&M and SLA Budget	**$**	**722,000**

PROPOSED BUDGET

Estimated EDU's = 921

	Principal	Annual Cost	Monthly Cost/EDU
Current Debt	$ 1,080,000	$ 180,000	$16
Proposed Loan	$ 5,000,000	$ 178,800	$16
Proposed O&M		$ 495,000	$45
Proposed Debt Reserve		$ 17,880	$2
Proposed Short-Lived asset reserve		$ 227,000	$21
Proposed Average Monthly Cost / EDU			$99

Cabinet Mountain Water Districe
Loan Analysis

Connections/EDU's	921	921	921	921	921		921	921	921
	RD Funds Only	DEQ Funds Only	RD Funds + Owner	RD + Owner + DEQ	RD + Owner + DEQ	% of Project	RD+Owner+DEQ +ACOE	% of Project	Less Existing Debt
Sources of Funds									
RD Loan	$6,161,500		$6,161,500						
DEQ Loan		$8,086,126							
DEQ Loan Forgivness		$127,874							
RD Loan Less DEQ Loan Foregiveness $127,874				$6,033,626	$5,665,000	68.96%	$5,000,000	60.86%	$5,000,000
RD Grant	$2,053,500		$1,753,500	$1,881,374	$2,250,000	27.39%	$2,415,000	29.40%	$2,415,000
Owner's Cash			$300,000	$300,000	$300,000	3.65%	$300,000	3.65%	$300,000
ACOE 595 Grant							$500,000	6.09%	$500,000
Total	$8,215,000	$8,214,000	$8,215,000	$8,215,000	$8,215,000		$8,215,000		$8,215,000
Annual Payment	$220,335	$348,835	$220,335	$215,762	$202,580		$178,800		$178,800
Reserve @ 10%	$22,034	$34,884	$22,034	$21,576	$20,258		$17,880		$17,880
Total	$242,369	$383,719	$242,369	$237,339	$222,838		$196,680		$196,680
Annual Cost per EDU	$263	$417	$263	$258	$242		$214		$214
Monthly Cost per EDU	21.93	34.72	21.93	21.47	20.16		17.80		17.80
Projected O&M Costs	$495,000	$495,000	$495,000	$495,000	$495,000		$495,000		$495,000
SLA Costs	$227,000	$227,000	$227,000	$227,000	$227,000		$227,000		$227,000
Existing Debt	$180,000	$180,000	$180,000	$180,000	$180,000		$180,000		
New Debt USDA-DEQ + Reserve	$242,369	$383,719	$242,369	$237,339	$222,838		$196,680		$196,680
Total	$1,144,369	$1,285,719	$1,144,369	$1,139,339	$1,124,838		$1,098,680		$918,680
Annual Cost/EDU	$1,243	$1,396	$1,243	$1,237	$1,221		$1,193		$997
Monthly Cost/EDU	$103.54	$116.33	$103.54	$103.09	$101.78		$99.41		$83.12

APPENDIX L

COW CREEK WELL TECHNICAL MEMORANDUM

KELLER ASSOCIATES

Technical Memorandum

TO: Ed Katz, Cabinet Mountain Water District

FROM: Larry Rupp, P.E., James Bledsoe, P.E., Kyle Meschko, P.E., and Julia Reese, E.I.

DATE: August 13, 2019

SUBJECT: Cow Creek Basin Well

CC: Jeremy Davy, CMWD and Deborah Youngwirth, Youngwirth, Davis and Associates

PROFESSIONAL ENGINEER REGISTERED 11629 9-13-19 STATE OF IDAHO LARRY S. RUPP

BACKGROUND

The Cabinet Mountain Water District (CMWD) is responsible for providing water to more than 900 accounts, typically delivering over 200,000 gallons of water per day. CMWD currently has two wells, located just south of the Kootenai River, that supply water to the system through a network of reservoirs and pipelines. In 2017, CMWD drilled a test well and purchased property to drill a new production well, coined the Cow Creek Well, with the goal of increasing system capacity and reducing system vulnerability. The production well was completed in May 2019, a few hundred feet away from the test well. Water sample analysis from the production well revealed high levels of manganese and iron in the water. Additionally, the well pump test only yielded about 200 gpm.

Due to their financial investment in the well development, CMWD would like to evaluate options and next steps for the Cow Creek Well. However, reducing pollutant concentrations and increasing capacity involves significant efforts, risks, and expenses. This technical memorandum identifies and evaluates possible options regarding the Cow Creek Well.

OVERVIEW

Constituents

On May 8, 2019 several water samples were collected from the Cow Creek production well. A series of analyses demonstrated that tested contaminants were below the maximum contaminant levels (MCL) for inorganic chemicals (IOC), volatile organics (VOC), synthetic organics (SOC), and radiological materials. However, the well water exhibited manganese and iron concentrations above the secondary maximum contaminant levels (SMCL). Manganese and iron SMCLs are defined in the Environmental Protection Agency's (EPA) National Secondary Drinking Water Regulations (NSDWR), as seen in Table 1. The NSDWR are considered "non-enforceable guidelines", as their impacts are primarily aesthetic in nature.

TABLE 1: COW CREEK WELL WATER QUALITY RESULTS

Constituent	Water Quality Test (mg/L)	EPA MCL (mg/L)
Manganese	0.099	0.050
Iron	2.38	0.30

It is our understanding that these concentrations were measured from samples taken after five days of continuous operation. Iron and manganese, both naturally occurring in sediment, can result in poor taste, water discoloration, and laundry and fixture stains. In extreme cases, build-up of manganese and iron deposits can compromise flow and pressure, leading to increased operational and maintenance issues and expenses. Manganese and iron also promote the growth of specialized bacteria, which, while not pathogenic, form a problematic and displeasing slime.

The iron and manganese likely originate from natural geologic formations. Like the existing CMWD wells, the test well, and other neighboring wells, the Cow Creek Well lies in an unconfined sand and gravel aquifer. The test well and production well are located relatively close to one another. However, the Cow Creek Well is over 100-feet deeper than the test well. Packer testing could be considered if multiple layers of water were encountered, although for this well its understood that there were not multiple veins of water. It is impossible to comprehensively predict subsurface characteristics and spatial variability; the features that introduce manganese and iron to the Cow Creek Well water may not exist elsewhere, as observed in the test well a few hundred feet away.

Capacity

The CMWD system currently relies on two wells, less than 20-feet apart, at the Crossport Well Facility which produce approximately 890 gpm together or 575 gpm individually (less flow is produced per well when both wells are running due to greater headloss). Due to drawdown in the immediate vicinity, the wells cannot maintain their individual production rate when operating concurrently. The appurtenant water right allows an instantaneous withdrawal of 897 gpm and an annual withdrawal of 1314.6 acre-ft (428 million gallons).

Flow and population projections suggest that by 2039 CMWD will experience a max day demand of 850 gpm with peak hour flow demand exceeding 1,200 gpm. Per the Idaho Department of Environmental Quality (IDEQ), the system should be capable of meeting the max day demand with their largest producing well offline. The Cow Creek Well could provide redundancy and supply peak demands by delivering more water to the reservoirs. The well could potentially support additional volume, although further test pumping would be required to confirm this. Additionally, it should be noted that adding well supply to reach the peak hour flow demand of 1,200 gpm would require additional or modified water rights.

The 24-hour pumping test at the Cow Creek Well withdrew up to 200 gpm. During the test, the static water level fell from 196 feet to approximately 230 feet and recovered to 198 feet in 5 hours following the test. In the nearby test well, the static water level dropped from 188 feet to 193 feet and recovered to 189 feet. The static water level recovery suggests water availability. However, because of the limited flowrate, it is difficult to confirm the upper limit in terms of well yield capacity. In order to reach the 2039 max day demand, the well would need to produce at least 275 gpm when running concurrently with a single Crossport well.

POTENTIAL SOLUTIONS

The Cow Creek water quality is very unlikely to improve with continued pumping, and, based on water quality concerns, ongoing use of the well is not recommended without significant treatment. There are several removal techniques for iron and manganese in water systems. However, treatment involves significant capital and ongoing operational and maintenance costs. These capital expenses may exceed those associated with developing another well or water source that does not require treatment. Additionally, ongoing treatment costs and additional expense to further vet this alternative (i.e. additional pump testing and pilot testing) make this a less attractive alternative. Regardless, the following options could be considered by the District:

1. Treat the iron and manganese to reduce the limits below the SMCL. This would require the addition of a treatment approach, which might include oxidation and filtration with a green sand pressure filter or a proprietary adsorptive media. Disposal of the backwash stream will need to be addressed.

2. Perform discrete depth sampling of the well, and, if possible, isolate and remove the zone that is producing iron and manganese. This will require mobilization of a drilling company to install the packers and pump the well at different depths. A hydrogeologist or experienced person will need to sample and test the water. If a discrete zone can be identified, the screen can be blanked off in that zone.

Due to the poor water quality and capacity concerns of the existing well, Option 1 above is not a sustainable option. Option 2 could be considered, but it would require additional investment and may not yield the results that District requires; however, it could also preserve the City's investment in this well.

It is recommended that CMWD abandon the Cow Creek Well and investigate other water sources where water quality concerns are less likely. Possible alternatives include:

1. Drilling an additional well at the existing Crossport Well Facility
2. Developing an intertie with the Bonners Ferry water system to establish emergency redundancy
3. Exploring other well sites

Additional Crossport Well

The Crossport wells, drilled in 1995, are a reliable and proven source of water for CMWD. They currently supply all the system's water with minimal drawdown during operations. Drilling an additional well at this location would allow CMWD to withdraw more water from the same, productive aquifer. As CMWD already owns the site and the infrastructure required to convey water from that location, this presents a low-cost solution to capacity needs.

However, an additional Crossport well would not provide the added security associated with separating the water sources. If the aquifer became contaminated or depleted, all water sources would be compromised. Development of a source water protection plan may ease some of this concern. This might involve developing best management practices, purchasing easements, or implementing pollution prevention activities.

Additionally, prior to drilling any production well, a test well should be drilled near the site to confirm the quantity and quality of the water. A hydrogeologist should be utilized to identify and design the test well, testing, and production well. Keller will work with the hydrogeologist to design the well lot, pump, site grading, power, building, etc.

Bonners Ferry Intertie

The CMWD system currently maintains an intertie with the Bonners Ferry water system. However, given system pressures, water from Bonner's Ferry would need to be boosted to serve the CMWD system. Either a permanent pump station or provisions to accommodate temporary pumping (i.e. portable pump) from Bonner's Ferry could provide an additional supply source to CMWD. However, it is our understanding that Bonner's Ferry does not have adequate supply capacity to provide anything other than an emergency supply source.

With CMWD's goal of providing two days of emergency water storage, an emergency intertie capable of supplying 350+ gpm could satisfy the DEQ requirement for firm capacity. Regardless of the water supply strategy selected by CMWD, Keller Associates recommends that provisions to use the intertie be incorporated into CMWD's long-term supply portfolio. Accomplishing this with a portable pump may be less costly and give the CMWD/City flexibility to use the pump for other emergency operations. It should be noted that the portable pump will need to be maintained as a potable water pump and should not be used for other purposes.

Unfortunately, an intertie would not provide additional water during normal conditions and could strain the relationship between CMWD and the City of Bonner's Ferry, if it was needed for an extended period during the summer.

Other Well Sites

Since the Crossport wells draw from the same aquifer in very close proximity to one another, they face the same contamination threat. An additional well site at a remote site would reduce the risks associated with relying on a single water source. The first step in locating a new well would be to complete a hydrogeologic siting study evaluation that considers available well production data, geology, and known water quality data.

One likely candidate site for a new well would be at the Cow Creek test well site. The test well, drilled prior to the Cow Creek Well, reportedly did not experience any water quality issues, even though it is within 200 feet of the production well, which showed high levels of iron and manganese. This suggests that a new well could be drilled directly adjacent to the test well, or the existing test hole could be reamed out to a diameter to support a production well. Should CMWD desire to pursue this alternative, we would recommend completing additional test pumping and water quality sampling at the test well site.

As part of a siting study, CMWD could also investigate additional well site options. For example, the neighboring Clifty View Nursery tree farm maintains irrigation wells, which draw upwards of 100 gpm (per our understanding with communications with CMWD). CMWD could approach the Nursery, or other well owners, for possible water quality sampling, and pending results, could entertain property purchase or water-use arrangement, or drilling near proven water source(s).

The development of an additional well could impose significant infrastructure costs. Whereas the pipe network required for transporting water from the Crossport wells is already in place, the CMWD would also need to establish a conveyance system from the new site. This, coupled with the cost of well construction itself, would likely exceed the expense of a new Crossport well and Bonner's Ferry intertie.

CONCLUSIONS/RECOMMENDATIONS

In addition to capacity concerns, reducing manganese and iron concentrations from Cow Creek Well water could require expensive, on-going treatment or could require a reduction in well production. Unless CMWD desires to retain the well for a future, untreated emergency water source, abandonment of this well may be in CMWD's best interest. Developing a new well near the tree farm or at the original Cow Creek test hole would be preferred alternatives to treating the Cow Creek well; however, these alternatives are not as certain and would be more costly than a new Crossport well.

Drilling a new Crossport well is the surest and lowest cost alternative to meeting CMWD long-term water supply needs. While many water utilities rely on a single water source, CMWD vulnerabilities are mitigated by the fact that there are multiple wells, and CMWD targets two days of emergency storage (similar to what many surface water source utilities target). Additional low-cost measures can be taken to mitigate risk through a source water protection plan and ensuring spare parts/materials and appropriate equipment is available to make timely repairs. Keller Associates recommends installing a pump at the Bonner's Ferry intertie in the near-term (this could be a secondary priority) and consider use of a portable pump (rated for potable water use), given the emergency nature of this operation.

APPENDIX M
STORAGE CALCULATIONS

Current System Analysis

CMWD Facility Plan Update
2019 Storage Analysis - System Wide

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	921	connections
Existing Operational Storage[1]	**130,200**	**gallons**

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	921	connections
Total Storage (rounded)	**178,000**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
Average Day Demand	196	gpm
Duration	48	hours
Total Storage (rounded)	**563,600**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage[2]	**120,000**	**gallons**

Total Storage Available	**382,300**	**gallons**
Total Storage Required (rounded)	**872,000**	**gallons**
Additional Storage Needed	**489,700**	**gallons**

Future System Analysis

CMWD Facility Plan Update
2039 Storage Analysis - System Wide

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	1252	connection
Existing Operational Storage[1]	**130,200**	**gallons**

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	1252	connection
Total Storage (rounded)	**242,000**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
2035 Average Day Demand	266	gpm
Duration	48	hours
Total Storage (rounded)	**766,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage[2]	**120,000**	**gallons**

Total Storage Available	**382,300**	**gallons**
Total Storage Required (rounded)	**1,138,000**	**gallons**
Additional Storage Needed	**755,700**	**gallons**

1. Keller Associates typically recommends operating storage at 10% of the actual tank volume to encourage tank circulation. However, the District currently uses a greater operating volume of 130,200 gallons, which was assumed to remain the same for 2039. At 2039, this volume equates to 11.4% of the recommended storage volume.

2. Fire storage is less than emergency storage and District has elected to nest fire storage within emergency storage.

Current System Analysis

CMWD Facility Plan Update
2019 Highlands Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	125	connections
Existing Operational Storage	**0**	**gallons**

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	125	connections
Total Storage (rounded)	**24,000**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
Average Day Demand	27	gpm
Duration	48	hours
Total Storage (rounded)	**77,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	500	gpm
Duration	2	hours
Total Storage[2]	**60,000**	**gallons**

2. Fire storage is less than Emergency Storage and District has elected to nest fire storage within emergency storage.

Total Storage Available	**0**	**gallons**
Total Storage Required (rounded)	**101,000**	**gallons**
Additional Storage Needed	**101,000**	**gallons**

Future System Analysis

CMWD Facility Plan Update
2039 Highlands Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	205	connection
Operational Storage[1]	**22,800**	**gallons**

1. This value equates to the 11.4% of the future Highlands storage of 200,000 gallons anticipated in this zone.

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	205	connection
Total Storage (rounded)	**40,000**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
2035 Average Day Demand	44	gpm
Duration	48	hours
Total Storage (rounded)	**126,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage[2]	**120,000**	**gallons**

Total Storage Available	**0**	**gallons**
Total Storage Required (rounded)	**188,800**	**gallons**
Additional Storage Needed	**188,800**	**gallons**

Current System Analysis

CMWD Facility Plan Update
2019 Naples Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	243	connections
Existing Operational Storage	**56,600**	**gallons**

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	243	connections
Total Storage (rounded)	**47,000**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
Average Day Demand	52	gpm
Duration	48	hours
Total Storage (rounded)	**149,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage[2]	**120,000**	**gallons**

Total Storage Available	**179,000**	**gallons**
Total Storage Required (rounded)	**252,600**	**gallons**
Additional Storage Needed	**73,600**	**gallons**

Future System Analysis

CMWD Facility Plan Update
2039 Naples Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	273	connection
Operational Storage[1]	**20,400**	**gallons**

1. This value equates to the 11.4% of the Naples tank volume in gallons.

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	273	connection
Total Storage (rounded)	**53,000**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
2035 Average Day Demand	58	gpm
Duration	48	hours
Total Storage (rounded)	**167,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage[2]	**120,000**	**gallons**

2. Fire storage is less than Emergency Storage and District has elected to nest fire storage within emergency storage.

Total Storage Available	**179,000**	**gallons**
Total Storage Required (rounded)	**240,400**	**gallons**
Additional Storage Needed	**61,400**	**gallons**

Current System Analysis

CMWD Facility Plan Update
2019 Paradise Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	505	connections
Existing Operational Storage	**56,600**	**gallons**

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	505	connections
Total Storage	**97,500**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
Average Day Demand	107	gpm
Duration	48	hours
Total Storage (rounded)	**309,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage[2]	**120,000**	**gallons**

Total Storage Available	**179,000**	**gallons**
Total Storage Required (rounded)	**463,100**	**gallons**
Additional Storage Needed	**284,100**	**gallons**

Future System Analysis

CMWD Facility Plan Update
2039 Paradise Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	725	connection
Operational Storage[1]	**54,600**	**gallons**

1. Assumes 11.4% of the future North Paradise Tank and Black Mountain Tank

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	725	connection
Total Storage	**140,000**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
2035 Average Day Demand	154	gpm
Duration	48	hours
Total Storage (rounded)	**443,500**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage[2]	**120,000**	**gallons**

2. Fire storage is less than Emergency Storage and District has elected to nest fire storage within emergency storage.

Total Storage Available	**179,000**	**gallons**
Total Storage Required (rounded)	**638,100**	**gallons**
Additional Storage Needed	**459,100**	**gallons**

Current System Analysis

CMWD Facility Plan Update
2019 River Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	47	connections
Existing Operational Storage	**17,000**	**gallons**

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	47	connections
Total Storage	**9,200**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
Average Day Demand	10	gpm
Duration	48	hours
Total Storage (rounded)	**29,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage	**120,000**	**gallons**

Total Storage Available	**24,300**	**gallons**
Total Storage Required (rounded)	**146,200**	**gallons**
Additional Storage Needed	**121,900**	**gallons**
Additional Storage Provided by Other Pressure Zones[2]	**-91,000**	**gallons**
Total Storage Needed From Pressure Zone	**55,200**	**gallons**
Remaining Storage Need from This Pressure Zone	**30,900**	**gallons**

2. Assumed that additional fire storage not covered by the zone's emergency storage will be provided by Paradise zone.

Future System Analysis

CMWD Facility Plan Update
2039 River Pressure Zone Storage Analysis

Operational Storage

Maximum Daily Demand	979	gal/connection/day
Number of Connections	47	connection
Operational Storage[1]	**32,400**	**gallons**

1. Assumes 11.4% of the 284,300 gallons of storage anticipated at Parker Canyon.

Peaking Storage

% of MDD	20%	
Maximum Daily Demand	979	gal/connection/day
Number of Connections	47	connection
Total Storage	**9,200**	**gallons**

Emergency Storage

Average Day Demand	306	gal/connection/day
2035 Average Day Demand	10	gpm
Duration	48	hours
Total Storage (rounded)	**29,000**	**gallons**

Fire Storage - Included in 48 hr Emergency Storage

Fire Demand	1,000	gpm
Duration	2	hours
Total Storage	**120,000**	**gallons**

Total Storage Available	**24,300**	**gallons**
Total Storage Required (rounded)	**161,600**	**gallons**
Additional Storage Needed	**137,300**	**gallons**
Additional Storage Provided by Other Pressure Zones[2]	**-91,000**	**gallons**
Total Storage Needed From Pressure Zone	**70,600**	**gallons**
Remaining Storage Need from This Pressure Zone	**46,300**	**gallons**

Existing Conditions	# of Connections		719				gpd per connection	gpm per connection
2019 MDD	489	gpm	704,160	gpd			979.4	0.68
2019 PHD	948	gpm	1,365,120	gpd			1,898.6	1.32
2019 Average Day	153	gpm	220,000	gpd	1.175214		306.0	0.21
Average Summer	269	gpm	388,000	gpd			539.6	0.37
Average Winter	107	gpm	154,500	gpd			214.9	0.15

This scenario was used as existing condtion

Scenario 2 Conditions	# of Connections		921		Checks	MDD to PHD		gpm per connection	gpd per connection
2019 MDD	625	gpm	900,000	gpd	1.278119	1.9392	626	0.68	977
2019 PHD	1212	gpm	1,745,280	gpd	1.278481		1214	1.32	1895
2019 Average Day	196	gpm	281,808	gpd			196	0.21	306
Average Summer	345	gpm	497,007	gpd			345	0.37	540
Average Winter	137	gpm	197,906	gpd			137	0.15	215

Scenario 2 Future Conditions	# of Connections		1,252		Checks	MDD to PHD		gpm per connection	New gpm
2039 MDD	850	gpm	1,223,453	gpd	1.359392	1.9392	2039 MDD	0.68	224.62
2039 PHD	1648	gpm	2,372,520	gpd	1.359392		2039 PHD	1.32	435.58
2039 Average Day	266	gpm	383,088	gpd			2039 Average Day	0.21	70.33
Average Summer	469	gpm	675,627	gpd			Average Summer	0.37	124.04
Average Winter	187	gpm	269,032	gpd			Average Winter	0.15	49.39

APPENDIX N
SHORT LIVED ASSETS

CMWD

Short Lived Assets Replacements and Additional Operations and Maintenance Calculations

KELLER ASSOCIATES

Short Lived Assets	Quantity	Useful Life	Unit Cost	Cost/Year	For Future Improvement Projects	
					Additional Operations Costs/Year	Additional Maintenance Costs/year
Distribution						
Fire Hydrants	31	15	$ 5,000.00	$ 10,417	$ 800	$ 800
Typical PRVs	160	10	$ 300.00	$ 4,800		
			Total Cost/Year	**$ 15,217**	**$**	**1,600**
Water Meters (replace 46/year)						
Water Meters	1252	15	$ 275.00	$ 22,953	$ 5,634	$ 2,817
Meter Vault Replacements	700	15	$1,400	$ 65,333		
			Total Cost/Year	**$ 88,287**	**$**	**8,451**
Well Facilities - Crossport existing two wells and new well						
Electrical	1	15	$ 35,000	$ 2,333		
Pump and motor	3	15	$ 40,000	$ 8,000		
SCADA	1	15	$ 20,000	$ 1,333		
Chlorination / treatment	1	15	$ 15,000	$ 1,000	$ 7,900	$ 2,400
Valves / meter /piping	3	15	$ 20,000	$ 4,000		
Site fencing and security	1	15	$ 5,000	$ 333		
Generators	1	15	$ 75,000	$ 5,000		
			Total Cost/Year	**$ 22,000**	**$**	**10,300**
Larger Booster Stations - Parker Canyon (new), Highland Flats (new) and Black Mountain (upgraded), 4 Corners						
Electrical	4	15	$ 22,500	$ 6,000		
Pump and motor	4	15	$ 57,000	$ 15,200		
Site fencing and security	4	15	$ 5,000	$ 1,333	$ 12,000	$ 9,600
SCADA	4	15	$ 20,000	$ 5,333		
Valves / meter	4	15	$ 10,000	$ 2,667		
Generators	3	15	$ 30,000	$ 6,000		
			Total Cost/Year	**$ 36,533**	**$**	**21,600**
Small Booster Stations - Kootenai Trail (new), Mountain Meadows (new) and Naples (existing)						
Electrical	3	15	$ 10,000	$ 2,000		
Pump and motor	3	15	$ 10,000	$ 2,000		
Site fencing and security	3	15	$ 5,000	$ 1,000	$ 9,120	$ 4,800
SCADA	3	15	$ 10,000	$ 2,000		
Valves / meter	3	15	$ 5,000	$ 1,000		
			Total Cost/Year	**$ 8,000**	**$**	**13,920**
Water Tanks - Highland Flats (new), Parker Canyon (new/existing), Naples (existing), Black Mountain (existing), Paradise Valley (new)						
Misc. Vent, Hatch, Equip.	6	15	$ 5,500	$ 2,200		
Crack/Leak Repair	6	10	$ 5,000	$ 3,000		
Site fencing and security	6	15	$ 5,000	$ 2,000	$ 5,400	$ 3,000
Inspection	6	3	$ 3,500	$ 7,000		
Paint/Coating	6	15	$ 30,000	$ 12,000		
Cleaning	6	6	$ 7,000	$ 7,000		
			Total Cost/Year	**$ 33,200**	**$**	**8,400**
PRV Station						
PRV Station	1	15	$ 30,000	$ 2,000	$ 360	
			Total Cost/Year	**$ 2,000**	**$**	**360**
Equipment						
Vehicles	2	10	$ 60,000	$ 12,000		
Trailers (two)	2	10	$ 8,000	$ 1,600	-	-
Excavator	1	10	$ 60,000	$ 6,000		
Misc. Equipment	1	10	$ 15,000	$ 1,500		
			Total Cost/Year	**$ 21,100**	**$**	**-**

	Short Lived Assests Yearly Cost	Total Additional Operations and Maintenance for future Improvement Projects
	$ 227,000	**$ 65,000**