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EAGLE SEWER DISTRICT

Wastewater Collection and Treatment Facilities Plan

February 2016

Final

FINAL

Wastewater Collection and Treatment Facilities Plan

Technically APPROVED for Public comment

By:

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Boise Regional Office

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Prepared for

Eagle Sewer District

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Acronyms and Abbreviations

°C	degrees Centigrade
°F	degrees Fahrenheit
AER	aerobic
ANX	anoxic
AOB	ammonia oxidizing bacteria
BNR	biological nutrient removal
BOD	biochemical oxygen demand
BPR	biological phosphorus removal
cfm	cubic feet per minute
CIP	Capital Improvement Plan
COMPASS	Community Planning Association of Southwest Idaho
CSTR	Continuously Stirred Tank Reactor
CWA	Clean Water Act
DEQ	Idaho Department of Environmental Quality
District	Eagle Sewer District
EBPR	enhanced biological phosphorus removal
ECs	Emerging Constituents
EDCs	Endocrine Disrupting Compounds
EPA	Environmental Protection Agency
ERU	Equivalent Residential Unit
ESD	Eagle Sewer District
ft^2	square foot
FY	fiscal year
GHG	greenhouse gas
gpd	gallons per day
gph	gallons per hour
gpcd	gallons per capita per day
gpm	gallons per minute
HDPE	High-density polyethylene
hp	horsepower
Hr	hours
HRT	hydraulic residence time
IDAPA	Idaho Administrative Procedures Act

IFAS	Integrated fixed-film activated sludge
kWh	kilowatt-hours
lb	pound
lb/cap-day	pounds per capita per day
lb/cf/d	pounds per cubic foot per day
lb/COD/d	pounds COD per day
lb COD/lb N	pounds COD per pound nitrogen
$lb/ft^3/d$	pounds per cubic foot per day
lb/day	pounds per day
lb/ton	pounds per ton
MBBR	moving bed biofilm reactor
MBR	membrane bioreactor
MG	million gallons
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/L/hr	milligrams per liter per hour
mgd	million gallons per day
MLSS	mixed-liquor suspended solids
NOB	nitrite oxidizing bacteria
NDN	nitrification and denitrification
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NPW	non-potable water
NTU	nephelometric turbidity unit
O&M	operation and maintenance
OUR	oxygen uptake rate
PAO	phosphate accumulating organism
PE	primary effluent
PH	peak hour
PhACs	Pharmaceutically Active Compounds
Plan	Eagle Sewer District Wastewater Facility Plan
POTWs	publicly owned treatment works
PPCPs	Pharmaceuticals and Personal Care Products
Pw	present worth
RAS	return activated sludge

SC	seasonal cold water
SCADA	supervisory control and data acquisition system
scfm	standard cubic feet per minute
SOTE	standard oxygen transfer efficiency
SOTR	Standard Oxygen Transfer Rate
SRT	solids retention time
SVI	sludge volume index
SWD	side water depth
TAC	Technical Advisory Committee
TDH	Total dynamic head
TKN	total Kjeldahl nitrogen
TMDL	total maximum daily loads
TOrCs	trace organic compound
TP	total phosphorus
TSS	total suspended solids
UV	ultraviolet
VFA	volatile fatty acids
VOC	volatile organic compound
VS	volatile solids
VSS	volatile suspended solids
WAS	waste activated sludge
WQBEL	water quality-based effluent limits
WSE	Water Surface Elevation
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

SECTION 1

Introduction

The Idaho Department of Environmental Quality has established rules in Idaho Administrative Code (IDAPA 58.01.16, Part 410) requiring all new and existing municipal wastewater conveyance and treatment facilities in the process of modification or expansion to have a current facility plan. The facility plan must address hydraulic capacity, treatment capacity, project financing, and operation and maintenance considerations sufficiently to determine the effects of a project on the overall wastewater infrastructure. A facility plan typically addresses the entire potential service area of the jurisdiction. A facility plan must be submitted to the Idaho Department of Environmental Quality (DEQ) for review and approval prior to submitting detail drawings and specifications for a specific project related to the facility plan. This facility plan includes facility plan for the wastewater treatment plan and a master plan for the wastewater collection system.

Eagle Sewer District began a wastewater facility planning process to establish an overall system wide guiding document that prioritizes needs, balances available resources, identifies specific actions, and identifies uncertainties regarding wastewater management and infrastructure. The purpose of this document is to provide a comprehensive compilation of the drivers for the development and results of the facility plan in alignment with the vision for the District as required by IDAPA 58.01.16, Part 410. The Eagle Sewer District Facility Plan is consistent with District's vision to complete a comprehensive strategic plan for a sustainable future that makes adequate provision for growth while protecting natural resources. The documentation of the detailed technical information has been put together so that near-term actions and long-term guidance decisions can be made.

1.1 Purpose and Need

Eagle Sewer District is a special use district in accordance with State of Idaho Statute (Title 42 Irrigation and Drainage – Water, Chapter 32) that was formed to provide wastewater collection and treatment services for the area that generally coincides with the City of Eagle's city limits and impact area. The Eagle Sewer District Wastewater Treatment Plant provides wastewater treatment services to residents and businesses in the Eagle area of impact.

The Eagle Sewer District WWTP discharges to the City of Boise West Boise WWTF for final wastewater treatment and discharge. The discharge agreement between Eagle Sewer District and the City of Boise limits the service area to the City of Eagle Area of Impact. Locations outside the City of Eagle Area of Impact are not allowed to connect to the West Boise WWTF and thus are required to have their own wastewater collection and treatment systems. This plan addresses the Eagle Sewer District wastewater collection and treatment systems currently in operation. Other wastewater planning documents, such as the plan for the Spring Valley Ranch or M3 development prepared by J-U-B Engineers, describe wastewater collection and treatment system for areas outside the City of Eagle Area of Impact, but still within city limits.

This Plan describes existing and future wastewater service needs of the Eagle wastewater management system, and also the preferred alternatives for the WWTP to meet those needs in the future. Alternatives for implementation of the expansions and upgrades are identified and evaluated in this plan, and recommendations are provided for specific near-term actions and long-term strategic guidance.

1.1.1 Statement of Purpose

It is the vision of the District to anticipate and support the needs of their growing community with a focus on financial stewardship and environmental sustainability. The primary purpose of the Plan is to

prepare short- and long-term planning that will protect the public health and the environment. A secondary purpose of the Plan is to prepare the necessary planning and alternative evaluation documentation for regulatory agency approval. This will allow the District to proceed with designing and constructing facilities that meet their needs now and in the future. The planning period used for this plan is from 2015 to 2040.

1.1.2 Statement of Need

The District does not maintain an NPDES permit, therefore there are no current system needs that would currently affect public health and the environment. There are upgrades that can potentially increase the efficiency of the treatment and collection systems, but the real need in the system is that of capacity due to future conditions. The District's future needs arise from the following:

- Providing competitive and cost-efficient wastewater services while investing in facilities that remain long-term assets.
- Responding to changes in discharge costs.
- Responding to the demands for wastewater service that arise from unpredictable growth that may occur within or near the current area of impact.

The wastewater management needs are listed and discussed in the following text.

1.1.2.1 Future Treatment Plant Utilization

The District's WWTP will continue to be the singular WWTP serving the City of Eagle Area of Impact through the planning period. A second wastewater treatment plant facility plan has been developed by JUB Engineers for the M3 development located north of Beacon Light Road and east of Highway 16. The plan calls for a completely separate wastewater treatment system with all of the discharge being reused. For more information refer to the M3 Facility Plan.

1.1.2.2 Water Reclamation and Recycled Water

There appears to be limited opportunity to cost effectively reuse wastewater near the District's WWTP so the District's efforts in developing a recycled water system has been focused on the M3 development.

1.1.2.3 Growth and Expansion of the Service Area

Future growth planning included considerations for population projections, area of impact, and land-use changes. Population projections were compiled from the Community Planning Association of Southwest Idaho (COMPASS), the area of impact was used to establish future planning areas, and the City of Eagle Comprehensive Plan was used for land-use changes. For the purposes of this report, the future service area was considered equal to the City of Eagle area of impact.

1.1.2.4 Wastewater Collection System

The District's collection system is anticipated to be expanded significantly as development continues. This plan includes a discussion of current collection system operation as well as the needs required to support expected growth in the District's service area. See Chapter 7 for the Collection System Master Plan.

1.2 Eagle Sewer District Infrastructure Planning

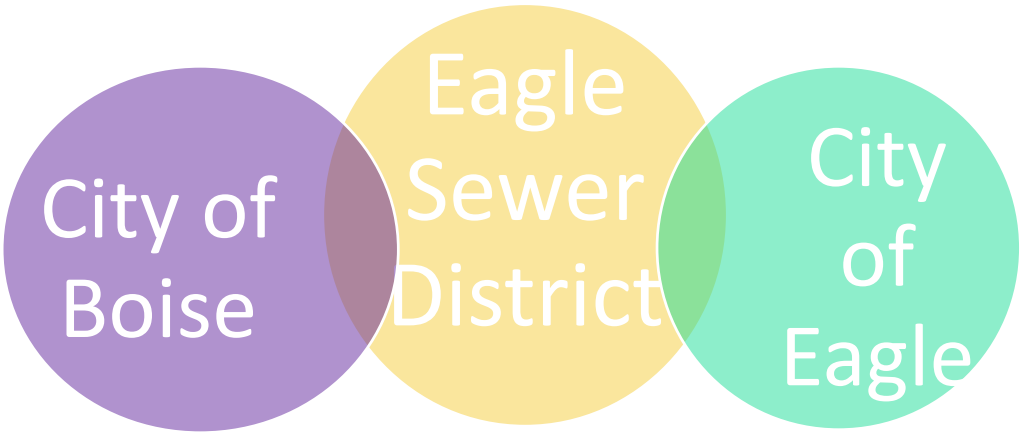
1.2.1 Coordination with City of Eagle Comprehensive Planning

The City of Eagle's comprehensive plan was based, in part, on population data compiled by COMPASS. The primary mission of COMPASS is to aid in regional planning in Ada and Canyon counties. COMPASS population data were used in preparing the existing and projected wastewater influent flow and loads for this wastewater facility plan. Details about the methods used by COMPASS and how they were incorporated into the population projections are provided in Section 3 regarding future conditions and Section 7 regarding the collection system buildout.

1.2.1.1 Coordination with the Eagle Sewer District Vision

At the outset of this wastewater facility planning process, a workshop facilitated by CH2M was held with the District's staff and management to ensure that evaluation criteria would be in alignment with the Eagle Sewer District vision. The elements of the District's vision are as follows:

- Strengthen the District's relationship with the City of Eagle and the City of Boise
- Provide a strategy to promote growth within the District service area
- Continue to protect water quality
- Foster environmentally conscious projects
- Commit to high quality projects
- Maintain fiscal responsibility
- Engage District members to seek project acceptance
- Maintain the District's flexibility for change
- Optimize treatment efficiency
- Choose alternatives with the highest value relative to other alternatives
- Employ industry common technologies and approaches
- Reuse existing infrastructure
- Be mindful of operability and maintenance requirements
- Commit to environmental sustainability
- Strive for limited social impacts and foster community acceptance



At the workshop the wastewater collection and treatment alternatives evaluation criteria were presented, discussed, and established. These criteria allow potential improvements to be evaluated and compared based on common factors ensuring that only the most appropriate improvements are pursued. Table 1-1 shows these criteria and how they are in alignment with the District's vision.

Table 1-1. Alternatives Evaluation Criteria Alignment with Eagle Sewer District's Vision

Alternative Evaluation Criteria	Vision Element Supported	Comments
Impacts to City of Boise discharge fee	Strengthen relationship with the City of Boise and maintain fiscal responsibility	It is anticipated that cooperation and coordination with the City of Boise on discharge parameters will create a mutually beneficial situation
System reliability	Protect water quality, maintain fiscal responsibility	Consistent, predictable operations allow the District to operate efficiently
Operational flexibility	Promote growth, maintain flexibility to change	
Environmental benefits	Foster projects that are environmentally conscious	
Environmental Sustainability	Maintain fiscal responsibility	Lower rates through member acceptance will gain rate payer support.
Social impacts	Engage District members to seek project acceptance	Projects with community favor will improve member acceptance.

1.2.2 Coordination with Surface Water Discharge Requirements

Eagle Sewer District WWTP secondary effluent is pumped to the City of Boise's West Boise Wastewater Treatment Facility for treatment and is discharged to the Boise River. Consequently, the District does not maintain a National Pollution Discharge Elimination System (NPDES) permit.

1.3 Scope of Study

This scope of work for the wastewater treatment plant and collection system planning includes the following:

- Description of the existing environment
- Description and condition of the existing wastewater treatment plant (WWTP) and collection system including all lift stations
- Hydraulic capacity and organic capacity analysis of the existing WWTP
- Hydraulic capacity analysis of the existing collection system and lift stations
- Twenty-five year treatment system capital improvement plan with alternatives
- Twenty-five year collection system capital improvement plan
- Sufficient documents to qualify the District for IDEQ Revolving Loan Fund
- Prediction of future conditions including population and flows

The scope of work for this plan does not include the following:

- SCADA Evaluation and Plan
- Instrumentation and Controls Standards Development
- Collection System Maintenance Evaluation
- Security
- Staffing
- Emergency Plan
- River Discharge

1.3.1 Development of Initial Treatment Alternatives

Background information was assembled and initial wastewater management alternatives were developed to satisfy system capacity and growth needs while complying with and optimizing discharge quality.

An initial list of wastewater treatment system alternatives, that includes lagoon upgrades and expansion, secondary treatment, tertiary treatment, and biosolids handling was developed by CH2M and presented to Eagle Sewer District at a workshop for preliminary screening. The purpose of the workshop was to present the extensive list of alternatives, conduct a preliminary evaluation, and narrow down the alternatives to a better defined set of treatment alternatives to be further evaluated. Multiple treatment systems and technologies were presented and evaluated according to the following criteria:

- Treatment efficiency
- Cost relative to other alternatives
- How common the technology or approach is in the industry
- Ability to use existing infrastructure
- Operability and maintenance requirements
- Environmental sustainability
- Social impacts and community acceptance

1.3.2 Evaluation of Alternatives

Planning-level process design for each treatment alternative was prepared to determine the infrastructure required to meet the water quality and quantity planning objectives. Water quality refers to the level of treatment and subsequent discharge concentration of the various wastewater constituents. Water quantity addresses the volume of wastewater in the collection and treatment systems. Each alternative was evaluated to determine its ability to treat the wastewater constituent concentrations as well as its effects on the ability of the system to handle increasing wastewater volumes. The advantages and disadvantages of each process were then identified to differentiate the non-monetary benefits of each process. A planning-level cost estimate was prepared for each alternative.

The results of the alternatives analysis was presented at the Alternatives Evaluation Workshop. The information was entered into a decision tool, spreadsheet, during the workshop in collaboration with the District. The decision tool provides a benefit-to-cost score of each alternative based on monetary and non-monetary criteria. At the conclusion of the meeting, a recommendation on the chosen treatment alternative was made based upon the results of the decision tool.

1.4 Report Organization

Section 1 - Introduction, is a brief introduction and background that includes the purpose and need for this document. The scope of the study is presented along with the report organization.

Section 2 - Existing Conditions, is a detailed description of the existing WWTP, existing flows, and water quality. The condition of existing treatment processes and infrastructure are assessed and detailed. Hydraulic and unit treatment processes are presented as well.

Section 3 - Future Conditions, is a discussion of the population forecasts and the increase in wastewater flows and loads based on the population forecasts. Planning criteria used to evaluate wastewater management scenarios is presented.

Section 4 - Initial Screening Alternatives, is a summary of the initial development and screening of the secondary treatment, tertiary treatment, and biosolids handling alternatives. This group of alternatives

is a broad group of potential alternatives that were narrowed down to include final screening alternatives presented in Section 5.

Section 5 - Final Screening of Wastewater Management Alternatives, is an evaluation of the required infrastructure for each treatment alternative and the advantages and disadvantages of each alternative. The alternative evaluation and screening process methodology is presented with the non-monetary and monetary criteria. Alternatives to meet planning criteria for the wastewater treatment system are presented in this section.

Section 6 - Selected Approaches, Description, and Implementation, is a description of the projects selected for implementation, outlines an approach for future studies, and presents long-term strategies.

Section 7 – Collection System Master Plan, is a planning document to address the current and future needs of the wastewater collection system.

Section 8 - References, contains the references cited in this plan.

Appendixes – Supporting information for the plan including (see Table of Contents for complete list):

- Information used to prepare the Collection System Master Plan
- Technical memoranda developed in preparation of this wastewater facility plan

SECTION 2

Evaluation of Existing Treatment Facilities

This section documents the existing wastewater treatment facilities owned and operated by Eagle Sewer District. The unit processes are described with their capacities and current condition. Work previously completed by District staff and others was used and updated.

2.1 Planning Area Identification

2.1.1 Current City of Eagle Area of Impact Planning Boundary

The Eagle Sewer District service area generally corresponds with the Eagle City limits. This plan covers that portion of the service area located within the City of Eagle Area of Impact and Eagle city limits. Other wastewater facility planning efforts can be referenced for details on areas inside city limits and outside the City of Eagle Area of Impact. These areas are not allowed to combine with the Eagle Sewer District WWTP effluent that is discharged to the City of Boise West Boise WWTF for final treatment per the discharge agreement between the City of Boise and Eagle Sewer District. The 2015 City of Eagle Comprehensive Plan states that it is the intention of both parties that Eagle Sewer District provide wastewater collection and treatment for the City's area of impact as given in Figure 2-1. Thus, areas inside City of Eagle city limits and outside of its impact area are required to have their own separate wastewater collection and treatment systems and are described under separate planning documents. The City of Eagle area of impact includes substantial agricultural area, much of which is expected to be developed in the next 20 years.

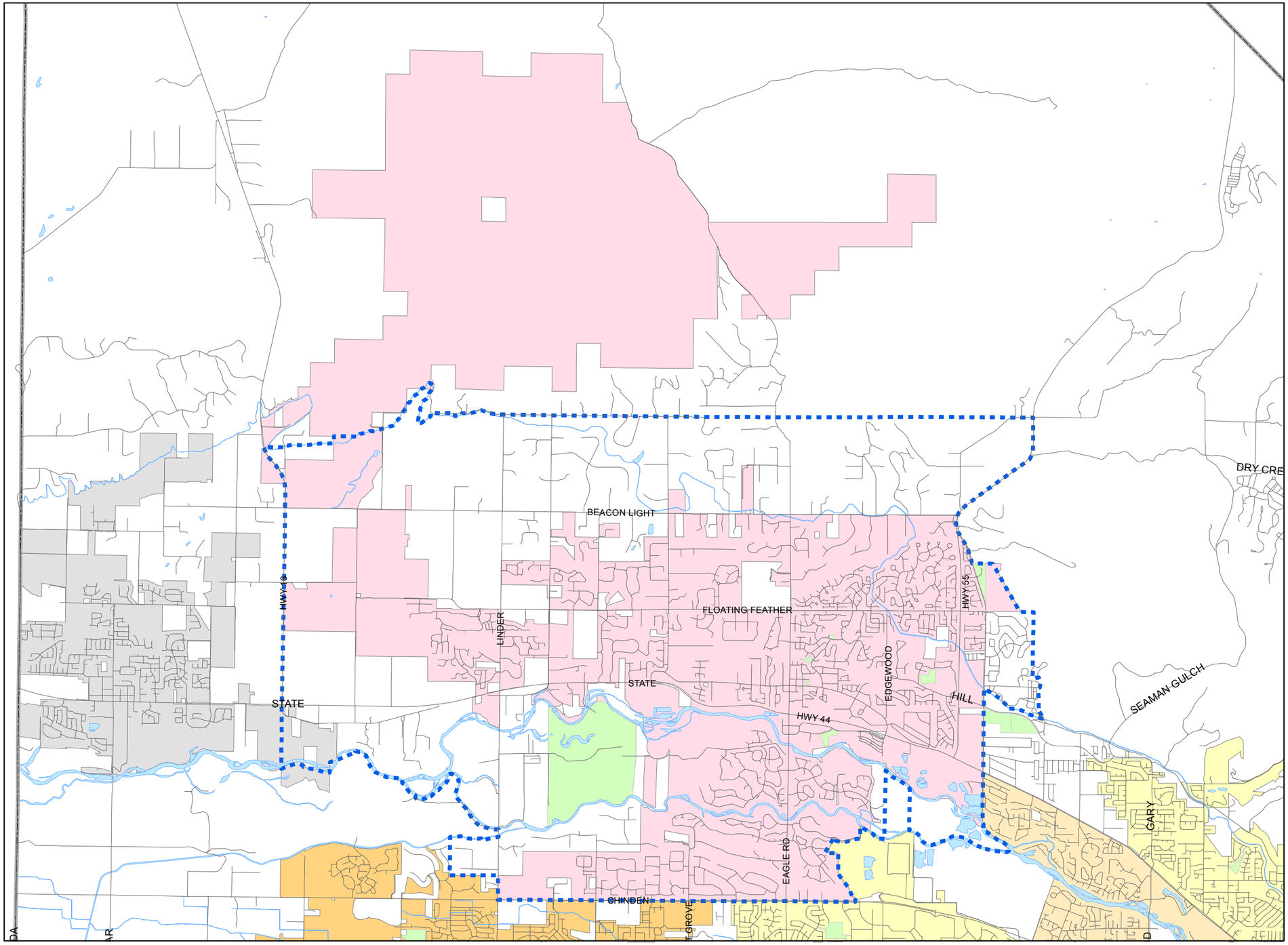
2.2 Existing Wastewater Treatment Facility Description

The Eagle Sewer District WWTP provides initial wastewater treatment prior to discharge to the City of Boise's West Boise WWTF for additional treatment and disinfection before discharge to the Boise River. Eagle Sewer District does not maintain an NPDES discharge permit. The existing facility includes a headworks with influent pumps, screening, grit removal and flow monitoring followed by treatment by aerated lagoons. This section includes details of the major equipment currently used at the facility, their capacities, and condition. An effluent pump station lifts treated effluent from a settling pond to the West Boise WWTF. An Operations and several maintenance buildings are located at the District's WWTP site.

Table 2-1 summarizes the unit processes, along with the major equipment used to provide treatment at the Eagle Sewer District WWTP.

Table 2-1. Eagle Sewer District WWTP: Summary of Existing Unit Processes

Unit Process	Existing and New Facilities	Treatment Criteria	Equipment Capacity	Remarks
Headworks				
Influent pumps	Number = 3 Type = screw centrifugal	Hydraulically pass peak instantaneous flow	Design: 4,000 gpm each @32 ft TDH, 1200 rpm, 50 hp	Current capacity: 3,600 gpm 2010 Construction
Screen	Number = 2 Type = Step	Hydraulically pass peak instantaneous flow	7.15 mgd (each)	2010 Construction Clear spacing = 0.25”
Screen	Number = 1 Manual Type = Manual raked	Hydraulically pass peak instantaneous flow		2010 Construction Clear spacing = 2”
Grit chamber	Number = 1 Type = Vortex	Hydraulically pass peak flow with a velocity slow enough to settle grit	20 mgd max	2010 Construction
Grit pump	Number = 1 Type = Vortex		250 gpm @25 ft, 7.5 hp, 1800 rpm	2010 Construction
Grit separator/classifier	Number = 1	Must match capacity of the largest grit pump	250 gpm	2010 Construction
Secondary Treatment				
Lagoon 1	10 feet deep normal water depth 3.4 acre surface area	<60 mg/L BOD	11.1 MG nominal volume	Assumes no sludge buildup; sludge last removed in 2008
Surface aerator	Number = 8 Type = mechanical		(4) 20 hp (4) 10 hp	1982 Construction; liner replaced in 2008
Submerged aerator	Number = 2 Type = turbine		20 hp	Air supplied by two 15 hp blowers, 160 scfm @ 4.35 psi
Lagoon 2	10 feet deep normal water depth 1.3 acre surface area	<60 mg/L TSS	4.2 MG nominal volume	Assumes no sludge buildup; sludge last removed in 2007 1982 Construction; liner replaced in 2008
Surface aerator	Number = 1 Type = mechanical		5 hp	
Effluent recycle pump	Number = 1 Type = submersible		700 gpm	Not in current operation
Effluent Transfer				
Effluent pumps	Number = 2 Type = submersible non-clog		1,800 gpm @ 190 TDH, 150 hp	Variable speed Replaced in 2012



City of Eagle
2014 City Limits

Ada County Data as of April 2014

N

1:60,000

Feet
0 2,400 4,800

City Limits

- Eagle
- Boise
- Garden City
- Meridian
- Star
- Eagle Impact Area
- Parks

Eagle Sewer District Area of Impact including the City of Eagle City Limits

Eagle Sewer District Facility Plan

ch2m

WT0820151021BOI

2.2.1 Headworks

The headworks lifts raw wastewater and removes screenings and grit before entering the WWTP and directs the screened and de-gritted flow to the treatment lagoons. The original headworks, constructed in 1982, was replaced by a new headworks in 2010 that consists of an influent pump station with three screw centrifugal pumps, flowmeter, two mechanical step screens, one manual bar screen, and one vortex grit chamber. The building is served with potable water from the Eagle Water Company. An odor control system treats foul air from the headworks building. The building is equipped with an auxiliary 600-kW generator that has an integral 1,000 gallon diesel fuel tank. All of the equipment was new in 2010 and is relatively new.

2.2.1.1 Influent Collection

Raw wastewater enters the influent collection box/wet well through one 30-inch diameter gravity line from the east. The influent is pumped from the collection box to the influent screening structure through two 18-inch diameter pipes that combine to one 24-inch diameter line before discharging to the screening channels. Current operation calls for the influent collection box to be vacuumed out every fall and spring to remove rocks and debris.

2.2.1.2 Influent Pumping

The raw wastewater influent is pumped using three screw centrifugal type pumps operating in parallel located in a dry pit opposite the wet well. The details for each of these pumps is listed in Table 2-2.

Table 2-2. Influent Pump Details

Pump Number	Type	Make/Model	Capacity (gpm)	TDH (ft)	Drive Type	Control
1	Screw Centrifugal	Wemco Hydrostal	4000	32	Variable	SCADA/ Level Switch
2	Screw Centrifugal	Wemco Hydrostal	4000	32	Variable	SCADA/ Level Switch
3	Screw Centrifugal	Wemco Hydrostal	4000	32	Variable	SCADA/ Level Switch
4	Future	Wemco Hydrostal	4000	32	Variable	SCADA/ Level Switch

Influent pumps can be removed from the dry pit with the use of an overhead portable crane to move the pumps to below a roof hatch where a second crane lifts them to the exterior grade level. There is space for an additional influent pump that would increase the current firm capacity of 5.6 mgd to 8.3 mgd.

Figure 2-2. Influent Pumps

With current flow rates, it is the standard operating procedure to only run one pump at a time, at full speed, for about 6 minutes in order to lower the wet-well level. A pump will cycle through twice before resting. The plant operators have witnessed a loss of capacity of 30 to 40 gpm per year due to impeller wear. This was confirmed upon inspection of the flowmeter reading 3,700 gpm at full speed discharge pressure which, when compared to pump curve show impeller wear.

2.2.1.3 Influent Flow Measurement

Each influent pump discharges raw influent wastewater to a common manifold where a flowmeter (Krohne) measures the total pumped influent flowrate. The common manifold is divided into two lines each with its own flowmeter to allow continuous flow measurement in the event one meter is removed from service.

2.2.1.4 Influent Screening

The purpose of screening is to remove rags and large items that are not biodegradable and therefore cannot be treated by the lagoons. These items can also cause clogging and undue wear of downstream mechanical equipment.

The influent screening structure consists of three channels. Two of the channels contain mechanical step screens (Huber) with 0.25-inch openings. The third channel is used as a bypass channel and is equipped with a manual bar screen with 2-inch openings. Each mechanical screen is rated for 7.15 mgd fixed.

Figure 2-3. Influent Screens

Screenings from the mechanical step screens are discharged to a single mechanical washer/compactor that washes the screenings to reduce the organic loading and compacts them to remove water. A screw conveyor then discharges them into a 3-yd dumpster. Screenings from the disposal bin are currently taken to the Ada County landfill as they are able to pass the paint filter test.

Normally both mechanical screens operate in parallel, interlocked, and move screenings based on the water surface elevation readings upstream and downstream of the screens measured by ultrasonic level sensors.

2.2.1.5 Grit Removal and Handling

Grit is removed using a vortex grit basin (Smith and Loveless) rated at 20 mgd. The basin is equipped with a centrifugal pump for removal of grit that accumulates in the bottom of the basin (Table 2-3). Structural provisions have been made to accommodate a second grit chamber in the future. If the existing grit chamber is taken offline, flow is simply bypassed directly to the lagoon treatment system.

Table 2-3. Grit Pump Details

Pump Number	Make/Model	Capacity (gpm)	Drive Type	Control
1	Wemco 3x3C	50	Continuous	SCADA/ Level Switch

The collected grit is pumped to a single grit separator/classifier (Huber) that washes organic material from the grit and returns the washwater to the grit basin effluent channel. Potable water is used for grit washing. When a density meter at the bottom of the vortex chamber reads a density of 92-percent, the grit pump starts and runs until the density is reduced to 88-percent. Currently, the grit pump starts once every 3 hours. Once washed to reduce screening organic load, the grit drops down into a 30yd dumpster and is disposed of in a sanitary landfill. The grit separator/classifier has a hydraulic capacity of 250 gpm.

Figure 2-4. Grit Classifier

2.2.2 Secondary Treatment

The secondary treatment system is comprised of two aerated lagoons operated in series that were constructed in 1982 and designed to reduce 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS). Two transfer structures control the flow between lagoons. An effluent pump station, located after the second lagoon pumps effluent to the City of Boise's West Boise WWTF for further treatment, disinfection, and discharge.

2.2.2.1 Transfer Structure 1

Screened and degritted primary effluent is conveyed through a 24-inch diameter gravity line where it enters Transfer Structure 1 and is directed to Lagoon 1 through an 18-inch diameter line or diverted through a 10-inch diameter bypass pipe to Lagoon 2. Currently the bypass line is being used to recycle Lagoon 1 effluent to back to Transfer Structure 1 and is not available for bypass. Transfer Structure 1 is equipped with an 8-inch diameter overflow line that directs wastewater into Lagoon 1 if the water surface in the structure is too high.

2.2.2.2 Lagoon 1

Lagoon 1 provides the majority of the BOD_5 reduction. It is equipped with eight surface mechanical aerators and two submerged aerators. Four of the surface aerators have 20-hp motors while the remaining four are 10-hp motors. Both of the submerged aerators are supplied with air by blowers housed within the Operations building. Two 15-hp blowers rated at 160 scfm of air at 4.35 psi are located in the mechanical room. These blowers supply air to the submerged aerators in Lagoon 1 (Table 2-4). Air is delivered via 8-inch diameter welded steel piping buried in the lagoon dike.

Table 2-4. Blower Details

Blower Number	Type	Make/Model	Motor Size (hp)	Capacity (scfm)	Pressure (psi)	Drive Type
1	Centrifugal	Hoffman 4110131	15	160	25	Continuous
2	Centrifugal	Hoffman 4110131	15	160	25	Continuous

Historically the lagoons have had a stable, accumulated sludge layer approximately two feet thick which reduces the usable volume (MWH 2008 Facility Plan). Sludge was last removed in 2007, wherein approximately 80 tons of sludge was removed and sent to the Ada County Landfill. Current sludge levels were measured in fall 2015 and found to vary between 0 and 3 feet with an average of nearly one foot in Lagoon 1 and between 3 and 7 feet for an average of five feet in Lagoon 2. This more rapid buildup of sludge is attributed to increased flow and loading due to growth in the service area. The District intends to remove solids in 2016. The dimensions of the lagoons are given in Table 2-5.

Table 2-5. Lagoon Capacity

Aerated Lagoon	Normal Water Depth (ft)	Average Sludge Depth (ft)	Water Surface Area (ac)	Nominal Volume (MG)	Usable Volume (MG)
1	10	2	3.4	11.1	8.9
2	10	2	1.3	4.2	3.4
		Total	**4.7**	**15.3**	**12.3**

Notes: based on 1982 JUB Design Drawings

The water surface elevation of Lagoon 1 is determined using a pressure transducer attached to the western most walkway. The average day flow during the maximum month (ADMM) in 2014 was 1.92 mgd and the combined usable lagoon volume of 12.3 MG. The corresponding hydraulic retention time was 6.4 days.

Both 60-mil HDPE lagoon liners were replaced in 2008 when a tear in the liner above the water surface was discovered. Replacing the liners required bypass pumping from Transfer Structure 1 to the West Boise WWTF. A rental pump supplier set up the bypass pumping operation and both lagoons were completely offline. Raw wastewater was pumped to the West Boise WWTF incurring additional surcharges due to the wastewater being untreated.

Figure 2-5. Lagoon 1 (Looking West)

2.2.2.3 Transfer Structure 2

Two 15-inch diameter pipes connect Lagoon 1 to Transfer Structure 2. Two 12-inch diameter pipes exit Transfer Structure 2 and combine into one 20-inch diameter pipe that enters the Effluent Recycle Pump wet well. One 12-inch diameter pipe routes Lagoon 1 effluent from the wet well into Lagoon 2 by overflowing a weir near the water surface. A second 15-inch diameter pipe routes Lagoon 1 effluent directly to Lagoon 2.

2.2.2.4 Lagoon 2

The majority of the TSS reduction occurs in Lagoon 2. It is smaller and primarily functions as a settling and storage basin. There is one surface mechanical aerator that provides limited mixing, but is currently out of service due to repeated failure caused by debris building up on the aerator blades.

Two 12-inch diameter pipes route flow from Lagoon 2 into the Effluent Pump Station. The upper pipe is actively used, whereas the lower pipe is used only as a lagoon drain line.

Figure 2-6. Lagoon 2 (Looking South)

2.2.2.5 Effluent Recycle Pump Station

The Effluent Recycle Pump Station is located in a wet well on the south end of Lagoon 2. The pump station recycles Lagoon 1 effluent back to Transfer Structure 1 to improve treatment. The pump station operates via on/off controls. Effluent recycle pump details are listed in Table 2-6.

Table 2-6. Effluent Recycle Pump Details

Pump Number	Make/Model	Capacity (gpm)	Drive Type	Motor Size (hp)	Control
1	ABS	700	Continuous	5	ON/OFF

2.2.2.6 Effluent Pump Station

Treated effluent is pumped to the West Boise WWTF through a 24,600-foot 14-inch diameter C905 PVC pipeline. The pipeline was constructed in 1997. The effluent pump station was modified in 2012 and new ABS non-clog submersible pumps replaced the vertical turbine pumps. Effluent Pump Station details are listed in Table 2-7. Effluent pumps have cooling jackets which allow them to operate in dry or low water surface conditions.

Table 2-7. Effluent Pump Details

Pump Number	Type	Make/ Model	Capacity (GPM)	TDH (ft)	Drive Type	Motor Size (hp)	Control
1	Non-clog Submersible	ABS	1800	150	Variable	150	Level Control: Pressure Transducer Pump Control: VFD
2	Non-clog Submersible	ABS	1800	150	Variable	150	Level Control: Pressure Transducer Pump Control: VFD

The effluent pumps are operated to maintain a 2-foot freeboard in Lagoon 1.

Figure 2-7. Effluent Pump Station

2.2.3 Utilities and Support Systems

Utilities that support the regular operation and maintenance of the WWTP are described in the following text.

2.2.3.1 Operations Building

The Operations Building houses an office, locker room, mechanical room, motor control center, auxiliary generator and a shop.

2.2.3.2 Maintenance and Storage Buildings

Four vehicle storage and maintenance buildings house the collection system maintenance equipment and supplies. A covered storage area also provides a storage area for equipment and materials.

Legend:

1. Headworks
2. Transfer Structure
3. Lagoon Pond
4. Transfer Structure
5. Lagoon Pond
6. Effluent Recycle Pump Station
7. Effluent Pump Station
8. Operations Building
9. Maintenance Building
10. Maintenance Building
11. Vehicle Storage Building

Figure 2-8. Eagle Sewer District Wastewater Treatment Plant Existing Site Plan

Eagle Sewer District Facility Plan

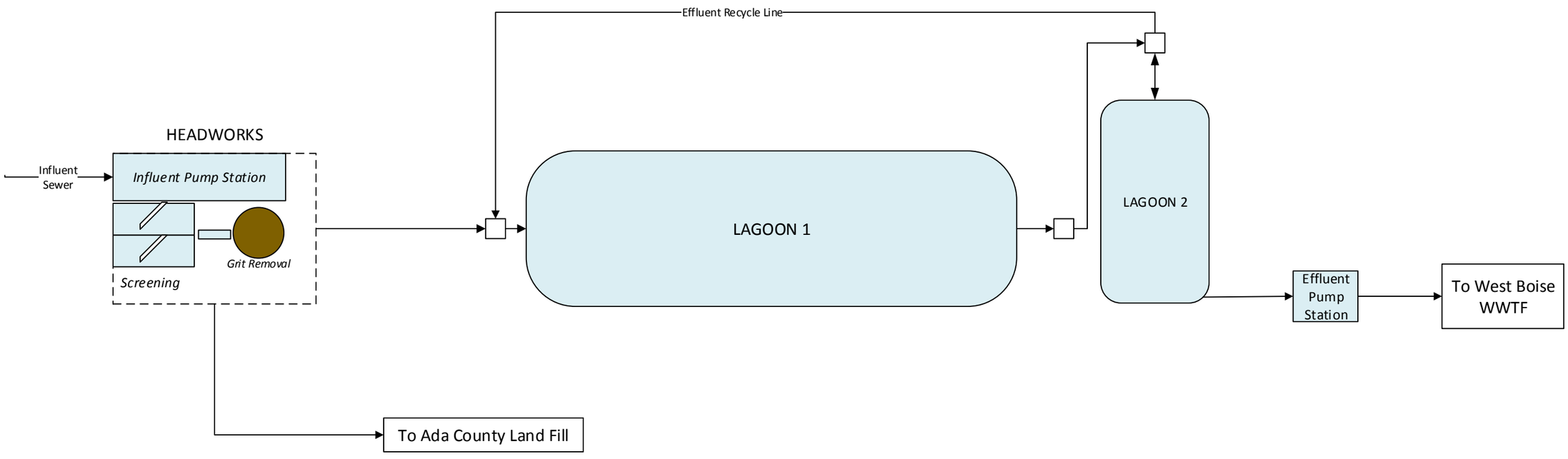
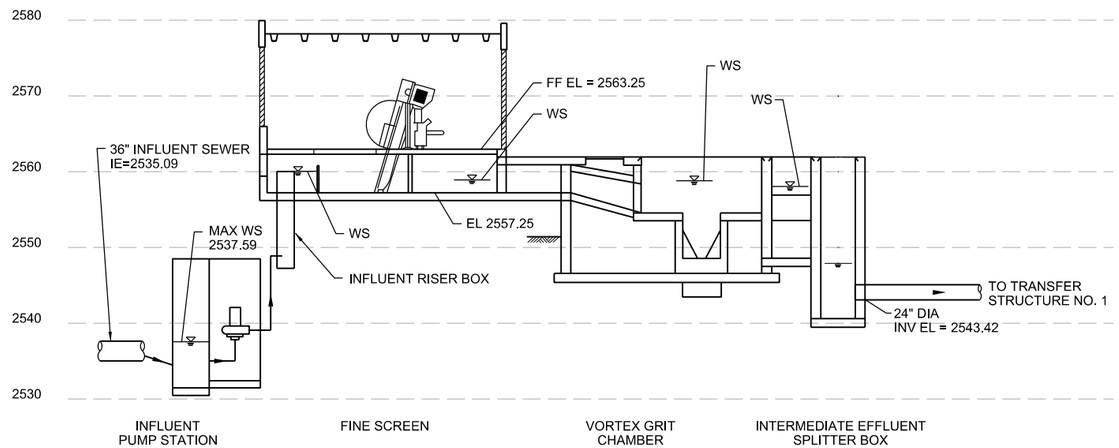


Figure 2-9. Eagle Sewer District WWTP Process Flow Diagram
Eagle Sewer District Facility Plan



NOTES:

1. RAS FLOW = 0 FOR ALL SCENARIOS.

SCENARIO	FLOW	INFLUENT FLOW (MGD)
1	YEAR 2015	3.3 (PEAK HOUR)
2	CURRENT HYDRAULIC CAPACITY	6.5 (PEAK HOUR)

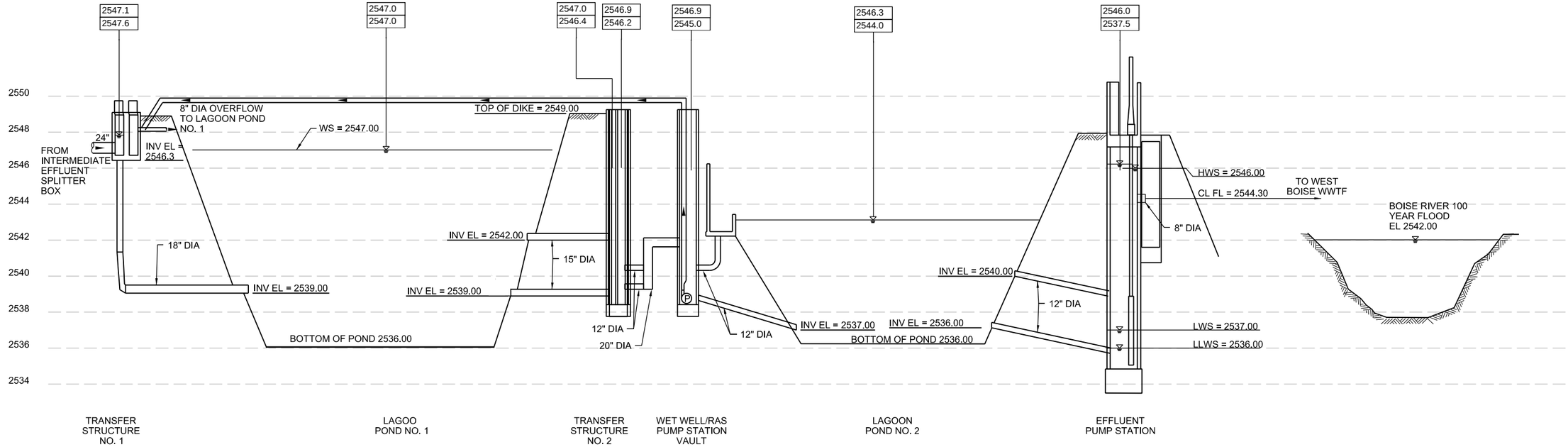


Figure 2-10. Eagle Sewer District WWTP Hydraulic Profile
Eagle Sewer District Facility Plan

2.2.3.3 Potable Water Service

The Operations Building and Headworks are supplied potable water by Eagle Water Company via a 12-inch diameter line from Highway 44. The Operations Building also has its own well located east of the building that was constructed in 1982 with the lagoon system. The well was designed to deliver 50 gpm at 65 psi. Potable water for the Headworks Building is supplied by Eagle Water Company via an 8-inch line located on the north side of the WWTP. Flow is measured with a master meter that is maintained by Eagle Water Company. Supply pressures are typically in the range of 60 to 80 psi. The grit classifier is the only wastewater treatment process that uses potable water.

2.2.3.4 Electrical Power Supply

The electrical distribution system at the Eagle Sewer District WWTP is currently served by Idaho Power from a single tap coming from State Highway 44. Eagle Sewer District accepts power at 12.5 kV routed to the main switchgear located on the plant entrance road west of the Headworks Building where the power is metered. From the switchgear, the Headworks Building is served by a 12.5 kV 600 amp breaker then a building transformer located southeast of the Headworks Building that reduces the voltage to 480 V 3 phase. The Operations Building is fed from a 300-amp breaker in the switchgear and then a 400 KVA transformer south of the building. The Operations Building feed does not appear large enough for all of the loads currently connected to the system. The electrical system needs reviewed to verify the existing loads and capacity. Any future projects that have an electrical component may require an upgrade of parts of the electrical system.

2.2.3.5 Standby Electrical Power

The Operations Building houses an auxiliary generator, a Caterpillar 3306 Diesel rated at 200-kW that serves the building and blowers. The 1,000 gallon diesel fuel tank is located outside south of the mechanical room. The auxiliary generator does not appear large enough to serve all of the loads connected to the system. A review of critical loads that should be on standby power is recommended. Upgrade of the existing generator may be required to meet current and future demands.

The Headworks Building is equipped with a 600 kW generator for the building and its processes.

2.2.3.6 SCADA System

The headworks building is equipped with a SCADA system to monitor its processes. In addition, the Mace and Palmer lift station are monitored on the WWTP SCADA system. The other lift stations are not currently connected to the SCADA system, but are intended to be connected in the future as opportunity arises. No other unit processes are monitored by the SCADA system. SCADA control and monitoring screens are available in the Operations Building in both the office and shop where computers are located.

2.2.3.7 Current Facility Needs

In the next 5 years, Operations foresees the need to purchase a new water truck, sewer cleaning truck, and facilities to house and service these additional assets.

The current system does not have a convenient method to perform seepage testing. Typically each lagoon would be isolated from inflow and outflow during the seepage test. These tests are required every 10 years and a typical range is 5-15 days, according to DEQ. Currently, bypass pumping is required to isolate the lagoons during the test and untreated wastewater is pumped directly to the West Boise WWTF incurring a high discharge cost. Eagle Sewer District Operations staff prefer a seepage testing method that is less expensive than bypass pumping.

The Operations Building needs a review of its electrical system and most likely an upgrade of the auxiliary generator.

Adding other unit processes and/or lift stations to the SCADA system may be value added to the District. Including SCADA upgrades for any improvement projects is recommended to expand control and monitoring capabilities.

2.2.3.8 Hydraulic Analysis Methods

Hydraulic analyses were performed to evaluate the existing hydraulic capacity of the Eagle Sewer District WWTP to determine need to increase the hydraulic capacity to accommodate future flow conditions. The existing Eagle Sewer District WWTP was analyzed to determine its current ultimate hydraulic capacity and to generate a hydraulic profile at different flow conditions. The hydraulic computer model HYDRO, developed by CH2M, was used for this hydraulic analysis. The model produces a hydraulic profile by calculating the head loss through the treatment plant hydraulic structures at a given flow rate. HYDRO is a steady-state model wherein as wastewater flows the flow rate at any point in the system is held constant.

Another hydraulic computer model REPLICA, also developed by CH2M, was used to create a dynamic model wherein with a changing influent flow rate is routed through the system. This will reveal the true capacity of a hydraulic system. In the case of the Eagle Sewer District WWTP a dynamic model will characterize attenuation of flow in Lagoon Cells 1 and 2.

Steady-State Modeling

The HYDRO computer model calculates steady state energy and hydraulic grade line elevations upstream and downstream of the hydraulic elements in the treatment plant. The hydraulic analysis begins at a water surface datum elevation at the downstream end of the plant. The hydraulic calculations proceed upstream from this datum elevation, one element at a time. In this evaluation the water surface elevation in the effluent pump station wet well was used as the downstream datum.

Steady-state modeling is generally used to size hydraulic structures as it yields a conservative result because it assumes a constant flow rate through the entire system. As discussed in the following sections, the flow rate is not constant through the entire system but sizing hydraulic structures to pass peak hydraulic flows is conservative and provides flexibility. For example, if Lagoon Cell 1 were taken offline but flow was pumped around directly to Lagoon Cell 2, then the flow attenuation available in Lagoon Cell 1 would not be available. The resulting peak flow rates downstream would be higher. Sizing structure and conveyance for the peak flow rates ensures sufficient hydraulic capacity.

Dynamic Modeling

The REPLICA computer model calculates the behavior of energy and hydraulic grade line elevations in time under varying flow conditions. It also has the ability to simulate control logic which improves system understanding and allows for complex systems to be analyzed and optimized.

A diurnal influent flow pattern was simulated with effluent pumps operating on variable frequency drives to maintain a water surface elevation of 2547.0 in Lagoon Cell 1. Flow rates were increased incrementally until a point was reached that the hydraulic design criteria described in Section 2.3.1.2 was reached.

2.2.3.9 Design Criteria and Assumptions

The design criteria for this hydraulic analysis is based on existing and future design conditions at the Eagle Sewer District WWTP. The evaluation identifies hydraulic bottlenecks where improvements are required to reduce or eliminate the hydraulic constraint. The design criteria and assumptions for this hydraulic evaluation are as follows.

- Maintain at least 1 foot of freeboard in all hydraulic structures except for Lagoon Cell 1 (see below).

- Optimize the operating level of Lagoon Cell 2. Keeping the depth as high as possible increases the hydraulic residence time and improves treatment. Also, increased water depth above the effluent pipe prevents a vortex from forming.
- Maintain a water surface elevation (WSL) of 2547.0 in Lagoon Cell 1 leaving 2 feet of freeboard.
- Assume no recycle flow. Because none of the alternatives (See Section 5) utilize recycle flow from Lagoon Cell 2 to Lagoon Cell No. 1, the hydraulic analyses were conducted assuming the recycle pump is turned off.
- Assume the 12-inch effluent pipe in Lagoon Cell 2 is clear. Previous hydraulic measurements have demonstrated higher headloss in this pipe than expected. This evaluation was conducted assuming no pipe restrictions.
- Pipe velocities for proposed improvements shall be 5 feet per second or less.

The existing and future design flow conditions used in the hydraulic analysis are presented in Table 2-8.

Table 2-8. Eagle Sewer District WWTP: Existing and Future Design Influent Flow Conditions

Scenario	Flow	Peak Hour Influent Flow (mgd)
1	Year 2015	3.3
2	Current Hydraulic Capacity	6.5
3	Year 2040 [a]	8.7

Notes:

[a] See Section 3.1

2.2.3.10 Current Hydraulic Capacity

Replica was utilized to evaluate the current hydraulic capacity of the system. In addition to all of the criteria and assumptions identified in 2.3.1.2, the following assumption is important to understand when evaluating the Eagle Sewer District WWTP:

- Lagoon Cell 1 WSL is used to adjust the speed of the effluent pumps as little as necessary so flow rate is practically constant.

There is enough attenuation in Lagoon Cells 1 and 2 that the effluent pumps can operate at almost a constant flow rate over a 24-hour period while maintaining the level in Lagoon Cell 1 to within an inch of the setpoint. This means that the pumps would not cycle on and off at all during a 24 hour period.

Figure 2-11 shows that when effluent pumps operate at a constant flow rate of 4.0 mgd, the system can pass a diurnal flow curve with peak hour flows up to 6.5 mgd and the level in Lagoon Cell 1 varies by less than one inch (Reference Figure 2-12). The hydraulic profile for this scenario is shown as Scenario 2 in the hydraulic profile (Figure 2-10).

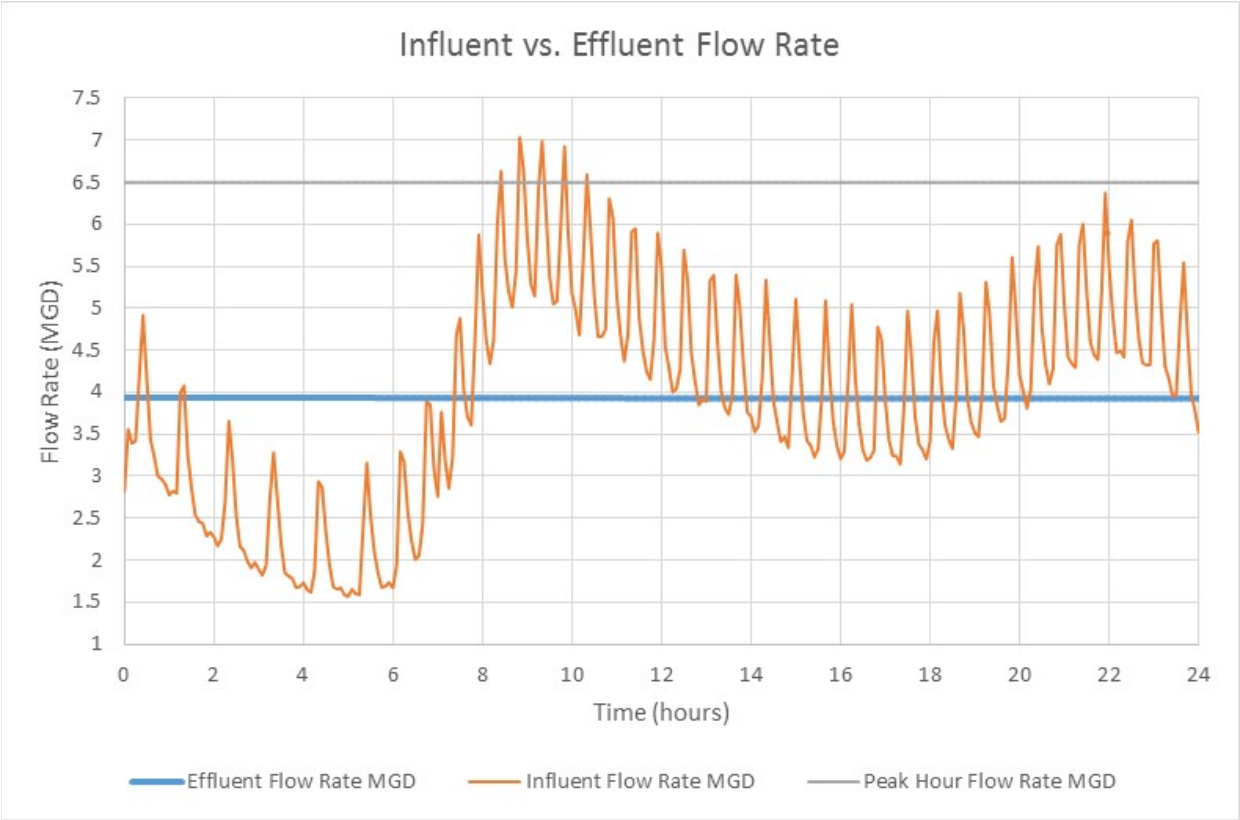


Figure 2-11. WWTP Influent and Effluent Flow Rates at Hydraulic Capacity

Figure 2-12. Lagoon Pond No. 1 Level at Hydraulic Capacity

2.2.3.11 Hydraulic Capacity Analysis Conclusions

The following hydraulic limitations or "bottlenecks" were identified during the hydraulic evaluation. Sizing recommendations are based on the steady state analysis using the HYDRO computer model where flow attenuation in the system is not taken into consideration.

- Conveyance Capacity Between Effluent Pump Station and West Boise WWTF
  - Assuming a maximum pipe velocity of 5 feet per second the capacity of the existing 14-inch effluent force main will be exceeded when the peak effluent pumping rate exceeds 3.5 mgd. The timing of this improvement is flexible due to the flow attenuation properties of the lagoon system as described above.
  - Using the same pipe velocity criteria the existing force main could be replaced with a 24-inch pipeline will increase its capacity to 8.7 mgd. This corresponds to the predicted 2040 peak hour capacity. The peak effluent pumping rate can be lower than this due to flow attenuation properties of the lagoon system as described above.
- Effluent Pump Station Capacity
  - The effluent pump station currently has two pumps rated at 1800 gpm each, or 2.6 mgd.
  - The impellers in the pumps can be replaced to increase the single pump capacity to about 3.4 mgd
- Conveyance Capacity Between Lagoon Cell 2 and the Effluent Pump Station
  - The level of Lagoon Cell 2 should be operated no lower than WSL 2544.00 to prevent vortexing at the entrance of the 12-inch diameter effluent pipe. Operating below this WSL is possible if a 24" x 12" eccentric reducer fitting that increases the opening size of the pipe is used.
  - Additional pipe capacity needs to be added in order to pass a future peak hour flow rate of 8.7 mgd. Building an additional 18" diameter effluent pipe between Lagoon Cell 2 and the Effluent Pump Station will allow peak hour flows to be passed with maximum pipe velocities being about 5 feet per second.
- Hydraulic Conveyance Capacity Between Lagoon Cells 1 and 2
  - Additional conveyance capacity is needed to pass the future peak hour flow of 8.7 mgd, as the headloss between the two lagoon cells at this flow rate is about 4.3 feet. This means that if Lagoon Cell 1 operates at WSL 2564.0, then Lagoon Cell 2 will be at WSL 2542.7 and at this WSL a vortex is formed at the Lagoon Cell 2 effluent pipe entrance and significantly reduces the treatment capacity of the cell. Trying to increase the capacity of the transfer structure is problematic because there is no room for additional pipe penetrations. We recommend that the transfer structure be replaced with a new structure that has adequate capacity.
- Hydraulic Conveyance Capacity Between Transfer Structure 1 and Lagoon Cell 1
  - The 18-inch diameter pipe between the two structures is undersized for the future peak hour flow rate of 8.7 mgd. At this flow rate velocities in the pipe approach 7.5 feet per second with a resulting headloss of about 1.7 feet. This would leave less than 1 foot of freeboard in the transfer structure. We recommend extending the transfer structure and installing an additional 18-inch diameter influent pipe to Lagoon Cell 1.
- Hydraulic Conveyance Capacity Between the Headworks and Transfer Structure 1
  - The 24-inch diameter pipe between the headworks and Transfer Structure 1 passes the future peak hour flow rate of 8.7 mgd. The resulting velocity in the pipe is 4.3 feet per second with a

total headloss of 2.5 ft. and does not surcharge flow at headworks where the vortex grit chamber weir is submerged.

- Hydraulic Capacity Within the Headworks
  - The headworks passes all of peak hour flows shown in Table 2-8.

2.2.4 Hydraulic Profiles

A hydraulic profile showing water surface levels for Scenario 1 and 2 (defined in Table 2-8) are shown in Figure 2-10.

2.3 Treatment Capacity Rating

A BioWin (commercially available biological treatment modeling software, version 4.0) model was created and calibrated to model the existing Eagle Sewer District WWTP, define existing performance, and evaluate proposed system improvements. Influent and effluent water quality and flow data from 2010-2013 were used for model development. The model was validated by comparing the 2013 data with a year-long dynamic simulation where predicted and measured effluent quality values were close or were within an acceptable tolerance.

At the annual average influent concentration of 211 mg/L BOD_5 or 4,575 lb/day, the BioWin model predicted the effluent soluble $cBOD_5$ ($sBOD_5$) concentration to be approximately 30 mg/L, which corresponds to a treatment capacity of 2.6 mgd. This loading rate is conservative when compared to the maximum week loading between 2011 and 2014 of 4,474 lb/day, as presented in Table 2-17. This $sBOD_5$ level meets the 60 mg/L BOD effluent water quality objective. The estimated effluent TSS value also meets the 60 mg/L target, assuming no TSS excursions which might occur due to seasonal changes of the lagoon conditions or algae growth.

Details on the treatment capacity rating and approaches on BioWin modeling are presented in Appendix H Process Modelling and Analyses for Alternative Evaluations.

2.4 City of Boise Discharge Agreement

The 2005 Agreement between Eagle Sewer District and the City of Boise that allows Eagle Sewer District to discharge treated effluent to the West Boise WWTF for further treatment, disinfection, and river discharge consists of two separate charges: a capacity charge and a monthly O&M charge. The capacity charge represents the capital cost of constructing assets to treat the wastewater. The monthly O&M charge represents the ongoing monthly cost associated with operations and maintenance of the capital assets. A sample bill from the City of Boise can be found in the Appendix.

2.4.1 West Boise WWTF Capacity Charge

The capacity charge is a one-time charge for the next increment of treatment capacity above a threshold value. These thresholds represent the capacity that has been historically purchased by Eagle Sewer District in the West Boise WWTF. This charge is not levied unless the current threshold has been exceeded at which time a bill for the difference in the threshold exceedance minus the existing threshold is sent to Eagle Sewer District for additional capacity. Once the additional capacity has been purchased, this new capacity becomes the new threshold. This capacity does not represent any physical ownership of assets in the West Boise WWTF, it merely allows Eagle Sewer District to discharge the threshold amount to the West Boise WWTF without incurring additional charges.

The following are the current threshold capacities with their corresponding effluent concentration:

- Flow: 1,870,810 gpd
- BOD: 855 lbs./day – 55 mg/L @ 1.8 mgd
- TSS: 1,708 lbs./day – 110 mg/L @ 1.8 mgd
- NH_3-N: 450 lbs./day – 29 mg/L @ 1.8 mgd

The current charges to purchase increase treatment capacity at the West Boise WWTF

- Flow (/1,000 gal/day): $2,280
- BOD (lb/day): $1,395
- TSS (lb/day): $765
- NH_3N (lb/day): $4,325

For example, if the Eagle Sewer District NH_3N quantity increased from its current level of 450 lb/day to 460 lb/day, an increase of 10 lb/day, Eagle Sewer District would incur a one-time capacity threshold charge of 10 lb/day x $4,325 = $43,250 and the new threshold would be 460 lb/day. The difference between the threshold amounts and the wastewater constituents actually discharged is compared monthly to determine if additional capacity must be purchased. The average increase in the capacity charges between 2010 and 2014 was 4-percent per year.

2.4.2 West Boise WWTF Operations and Maintenance Charge

The monthly O&M charge is calculated based on the actual quantities of flow, BOD, TSS and NH_3–N that are discharged to the City of Boise. The Operations and Maintenance charges are calculated for the listed parameters using the following formulas:

- Flow: Flow Charge = Flow (mgd) x Flow Operation & Maintenance Fee
- BOD: BOD Charge = BOD (lb/day) x BOD Operation & Maintenance Fee
- TSS: TSS Charge = TSS (lb/day) x TSS Operation & Maintenance Fee
- NH_3-N: NH_3-N Charge = NH_3-N (lb/day) x NH3-N Operation & Maintenance Fee

The total Monthly Operation & Maintenance Fee is the sum of all four charges. Refer to Table 2-9 for historical annual and monthly Operation & Maintenance unit rates.

Table 2-9. Annual Eagle Sewer District O&M Rates

	Flow ($/mgd)	BOD ($/lb)	TSS ($/lb)	NH_3-N ($/lb)
2010	$ 247,414 (20,618)	$ 182,365 ($15.20)	$ 85,130 ($7.09)	$ 48,990 ($4.08)
2011	$ 259,784 (21,649)	$ 191,483 ($15.96)	$ 89,386 ($7.45)	$ 51,439 ($4.29)
2012	$ 266,279 (22,190)	$ 196,270 ($16.34)	$ 91,620 ($7.64)	$ 52,724 ($4.40)
2013	$ 274,267 (22,856)	$ 202,158 ($16.25)	$ 94,369 ($7.86)	$ 54,307 ($4.53)
2014	$ 287,981 (23,998)	$ 212,266 ($17.69)	$ 99,087 ($8.26)	$ 57,022 ($4.75)

Notes: Monthly unit rates are listed in parenthesis

Table 2-10 presents the actual O&M charges paid by Eagle Sewer District to the City of Boise over the last 5 years. Figure 2-13 shows the portion of the total O&M charge for 2014 for each constituent. It is very apparent that the majority of the monthly O&M charge is for the West Boise WWTF to treat the wastewater flow from Eagle Sewer District. Alternatives that address flow will have much larger financial impact versus alternatives that address the other constituents.

Table 2-10. Actual Eagle Sewer District O&M Charges Paid to the City of Boise

	Flow $	BOD $	TSS $	NH_3-N $	Total
2010	$ 416,585	$ 70,705	$ 77,839	$ 17,073	$ 582,257
2011	$ 452,822	$ 78,814	$ 62,448	$ 18,265	$ 612,407
2012	$ 456,599	$ 102,089	$ 85,404	$ 19,302	$ 663,453
2013	$ 482,671	$ 118,494	$ 100,653	$ 23,359	$ 725,239
2014	$ 517,447	$ 127,667	$ 83,880	$ 21,507	$ 750,565

These charges do not include the Lakemoor Subdivision charges

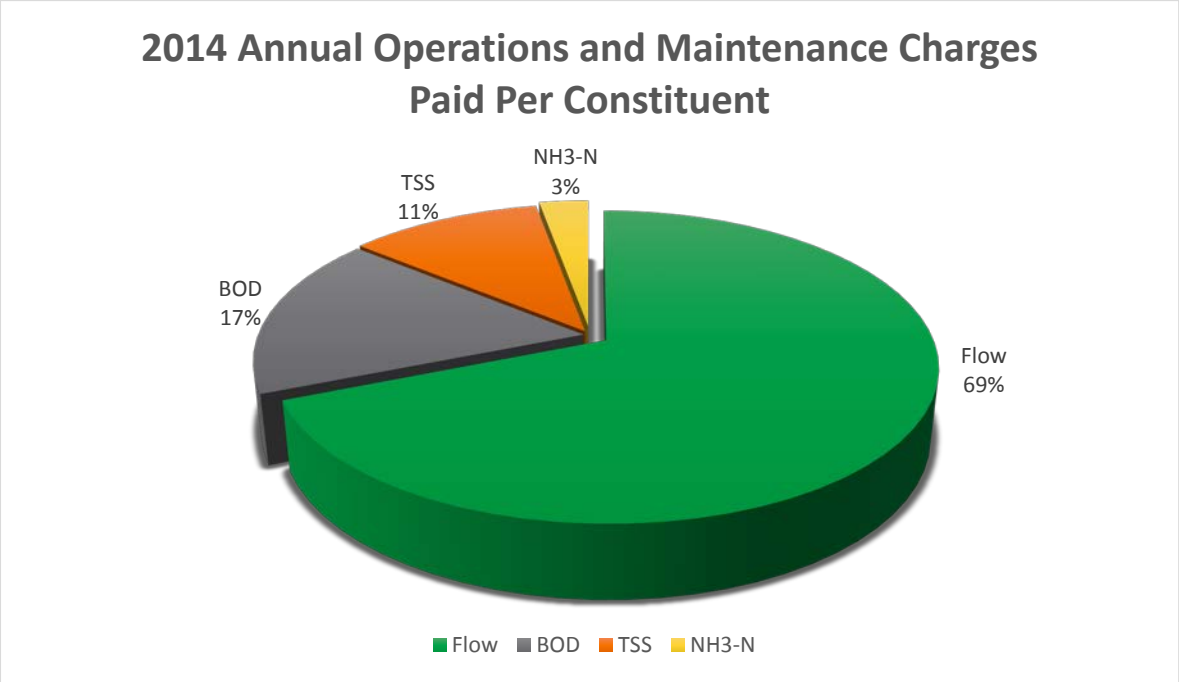


Figure 2-13. WWTP Performance 2011-2013

Under the O&M charges, there are two separate rates, one for wastewater discharged from the Eagle Sewer District WWTP and the other for a direct connection to the West Boise WWTF without any treatment. The Lakemoor subdivision does not pass through the Eagle Sewer District WWTP; it is located adjacent to the West Boise WWTF and has a lift station that pumps directly to the West Boise WWTF where it is measured and sampled. There are two additional direct connections to the City of Boise collection system, the Lakeland Estates and Eagle City Marketplace connections, which are not monitored or sampled. For the purposes of this plan, the cost of the direct connections that do not pass through the Eagle Sewer District WWTP are not included, as any improvements at the Eagle Sewer District WWTP would not affect the charges from these connections.

In the future, other rates may be imposed by the City of Boise as the agreement with the Eagle Sewer District states: “If Boise implements other charges for wastewater constituents such as, but not limited to, nitrogen, phosphorous, sulfur, and fluoride during the period of this Agreement, the District shall pay said Charges.” Should these charges be applied, they would be calculated similarly to the other constituents which are currently assessed. The City of Boise is currently increasing WWTF technology to address phosphorus and may assess the District for this constituent.

2.5 Wastewater Treatment Plant Performance

2.5.1 Effluent Characteristics

The effluent water quality from 2010 to 2014 is presented in Table 2-11.

Table 2-11. Eagle Sewer District WWTP Effluent Water Quality 2010 to 2014

	Flow (mgd)	BOD (lb/d)	BOD (mg/l)	TSS (lb/d)	TSS (mg/l)	NH_3-N (lb/d)	NH_3 (mg/L)
2010	1.79	614	45	1,705	116	418	28
2011	1.85	536	40	1,022	68	402	26
2012	1.83	711	52	1,434	96	404	26
2013	1.85	784	59	1,498	99	759	49
2014	1.89	842	59	1,140	75	423	27

All values are maximum month discharge from the Eagle Sewer District WWTP and does not include flow from the Lakemoor lift station which is pumped directly to the West Boise WWTF

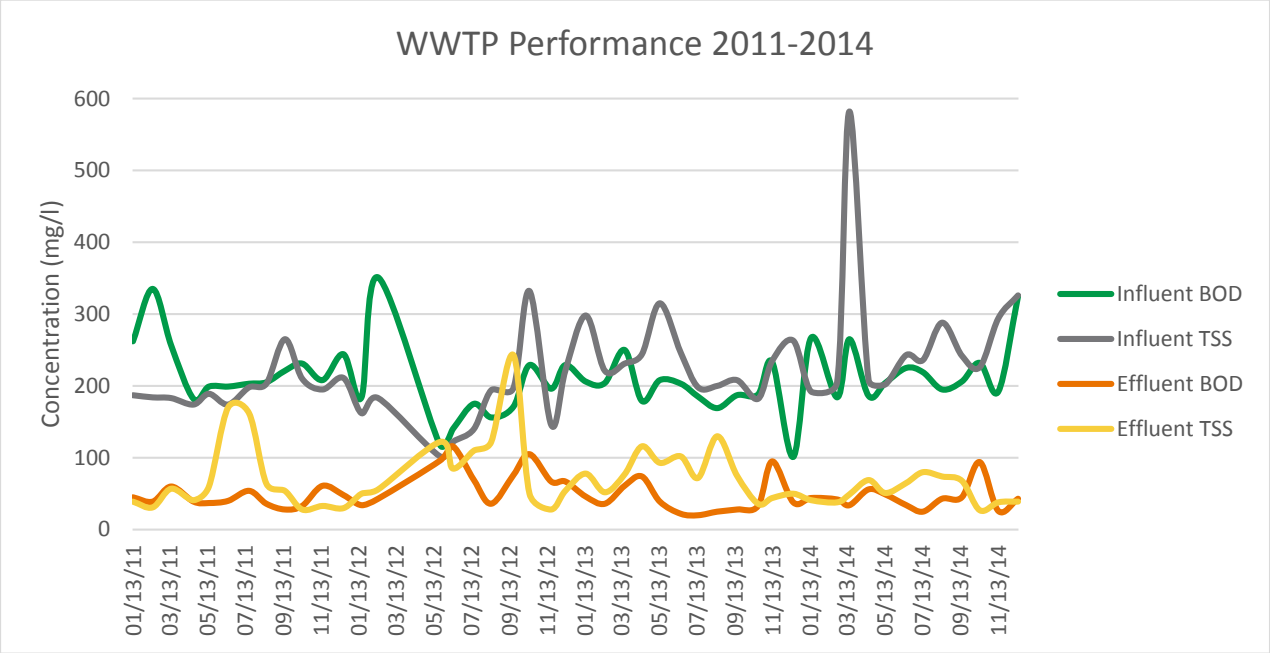


Figure 2-14. WWTP Performance 2011-2014

The Eagle Sewer District has been effective in reducing the influent BOD and TSS to relatively lower concentrations. The Figure 2-14 shows that there can be large variations in the influent BOD and TSS which are somewhat dampened by the lagoon treatment system. The effluent BOD is more consistent than the effluent TSS which can be due to seasonal algae growth in the lagoons. Due to the increasing flow in the WWTP and the reduced hydraulic retention time, the WWTP does not produce as reliable effluent water quality as it would with longer hydraulic retention time.

2.6 Extent of Flow Reduction Measures

As most of the ESD charges are flow based, ways to reduce flow discharged to City of Boise would significantly reduce cost.

2.6.1 Water Conservation

The City of Eagle is served by three different water purveyors and none have reportedly conducted a water conservation program in the recent past. The City of Eagle 2015 Comprehensive Plan includes details for a general water conservation program, but no coordinated approach has been initiated. Conserving potable water used indoors would reduce the wastewater flow resulting in less charges by the City of Boise to treat the wastewater.

2.6.2 Infiltration and Inflow Reduction

Most of the Eagle Sewer District service area has high ground water levels causing most of the collection system lines to be submerged in groundwater throughout the year. In response, Eagle Sewer District has an extensive program to reduce infiltration and inflow including cleaning and inspecting the collection system and repairing issues encountered. Even though very little of the wastewater treatment plant flow is attributed to infiltration and inflow, the inspection program is continued to further reduce what infiltration and inflow remains. The collection system is further detailed in Section 7.

2.7 Existing System Flows

Historical population, wastewater flow, and influent wastewater characteristics are presented in this section.

For reference, Table 2-12 defines key terms used in the development and analysis of historical and future wastewater flows and loads. The definition from the Idaho Administrative Procedures Act (IDAPA) Wastewater Rules for maximum months does not align directly with the definition used for this planning effort. Maximum month flow, as defined by IDAPA, is the maximum flow that occurs in a calendar month. Statistical analysis, however, was used to estimate the maximum month flows for this plan. These statistical analyses are similar to 30-day running averages, but are more conservative than the calendar month maximum.

Table 2-12. Definition of Flow Terms

	IDAPA Definition*	Definition used for Eagle Sewer District WWTP Facility Plan Study
Base Sanitary Flow	-	Residential, commercial, and industrial wastewater flow carried to the wastewater treatment plant
Inflow/Infiltration (I/I)	-	Flow that enters the collections system from surrounding soil (infiltrations) or through direct connections (inflow)
Average day flow	The average day flow is the average of daily volumes to be received for a continuous 12-month period expressed as a volume per unit time. However, the average day flow for design purposes for facilities having critical seasonal high hydraulic loading periods, such as recreational areas or industrial facilities, shall be based on the average day flow during the seasonal period.	Average total daily flow that occurs for a 12-month calendar year period
Maximum week flow	-	Highest 7-day average flow
Maximum month flow	The maximum month flow is the largest volume of flow to be received during any calendar month expressed as a volume per unit time.	Highest 30-day average flow

Table 2-12. Definition of Flow Terms

	IDAPA Definition*	Definition used for Eagle Sewer District WWTP Facility Plan Study
Maximum day flow	The maximum day flow is the largest volume of flow to be received during a continuous 24-hour period expressed as a volume per unit time.	Highest 24-hour average flow
Peak hour flow	The design peak hour flow is the largest volume of flow to be received during a 1-hour period expressed as a volume per unit time.	Maximum flow that occurs in a 1-hour period

NOTE:

*IDAPA 58.01.16.010 "Wastewater Rules"

2.7.1 Population

The population of the City of Eagle more than tripled between 1999 and 2010 from approximately 7,500 to nearly 20,000 residents (Table 2-13). The 2013 U.S. Census estimate for the City of Eagle was 21,646. The Treasure Valley economy is expected to continue to grow creating demand for housing throughout Ada and Canyon Counties which includes the City of Eagle and other surrounding areas served by the Eagle Sewer District.

Table 2-13. 2007-2015 City of Eagle Population by COMPASS

Year	Population Estimate
2007	20,095
2008	21,090
2009	21,370
2010	19,908
2011	20,140
2012	20,550
2013	21,350
2014	23,460
2015	24,600

While the total population of the City of Eagle is captured well by the COMPASS population estimates, the population served by the Eagle Sewer District is not well represented. There are a number of developments and areas within city limits that are not connected to the Eagle Sewer District collection system. Some of these developments are anticipated to connect in the future, whereas others are never expected to connect. In developing a wastewater collection master plan (see Section 7), it was determined that of the 24,600 people reported by the City of Eagle to live in the Eagle area of impact, only about 18,500 were served by the Eagle Sewer District. As a percentage, only 75-percent of the City of Eagle population is served by the District. Section 3 addresses future flow and loading projections expected due to population increase and focuses on the actual population served by the Eagle Sewer District and not the entire City of Eagle population.

2.7.2 Flow and Loadings

This section includes a discussion on the existing wastewater flow and loadings and statistical analysis to develop peaking factors used in subsequent analyses in the wastewater facility plan.

2.7.2.1 Wastewater Flow Baseline Conditions

Historical WWTP data was used to approximate baseline flow parameters and average organic, solids, and nutrient loads. The 30-day average effluent flow is shown in Figure 2-14. Influent flow to the treatment plant varies seasonally with the maximum month typically occurring in August or September, as shown in Figure 2-14. The plant influent data is from Eagle Sewer District sampling activities and the effluent data was taken from the City of Boise billing reports.

Table 2-14 shows the average per capita flow for the years 2010 through 2014 using 75-percent of the population data from the City of Eagle planning department to represent the population connected to Eagle Sewer District. These values fall within the typical range of 55-190 gpcd (2003 Metcalf and Eddy). Eagle Sewer District currently serves nearly 9,700 Equivalent Residential Units (ERUs) (based on a sewered population of 18,500 and an average household size of 2.4 persons per household and 1,800 ERUs of commercial flow). Figure 2-15 shows the 30-day average flows for each year.

Table 2-14. Per Capita Average Flows per Year

Year	Sewered Population	Annual Average Flow (mgd)	Per Capita Flow (gpcd)
2010	14,900	1.66	111
2011	15,100	1.73	114
2012	15,400	1.70	110
2013	16,000	1.74	109
2014	17,600	1.77	101

The per capita flow was calculated based on the average annual flow (1.77 mgd) and the average population served by the wastewater system in 2014. The calculated residential per capita flow was 101 gallons per capita per day. The 2014 data are close to the average per capita wastewater flows for the previous years (2010-2013).

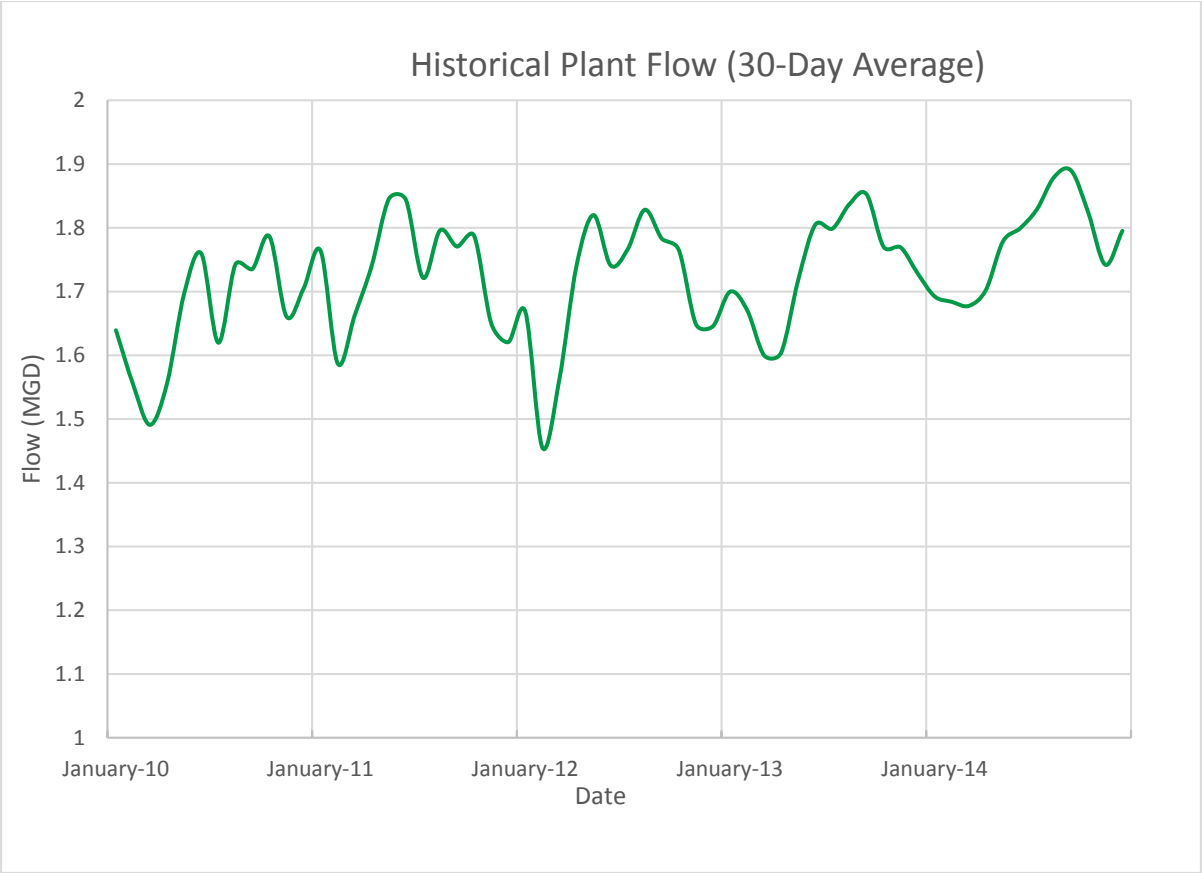


Figure 2-15. 30-Day Average Plant Effluent Flow from 2010 to 2014

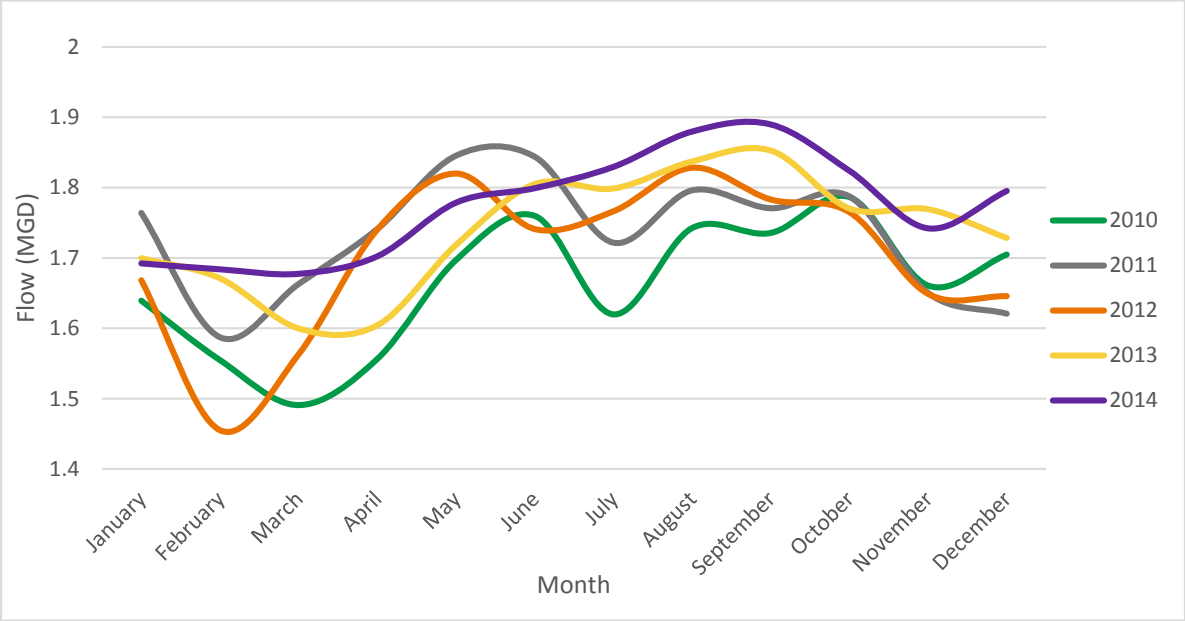


Figure 2-16. Monthly Average Wastewater Flows 2010 to 2014

The 2014 (calendar year) Eagle Sewer District WWTP data was used to approximate baseline flow parameters and average BOD, TSS, and NH_3-N loads. Peaking factors were also calculated for each year of plant data as a comparison. To maintain continuity, the 2014 peaking factors were used to project

flow values. A summary of the maximum month, maximum week, and peak day peaking factors is presented in Table 2-15.

Table 2-15. Eagle Sewer District WWTP Calculated Flow Peaking Factors

Year	Maximum Month (mgd)	Maximum Week (mgd)	Peak Day (mgd)
2012	1.08	1.13	1.42
2013	1.08	1.12	1.38
2014	***1.06***	***1.10***	***1.41***

Statistical analysis was used to estimate the average annual flow, maximum month flow, maximum week flow, and peak daily flow based on the previous five years of data. The probability of influent flows or loads occurring was used to establish average and peak flows and loads. The percentile method can be used since wastewater flows are typically log-normally distributed. The following percentiles apply to flow and load conditions:

- Annual average = 50th percentile (base)
- Maximum month = 91.7th percentile (11/12th percentile)
- Maximum week = 98.1st percentile (51/52nd percentile)
- Peak Day = 99.7th percentile (364/365th percentile)

Using a statistical program in Excel, these percentiles were calculated from the actual monthly average data provided. The statistics were calculated for each year, providing average and peak flows for 2010 to 2014.

Table 2-16. Statistically Calculated Eagle Sewer District WWTP Flow Peaking Factors

Year	Unit	Annual Average	Maximum Month	Maximum Week	Peak Day
2010	mgd	1.68	1.76	1.78	1.79
2011	mgd	1.75	1.84	1.84	1.85
2012	mgd	1.75	1.92	1.99	2.15
2013	mgd	1.74	1.91	2.06	2.26
2014	***mgd***	***1.80***	***1.96***	***2.11***	***2.39***

2.7.2.2 Influent BOD and Solids Loading

BOD and TSS loads for 2014 were based on influent sampling results recorded by the Eagle Sewer District. The same statistical analysis that was completed for historical flows was performed for the BOD and TSS loads to establish historical average and peak loads. Summaries of the BOD and solids loads are provided in Table 2-17 and Table 2-19 respectively. The 30-day running average BOD and TSS influent loads are shown in Figure 2-17.

The loads presented represent primarily residential and limited commercial discharges to Eagle Sewer District. Very little load is attributed to industrial discharges.

Table 2-17. Historical BOD Influent Loads Based on Statistical Analysis

Year	Units	Annual Average	Maximum Month	Maximum Week	Peak Day
2011	lb/day	3,161	3,776	4,268	4,391
2012	lb/day	2,608	3,665	4,270	4,421
2013	lb/day	2,765	3,191	3,222	3,230
2014	lb/day	3,196	3,841	4,474	4,632

Table 2-18. Historical TSS Influent Loads Based on Statistical Analysis

Year	Units	Annual Average	Maximum Month	Maximum Week	Peak Day
2011	lb/day	2,744	3,123	3,731	3,883
2012	lb/day	2,376	3,450	4,590	4,875
2013	lb/day	3,140	4,058	4,312	4,375
2014	lb/day	3,535	4,979	7,428	8,040

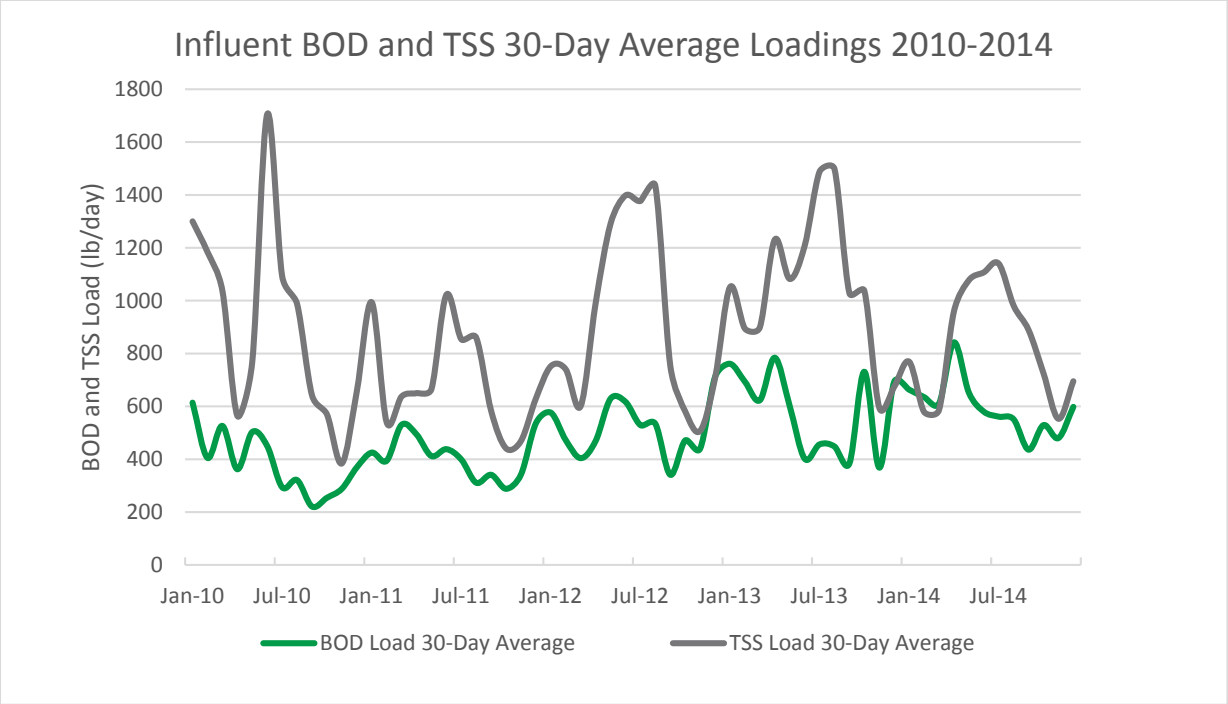


Figure 2-17. 30-Day Running Average Influent BOD Load and TSS Load from 2010 to 2014

Peaking factors were calculated for each year based on recorded data. Table 2-19 summarizes the peaking factors. These values are the per capita loading for BOD and TSS was calculated to be 0.14 and 0.15 pound per capita per day (lb/cap-day), respectively. The per capita values are also within the typical ranges (0.11 to 0.26 lb/cap-day for BOD and 0.13 to 0.33 lb/cap-day for TSS [Metcalf and Eddy 2003]). These values falling at the low end of expected range seems accurate as wastewater is primarily residential.

Table 2-19. BOD and TSS Peaking Factors

Year	BOD Peaking Factor				TSS Peaking Factor		
	Units	Maximum Month	Maximum Week	Peak Day	Maximum Month	Maximum Week	Peak Day
2010	lb/day						
2011	lb/day	1.11	1.32	1.42	1.11	1.15	1.17
2012	lb/day	1.34	1.78	2.05	1.16	1.38	1.49
2013	lb/day	1.24	1.31	1.39	1.09	1.10	1.08
2014	lb/day	1.28	1.91	2.27	1.11	1.18	1.18

2.7.2.3 Influent Nutrient Loading

Influent wastewater characteristics, including total Kjeldahl nitrogen and total phosphorus were evaluated based on Eagle Sewer District WWTP data. The historical TKN and total phosphorus average and peak loads are presented in Tables 2-20 and 2-21. The typical per capita loading values for TKN are 0.011-0.026 lb/cap-day and the calculated values are within this range (Metcalf and Eddy 2003).

Table 2-20. Historical TKN Influent Loads Based on Statistical Analysis

Year	Units	Annual Average	Maximum Month	Maximum Week	Peak Day
2011	lb/day	464	517	536	541
2012	lb/day	476	574	683	710
2013	lb/day	508	543	546	546
2014	lb/day	528	575	612	622

Table 2-21. Historical Total Phosphorus Influent Loads Based on Statistical Analysis

Year	Units	Annual Average	Maximum Month	Maximum Week	Peak Day
2011	lb/day	64	69	73	74
2012	lb/day	59	75	84	87
2013	lb/day	59	63	66	67
2014	lb/day	62	73	77	78

Peaking factors were calculated for each year based on historical values. The 2014 maximum month TKN peaking factor was 1.11 and the peak day peaking factor was 1.18. The 2014 maximum month total phosphorus peaking factor was 1.13 and the peak day peaking factor was 1.25. Table 2-22 summarizes the peaking factors.

Table 2-22. Influent TKN and Total Phosphorus Peaking Factors

Year	TKN Peaking Factor				Total Phosphorus Peaking Factor		
	Units	Maximum Month	Maximum Week	Peak Day	Maximum Month	Maximum Week	Peak Day
2011	lb/day	1.11	1.15	1.17	1.06	1.11	1.14
2012	lb/day	1.16	1.38	1.49	1.22	1.36	1.46
2013	lb/day	1.09	1.10	1.08	1.07	1.12	1.13
2014	lb/day	1.11	1.18	1.18	1.13	1.18	1.25

2.7.2.4 Industrial Flows and Loadings

Eagle Sewer District currently has no significant industrial users and there are no new immediate plans for adding industrial users. However, allowances for future industrial discharges are included in future planning efforts to coincide with the City of Eagle Comprehensive Plan.

SECTION 3

Future Conditions

This section documents flow and load projections for the Eagle Sewer District WWTP. These flows and loadings do not include the Lakemoor subdivision located adjacent to the West Boise WWTF since it is equipped with its own lift station and pumps directly to the West Boise WWTF.

3.1 Projected Flow and Loadings

Establishing realistic flow and loading projections is critical in defining the necessary wastewater facilities to meet future conditions. Projected population, wastewater flow, and influent wastewater characteristics are presented in this section. This information is used to establish the basis of planning for future facilities. Eagle Sewer District currently serves nearly 9,700 ERUs (based on a sewered population of 18,500 and an average household size of 2.4 persons per household and 1,800 ERUs of commercial flow). The estimate of current and future population, wastewater flow, and corresponding ERU's are presented in Table 3-1.

Table 3-1. Eagle Sewer District WWTP Projected Flowrates

Date	Annual Average Flow (mgd)	Projected ERU
2015	1.9	9,700
2020	2.3	11,400
2025	2.8	13,400
2030	3.5	15,800
2035	4.3	18,500
2040	5.2	21,800

Population and flow projections are based on the City of Eagle's forecasted growth rate of 4-percent per year. The City of Eagle expects non-uniform future growth where during times of economic prosperity, such as 2014, growth is closer to 10-percent, and during slow economic times growth is as low as 2-percent. Historical and projected population values in Figure 3-1 are shown assuming a 4-percent growth rate.

COMPASS predicts growth in Eagle to be closer to 2.4-percent per year. However, COMPASS projects a growth rate for a larger area that includes several municipalities and then divides the growth rate between the municipalities. The growth rate for the entire area can be low but higher in one area, which is within the Eagle Sewer District area of impact.

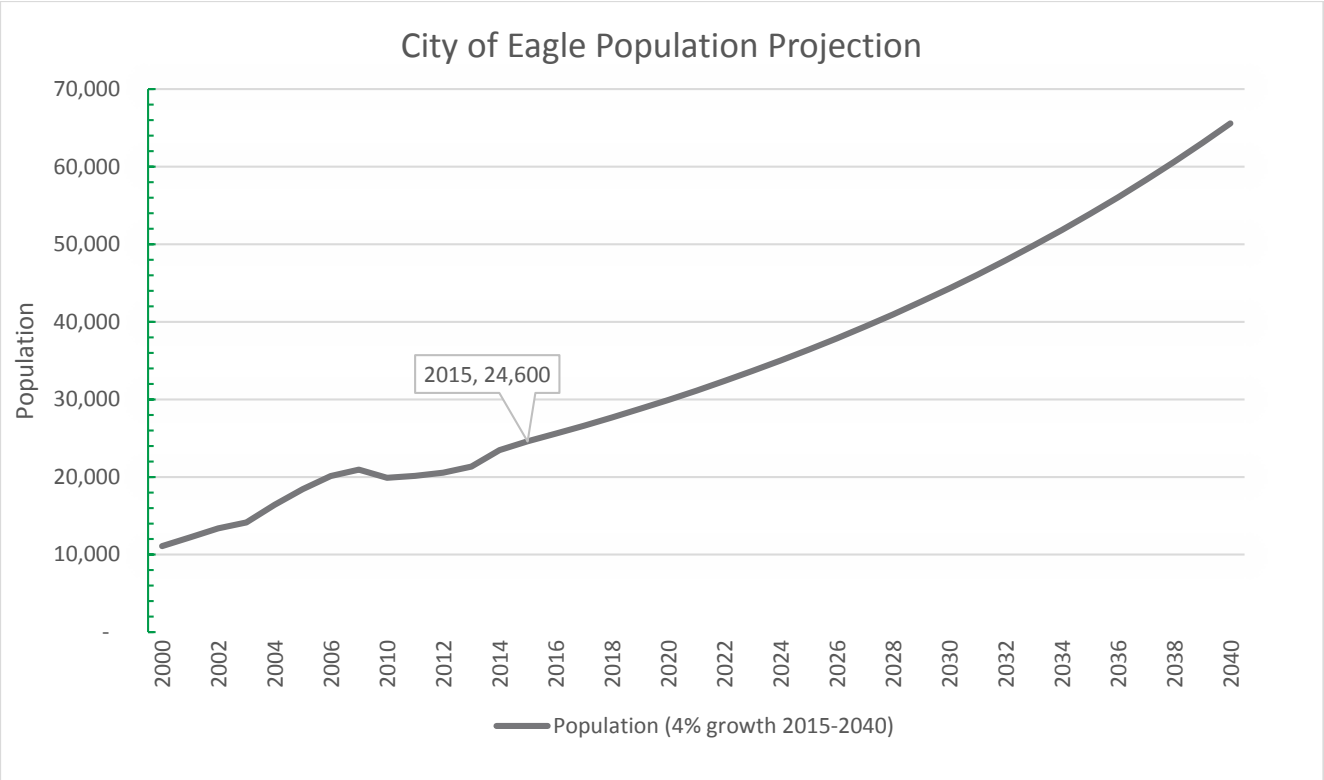


Figure 3-1. Population Projection

3.1.1 Residential Projections

The City of Eagle Planning Department provided their plan for where they expect growth to occur in the City Area of Impact which roughly aligns with the Eagle Sewer District service area. The City divided its area of impact into sections and defined where anticipated growth would occur. Criteria such as existing development agreements and existing roads and utilities, including wastewater collection, was used to project a development timeline. Details on where growth is anticipated is presented in Section 7, Collection System Master Plan.

The City and Ada County have not agreed to an area of impact and therefore, the City currently extends its planning much further than the current area of impact as defined by the County. This is significant as the Eagle Sewer District will need to anticipate providing sewer service to property annexed by the City which is outside the City's area of impact, similar to what is being done with the Spring Valley Ranch development on the M3 property. The City of Eagle planning area extends northward to the Gem County line (from personal communication with Nichoel Baird-Spencer of Eagle Planning and Zoning on November 10, 2015).

Although the overall population of the City of Eagle is projected to increase by an average of 4-percent per year between 2015 and 2040, the population, actually served by the Eagle Sewer District is estimated to be closer to 3.3-percent. The reason for this difference is that certain developments are not expected to connect to the Eagle Sewer District collection system. There is other infill development in existing City of Eagle city limits that is expected to develop further, but not connect to the Eagle Sewer District systems.

Residential flow and loading projections were calculated using the 2040 population projections, the per capita flow and loading values, and the peaking factors presented in Section 2.

Table 3-2 presents estimated average annual, maximum month, and peak day values for flow, BOD, TSS, TKN, and total phosphorus at year 2040. Annual average per capita-day flow and loading values were

calculated from 2014 data and were applied to the 2040 population projection to determine annual average values. The peaking factors calculated in Section 2 were then applied to determine the maximum month, maximum week, and peak day loading. The peak hour flow projection for 2040 was determined with the collection system model.

Table 3-2. Projected Residential Flow and Loads for 2040

Constituent	Unit	Annual Average	Maximum Month	Maximum Week	Peak Day	Peak Hour
Flow	mgd	4.6	4.9	5.0	6.7	7.7
BOD	lb/day	7,212	9,210	13,740	16,403	
TSS	lb/day	7,976	8,863	9,438	9,381	
TKN	lb/day	1,192	1,325	1,411	1,402	
TP	lb/day	140	158	166	176	

3.1.2 Commercial Projections

Commercial flow projections were based on the COMPASS projected commercial, mixed use, and business park development within the Eagle Sewer District service area and typical wastewater flow rates from these sources (Metcalf and Eddy, Inc., 2003; WEF 2010). The City of Eagle Planning and Zoning Department was highly involved in the development of the COMPASS projections and indicated that use of COMPASS data was appropriate for use in this plan. Land designated by COMPASS for commercial and mixed use development is presented in Table 3-3. The flow and load values for future commercial sources are presented in Table 3-4.

Table 3-3. 2040 Commercial and Mixed Use Development Loads

Development Type	Land Area (ac)	Flow (gpd/ac)	Total Flow (mgd)
New Village Center	258	1,500	0.39
Business Park	161	560	0.09
Commercial	43	1,500	0.06
Professional Office	140	560	0.08
		Total	**0.62**

Table 3-4. Projected Commercial Flow and Loads for 2040

Constituent	Unit	Annual Average	Maximum Month	Maximum Week	Peak Day	Peak Hour
Flow	mgd	0.7	0.7	0.7	1.0	1.0
BOD	lb/day	4,085	5,217	7,783	9,291	
TSS	lb/day	4,518	5,020	5,346	5,313	
TKN	lb/day	675	751	799	794	
TP	lb/day	79	90	94	100	

3.1.3 Recommended Flow and Loading Projections

Combining the residential and commercial projections from Tables 3-3 and 3-4 results in the total future flows and loadings in Table 3-5.

Table 3-5. Projected Combined Residential and Commercial Flow and Loads for 2040

Constituent	Unit	Annual Average	Maximum Month	Maximum Week	Peak Day	Peak Hour
Flow	mgd	5.3	5.6	5.7	7.6	8.7
BOD	lb/day	11,296	14,427	21,523	25,694	
TSS	lb/day	12,493	13,883	14,785	14,694	
TKN	lb/day	1,868	2,076	2,210	2,197	
TP	lb/day	220	248	260	275	

3.2 Emerging and Water Quality Issues

Although Eagle Sewer District does not maintain an NPDES permit and therefore is not required to meet surface water quality limits, it is beneficial for the District to be aware of the effects their discharge could have on the City of Boise NPDES permit at the West Boise WWTF. This section briefly describes emerging and potential future water quality issues that could affect effluent limitations for wastewater facilities, including the City of Boise. Wastewater facility planning involving evaluation of wastewater treatment options for various discharge limits are set by federal and state regulations. Ultimately, the wastewater facility plans must consider alternatives that not only meet today's regulatory environment, but provide sufficient flexibility to meet future anticipated requirements. This sub-section discusses the following key water quality issues which may be included in a future NPDES permit:

- Temperature
- Micro-constituents
- Ammonia-Nitrogen
- Nutrients

3.2.1 Temperature

The mainstream of the lower Boise River from Star to the Snake River has been included on the State's 303(d) list as being impaired by temperature since 1996. The Idaho DEQ determined in the lower Boise River Total Maximum Daily Limit (TMDL) (DEQ, 1999) that point source discharges and agricultural return flows are not significant thermal sources, and that climate and elevation preclude attainment of the main stem temperature criteria. DEQ suggested delisting the river for temperature and suggested alternative regulatory approaches for addressing temperature conditions. Potential alternative regulatory approaches for temperature included use attainability analyses, variances, modification of the water quality standards, or development of site-specific criteria. In fact, the river was not delisted for temperature in subsequent 303(d) lists, and EPA added additional segments of the mainstream river (from Star to Diversion Dam) to the 1998 303(d) list in 2000. In 2000, EPA also approved the lower Boise River sediment and bacteria TMDLs, and took no action regarding the temperature discussion contained in the 1999 TMDL document.

The Snake River-Hells Canyon temperature TMDL was approved by EPA in 2004. The Snake River-Hells Canyon temperature TMDL identified natural conditions in the main stem Snake River as being potentially responsible for observed temperatures greater than the criteria. Nonetheless, the TMDL requires a temperature assessment for each of the five major tributaries, including the lower Boise

River, to determine whether temperature increases in these tributaries are due to anthropogenic or natural causes. If anthropogenic sources are determined to cause more than the allowable increase (0.3ºC over natural conditions according to Idaho standards), a follow-up temperature TMDL is required.

In addition, in April 2003, EPA Region 10 promulgated new temperature criteria for the Pacific Northwest for aquatic life, primarily driven by listed salmonid species. DEQ participated in the regional temperature process, but chose not to adopt the criteria because they believed the criteria represented optimum conditions that were not a reasonable expectation throughout Idaho. However, in March 2006, DEQ coordinated a state-wide "Temperature Summit" process to try and determine a path forward for temperature standards and TMDLs in Idaho. No individual option was selected during the workshop but concepts of scientifically defensible criteria, site-specific criteria, and implementation flexibility received general support. Thus, no further regulatory action has been taken to date by DEQ or EPA related to temperature in the lower Boise River.

The Boise River temperature issues are still currently awaiting a regulatory solution. DEQ recently has proposed temperature limits for WWTPs discharging to the Boise River that are substantially cooler than existing effluent temperatures. In addition, EPA recently has indicated that it is likely to address temperature in the upcoming reissuance of permits in the lower Boise watershed.

3.2.1.1 Implications of Temperature

Restrictive temperature limits could be established in future NPDES permits for the West Boise WWTP. This could require reduction of Boise River discharge, or cooling or chilling technologies at the WWTPs if alternative regulatory solutions are not implemented. Reduction or cessation of discharges have not been implemented in Oregon, which has already developed numerous temperature TMDLs and implementation plans involving WWTPs. Recognizing the very high energy requirements and related greenhouse gas (GHG) emissions for chilling/cooling technologies, not to mention very high cost, the Oregon DEQ and affected entities like Clean Water Services in the Tualatin River basin, have developed offset/trading programs that use riparian shade restoration, flow augmentation, and effluent reuse to offset direct thermal loads from WWTPs.

3.2.1.2 Recommendations for Temperature

Temperature may become a potential opportunity for Eagle Sewer District to strengthen its relationship with the City of Boise by helping them meet their temperature permit limits. The wastewater from the Eagle Sewer District lagoon system is cooler than the flow at the West Boise WWTP due to the residence time in the lagoon system. Although currently Eagle Sewer District flow is about 10-percent of the total West Boise flow, this cooler temperature water has the potential to help offset some of the wastewater cooling requirements in future West Boise WWTP discharge permits.

3.2.2 Micro-Constituents

Micro-constituents are chemicals and chemical compounds in trace amounts measuring in concentrations of parts per billion or parts per trillion. As equipment and laboratory procedures to detect micro-constituents have increased, so have media attention and public concern. Micro-constituents are also referred to as emerging constituents (ECs), endocrine disrupting compounds (EDCs), trace organic compounds (TOrCs), pharmaceutically active compounds (PhACs), and pharmaceuticals and personal care products (PPCPs).

Micro-constituents may become an issue in the Boise River system and in relation to disposal of biosolids. Specifically, EDCs are synthetic compounds that may interfere with the endocrine system of organisms. Endocrine disruptors have the potential to:

- Mimic the action of naturally occurring hormones
- Block cell receptors, preventing action of naturally occurring hormones

- Affect synthesis, transport, metabolism, and excretion of hormones

Many types of compounds can be considered EDCs: pesticides, surfactants, heavy metals, and PhACs. For some of these, such as heavy metals, EDCs will only occur at dosages greater than any established water quality standards. However, many other compounds that act as EDCs have been found in the environment in trace amounts. Natural hormones are found in humans and animals. Soybeans and alfalfa contain phytoestrogens. PhACs are synthetically produced hormones, such as those used for oral contraceptives, hormone replacement treatment, and animal feed additives. PhACs are used for diagnosis, treatment, alteration, or prevention of disease or health condition. PhACs are also used for similar veterinary purposes. Industrial chemicals, such as cleaning agents, pesticides, and plastics, contain synthetically produced hormones. Although some potent pesticides and herbicides have been banned, many other sources of EDCs see continued use.

The concern surrounding EDCs centers on the potential effects on wildlife, the environment, and humans. Although recent studies suggest minimal human health risk associated with PhACs in surface and drinking water, several studies have identified effects or potential effects of EDCs on aquatic life. Many concerns surround PhACs in particular. PhACs are able to pass through conventional wastewater treatment facilities. PhACs are typically designed to be resistant to biological degradation, and therefore resistant to biological treatment, but some treatment processes are available to remove the PhAC compounds.

Because of the concerns identified above, the Water Environment Research Foundation has been conducting and is continuing to conduct extensive research on the following:

- Wastewater treatment plant removal of TOrCs. One finding is that WWTPs that employ longer SRTs—such as plants removing nutrients—have greater TOrC removal efficiencies than plants with short SRTs.
- Fate of estrogenic compounds during municipal sludge stabilization.
- Presence of TOrCs in biosolids and whether that should be of concern.
- Aquatic ecosystem and human health effects.

The United States Geological Survey (USGS) conducted a survey of the Boise River for an array of 95 trace organic compounds including pharmaceuticals, antibiotics, hormones, and household wastes. This was part of a nationwide USGS survey of 139 sites in 30 states to determine the quality of streams with respect to these pollutants. The results specific to the Boise River have not been formally published, however, a presentation was made to the watershed advisory group by local USGS staff. The study found ten different organic compounds in the Boise River: three at Diversion Dam, six at Middleton, and nine at Parma. The only hormone detected, however, was estriol, and only at Parma.

3.2.2.1 Implications of Micro-Constituents

The issue of EDCs continues to be an important one nationally and regionally (for example, EPA, 2010b). In January 2008, the annual regional water quality conference sponsored by DEQ featured several presentations related to effects of EDCs and other trace organics in the water environment. Future regulation of endocrine disruptors and PhACs is possible and likely, although resolution of monitoring, sampling, and testing procedures will be needed prior to any regulations. Because of the public's risk perception, public communication and education is needed regarding any regulatory decisions.

3.2.2.2 Recommendations for Micro-Constituents

Eagle Sewer District may consider a prescription drug take back program that would remove these compounds from the wastewater. Similar programs have been implemented in many municipalities in the Treasure Valley with success and if the future need dictates, a program would be beneficial. Ada County has several locations where unused prescription drugs can be dropped off for safe disposal.

Eagle Sewer District may consider a more formal campaign or program if this issue becomes more prominent.

3.2.3 Ammonia-Nitrogen

Ammonia can be toxic to most aquatic organisms. Accordingly, ammonia water quality criteria were originally developed by EPA in 1984 and subsequently updated in 1992 and 1999 as new toxicological information became available. Ammonia toxicity and associated criteria are a function of both pH and temperature. Unionized ammonia (NH3), and not the ammonium ion (NH4+), is the principal toxic form of ammonia. Aqueous ammonia equilibrium is affected by pH, causing the fraction of unionized ammonia in solution to increase as pH increases. Therefore, ammonia toxicity increases as pH increases. Ammonia toxicity has also been shown to increase as temperature increases. Nearly all states have adopted EPA criteria for ammonia toxicity, although some are still using the 1984 or 1992 criteria and have not yet adopted the 1999 version. Some significant differences among these versions of the criteria exist. DEQ has incorporated the 1999 EPA criteria into the state water quality standards—an action that has been approved by EPA.

Table 3-6. Comparison of EPA Recommended Ammonia Toxicity Criteria*

Temperature °C	Units	1999	Draft 2009	
			Freshwater Mussels Present	Freshwater Mussels Absent
15	mg/L	13.3	15.6	23.6
20	mg/L	13.3	10.3	17.8
15	mg/L	4.2	0.88	6.3
20	mg/L	3.1	0.63	4.6

*All values shown are at a pH of 7.5. 1999 values shown assume salmonids and early life stages present. These 1999 criteria have been adopted by DEQ and approved by EPA

EPA is in the process of re-evaluating the aquatic life criteria for ammonia in relation to recent scientific data on the toxicity of ammonia to a certain family of freshwater mussels (commonly called “Unionids”). This family has an early parasitic larval life stage (glochidium) that floats in the water for a few seconds or days until it attaches to gills or fins of fish. This short duration glochidium stage has been shown in recent studies to be most sensitive to ammonia. In 2009, EPA published public comment draft revised criteria based on mussel toxicity (included in Table 3-6). Final criteria have not been published yet, but it is anticipated that these new criteria may result in significantly more stringent ammonia effluent limits for some treatment plants when future per units are developed, depending on which of the EPA recommended criteria are currently in place in a particular state and possibly on whether this family of mussels is present or absent in the state or in a particular receiving water body. This family of mussels is not found in the lower Boise River.

3.2.3.1 Implications of Ammonia

Although Eagle Sewer District does not maintain an NPDES permit, there are recent changes to the West Boise WWTF permit limitations. These limits more stringent and could result in modifications to the District’s discharge agreement.

3.2.3.2 Recommendations for Ammonia

A constant dialog should be maintained with the City of Boise to ensure that any implications with the updated ammonia-nitrogen limits at the West Boise WWTF can be addressed.

3.2.4 Nutrients

Phosphorus is a nutrient of concern based on the Snake River-Hells Canyon TMDL for phosphorus. Although the District is not currently charged for phosphorus, the fact that the City of Boise is expanding its facility and adding processes to remove phosphorus is a good indication that this may change.

At the national level, the EPA is currently developing guidance on regional nutrient criteria. On January 9, 2001, EPA published a notice in the Federal Register that numeric criteria have been developed for specific ecoregions throughout the U.S., including criteria for lakes and reservoirs, streams and rivers, and wetlands. The EPA notice included reference conditions for two causal variables (total nitrogen and total phosphorus) and two response variables (chlorophyll a representing algal biomass and turbidity to provide a measure of water clarity) for each ecoregion and sub-ecoregion. These are for use by the states and Tribes as starting points in establishing their own criteria and standards to protect uses. The reference conditions represent the natural, least impacted conditions. One of the 14 types of ecoregions is the "Xeric West," which includes southern Idaho and portions of the Snake and Boise Rivers. The instream reference conditions for Level III Ecoregion 12, Snake River Basin (EPA, 2000) are as follows:

- Total nitrogen = 0.544 mg/L (calculated),
- Total phosphorus = 42.5 micrograms per liter [µg/L]
- Turbidity = 3.25 Turbidity Units
- chlorophyll a = 4.85 µg/L (fluorometric method)

If the State is not able to develop its own reference conditions, the conditions developed by the EPA may be established as the criteria. EPA's initial expectation was that states would develop a plan to adopt these criteria within 3 years of the Federal Register notice, formally including these criteria in their water quality standards by 2004. This has not happened however, and only several states have actually adopted the numeric criteria to date. On May 25, 2007, EPA sent a memorandum to the states that reemphasized EPA's intent for all states to move forward expeditiously to adopt numeric nutrient criteria, and more recently, in January 2009, EPA notified one state (Florida) that EPA will promulgate federal numeric nutrient criteria for Florida if the state does not adopt EPA-acceptable criteria on its own within 1 year of the date of the determination letter from EPA to the state. Most recently (in 2010), EPA has proposed draft public comment criteria for some waters in Florida.

As nutrient removal treatment technologies have improved over the past few years, a movement toward technology-based effluent limitations for nutrients has gained momentum. State regulators are considering and have requested that EPA implement effluent nitrogen and phosphorus limitations for POTWs based on the availability of the technology (ASWPCA, 2007). The letter did not identify what the nutrient limits should be. In addition, on November 27, 2007 the Natural Resources Defense Council filed a petition to EPA to establish nutrient limits within the definition of secondary treatment for POTWs. The petition identified limits of 3.0 mg/L for total nitrogen and 0.3 mg/L for total phosphorus. Although EPA has not taken action on these requests to date, it is taking them seriously and considering what the appropriate course of action should be.

3.2.4.1 Implications of Nutrients

The ecoregion criteria for the Xeric West are much more restrictive than the TMDL targets established for Snake River TMDLs and current Boise River implementation plans. However, EPA is also promoting the following options, in order of preference, for the development of state water quality standards:

- Develop site-specific criteria that fully reflect localized conditions.
- Adopt EPA's ecoregion standards.
- Establish nutrient criteria protective of designated uses.

If technology-based effluent criteria are established as secondary treatment standards, City of Boise facilities could face significant upgrades and treatment cost increases; depending on level of control needed relative to the treatment that may be needed to comply. This in turn could result in a modification of the existing agreement with the Eagle Sewer District.

3.2.4.2 Recommendations for Nutrients

A constant dialog should be maintained with the City of Boise to ensure that plans are in place before any discharge permit agreement modifications are made. The City of Boise is required to remove TP from its treatment facilities and is currently developing infrastructure to meet the associated compliance schedule within their NPDES permit.

3.2.5 Conditions without the Project

As stated previously, the primary purpose of the Plan is to prepare short- and long-term planning that will protect the public health and the environment.

The recommended collection system and treatment process improvements presented in this facility plan are to meet future capacity and anticipated City of Boise NPDES permit discharge requirements. If the recommendations of this facility plan are not implemented, the District may see higher rates from the City of Boise as the City of Boise NPDES permit limits evolve.

3.3 Reference Land Use Plans

The City of Eagle Planning Department has developed a comprehensive plan as well as land use plans for the area of impact and beyond. Future land use mapping and planning extends to the Elmore and Boise county lines. Current and future land uses include low, medium, and high-density residential, commercial, and several mixed use areas. Details and definitions for each of these land use types are provided in the City's Comprehensive Plan. No industrial dischargers to the wastewater system have been specifically identified at this time. If a significant industrial discharger approaches the District with intentions to be connected to the collection and treatment systems, a thorough evaluation of the impacts should be conducted.

SECTION 4

Initial Screening of Alternatives

This section documents the initial list of wastewater treatment system alternatives developed and presented to the Eagle Sewer District.

4.1 Development of Wastewater Management Options

An initial list of wastewater treatment system alternatives, that includes lagoon upgrades and expansion, secondary treatment, tertiary treatment, and biosolids handling was developed and presented to Eagle Sewer District at a workshop for preliminary screening. The purpose of the workshop was to present an extensive list of alternatives, conduct a preliminary evaluation, and narrow down the alternatives to a better defined set of treatment alternatives to be further evaluated. Criteria discussed included elements of the District's vision to:

- Strengthen the District's relationship with the City of Eagle and the City of Boise
- Provide a strategy to promote growth within the District service area
- Continue to protect water quality
- Foster environmentally conscious projects
- Commit to high quality projects
- Maintain fiscal responsibility
- Engage District members to seek project acceptance
- Maintain the District's flexibility for change
- Optimize treatment efficiency
- Choose alternatives with the highest value relative to other alternatives
- Employ industry common technologies and approaches
- Reuse existing infrastructure
- Be mindful of operability and maintenance requirements
- Commit to environmental sustainability
- Strive for limited social impacts and foster community acceptance

This section provides a brief discussion and tables developed to summarize the initial list of alternatives developed for the District in the workshop.

4.1.1 Secondary Treatment Enhancements

This section summarizes the alternatives that were developed and evaluated as enhancements to the secondary treatment process. The major liquids process alternatives that can achieve the long-term wastewater treatment objectives of the District are summarized in the following sections.

4.1.1.1 Aeration System Upgrades

Increasing the dissolved oxygen concentration in Lagoon 1 will enhance the ability of the existing lagoon system to treat future flows and loading, specifically by reducing the BOD loading. There are multiple methods to increase the aeration and mixing including:

- Install additional surface aerators
- Install submerged fine diffused aerators
- Install submerged fine and coarse diffused aerators

Multiple equipment manufacturers supply surface aerators and submerged aerators. An alternative analysis of the aeration system types should be undertaken when the aeration and mixing system is

upgraded to determine the most appropriate system. No further evaluation to identify a specific aeration system or manufacturer will be undertaken as part of this facility plan.

Table 4-1. Potential Aeration Upgrades for Industrial Screening

Manufacturer/ Equipment Type	Description	Explanation
Surface aerators/ Multiple manufacturers	Install additional surface aerators	Surface aerators are low capital cost, but reportedly have lower oxygen transfer efficiency and have additional power requirements than fine bubble submerged aerators
Parkson Biolac	Fine bubble submerged aerators suspended from a floating header	Submerged fine bubble aerators typically have higher oxygen transfer efficiency than surface aerators, but require blowers and air distribution piping.
Triplepoint Environmental MARS aerators	Submerged fine and coarse bubble aeration and mixing system sits on the lagoon liner	Submerged fine bubble aerators have high oxygen transfer and coarse bubble provides mixing.
Bioworks Oxiworks	Fine bubble submerged aerators suspended from a floating header	Submerged fine bubble aerators typically have higher oxygen transfer efficiency than surface aerators, but require blowers and air distribution piping. Very similar to Parkson Biolac with major difference in maintenance.

4.1.1.2 Increased Solids Inventory

Lagoon wastewater treatment differs from conventional activated sludge process at mechanical WWTPs where the Mixed Liquor Suspended Solids (MLSS) concentration is much higher. Conventional activated sludge includes physical separation of solids, typically through secondary clarifiers, and a return of the solids to the treatment process (Return Activated Sludge - RAS). This increase of MLSS allows the system to treat much higher flows and loads. Excess mixed liquor (Waste Activated Sludge - WAS) is typically continuously or intermittently removed from the process and dewatered before disposal. The increased MLSS in the treatment system reduces BOD and ammonia and improves effluent water quality. Membrane bioreactors (MBR) and integrated fixed film activated sludge (IFAS) systems both rely on higher bioreactor solids inventories, either in the form of increased MLSS concentrations or supplemented biofilm-based organisms in an activated-sludge environment. Moving bed bioreactors (MBBR), rock filters, and trickling filters do not utilize RAS systems as these are pure biofilm technologies.

Multiple equipment manufacturers supply clarifier mechanisms, mixed liquor pump stations, and solids dewatering equipment.

4.1.1.3 Ammonia Reduction

Once the BOD has been consumed, nitrifying bacteria will begin to oxidize ammonia to nitrite and then to nitrate in the presence of additional oxygen. Nitrifying bacteria grow slowly and are very sensitive to cold temperatures. Their activity decreases as temperatures decrease to where little nitrification occurs. It is common in colder climates to construct fixed-film (biofilm) processes for nitrification to give the bacteria a protected environment to grow. Fixed-film processes typically used for nitrification range from MBBR and IFAS systems, to rock filters and trickling filters. A preliminary screening of alternatives are presented in Table 4-2.

Table 4-2. Ammonia Reduction Technologies

Manufacturer/ Equipment Type	Description	Include in Alternative Analysis (Yes/No)	Explanation
Moving Bed Biofilm Reactor (MBBR)	Attached growth process using biofilm carriers to provide environment for nitrifying bacteria.	Yes	MBBR are proven to nitrify at low temperatures
Integrated Fixed-Film Activated Sludge (IFAS)	Essentially an MBBR with returned activated sludge (RAS) to increase treatment	Yes	Addition of RAS to MBBR system increases treatment capacity.
Rock Filter (SAGR)	Attached growth process using a submerged stone filter	No	Vendor requires 30 day HRT in the aerated lagoon system prior to SAGR system which is not compatible with current system or future system with increasing flows.

In addition to reducing ammonia, the MBBR or IFAS systems could be used after the existing or expanded lagoon system as a tertiary process to reduce BOD and ammonia to very low levels.

4.1.1.4 Phosphorus Removal

Eagle Sewer District is not currently charged for phosphorus discharge, but the City of Boise has been adding unit processes to remove phosphorus in order to meet NPDES discharge limits. Often phosphorus is removed via chemical addition with metal salts upstream of the solids-separation processes, allowing the phosphorus to be removed from the liquids stream through precipitation and adsorption to the biosolids. Metal salt addition could be used in a lagoon system, but would result in additional solids generation requiring dewatering before disposal.

A common alternate approach for treatment facilities is to biologically remove phosphorus. The West Boise WWTF currently operates an enhanced biological phosphorus removal system to reduce effluent phosphorus. The City of Boise has not indicated an intention of beginning to charge Eagle Sewer District for phosphorus load; however, phosphorus removal should be further investigated if the City of Boise ever begins to charge for phosphorus or when designing a solids handling system. The treatment alternatives should be revisited at that time to ensure that the most appropriate alternatives are implemented.

4.1.2 Biosolids Management Options

Biosolids were removed from the treatment system for the first time in 2007 when the lagoon liners were replaced. A biosolids contractor used centrifuges to dewater the sludge and the solids were landfilled at the Ada County Landfill. Biosolids are anticipated to be removed for the second time in 2016. As flows and loads increase, the solids will need to be removed more frequently, as often as every two years. Using historical cost data as reference, at a future point it will be economically viable to construct a permanent solids handling system. Solids handling systems typically consist of a clarifier for solids separation, sludge pumps, and a dewatering system. There are multiple dewatering technologies including belt press, centrifuge, and screw press systems and an alternative analysis of each technology should be conducted to determine the most appropriate system for the District. No further analysis of biosolids management will be undertaken as part of this facility plan.

4.1.3 Administration, Operations, Laboratory, and Maintenance Buildings

The administration and operations building have been updated and expanded over the years and are reported to be sufficient for current operations. Limited treatment system testing is performed in the

operations building and most laboratory tests are taken to a commercial laboratory for analysis. Any upgrades to the existing treatment system that require more frequent testing or monitoring would most likely result in the need to construct a space for laboratory testing, or potentially expand the agreement with the City of Boise to cover lab testing.

The existing maintenance facilities are sufficient for current operations, but in the next five years Operations foresees the need to purchase a new water truck, sewer cleaning truck, and facilities to house and service these additional assets.

4.1.4 Energy and Sustainability Projects

Eagle Sewer District is committed to energy efficiency and plans to incorporate energy reduction in its criteria for future projects. There is the potential for energy savings during the aeration system improvements as well as larger lagoon expansion improvements. Controlling the aeration system based on dissolved oxygen levels has the potential to save energy cost by providing the minimum required dissolved oxygen for treatment.

4.2 Existing Wastewater Treatment Facility Capacity or Rehabilitation Considerations

As alternatives were evaluated for the Eagle Sewer District WWTP to meet treatment goals, the associated capacity improvements, redundancy, and operability were considered. Section 2 provides detailed information on the existing capacities of the unit processes and associated equipment at the WWTP. The overall wastewater treatment plant capacity is determined through a combination of treatment capacity, hydraulic capacity, and system redundancy. The following sections detail the expansion required to provide the necessary capacity at the WWTP as the various alternatives are implemented throughout the 2040 planning period.

4.2.1 Equipment Replacement

As the WWTP expands throughout the identified planning period, equipment at the WWTP will need to be replaced due to service life or unit capacity concerns. Table 4-3 identifies some of the key equipment planned for replacement during the planning period.

Table 4-3. WWTP Equipment Replacement

Unit Process	Description	Explanation
Headworks	Fine Screens Grit Classifier Influent Pumps	This equipment was installed in 2010 and is expected to have a 25-year life. This means that the equipment will reach the end of its useful life and is expected to need replaced near the end of the planning period. Unit capacities will require additional screens and influent pumps. A second grit classifier and vortex chamber should be considered to improve unit process redundancy.
Secondary Treatment	Surface Aerators Submerged Aerators and Blowers	Existing surface aerators and submerged aerators and blowers will exceed their useful life during the planning period and additional units required for increased capacity.
Secondary Treatment	Lagoons	The 60-mil HDPE liner was replaced in 2008 and should not need to be replaced in the planning period. But gates at transfer structures most likely will need to be changed.
Secondary Treatment	Effluent Pump Station	As flows increase, the effluent pump station pumps will need to be upgraded to handle the higher flows to the City of Boise.
Support	Standby Power	Existing generator in the Operations Building will need to be replaced with a larger unit.
	SCADA	SCADA may require upgrades to remain functional and serviceable as technology advances

4.2.2 Hydraulic Bottleneck Improvements

Among other improvements, hydraulic bottlenecks will need to be eliminated with the expansion of the WWTP to meet the 2040 flow capacity. Hydraulic improvements will be incorporated throughout the phased expansion planned for the WWTP. Some of key hydraulic modifications required at the WWTP are presented in Table 4-4.

Table 4-4. Eagle Sewer District WWTP Hydraulic Improvements

Description of Proposed Improvement	Urgency
Inspect & clean all pipelines in the lagoon system	As part of a regular maintenance program
Add 18" Effluent Pipe From Lagoon Cell 2 to Effluent Pump Station	Near term to reduce headloss and high pipe velocities
Construct New Transfer Structure From Lagoon Cell 1 to Lagoon Cell 2	Near term to allow Lagoon Pond No. 2 to operate at a higher level
Add 18" Influent Pipe from Transfer Structure No. 1 to Lagoon Cell 1	At peak hour flow rate of 5.7 mgd

4.2.3 Redundancy

Redundancy requirements at wastewater treatment facilities are key to providing overall plant performance. Guidance for the reliability and redundancy at wastewater treatment plants are provided through the EPA (Design Criteria for Mechanical, Electric, and Fluid Systems and Component Reliability, 1974) and the Idaho Department of Environmental Quality (IDAPA – 58.01.06 – Wastewater Rule, 2006). The reliability and redundancy requirements are included in all of the alternative evaluations. Table 4-5 presents the reliability and redundancy requirements for various unit processes cited by these guidance documents.

Table 4-5. WWTP Equipment Replacement

Unit Process	EPA	IDEQ
Mechanically Cleaned Screens	(1) Backup screen (manual or mechanical)	Where two or more mechanically cleaned screens are used, the design shall provide for taking any unit out of service without sacrificing the capability to screen the design peak instantaneous flows.
Pumping Systems	(1) Backup pump for each system performing the same function	Capacity such that with any pump out of service, the remaining pumps have capacity to treat the peak hourly flow.
Grit Removal	None	None listed.
Lagoons	None	None listed, although seepage testing requires isolation of lagoon that currently requires bypass pumping. A second lagoon train would allow isolation during seepage testing.

4.2.4 Operability

During the review of the existing conditions and development of alternatives, a review of the operability of the existing WWTP was completed. Operability is used to describe the features included at the WWTP that allow staff to monitor, operate, and maintain unit processes and associated equipment to provide the required system performance. As the WWTP is expanded through the planning period identified in

the facility plan, improvements to the operability of the system will be incorporated. Improvements to the operability warranted at the WWTP were developed and are listed in Table 4-6.

Table 4-6. WWTP Operability Improvements

Unit Process	Control Philosophy/Operations Issues	Near-Term Actions Recommended
SCADA system	The headworks building is controlled and monitored via a SCADA system. The Mace and Palmer lift stations are also connected to the WWTP SCADA system. If there is a failure at a lift station, an auto-dialer calls the operator. While this is generally effective, more information could be gathered about the issue via the SCADA system to allow the operator to be more prepared when responding. It could also provide real-time monitoring and control at all the lift stations.	Expand the SCADA system to include all the lift stations and WWTP unit processes.
Secondary Treatment	The aeration in Lagoons 1 and 2 is based off historical practices rather than measured dissolved oxygen concentration. At times this may result in unnecessary aeration or insufficient aeration. Real-time DO control would allow the necessary DO to be delivered to the lagoons.	Include DO control in the aeration system upgrades to deliver the necessary oxygen to the lagoons. Include this control in the SCADA upgrades or in a separate project.
Effluent Pump Station	Vortexing occurs at the pump station influent piping in Lagoon 2.	Camera the line to ensure that there is no blockage. There is higher headloss through this section of pipe than is typical. Install a concentric reducer/expansion fitting on the end of the pipe to reduce the entrance velocity.

SECTION 5

Final Screening of Alternatives

This section documents the final list of wastewater treatment system alternatives which were further developed and presented to the Eagle Sewer District for additional consideration.

5.1 Summary of the Wastewater Management Alternatives

5.1.1 Liquids Treatment Enhancement Alternatives

Based on Eagle Sewer District's vision and future flows and loads, five wastewater treatment alternatives were developed that will allow Eagle Sewer District to treat the anticipated wastewater flows and loads during the planning period (2015 to 2040). The ADMM 2040 flow is estimated as 5.25 mgd and BOD load as 15,400 lb/day. The five alternatives are summarized as follows:

- **Alternative 1 - Do Nothing.** No capital investment would be undertaken as part of this alternatives. As equipment reaches the end of its useful life, it would be replaced without any additional investment made. As flows and loads increase, the treatment capacity of the existing lagoon system would degrade and the effluent water quality would degrade in time. This alternative would incur substantial capacity and O&M costs from the City of Boise and therefore, also increase District charges.
- **Alternative 2 - Existing Lagoon Upgrades.** The existing lagoons would have aeration upgrades made to increase treatment capacity. BOD would be reduced somewhat, but as the flows increase, the BOD and TSS loadings would increase which incurs higher capacity and O&M costs from the City of Boise.
- **Alternative 3 - Lagoon Expansion.** A new lagoon system and effluent pump station would be constructed and flow would be split between the two lagoon systems. This would provide a completely redundant lagoon system accommodating seepage testing. The treatment capacity of the system would be sufficient to maintain current discharge concentrations of BOD and TSS as influent flows and loads increase. Ammonia-nitrogen and phosphorus discharge concentrations would remain unchanged.
- **Alternative 4 - Lagoon Expansion, Clarification, MBBR, Tertiary Filter, and Solids Handling.** In addition to lagoon expansion, a MBBR would be constructed for BOD polishing and ammonia-nitrogen removal. A tertiary filter would help with TSS removal and a chemical addition system before the filter would remove phosphorus. A clarifier would boost the solids concentration in the system to increase treatment performance and a solids dewatering facility would be constructed to remove unneeded solids. This alternative has the potential to produce effluent water quality. Because of filtration step, effluent would be considered a Class A reuse water typically allowed to be directly discharged to the Boise River under typical current NPDES permits.
- **Alternative 5 - MBR with NPDES Discharge and Solids Handling.** This alternative includes a new membrane bioreactor (MBR) activated sludge type facility. This would take the place of the lagoon system all together and include a bioreactor (aeration basin), membrane filtration, solids stabilization and solids handling, and odor control. This system would reduce BOD, TSS, ammonia, and phosphorus to levels that would meet typical Boise River NPDES permit requirements and also produce a Class A reuse water.

5.2 Alternative Selection and Decision-making Process

The wastewater treatment system alternatives, including liquids treatment, and biosolids, were developed by CH2M with direction from the District. Workshops were conducted by CH2M for the District to discuss each alternative. CH2M then facilitated the evaluation and ranking of each alternative.

This section lists the different evaluation criteria used in assessing each alternative. Evaluation criteria are broken into two main criteria categories: (1) non-monetary; and (2) monetary.

To support evaluation and strategic plan alignment, the following non-monetary evaluation criteria were developed by District Staff and CH2M. The following criteria were developed based on the objectives in the District's Vision Statement and discussions at the project kick-off and vision alignment workshop:

- Effluent water quality
- System reliability
- Ease of operation and maintenance
- Adaptability and phasing
- Environmental sustainability
- Social impacts

Definitions for the six non-monetary criteria are presented in the following sections (quantity metrics were also developed for each criterion).

5.2.1 Effluent Water Quality

Since Eagle Sewer District does not maintain an NPDES permit, there are no hard limits that define the level of treatment that must be achieved. As flows and loads change, the capacity and O&M costs paid to the City of Boise change as well. The effluent water quality category was divided into different levels of treatment to determine the most appropriate level of treatment that maximizes existing assets and limits discharge costs. Categories of Effluent Water Quality include:

- Level 1 - Impacts with no process upgrades
- Level 2 - Maintain existing treatment performance (60/60 mg/L BOD/TSS)
- Level 3 - Improve treatment to match typical "Secondary Effluent" (30/30 mg/L BOD/TSS and Ammonia)
- Level 4 - National Pollution Discharge Elimination System Discharge – Boise River Effluent requirements (5/5 mg/L BOD/TSS, Ammonia and Phosphorus)

5.2.2 System Reliability

A qualitative examination of how common and historically predictable each treatment system operates was performed to evaluate this planning criterion. Additionally, the propensity of each system for upsets and the ramifications of those upsets were considered for the planning criteria.

5.2.3 Ease of Operation and Maintenance

Ease of operation was examined from two points of view: (1) how many tools does the process provide to operations staff to deal with unusual process conditions; and (2) how complicated is the process to operate. The number and complexity of equipment, and flexibility of process operation to accommodate varying treatment situations was considered as well.

5.2.4 Adaptability and Phasing

Eagle Sewer District anticipates that a phased approach will best treat future flows and loads. Since much of the area growth and development is driven by economic factors, an alternative approach that can be set in motion once certain flow or loading triggers are reached is likely the most cost effective approach. This allows infrastructure to be built only when needed. In addition, the District wants to build infrastructure for long-term use and avoid constructing improvements which are later abandoned with available service remaining. The ability of each alternative to be phased and adapt to changing conditions was evaluated.

5.2.5 Environmental Sustainability

Energy and chemical costs dominated the evaluation of environmental sustainability. High-energy usage processes received low marks compared to lower energy intense alternatives. Energy use for wastewater treatment not only drives up treatment cost but consumes natural resources which may be more used in a more sustainable manner for other purposes.

5.2.6 Social Impacts

The alternatives were also evaluated based on community acceptance and possible contribution to surrounding area. For example, potential for odors and increased visibility (negative) and possible water reuse, smaller footprint, and reduced biosolids haul traffic (positive) were considered under this criterion.

5.3 Comparison of Technical Features of Wastewater Management Alternatives

This section gives a description of the technical aspects of the final wastewater alternatives while considering the level of treatment for the various wastewater constituents. Advantages and disadvantages of each system are also presented.

5.3.1 Alternative 1 - Do Nothing

The existing wastewater treatment process at the Eagle Sewer District WWTP is a lagoon system. When first constructed in 1982, the days hydraulic residence time (HRT) in the original lagoon system was typical for a lagoon system. However, as flows have increased, the HRT has decreased to about 6 days and is operating much less like a true lagoon system and more like a pretreatment system. The treatment capacity of the lagoons has decreased as the HRT has been reduced.

For this alternative, no wastewater treatment process upgrades would be implemented. As the HRT continues to be reduced, treatment is degraded and more BOD and TSS load is sent to the West Boise WWTP for final treatment. Under this approach, equipment is only replaced as it reaches the end of its service life without any upgrades.

BOD Removal. As the HRT decreases, the effluent BOD will increase to where the lagoon system is providing minimal treatment. The anticipated effluent BOD concentration in year 2040 is estimated to be 215 mg/L.

TSS Removal. As the HRT decreases, the effluent TSS will increase, to where the effluent TSS concentration in 2040 is estimated to be 105 mg/L.

Ammonia Removal. Ammonia is not removed in the current system, is not reduced under this alternative either and is anticipated to remain at 35 mg/L, approximately.

Phosphorus Removal. Phosphorus is not removed in the current system, will not be reduced in this alternative either and is anticipated to remain at 6 mg/L.

Required Infrastructure. The effluent pumps and force main to West Boise WWTP will need to be upgraded when it reaches its hydraulic capacity. Otherwise, equipment will be replaced when it reaches the end of its service life, but no additional infrastructure is required.

Advantages and Disadvantages. The primary advantages and disadvantages of maintaining the existing system without upgrades or expansions are as follows:

- Advantages
  - Easy to operate
  - System is already constructed and only additional capital investment is needed to upgrade the effluent pumps and force main to West Boise WWTP when hydraulic capacities are reached
- Disadvantages
  - There is no lagoon redundancy to accommodate seepage testing which is currently a challenge and is not DEQ compliant
  - Potential odors
  - There is no provision for solids handling and at anticipated 2040 loading rate solids will need to be removed from the lagoons every 2 years
  - Increased City of Boise charges
  - No potential for reuse
  - Hydraulic limitations as flows increase

5.3.2 Alternative 2 - Existing Lagoon Upgrades

The aeration system is upgraded incrementally as flows and loads increase. The aeration system upgrades could be either additional surface aerators or submerged aerators with corresponding blowers. Surface aerators are typically less capital cost but have shorter useful life and higher energy consumption than submerged aerators. Submerged aerators include blowers, air distribution piping, and the aerators themselves which increases number of system components and complexity. This alternative also includes hydraulic upgrades between the Headworks and Transfer Structure 1, between Lagoons 1 & 2, and between Lagoon 2 and the Effluent Pump Station.

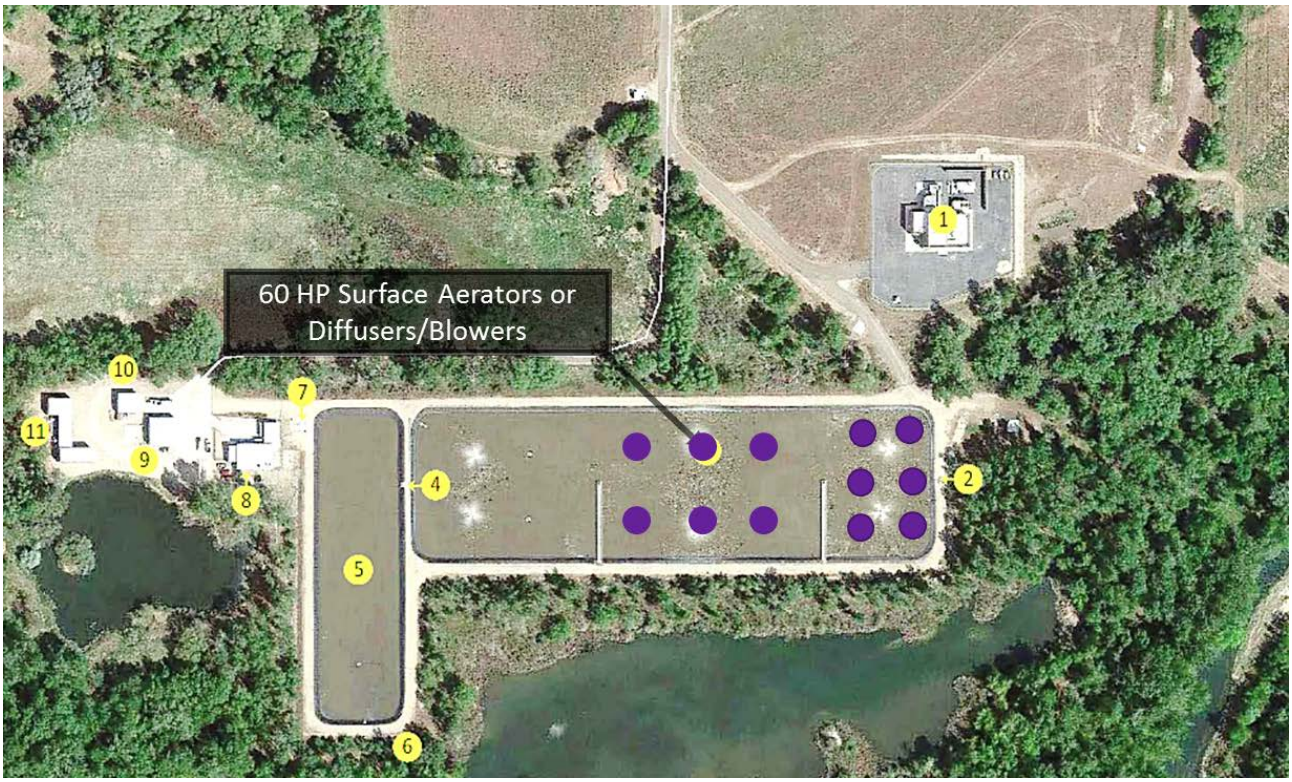


Figure 5-1. Alternative 2 – Existing Lagoon Upgrades

BOD Removal. This alternative is specifically designed for BOD reduction as flows and loads increase. The addition of surface or subsurface aerators increases the dissolved oxygen concentration which provides the aerobic environment for greater biological activity. The 2040 effluent BOD concentration is anticipated to be 54 mg/L.

TSS Removal. TSS will increase as more lagoon volume is converted to treatment with mixed conditions. This leaves less lagoon volume for solids settling in partially mixed conditions. The 2040 effluent TSS concentration is anticipated to be 105 mg/L.

Ammonia Removal. Ammonia-nitrogen is not removed in the current system and ammonia will not be reduced in this alternative and is anticipated to remain at 35 mg/L in Year 2040.

Phosphorus Removal. Phosphorus is not removed in the current system and phosphorus will not be reduced in this alternative, and is anticipated to remain at 6 mg/L in Year 2040.

Required Infrastructure. Aeration system upgrades will need to be installed to satisfy the 2040 planning criteria. Hydraulic upgrades for each of the lagoon hydraulic structures is required. The effluent pumps and force main to West Boise WWTP will need to be upgraded as well.

Advantages and Disadvantages. The primary advantages and disadvantages of upgrading the existing system under this alternative as follows:

- Advantages
  - Easy to operate
  - Only a relatively small capital investment would be required for aeration system and hydraulic improvements
  - Reduced City of Boise charges

- Disadvantages
  - There is no lagoon redundancy to accommodate seepage testing which is currently a challenge and is not DEQ compliant
  - There is no provision for solids handling and at 2040 loading it is anticipated that solids will need to be removed from the lagoons every 1.5 years
  - No opportunity for reuse

5.3.3 Alternative 3 - Lagoon Expansion

Under Alternative 3, a new lagoon system approximately the same size as the existing system is constructed. This alternative provides complete redundancy of lagoon operation where flow can be split between the two systems and seepage testing is possible by taking one system offline at a time. A new effluent pump station will be required for the new lagoon system. The same lagoon aeration system upgrades are included as described in Alternative 2.

Connection between the new lagoon system and the existing Headworks is made by connecting to an existing 20-inch diameter pipe stubbed out from the Headworks effluent splitter box. Figure 5-2 shows how the lagoons are located on the District's property, the location of a new effluent pump station and interconnecting piping.

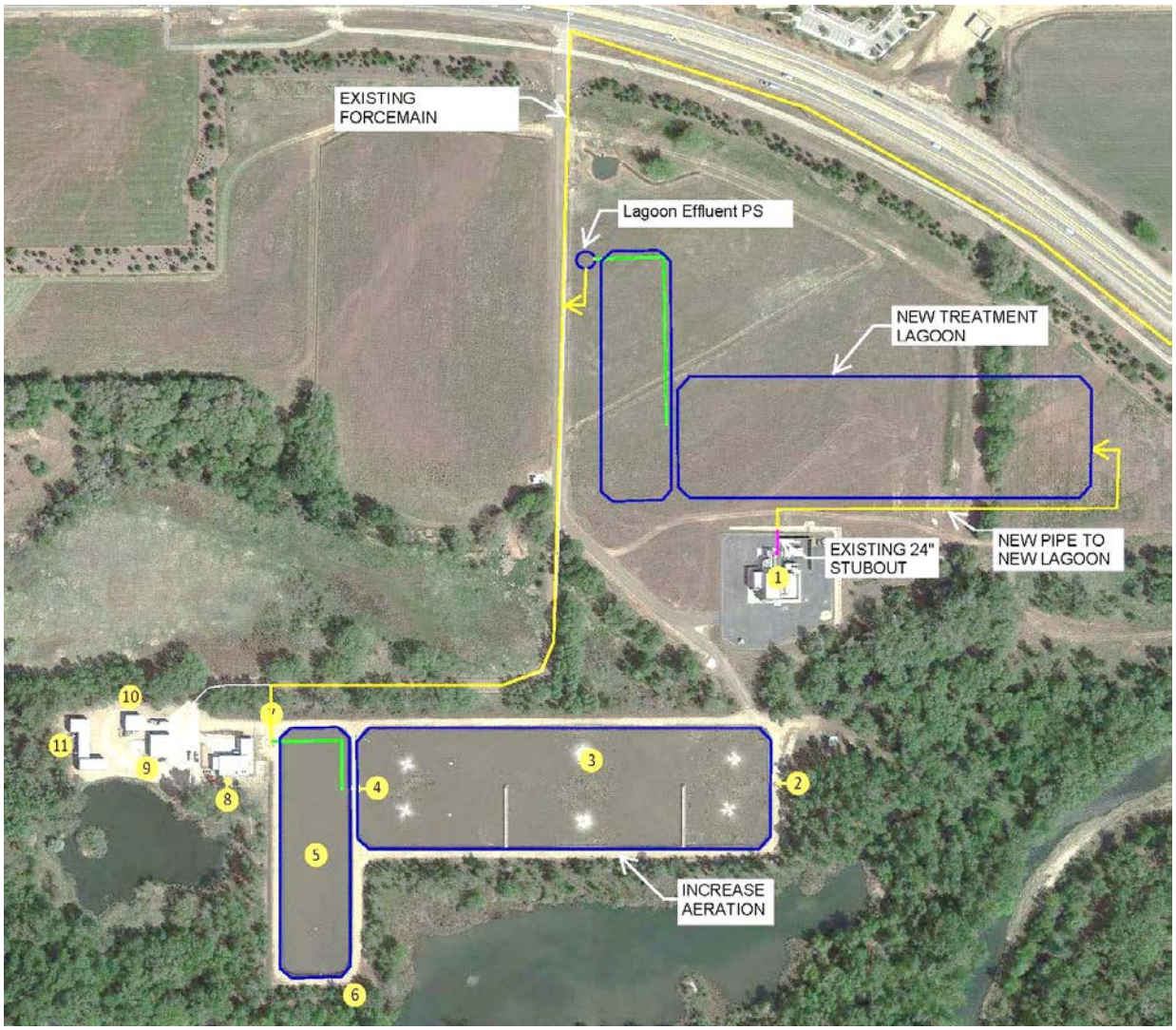


Figure 5-2. Alternative 3 – Lagoon Expansion

BOD Removal. This alternative significantly reduces the BOD loading as the additional lagoon capacity increases the HRT and the aeration provides a favorable biological environment. The 2040 effluent BOD concentration is estimated to be 35 mg/L.

TSS Removal. TSS will increase slightly as the flows increase and HRT decreases. The 2040 effluent TSS concentration is estimated to be 60 mg/L.

Ammonia Removal. Ammonia-nitrogen is not reduced under this alternative.

Phosphorus Removal. Phosphorus is not reduced under this alternative.

Infrastructure Required to Reach 2040 Planning Criteria. The improvements to the existing lagoon system described in alternative 2 are required as well as the construction of a second lagoon system consisting of two lagoons similar to the upgraded existing lagoon system. A new effluent pump station to serve the new lagoons would be required. The effluent force main to West Boise WWTP will need upgraded as well.

Advantages and Disadvantages. The primary advantages and disadvantages of construction a new lagoon system and upgrading the aeration in the existing system are as follows:

- Advantages
  - Low capital and O&M cost
  - A completely redundant lagoon system with a high level of operator flexibility conducive to seepage testing and makes the system DEQ compliant
  - Good BOD and TSS removal
  - Bypass pumping is not required for solids removal
- Disadvantages
  - No ammonia-nitrogen or phosphorus removal
  - There is no provision for solids handling and at 2040 loading, it is anticipated that solids will need to be removed from the lagoons every 3 years
  - No opportunity for reuse

5.3.4 Alternative 4 - Lagoon Expansion, Clarification, MBBR, Tertiary Filter, and Solids Handling

Alternative 4 is designed to reduce BOD, TSS, and ammonia to secondary effluent quality. This system is capable of discharge to the Boise River under typical permit limits. As described under Alternatives 3 and 4, the lagoon expansion reduces the BOD and TSS and ammonia is reduced in the MBBR by nitrifying bacteria attached to media carriers that are effective even at low water temperatures. Clarifiers return RAS to the MBBR to increase treatment efficiency and tertiary filters with chemical addition reduces effluent total phosphorus to 1 mg/L. Due to the increased biology in the system a solids handling process is included.

Since these processes do not need to be constructed at once, each unit process is added as their targeted constituent needs to be removed. This allows a great deal of flexibility in deciding when to add processes and avoids treating the wastewater to a higher quality than is necessary. For example, the lagoons would first be constructed and improved as indicated in Alternative 3. To address higher loading, clarifiers and solids handling components including solids holding and dewatering would follow. The second lagoon in each lagoon system is upgraded to become a treatment lagoon with the addition of aeration since solids separation occurs in clarifiers. Lastly, the MBBR and tertiary filters would be constructed.

Figure 5-3 shows how Alternative 4 facilities would be sited on the District's WWTP property.

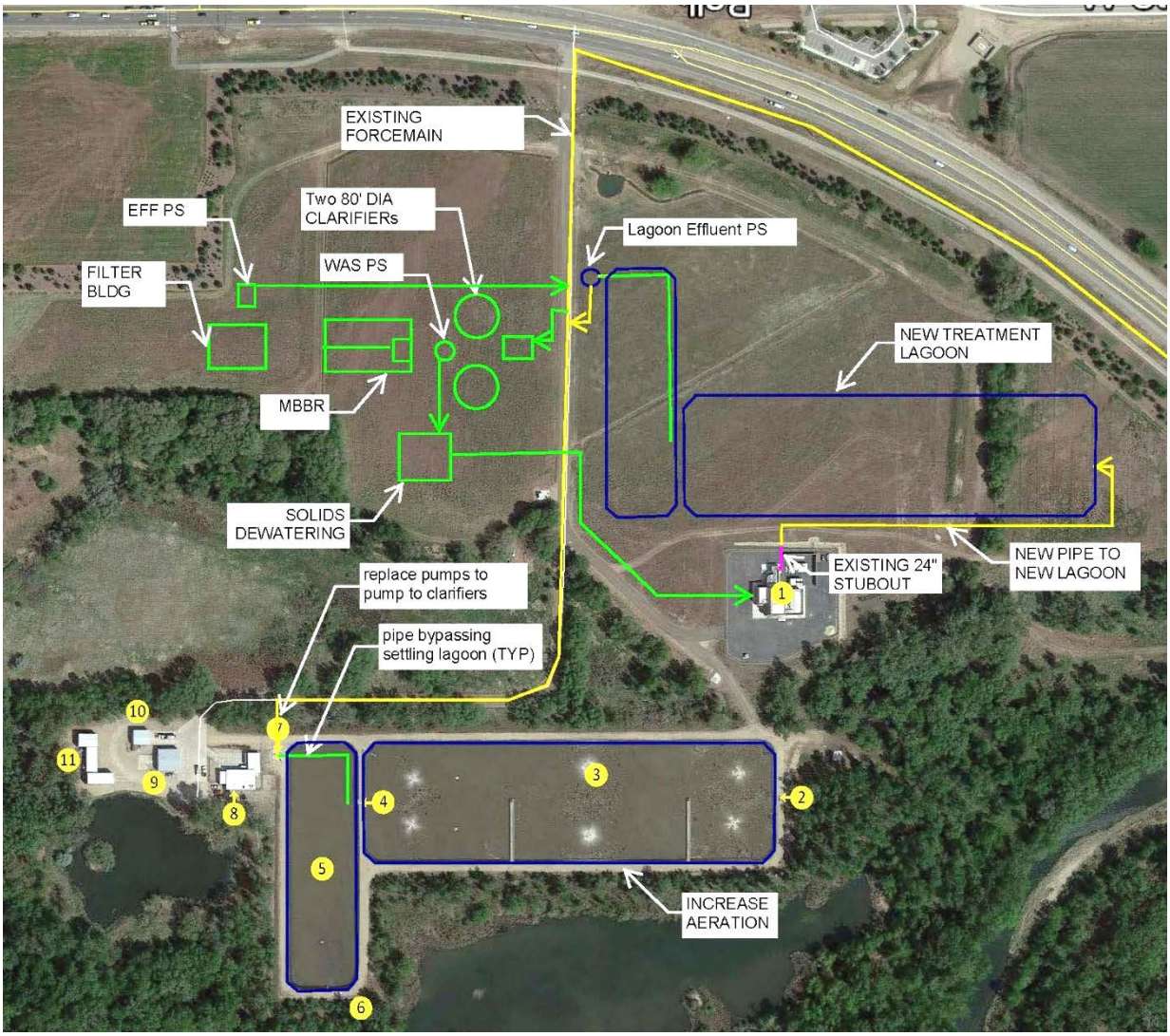


Figure 5-3. Lagoon Expansion, MBBR and Tertiary Filter Addition, Solids Handling

BOD Removal. This alternative substantially reduces the effluent BOD as described under Alternative 3, but the MBBR ensures very low effluent BOD. The 2040 effluent BOD concentration is estimated to be as low as 2 mg/L.

TSS Removal. TSS will be significantly reduced to a 2040 effluent concentration estimated to be 5 mg/L.

Ammonia Removal. Ammonia-nitrogen is significantly removed by the MBBR and tertiary filters. The anticipated 2040 effluent concentration is estimated to be less than 0.3 mg/L.

Phosphorus Removal. The tertiary filters, with chemical addition, remove total phosphorus to a 2040 effluent concentration of less than 1 mg/L.

Infrastructure Required to Reach 2040 Planning Criteria. The improvements to the existing lagoon system described in alternative 2 would be required as well as the lagoon expansion described in alternative 3. In addition, two clarifiers, an MBBR, a RAS/WAS pump station, tertiary filters, and solids handling system are required.

Advantages and Disadvantages. The primary advantages and disadvantages of Alternative 4 are as follows:

- Advantages
  - A completely redundant lagoon system with a high level of operator flexibility and conducive to seepage testing and makes the system DEQ compliant
  - Secondary effluent water quality with the potential for reuse or direct discharge to the Boise River avoiding City of Boise Discharge costs
  - Permanent solids handling system replaces the need for periodic solids removal from lagoons
  - Unit processes could be added when their targeted constituent becomes important to remove
- Disadvantages
  - Several unit processes are added which significantly increase the operations and maintenance effort
  - Cost to construct new infrastructure

5.3.5 Alternative 5 - MBR with NPDES Discharge and Solids Handling

In lieu of upgrading or expanding the lagoon treatment system, a new membrane bioreactor activated sludge facility could be constructed which improves effluent water quality to where it can be reused or even discharged to the Boise River, if necessary. This would take the place of the lagoon system all together and include a bioreactor (aeration basin), membrane filtration, solids handling, and odor control. This system would reduce BOD, TSS, ammonia, and phosphorus to levels that would meet typical Boise River NPDES permit requirements. This alternative includes abandoning the existing effluent forcemain to the West Boise WWTF and constructing a new reuse system or Boise River discharge.

This alternative has some ability to be phased or expanded as flows and loads increase by constructing additional bioreactors and membrane filtration facilities. Alternative 5 infrastructure is shown in Figure 5-4.

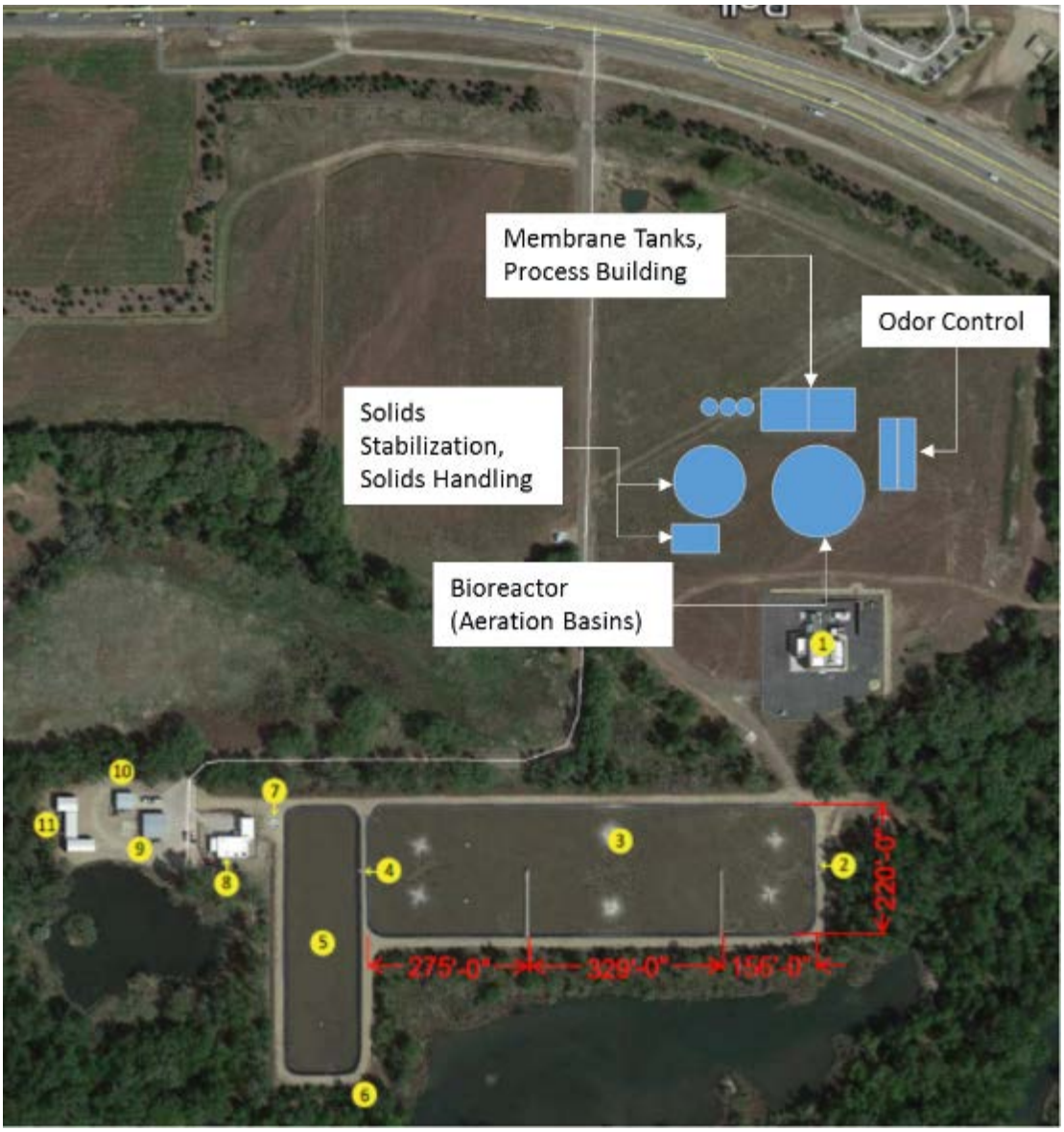


Figure 5-4. Alternative 5 – New MBR Facility with Solids Stabilization and Solids Handling

BOD Removal. This is a very common activated sludge system and BOD would be reliably reduced under this alternative. The system is designed to have a 2040 effluent BOD concentration of 2 mg/L or less.

TSS Removal. TSS is also reliably reduced by this system to where the 2040 effluent concentration could be 5 mg/L or less.

Ammonia Removal. It is estimated that ammonia is reduced to a 2040 effluent concentration of less than 0.5 mg/L.

Phosphorus Removal. A biological phosphorus removal system replaces chemical addition. Effluent phosphorus concentrations are estimated to be less than 1 mg/L.

Infrastructure Required to Reach 2040 Planning Criteria. An MBR with solids handling and odor control would be constructed to meet the 2040 design criteria. Existing lagoons are decommissioned, fine screens installed in the Headworks, and new disinfection system for reuse or discharge to Boise River constructed.

Advantages and Disadvantages. The primary advantages and disadvantages of Alternative 5 are as follows:

- Advantages
  - High effluent water quality accommodates Class A reuse or direct discharge to the Boise River avoiding City of Boise Discharge costs
  - Permanent solids handling system replaces frequent solids removal from lagoons
  - Common treatment technology with multiple vendors
  - Small footprint
  - Stabilized solids could be land applied as Class B biosolids
- Disadvantages
  - Complicated mechanical operation
  - High cost for both construction and O&M
  - Membranes have to be replaced
  - Potential for odor

5.4 Comparison of Costs for the Wastewater Management Alternatives

Costs for each of the five alternatives were estimated based on the following four different categories:

- Eagle Sewer District Capital Costs
- Eagle Sewer District WWTP Operations and Maintenance Costs
- City of Boise Wastewater Treatment Capacity Costs
- City of Boise Monthly Operation and Maintenance Costs

Capital costs are associated with building new facilities or expanding and renovating existing facilities. The economic evaluation considered 25-year net present value comparisons using the following:

- The facility construction cost includes the cost for building a new unit process or treatment facility in order to satisfy a specific treatment objective. These costs are based on CH2M cost models for high-level planning efforts, past project costs in the area, and engineering judgement.
- Inflation during the planning period was estimated to be 3-percent per year and the interest rate (discount rate) used was 5-percent per year.
- Land acquisition costs are assumed to be zero for the Eagle Sewer District WWTP since the District owns sufficient land all of the alternatives evaluated.
- Plant utility costs were estimated based on the 2015 operating budget. Alternatives anticipated to have similar electrical loads as the current system include this cost, increased by 3-percent inflation. Electrical costs for alternatives expected to have much higher electrical loads were adjusted accordingly.
- The frequency at which solids are removed from the lagoons was predicted by the Biowin process model. The historical cost of solids dewatering and disposal was adjusted for inflation for each predicted occurrence. As flows and loads increased, the frequency of solids removal was more frequent, nearly every two years for most alternatives.

- No contingency, contractor overhead, or engineering costs are included for the alternative cost estimates.
- Chemical costs were based on manufacturer quotes and adjusted for inflation.
- City of Boise West Boise WWTF capacity charges are assumed to increase each year by an average 4 percent to reflect average annual increases between 2010-2015.

The estimated 25-year net present value cost for each alternative is presented in Table 5-1.

Table 5-1. Monetary Comparison of Eagle Sewer District WWTP Treatment Alternatives

	Alternative 1: Do Nothing	**Alternative 2: Existing Lagoon Mixing System Upgrades**	**Alternative 3: Construct Additional Lagoon Train**	**Alternative 4: Construct Additional Lagoon Train with MBBR and Tertiary Filter**	**Alternative 5: New MBR Plant with Tertiary Filters and River Discharge**
	Capital replacement with no capital investment	**Upgrade existing system with new aeration and mixing system**	**Operate two lagoons in parallel for redundancy**	**Remove BOD, Ammonia, and Phosphorus before sending to West Boise WWTP**	**New mechanical plant with NPDES permit**
ESD Capital Replacement Cost	$7,500,000	$8,300,000	$14,800,000	$38,700,000	$103,100,000
ESD O&M Costs	$10,700,000	$12,500,000	$14,400,000	$61,000,000	$41,200,000
City of Boise Capacity Charges	$19,900,000	$11,900,000	$10,300,000	$5,800,000	$0
City of Boise O&M Charges	$44,800,000	$30,000,000	$29,100,000	$19,700,000	$0
Total NPV Cost (2015 Dollars)	**$82,900,000**	**$62,700,000**	**$68,600,000**	**$125,200,000**	**$144,300,000**

The Do Nothing alternative incurs the highest capacity and O&M charges from the City of Boise. In this scenario the effluent quality would degrade as flows and load increase causing additional discharge cost increases. It may also have the potential for excessive odors as treatment degrades. The lowest cost alternative is alternative 2 which includes an upgrade of existing lagoon system with new aeration and mixing equipment. The second lowest cost alternative is to build a new lagoon system with an associated effluent pump station. This alternative is slightly more cost than alternative 2, but it has the highest overall value when considering the non-monetary benefits described in Section 5.6.

The most costly alternative is to construct a new MBR plant with tertiary filters and an NPDES direct discharge to the Boise River. In this alternative there would no longer be City of Boise capacity or O&M charges, but the high capital and O&M costs borne by Eagle Sewer District make this alternative unattractive. In addition, Eagle Sewer District has purchased capacity in the West Boise WWTF and this capacity would not be utilized with a direct river discharge.

5.4.1 Cursory Environmental Screening of Alternatives Considered

The cursory environmental screening in Table 5-1 describes, in general, anticipated impacts associated with the various alternatives, as well as comparative costs of construction. More detail relative to anticipated impacts associated with the proposed action and alternatives may be found in the Affected Environment and Environmental Impacts sections of the Environmental Information Document (EID).

In general, all alternatives including the No Action Alternative, would result in increased user rates. Upgrading the existing lagoons and No Action are the lowest cost alternatives, with full mechanical treatment (Alternative 5) being the highest in cost. No action alternative would affect population, commercial, or industrial growth; land use; wild and scenic rivers; environmental justice; agricultural lands; water quality or quantity; public health; or regionalization. Other resources would be temporarily or permanently impacted to various degrees as shown in Table 5-2 and described in the EID.

Table 5-2. ESD Wastewater Treatment Plant Upgrade Cursory Environmental Screening

	Alternatives				
Environmental Criteria	**Alternative 3 Proposed Action**	**Alternative 1 No Action**	**Alternative 2 Existing Lagoon Upgrade**	**Alternative 4 Lagoon Expansion, Clarification, Moving Bed Bioreactor, Tertiary Filter, and Solids Handling**	**Alternative 5 Membrane Bioreactor with NPDES Discharge and Solids Handling**
Physical Aspects (topography, geology, and soils)	Requires excavation for new lagoon train and connecting infrastructure	No Impact	No Impact	Requires excavation for new lagoon train, treatment buildings, and connecting infrastructure	Requires excavation for new treatment buildings, connecting infrastructure, and discharge to river pipeline
Climate	Slight increase in GHG emissions from increased power requirements	No impact	No Impact	Slight increase in GHG emissions from increased power requirements	Slight increase in GHG emissions from increased power requirements
Population, Commercial, and Industrial Growth	No impact	No impact	No impact	No impact	No impact
Economics and Social Profile	Increased user rates	Increased user rates	Increased user rates	Increased user rates	Increased user rates
Land Use	No impact	No impact	No impact	No impact	No impact
Floodplain Development	No impact	No impact	No impact	No impact	Temporary effect during construction
Wetlands and Waters of the U.S.	No impact	No impact	No impact	No impact	Temporary effect during construction
Wild & Scenic Rivers	No Wild and Scenic Rivers within project vicinity	No Wild and Scenic Rivers within project vicinity	No Wild and Scenic Rivers within project vicinity	No Wild and Scenic Rivers within project vicinity	No Wild and Scenic Rivers within project vicinity
Cultural Resources	No Impact	No Impact	No Impact	No Impact	Potential for cultural resources along the river
Environmental Justice	No Impact	No Impact	No Impact	No Impact	No Impact
Flora	Loss of grassland	No Impact	No Impact	Loss of grassland	Loss of grassland

Table 5-2. ESD Wastewater Treatment Plant Upgrade Cursory Environmental Screening

Environmental Criteria	Alternatives				
	Alternative 3 Proposed Action	**Alternative 1 No Action**	**Alternative 2 Existing Lagoon Upgrade**	**Alternative 4 Lagoon Expansion, Clarification, Moving Bed Bioreactor, Tertiary Filter, and Solids Handling**	**Alternative 5 Membrane Bioreactor with NPDES Discharge and Solids Handling**
Fauna	Temporary disturbance during construction	No Impact	Temporary disturbance during construction	Temporary disturbance during construction	Temporary disturbance during construction
Recreation/Open Space	Reduction in open space on the ESD property	No Impact	No Impact	Reduction in open space on the ESD property	Reduction in open space on the ESD property
Agricultural Lands	No Impact	No Impact	No Impact	No Impact	No Impact
Air Quality	• Temporary construction dust • Slight permanent increase in odors	No Impact	• Temporary construction dust • Slight permanent increase in odors	• Temporary construction dust • Slight permanent increase in odors	• Temporary construction dust • Slight permanent increase in odors
Noise	• Temporary construction noise • Increased operating machinery noise	No Impact	• Temporary construction noise • Increased operating machinery noise	• Temporary construction noise • Increased operating machinery noise	• Temporary construction noise • Increased operating machinery noise
Water Quality and Quantity	No Impact	No Impact	No Impact	No Impact	No Impact
Public Health	No Impact	No Impact	No Impact	No Impact	No Impact
Energy	Double the energy use	No Impact	No Impact	Triple the energy use	Triple the energy use
Regionalization	No Impact	No Impact	No Impact	No Impact	No Impact
Capital Replacement Cost Comparison	$14,800,000	$7,500,000	$8,300,000	$38,700,000	$103,100,000

5.5 Evaluation of Non-Monetary Benefits and Costs

The relative importance or ranking of the criteria was determined to weight criteria when evaluating alternatives. Comparison and relative ranking was done using a pair wise comparison, as presented in Table 5-3. The criteria listed in the left column are compared with each of the other criteria which is again listed across the top of the table. If the criterion in the left column is significantly more important

than the one listed at the top, the value 5 would be entered into the yellow cell. The criterion with highest floor (summed across the row) is the most important. Based on this approach the criteria were prioritized as listed in Table 5-3 with system reliability being ranked as most important and effluent water quality as the least important.

Table 5-3. Non-Monetary Evaluation Criteria and Weights

Criteria	A Effluent Quality	B System Reliability	C Ease of Operation and Maintenance	D Adaptability and Phasing	E Environmental Sustainability	F Social Impacts	Total Scores	Weighting Percentage	Relative Weights
Effluent Quality	A	1	1	1	1	1	5	5.6%	1.00
System Reliability	5	B	4	3	5	4	21	23.3%	4.20
Ease of Operation and Maintenance	5	2	C	3	4	4	18	20.0%	3.60
Adaptability and Phasing	5	3	3	D	4	3	18	20.0%	3.60
Environmental Sustainability	5	1	2	2	E	2	12	13.3%	2.40
Social Impacts	5	2	2	3	4	F	16	17.8%	3.20
							90	**100.0%**	**18.00**

The recommended approaches for estimating and comparing the monetary costs of alternatives are to use a net present value (NPV) analysis. For each set of project alternatives, CH2M estimated capital and operating costs that were presented in Section 5.5.

The comparison of alternatives for needed facility, system, or sub-system improvements identified in the Facilities Plan are on a benefit-to-cost basis. The benefits of an alternative were assigned by District staff using the five non-monetary criteria identified above that are in alignment with the District's goals. Each non-monetary criterion for each alternative was rated using the following numerical score system:

1 = Significantly Less Important
2 = Less Important
3 = Equal in Importance
4 = More Important
5 = Significantly More Important

The total benefit for an alternative is the sum of individual criterion scores multiplied by their respective weightings to produce a weighted benefit score. The benefit-to-cost rating of an alternative will be determined by dividing its total weighted benefit score by its normalized NPV cost. The normalized NPV cost for each alternative is the NPV cost of that alternative divided by the lowest NPV cost of the alternatives.

During the alternative evaluation workshop, District staff determined non-monetary criteria scores for each of the proposed alternatives. The results of the scoring are presented in Table 5-4 and 5-5 where Table 5-4 presents the raw scores and Table 5-5 presents the weighted scores based on the prioritization of each individual criterion listed in Table 5-2.

Table 5-4. Raw Non-Monetary Scores for Treatment Alternatives

Criteria	Liquid Treatment Alternatives			
	Alt 2: Existing Lagoon Upgrades	**Alt 3: New Lagoon**	**Alt 4: Lagoon + MBBR + Filter**	**Alt 5: MBR**
Effluent Water Quality	3	3	4	5
System Reliability	2	5	4	3
Ease of Operation and Maintenance	4	5	3	2
Adaptability and Phasing	4	4	4	3
Environmental Sustainability	2	4	3	2
Social Impacts	2	3	2	1
Raw Score =	17	24	20	16
Number of criteria =	6	6	6	6
Relative Score =	**0.94**	**1.33**	**1.11**	**0.89**

Note:

Scores >1 indicate net positive; Scores <1 indicate net negative

Table 5-5. Weighted Non-Monetary Scores for Treatment Alternatives

Criteria	Criteria Weighting	Liquid Treatment Alternatives			
		Alt 2: Existing Lagoon Upgrades	**Alt 3: New Lagoon**	**Alt 4: Lagoon + MBBR + Filter**	**Alt 5: MBR**
Effluent Water Quality	5.6%	0.17	0.17	0.22	0.28
System Reliability	23.3%	0.47	1.17	0.93	0.70
Ease of Operation and Maintenance	20.0%	0.80	1.00	0.60	0.40
Adaptability and Phasing	20.0%	0.80	0.80	0.80	0.60
Environmental Sustainability	13.3%	0.27	0.53	0.40	0.27
Social Impacts	17.8%	0.36	0.53	0.36	0.18
	100%				
	Weighted Score =	**2.86**	**4.20**	**3.31**	**2.42**

Alternative 2 received the highest non-monetary ranking due to its reliability, ease of operations and maintenance, and environmental sustainability. Alternative 5 received the lowest score due to its lower comparative system reliability, ease of operations and maintenance, environmental sustainability, and social impacts.

Table 5-6. Normalized NPV Costs for Treatment Alternatives

	Alt 2: Existing Lagoon Upgrades	**Alt 3: New Lagoon**	**Alt 4: Lagoon + MBBR + Filter**	**Alt 5: MBR + Solids Handling**
Normalized NPV	1.00	1.10	1.96	2.25
Benefit to Cost Ratio	2.9	3.8	1.7	1.1

Note:

The normalized NPV cost for each alternative is the NPV cost of that alternative divided by the lowest NPV cost of the alternatives, The benefit to cost ratio is the ratio of the weighted non-monetary score divided by the normalized NPV cost score.

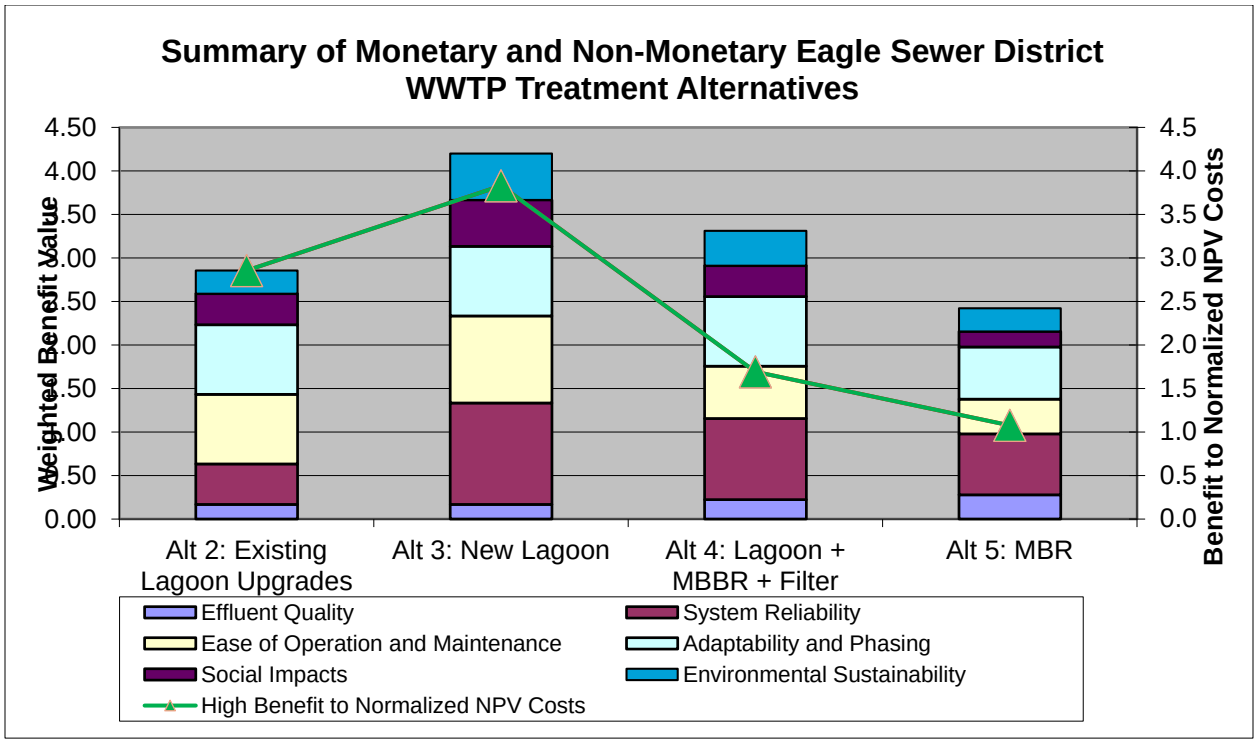


Figure 5-5. Weighted Non-Monetary Scores and Normalized NPV Costs for Treatment Alternatives

Alternative 3: New Lagoon has the highest benefit to normalized NPV costs and has the highest non-monetary cost, therefore, it provides the most benefit at the lowest cost.

5.6 Wastewater Management Alternative Evaluation Results

As presented in this section, the alternatives evaluation workshop resulted in preferred alternatives for the Eagle Sewer District WWTP treatment process required to meet future flows and loads driven by growth in the Eagle Sewer District Area of Impact. A critical aspect of implementation of this facility plan will be how the various facilities are phased based on development and population growth and evolving discharge costs in the agreement with the City of Boise. The discharge agreement will evolve as the City of Boise sees changes in its NPDES discharge permit. Phased implementation and development of a recommended capital improvement plan is further described in Section 8.

SECTION 6

Selected Approaches, Description, and Implementation

This section presents selected treatment options and the recommended implementation schedule for these improvements. A list of future alternatives recommended to be studied further is also presented.

6.1 Description of the Selected Approaches for Specific Improvements

The proposed projects described in this section either increase or improve the hydraulic or treatment capacity and most of the projects which are planned over more than 1 year include the cost and schedule for design and construction. The following hydraulic improvements are necessary to increase the capacity of existing lagoon systems.

Table 6-1. Selected Hydraulic Improvements

No.	Description	Flow Trigger (mgd)	Estimated Schedule
1	Inspect and clean the 12-inch diameter Effluent Line between Lagoon Pond No. 2 and the Effluent Pump Station	-	Near term to reduce headloss
2	Add new 18-inch diameter effluent pipe between Lagoon Pond No. 2 and Effluent Pump Station	-	Near term to reduce headloss and high pipe velocities
3	Construct New Transfer Structure #2	-	Near term to allow Lagoon Pond No. 2 to operate at a higher water surface
4	Add 18-inch diameter influent pipe between Transfer Structure No. 1 and Lagoon Pond No. 1	When peak hour flow rate reaches 5.7 mgd	After 2040 planning period

The following treatment improvements are recommended to improve treatment capacity:

Table 6-2. Selected Treatment Improvements

No.	Description	Flow Trigger (mgd)	Estimated Schedule
5	Aeration system improvements	-	Near term to improve treatment
6	New lagoon system including two new lagoons and a second effluent pump station	-	Near the end of the current CIP (2020)

6.2 Implementation Schedule for Selected Approaches

Currently there are hydraulic issues at the Eagle Sewer District WWTP that should be addressed to make the system more reliable and reduce the potential for overtopping flow control structures. These issues are described in Section 4: Hydraulic Bottlenecks and issues should be corrected as soon as reasonably possible. Some of the more involved issues can be resolved when the existing lagoons are isolated for solids removal or after a second lagoon system has been constructed.

Upgrading the aeration system in the existing lagoon system has the potential to reduce electricity costs and increase the oxygen transfer efficiency by changing from surface aerators to submerged fine bubble type aerators. It is recommended that the existing lagoon aeration system be upgraded as soon as reasonably possible, anticipated in 2016. This upgrade is expected to increase treatment and reduce electrical costs.

The effluent force main to the West Boise WWTF should be upgraded when the effluent pumping rate exceeds 3.5 mgd. If the flow attenuation properties of the lagoon system are utilized as described in Section 4 then this will occur in about 2030. The new forcemain is anticipated to include a new sampling station at the West Boise WWTF.

Lagoon seepage testing is required by the DEQ permit in 2018, ten years since the HDPE lagoon liners were installed in 2008. Currently seepage testing requires bypass pumping where raw wastewater is sent directly to the West Boise WWTF and additional treatment charges are incurred. The construction of the new second lagoon system will provide unit redundancy where each lagoon can be taken offline and tested without need for bypass pumping or incurring additional treatment charges. Design and construction of the lagoons is anticipated to take 1.5 years. Therefore, it is recommended that the second lagoon system be constructed prior to seepage testing.

As flows increase to 4.3 mgd, the existing effluent pump station pumps will need to be upgraded. The system is expected to reach this flowrate in 2034. The new lagoon system is planned to be a completely redundant system, so the existing effluent pump station will need required when flows reach 4.3 mgd regardless of the second lagoon system construction.

6.3 Future Studies

During the development of this facility plan several additional potential improvements to the Eagle Sewer District WWTP were discussed but were determined to have limited applicability in the short term, or maybe even in the planning period. However, with evolving permit and economic factors, these improvements may be valuable to consider in the future. These alternatives are presented in Table 6-3. Several of the future studies involve discussions between the City of Boise and the Eagle Sewer District regarding discharge to the West Boise WWTF. The City of Boise is currently beginning a wastewater facility plan update and although efforts were made to coordinate potential improvements at the West Boise, the City of Boise asked to postpone the conversations until their facility plan is underway and maybe even completed.

Table 6-3. Future Alternatives to Study Further

Potential Study	Description	Schedule
Relocate Eagle Sewer District Effluent Discharge Point at the West Boise WWTF	The Eagle Sewer District discharge currently enters the City of Boise collection system on the West Boise WWTF property, roughly 1,200 feet from the Headworks facility where it joins with raw wastewater. Since the Eagle Sewer District WWTP discharge has already been screened, degritted, and treated somewhat more than primary effluent standards, there is the potential that relocating the connection point to downstream of the primary clarifiers may be beneficial to the City of Boise and to the District. Although the District discharge is currently only 10-percent of the total wastewater flow at West Boise WWTP, growth in Eagle compared to Boise may make it even more significant. It may be mutually beneficial for the connection point to be moved so that previously treated wastewater is not re-treated and it could free up some capacity in the existing unit processes. Note, however, that the NPDES permit sampling requirements may preclude this relocation – additional coordination and investigation with the City is required.	2016 during the City of Boise wastewater facility plan development

Table 6-3. Future Alternatives to Study Further

Potential Study	Description	Schedule
Discharge temperature benefits to West Boise WWTF	There is the potential that the City of Boise will have challenging temperature limits included in a future NPDES permit. The Eagle Sewer District WWTP effluent is anticipated to be at least 10 degrees cooler than the West Boise WWTF effluent due to its residence time in the lagoon system. There may be a potential benefit to be realized by the Eagle Sewer District for the temperature of their effluent in its ability to lower the West Boise effluent temperature and help meet future permit limits.	When new NPDES permits are released
Construct solids handling facility	As flows and loads increase the lagoons will fill more quickly with sludge. At some point it will be more cost effective to construct and operate a solids handling facility instead of having a contractor remove the solids.	Near-term
Return of treated wastewater from West Boise WWTF to Eagle Sewer District	Discharge of West Boise WWTF effluent to the Boise River is increasingly challenging due to more stringent regulations. There may be a possibility in the future for all of Eagle Sewer District's wastewater to be treated at the West Boise WWTF and then returned to the District for reuse. This highly treated wastewater could have benefits to Eagle Sewer District depending on the economic and regulatory landscape and water use at that time.	2016 during the City of Boise wastewater facility plan development
Reuse at the Eagle Sewer District WWTP	There is a potential for reuse where the Eagle Sewer District would treat wastewater to a Class A reuse standard and use as irrigation water by local canal company. Depending on the discharge agreement with the City of Boise, it may be economical for Eagle Sewer District to construct wastewater treatment unit processes that would treat the wastewater sufficient for use as irrigation, thus offsetting the cost of discharging to West Boise WWTF. Explore the opportunity of constructing a solids pipeline to the City of Boise for biosolids stabilization, fermentation, and energy recovery at West Boise WWTF.	When changes in the City of Boise discharge permit occur
Phosphorus Charges by City of Boise	As the City of Boise builds new wastewater treatment processes to reduce phosphorus in final effluent discharged to the river and comply with new low total phosphorus limits in its NPDES permit, it may impose a fee on the Eagle Sewer District. Investigate phosphorus removal at the Eagle Sewer District WWTP to avoid discharge costs.	When Boise finalizes investment to reduce total phosphorus in effluent

Additional studies that Eagle Sewer District may find beneficial to study are given in Table 6-4.

Table 6-4. Other Items Eagle Sewer District Might Consider Studying

Potential Study	Description	Schedule
Additional Service Area Planning	The City of Eagle currently plans to annex property beyond the existing Area of Impact and the Eagle Sewer District may consider developing plans to serve this same planning area. The City planning area currently extends northward to the Elmore and Boise County lines and includes the M3 and Avimor developments. The District might consider additional study of this area to define sewer collection basins and generally locate satellite treatment facilities.	Soon to match the City of Eagle planning area

SECTION 7

Collection System Model

This section documents the development of a wastewater collection system model for Eagle Sewer District located in Eagle, ID. This section documents the model development and calibration, as well as the capital improvements identified as part of this study for the planning timeframe of 25 years.

The Eagle Sewer District (ESD) wastewater collection system serves a variety of customer types, including residential and commercial users. CH2M assisted ESD in developing a collection system model to identify existing system deficiencies and to evaluate plans to accommodate new growth. To build and calibrate the model, following data was compiled:

- 2008 H2OMap Sewer collection system model was converted to Info SWMM and updated with ESD's GIS data through July 2015.
- Flow monitoring was conducted by a subcontractor (ADS) for a period of two weeks from April 8 to April 21, 2015.
- Drawdown tests were completed on ESD's lift stations in July 2015.

7.1 System Description

CH2M received GIS data from ESD that includes infrastructure updates to the ESD collection system through July 2015. Below is a summary of the ESD's collection system based upon the GIS data:

- 3,189 Manholes
- One diversion manhole (MH ETR-013) with two slide gates.
- 134.2 linear miles of gravity pipe
- 18.5 linear miles of pressure pipe
- Eight lift stations
- Outfall location – free discharge to influent pump station at the Eagle Sewer District WWTP Headworks Facility

Eagle Sewer District's collection system model consists of pipes that are 8-inches in diameter and greater, representing 99.9-percent of the system in the model. Seven of the eight lift stations in ESD's collection system are included in the model. Lakemoor Lift Station is not included in the model because it discharges directly to the City of Boise's West Boise WWTP.

The outfall from the collection system is ESD's WWTP headworks facility which is located near the Boise River. The ESD WWTP provides primary treatment that includes a headworks facility, lagoon system, and effluent pump station. After wastewater is treated in the lagoon system the effluent pump station discharges flow to the City of Boise's West Boise WWTP. Eagle Sewer District does not maintain a National Pollutant Discharge Elimination System (NPDES) discharge permit. Figure 7-1 and the figure in Appendix A show the collection system, lift stations, and the location of ESD's WWTP and the City of Boise's WWTP.

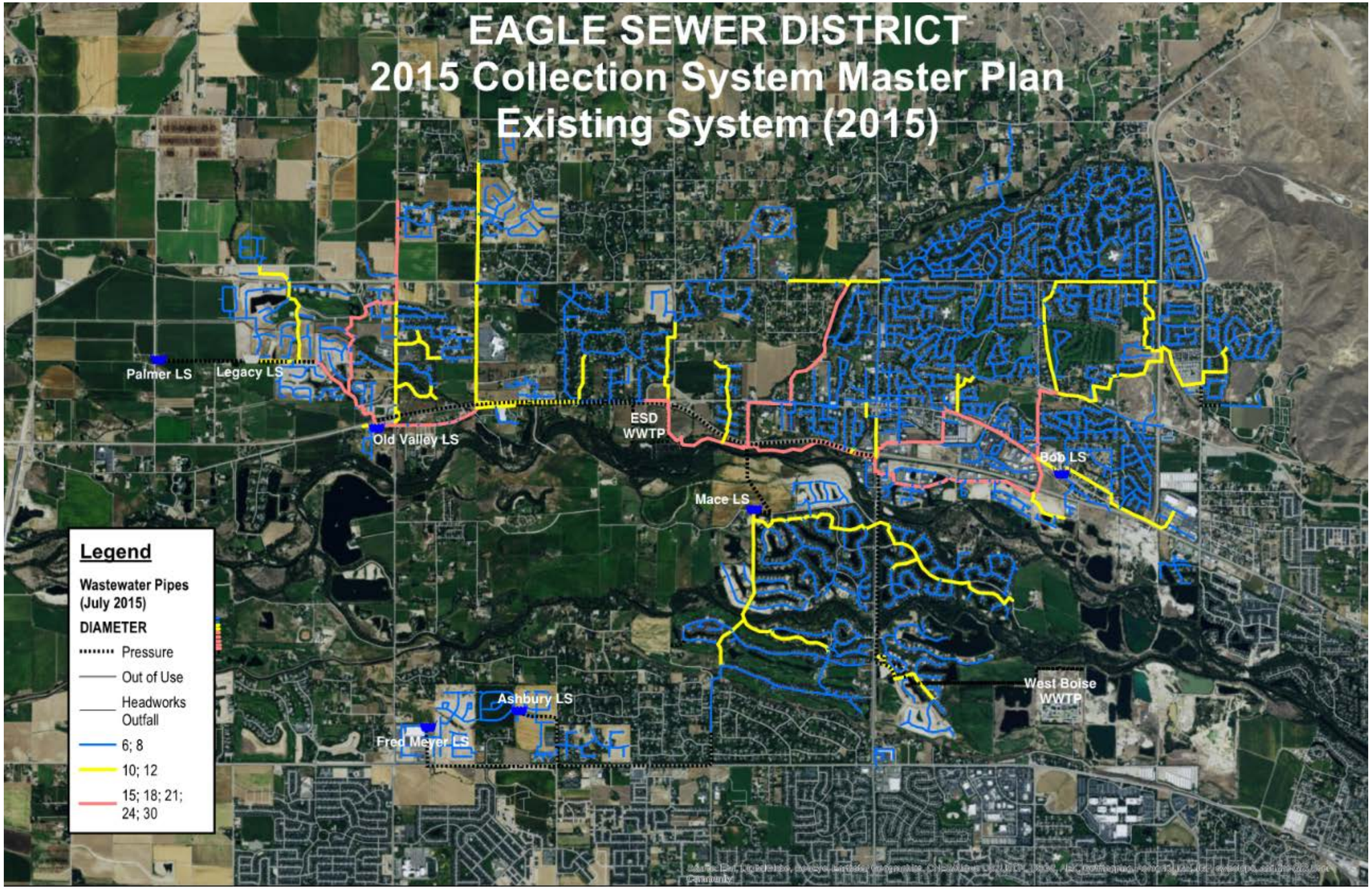


Figure 7-1. Existing ESD Collection System

7.2 Model Network Construction

For the 2015 Collection System Master Plan, a InfoSWMM version Suite 12.0 hydraulic model was used to assess the hydraulic performance of the existing (as of July 2015) system and impacts of future development. The model construction was based on the following general steps:

1. ESD's prior model (H2O Map Sewer model developed in 2008) was converted to InfoSWMM.
2. Pipes and manhole were adjusted to better align with the geographical information system (GIS) data. The horizontal datum is NAD 1983 Transverse Mercator, feet, and the vertical datum is NAVD88.
3. Model was updated to 2015 conditions (e.g., new pipes, configurations) using GIS and as-built data.
4. Pipe profiles were reviewed. Approximately 12 pipe segment areas were identified requiring adjustment likely due to vertical datum inconsistencies among projects. Pre- and post-adjustment profiles are provided in Appendix B. Approximately 1 to 2 percent of manhole elevations were approximated by interpolation to fill data gaps—these are denoted in GIS with user flags.

7.2.1 Lift Stations

The Eagle Sewer District Collection System contains a total of eight lift stations. Seven of the eight lift stations in the ESD collection system are incorporated into the InfoSWMM model. However, only six lift stations are active in the existing or future buildout scenarios. In the existing system scenarios, Palmer Lift Station is not activated in the model. Its contributing flow is conveyed through the Legacy Lift Station, however, as development in the area occurs, the increased flow will warrant Palmer to be placed in service and Legacy Lift Station will be decommissioned.

Legacy Lift Station was in service during the flow monitoring period and remains in service as of December 2015. In the future buildout scenarios, Palmer Lift Station is activated in the model.

All of ESD's lift stations are included in the InfoSWMM model (with the exception of the Lakemoor Lift Station because of its direct discharge to City of Boise's West Boise WWTP). The following are modeled lift stations:

- Bob Lift Station
- Mace Lift Station
- Ashbury Lift Station
- Fred Meyer Lift Station
- Legacy Lift Station (Active in existing system models only)
- Old Valley Lift Station
- Palmer Lift Station (Active in future buildout models only)

Data compiled for each lift station is listed in the following sections and data sheets were are included in Appendix C.

7.2.1.1 Drawdown Tests

To increase the accuracy of the model, draw-down tests were performed on the following lift stations in July 2015:

- Bob Lift Station
- Ashbury Lift Station
- Old Valley Lift Station

Excluded from the drawdown tests are relatively new lift stations. Mace Lift Station was rebuilt in 2014, Fred Myer Lift Station was built in 2012 and contributing flows are low, and Palmer Lift Stations is a new

lift station that is not currently online. Legacy Lift Station was not tested because of the "temporary" status. For these stations, the manufacturer pump curves are used in the model.

The detailed results of the lift station draw down tests are summarized in Appendix C.

7.2.1.2 Bob Lift Station

Bob Lift Station (LS) was constructed in 1989 and contains two submersible ABS pumps in a 6-foot-diameter wet well that is 6 feet deep. Bob Lift Station serves the northeast area of ESD's collection system. Table 7-1 summarizes the rated flow rates and total dynamic head, as well as the results from the drawdown tests.

Table 7-1. Bob Lift Station Design and Drawdown Test Results

Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)	Drawdown Test Pump Rate 2 (gpm)	Drawdown Test Pump Rate Average (gpm)
1	4.7 hp ABS	12	640	419	556	488
2	4.7 hp ABS	12	640	477	478	478
1 & 2				1130	1065	1098

There is not a permanent flowmeter located at the lift station, therefore flow rates for the drawdown tests were estimated using a float and timer. In the InfoSWMM model, a single pump flowrate of 549 gpm and a combined flow rate for pumps 1 and 2 of 1098 gpm was used.

7.2.1.3 Mace Lift Station

Mace Lift Station was rebuilt in 2014 and contains three submersible variable speed ABS pumps in a 12-foot-diameter wet well that is 39.4 feet deep. The station is equipped with a flow meter. Mace Lift station serves the entire southern area of ESD's collection system. Because the three pumps located in this lift station are new and the flow meter was available, the pumps were exercised in single and dual pump operation. The third pump is used as a standby pump. Table 7-2 summarizes the rated flow rates and total dynamic head, as well as the flow rates observed on site.

Table 7-2. Mace Lift Station Design and Drawdown Test Results

Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)
2	49 hp ABS	102	1190	970
3	49 hp ABS	102	1190	930
1 & 2				1160

In the InfoSWMM model, Mace pumps 1, 2, and 3 were modeled as having a 930 gpm flow rate which is the flow rate at 90-percent pump speed—these flow rates aligned with downstream flow monitors.

7.2.1.4 Ashbury Lift Station

Ashbury Lift Station was constructed in 2014 and contains two submersible Sulzer/ABS pumps in a 6-foot diameter, 34.3 feet deep wet well. Ashbury Lift Station serves the Ashbury Subdivision, Castlebury West Subdivision, and the Castlebury West Business area. This lift station is located in the southwest area of the ESD collection system. Table 7-3 summarizes the rated flow rates and total dynamic head, as well as the results from the drawdown tests.

Table 7-3. Ashbury Lift Station Design and Drawdown Test Results

Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)	Drawdown Test Pump Rate 2 (gpm)	Drawdown Test Pump Rate Average (gpm)
2	14 hp ABS	80	140	145	N/A	N/A
1 & 2				197	N/A	N/A

In the InfoSWMM model, Ashbury Lift Station had a single pump flowrate of 145 gpm and combined rate of 197 gpm.

7.2.1.5 Fred Meyer Lift Station

Fred Meyer Lift Station was constructed in 2012 and contains two submersible Sulzer/ABS pumps in a 6-foot-diameter wet well that is 26 feet deep. Fred Meyer Lift Station serves the Eagle Island Market Place and is located in the southwest area of the ESD collection system. As stated previously, a drawdown test was not performed at this lift station. The contributing flows are low and the lift station is relatively new. As a result, the manufacturer pump curve data was used in the model and is listed in Table 7-4.

Table 7-4. Fred Meyer Lift Station Design and Drawdown Test Results

Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)	Drawdown Test Pump Rate 2 (gpm)	Drawdown Test Pump Rate Average (gpm)
1	14 hp ABS	94	240	N/A	N/A	N/A
2	14 hp ABS	94	240	N/A	N/A	N/A

7.2.1.6 Old Valley Lift Station

Old Valley Lift Station was constructed in 2002 and contains two submersible Hydromatic pumps in an 8 foot by 8 foot by 22 feet deep wet well. Old Valley Lift Station serves the northwest portion of the ESD system. Table 7-5 summarizes the rated flow rates and total dynamic head, as well as the results from the drawdown tests.

Table 7-5. Old Valley Lift Station Design and Drawdown Test Results

Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)	Drawdown Test Pump Rate 2 (gpm)	Drawdown Test Pump Rate Average (gpm)
1	25 hp ABS	117	315	501	478	490
2	25 hp ABS	117	315	521	521	521
1 & 2				553	527	540

The drawdown test with both pumps No. 1 and No. 2 in operation resulted in a flow rate that is slightly higher than with a single pump in operation. This is likely because the pumps are currently configured to discharge into the same 6-inch diameter forcemain. It should be noted that Old Valley Lift Station is configured so that each pump can discharge into a dedicated 6-inch diameter forcemain and once flow into the lift station warrants this configuration ESD can change the configuration. But with current peak influent flows into Old Valley LS of 202 gpm (See Table 7-10), the current configuration is appropriate. In summary, when both pumps are in operation and share the same forcemain the discharge will not

increase significantly, however, based upon the configuration of the lift station each pump can have a dedicated forcemain, therefore, each pump is capable of discharging up to 520 gpm. In the InfoSWMM model, Old Valley Lift Station had a single pump flowrate of 520 gpm and a combined flow rate of 1040 gpm with the assumption that each pump will have a dedicated forcemain.

7.2.1.7 Legacy Lift Station

Legacy Lift Station was constructed in 2007 and contains two submersible ABS pumps in a 6-foot-diameter wet well that is 23 feet deep. Legacy Lift Station serves the Legacy subdivision located in the northwest portion of the ESD collection system. Table 7-6 summarizes the rated flow rates and total dynamic head. As stated previously, this lift station was not drawdown tested because this is a temporary lift station that will be abandoned once Palmer Lift Station is brought online. The rated flow rates were used in model calibration.

Table 7-6. Legacy Lift Station Design and Drawdown Test Results

Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)	Drawdown Test Pump Rate 2 (gpm)	Drawdown Test Pump Rate Average (gpm)
1	14 hp ABS	95	280	N/A	N/A	N/A
2	14 hp ABS	95	280	N/A	N/A	N/A

7.2.1.8 Palmer Lift Station

The Palmer Lift Station was constructed in 2009 and contains two variable speed Fairbanks Morse pumps located in a dry well. The wet well is 5 feet by 40 fet by 10 feet deep. Palmer Lift Station is currently not online, but once areas in the northwest are developed it will serve the Legacy Subdivision and the newly developed areas located in the northwest area of the ESD system (Legacy Lift Station will be abandoned). Table 7-7 summarizes the rated flow rates and total dynamic head used in the model.

Table 7-7. Palmer Lift Station Design and Drawdown Test Results

Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)	Drawdown Test Pump Rate 2 (gpm)	Drawdown Test Pump Rate Average (gpm)
1	60 hp Fairbanks Morse	172	720	N/A	N/A	N/A
2	60 hp Fairbanks Morse	172	720	N/A	N/A	N/A
3	60 hp Fairbanks Morse	172	720	N/A	N/A	N/A

This lift station was not activated during model calibration or current system simulations, however, Palmer Lift Station was activated in the future buildout (2040) scenarios.

7.3 Model Flow Loading

Flow monitoring conducted for a period of 2 weeks, April 8 to April 21, 2015, was used for calibration. This period for flow monitoring was specifically selected as it corresponds with the seasonally high flows observed in the system. The increased flows are due to the increased irrigation and groundwater in the vicinity of the ESD collection system.

7.3.1 Flow Monitoring

ESD maintains the following permanent flow monitoring locations:

- Wastewater treatment plant headworks
- Wastewater treatment plant effluent pump station
- Mace Lift Station

To supplement this data, additional flow monitoring data was needed. A flow monitoring specialty firm, ADS, was contracted to install and maintain the monitors along with two rain gauges. Detailed flow monitoring results are provided in Appendix D. Figure 7-2 shows the flow monitoring basins. The two rain gauges were located at Old Valley Lift Station and Mace Lift Station.

Ideally, the flow monitoring period would have included storms to measure the effect of storms on the system. However, reviews of flows at the plant and interviews with engineering and operations personnel yielded that increased flows due to inflow/infiltration (I/I) are not problematic for the utility. For this reason a relatively short flow monitoring period was used to support model calibration—system flows are more dominated by ESD's residential and commercial customers and groundwater infiltration. Additional simulations were performed to extrapolate impacts on the system based on historical data and these findings are summarized in Section 7.4.1.2.

To support model calibration, data from each flow monitoring location was analyzed to identify representative diurnal patterns (defined by 24 hourly flow averages) for each basin. Distinct patterns were developed for both weekdays and for weekends. The results of a basin analysis is presented in Figure 7-3. "Measured" denotes the flow measured at the site and "Net Basin" is the basin's discrete contribution into the system. For terminal basins, the two flows are equivalent; however, for flow monitors located downstream of another basin, the net basin flow is calculated by subtracting out upstream flows. In short, the net basin is used for flow distribution within the model. Dry weather patterns and average flows results for each flow monitoring basin are provided in Appendix E.

7.3.2 Distribution of Flow Loads

Flow loading consists of identifying the quantity and spatial location of inflows to the collection system. To parse the flow measured at the flow monitoring locations further upstream in the flow basins, TAZ population information was used. The TAZ data was provided by the City of Eagle and Community Planning Association of Southwest Idaho, referred to as COMPASS. Included in the TAZ data was current (2015) and future buildout (2040) conditions.

Overlaying flow basin and TAZ shapefile boundaries provided by COMPASS, a per person flow rate (gallons per minute per person) was developed based upon two data sets, 1) the total population located within the flow meter basin, and 2) the average day flow rate in each basin as measured by the temporary flow monitors. Table 7-8 summarizes the weekday average flow rate for each basin and the per capita flow rates estimated in each. Per capita loading ranges from 64 to a high of 201 gpd/person. The high rates (compared to industry factors) were retained due to the likely effects of groundwater infiltration in the basin. An average per capita rate of 100 gpd/person was used for future buildout scenarios, discussed in Section 7.3.5.

Appendix F contains a summary of the process used to develop the flow loads and includes a summary of the flow rates for each TAZ and each flow meter basin.

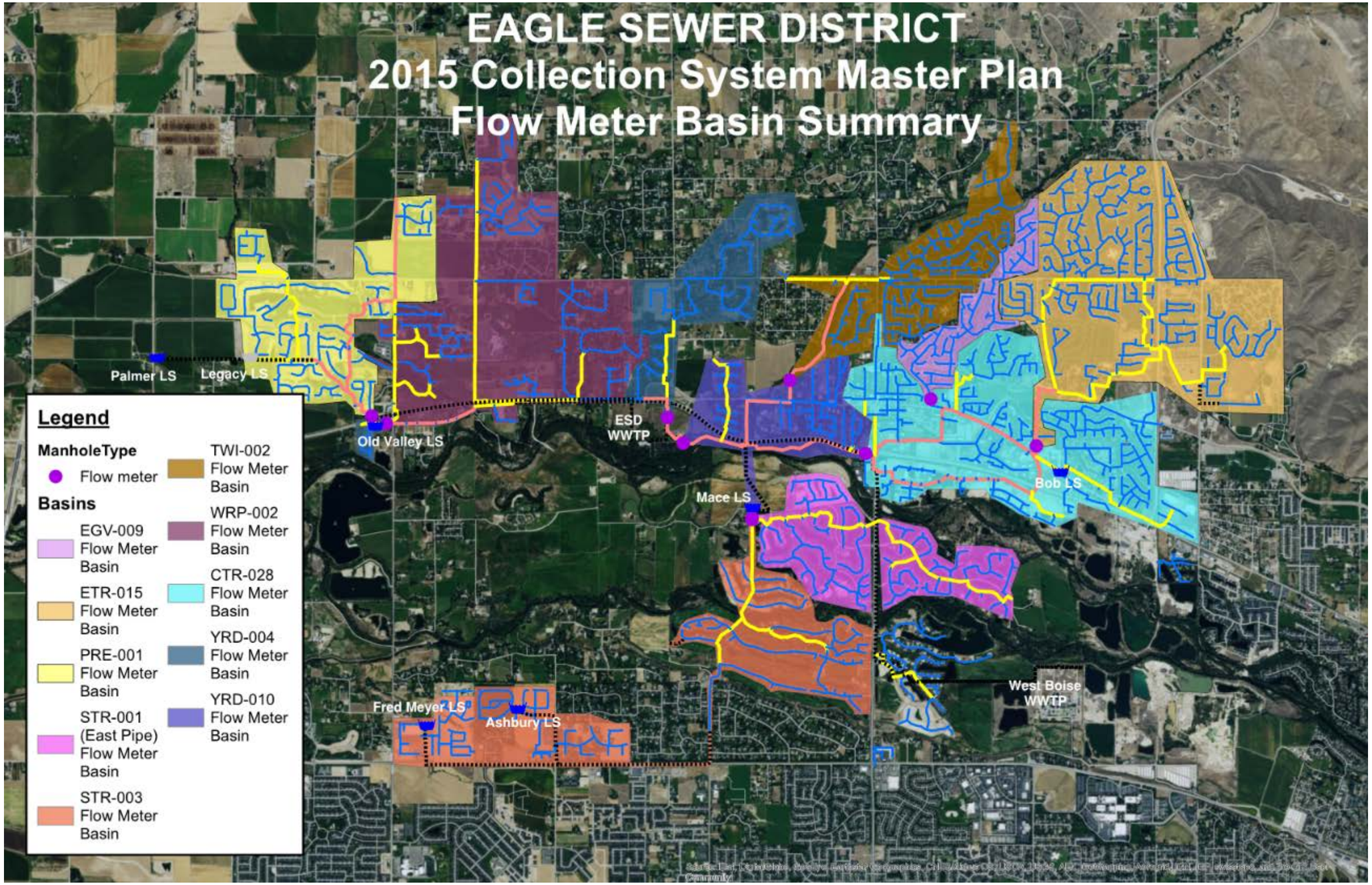


Figure 7-2. Existing ESD Collection System – Flow Meter Basins

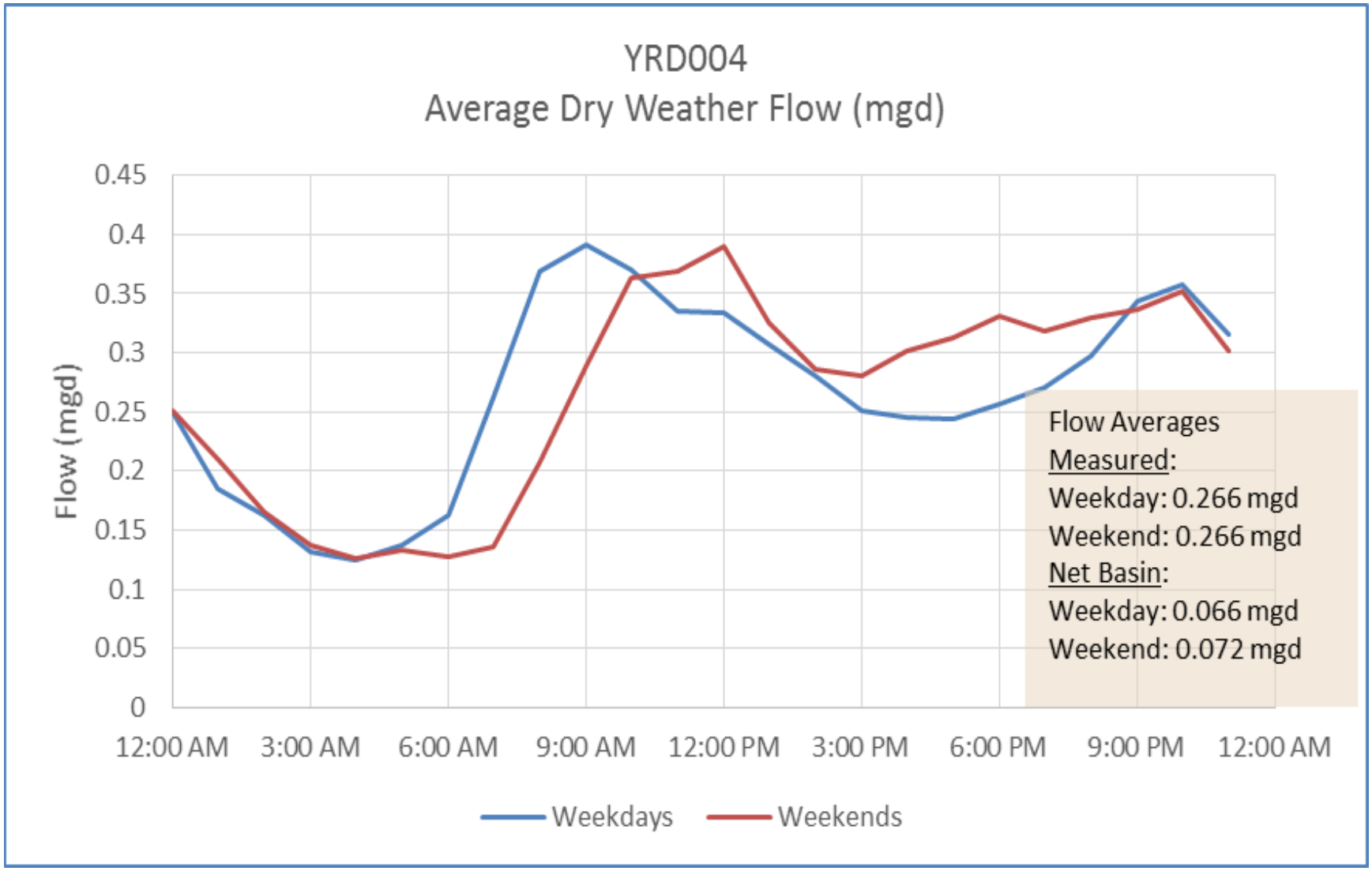


Figure 7-3. Diurnal Curves for Flow Meter Basin YRD-004

Table 7-8. Summary of ADS Flow Results and 2015 Served Population – Existing (as of April 2015) System

Flow Meter Basin	ADS Weekday Average Flow Rate (mgd)	2015 Population Served	2015 Flow per person (gpd/person)
PRE-001	0.056	765	73.2
WRP-002	0.143	2,253	63.5
YRD-004	0.066	766	86.1
EGV-009	0.068	1,044	65.1
ETR-015	0.250	5,288	47.3
CTR-028	0.751	3,729	201.4
TWI-002	0.131	1,934	67.8
STR-002E	0.168	704	238.8
STR-003	0.126	1,167	108.0
YRD-010	0.071	905	78.5
Total	**1.83**	**18,554**	
Average			**98.6**

7.3.3 Existing System Flow Summary

As referenced in Chapter 2, Existing Conditions, approximately 75 percent of the City of Eagle population is currently being served by Eagle Sewer District. The current population of the City of Eagle (2015) is 24,600 people and ESD serves/conveys wastewater flow from 18,500 of their residents. The wastewater from the balance are treated through septic tanks or conveyed directly to the City of Boise WWTP.

ADS flow meters—YRD-004 and YRD-010 are located just upstream of the ESD treatment plant and monitor all the flow into the plant. Based on the data from these monitors, approximately 1.8 million gallons per day (mgd) was measured as plant influent.

7.3.4 Calibration

After model construction and initial flow loading was completed, the model was calibrated to the April 8 to April 21, 2015 flow monitoring data and observed field conditions. Primary adjustment to the model included the following:

- Refinements to the flow loading
- Adjustments to pump station configurations—primarily start/stop elevation and pump rates
- Gate position at Diversion MH ETR-013. There are two slide gates that divert flow to downstream manholes ETR-012 and EMP-017.

During the flow monitoring period, the gates at Diversion MH ETR-013 were positioned in their nominal operating position—25-percent of the flow was diverted south to MH ETR-012 and 75-percent diverted to MH EMP-017. These gate positions were retained in all modeling scenarios.

Figures 7-4 and 7-5 show calibration results of the most downstream monitors (YRD-004 and YRD-010) just before ESD's WWTP. The results demonstrate good model correlation based on visual comparison of measured and predicted flow. Similar results were evident at all monitoring sites and are provided in Appendix G. In general, the model simulates the system well and can be used by ESD to assess system performance and guide asset management decisions.

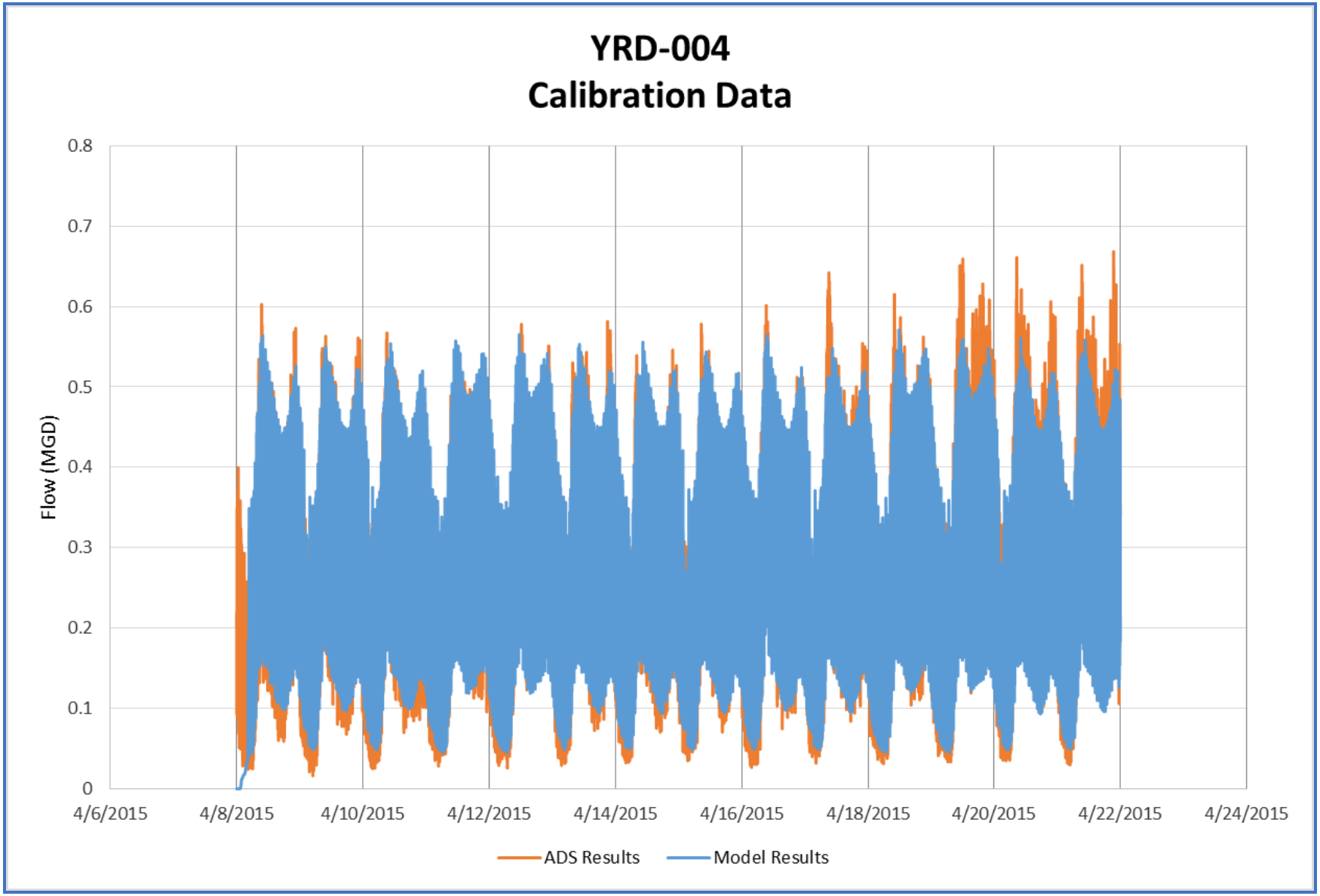


Figure 7-4. Dry Weather Flow Calibration of YRD-004

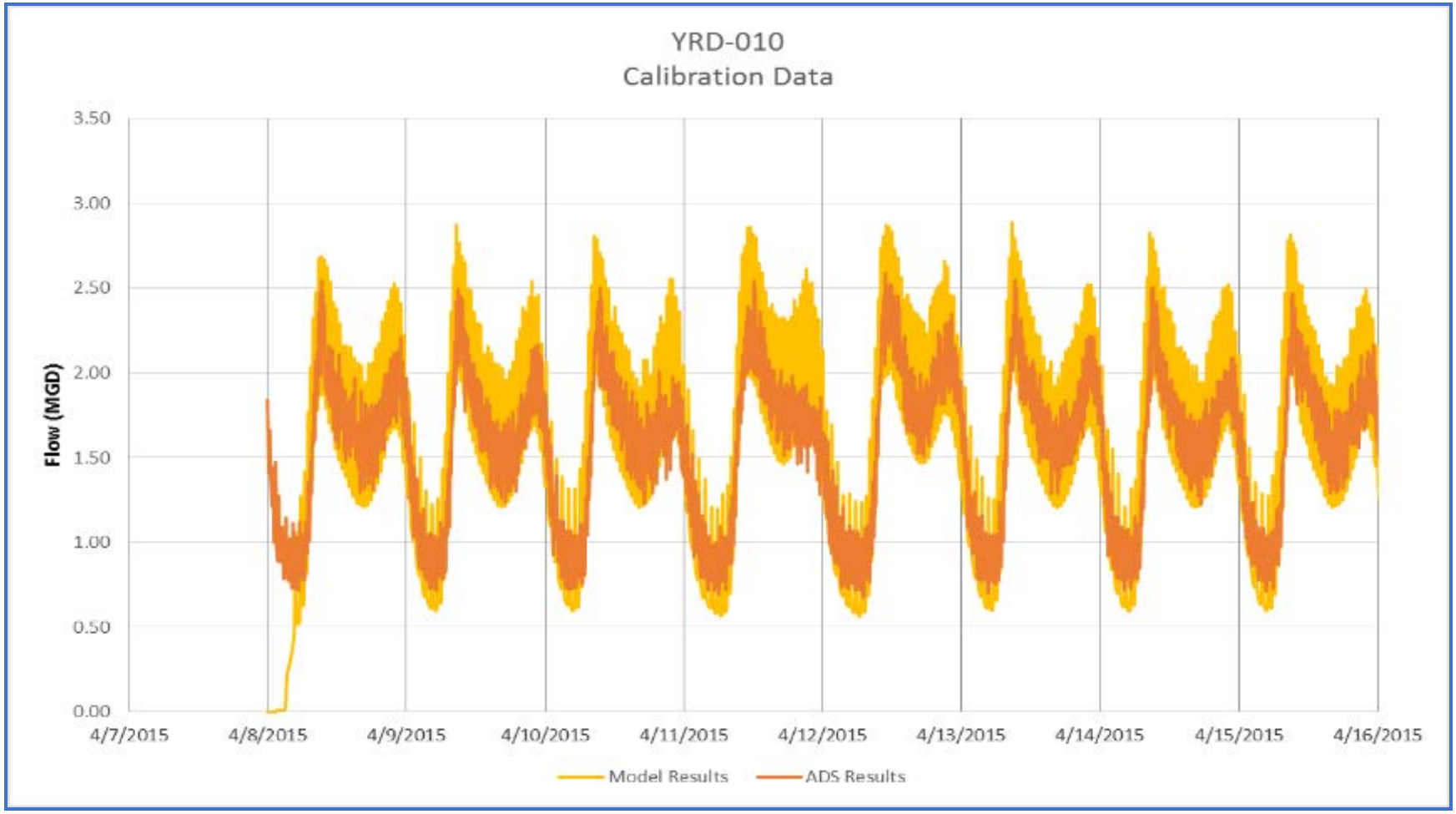


Figure 7-5. Dry Weather Flow Calibration of YRD-010

7.3.5 Future Buildout (2040) System Flows and Loading

After the existing system loading was defined and the existing system model was calibrated, future flow loading was incorporated based on the City of Eagle and COMPASS planning data and growth projections for the 25-year planning horizon. The future flow loading was developed based on TAZ projected population data for the year 2040, available land use data, and unit flow factors. Equivalent per capita unit factors were used for the buildout scenario for basins currently served by ESD. For areas external to the existing system, the average per capita loading (100 gpd/person) was applied. This value is the average flow loading for all the basins based on 2015 flow monitoring and the TAZ data and is consistent with industry standards.

Included in the future buildout scenario were areas ESD anticipates serving in 2040 shown in Figure 7-6. The projected population to be served by ESD in 2040 is approximately 45,000 people (compared to 18,500 in 2015).

For commercial land areas to be developed and connected to the ESD system in 2040, a per acre flow rate was estimated based upon land use, and its loading is summarized below:

- New Village Center and Commercial zoned areas: 1,500 gpd/acre (Metcalf and Eddie, 4th edition). The New village Center flow rate was loaded at MH 2040_NW_1 and the Commercial Zoned area flow rate was loaded at MH 2040_NW_2.
- Business Park and Professional zoned areas: 560 gpd/acre (2008 ESD Wastewater Facility Plan) loaded at MH 2040_NW_2

Appendix F contains a summary of the processes used to develop the 2040 flow loads and includes a summary of the 2040 flow rates for each TAZ and each flow meter basin.

Based on the above approach and the data, the anticipated 2040 average daily flow rate into the ESD treatment plant is estimated to be approximately 5.2 mgd—an increase of 3.4 mgd (185-percent) over 2015 conditions. Table 7-9 summarizes the 2040 weekday average flow rate for each basin and the 2040 per capita flow rates estimated in each basin based upon 2040 population served, land use data, and the average flow rate for each basin.

Table 7-9. Summary of Flow Results and Population Served - 2040 System

Flow Meter Basin/TAZ	Projected 2040 Weekday Average Flow Rate (mgd)	2040 Population Served	2040 Flow per person (gpd/person)
PRE-001	0.316	4,318	73.2
WRP-002	0.307	4,835	63.5
YRD-004	0.108	1,259	86.1
EGV-009	0.068	1,037	65.1
ETR-015	0.276	5,857	47.1
CTR-028	1.075	5,340	201.4
TWI-002	0.218	3,218	67.8
STR-002E	0.337	1,410	238.7
STR-003	0.267	2,473	107.9
YRD-010	0.093	1,184	78.5
795, 759, 760, 763, 758, 769, New Village Center	1.003	6,154	163.0
767, 766, 770, 773, Business Park, Commercial, Professional Office	0.552	3,195	172.6
762	0.001	15	100.0
799, 794, 761	0.297	2,973	100.0
777, 776, 778	0.066	664	100.0
774	0.002	22	100.0
744	0.245	1,026	238.8
Total	**5.232**	**44,981**	
Average			**116.3**

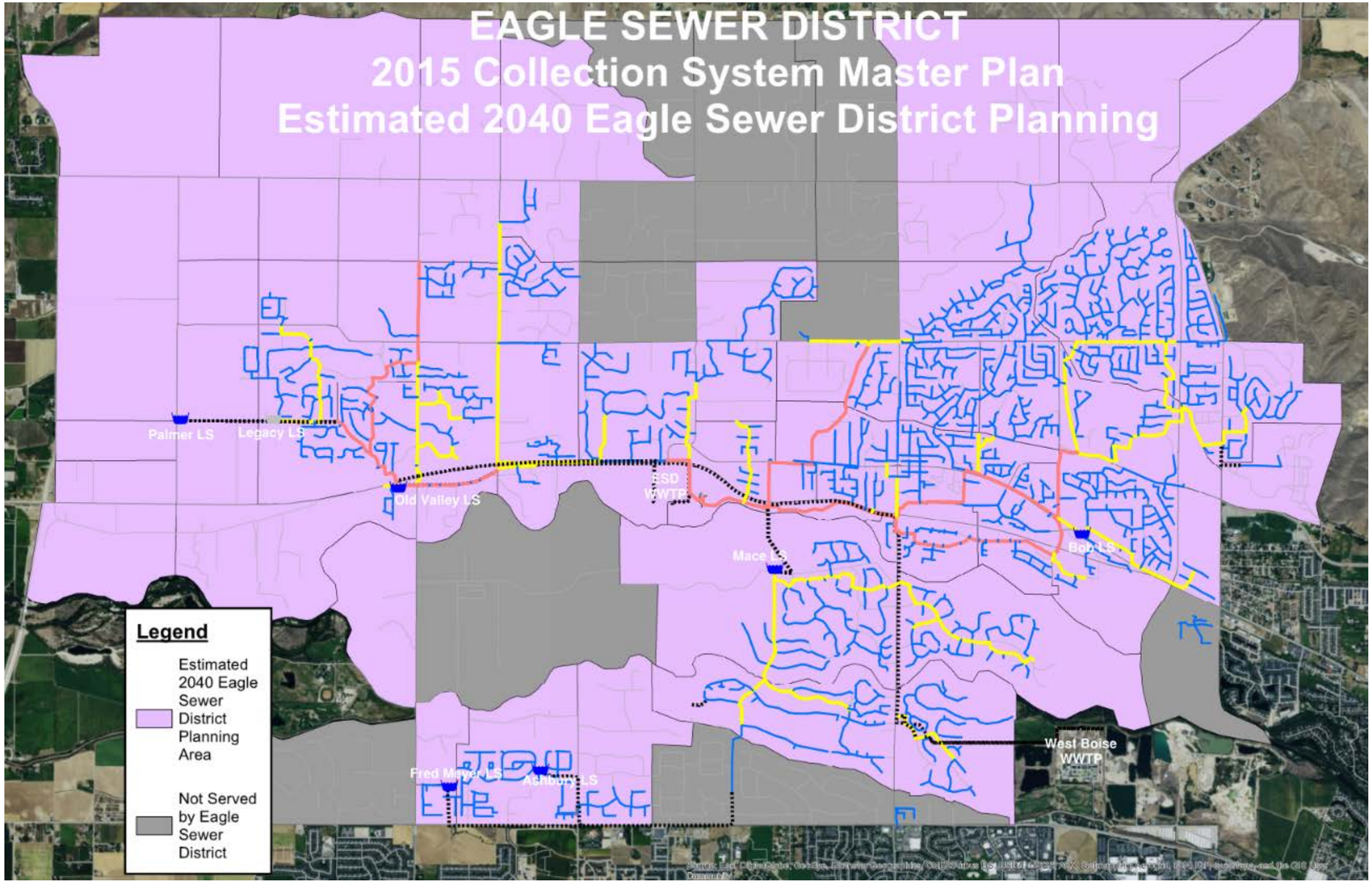


Figure 7-6. Estimated 2040 Eagle Sewer District Planning Area

7.4 Collection System Hydraulic Analyses

7.4.1 Existing 2015 System

This section summarizes the analysis of ESD's existing system to determine potential deficiencies in the existing collection system. Two scenarios were modeled to assess the performance of the system as it exists in July 2015: 1) Existing Dry Weather Flow (DWF) and 2) Existing Wet Weather Flow (WWF).

7.4.1.1 Existing System with Dry Weather Flow

The Existing DWF scenario modeled ESD's existing collection system as it is currently operated with the flow rates estimated during the ADS flow monitoring study. Six lift stations were in operation in this scenario: Bob LS, Mace LS, Ashbury LS, Fred Meyer LS, Old Valley LS, and Legacy LS. Palmer Lift Station is not online in the Existing DWF model.

A hydraulic deficiency was defined prompting further review if the ratio of the maximum flow to pipe diameter was greater than 80-percent (d/D > 0.8). Figure 7-7 shows the flow to depth diameter ratio identified in the Existing DWF scenario. Based upon the model results, there are currently no deficiencies in ESD's system.

To assess the existing DWF impacts on the lift stations, each lift station was reviewed to assess the peak flows in comparison to the station's firm capacity. As summarized in Table 7-10, at no time did the peak flow exceed each station's firm capacity.

Table 7-10. Lift Station Operation—Existing System with Dry Weather Flow

Lift Station Name	Peak Flow into Lift Station (gpm)	Firm Capacity of Lift Station (gpm)	Number of Pumps in Lift Station	Number of Pumps Required to Convey DWF
Ashbury Lift Station[1]	27.3	145	2	1
Bob Lift Station[1]	436.1	549	2	1
Fred Meyer Lift Station	15.5	240	2	1
Legacy Lift Station	28.4	280	2	1
Mace Lift Station	348.8	2380	3	1
Old Valley Lift Station[1]	201.6	520	2	1

1. Firm capacity based upon drawdown test results completed in July 2015

7.4.1.2 Existing System with Wet Weather Flow

During the ADS flow monitoring study there were a few storm events that occurred, however, the storms were not large enough to impact the system. Although the flow monitoring data did not support the calibration of a wet weather model and inflow/infiltration (I/I) is not currently a significant issue for ESD, CH2M in coordination with ESD assessed the system under a wet weather condition.

Historical flow records at ESD's treatment plant were reviewed to determine the peak flows into the plant during storm events. Based on the review, the peak historical flow into the plant was 2.5 mgd. To achieve this flow at the plant, all model flow loading points were multiplied by 1.4. Although it is recognized that increased flows due to I/I are not proportional to DWF loading, no data was available to support redistribution of system flow loading.

Six lift stations were included in the model in this WWF scenario: Bob LS, Mace LS, Ashbury LS, Fred Meyer LS, Old Valley LS, and Legacy LS. (Palmer Lift Station is not activated in the model.)

The same definition of a deficiency was applied—80 percent full (d/D > 0.8). Figure 7-8 shows the flow to depth diameter ratio identified in the system for the Existing WWF scenario. Based upon the model results, there are currently no deficiencies in ESD's system. There are specific pipes near Bob LS where the ratio is greater than 70 percent full (d/D > 0.7). The profiles of these pipes were examined and were determined to be localized issues where no upgrades are necessary because the pipes upstream and downstream have capacity remaining.

A critical asset in the ESD system is the Central Trunkline (CTR Manholes) located to the east of the ESD Headworks facility. Figure 7-9 shows a profile of maximum water surface elevation (WSE) of the Central Trunkline. This profile view demonstrate there are no deficiencies in this pipeline during the Existing WWF scenario.

Similar to the lift station analysis under DWF conditions, each of the lift stations were reviewed to determine the number of pumps needed to convey the WWF. Table 7-11 shows the results of the analysis. At no time was there a need to have more than one pump operating at each lift station to convey the WWF

Table 7-11. Lift Station Operation-- Existing System with Wet Weather Flow

Lift Station Name	Peak Flow into Lift Station (gpm)	Firm Capacity of Lift Station (gpm)	Number of Pumps in Lift Station	Number of Pumps Required to Convey WWF
Ashbury Lift Station[1]	39.8	145	2	1
Bob Lift Station[1]	436.1	549	2	1
Fred Meyer Lift Station	22.8	240	2	1
Legacy Lift Station	41.3	280	2	1
Mace Lift Station	488.6	2380	3	1
Old Valley Lift Station[1]	500.5	520	2	1

[1.] Firm capacity based upon drawdown test results completed in July 2015

7.4.2 Future Buildout (2040) Hydraulic Analysis

This section summarizes the analysis of ESD's existing system to determine potential deficiencies in the future buildout (2040) flow scenario.

7.4.2.1 Future Buildout (2040) DWF—Existing System

The existing system (as of July 2015) was assessed under the Future Buildout (2040) DWF flow scenario. For this scenario, six lift stations were in operation: Bob LS, Mace LS, Ashbury LS, Fred Meyer LS, Old Valley LS, and Palmer LS. Legacy Lift Station was not included in the model—it is to be decommissioned once the Palmer LS is placed in service. The configuration change of adding Palmer LS results in hydraulic restrictions that will need to be addressed.

As shown in Figure 7-10, with the anticipated 2040 buildout flows, the existing system cannot convey the predicted flows in the vicinity of Old Valley and Palmer Lift Stations. Model predicts sanitary sewer overflows in the Preserve Trunkline and the Palmer Trunkline (see pipe profiles shown in Figures 7-11 and 7-12). A single pump at Palmer LS conveys 720 gpm compared to the 540 gpm total firm capacity of the downstream Old Valley Lift Station. The remaining system have no deficiencies—all peak 2040 DWF is conveyed within the pipe complying with the 0.8 d/D criteria.

7.4.2.2 Palmer and Old Valley Lift Station Planning

As noted above, Palmer Lift Station is currently inactive, but Palmer Lift Station was designed and constructed to service flow currently being conveyed the existing Legacy Lift Station as well as the planned future development in the area. As of April 2015, the peak flow into Legacy Lift Station is approximately 28 gpm and collector pipes conveying flow to the Palmer Lift Station are in the planning phase—no flow is currently conveyed to Palmer. Although there are small flows currently in the Legacy Lift Station and the Palmer drainage areas, future projections of the area result in peak flow estimates of 2,215 gpm.

A single pump at Palmer Lift Station conveys 720 gpm compared to the 520 gpm firm capacity of the downstream Old Valley Lift Station; however, ESD planned for and equipped Palmer Lift Station with variable frequency drives (VFDs) to convey development flows as it occurs without prematurely overloading Old Valley Lift Station. This functionality at Palmer provides flexibility in the system until Old Valley Lift Station can to be upgraded or replaced as needed. Eventually, however, Palmer Lift Station will convey flows that will exceed the capacity of Old Valley Lift Station.

The anticipated future peak flow that will be conveyed to Old Valley Lift Station is 3,140 gpm (compared to 202 gpm as of April 2015). At full buildout, CH2M estimates that a new lift station at Old Valley will likely be needed. For this Master Plan, a new station equipped with four 2,000 gpm pumps will be needed to convey the projected peak flow—two duty pumps for sanitary flow, one pump for wet weather, and one standby. Eagle Sewer District plans on utilizing their existing parallel 6-inch diameter Old Valley force mains as well as their existing 10-inch force main located on W State St/W Highway 44 to convey the flow from the new Old Valley Lift Station.

The alternative presented above is for budgetary planning purposes for this Master Plan. Further review will be needed as development occurs.

7.4.2.3 Future Buildout (2040) DWF—Upgraded System

Based upon hydraulic restrictions under future buildout conditions, a new scenario was developed in the model that includes the following upgrades:

- Four new pumps capable of discharging 2,000 gpm each at Old Valley LS—two duty pumps for sanitary flow, one pump for wet weather, and one standby,
- Two new 60 horsepower (HP), 720 gpm pumps to be installed in Palmer LS,
- 1,600 LF of 21-inch trunk line (PRE-034 to PRE-055) upgraded to 36-inch diameter downstream of Palmer LS and upstream of Old Valley LS, and
- 1,800 LF of 24-inch trunk line (Old Valley Wet Well to PRE-034) upgraded to 36-inch diameter downstream of Palmer LS and upstream of Old Valley LS.

These upgrades are shown in Figure 7-13. As design criteria, any system components upgraded in the model result in peak flows conveyed at less than 0.5 d/D (less than 50-percent full).

Figure 7-13 shows the flow to depth diameter ratio identified in the system for the Future Buildout (2040) DWF scenario after upgrades to the system are incorporated. All pipes comply with the 0.80 d/D hydraulic criteria. The next tier of pipes in the upgraded system between 70 and 80-percent full are noted for comparison. These are in the main trunkline just upstream of the headworks at the ESD WWTP (YRD pipeline). A profile view of this main trunkline into WWTP is shown in Figure 7-14. The profiles of these pipes were examined and were determined to be localized issues where no upgrades are necessary because the pipes upstream and downstream have capacity remaining.

After system upgrades are incorporated in the system and any potential hydraulic restrictions are removed, the peak flows predicted under 2040 DWF buildout conditions are summarized in Table 7-12 for all lift stations.

Table 7-12. Lift Station Operation--Future Buildout (2040) DWF—Upgraded System

Lift Station Name	Peak Flow into Lift Station (gpm)	Firm Capacity of Lift Station (gpm)	Number of Pumps in Lift Station	Number of Pumps Required to Convey Future DWF
Ashbury Lift Station[1]	78.0	145	2	1
Bob Lift Station[1]	409.9	520	2	1
Fred Meyer Lift Station	65.0	240	2	1
Mace Lift Station	951.1	2380	3	1
Palmer Lift Station[2]	2214.9	2220	4	3
Old Valley Lift Station[2]	3137.9	6000	4	2

1. Firm capacity based upon drawdown test results completed in July 2015
2. Upgraded lift station. The firm capacity is based upon projected peak flow.

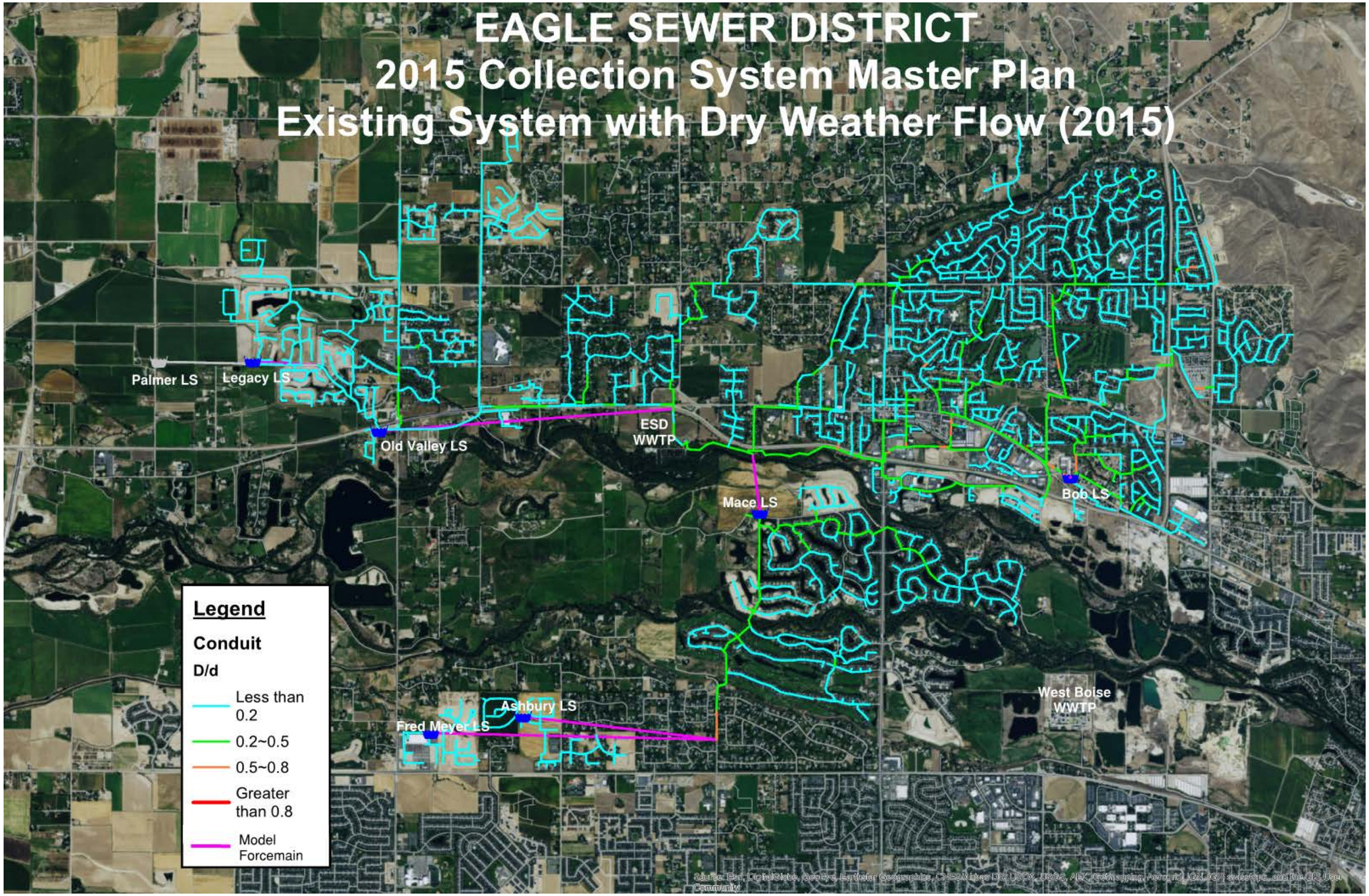


Figure 7-7. Existing System Dry Weather Flow - Pipeline Criteria Deficiencies.

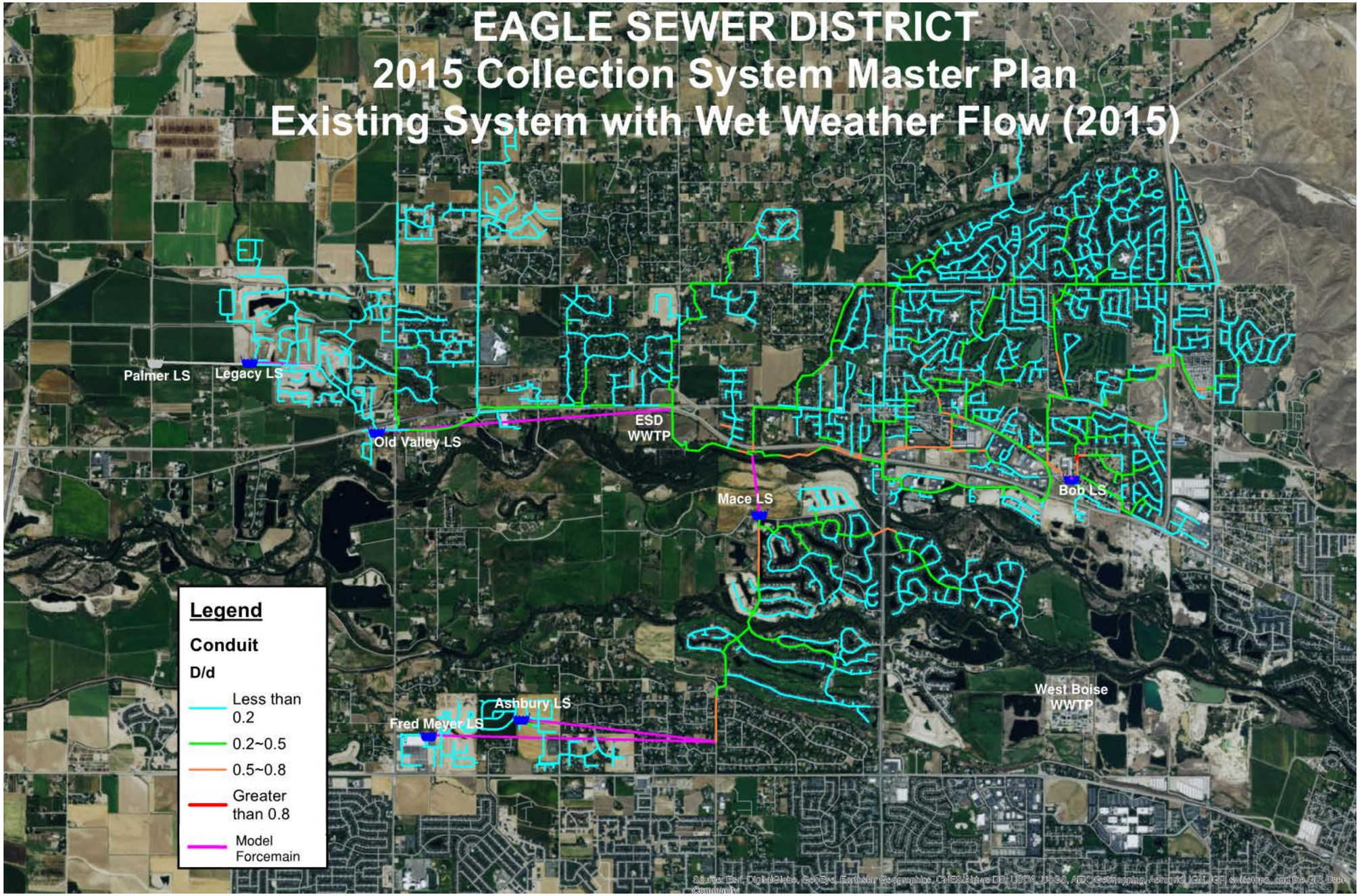


Figure 7-8. Existing System Wet Weather Flow - Pipeline Criteria Deficiencies.

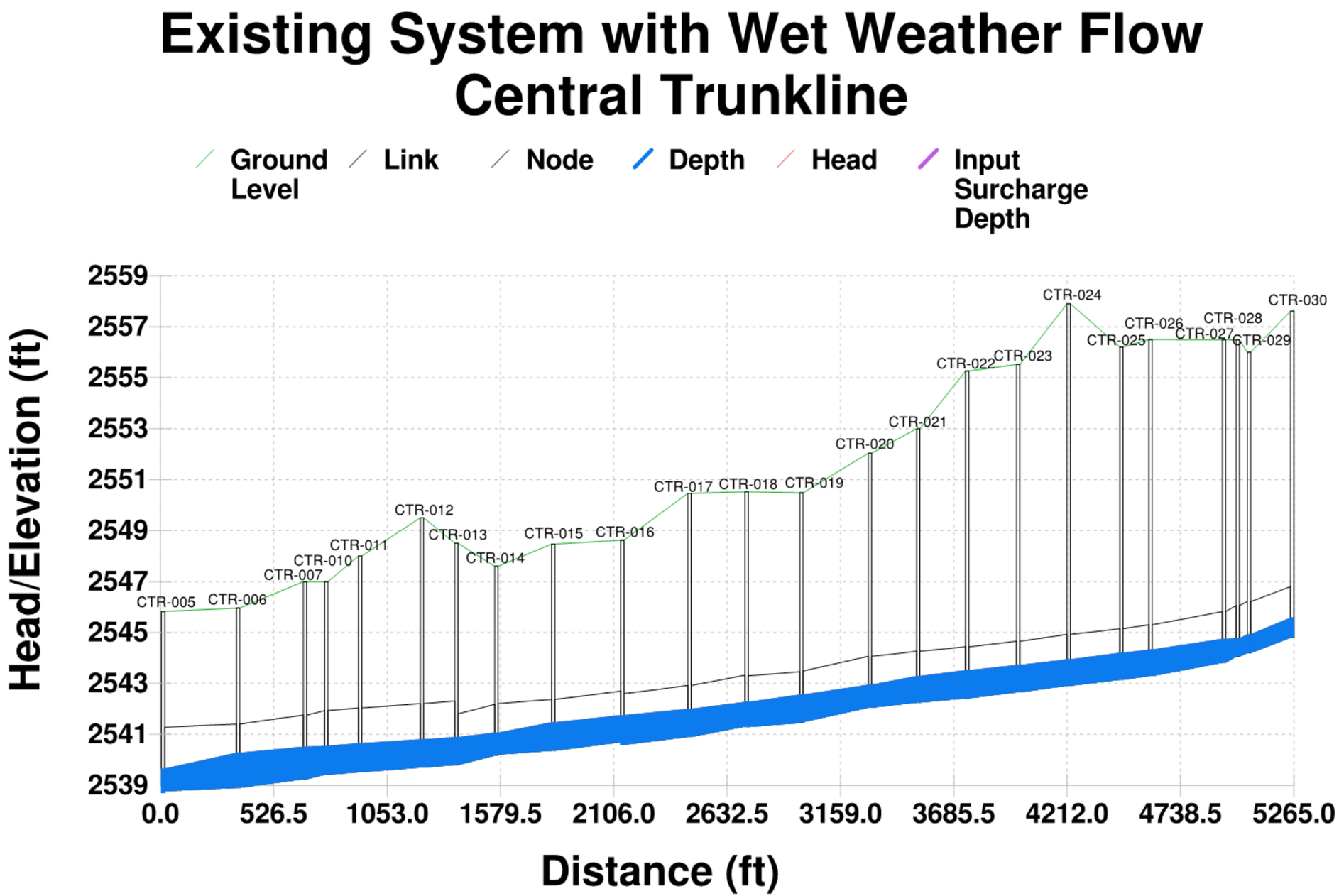


Figure 7-9. Central Trunkline (CTR) with Maximum WSE (Profile view)

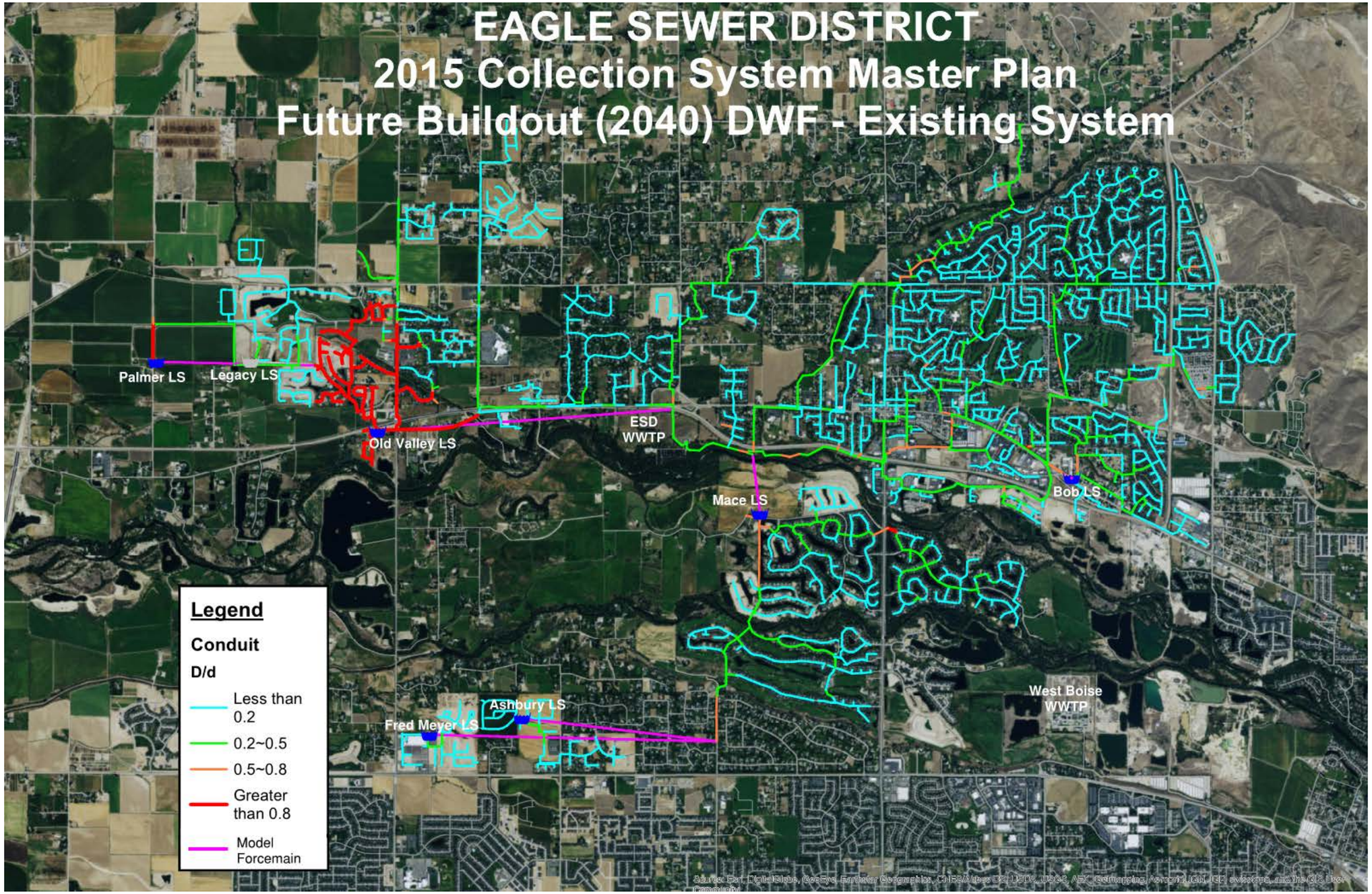


Figure 7-10. Future Buildout Scenario with Existing Facilities - Pipeline Criteria Deficiencies.

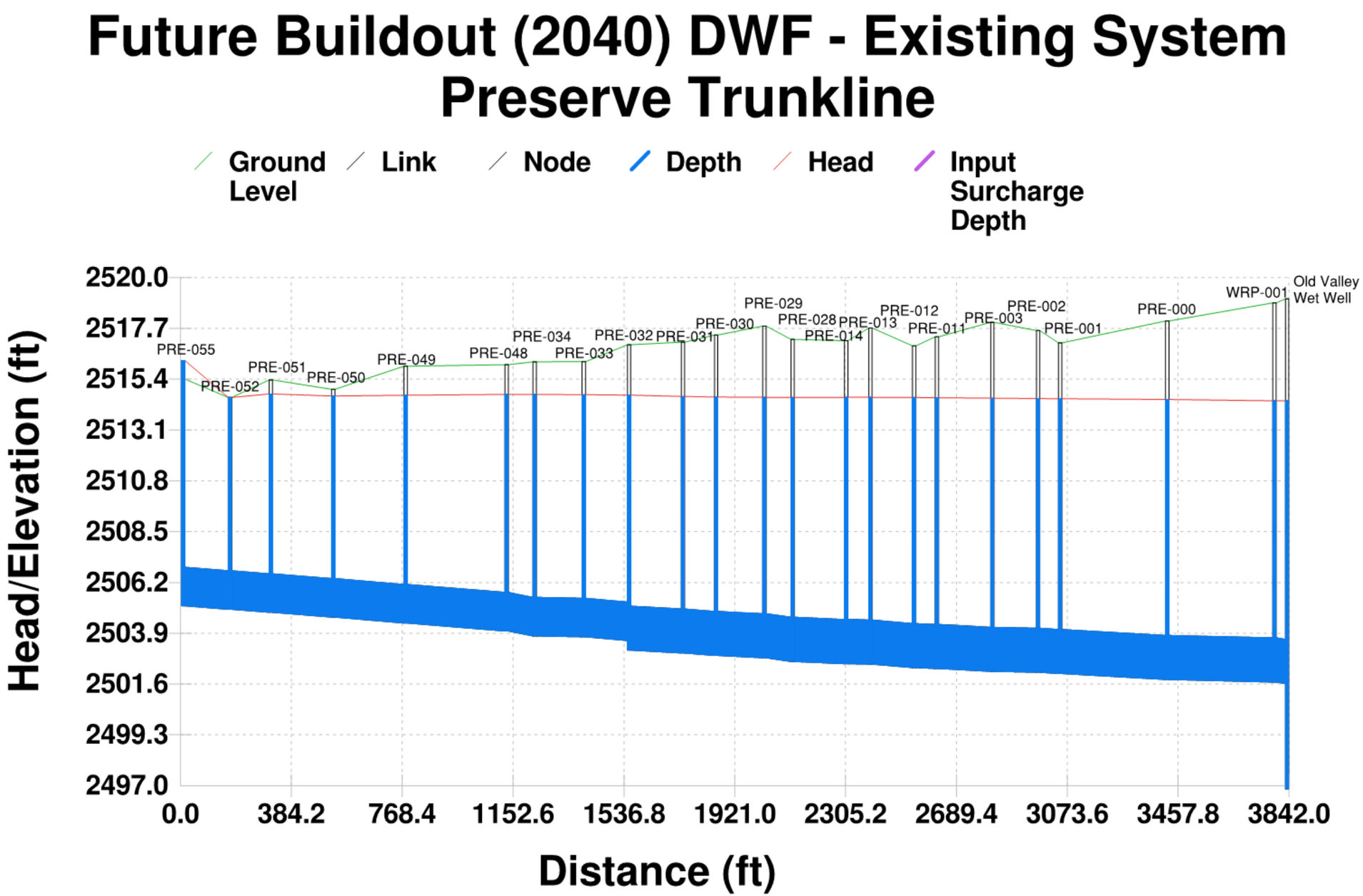


Figure 7-11. Preserve Trunkline (PRE) with Maximum WSE (Profile view)

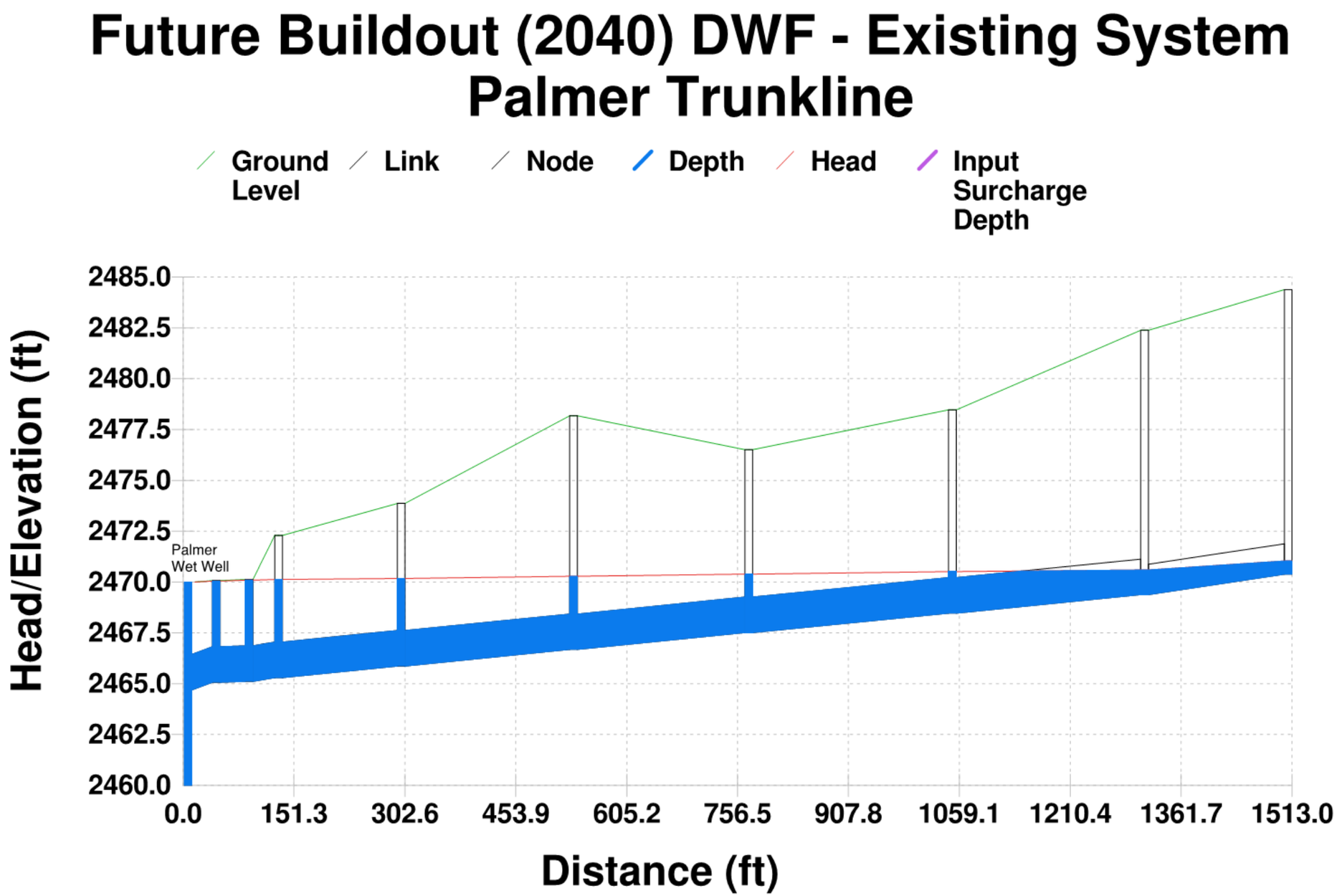


Figure 7-12. Palmer LS Trunkline with Maximum WSE (Profile view)

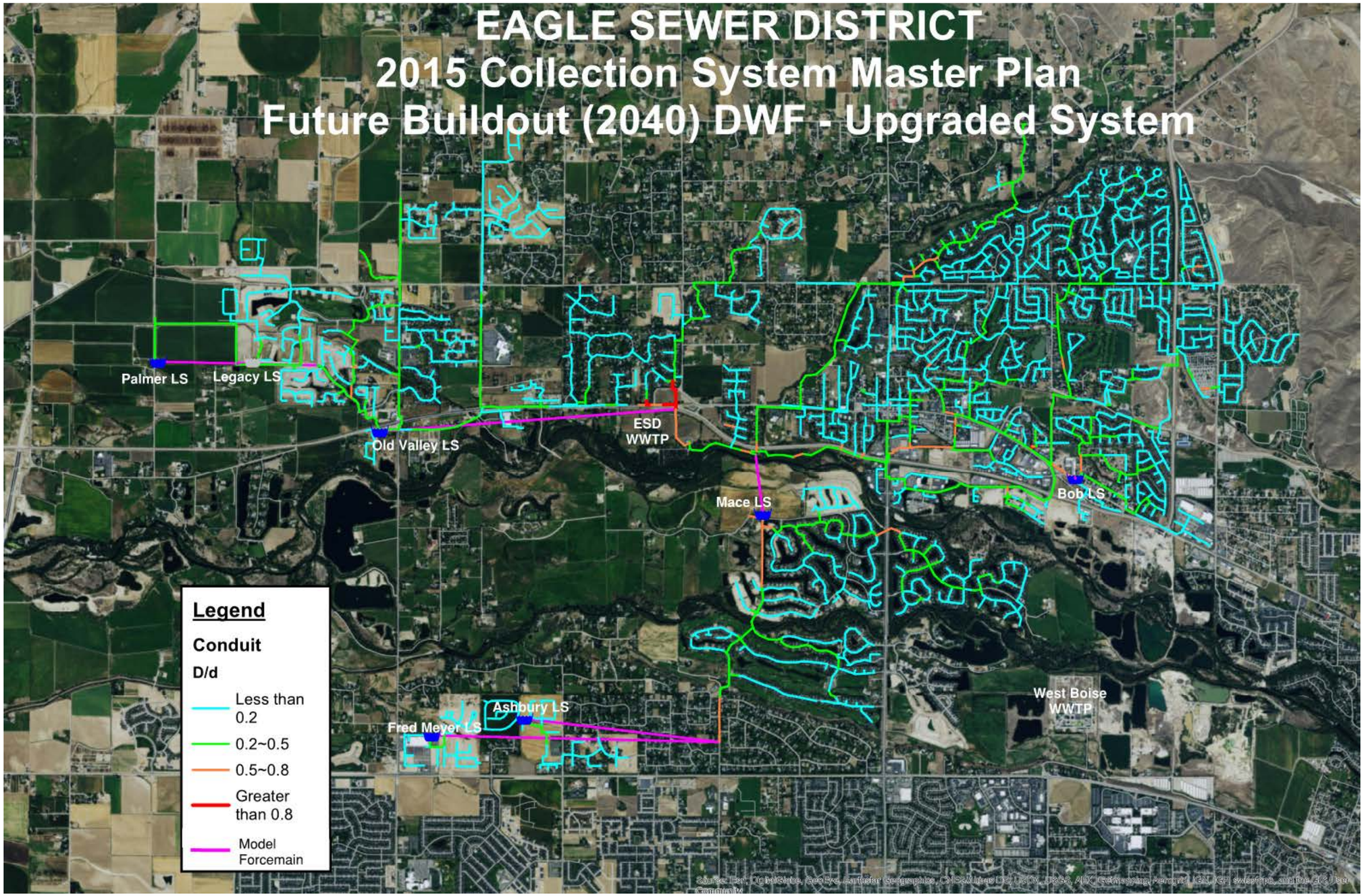


Figure 7-13. Future Buildout Scenario with Upgrades to Existing Facilities - Pipeline Criteria Deficiencies.

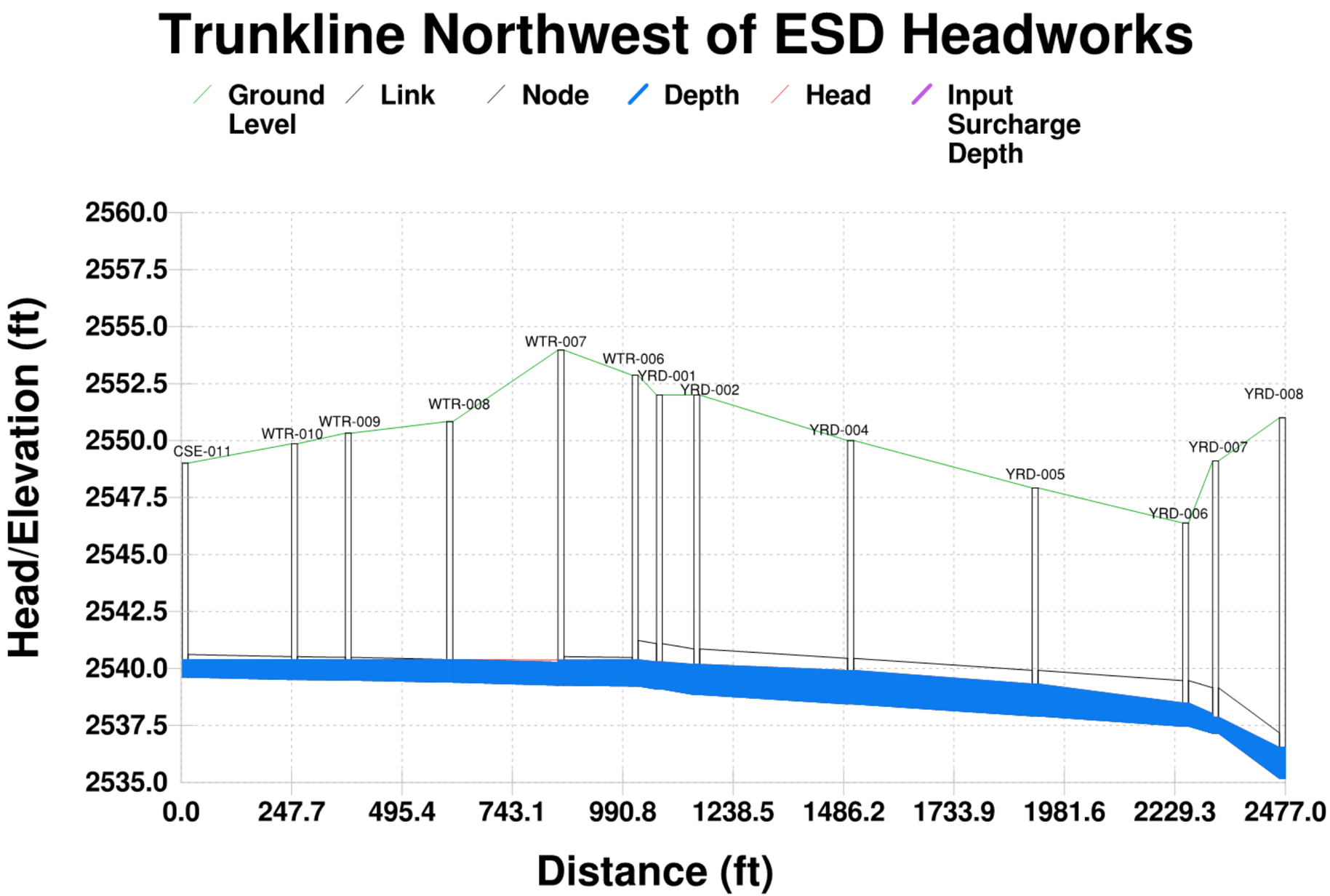


Figure 7-14. Future Buildout Scenario with Upgrades to Existing Facilities – Main Trunkline Northwest of ESD Headworks

7.5 Capital Improvement Program

Table 7-13 documents recommended improvements and estimated cost, 2015 dollars, as the conclusion of this study.

Table 7-13. Recommended Improvements and Estimated Costs

Improvement	Description	Cost (2015 Dollars)	
		Construction Costs	Total Costs
Palmer Lift Station - New Pumps	Two (s) new 60 HP, 720 gpm pumps to be installed in Palmer LS	$644,000	$792,000
The Preserve (PRE) Trunkline Upgrades	Replacement Sewer Pipes—1,600 feet of 21-inch trunk line (PRE-034 to PRE-055) upgraded to 36-inch diameter downstream of Palmer LS and upstream of Old Valley LS Replacement Sewer Pipes—1,800 feet of 24-inch trunk line (Old Valley Wet Well to PRE-034) upgraded to 36-inch diameter downstream of Palmer LS and upstream of Old Valley LS	$1,597,000	$1,964,000
Old Valley LS Pump Upgrades	Four new pumps capable of discharging 2,000 gpm each at Old Valley LS—two duty pumps for sanitary flow, one pump for wet weather, and one standby	$2,298,000	$2,827,000
	Total Cost	**$4,539,000**	**$5,583,000**

7.6 Summary

A hydraulic model of the Eagle Sewer District collection system was developed to assess the hydraulic performance of the system—under existing and future buildout scenarios. The model was calibrated to flow monitoring data collected between April 8 and April 21, 2015, and updated based on GIS and as-built information. Drawdown tests at the lift stations were performed to increase the accuracy of the model. Calibration of the model was performed by comparing the model predicted flow at each of the flow monitoring points to the flow that was measured in the field. The comparison of the model data to the field data showed good correlation, and the model was deemed to have a strong calibration and could confidently be applied to evaluate the collection system for a range of buildout flow conditions.

Based on the results of the model, the system as it exists in July 2015 has no hydraulic deficiencies (based on each pipe being less than a depth to pipe diameter ratio of 0.8). In addition, reviews of flow at the treatment plant and interviews with ESD staff conclude that no areas of surcharged conditions exist in the system during elevated periods of flow increase. Inflow and infiltration have no significant impacts to the system due to the continued maintenance and operation of the system by ESD. The inspections techniques (e.g., closed circuit TV inspection) and cleaning programs are proving effective. The modeled flow into the plant under 2015 conditions was1.8 mgd.

The existing 2015 system was also evaluated under a wet weather storm event by increasing all flows in the system by a factor of 1.4 to match a maximum historical peak of 2.5 mgd at the plant. No hydraulic deficiencies were noted in the system.

To assess the hydraulic performance of the system for 25-year planning horizon (2040), flows were increased based on information related to population growth, future land use, and the location of growth in the Eagle Sewer District area. Restrictions in the capacity of the system in the vicinities of Old Valley LS and Palmer LS require upgrades at the lift stations and receiving pipes downstream of the Palmer lift station forcemain. These are summarized as follows:

- Four new pumps capable of discharging 2,000 gpm each at Old Valley LS—two duty pumps for sanitary flow, one pump for wet weather, and one standby,
- Two new 60 HP, 720 gpm pumps to be installed in Palmer LS,
- 1,600 LF of 21-inch trunk line (PRE-034 to PRE-055) upgraded to 36-inch diameter downstream of Palmer LS and upstream of Old Valley LS, and
- 1,800 LF of 24-inch trunk line (Old Valley Wet Well to PRE-034) upgraded to 36-inch diameter downstream of Palmer LS and upstream of Old Valley LS.

If fully implemented, the peak into the plant under dry weather conditions is estimated to be 5.2 mgd—an increase of 3.4 mgd (185%) over 2015 conditions.

The projected cost for all improvements is $5.6M in 2015 dollars.

SECTION 8

Capital Improvement Plan and Rate Impact Study

8.1 Introduction

This section summarizes the effect of the Wastewater Management Alternative 3 and recommend collection system improvements on ESD wastewater service rates. A financial planning model, with a 10-year projection period, was developed to evaluate revenue increase required to incorporate the chosen alternative. The near-term results (5-year projection) are included in this section. The 10-year projections of cash flow are attached in Appendix J.

8.2 Assumptions

Cash flow projections were developed for ESD's general operating and capital funds. The following assumptions were made while preparing the financial planning model:

8.2.1 Expense Assumptions

- ESD's budgeted 2015 O&M expenses were used as the baseline for the O&M expense projection. An annual rate of inflation of 3 percent was used to escalate these expenses, which is consistent with the inflation assumption used in development of the costs for each Wastewater Management Alternative.
- A 10-year projection period was used for the financial plan starting in 2016. This captures the additional O&M expenses of implementing the capital improvements for Wastewater Management Alternative 3 and the recommended improvements for the collection system.

8.2.2 Revenue Assumptions

- The expected ERU growth projection, as listed in Table 3-1 in Section 3 Future Conditions, was used to determine the number of new connections to the system, and the resulting growth in system operating revenues. The number ERU's added to the system each year were estimated using a straight-line projection between the five-year intervals presented in Table 3-1. It was assumed that each new ERU is equivalent to one new connection.
- The annual service revenue was projected using the 2015 budget of $3.2 million as a basis, and then increased by the revenue expected from new customers added to the system.
- The annual connection fee revenue is projected based on the number of ERUs added to the system multiplied by the connection fee. It was assumed the connection fee remains at the current connection fee of $4,695/ERU through the projection period.
- Other sources of revenue, such as annexation plan Revenue, other operating revenue, and Property Tax revenue were assumed to continue at the 2015 budgeted level through the projection period. These sources are of revenue amount to $96,000 per year.

8.2.3 Debt Service Assumptions

- There is an existing debt service obligation for ESD. Since this payment is made using a separate fund (Bond Bank Fund), an annual transfer out of the operating fund of $500,000 to the Bond Bank is assumed through payoff in 2028.

8.2.4 Cash Balance/Reserves Assumptions

- The 2015 ending balance for the operating fund was assumed to be $3,276,917, which is the amount in the Invest/General Fund as of the September 30, 2015 financial documents provided by ESD on October 30, 2015. This is assumed to be the beginning balance for the operating fund cash reserve in this analysis.
- The 2015 ending balance for the capital fund was assumed to be $9,187,176, which is the sum of the amounts in the Invest/Diversified Bond and Invest/WWTP&Collection Deprec in the General Fund, and the sum of the assets in the Capital Replacement Fund. Funds as of the September 30, 2015 financial documents provided by ESD on October 30, 2015. This is assumed to be the beginning balance for the capital fund cash reserve in this analysis.
- Reference is made to total ESD cash reserves throughout this section. This is simply the sum of the operating fund cash reserve and the capital fund cash reserve.

8.3 Current System Financial Condition

Currently, ESD generates approximately $3.1 million in operating revenue per year versus system O&M expenses of approximately $2.3 million. Revenue is generated from monthly service charges to residential and non-residential customers. Connection fees are also charged for new connections to the sewer system to fund future capital investments to serve new customers.

8.4 Revenue Forecast

The revenue forecast due to estimated growth in the system is presented in Table 8-1.

Table 8-1. Projected System Revenue due to Growth

Description	Budget	Projected				
	2015	2016	2017	2018	2019	2020
Projected System Growth (ERUs)		280	280	280	280	280
Total Service Fee Revenue	$3,345,600	$3,459,840	$3,574,080	$3,688,320	$3,802,560	$3,916,800
Connection Fee Revenue	$1,105,200	$1,314,600	$1,314,600	$1,314,600	$1,314,600	$1,314,600

At the current residential service fee of $34 per month, service fee revenue is projected to increase from $3.4 million as budgeted in 2015 to $3.9 million by 2020 due to the anticipated growth in number of ERUs. The connection fees estimated to generate approximately $1.3 million annually in revenue through 2020.

8.5 Facilities Plan Alternative 3 O&M Expense Forecast

The inflated O&M expenses and capital costs associated with the recommended improvements for Alternative 3 and for the collection system were uploaded into the financial model. Two line items from ESD's O&M budget, Boise O&M/Annual Rental and Plant Power, were adjusted to reflect the influence

of Alternative 3 on the system O&M expenses projection. The five-year expense projection is provided in Table 8-2.

Table 8-2. 5-year O&M Expenses Projection (Inflated)

Description	Budget	Projected				
	2015	2016	2017	2018	2019	2020
Plant Expenses – Baseline	$686,000	$707,000	$728,000	$750,000	$772,000	$795,000
Plant Expenses - Boise O&M/Annual Rental*	850,000	974,000	1,014,000	1,088,000	1,168,000	1,254,000
Plant Expenses - Plant Power*	135,000	230,000	404,000	416,000	428,000	441,000
Administrative Expenses	631,000	650,000	669,000	689,000	710,000	731,000
Biosolids Removal*	-	1,030,000	-	-	-	-
Seepage Testing Existing Lagoons*	-	-	-	81,000	-	-
Seepage Testing New Lagoons*	-	-	-	-	72,000	-
Total Projected Expenses	**$2,302,000**	**$3,591,000**	**$2,815,000**	**$3,024,000**	**$3,150,000**	**$3,221,000**

*Indicates O&M expenses projected for Alternative 3

Over the next five years, O&M expenses will average approximately $3.0 million per year. Biosolids removal and seepage testing of the existing and new lagoons are not annual expenses, but are maintenance items are expected to occur on five- and ten-year intervals, respectively.

8.6 Wastewater Management Alternative 3 and Collection System Capital Cost Forecast

The five-year capital improvements projection for Alternative 3 and for the collection system are listed in Table 8-3.

Table 8-3. 5-Year CIP (Inflated)

Description	Budget	Projected				
	2015	2016	2017	2018	2019	2020
2015 CIP	$4,860,000					
Wastewater Management Alternative 3						
Boise Connection Fee	-	298,000	320,000	345,000	370,000	398,000
Mixer Addition	-	773,000	-	-	-	-
Hydraulic upgrades	-	-	905,000	-	-	-
New lagoon	-	-	-	-	7,695,000	-
New effluent pump station	-	-	-	-	394,000	-
Collection System						
Old Valley LS Pump Upgrades	-	-	-	-	-	3,277,000
Total Projected CIP	**$4,860,000**	**$1,071,000**	**$1,225,000**	**$345,000**	**$8,459,000**	**$3,675,000**

The capital cost associated with Alternative 3 is $8.5 million in 2019, which is relatively large in comparison to the capital expenditures ESD experienced in 2013 ($1.2M million) and in 2014 ($2.2 million), and budgeted for in 2015 ($4.8 million). Two scenarios were developed to analyze the potential rate impacts of implementing these recommended capital improvements, as discussed in the following section.

8.7 Financial Scenarios

Two scenarios were evaluated to determine the impact of Alternative 3 and the collection system improvements on ESD's operating and capital funds. The scenarios are as follows:

- Scenario 1: No Rate Increase, Discontinue Depreciation Funding – This scenario does not require a rate increase; however, depreciation funding is discontinued during the 10-year projection period.
- Scenario 2: Rate Increase, Continue Depreciation Funding – This scenario incorporates a one-time rate increase to continue funding depreciation at historical levels.

Under both scenarios, it was assumed ESD would draw from operating reserves to fund biosolids removal, which occurs on a five-year interval and increases that year's O&M expense by approximately $1.0 million. Additionally, it was assumed ESD would draw down capital reserves to fund the capital improvements instead of issuing municipal bonds.

8.8 Financial Impacts

The five-year impact on the operating fund and capital reserve balances is demonstrated in Table 8-4 for Scenario 1: No Rate Increase, Discontinue Depreciation Funding.

Table 8-4. Scenario 1: No Rate Increase, Discontinue Depreciation Funding

Year	Revenue Increase Required	Implied Residential Service Fee	Operating Fund Reserve Balance	Capital Fund Reserve Balance
2015	0%	$34.00	$3,277,000	$9,187,000
2016	0%	$34.00	$2,743,000	$9,431,000
2017	0%	$34.00	$3,100,000	$9,521,000
2018	0%	$34.00	$3,361,000	$10,491,000
2019	0%	$34.00	$3,611,000	$3,346,000
2020	0%	$34.00	$3,905,000	$985,000

Under this scenario, there is an average annual surplus in the operating fund of $250,000, not including years when biosolids removal is scheduled. As demonstrated in the table above, the operating fund reserve balance is maintained around $3.0 million through the 5-year planning period. The low point in the operating reserve occurs in 2016, which is a year biosolids removal is scheduled. The 10-year projection of operating fund cash flow is shown in Table 1 of Appendix J.

The capital fund reserve balance is projected to grow between 2016 and 2018 to a high of $10.5 million in 2018. Since depreciation is not funded under this scenario, projected collection fee revenue is the only source of revenue in the capital fund. Large capital expenditures scheduled in 2019 and 2020 ($8.5 million and $3.7 million, respectively) cause the capital fund reserve balance to drop to a low of just under $1.0 million in 2020. Beyond 2020, the capital fund reserve balance increases through the end of the 10-year projection period to reach a balance of $5.7 million. The 10-year projection of capital fund cash flow is shown in Table 2 of Appendix J.

In order for ESD to continue funding depreciation, a revenue increase is required. Scenario 2 Rate Increase, Continue Depreciation Funding was developed to determine the revenue increase required to maintain depreciation funding at a level consistent with previous years. The implied impact on the residential rate and the impact on cash reserves is demonstrated in Table 8-5.

Table 8-5. Scenario 2: Rate Increase, Continue Depreciation Funding

Year	Revenue Increase Required	Implied Residential Service Fee	Operating Fund Reserve Balance	Capital Fund Reserve Balance
2015	0%	$34.00	$3,277,000	$9,187,000
2016	0%	$34.00	$2,743,000	$9,431,000
2017	25%	$42.50	$2,742,000	$10,771,000
2018	0%	$42.50	$2,674,000	$12,991,000
2019	0%	$42.50	$2,624,000	$7,096,000
2020	0%	$42.50	$2,645,000	$5,985,000

With a rate increase of 25 percent in 2017, approximately $1.25 million is available to fund depreciation annually (excluding years in which biosolids removal is scheduled). The operating fund reserve balance is, on average, $2.7 million through the 10-year projection period. The 10-year projection of operating fund cash flow for Scenario 2 is shown in Table 3 of Appendix J.

Revenue increase required does not necessarily equate to a rate increase. ESD may choose to adjust the residential and commercial service fees and/or connection fees to offset the recommended revenue increase required. The revenue increase required was applied to the residential service fee to calculate an implied residential service fee of $42.50 per month to demonstrate the potential rate impact for residential customers.

The forecasted depreciation funding boosts the capital fund reserve balance to $13.0 M in 2018. The capital fund reserves are then drawn down in 2019 and 2020 to fund the recommended capital improvements. Capital fund cash reserves then hit a low point in 2020 of $6.0 million. The 10-year projection of capital fund cash flow for Scenario 2 is shown in Table 4 of Appendix J.

8.9 Depreciation Funding

ESD's current practice for funding depreciation is to transfer excess funds from the operating fund to the capital fund at the end of the year. In the last three years, depreciation funding had increased from a low of no depreciation funding in 2013 to a budgeted $1.2 million in depreciation funding for 2015. Internal policies regarding depreciation will drive the timing and the magnitude of potential future rate increase(s). Higher rate increases generate more funds available for depreciation funding. As demonstrated by analysis of a 25 percent rate increase in 2017, ESD has potential to fund deprecation on the order of $1.25 million per year (except for years where biosolids removal is scheduled), which is slightly greater than budgeted depreciation funding for 2015.

8.10 Connection Fees

The total connection fee (currently $4,695) is assumed to remain at this level for the analysis. However, this is another source revenue that can be further evaluated as new infrastructure is added to the system.

8.11 Conclusions and Recommendations

CH2M HILL developed a financial model to determine the effects of the Wastewater Management Alternative 3 and the recommended collection system improvements on the future cash flow of ESD. The analysis included a forecast of the impacts on cash reserves and depreciation funding given increased O&M expenses and planned capital costs over a 10-year planning period under two scenarios. Under Scenario 1: No Rate Increase, Discontinue Depreciation Funding, total cash reserves fall to a low point of $4.9 million in 2020, after which the reserve balance begins to recover and reaches $8.0 million by 2025.

Under Scenario 2: Rate Increase, Continue Depreciation Funding, depreciation of $1.25 million per year is available following a 25 percent revenue increase in 2017. Total cash reserves recover from a low of $8.6 million in 2020, and are projected to reach a total of $17.2 million by 2025. The resulting revenue increase, equates to an implied residential service fee of 42.50 per month. Higher rate increases will generate more funds available for depreciation funding, so the magnitude of future rate increases is dependent on ESD's comfort level in drawing down cash reserves and/or halting depreciation funding until the major capital improvements are implemented over the next ten years.

SECTION 9

References

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McGraw Hill.

Metcalf and Eddy, Inc. 2003. *Wastewater Engineering: Treatment and Reuse. 4th ed*. New York:

MWH. 2008. *Wastewater Facility Plan Final Report*

Record Drawings Including:

J-U-B Engineers. 1982. *Eagle Sewer District Wastewater Treatment Facilities*

J-U-B Engineers. 1999. *Eagle Sewer District Wastewater Treatment Plant Modifications*

MWH. 2010. *Eagle Sewer District Wastewater Treatment Plant Improvements – Headworks Facility*

Bowen Collins & Associates. 2012. *Final Effluent Pump Replacement Project*

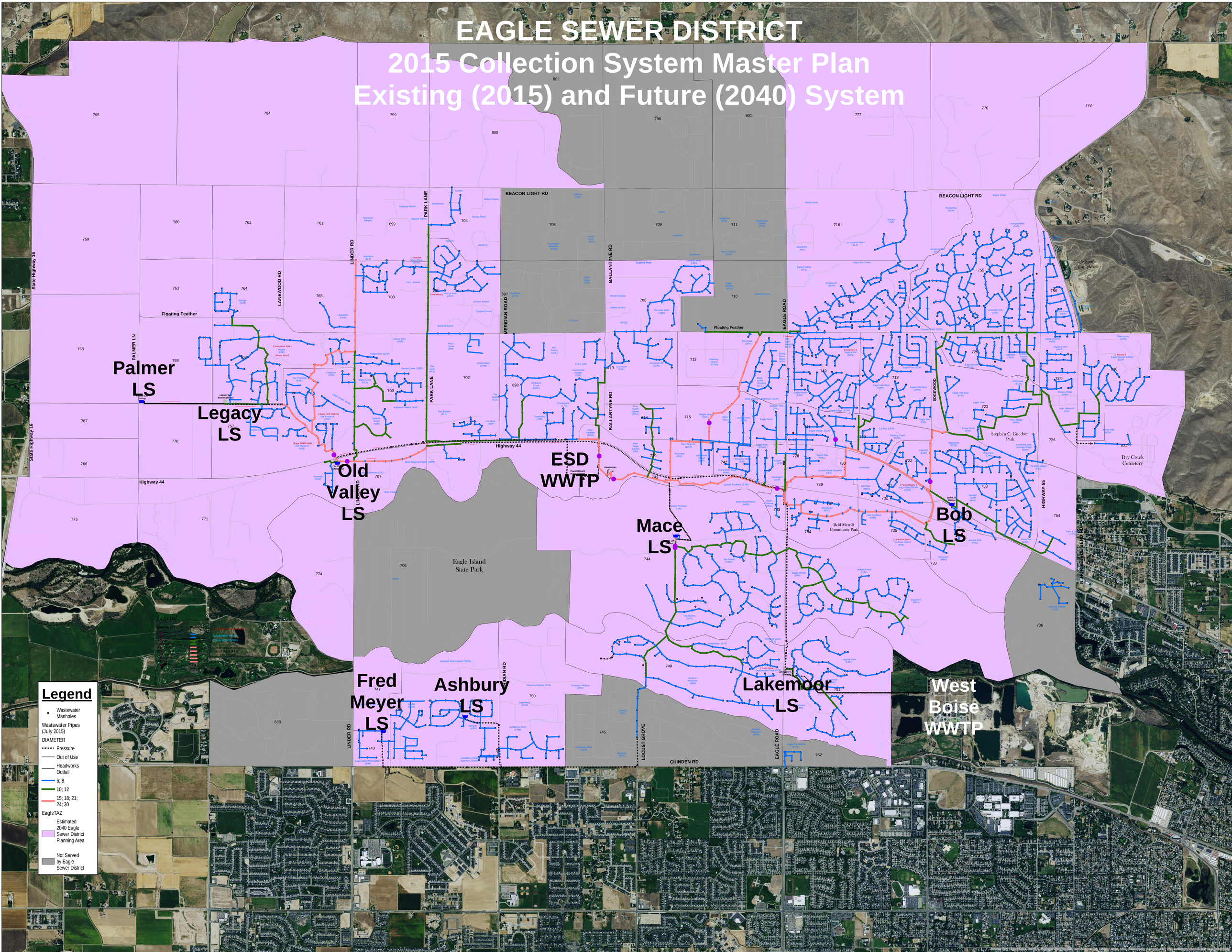
See additional references in the Appendix used for Process Modeling and Alternative Analysis

Appendix A
Existing System Map (Size ANSI E)

EAGLE SEWER DISTRICT

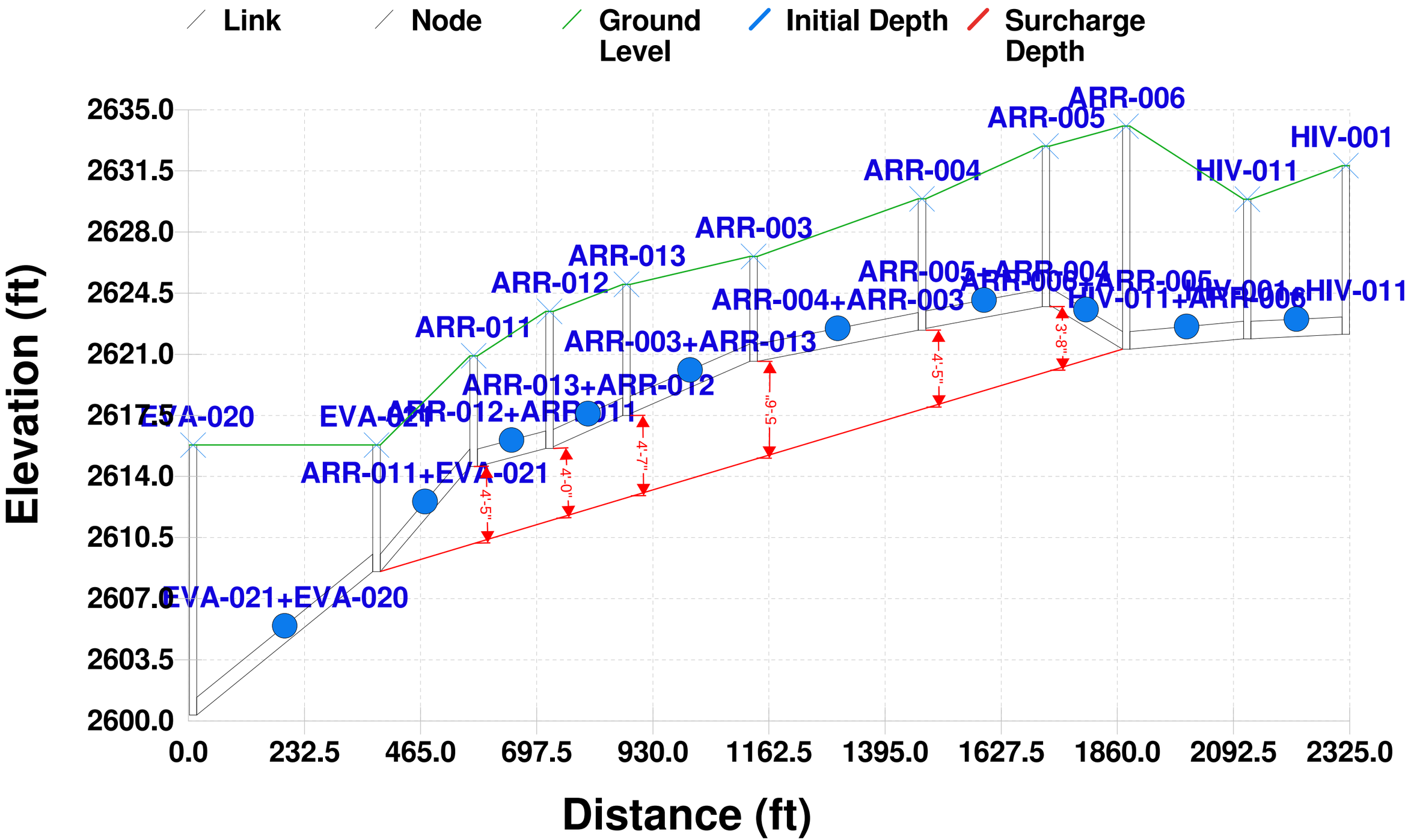
2015 Collection System Master Plan

Existing (2015) and Future (2040) System

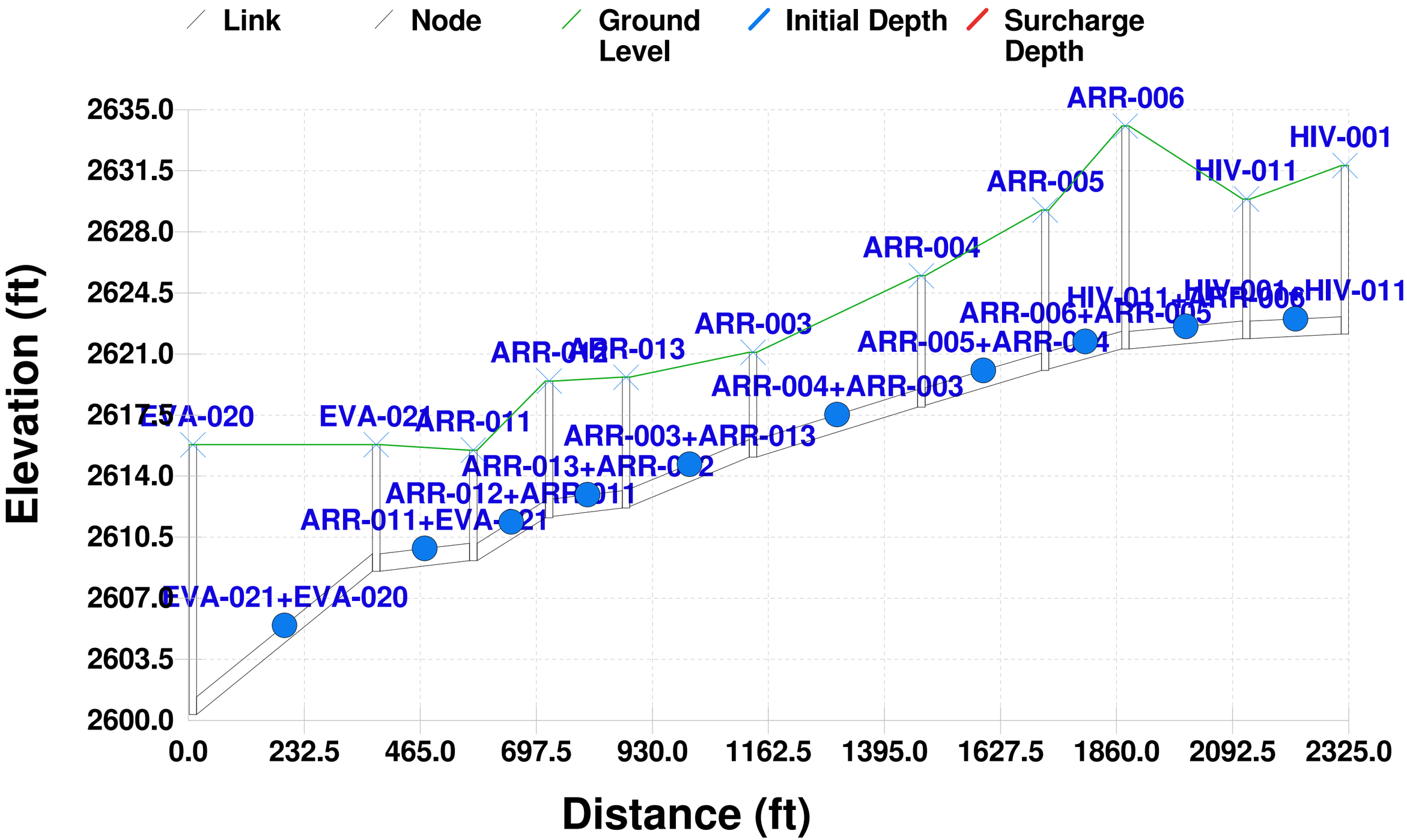


Appendix B
Profile Adjustments – Before and After

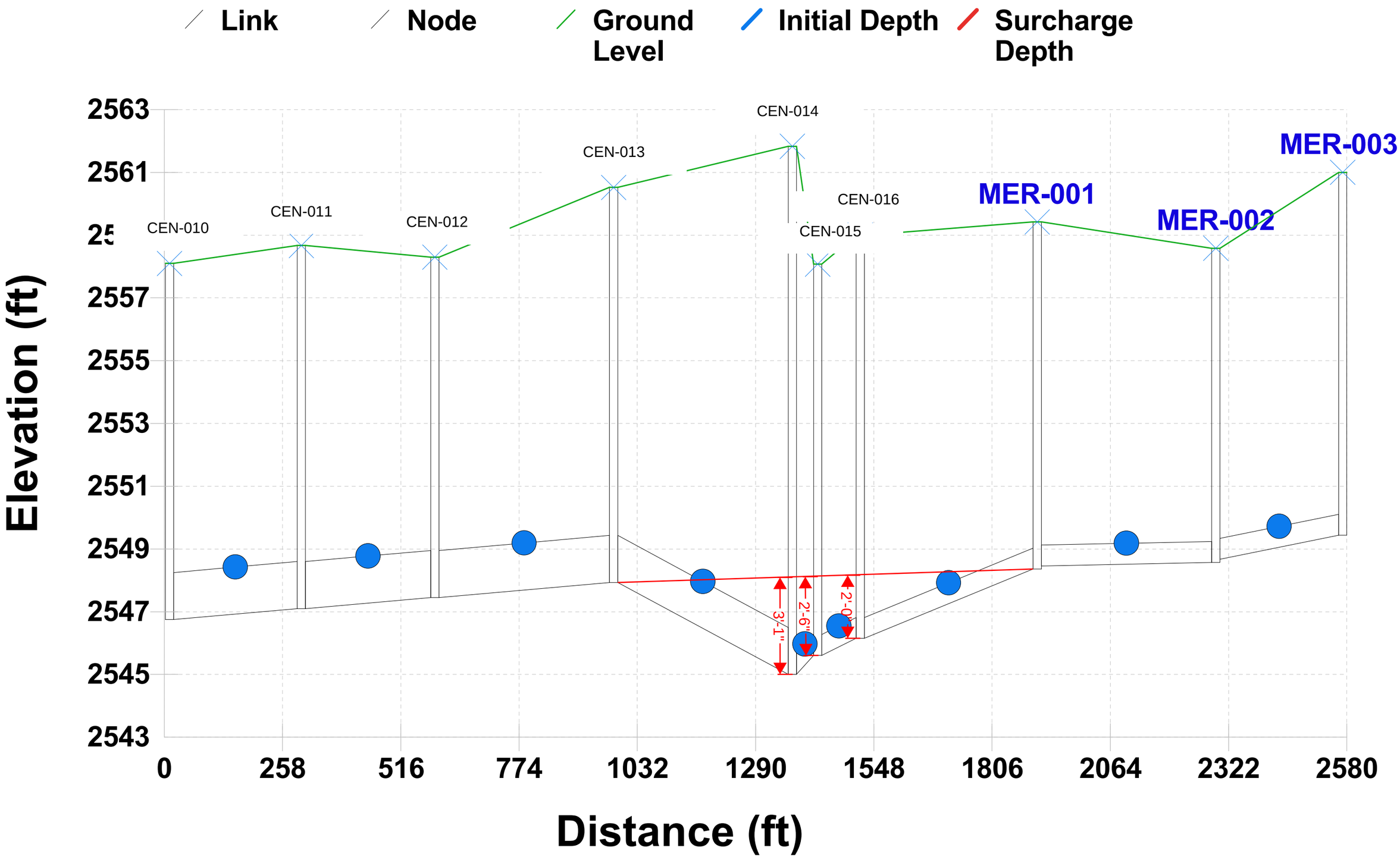
Arbor Ridge Profile - Before



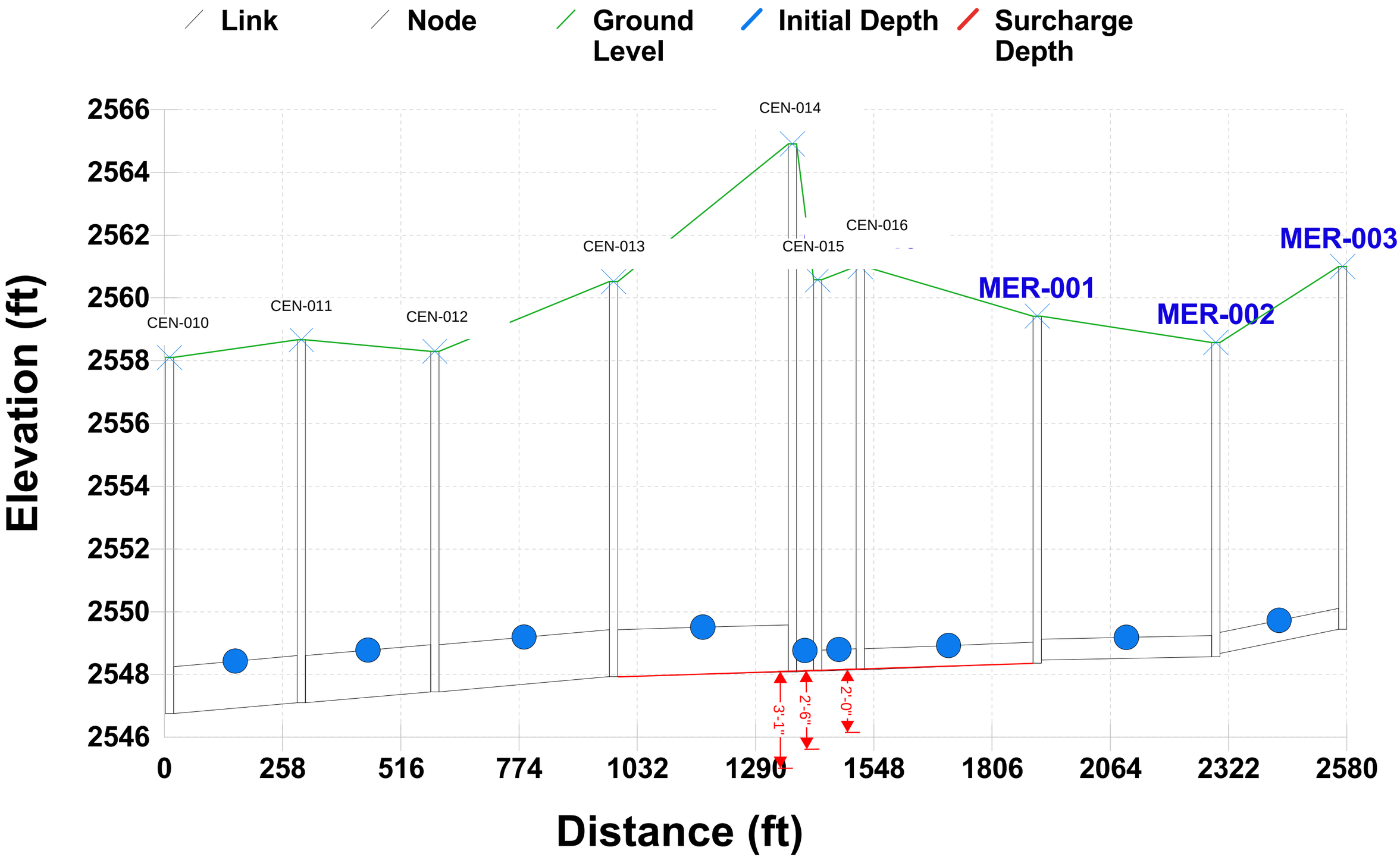
Arbor Ridge Profile - After



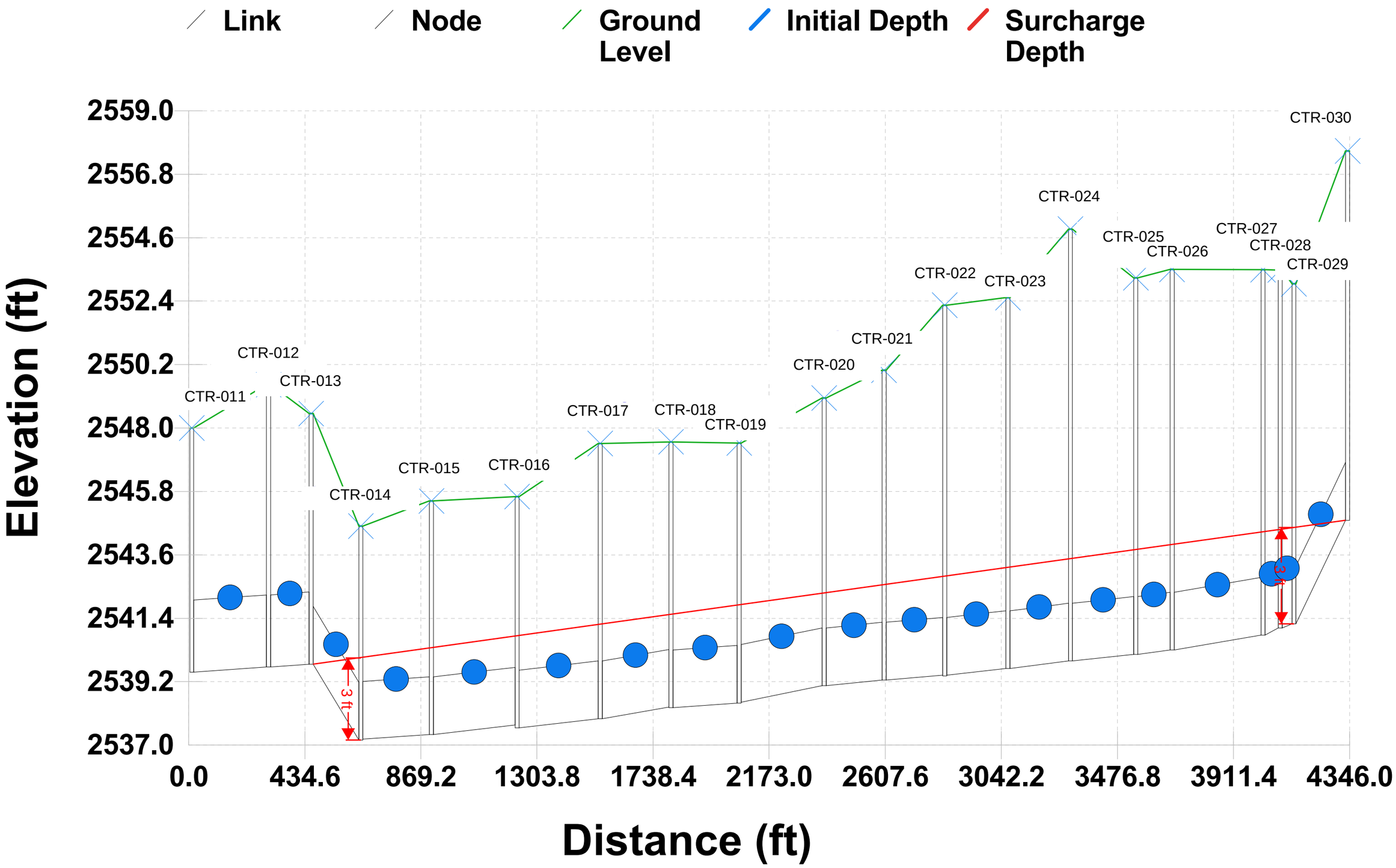
Central Eagle Trunk Profile - Before



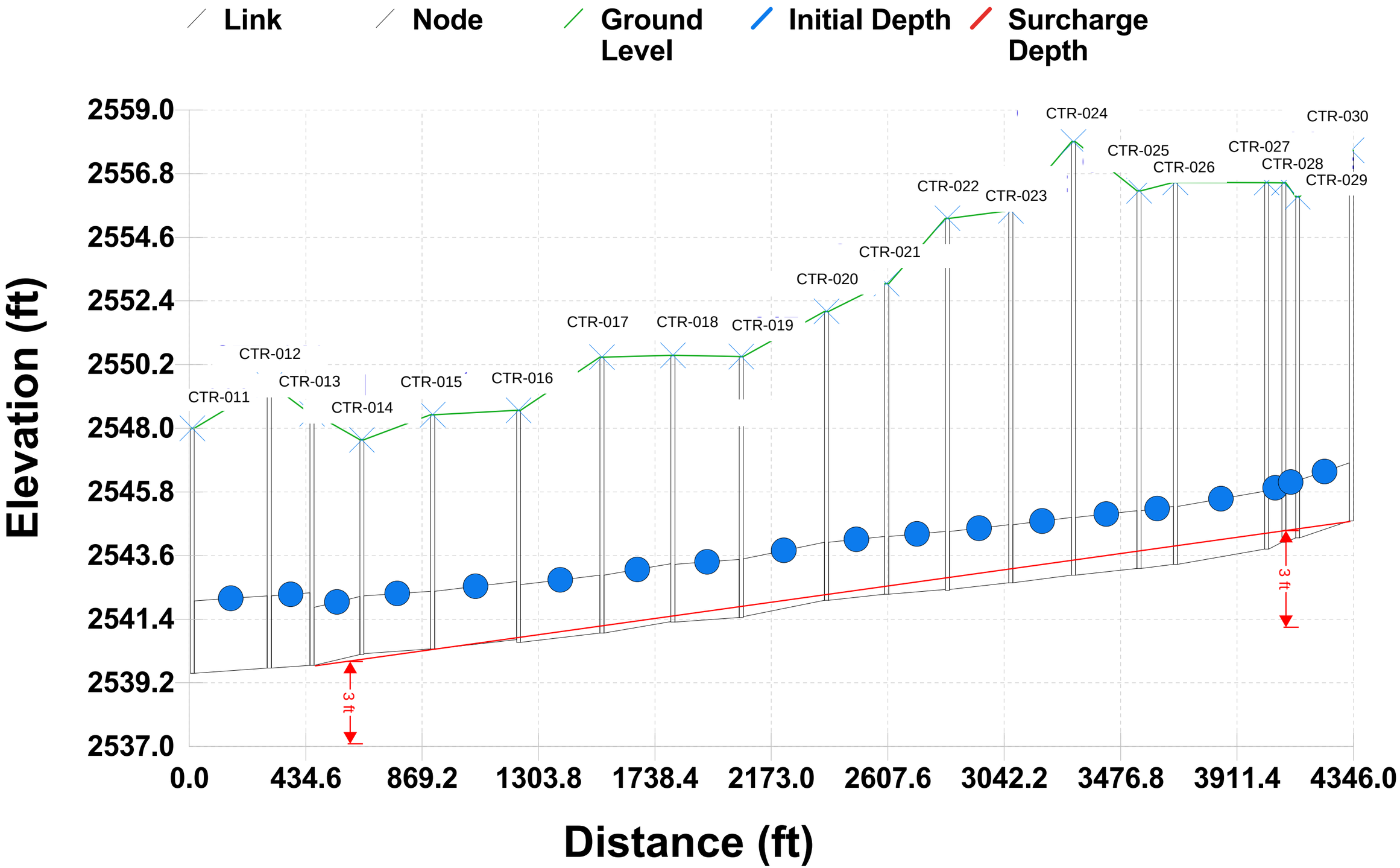
Central Eagle Trunk Profile - After



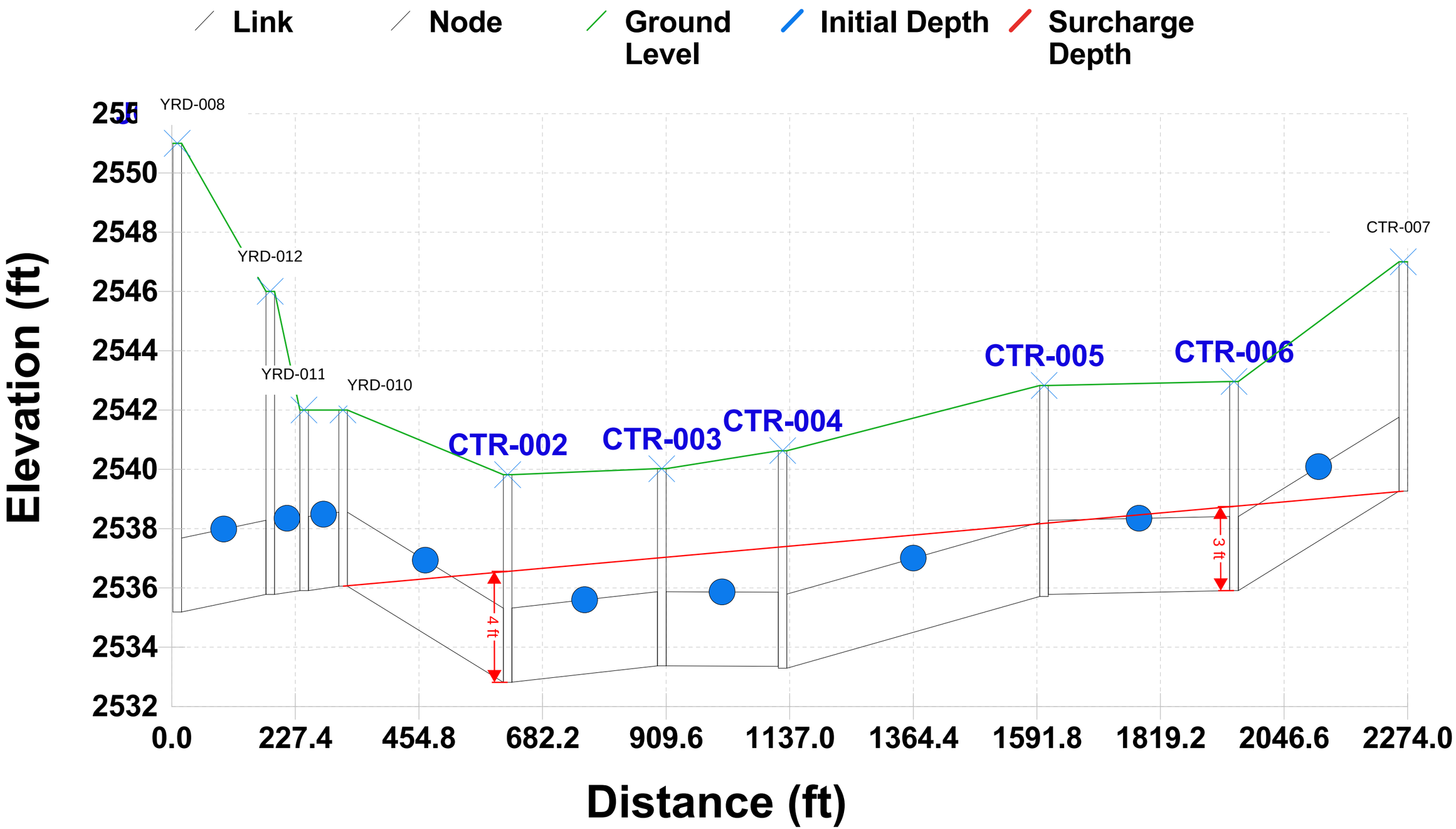
Central Trunk Line - Before



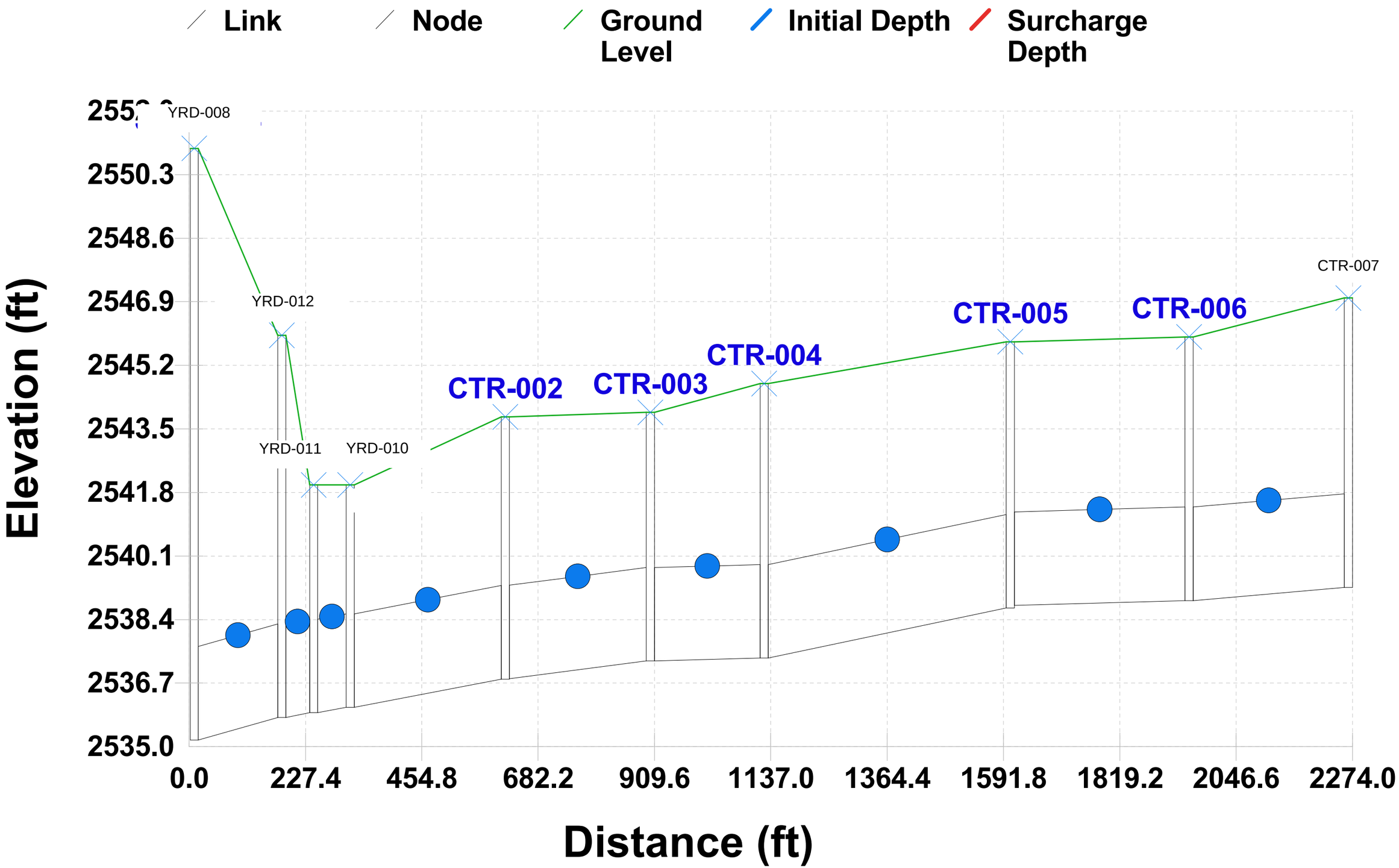
Central Trunk Line - After



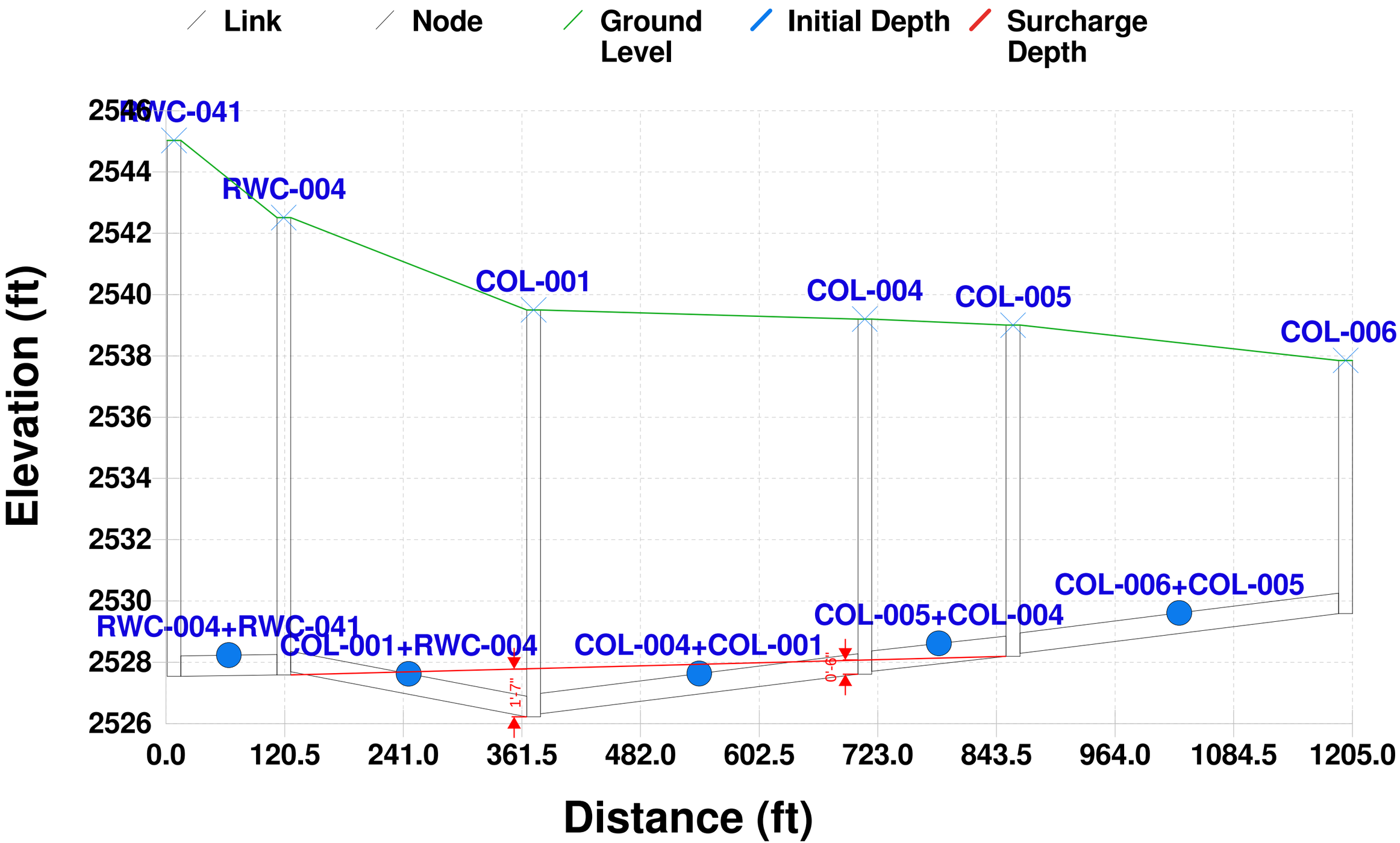
Central Trunk Line East of Headworks - Before



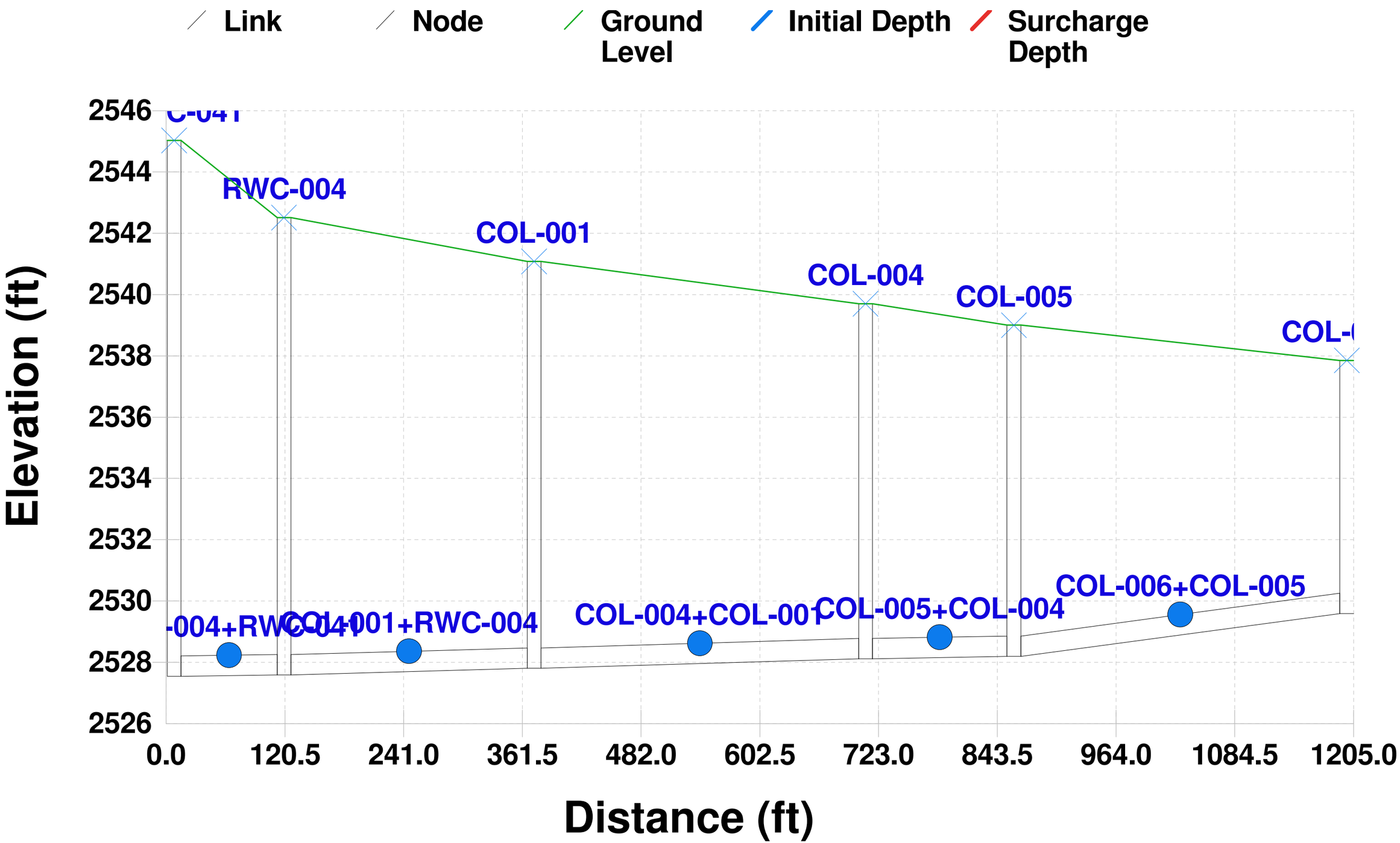
Central Trunk Line East of Headworks - After



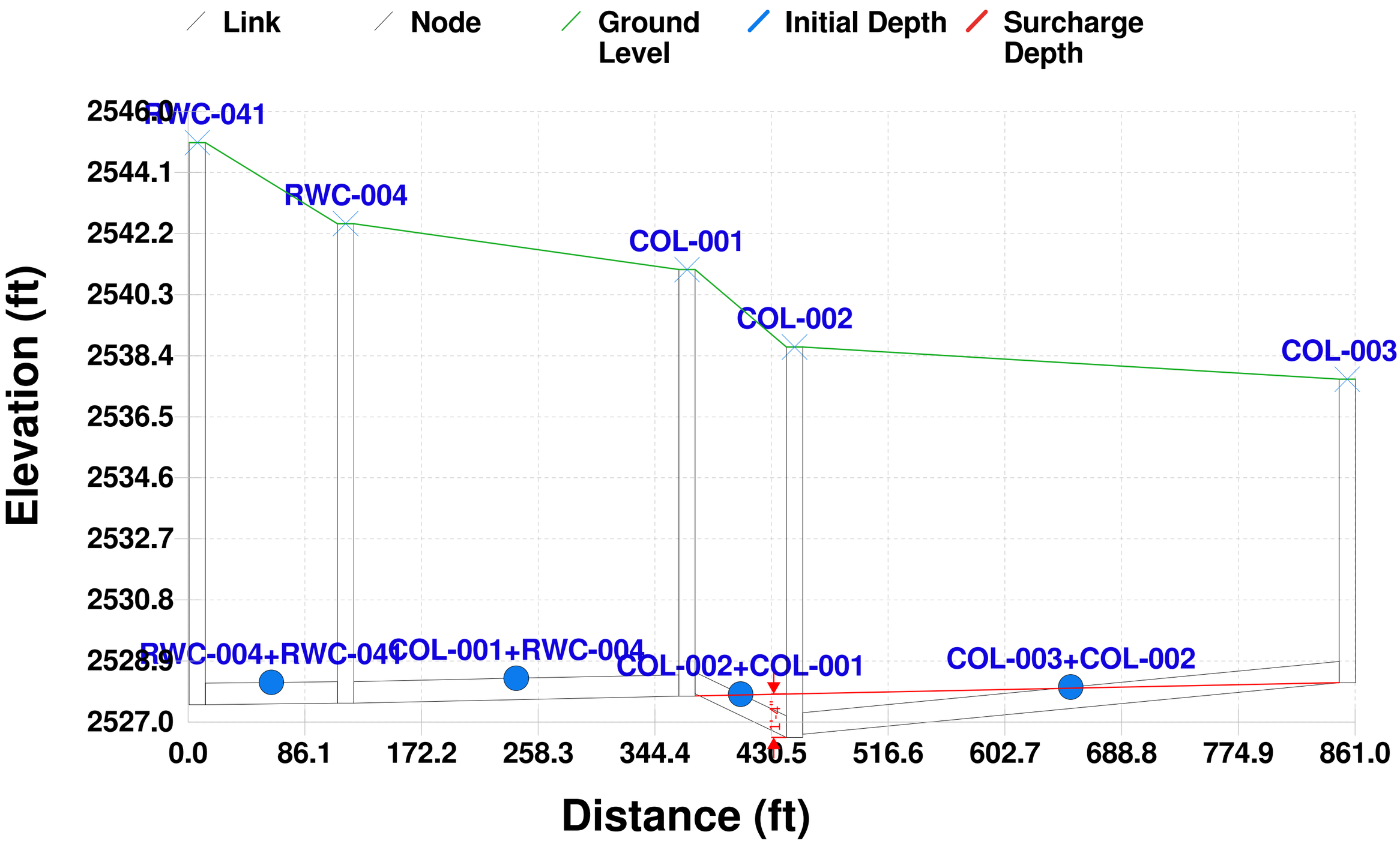
Cove Colony (COL) Profile - Before



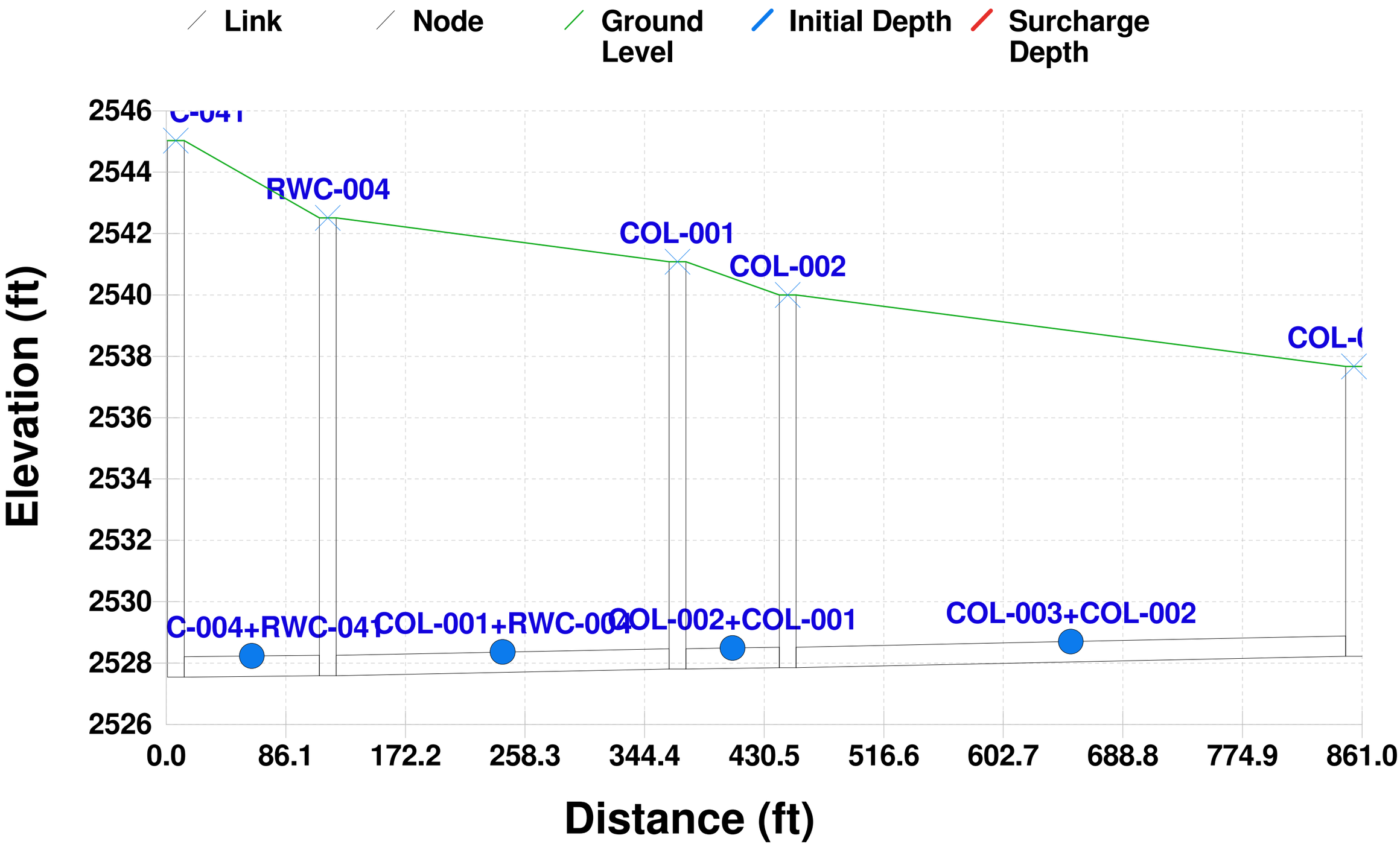
Cove Colony (COL) Profile - After



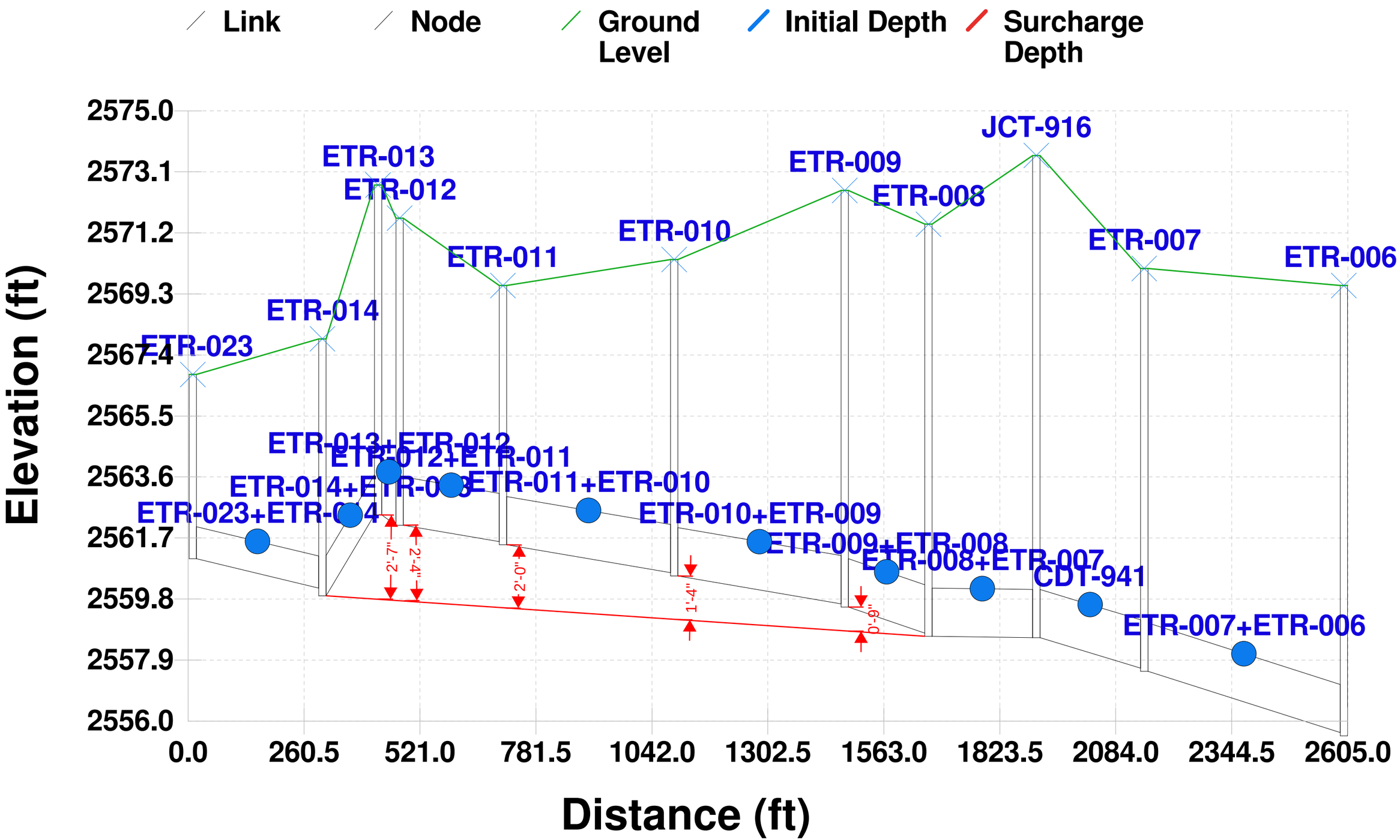
Cove Colony (COL) Profile - Before



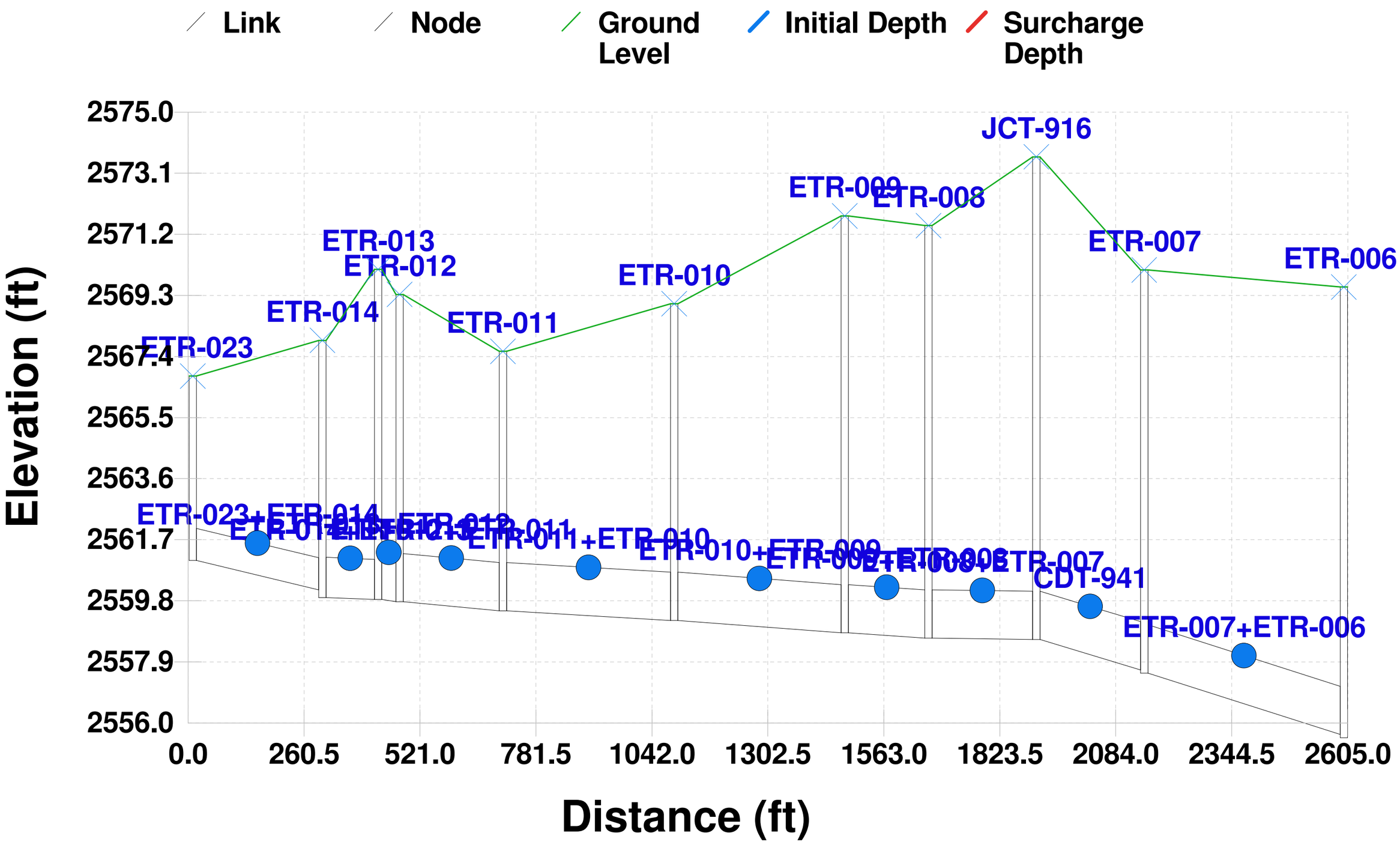
Cove Colony (COL) Profile - After



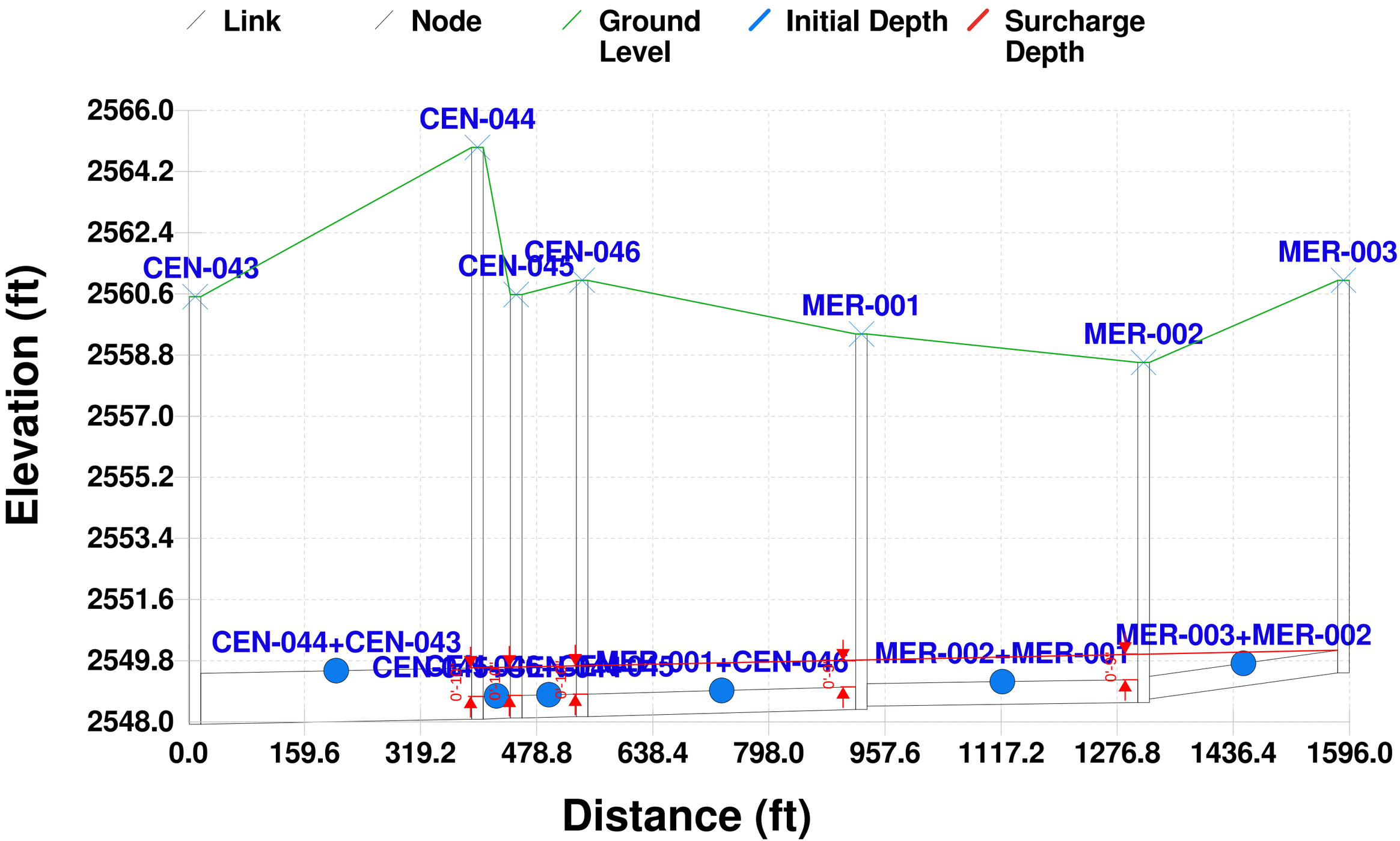
Eastern Trunk (ETR) Profile - Before



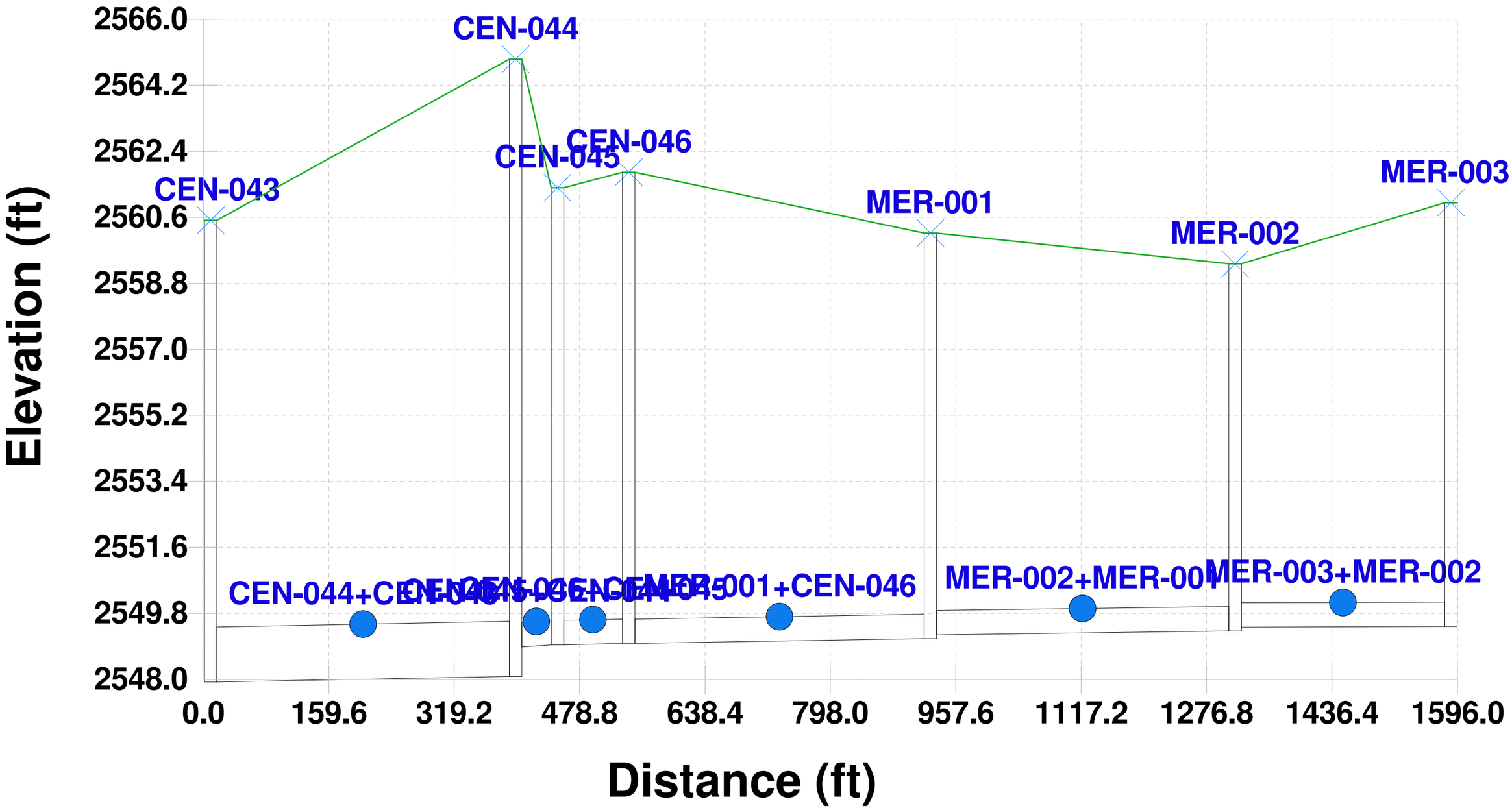
Eastern Trunk (ETR) Profile - After



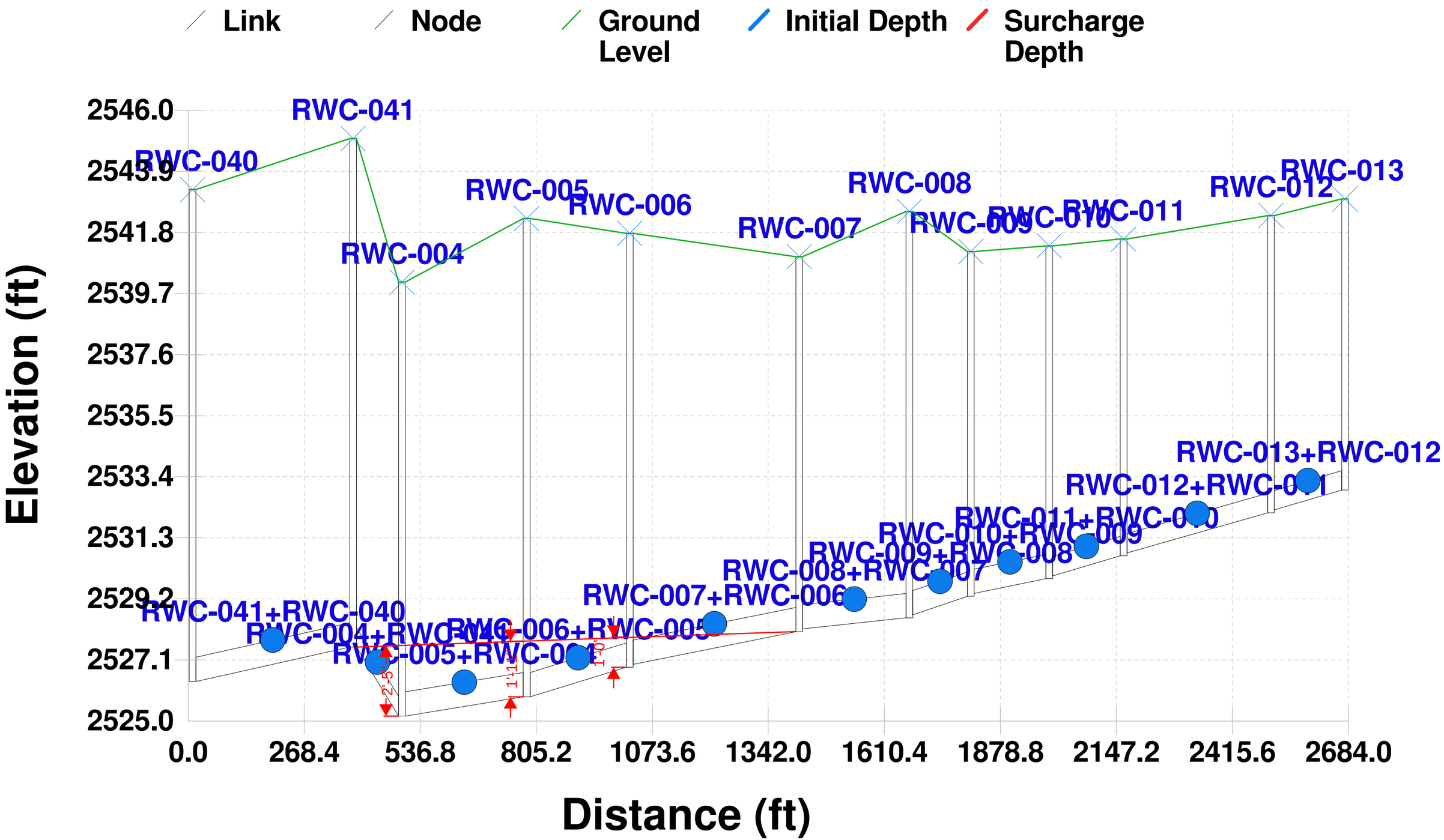
Eastern Trunk (ETR) Profile - Before



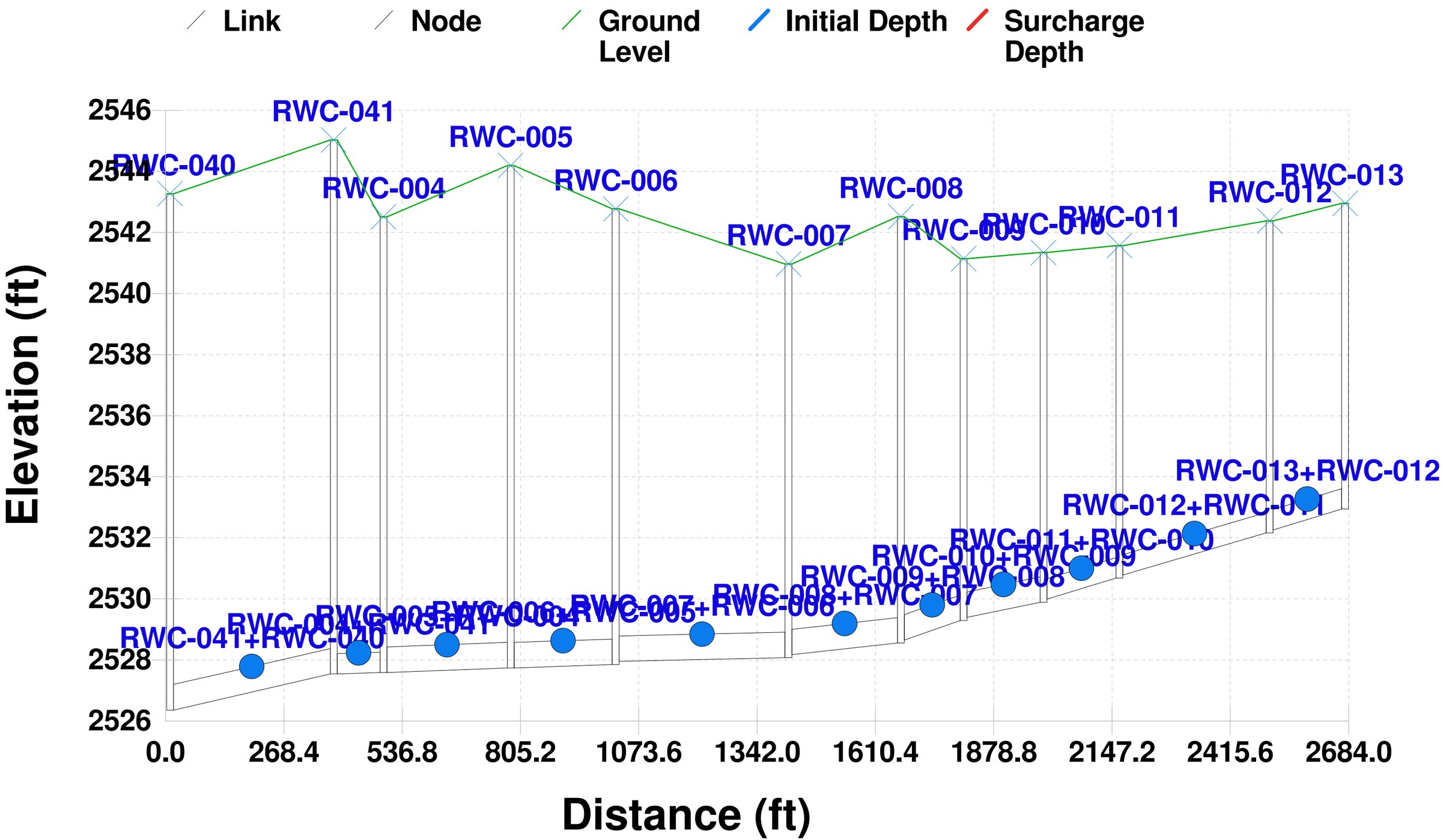
Eastern Trunk (ETR) Profile - After



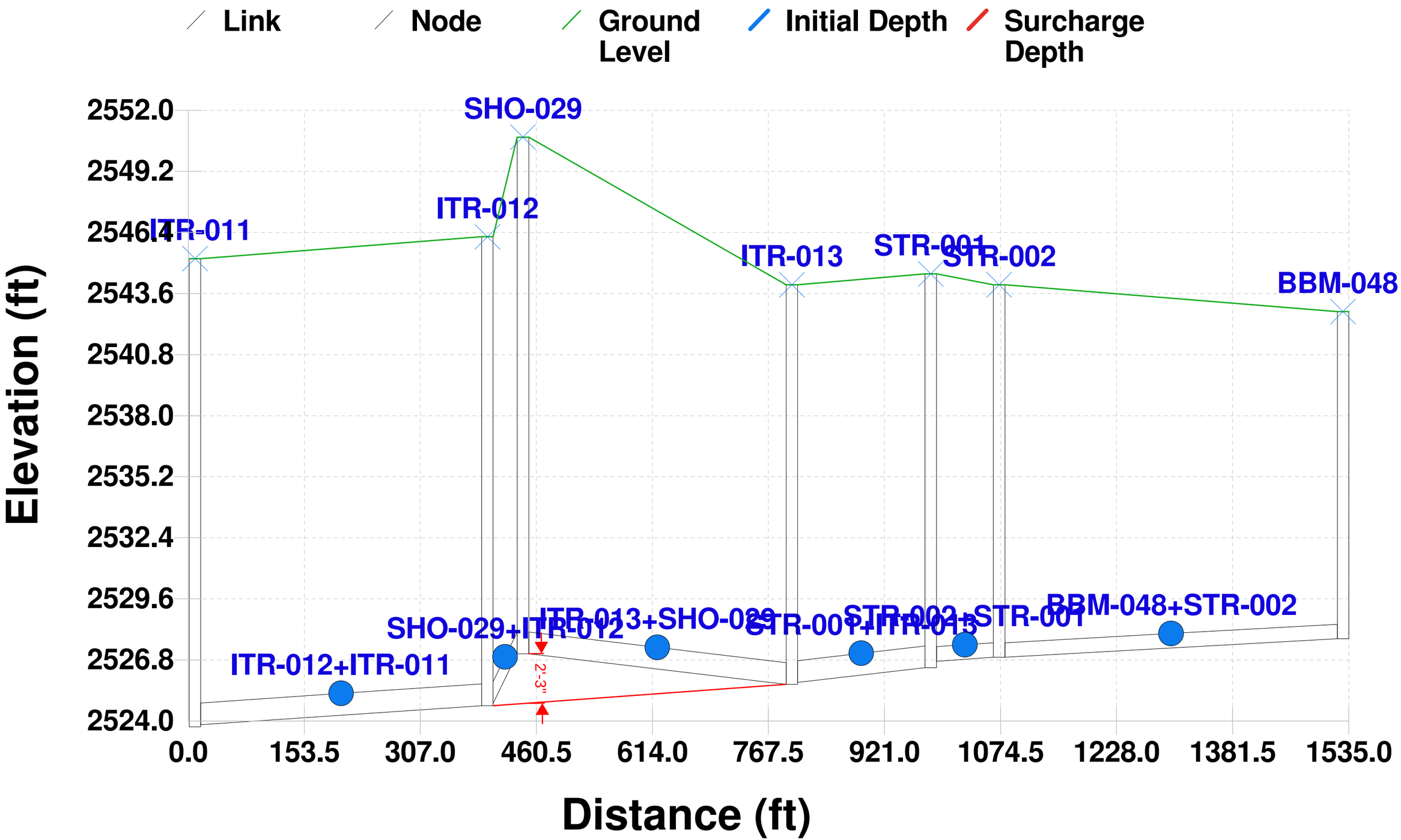
Redwood Creek (RWC) Profile - Before



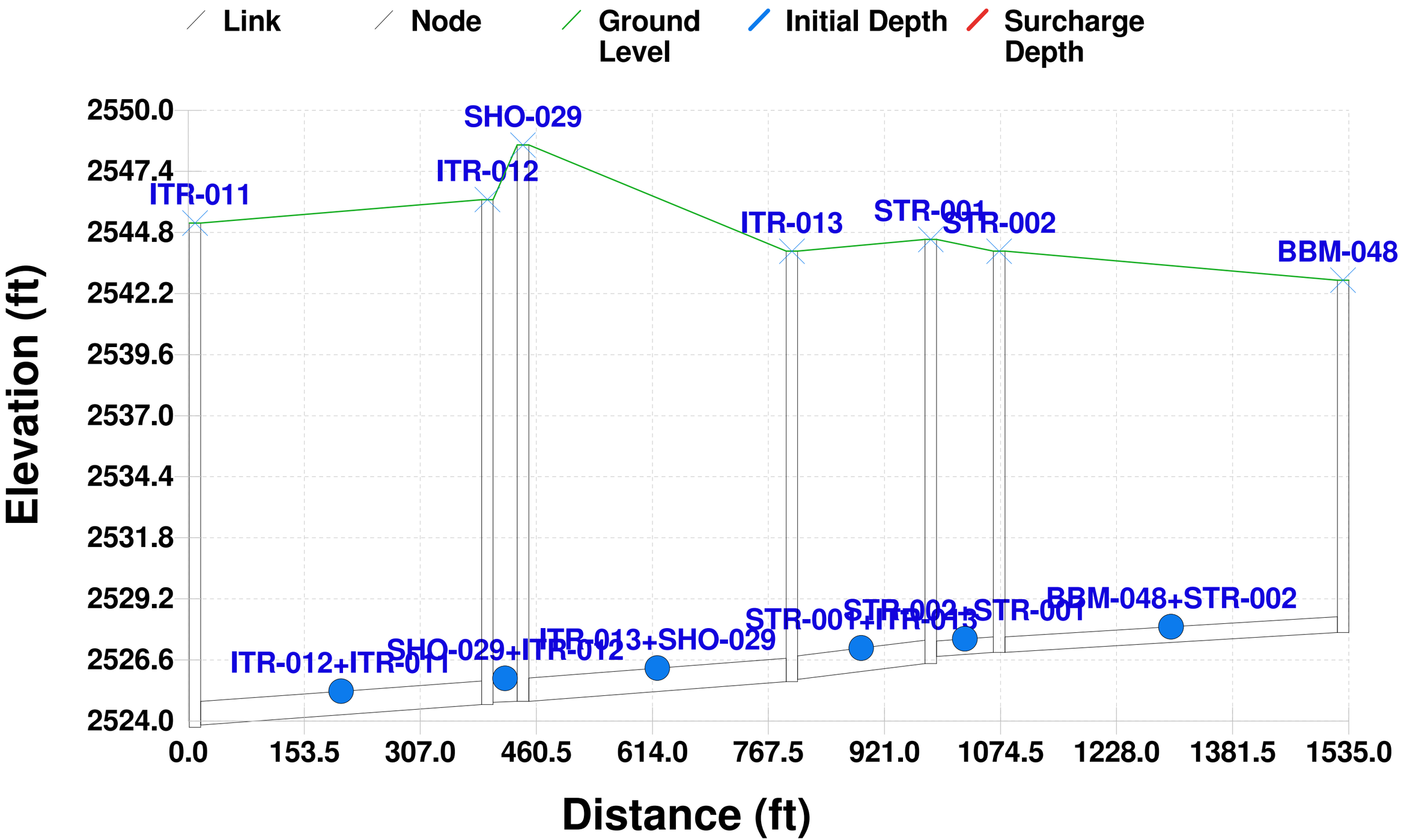
Redwood Creek (RWC) Profile - After



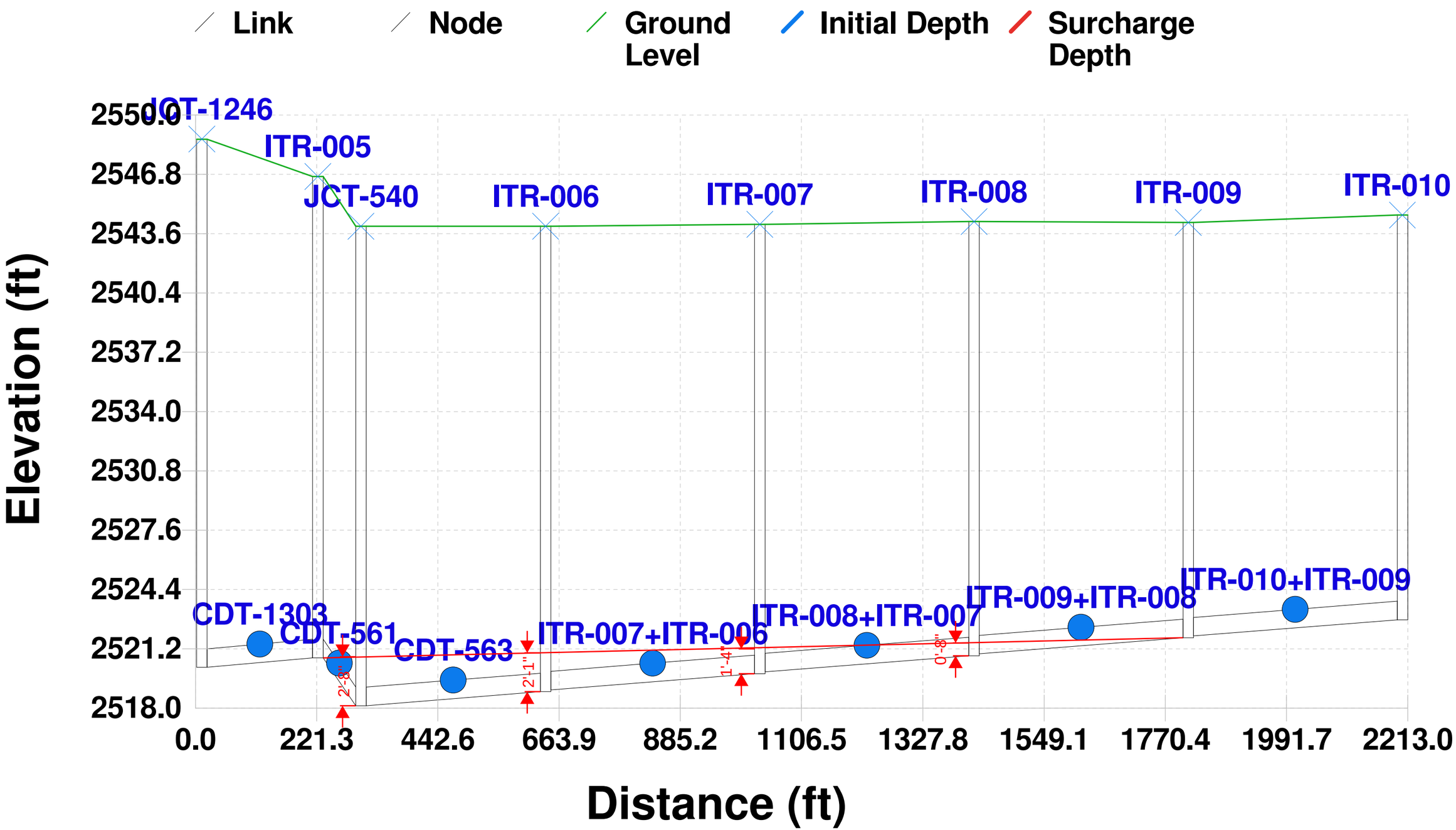
The Shores (SHO) Profile - Before



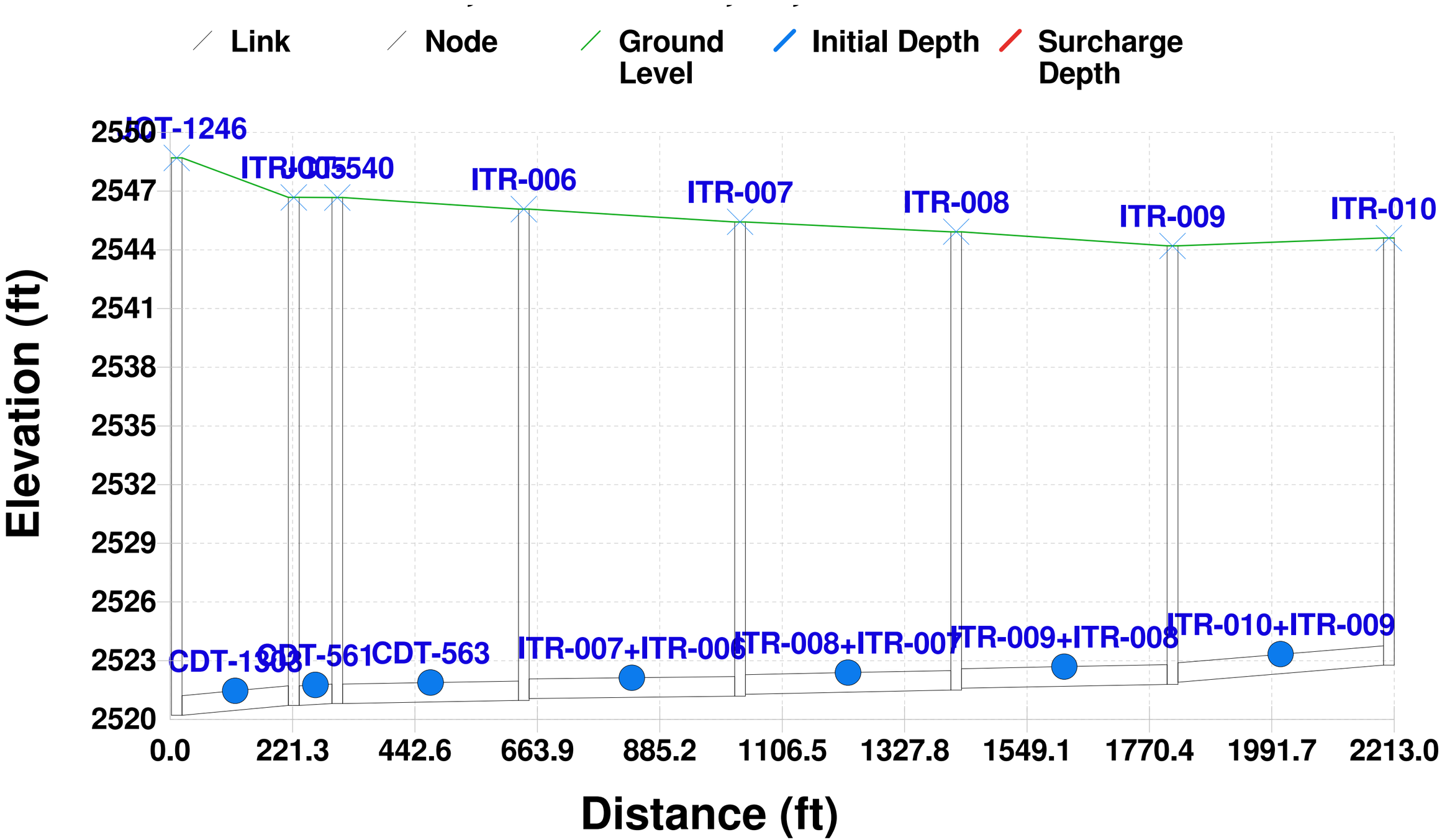
The Shores (SHO) Profile - After



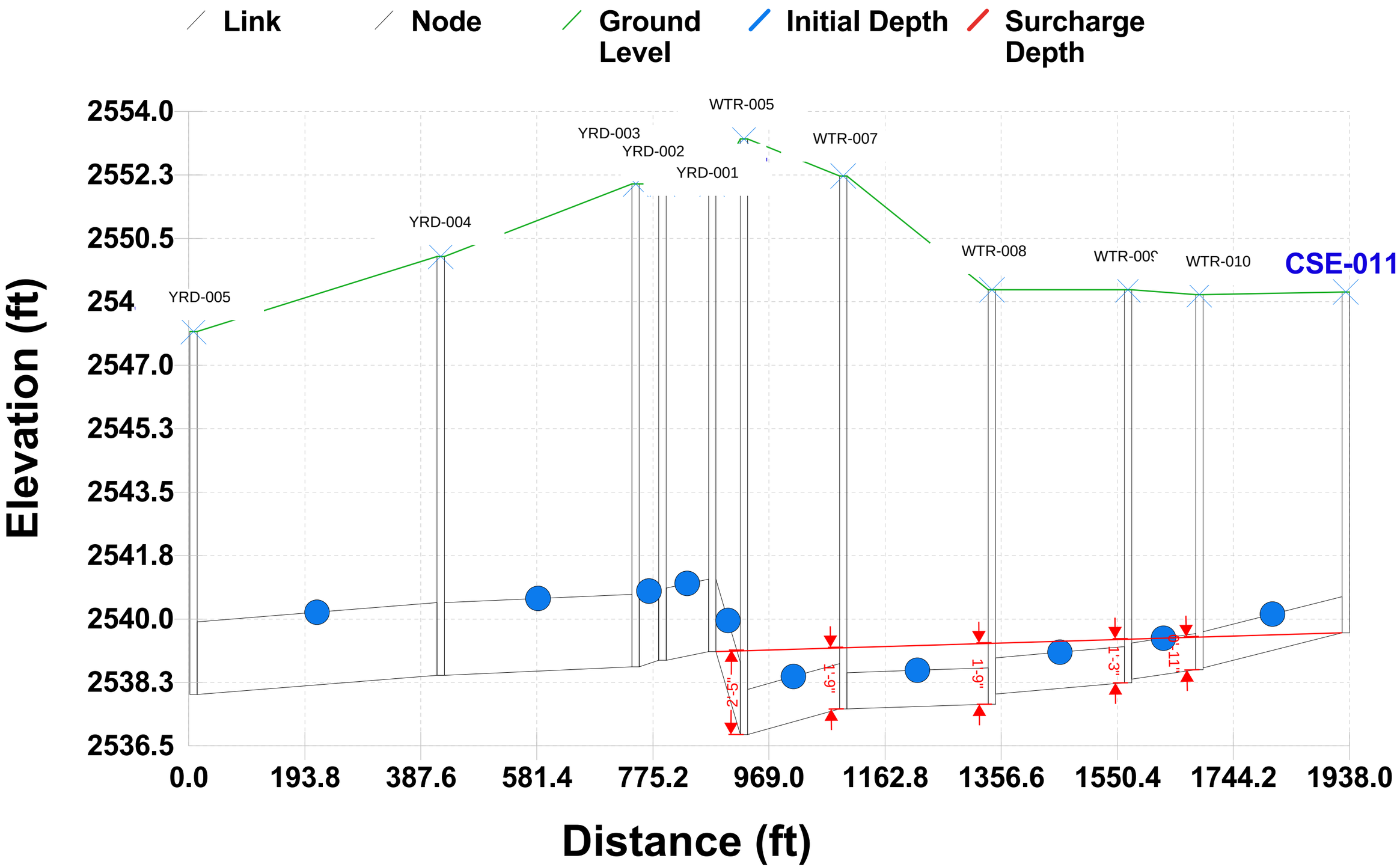
South Trunk (STR) Profile - Before



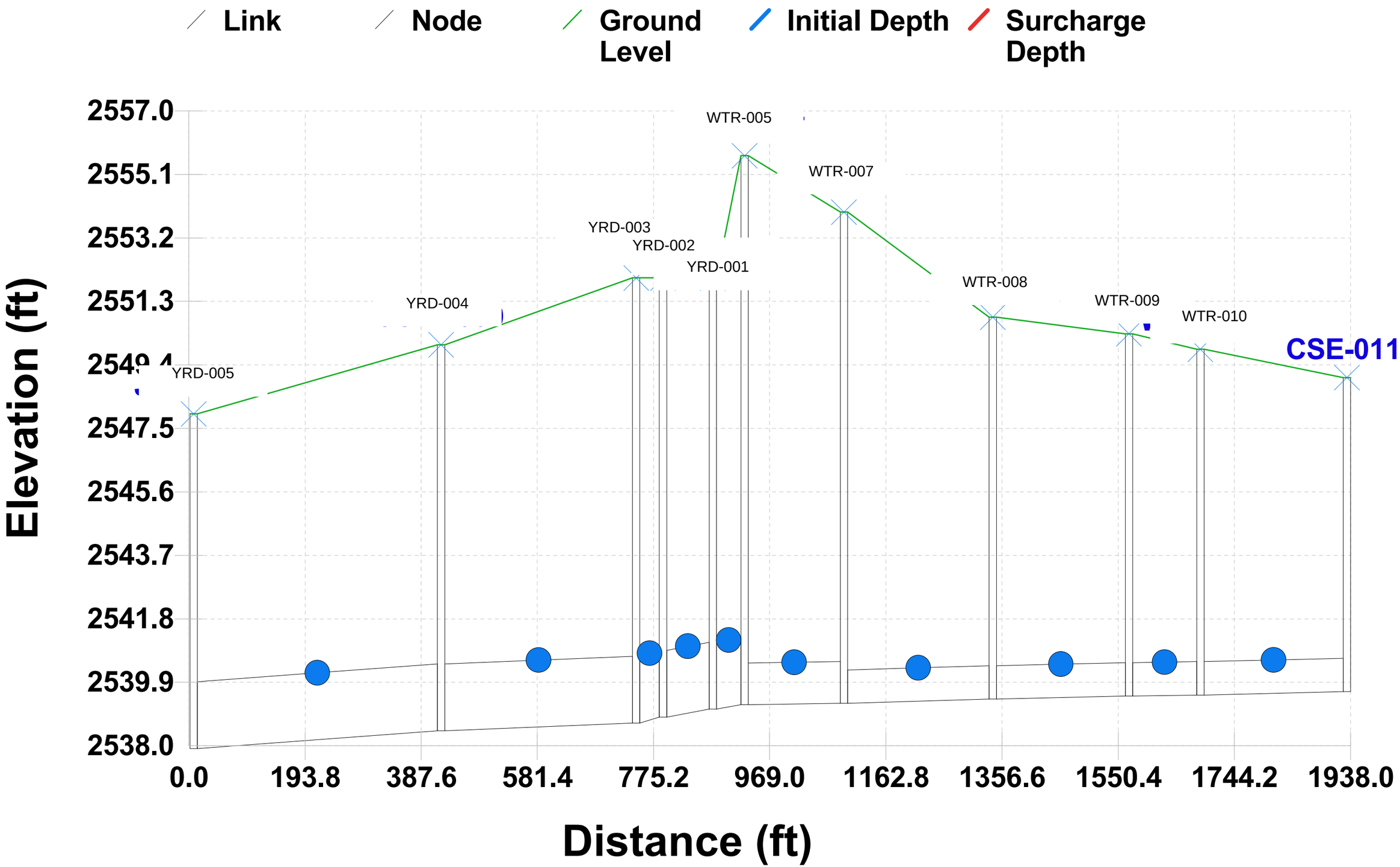
South Trunk (STR) Profile - After



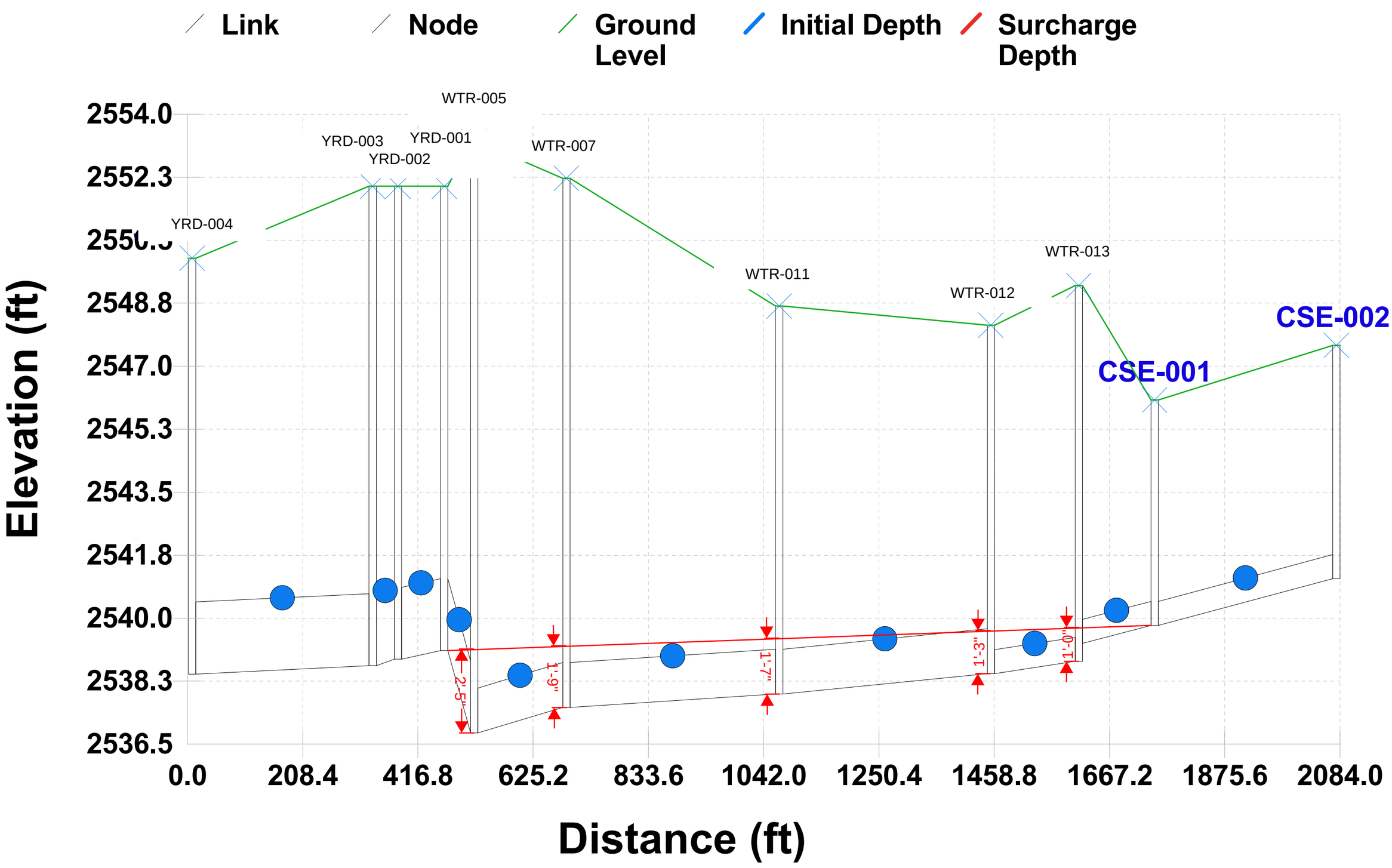
Trunk Line West of Headworks - Before



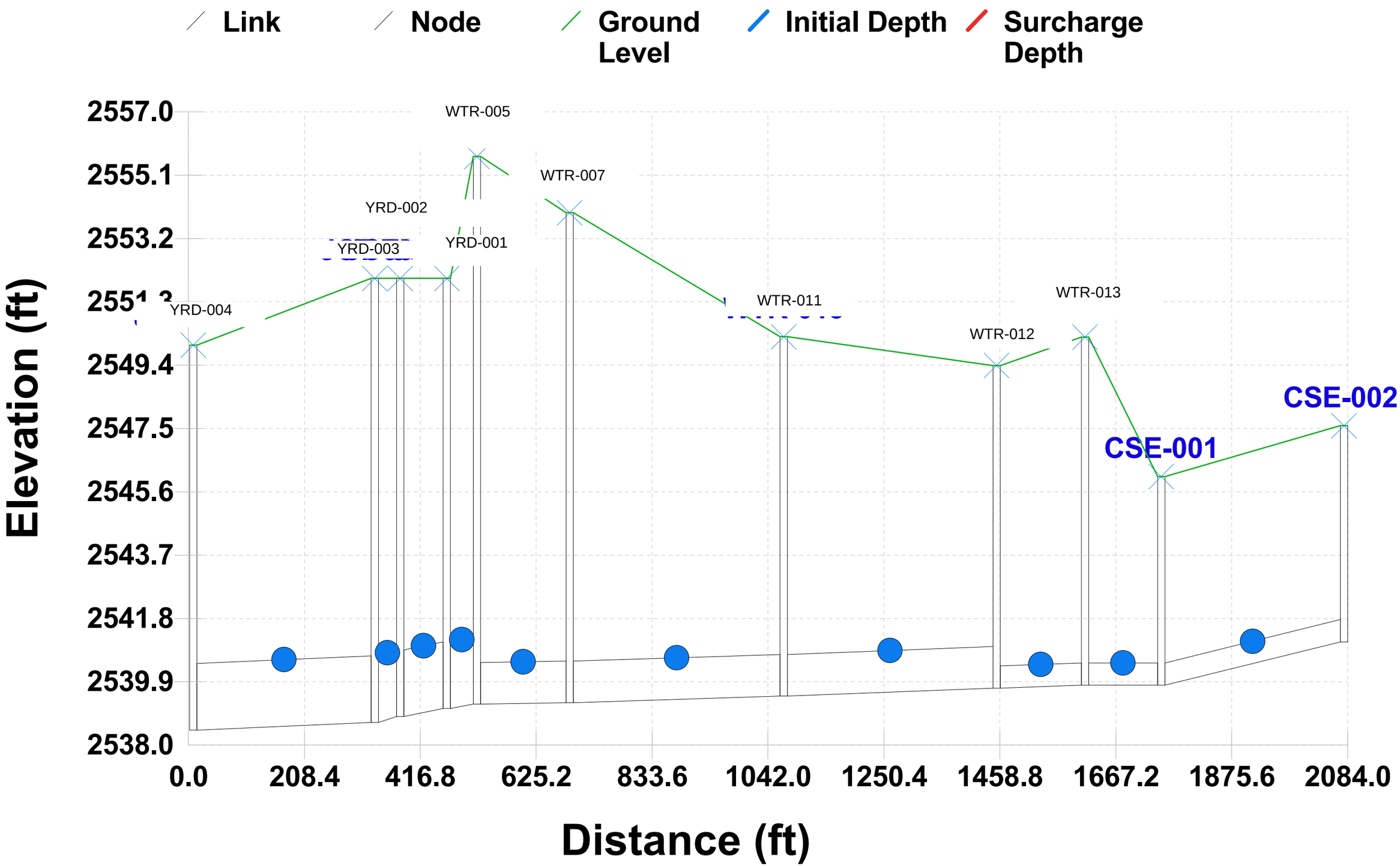
Trunk Line West of Headworks - After



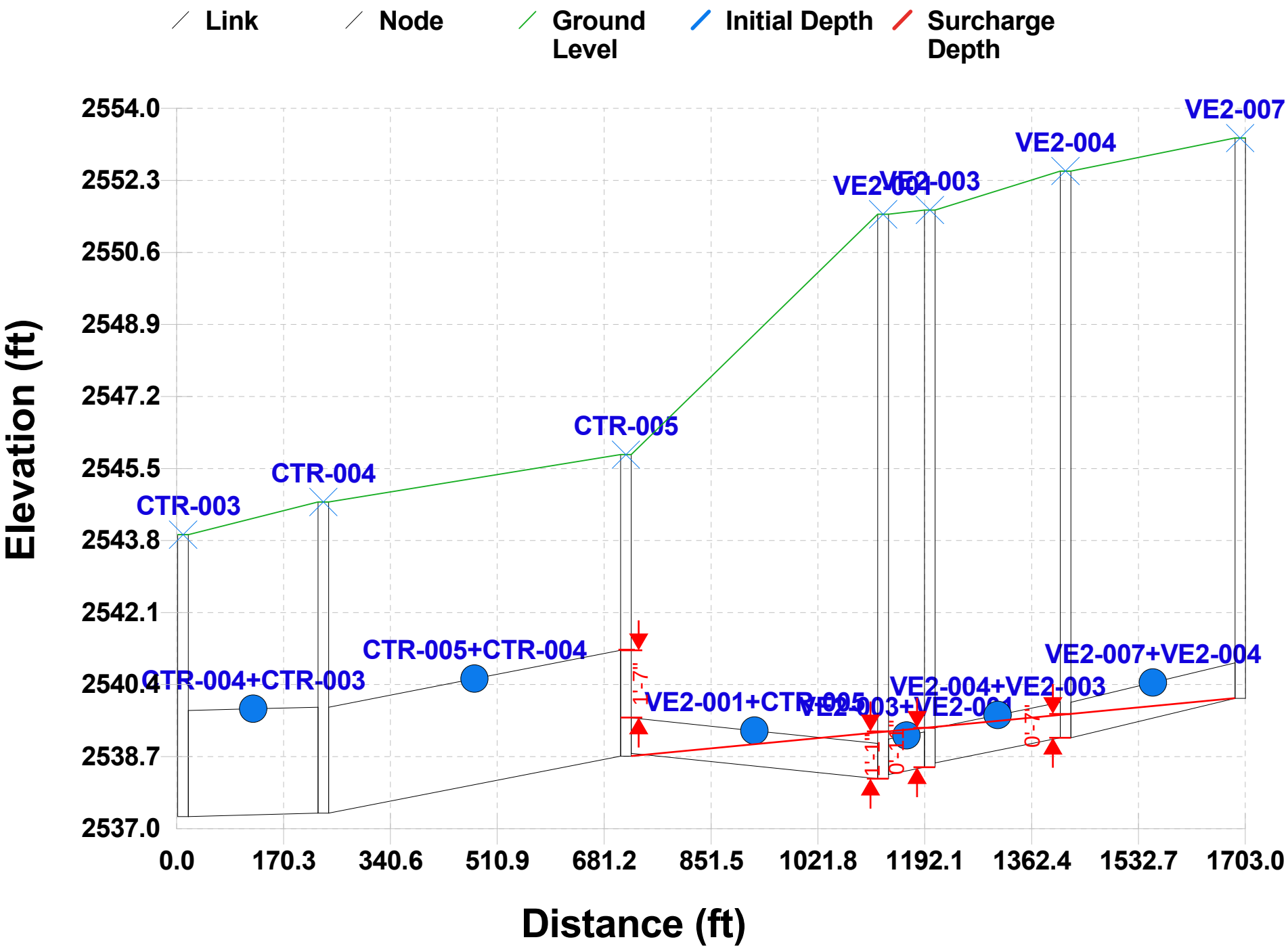
West Trunk (WTR) Profile - Before



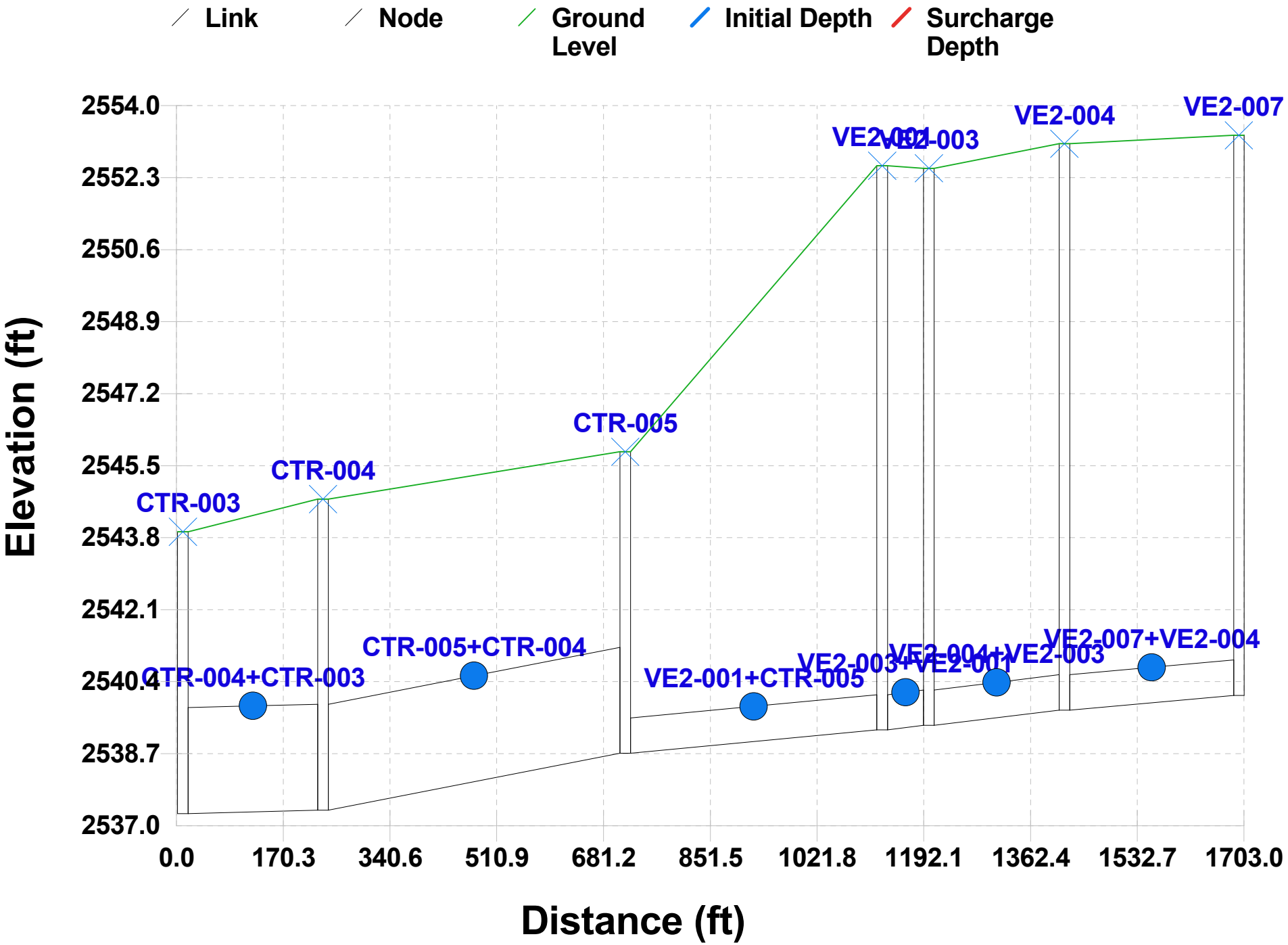
West Trunk (WTR) Profile - After



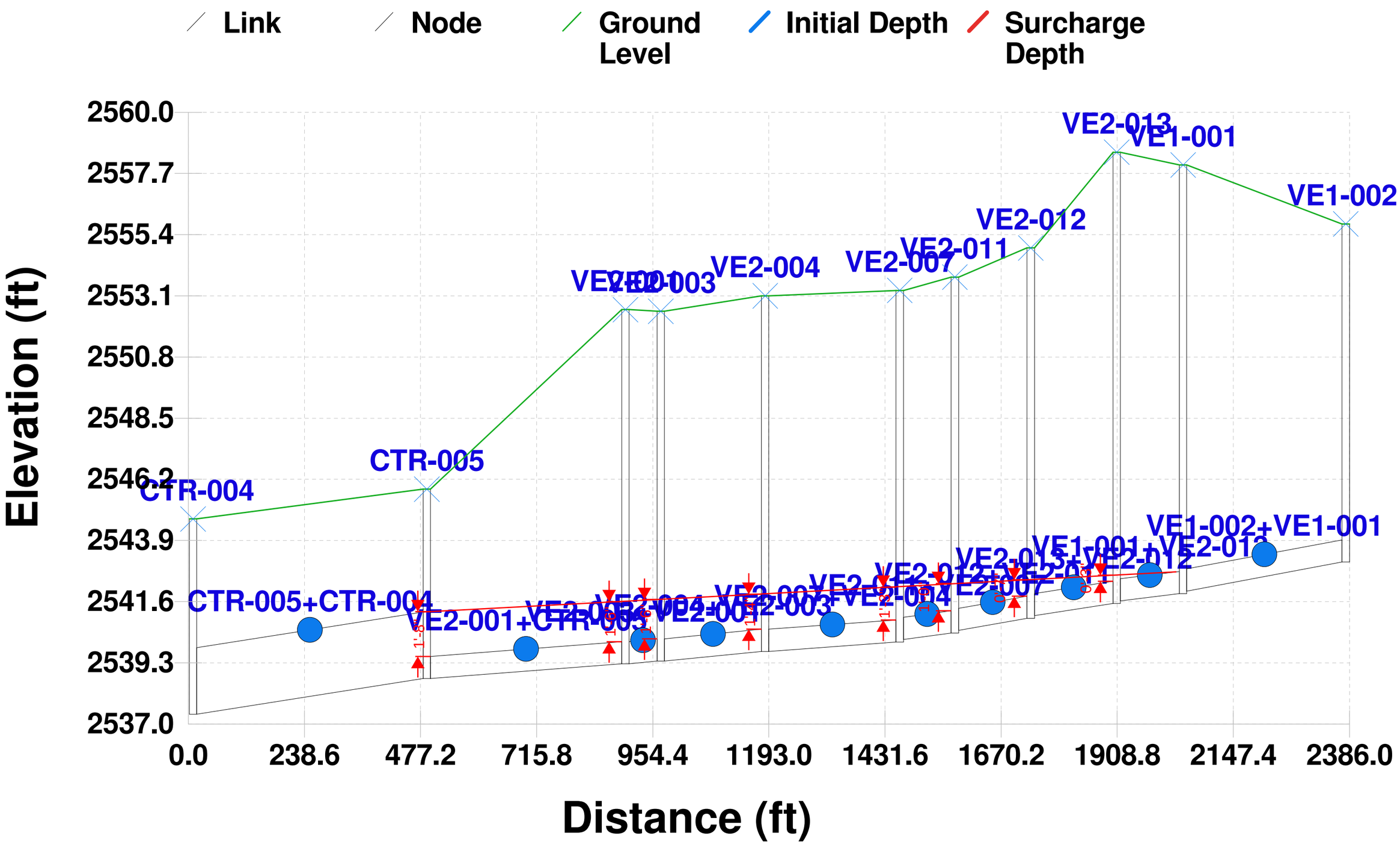
Pine Ridge Estates (PRI) Profile - Before



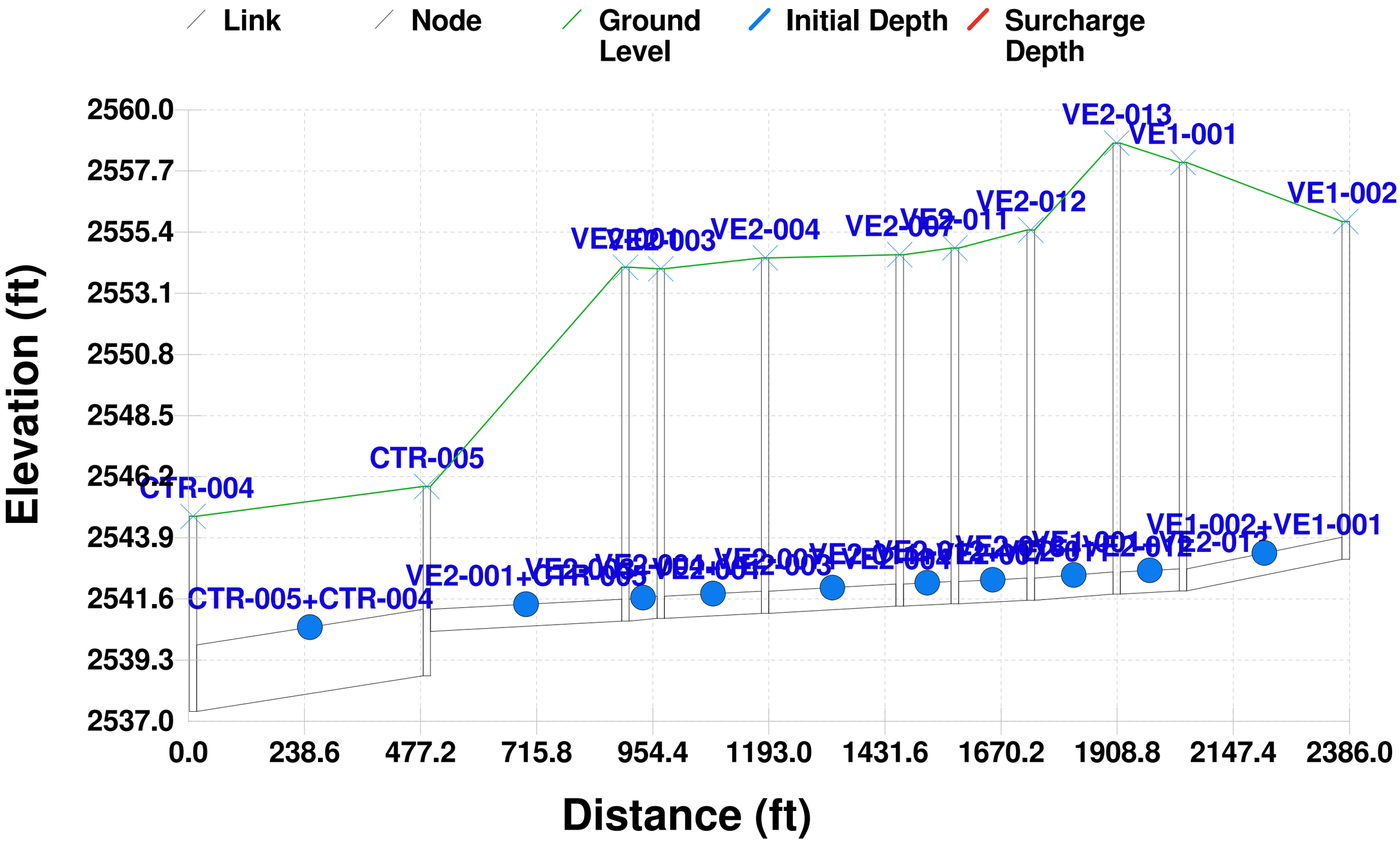
Pine Ridge Estates (PRI) Profile - After



Pine Ridge Estates (PRI) Profile - Before



Pine Ridge Estates (PRI) Profile - After



Appendix C
Lift Station Data Sheets and Drawdown Test Summary

Lift Station Name	Pump No.	Pump Manufacturer	Design TDH (ft)	Design Flow (gpm)	Drawdown Test Pump Rate 1 (gpm)	Drawdown Test Pump Rate 2 (gpm)	Drawdown Test Pump Rate Average (gpm)
Bob Lift Station	1	4.7 hp ABS	12?	640	419	556	488
Bob Lift Station	2	4.7 hp ABS	12?	640	477	478	478
Bob Lift Station	1 &2				1130	1065	1098
Mace Lift Station	2	49 hp ABS	102	1190	970		
Mace Lift Station	3	49 hp ABS	102	1190	930		
Mace Lift Station	1 & 2				1160		
Ashbury Lift Station	2	14 hp ABS	80	140	145		
Ashbury Lift Station	1 & 2				197		
Fred Meyer Lift Station	1	14 hp ABS	94	240			
Fred Meyer Lift Station	2	14 hp ABS	94	240			
Old Valley Lift Station	1	25 hp ABS	117	315	501	478	490
Old Valley Lift Station	2	25 hp ABS	117	315	521	521	521
Old Valley Lift Station	1 &2				553	527	540
Palmer Lift Station	1	60 hp Fairbanks Morse	172	720			
Palmer Lift Station	2	60 hp Fairbanks Morse	172	720			
Palmer Lift Station	3	60 hp Fairbanks Morse	172	720			

Pump Station Draw Down Test
Field Data Sheet

PUMP STATION NAME: Bob Lift Station **DATE** 7/14/2015

PUMP(s) Tested (eg. 1 of 2; 1 and 2 of 3) 2 of 2

I. BASE INFORMATION

PUMP MANUFACTURER	ABS
MODEL	
SERIAL NUMBER	
HP	4.7 hp
IMPELLER SIZE	

PUMP DESIGN 640 GPM 12 TDH (Ft) Check this. RJ did not have this information

	DIAMETER OR LENGTH (FEET)	WIDTH (FEET)	AREA SQ FEET	GALLON PER VERT FT
WET WELL DIAMETER (LENGTH x WIDTH)	6		28.26	211.4

AREA OF WET WELL (0.785 x Diameter ^2) OR L X W

II. DRAW DOWN TEST (2 PARTS-A. DETERMINE AVERAGE INFLOW THEN DO B. DETERMINE AVERAGE PUMP DOWN FLOWS. DO ALL OF TEST 1 A&B, THEN TEST 2, A & B THEN TEST 3, A & B)

A. DETERMINE AVERAGE INFLOWS
(MEASURE TIME IT TAKES WET WELL TO FILL THE MINIMUM DISTANCE IN FEET FROM TABLE 1)

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START	2		1.0	34.6		18	6.0	3.5
END	0		4	8.44			8	22.35
TOTAL	2.00 FEET		2.56 MINUTES		1.50 FEET		2.31 MINUTES	
	165 GPM INFLOW RATE (HEIGHT /TIME)				137 GPM INFLOW RATE (HEIGHT /TIME)			

151 **GPM AVERAGE INFLOW RATE FOR PUMP # 1**

	TEST 3				TEST 4				TEST 5			
	HEIGHT		TIME		HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START		14.25	0.0	0.0		19.125				19.875		
END			2	6.09	0		2	53.98	0		2	41.81
TOTAL	1.19 FEET		2.10 MINUTES		1.59 FEET		2.90 MINUTES		1.66 FEET		2.70 MINUTES	
	119 GPM INFLOW RATE (HEIGHT /TIME)				116 GPM INFLOW RATE (HEIGHT /TIME)				130 GPM INFLOW RATE (HEIGHT /TIME)			

124 **GPM AVERAGE INFLOW RATE FOR PUMPS #1 & #2** 122 **GPM AVERAGE INFLOW RATE FOR PUMP #2**

B. DETERMINE AVERAGE PUMP DOWN FLOWS
Pump No. 1

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START							4.0	8.4
END	2		1.0	34.6	2		5	10.99
TOTAL	2.00 FEET		1.58 MINUTES		2.00 FEET		1.04 MINUTES	
	419 (HEIGHT /TIME+GPM AVE INFLOW RATE)				556 (HEIGHT /TIME+GPM AVE INFLOW RATE)			

487.8 **GPM AVERAGE PUMP RATE**

Pump No. 1 and No. 2

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START								
END		20		21.0	2			26.97
TOTAL	1.67 FEET		0.35 MINUTES		2.00 FEET		0.45 MINUTES	
	1130 (HEIGHT /TIME+GPM AVE INFLOW RATE)				1065 (HEIGHT /TIME+GPM AVE INFLOW RATE)			

1098 **GPM AVERAGE PUMP RATE**

Pump No. 2

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START								
END	2		1.0	11.5	2		1	11.16
TOTAL	2.00 FEET		1.19 MINUTES		2.00 FEET		1.19 MINUTES	
	477 (HEIGHT /TIME+GPM AVE INFLOW RATE)				478 (HEIGHT /TIME+GPM AVE INFLOW RATE)			

477.6 **GPM AVERAGE PUMP RATE**

Pump Station Draw Down Test
Field Data Sheet

PUMP STATION NAME: Mace Lift Station **DATE** 7/14/2015

PUMP(s) Tested (eg. 1 of 2; 1 and 2 of 3) 3 of 3

I. BASE INFORMATION

PUMP MANUFACTURER	ABS
MODEL	XFP
SERIAL NUMBER	XFP105J-CB2-PE 403/4FM-D61-20C
HP	49 hP
IMPELLER SIZE	300 mm

PUMP DESIGN 1190 GPM 102 TDH (Ft)

	DIAMETER OR LENGTH (FEET)	WIDTH (FEET)	AREA SQ FEET	GALLON PER VERT FT
WET WELL DIAMETER (LENGTH x WIDTH)	12		113	846

AREA OF WET WELL (0.785 x Diameter ^2) OR L X W

II. DRAW DOWN TEST WAS NOT COMPLETED ON MACE LIFT STATION. WE USED INFORMATION FROM THE LS MAG METERS

Pump No. 2

970 **GPM AVERAGE PUMP RATE @ 90% SPEED**

Pump No. 1 and No. 2

1160 **GPM AVERAGE PUMP RATE @ 90% SPEED**

Pump No. 3

930 **GPM AVERAGE PUMP RATE @ 90% SPEED**

Pump Station Draw Down Test
Field Data Sheet

PUMP STATION NAME: Ashbury Lift Station **DATE** 7/14/2015

PUMP(s) Tested (eg. 1 of 2; 1 and 2 of 3) 2 of 2

I. BASE INFORMATION

PUMP MANUFACTURER	Sulzer/ABS
MODEL	XFP
SERIAL NUMBER	PE2 (60 Hz) 100E-CB-1
HP	14 hP
IMPELLER SIZE	

PUMP DESIGN 140 GPM 80 TDH (Ft)

	DIAMETER OR LENGTH (FEET)	WIDTH (FEET)	AREA SQ FEET	GALLON PER VERT FT
WET WELL DIAMETER (LENGTH x WIDTH)	6		28	211

AREA OF WET WELL (0.785 x Diameter ^2) OR L X W

II. DRAW DOWN TEST (2 PARTS-A. DETERMINE AVERAGE INFLOW THEN DO B. DETERMINE AVERAGE PUMP DOWN FLOWS. DO ALL OF TEST 1 A&B, THEN TEST 2, A & B THEN TEST 3, A & B)

A. DETERMINE AVERAGE INFLOWS
(MEASURE TIME IT TAKES WET WELL TO FILL THE MINIMUM DISTANCE IN FEET FROM TABLE 1)

TEST 1

	HEIGHT FEET	HEIGHT INCHES	TIME MINUTES	TIME SECONDS
START		7.25		
END	0		3	50.96
TOTAL	0.60 FEET		3.85 MINUTES	

33 GPM INFLOW RATE (HEIGHT /TIME)

33 **GPM AVERAGE INFLOW RATE FOR PUMP # 2**

TEST 3

	HEIGHT FEET	HEIGHT INCHES	TIME MINUTES	TIME SECONDS
START		9.25	0.0	0.0
END			7	13.66
TOTAL	0.77 FEET		7.23 MINUTES	

23 GPM INFLOW RATE (HEIGHT /TIME)

23 **GPM AVERAGE INFLOW RATE FOR PUMPS #1 & #2**

B. DETERMINE AVERAGE PUMP DOWN FLOWS
Pump No. 2

TEST 1

	HEIGHT FEET	HEIGHT INCHES	TIME MINUTES	TIME SECONDS
START				
END	3		5.0	41.5
TOTAL	3.00 FEET		5.69 MINUTES	

145 (HEIGHT /TIME+GPM AVE INFLOW RATE)

145 **GPM AVERAGE PUMP RATE**

Pump No. 1 and No. 2

TEST 1

	HEIGHT FEET	HEIGHT INCHES	TIME MINUTES	TIME SECONDS
START				
END	2	8.25	3.0	14.9
TOTAL	2.69 FEET		3.25 MINUTES	

197 (HEIGHT /TIME+GPM AVE INFLOW RATE)

197 **GPM AVERAGE PUMP RATE**

Pump Station Draw Down Test
Field Data Sheet

PUMP STATION NAME: Old Valley Lift Station **DATE** 7/14/2015

PUMP(s) Tested (eg. 1 of 2; 1 and 2 of 3) 2 of 2

I. BASE INFORMATION

PUMP MANUFACTURER	Hydromatic
MODEL	
SERIAL NUMBER	
HP	24.8 hP
IMPELLER SIZE	

PUMP DESIGN 315 GPM 117 TDH (Ft)

	DIAMETER OR LENGTH (FEET)	WIDTH (FEET)	AREA SQ FEET	GALLON PER VERT FT
WET WELL DIAMETER (LENGTH x WIDTH)	8	8	64	479

AREA OF WET WELL (0.785 x Diameter ^2) OR L X W

II. DRAW DOWN TEST (2 PARTS-A. DETERMINE AVERAGE INFLOW THEN DO B. DETERMINE AVERAGE PUMP DOWN FLOWS. DO ALL OF TEST 1 A&B, THEN TEST 2, A & B THEN TEST 3, A & B)

A. DETERMINE AVERAGE INFLOWS
(MEASURE TIME IT TAKES WET WELL TO FILL THE MINIMUM DISTANCE IN FEET FROM TABLE 1)

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START		17.5				19		
END	0		3	47.32			4	2.73
TOTAL	1.46 FEET		3.79 MINUTES		1.58 FEET		4.05 MINUTES	
	184 GPM INFLOW RATE (HEIGHT /TIME)				187 GPM INFLOW RATE (HEIGHT /TIME)			

186 **GPM AVERAGE INFLOW RATE FOR PUMP # 1**

	TEST 3				TEST 4				TEST 5				TEST 6			
	HEIGHT		TIME		HEIGHT		TIME		HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START		17.25	0.0	0.0		19.5				20.5				14.25		
END			3	32.62	0		3	47.41	0		4	15.98			2	53.78
TOTAL	1.44 FEET		3.54 MINUTES		1.63 FEET		3.79 MINUTES		1.71 FEET		4.27 MINUTES		1.19 FEET		2.90 MINUTES	
	194 GPM INFLOW RATE (HEIGHT /TIME)				205 GPM INFLOW RATE (HEIGHT /TIME)				192 GPM INFLOW RATE (HEIGHT /TIME)				196 GPM INFLOW RATE (HEIGHT /TIME)			

196 **GPM AVERAGE INFLOW RATE FOR PUMPS #1 & #2** 198 **GPM AVERAGE INFLOW RATE FOR PUMP #2**

B. DETERMINE AVERAGE PUMP DOWN FLOWS

Pump No. 1

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START								
END		21.75	2.0	45.2		21.25	2	53.97
TOTAL	1.81 FEET		2.75 MINUTES		1.77 FEET		2.90 MINUTES	
	501 (HEIGHT /TIME+GPM AVE INFLOW RATE)				478 (HEIGHT /TIME+GPM AVE INFLOW RATE)			

490 **GPM AVERAGE PUMP RATE**

Pump No. 1 and No. 2

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START								
END		19	2.0	7.1		20.34	2	26.76
TOTAL	1.58 FEET		2.12 MINUTES		1.70 FEET		2.45 MINUTES	
	553 (HEIGHT /TIME+GPM AVE INFLOW RATE)				527 (HEIGHT /TIME+GPM AVE INFLOW RATE)			

540 **GPM AVERAGE PUMP RATE**

Pump No. 2

	TEST 1				TEST 2			
	HEIGHT		TIME		HEIGHT		TIME	
	FEET	INCHES	MINUTES	SECONDS	FEET	INCHES	MINUTES	SECONDS
START								
END	2		2.0	57.6		20.5	2	31.56
TOTAL	2.00 FEET		2.96 MINUTES		1.71 FEET		2.53 MINUTES	
	521 (HEIGHT /TIME+GPM AVE INFLOW RATE)				521 (HEIGHT /TIME+GPM AVE INFLOW RATE)			

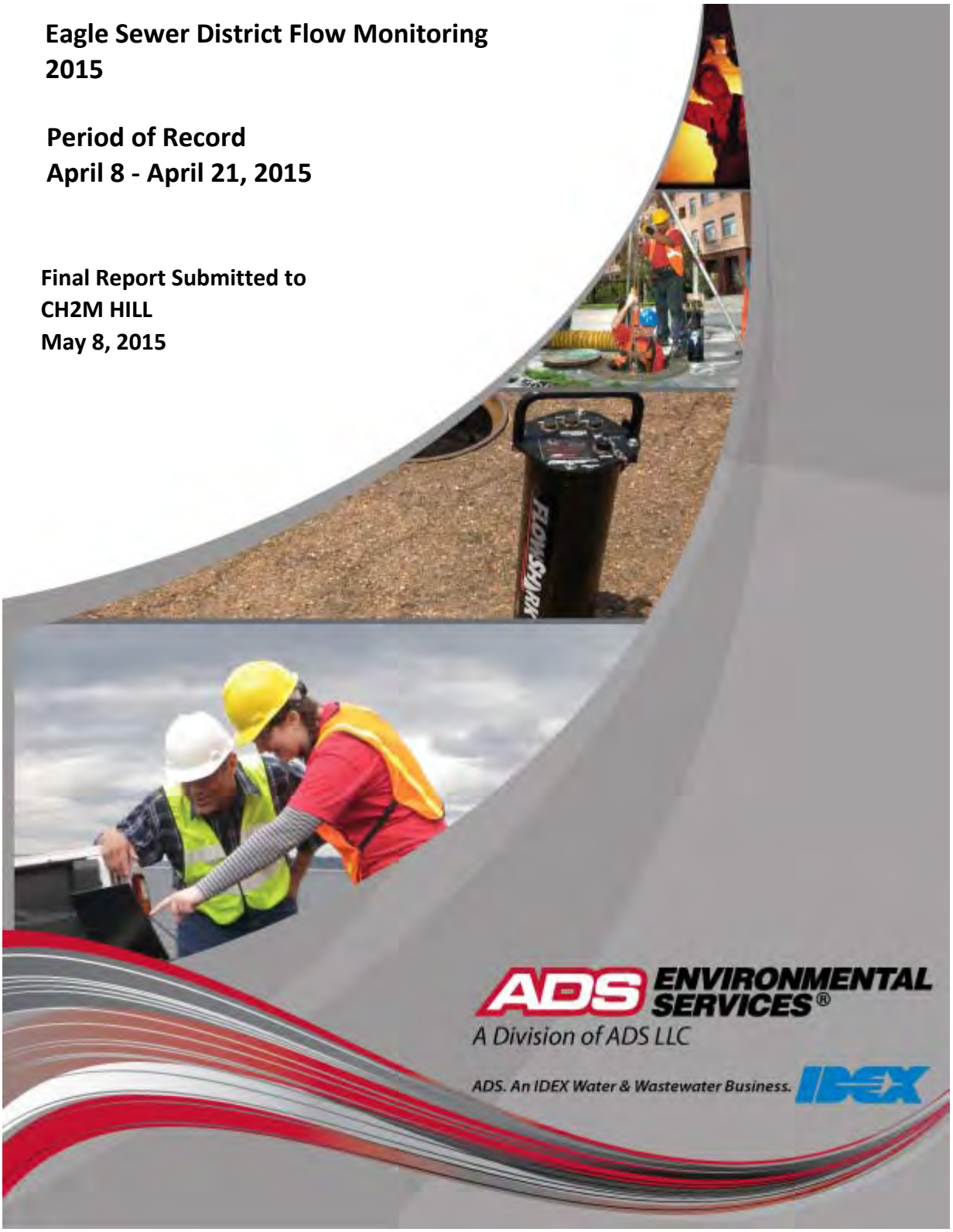
521 **GPM AVERAGE PUMP RATE**

Appendix D
ADS Flow Monitoring Report

Eagle Sewer District Flow Monitoring 2015

Period of Record
April 8 - April 21, 2015

Final Report Submitted to
CH2M HILL
May 8, 2015



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A Division of ADS LLC
ADS. An IDEX Water & Wastewater Business. IDEX

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Eagle Sewer District
2015 Flow Monitoring Project

Prepared for:

Ms. Jodi Burns
CH2M Hill
322 E. Front St, Ste 200
Boise, ID 83702

Prepared by:

ADS, LLC
4455 South 134th Place
Tukwila, WA 98168-6204

Letter of Transmittal

A Division of ADS LLC
4455 South 134th
Place
Tukwila, WA 98168-6204

May 1, 2015

Ms. Jodi Burns
CH2M Hill

Dear Ms. Burns,

ADS is pleased to submit the Final Report for the Monitoring study. The Study was conducted on behalf of CH2M Hill. Metering was performed during the period of Wednesday, April 08, 2015 through Tuesday, April 21, 2015. Included in the report are depth, velocity and quantity hydrographs, scattergraphs, site summary and data in excel format.

In addition, we would be happy to further explain any details about the report that may seem unclear. Should you have any questions or comments, I can be reached at 714-658-5574. You may also contact the Project Manager, Mike Pina at 206-762-5070.

Thank you for choosing ADS products and services to meet your flow monitoring needs.

Regards,

Heather McPherson P.E.
Data Analyst, West Coast
ADS LLC
An IDEX Fluid & Metering Business
Accusonic
ADS Environmental Services
Hydra-Stop

Methodology

Introduction

Background

CH2M Hill entered into agreement with ADS Environmental Services to conduct flow monitoring at (10) ten metering points and (2) two rain gauges for the Eagle Sewer District. The study was for a (2) two week period. The objective of this study was to measure depth, velocity and to quantify flows.

Project Scope

The scope of this study involved using temporary flow monitors to quantify wastewater flow at the designated locations. Specifically, the study included the following key components.

- Investigate the proposed flow-monitoring sites for adequate hydraulic conditions.
- Flow monitor installations.
- Flow monitor confirmations and data collections.
- Flow data analysis.
- Dry weather analysis

Equipment installation was accomplished on April 1, 2015. The monitoring period began on April 08, 2015 and was completed on April 21, 2015.

Equipment and Methodology

Flow Quantification Methods

There are two main equations used to measure open channel flow: the Continuity Equation and the Manning Equation. The Continuity Equation, which is considered the most accurate, can be used if both depth of flow and velocity are available. In cases where velocity measurements are not available or not practical to obtain, the Manning Equation can be used to estimate velocity from the depth data based on certain physical characteristics of the pipe (i.e. the slope and roughness of the pipe being measured). However, the Manning equation assumes uniform, steady flow hydraulic conditions with non-varying roughness, which are typically invalid assumptions in most sanitary sewers. The Continuity Equation was used exclusively for this study.

<u>Continuity Equation</u>

The Continuity Equation states that the flow quantity (Q) is equal to the wetted area (A) multiplied by the average velocity (V) of the flow.

$$Q = A * V$$

This equation is applicable in a variety of conditions including backwater, surcharge, and reverse flow. Most modern flow monitoring equipment, including the ADS Models, measure both depth and velocity and therefore use the Continuity Equation to calculate flow quantities.

Flow Monitoring Equipment

The monitor selected for this project was the ADS Model Flowshark monitor. This flow monitor is an area velocity monitor that uses both the Continuity and Manning's equations to measure flow. The ADS Model FlowShark monitor consists of data acquisition sensors and a battery-powered microcomputer. The microcomputer includes a processor unit, data storage, and an on-board clock to control and synchronize the sensor recordings. The monitor was programmed to acquire and store depth of flow and velocity readings at 5-minute intervals.

Three types of data acquisition sensors are available for the FlowShark monitor. The primary depth measurement device is the ADS quad-redundant ultrasonic level sensor. This sensor uses four independent ultrasonic transceivers in pairs to measure the distance from the face of the transceiver housing to the water surface (air range) with up to four transceiver pairs, of the available ones, active at one time. The elapsed time between transmitting and receiving the ultrasonic waves is used to calculate the air range between the sensor and flow surface based on

the speed of sound in air. Sensors in the transceiver housing measure temperature, which is used to compensate the ultrasonic signal travel time. The speed of sound will vary with temperature. Since the ultrasonic level sensor is mounted out of the flow, it creates no disturbance to normal flow patterns and does not affect site hydraulics.

Redundant flow depth data can be provided by a pressure depth sensor, and is independent from the ultrasonic level sensor. This sensor uses a piezo-resistive crystal to determine the difference between hydrostatic and atmospheric pressure. The pressure sensor is temperature compensated and vented to the atmosphere through a desiccant filled breather tube. Pressure depth sensors are typically used in large size channels and applications where surcharging is anticipated. Its streamlined shape minimizes flow distortion.

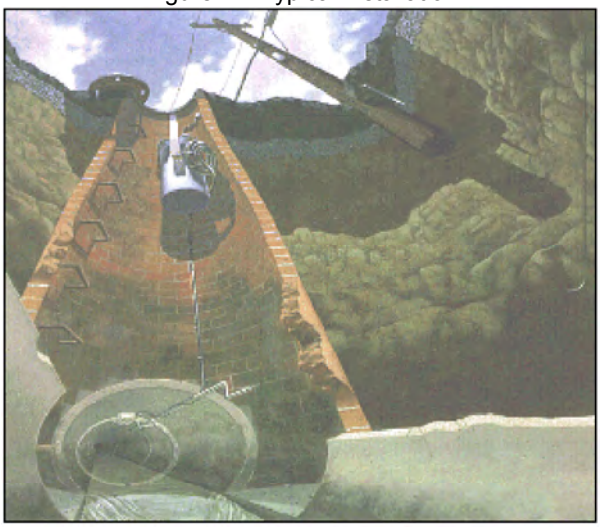
Velocity is measured using the ADS V-3 digital Doppler velocity sensor. This sensor measures velocity in the cross-sectional area of flow. An ultrasonic carrier is transmitted upstream into the flow, and is reflected by suspended particles, air bubbles, or organic matter with a frequency shift proportional to the velocity of the reflecting objects. The reflected signal is received by the sensor and processed using digital spectrum analysis to determine the peak flow velocity. Collected peak velocity information is filtered and processed using field confirmation information and proprietary software to determine the average velocity, which is used to calculate flow quantities. The sensor's small profile, measuring 1.5 inches by 1.15 inches by 0.50 inches thick, minimizes the affects on flow patterns and site hydraulics.

Installation

Installation of flow monitoring equipment typically proceeds in four steps. First, the site is investigated for safety and to determine physical and hydraulic suitability for the flow monitoring equipment. Second, the equipment is physically installed at the selected location. Third, the monitor is tested to assure proper operation of the velocity and depth of flow sensors and verify that the monitor clock is operational and synchronized to the master computer clock. Fourth, the depth and velocity sensors are confirmed and line confirmations are performed. A typical flow monitor installation is shown in Figure 2.1.

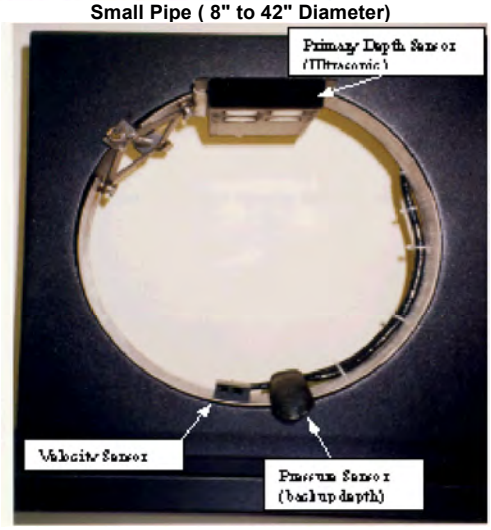
The installations depicted in Figures 2.1 are typical for circular or oval pipes up to approximately 104-inches in diameter or height. In installations into pipes 42-inches or less in diameter, depth and velocity sensors are mounted on an expandable stainless steel ring and installed one to two pipe diameters upstream of the pipe/manhole connection in the incoming sewer pipe. This reduces the affects of turbulence and backwater caused by the connection. In pipes larger than 42 inches in diameter, a special installation is made using two sections of the ring installed one to two feet upstream of the pipe/manhole connection; one bolted to the crown of the pipe for the depth sensor, and the other bolted to the bottom of the pipe (bolts are usually placed just above the water line) to hold the velocity sensor.

Figure 2.1 Typical Installation



Large Pipe (> 42" Diameter)

Small Pipe (8" to 42" Diameter)



Data Collection, Confirmation, and Quality Assurance

During the monitoring period, field crews visit each monitoring location to retrieve data, verify proper monitor operation, and document field conditions. The following quality assurance steps are taken to assure the integrity of the data collected:

- **Measure Power Supply:** The monitor is powered by a dry cell battery pack. Power levels are recorded and battery packs replaced, if necessary. A separate battery provides back-up power to memory, which allows the primary battery to be replaced without the loss of data.

- **Perform Pipe Line Confirmations and Confirm Depth and Velocity:** Once equipment and sensor installation is accomplished, a member of the field crew descends into the manhole to perform a field measurement of flow rate, depth and velocity to confirm they are in agreement with the monitor. Since the ADS V-3 velocity sensor measures peak velocity in the wetted cross-sectional area of flow, velocity profiles are also taken to develop a relationship between peak and average velocity in lines that meet the hydraulic criteria.

- **Measure Silt Level:** During site confirmation, a member of the field crew descends into the manhole and measures and records the depth of silt at the bottom of the pipe. This data is used to compute the true area of flow.

- **Confirm Monitor Synchronization:** The field crew checks the flow monitor's clock for accuracy.
- **Upload and Review Data:** Data collected by the monitor is uploaded and reviewed for comparison with previous data. All readings are checked for consistency and screened for deviations in the flow patterns, which indicate system anomalies or equipment failure.

Data Analysis and Presentation

Data Analysis
A flow monitor is typically programmed to collect data at either 15-minute or 5-minute intervals throughout the monitoring period. The monitor stores raw data consisting of (1) the air range (distance from sensor to top of flow) for each active ultrasonic depth sensor pair and (2) the peak velocity. If the monitor is equipped with a pressure sensor, then a depth reading from this sensor may also be stored. When the field personnel collects the data, the air range is converted to depth data based on the pipe height and physical offset (distance from the top of the pipe to the surface of the ultrasonic sensor). The data is imported into ADS's proprietary software and is examined by a data analyst to verify its integrity. The data analyst also reviews the daily field reports and site visit records to identify conditions that would affect the collected data.

Velocity profiles and the line confirmation data developed by the field personnel are reviewed by the data analyst to identify inconsistencies and verify data integrity. Velocity profiles are reviewed and an average to peak velocity ratio is calculated for the site. This ratio is used in converting the peak velocity measured by the sensor to the average velocity used in the Continuity equation. The data analyst selects which ultrasonic pairs and/or depth sensor entity will be used to calculate the final depth information. Silt levels present at each site visit are reviewed and representative silt levels established.
Selections for the above parameters can be constant or can change during the monitoring period. While the data analysis process is described in a linear manner, it often requires an iterative approach to accurately complete.

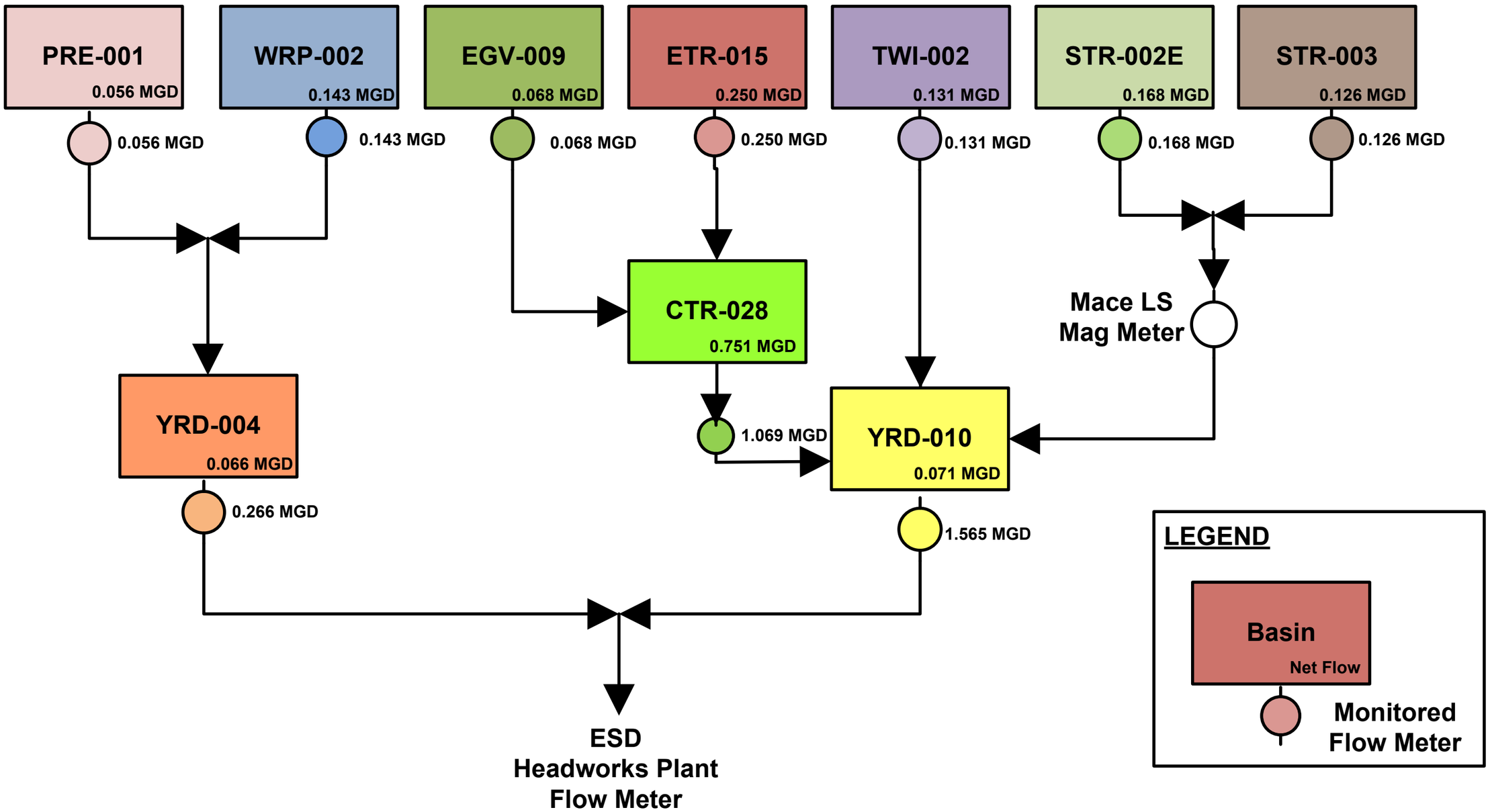
Data Presentation
This type of flow monitoring project generates a large volume of data. To facilitate review of the data, results have been provided in graphical and tabular formats. The flow data is presented graphically in the form of scattergraphs and hydrographs. The data depicted on the hydrograph is based on hourly averaged data. The table is provided in daily average format. The table shows the flow rate for each day, along with the daily minimum and maximums, the times they were observed, the total daily flow, and total flow for the month (or monitoring period). The following explanation of terms may aid in interpretation of the table and hydrograph.

DEPTH (DFINAL) - Final calculated depth measurement (in inches)
QUANTITY (QFINAL) - Final calculated flow rate (in MGD)

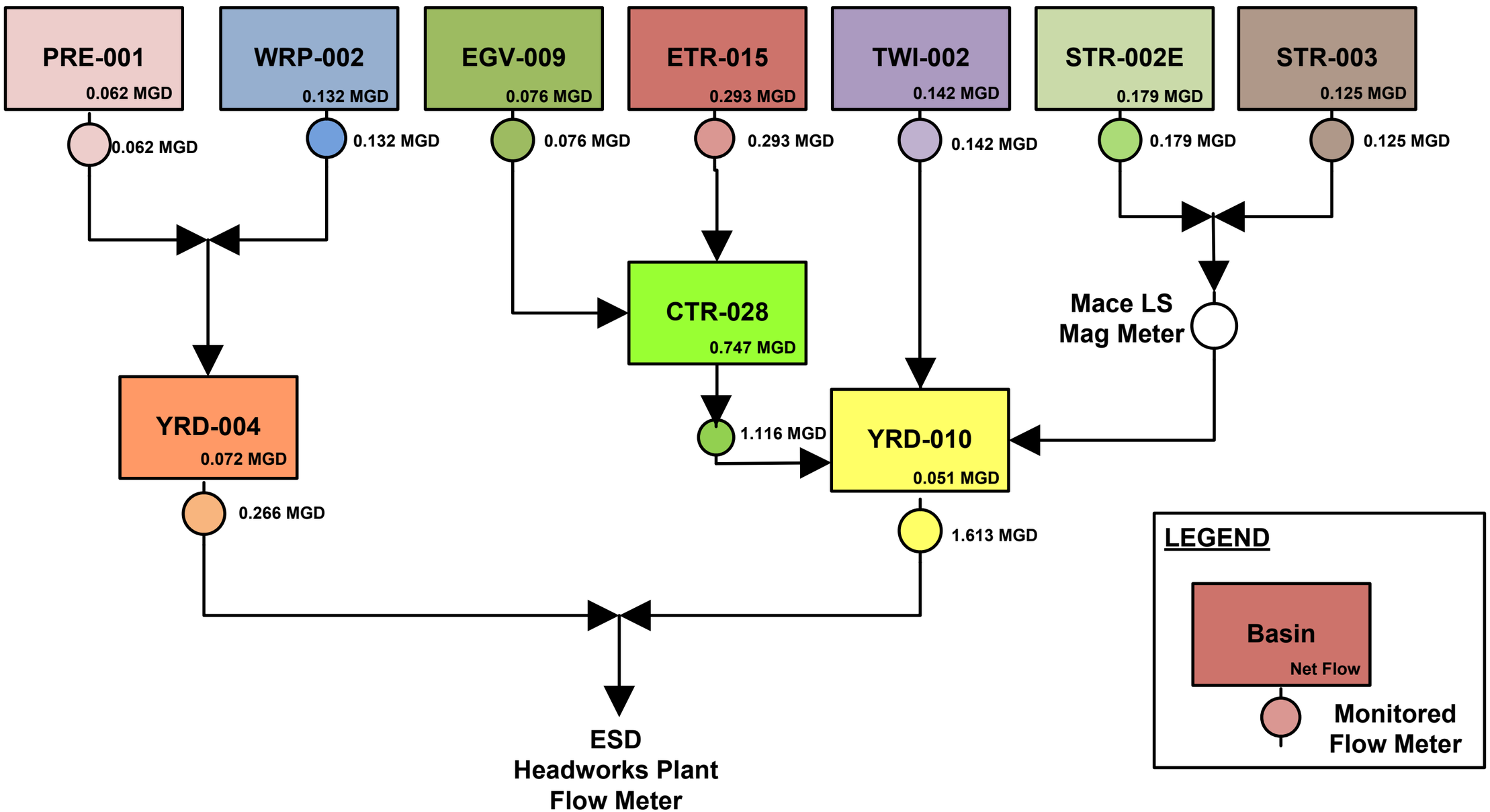
VELOCITY (VFINAL) - Final calculated flow velocity (in feet per second)

REPORT TOTAL - Total volume of flow recorded for the indicated time period (in MG)

Eagle Sewer District (ESD)
Flow Meter Schematic
Weekday



Eagle Sewer District (ESD)
Flow Meter Schematic
Weekend



Site Commentary

Site Information

CTR_028	
Pipe Height (in)	24
Silt Level (in)	0.00

Overview

Site CTR_028 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review o fhydrograph data for location CTR_028 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	6.29	2.48	1.069
Minimum	4.35	1.76	0.458
Maximum	8.07	2.98	1.697
Time of Minimum	4/8/2015 4:45 AM	4/17/2015 3:40 AM	4/10/2015 4:25 AM
Time of Maximum	4/21/2015 8:55 AM	4/12/2015 12:10 PM	4/21/2015 9:00 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

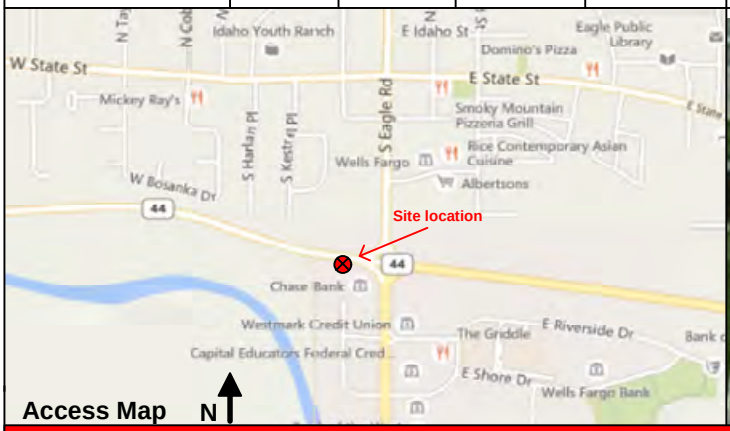
A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below:

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
CTR028	1.573	1.069	1.116	0.751	0.747	1.47	1.41	0.264	0.256

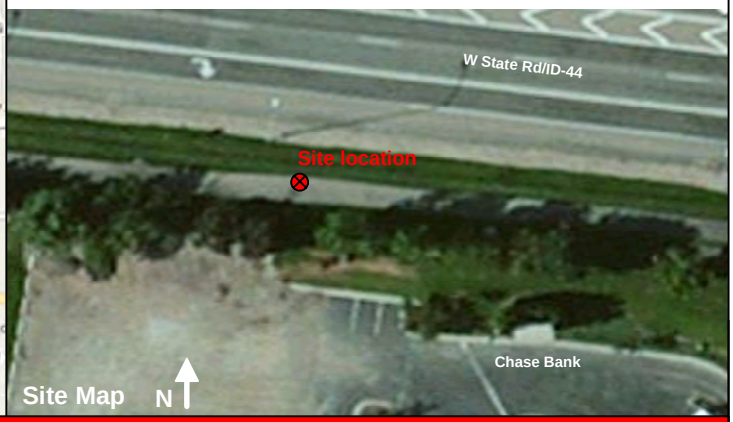
ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	CTR_028	**Monitor Series:**	5000-AG	**Monitor S/N:**	21563
Address/Location:	W State Rd & Eagle Rd (on trail N of Chase bank)			**Manhole #**	CTR-028
				GPS	43.690798°; -116.355224°
				Pipe Height:	24.00"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	23.75"
				IP Address:	166.219.48.119



Access Map

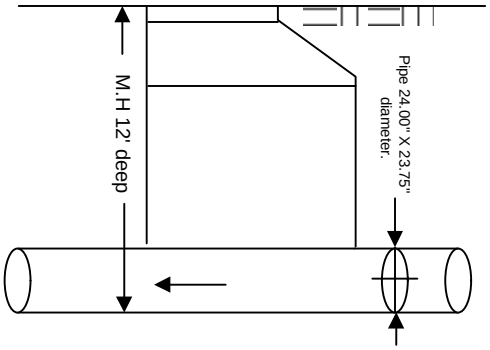


Site Map

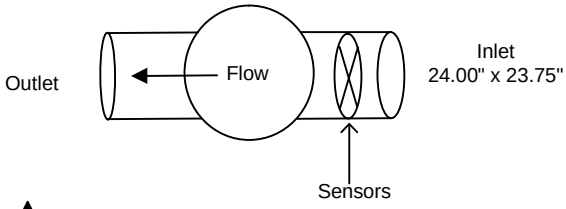
Investigation Information:

Date/Time of Investigation:	03/31/15 @ 14:59	**Manhole Depth:**	12'
Site Hydraulics:	Small waves with moderate velocity	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)	Liftstation	**Pipe Material / Condition:**	Concrete/ Good
Upstream Manhole:	1 inlet / 1 outlet	**Mini System Character:**	Residential [X] Commercial [X] Industrial [ ] Trunk [X]
Downstream Manhole:	1 inlet / 1 outlet	**Telephone Information:**	Does not apply
Depth of Flow:	6.13" +/- 0.38"	**Access Pole #:**	Does not apply
Range (Air DOF):	17.88" +/- 0.38"	**Distance From Manhole:**	Does not apply Feet
Peak Velocity:	2.70 fps	**Road Cut Length:**	Does not apply Feet
Silt:	0.00"	**Trench Length:**	Does not apply Feet

Other Information:



Cross Section



Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_LM	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** CTR_028	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway.	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	X
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

Site located on paved trail, make sure to create a barrier between pedestrians and work zone.

*** Site Classification**

	Class	Description
X	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No Site Specific Safety Requirements

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

- X This worksite does NOT require a traffic control Plan
- ☐ Standard Traffic Control Plan is to be used at this work site
- ☐ This site requires a special Traffic Control Plan which is attached

Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: *Sean Winder*	Signature: *Mike Pina*
Date: 3/31/15	Date: 3/31/15

SCATTERGRAPH REPORT

CTR_028

Flow Monitor

CTR_028

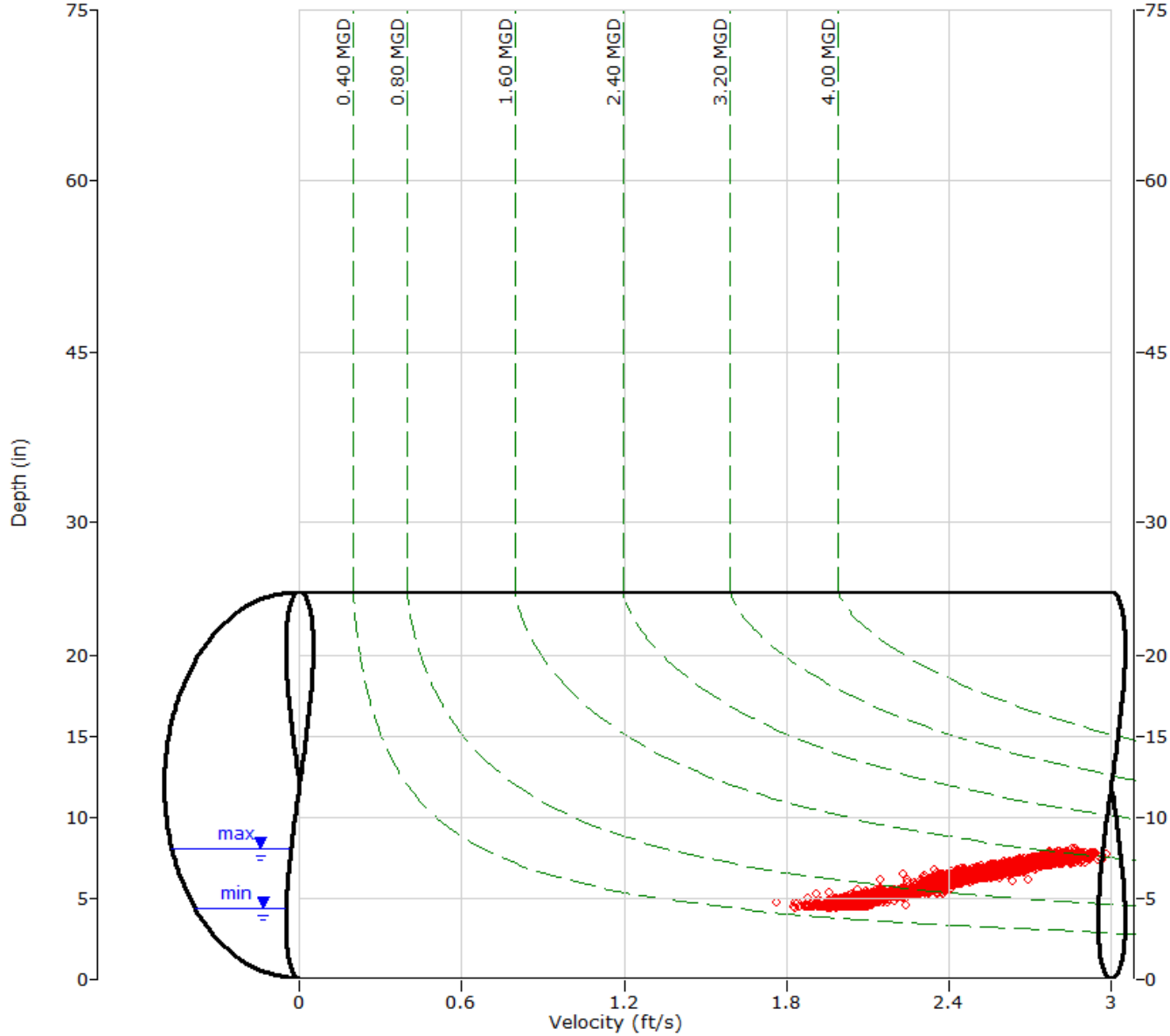
Pipe Height
24.00 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

CTR_028

Flow Monitor

CTR_028

Pipe Height
24.00 in

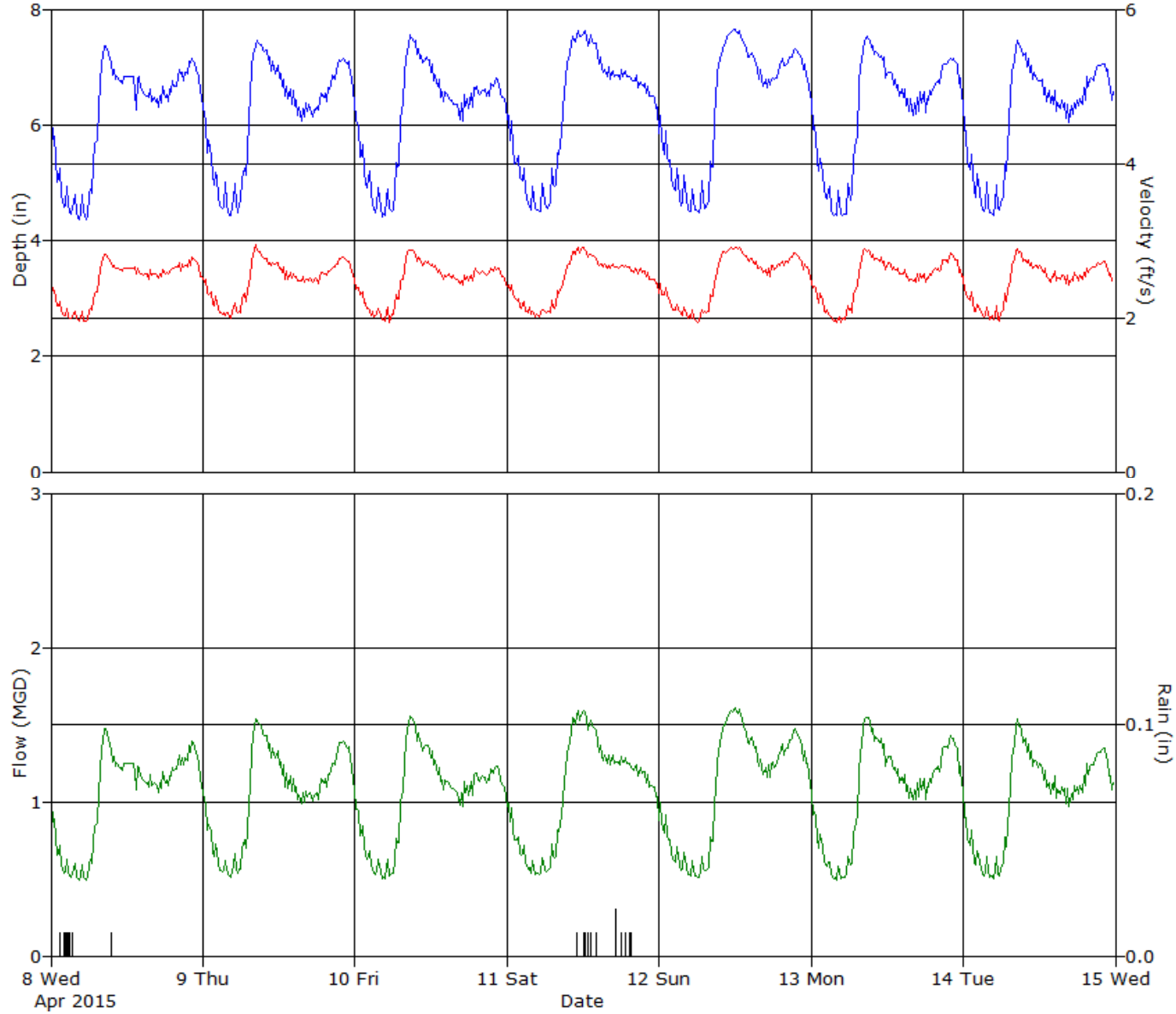
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

CTR_028

Flow Monitor

CTR_028

Pipe Height
24.00 in

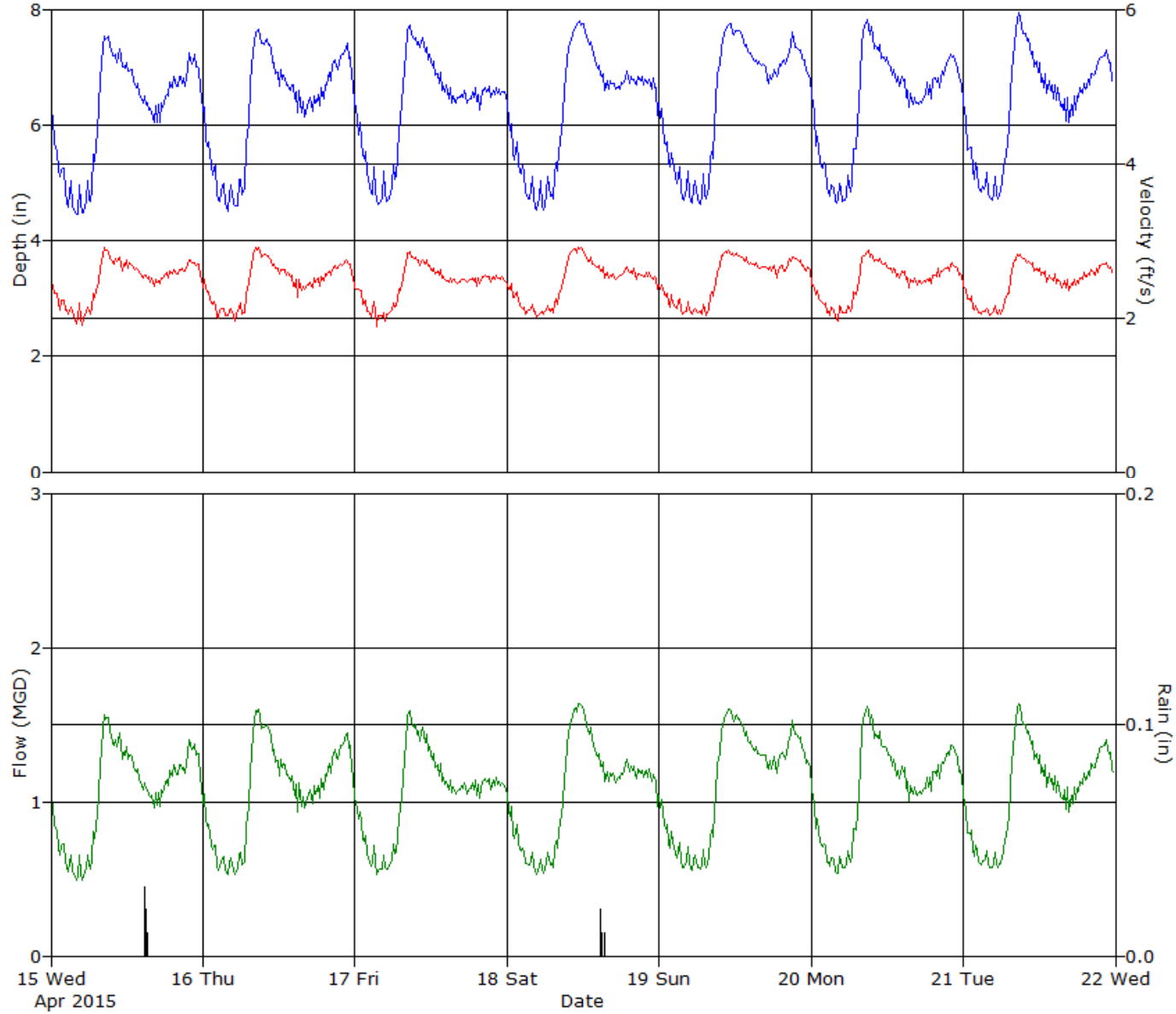
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

CTR_028, Pipe Height: 24 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	04:45	4.35	08:30	7.44	6.18	05:25	1.87	08:30	2.84	2.47	04:45	0.484	08:30	1.505	1.040	1.040	0.08
4/9/2015	04:35	4.41	08:40	7.52	6.23	04:35	1.95	08:20	2.96	2.49	04:35	0.494	08:40	1.546	1.057	1.057	
4/10/2015	04:25	4.37	08:50	7.58	6.19	04:25	1.83	08:40	2.92	2.47	04:25	0.458	08:50	1.572	1.041	1.041	
4/11/2015	03:45	4.49	12:00	7.68	6.29	04:00	1.97	11:10	2.95	2.49	05:10	0.518	12:00	1.626	1.077	1.077	0.12
4/12/2015	06:25	4.47	12:10	7.70	6.34	06:10	1.91	12:10	2.98	2.52	06:10	0.501	12:10	1.658	1.107	1.107	
4/13/2015	03:35	4.41	08:45	7.56	6.27	03:30	1.85	09:00	2.93	2.50	03:30	0.476	09:00	1.573	1.071	1.071	
4/14/2015	04:45	4.41	08:35	7.55	6.18	04:55	1.82	08:30	2.91	2.47	04:55	0.467	08:35	1.567	1.038	1.038	
4/15/2015	04:15	4.43	09:00	7.59	6.24	05:00	1.88	08:30	2.92	2.48	04:00	0.488	08:35	1.579	1.057	1.057	0.06
4/16/2015	04:15	4.49	08:30	7.71	6.33	05:00	1.91	08:20	2.93	2.47	05:00	0.506	08:20	1.616	1.071	1.071	
4/17/2015	03:55	4.62	08:45	7.76	6.31	03:40	1.76	08:25	2.89	2.44	03:40	0.488	08:25	1.615	1.052	1.052	
4/18/2015	04:55	4.50	11:35	7.82	6.30	04:55	1.95	12:00	2.94	2.47	04:55	0.508	12:00	1.666	1.068	1.068	0.04
4/19/2015	06:30	4.61	11:15	7.77	6.45	07:30	1.98	09:55	2.89	2.51	07:35	0.549	11:10	1.616	1.126	1.126	
4/20/2015	03:55	4.62	08:45	7.87	6.39	04:15	1.83	09:05	2.90	2.47	04:15	0.503	08:45	1.651	1.086	1.086	
4/21/2015	04:35	4.69	08:55	8.07	6.37	04:20	1.99	09:00	2.86	2.45	04:20	0.559	09:00	1.697	1.072	1.071	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			14.962	0.30
Avg	6.29	2.48	1.069	

Site Commentary

Site Information

EGV_009	
Pipe Height (in)	9.75
Silt Level (in)	0.00

Overview

Site EGV_009 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review of hydrograph data for location EGV_009 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	2.27	1.07	0.070
Minimum	0.99	0.43	0.008
Maximum	3.45	1.51	0.162
Time of Minimum	4/15/2015 3:50 AM	4/16/2015 3:25 AM	4/15/2015 3:50 AM
Time of Maximum	4/19/2015 10:15 AM	4/19/2015 10:15 AM	4/19/2015 10:15 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below:

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
EGV009	0.134	0.067	0.076	0.067	0.076	2.00	1.76	0.013	0.015

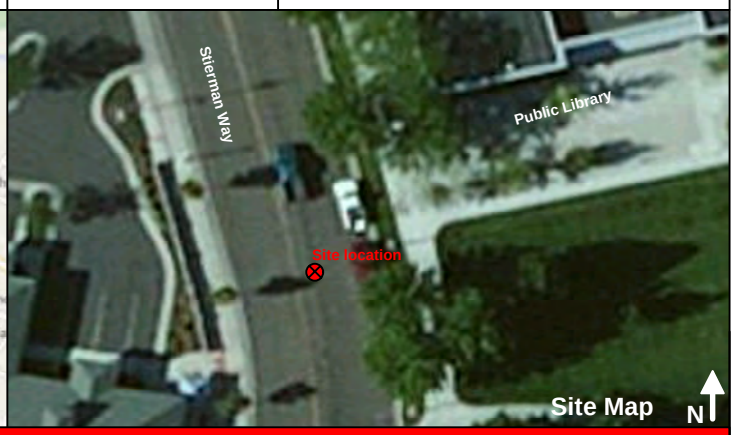
ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW

Site Name: EGV_009	**Monitor Series:** 5000-AG	**Monitor S/N:**	21560
Address/Location: 100 Stierman Way (by library in road)		**Manhole #**	EGV-009
		GPS	43.695723°; -116.347225°
		Pipe Height:	9.75"
Access: Drive	**Type of System:** Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	9.88"
		IP Address:	166.219.48.109

Access Map



Site Map

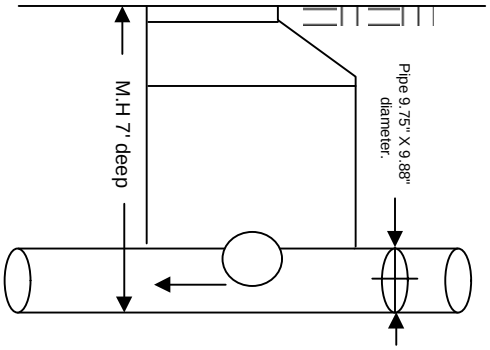
Investigation Information:

Date/Time of Investigation:	04/01/15 @ 15:57
Site Hydraulics:	Smooth flow with moderate velocity
Upstream Input: (L/S, P/S)	Not influenced
Upstream Manhole:	1 inlet / 1 outlet
Downstream Manhole:	1 inlet / 1 outlet (90 degree bend)
Depth of Flow:	2.50" +/- 0.38"
Range (Air DOF):	6.25" +/- 0.38"
Peak Velocity:	1.30 fps
Silt:	0.00"

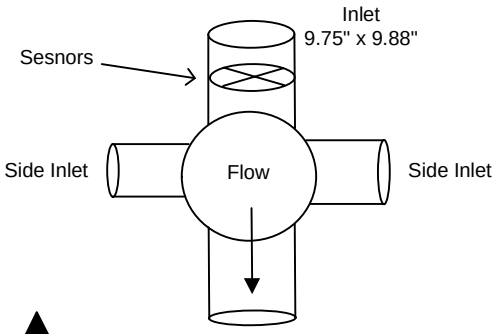
Manhole Information:

Manhole Depth:	7'			
Manhole Material / Condition	Concrete / Good			
Pipe Material / Condition:	PVC/ Good			
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]
Telephone Information:	Does not apply			
Access Pole #:	Does not apply			
Distance From Manhole:	Does not apply	Feet		
Road Cut Length:	Does not apply	Feet		
Trench Length:	Does not apply	Feet		

Other Information:



Cross Section



Planar

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_LM	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** EGV_009	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	X
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

Manhole doesn't have rungs, need to setup self rescue retrieval equipment

*** Site Classification**

	Class	Description
☐	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
X	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

Need to contact RJ w/ the district at 208-941-5382 at least 24hrs prior to access so he can place no parking signs

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

- ☐ This worksite does NOT require a traffic control Plan
- X Standard Traffic Control Plan TA-15 is to be used at this work site
- ☐ This site requires a special Traffic Control Plan which is attached

Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: *Sean Winder*	Signature: Mike Pina
Date: 4/1/15	Date: 4/1/15

SCATTERGRAPH REPORT

EGV_009

Flow Monitor

EGV_009

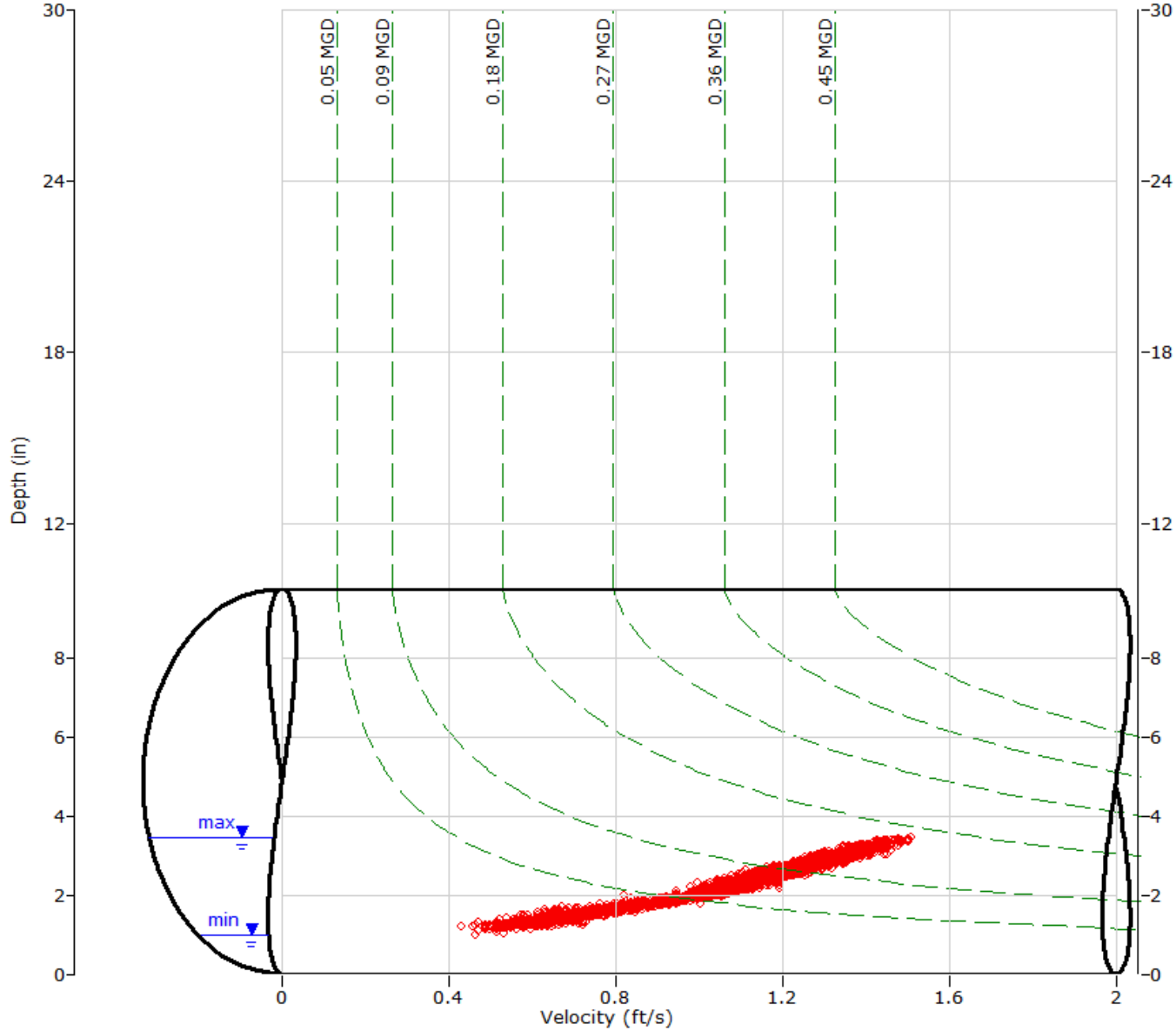
Pipe Height
9.75 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



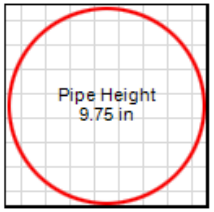
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

EGV_009

Flow Monitor

EGV_009



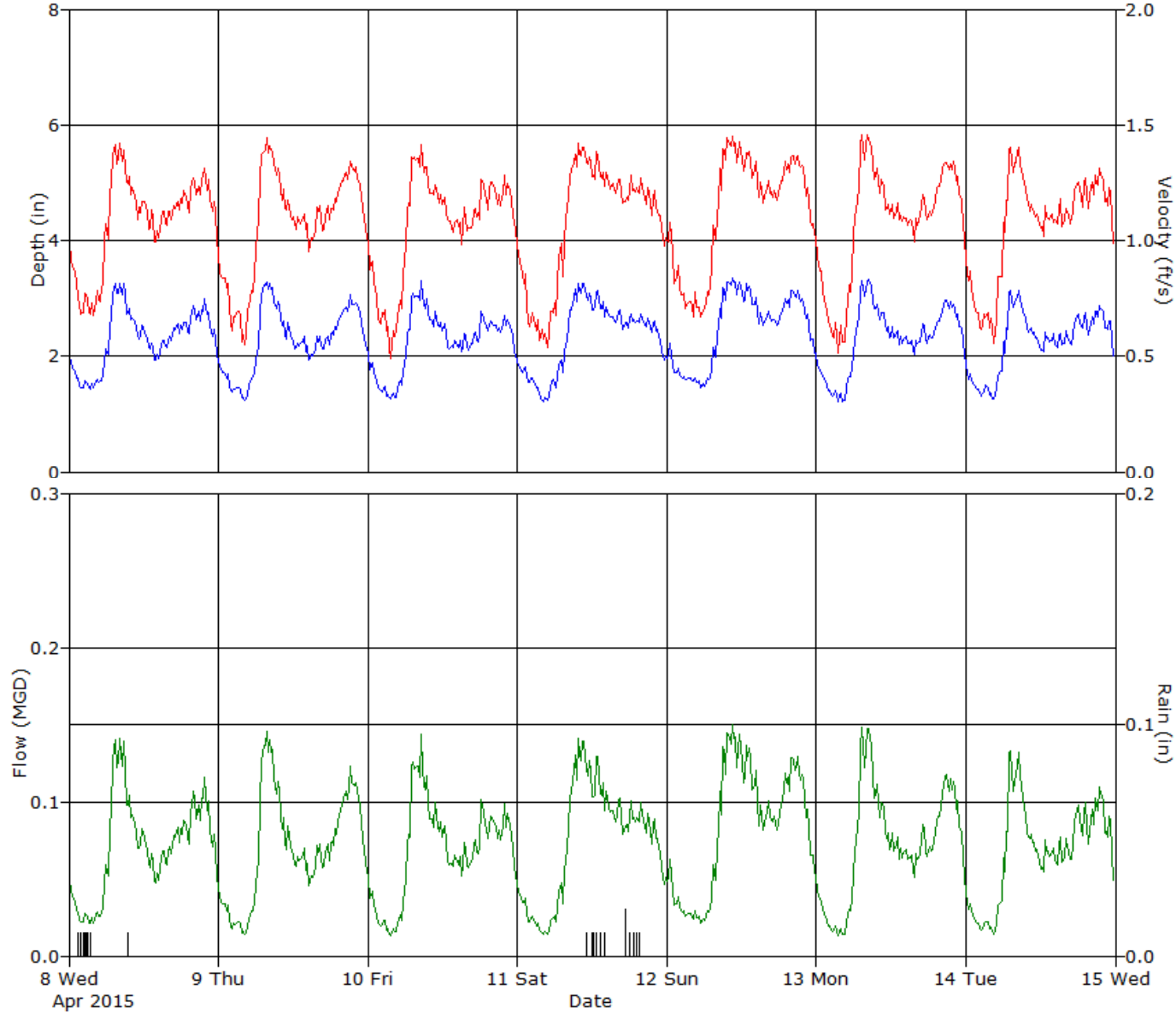
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



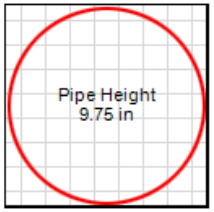
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

EGV_009

Flow Monitor

EGV_009



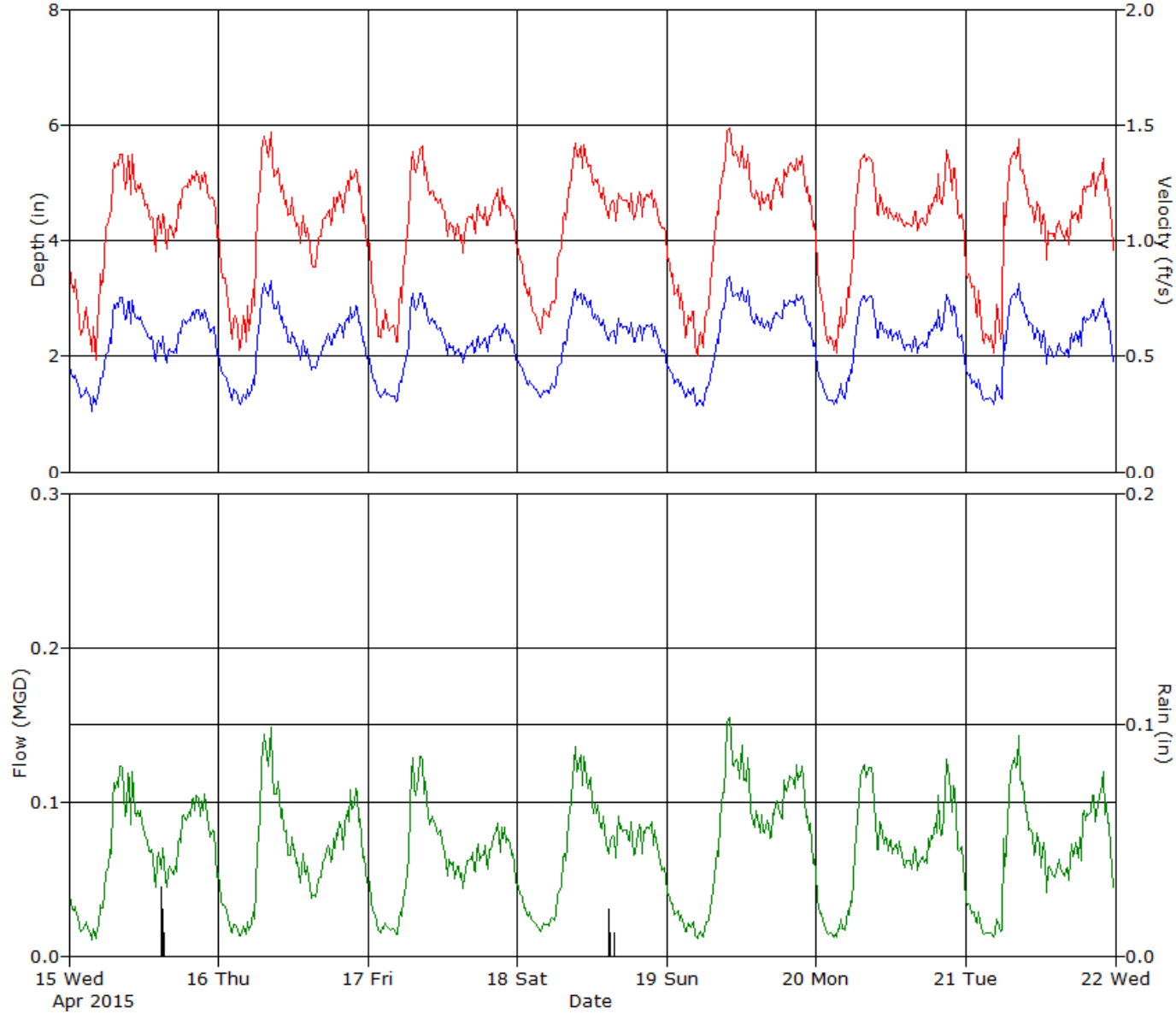
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

EGV_009, Pipe Height: 9.75 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	03:25	1.43	08:50	3.39	2.31	02:20	0.62	08:50	1.44	1.08	03:25	0.019	08:50	0.152	0.071	0.071	0.08
4/9/2015	04:25	1.21	07:50	3.40	2.28	03:55	0.53	07:55	1.49	1.07	04:25	0.013	07:50	0.156	0.070	0.070	
4/10/2015	02:30	1.13	08:30	3.38	2.25	03:45	0.46	07:40	1.45	1.06	02:30	0.011	08:30	0.152	0.068	0.068	
4/11/2015	04:20	1.16	10:50	3.31	2.34	03:35	0.52	09:50	1.44	1.08	04:20	0.012	10:50	0.146	0.074	0.074	0.12
4/12/2015	06:15	1.34	11:50	3.39	2.48	04:15	0.59	10:35	1.49	1.13	06:15	0.018	10:35	0.155	0.083	0.083	
4/13/2015	04:30	1.18	08:35	3.39	2.31	04:30	0.46	08:20	1.50	1.08	04:30	0.011	08:20	0.155	0.072	0.072	
4/14/2015	04:25	1.20	07:15	3.33	2.25	04:30	0.52	07:10	1.49	1.06	04:30	0.013	07:15	0.152	0.068	0.068	
4/15/2015	03:50	0.99	07:40	3.12	2.24	04:25	0.46	10:15	1.44	1.07	03:50	0.008	07:40	0.133	0.068	0.068	0.06
4/16/2015	03:30	1.12	08:35	3.38	2.19	03:25	0.43	08:35	1.50	1.05	03:25	0.010	08:35	0.157	0.065	0.065	
4/17/2015	04:40	1.17	08:30	3.25	2.15	04:45	0.49	08:30	1.47	1.04	04:45	0.012	08:30	0.146	0.062	0.062	
4/18/2015	03:50	1.27	09:20	3.19	2.24	03:50	0.58	10:50	1.46	1.07	03:50	0.015	09:20	0.139	0.068	0.068	0.04
4/19/2015	05:50	1.14	10:15	3.45	2.36	05:00	0.46	10:15	1.51	1.09	05:00	0.011	10:15	0.162	0.077	0.077	
4/20/2015	02:55	1.12	21:05	3.13	2.23	03:20	0.49	21:00	1.40	1.05	03:20	0.011	21:05	0.131	0.067	0.067	
4/21/2015	05:45	1.04	08:35	3.31	2.21	05:40	0.47	08:35	1.49	1.04	05:40	0.010	08:35	0.151	0.066	0.066	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			0.980	0.30
Avg	2.27	1.07	0.070	

Site Commentary

Site Information

ETR_015	
Pipe Height (in)	14.25
Silt Level (in)	0.00

Overview

Site ETR_015 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review of hydrograph data for location ETR_015 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	4.12	1.40	0.259
Minimum	2.34	0.66	0.056
Maximum	6.25	2.05	0.606
Time of Minimum	4/21/2015 3:05 AM	4/18/2015 6:15 AM	4/18/2015 6:15 AM
Time of Maximum	4/14/2015 7:55 AM	4/9/2015 8:05 AM	4/14/2015 7:55 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

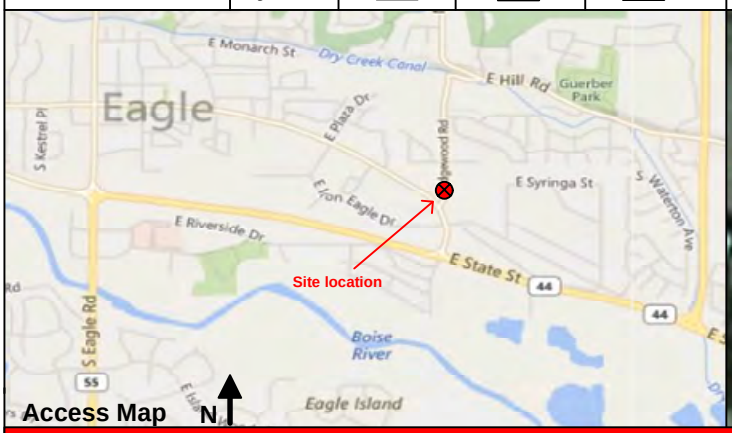
A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below:

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
ETR015	0.489	0.250	0.293	0.250	0.293	1.96	1.67	0.048	0.044

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	ETR_015	**Monitor Series:**	5000-AG	**Monitor S/N:**	21809
Address/Location:	320 Edgewood Rd (behind Buster's)			**Manhole #**	ETR-015
				GPS	43.691526°; -116.334096°
				Pipe Height:	14.25"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	14.25"
				IP Address:	166.219.49.128



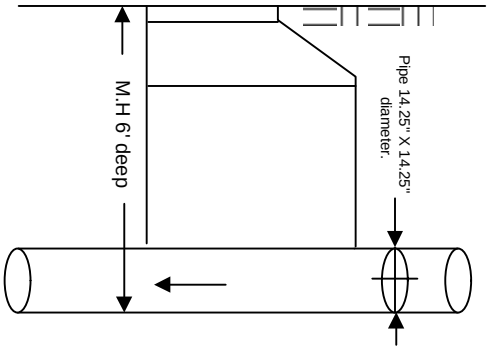
Access Map

Site Map

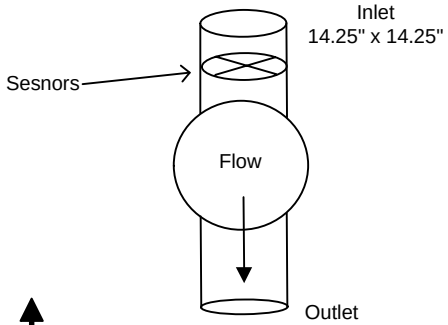
Investigation Information:

Date/Time of Investigation:	04/01/15 @ 14:21	**Manhole Depth:**	6'
Site Hydraulics:	Small waves and moderate velocity	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)	Not influenced	**Pipe Material / Condition:**	PVC/ Good
Upstream Manhole:	2 inlets / 1 outlet	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	2 inlets / 1 outlet	**Telephone Information:**	Does not apply
Depth of Flow:	3.63" +/- 0.38"	**Access Pole #:**	Does not apply
Range (Air DOF):	10.63" +/- 0.38"	**Distance From Manhole:**	Does not apply Feet
Peak Velocity:	1.38 fps	**Road Cut Length:**	Does not apply Feet
Silt:	0.00"	**Trench Length:**	Does not apply Feet

Other Information:



Cross Section



Planar

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_LM	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** ETR_015	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards outside the norm found at this site

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this site

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a traffic control Plan
☐ Standard Traffic Control Plan is to be used at this work site
☐ This site requires a special Traffic Control Plan which is attached

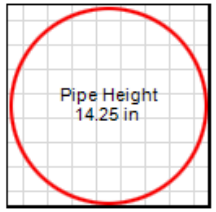
Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: *Sean Winder*	Signature: *Mike Pina*
Date: 4/1/15	Date: 4/1/15

SCATTERGRAPH REPORT

ETR_015

Flow Monitor

ETR_015

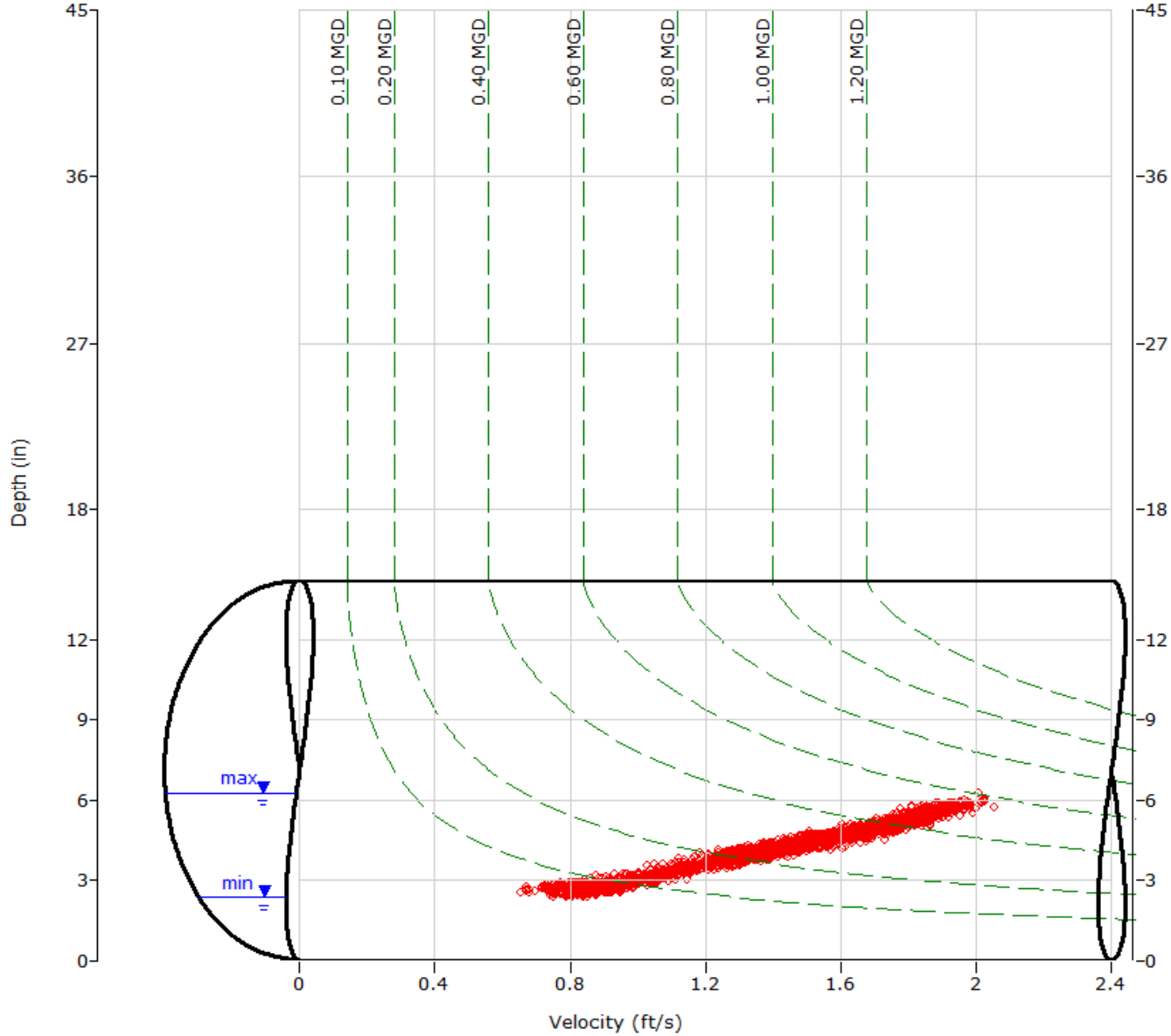


Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



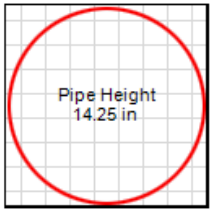
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

ETR_015

Flow Monitor

ETR_015



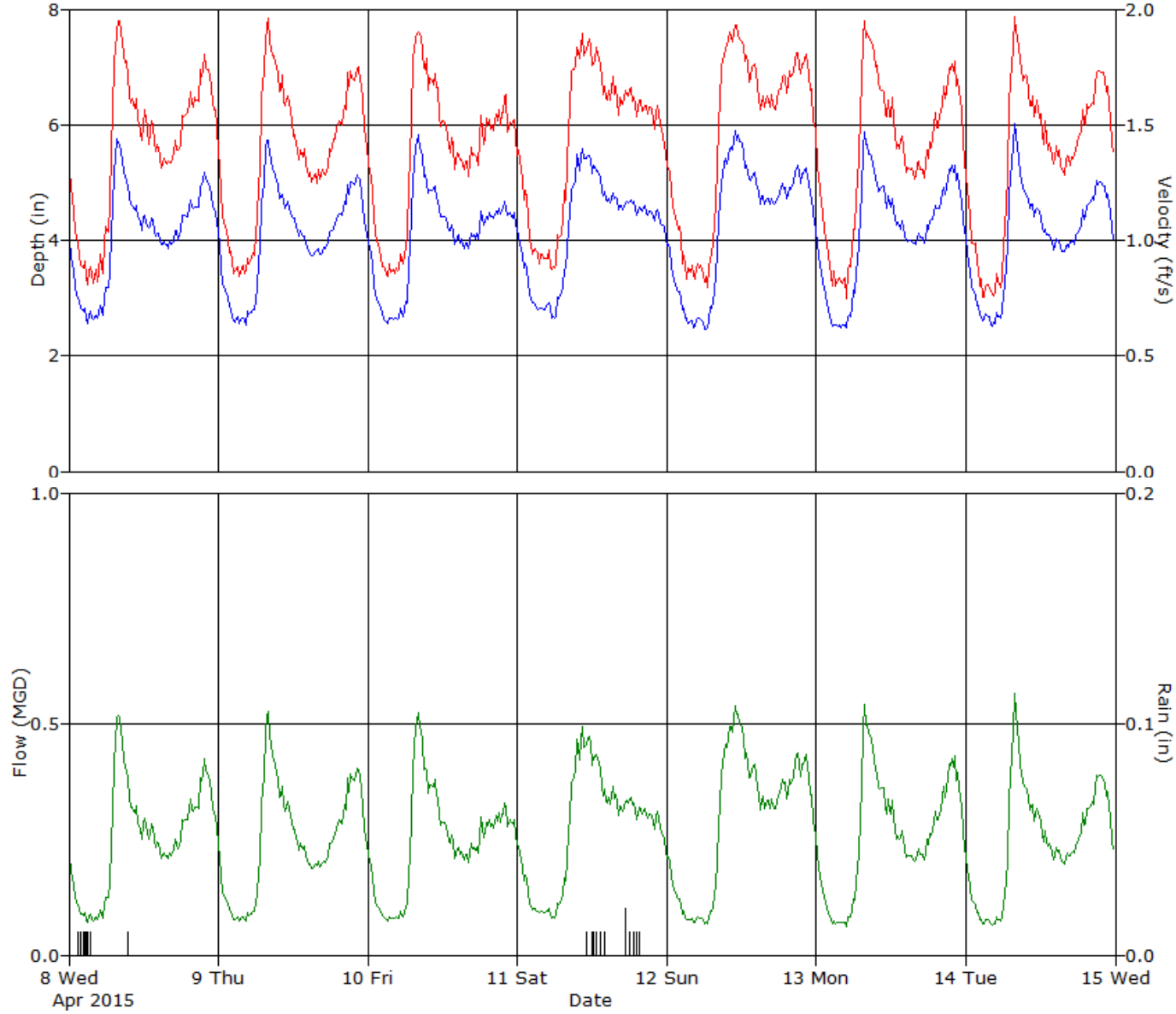
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



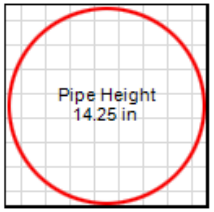
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

ETR_015

Flow Monitor

ETR_015



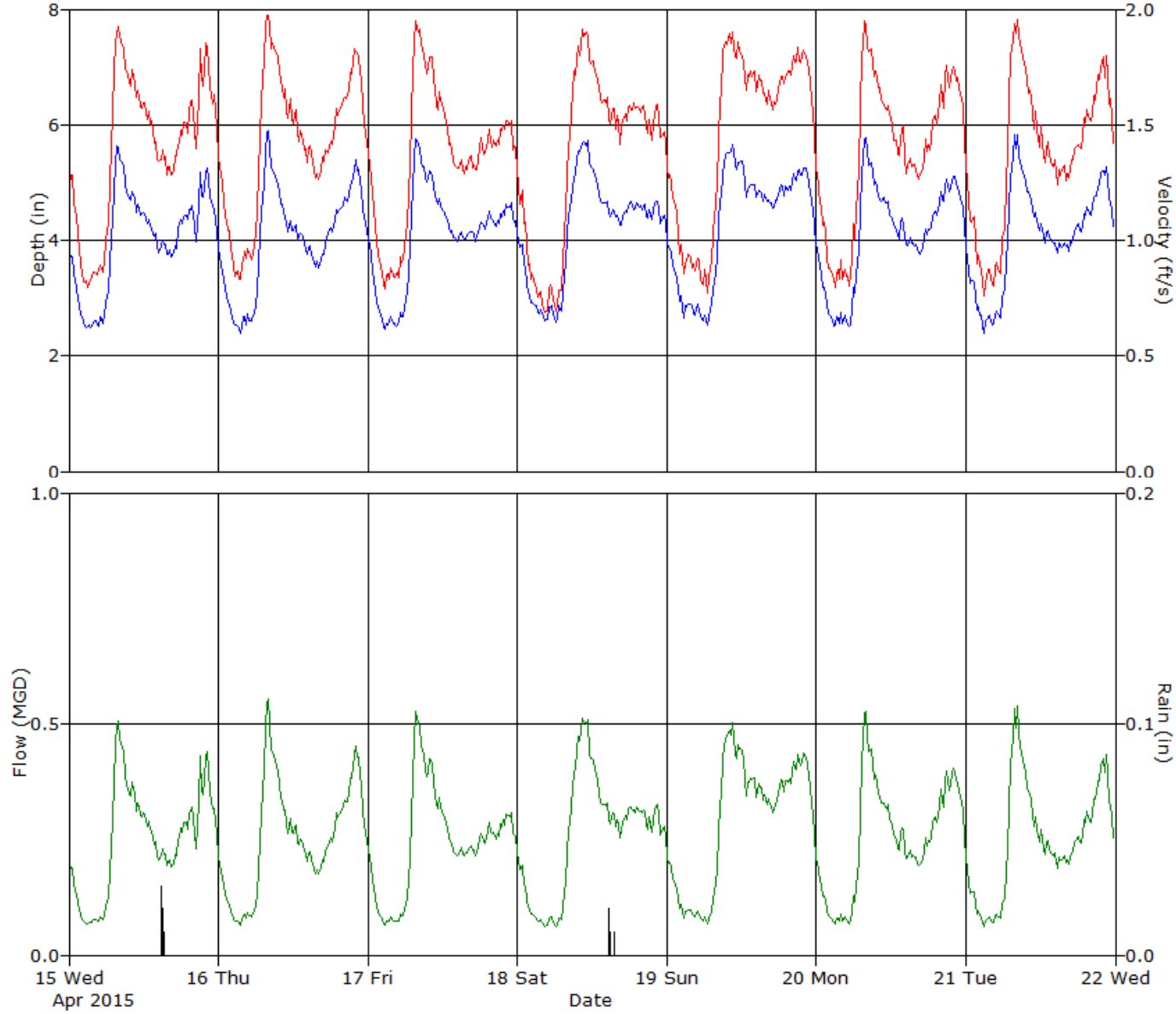
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

ETR_015, Pipe Height: 14.25 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	03:15	2.47	07:55	5.85	4.10	03:10	0.77	08:20	1.97	1.40	03:10	0.065	07:55	0.534	0.255	0.255	0.08
4/9/2015	03:25	2.48	08:00	5.95	4.06	02:40	0.82	08:05	2.05	1.38	03:25	0.071	08:00	0.552	0.248	0.248	
4/10/2015	03:10	2.49	08:00	5.90	4.05	04:00	0.81	08:00	1.94	1.38	03:15	0.071	08:00	0.542	0.246	0.246	
4/11/2015	05:35	2.62	10:40	5.62	4.22	03:40	0.84	10:30	1.94	1.44	05:40	0.079	10:30	0.509	0.274	0.274	0.12
4/12/2015	06:05	2.43	11:05	5.90	4.32	06:40	0.79	11:15	2.01	1.47	06:40	0.064	11:15	0.558	0.295	0.295	
4/13/2015	04:45	2.44	07:50	5.97	4.15	04:45	0.74	07:40	1.98	1.38	04:45	0.061	07:50	0.559	0.259	0.259	
4/14/2015	04:15	2.45	07:55	6.25	4.06	03:00	0.72	08:00	2.02	1.37	04:15	0.062	07:55	0.606	0.248	0.248	
4/15/2015	02:50	2.43	07:55	5.79	4.03	02:30	0.79	08:05	1.98	1.40	02:30	0.065	08:05	0.525	0.251	0.251	0.06
4/16/2015	03:35	2.37	07:55	5.98	4.02	03:40	0.81	07:55	2.02	1.42	03:40	0.064	07:55	0.576	0.253	0.253	
4/17/2015	02:50	2.39	08:10	5.84	4.05	02:35	0.78	08:15	2.00	1.36	02:50	0.063	08:10	0.539	0.243	0.243	
4/18/2015	06:15	2.53	10:50	5.82	4.18	06:15	0.66	10:30	1.94	1.36	06:15	0.056	10:40	0.519	0.260	0.260	0.04
4/19/2015	06:30	2.52	10:40	5.81	4.31	06:35	0.74	11:35	1.95	1.47	06:35	0.064	10:40	0.533	0.291	0.291	
4/20/2015	05:20	2.46	08:00	5.84	4.09	03:00	0.79	08:00	1.98	1.39	05:20	0.066	08:00	0.548	0.254	0.254	
4/21/2015	03:05	2.34	08:20	5.91	4.07	03:00	0.75	08:20	2.01	1.37	03:05	0.058	08:20	0.565	0.250	0.250	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			3.627	0.30
Avg	4.12	1.40	0.259	

Site Commentary

Site Information

PRE_001	
Pipe Height (in)	23
Silt Level (in)	0.00

Overview

Site PRE_001 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review ofhydrograph data for location PRE_001 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	2.18	0.60	0.059
Minimum	1.36	0.26	0.014
Maximum	3.09	0.87	0.129
Time of Minimum	4/11/2015 6:05 AM	4/19/2015 6:00 AM	4/18/2015 7:40 AM
Time of Maximum	4/19/2015 11:55 AM	4/11/2015 5:25 PM	4/19/2015 11:55 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

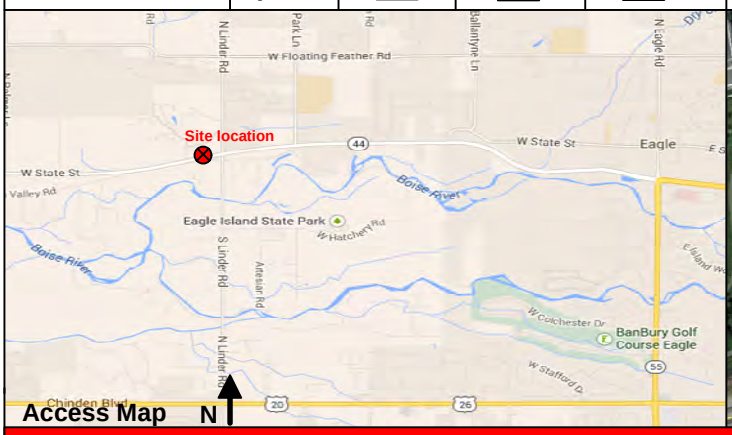
A dry weather analysis was conducted on the site to determine the Net Basein Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
PRE001	0.108	0.056	0.062	0.056	0.062	1.93	1.74	0.020	0.017

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	PRE_001	**Monitor Series:**	5000-AG	**Monitor S/N:**	21494
Address/Location:	Located on grass hill north of W State Rd And west of N. Linder Rd (next to trail)			**Manhole #**	PRE-001
				GPS	43.693995°; -116.416533°
				Pipe Height:	23.00"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	22.75"
				IP Address:	166.219.49.163



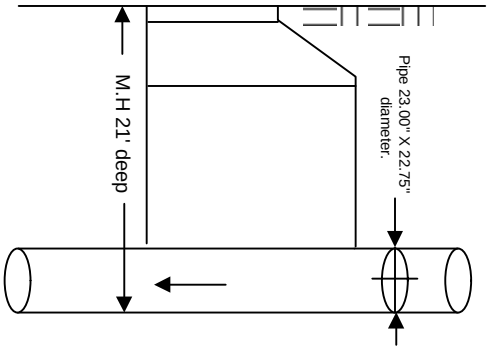
Access Map N

Site Map N

Investigation Information:

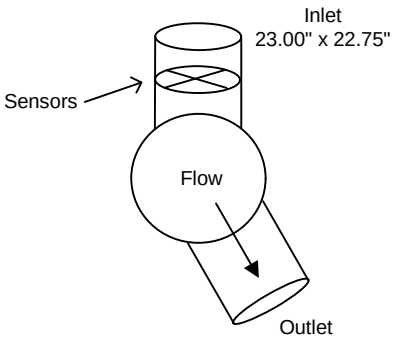
Date/Time of Investigation:	03/31/15 @ 06:49	**Manhole Depth:**	21'
Site Hydraulics:	Smooth and slow moving flow	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)	Not influenced	**Pipe Material / Condition:**	PVC/ Good
Upstream Manhole:	1 inlet / 1 outlet	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [ ]
Downstream Manhole:	1 inlet / 1 outlet	**Telephone Information:**	Does not apply
Depth of Flow:	2.25" +/- 0.38"	**Access Pole #:**	Does not apply
Range (Air DOF):	20.75" +/- 0.38"	**Distance From Manhole:**	Does not apply Feet
Peak Velocity:	0.70 fps	**Road Cut Length:**	Does not apply Feet
Silt:	0.00"	**Trench Length:**	Does not apply Feet

Other Information:



N

Cross Section



Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[ ]	[X]	D/S ~300'
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_OV	Other	[ ]	[ ]	[X]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** PRE_001	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☒
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

Worksite located on grass hillside, make sure to offset Tripod legs so that tripod is level for entry. Be sure of footing while working around site

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

- ☒ This worksite does NOT require a traffic control Plan
- ☐ Standard Traffic Control Plan is to be used at this work site
- ☐ This site requires a special Traffic Control Plan which is attached

Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: Sean Winder	Signature: Mike Pina
Date: 3/31/15	Date: 3/31/15

SCATTERGRAPH REPORT

PRE_001

Flow Monitor

PRE_001

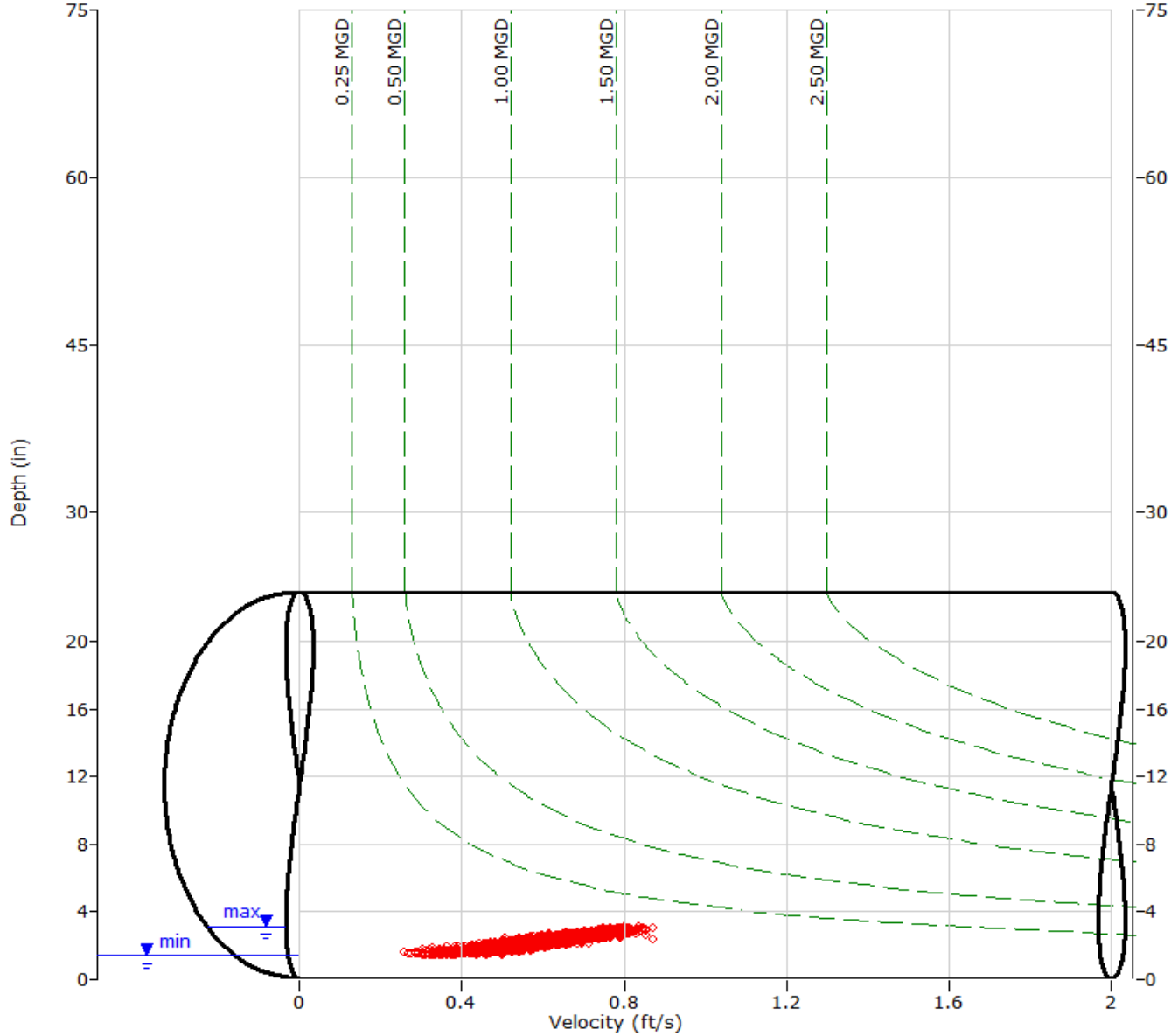
Pipe Height
23.00 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



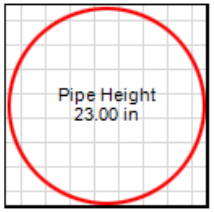
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

PRE_001

Flow Monitor

PRE_001



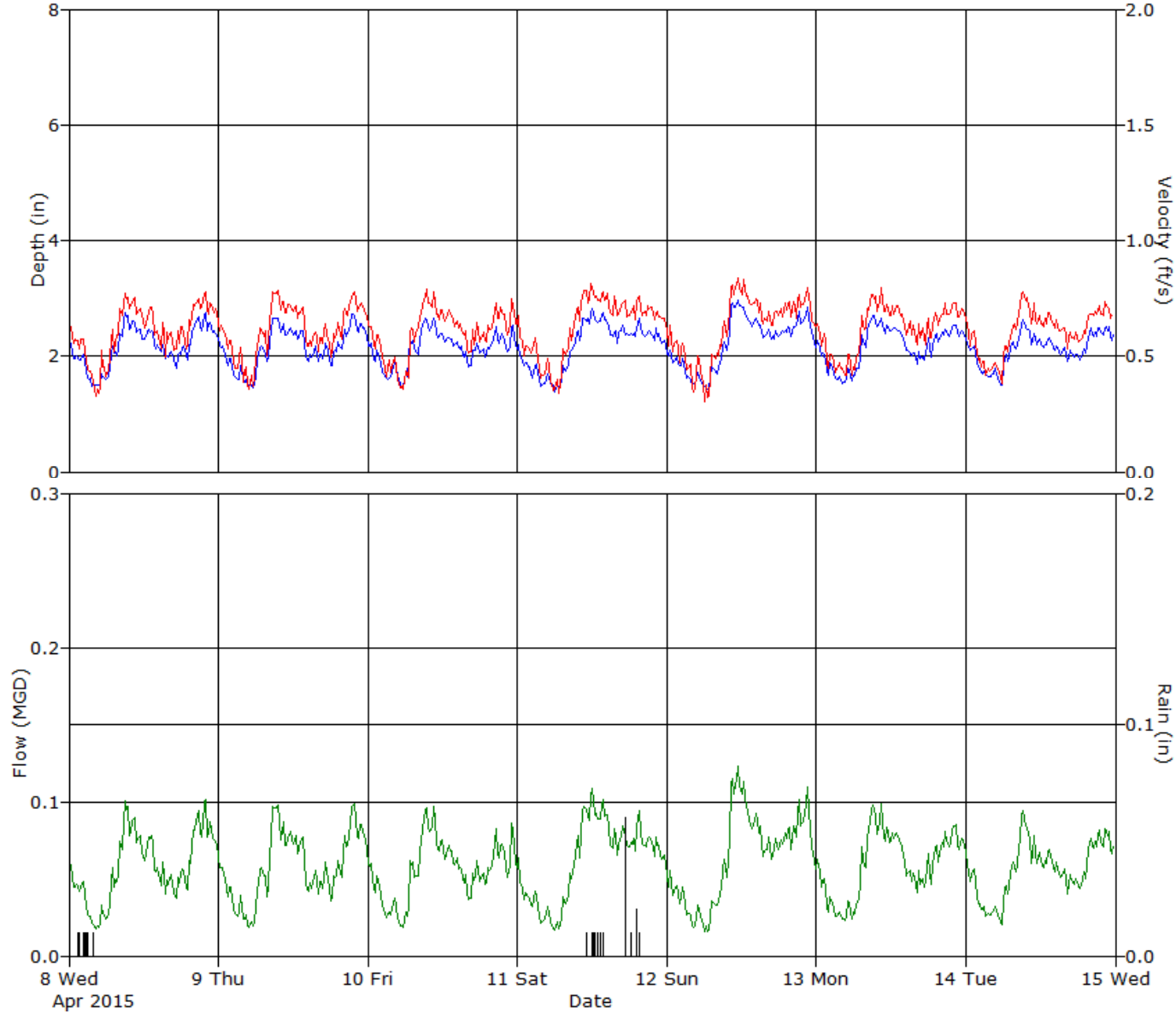
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_OV



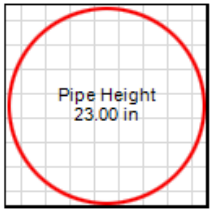
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

PRE_001

Flow Monitor

PRE_001



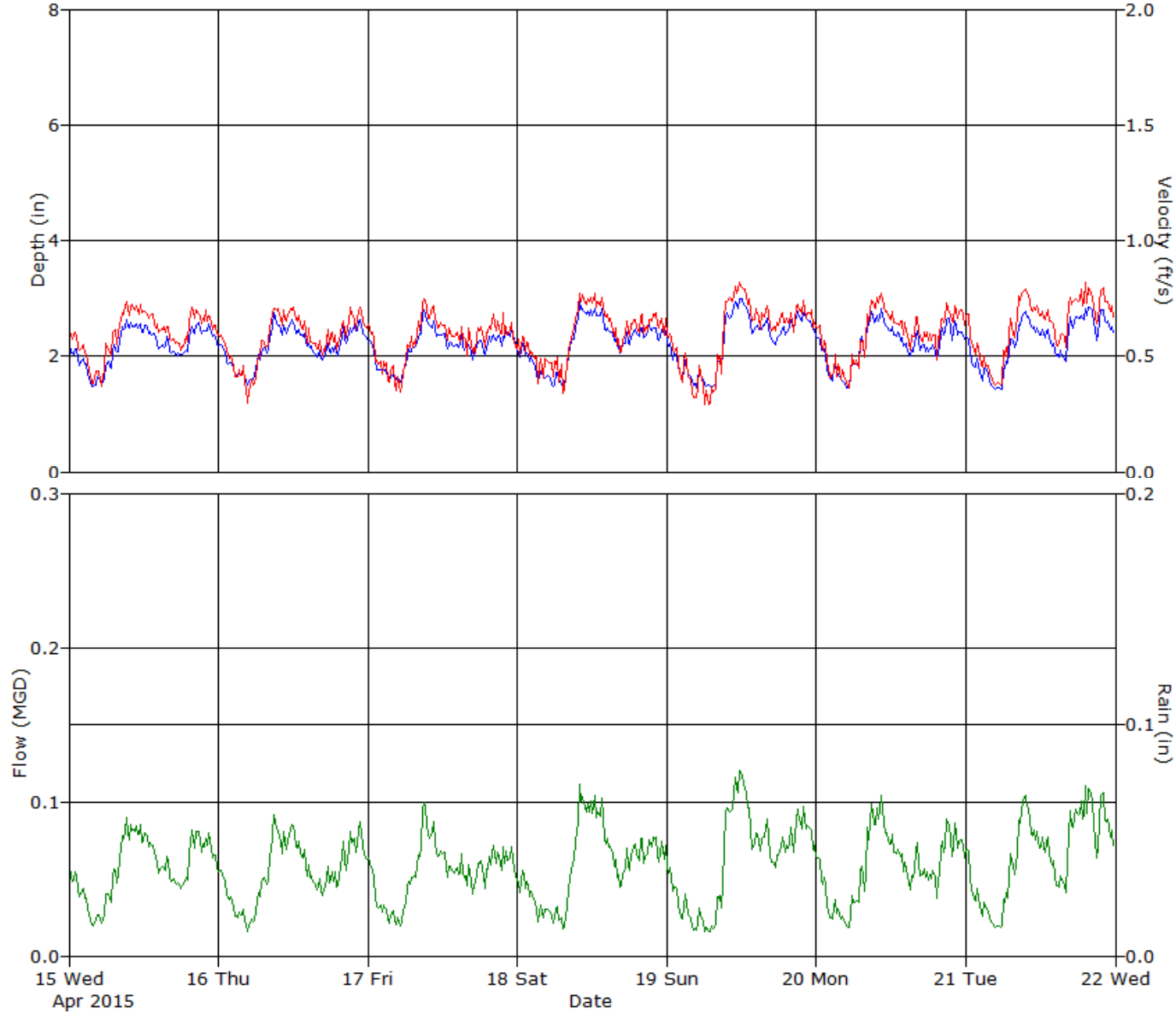
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_OV



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

PRE_001, Pipe Height: 23 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	03:50	1.45	22:00	2.85	2.16	04:15	0.28	09:10	0.81	0.61	05:00	0.015	09:10	0.110	0.058	0.058	0.07
4/9/2015	05:40	1.42	21:40	2.81	2.14	04:45	0.33	09:00	0.81	0.61	04:45	0.018	21:40	0.103	0.058	0.058	
4/10/2015	05:30	1.43	10:35	2.74	2.13	05:50	0.30	09:35	0.85	0.60	05:50	0.016	10:35	0.103	0.056	0.056	
4/11/2015	06:05	1.36	13:45	2.86	2.18	05:50	0.29	17:25	0.87	0.63	06:55	0.015	12:05	0.112	0.062	0.062	0.17
4/12/2015	06:30	1.41	11:35	3.01	2.24	06:00	0.29	11:40	0.87	0.63	06:40	0.015	11:40	0.128	0.065	0.065	
4/13/2015	04:15	1.51	09:10	2.76	2.17	04:35	0.35	10:35	0.83	0.62	04:35	0.019	10:35	0.103	0.059	0.059	
4/14/2015	05:45	1.43	09:15	2.69	2.12	05:55	0.36	09:15	0.80	0.61	05:45	0.019	09:15	0.101	0.056	0.056	
4/15/2015	04:10	1.46	09:20	2.66	2.17	05:20	0.33	11:30	0.76	0.60	05:20	0.018	09:20	0.093	0.057	0.057	
4/16/2015	04:50	1.48	09:00	2.78	2.16	04:45	0.27	11:40	0.74	0.57	04:45	0.014	09:10	0.093	0.055	0.055	
4/17/2015	05:25	1.50	08:55	2.88	2.16	04:30	0.31	09:15	0.78	0.57	04:35	0.018	09:00	0.105	0.054	0.054	
4/18/2015	05:40	1.42	10:05	2.99	2.22	07:40	0.27	12:30	0.81	0.59	07:40	0.014	10:05	0.115	0.060	0.060	
4/19/2015	07:25	1.38	11:55	3.09	2.26	06:00	0.26	11:00	0.85	0.59	05:00	0.014	11:55	0.129	0.063	0.063	
4/20/2015	04:50	1.44	10:30	2.84	2.20	02:20	0.33	10:15	0.78	0.59	05:30	0.017	10:35	0.106	0.058	0.058	
4/21/2015	04:45	1.42	19:55	2.91	2.25	03:55	0.36	19:55	0.85	0.64	04:45	0.018	19:55	0.121	0.065	0.065	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			0.826	0.24
Avg	2.18	0.60	0.059	

Site Commentary

Site Information

STR_002E	
Pipe Height (in)	12
Silt Level (in)	0.00

Overview

Site STR_002E functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing. Velocity dropping out to zero in minimum flows due to shallow and slow flow was reconstituted and should be considered to have a lower level of accuracy.

Observations

A review of hydrograph data for location STR_002E indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the tab le herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	6.29	0.68	0.173
Minimum	4.88	0.30	0.056
Maximum	7.73	1.19	0.342
Time of Minimum	4/20/2015 4:20 AM	4/9/2015 3:10 AM	4/17/2015 2:35 AM
Time of Maximum	4/8/2015 10:25 AM	4/16/2015 10:30 PM	4/21/2015 7:50 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period. Site STR_002E was removed for several hours to accomodate for cleaning of the line which is the cause of the minimal downtime.

Percent Uptime	
Depth (in)	97
Velocity (f/s)	97
Quantity (mgd)	97

Dry Weather Analysis

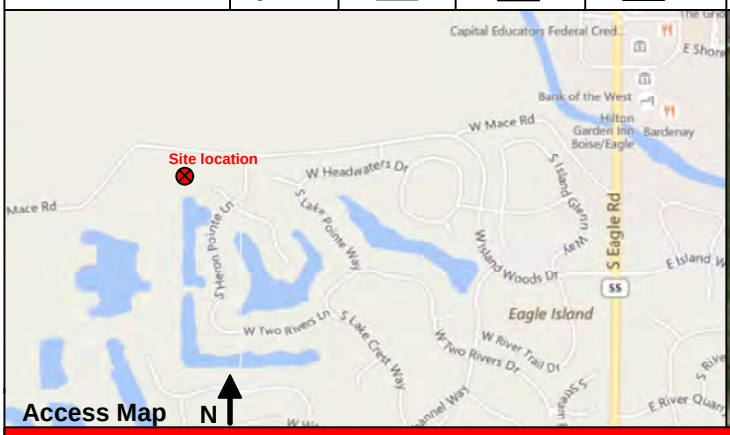
A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below:

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
STR002E	0.282	0.172	0.179	0.172	0.179	1.64	1.58	0.055	0.059

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	STR_002E	**Monitor Series:**	5000-AG	**Monitor S/N:**	21764
Address/Location:	1135 W Mace Rd (dirt road down from pump station)			**Manhole #**	STR-002
				GPS	43.684966°; -116.369423°
				Pipe Height:	12.00"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	12.00"
				IP Address:	166.219.174.173



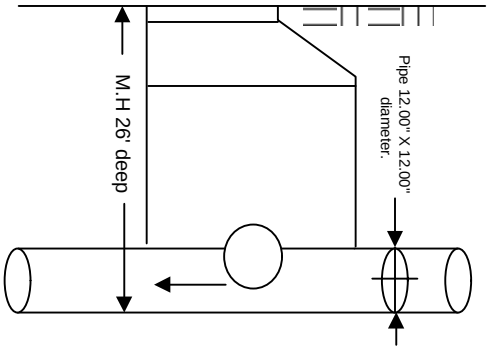
Investigation Information:

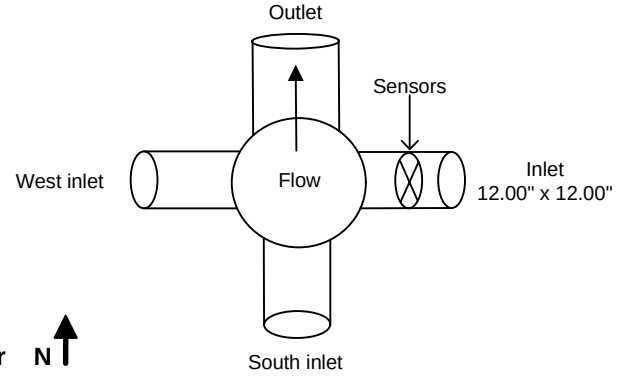
Date/Time of Investigation:	03/31/15 @ 16:27
Site Hydraulics:	Deep slow flow with silt (district to clean line and remove silt)
Upstream Input: (L/S, P/S)	Not influenced
Upstream Manhole:	1 inlet / 1 outlet
Downstream Manhole:	1 inlet / 1 outlet
Depth of Flow:	5.13" +/- 0.38"
Range (Air DOF):	6.88" +/- 0.38"
Peak Velocity:	1.02 fps
Silt:	1.00"

Manhole Information:

Manhole Depth:	26'			
Manhole Material / Condition	Concrete / Good			
Pipe Material / Condition:	PVC/ Good			
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]
Telephone Information:	Does not apply			
Access Pole #:	Does not apply			
Distance From Manhole:	Does not apply	Feet		
Road Cut Length:	Does not apply	Feet		
Trench Length:	Does not apply	Feet		

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_OV	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** STR_002E	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards outside of norm found at this site

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this location

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a traffic control Plan
☐ Standard Traffic Control Plan is to be used at this work site
☐ This site requires a special Traffic Control Plan which is attached

Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: *Sean Winder*	Signature: *Mike Pina*
Date: 3/31/15	Date: 3/31/15

SCATTERGRAPH REPORT

STR_002E

Flow Monitor

STR_002E

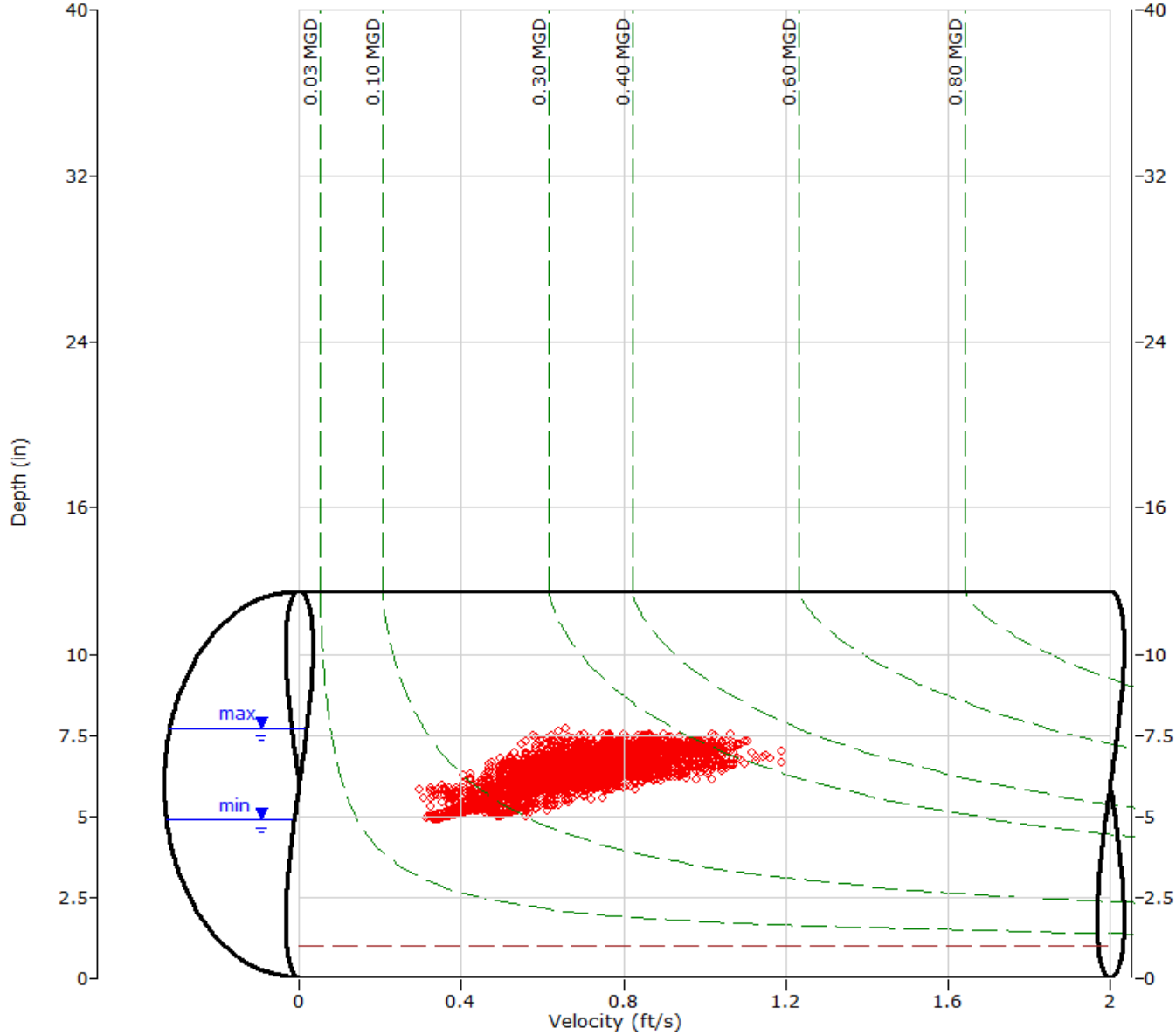
Pipe Height
12.00 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

STR_002E

Flow Monitor

STR_002E

Pipe Height
12.00 in

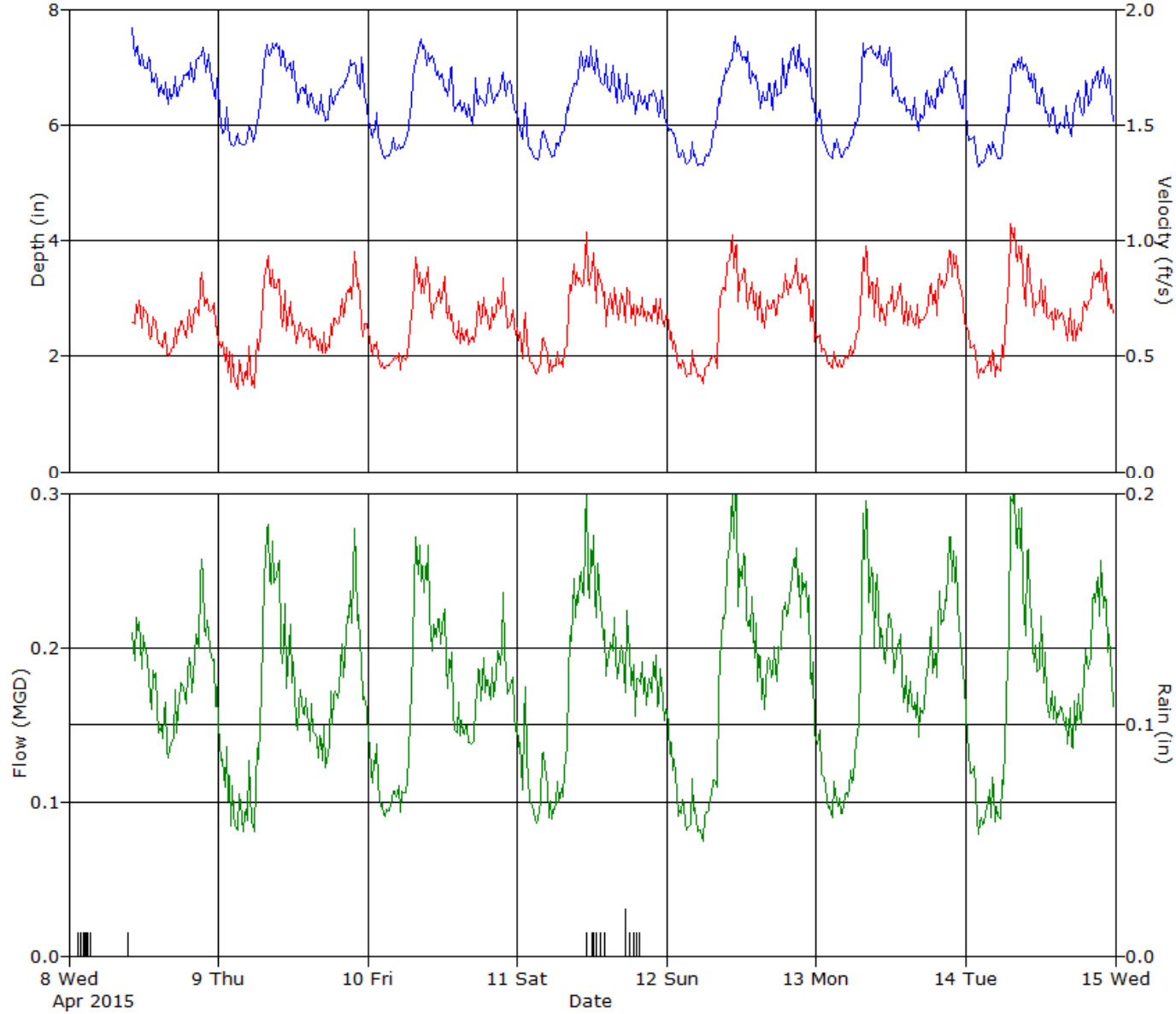
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



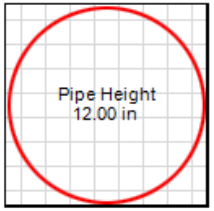
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

STR_002E

Flow Monitor

STR_002E



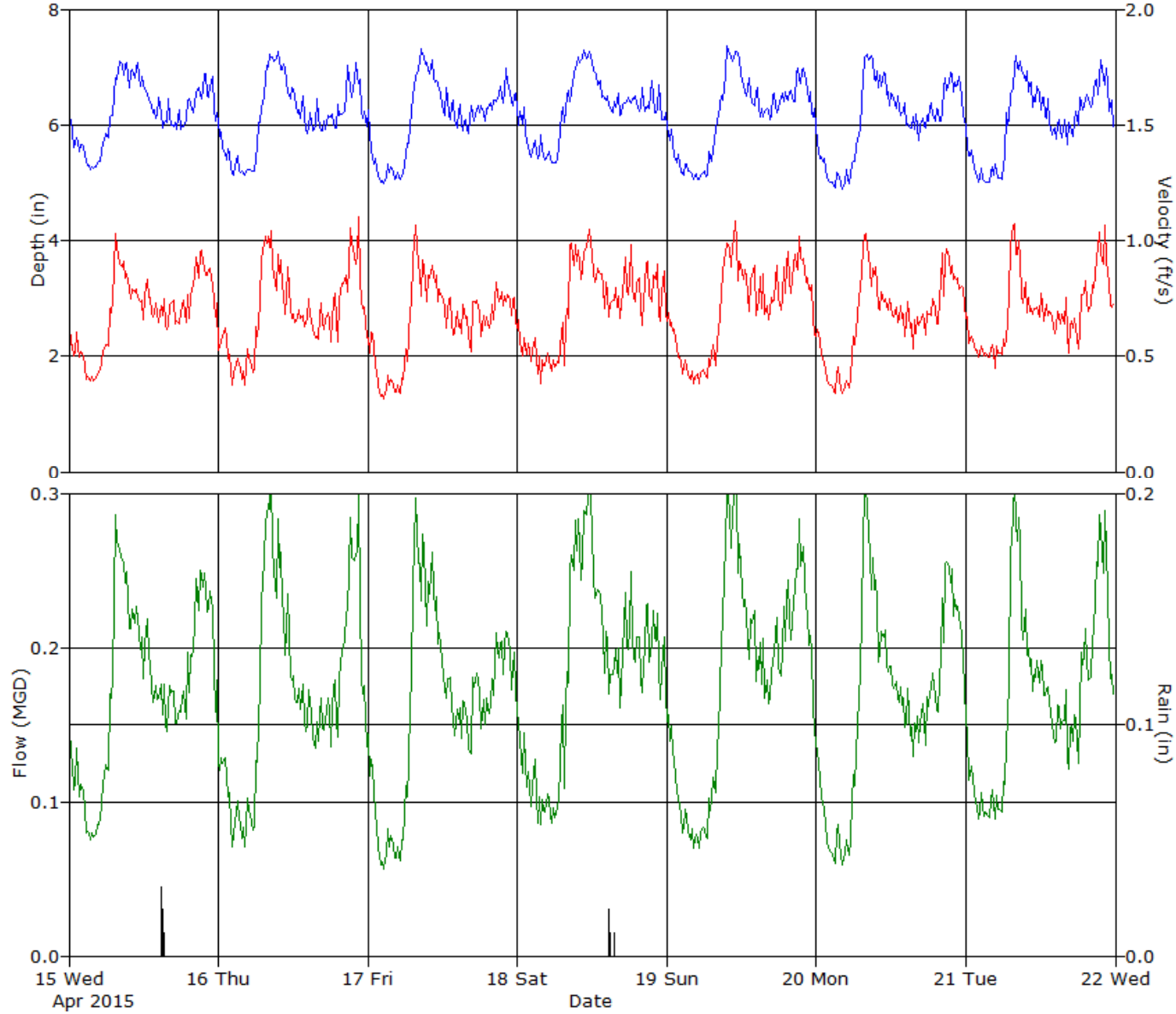
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

STR_002E, Pipe Height: 12 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	16:00	6.32	10:25	7.73	6.87	15:55	0.47	21:10	0.88	0.65	16:10	0.120	21:10	0.267	0.183	0.104	0.08
4/9/2015	02:45	5.58	08:45	7.55	6.50	03:10	0.30	21:55	1.00	0.62	03:10	0.067	07:50	0.296	0.165	0.165	
4/10/2015	02:40	5.42	08:40	7.54	6.39	05:25	0.33	07:45	0.99	0.64	05:25	0.070	09:50	0.298	0.166	0.166	
4/11/2015	03:15	5.38	12:45	7.48	6.34	05:00	0.32	11:05	1.09	0.67	05:00	0.068	11:05	0.325	0.172	0.172	0.12
4/12/2015	05:10	5.26	11:05	7.55	6.42	05:50	0.32	10:35	1.05	0.68	05:50	0.063	11:10	0.322	0.180	0.180	
4/13/2015	02:30	5.41	08:15	7.54	6.42	03:20	0.36	08:15	1.06	0.69	03:20	0.080	08:15	0.335	0.180	0.180	
4/14/2015	02:10	5.22	09:00	7.28	6.26	04:55	0.31	07:20	1.16	0.69	04:55	0.064	08:30	0.322	0.174	0.174	
4/15/2015	03:35	5.22	09:10	7.30	6.22	02:55	0.37	21:10	1.06	0.69	02:55	0.073	08:25	0.292	0.174	0.174	0.06
4/16/2015	02:40	5.08	09:40	7.33	6.16	02:40	0.35	22:30	1.19	0.69	02:40	0.064	22:30	0.319	0.172	0.172	
4/17/2015	02:35	4.96	08:30	7.40	6.14	02:35	0.31	07:45	1.12	0.65	02:35	0.056	07:45	0.314	0.162	0.162	
4/18/2015	06:00	5.30	11:35	7.31	6.28	07:00	0.32	11:30	1.11	0.72	07:00	0.072	11:30	0.335	0.183	0.183	0.04
4/19/2015	04:20	5.03	09:45	7.47	6.18	04:20	0.38	11:00	1.11	0.71	04:20	0.069	11:00	0.336	0.179	0.179	
4/20/2015	04:20	4.88	08:15	7.31	6.10	04:45	0.32	08:05	1.06	0.67	04:20	0.058	08:05	0.317	0.165	0.165	
4/21/2015	02:20	4.98	07:55	7.32	6.08	04:45	0.40	07:50	1.19	0.70	04:45	0.079	07:50	0.342	0.170	0.170	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			2.348	0.30
Avg	6.29	0.68	0.173	

Site Commentary

Site Information

STR_003	
Pipe Height (in)	11.75
Silt Level (in)	0.00

Overview

Site STR_003 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review of hydrograph data for location STR_003 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	5.43	0.55	0.123
Minimum	4.03	0.23	0.040
Maximum	7.24	1.04	0.326
Time of Minimum	4/20/2015 4:20 AM	4/9/2015 4:35 AM	4/15/2015 5:15 AM
Time of Maximum	4/12/2015 10:00 AM	4/10/2015 10:10 AM	4/10/2015 10:10 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period. Site STR_003 was moved to this more favorable hydrualic location, which is the cause of the minimal downtime.

Percent Uptime	
Depth (in)	97
Velocity (f/s)	97
Quantity (mgd)	97

Dry Weather Analysis

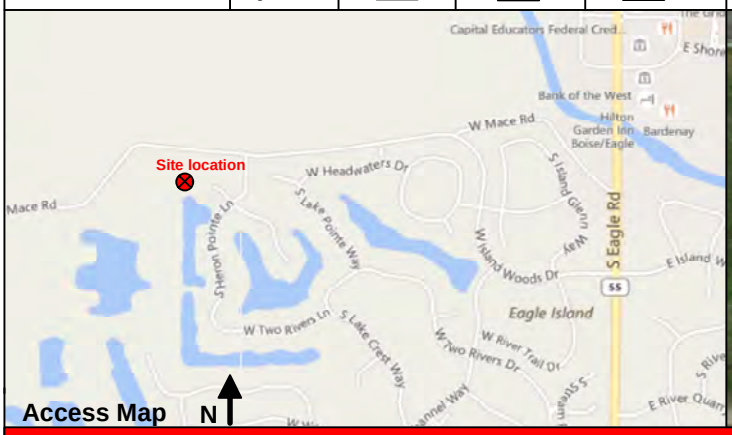
A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below:

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
STR003	0.201	0.126	0.125	0.126	0.125	1.60	1.61	0.053	0.047

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	STR_003	**Monitor Series:**	5000-AG	**Monitor S/N:**	20015
Address/Location:	1135 W Mace Rd (dirt road down from pump station)			**Manhole #**	STR-003
				GPS	43.684810°; -116.369406°
				Pipe Height:	11.75"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	11.75"
				IP Address:	166.213.6.110



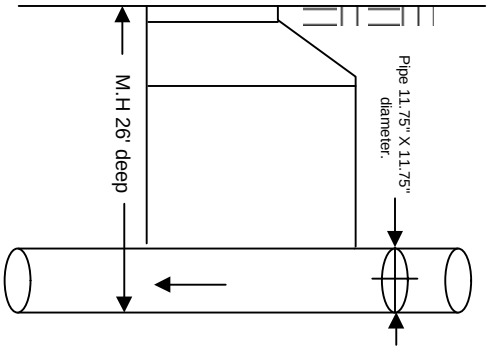
Investigation Information:

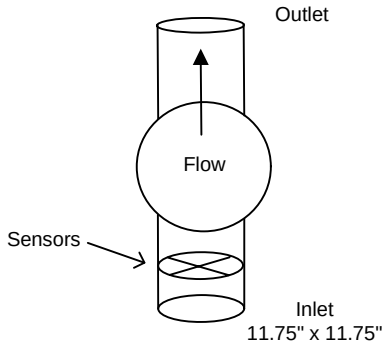
Date/Time of Investigation:	04/08/15 @ 11:13
Site Hydraulics:	Smooth and slow flow (district to clean line and remove debris)
Upstream Input: (L/S, P/S)	Not influenced
Upstream Manhole:	1 inlet / 1 outlet
Downstream Manhole:	3 inlets / outlet (line is dominated by east inlet)
Depth of Flow:	6.13" +/- 0.38"
Range (Air DOF):	5.63" +/- 0.38"
Peak Velocity:	0.82 fps
Silt:	1.00"

Manhole Information:

Manhole Depth:	26'			
Manhole Material / Condition	Concrete / Good			
Pipe Material / Condition:	PVC/ Good			
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [ ]
Telephone Information:	Does not apply			
Access Pole #:	Does not apply			
Distance From Manhole:	Does not apply	Feet		
Road Cut Length:	Does not apply	Feet		
Trench Length:	Does not apply	Feet		

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_LM	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** STR_003	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards outside the norm found at this site

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this site

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a traffic control Plan
☐ Standard Traffic Control Plan is to be used at this work site
☐ This site requires a special Traffic Control Plan which is attached

Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: *Sean Winder*	Signature: *Mike Pina*
Date: 3/31/15	Date: 3/31/15

SCATTERGRAPH REPORT

STR_003

Flow Monitor

STR_003

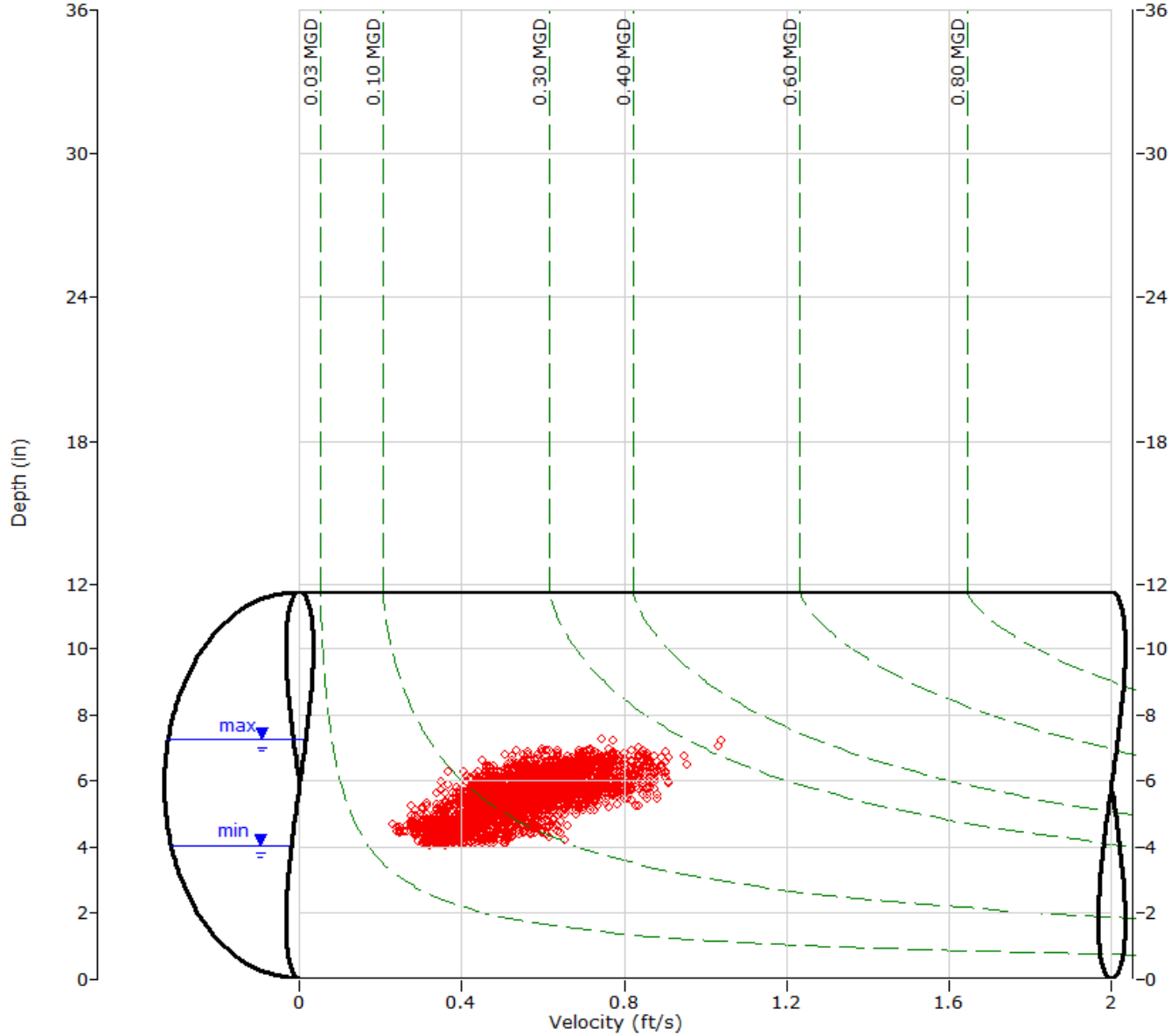
Pipe Height
11.75 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



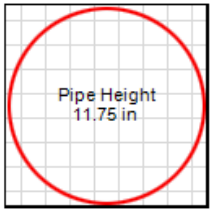
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

STR_003

Flow Monitor

STR_003



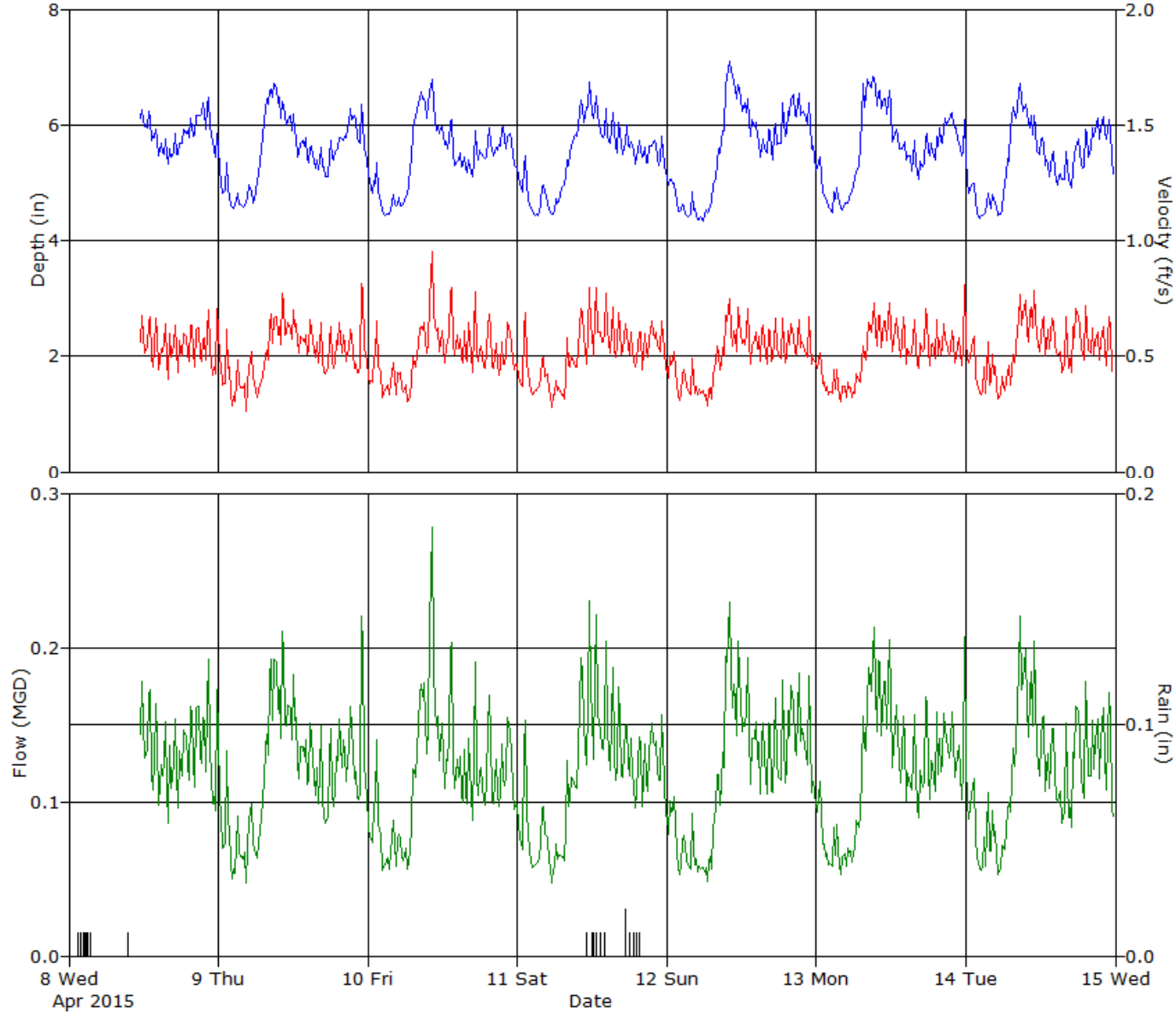
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

STR_003

Flow Monitor

STR_003

Pipe Height
11.75 in

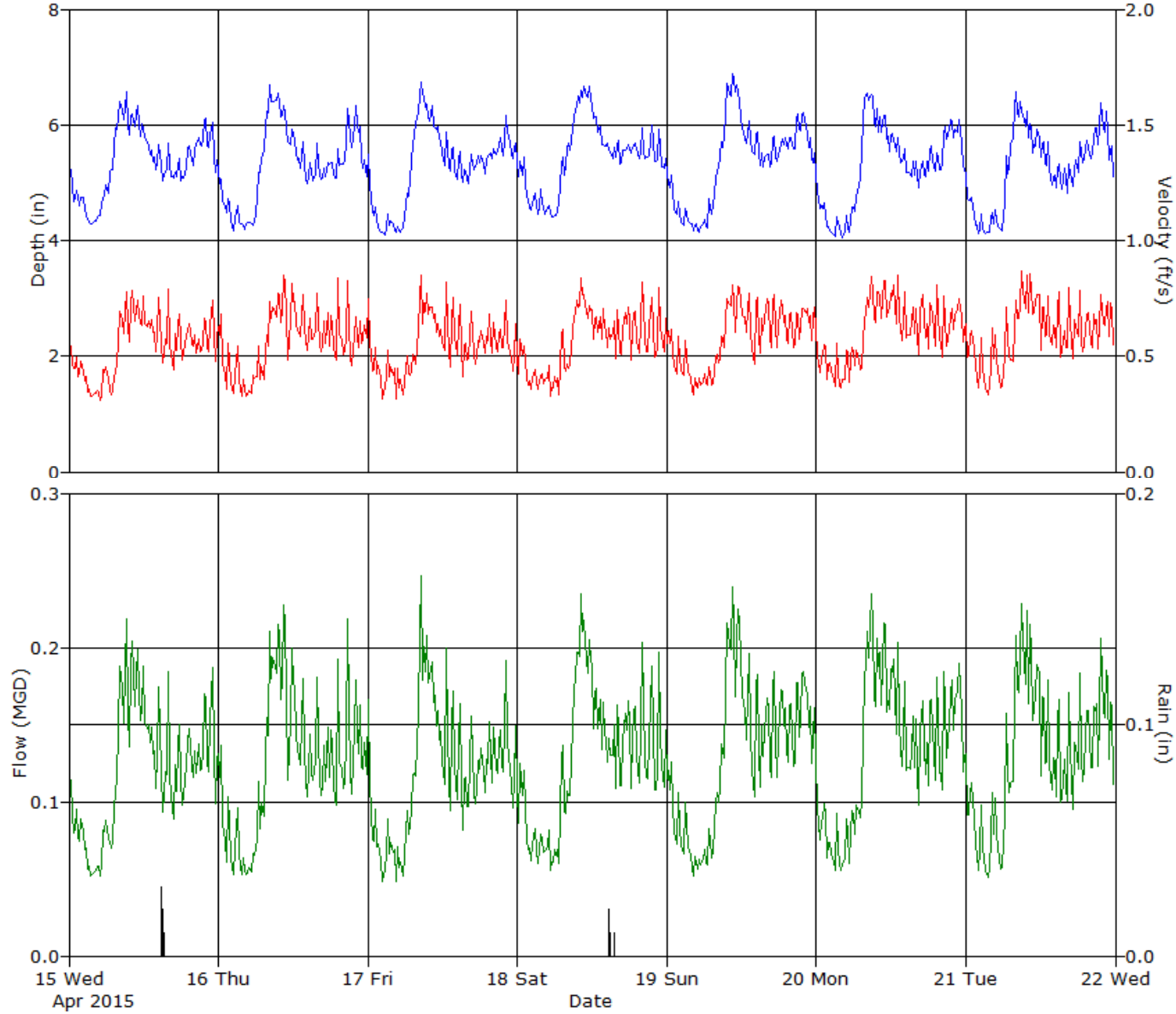
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

STR_003, Pipe Height: 11.75 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	16:00	5.27	22:25	6.75	5.85	13:30	0.35	14:10	0.75	0.55	16:00	0.082	22:25	0.210	0.134	0.069	0.08
4/9/2015	02:40	4.53	09:10	6.86	5.55	04:35	0.23	23:15	0.90	0.51	04:35	0.041	23:10	0.245	0.119	0.119	
4/10/2015	02:45	4.41	10:10	7.21	5.46	02:25	0.26	10:10	1.04	0.51	02:25	0.044	10:10	0.326	0.116	0.116	
4/11/2015	02:45	4.42	11:35	6.79	5.45	05:35	0.27	12:45	0.89	0.51	05:35	0.045	12:45	0.256	0.116	0.116	0.12
4/12/2015	05:50	4.31	10:00	7.24	5.60	06:40	0.25	10:05	0.77	0.50	06:40	0.042	10:05	0.242	0.119	0.119	
4/13/2015	02:35	4.46	09:00	6.96	5.60	04:55	0.25	23:45	0.87	0.51	04:55	0.044	23:45	0.231	0.121	0.121	
4/14/2015	02:15	4.32	08:40	6.92	5.41	05:25	0.25	11:05	0.86	0.53	05:25	0.041	08:40	0.244	0.119	0.119	
4/15/2015	03:40	4.27	09:10	6.72	5.36	05:15	0.24	16:00	0.87	0.54	05:15	0.040	09:15	0.242	0.120	0.120	0.06
4/16/2015	02:35	4.16	08:20	6.74	5.32	01:25	0.28	10:40	0.87	0.57	01:25	0.047	10:40	0.234	0.125	0.125	
4/17/2015	02:35	4.10	08:30	6.88	5.28	06:45	0.29	12:35	0.91	0.55	02:45	0.046	08:30	0.267	0.120	0.120	
4/18/2015	05:55	4.39	10:25	6.74	5.45	06:55	0.29	10:20	0.90	0.56	05:25	0.051	10:20	0.251	0.128	0.128	0.04
4/19/2015	05:20	4.13	10:35	6.98	5.37	04:20	0.31	16:05	0.88	0.58	04:20	0.048	10:35	0.252	0.131	0.131	
4/20/2015	04:20	4.03	08:55	6.68	5.30	04:30	0.32	08:55	0.91	0.61	04:30	0.048	08:55	0.260	0.134	0.134	
4/21/2015	02:10	4.08	07:55	6.74	5.27	03:30	0.29	10:20	0.90	0.60	03:30	0.045	07:55	0.242	0.131	0.131	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			1.669	0.30
Avg	5.43	0.55	0.123	

Site Commentary

Site Information

TWI_002	
Pipe Height (in)	14.25
Silt Level (in)	0.00

Overview

Site TWI_002 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review of hydrograph data for location TWI_002 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	3.12	1.04	0.130
Minimum	1.75	0.50	0.026
Maximum	4.59	1.57	0.309
Time of Minimum	4/8/2015 2:55 AM	4/8/2015 2:40 AM	4/8/2015 2:40 AM
Time of Maximum	4/19/2015 10:50 AM	4/20/2015 8:05 AM	4/20/2015 8:05 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

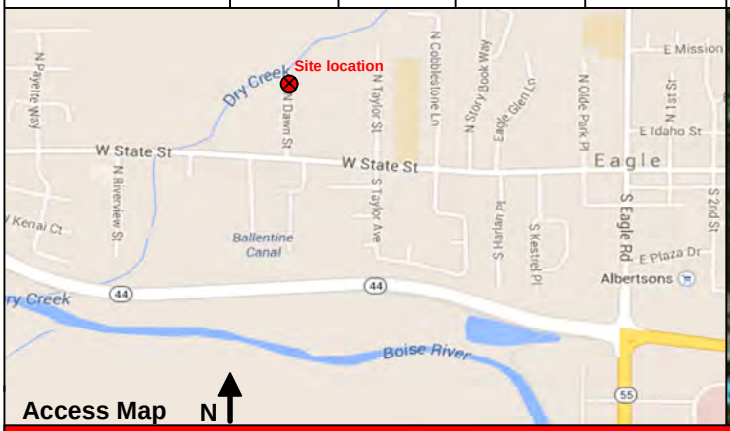
A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below:

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
TWI002	0.256	0.131	0.142	0.131	0.142	1.95	1.80	0.032	0.031

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	TWI_002	**Monitor Series:**	5000-AG	**Monitor S/N:**	21475
Address/Location:	268 Dawn St.			**Manhole #**	TWI-002
				GPS	43.697345°; -116.364694°
				Pipe Height:	14.25"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	14.25"
				IP Address:	166.219.171.203



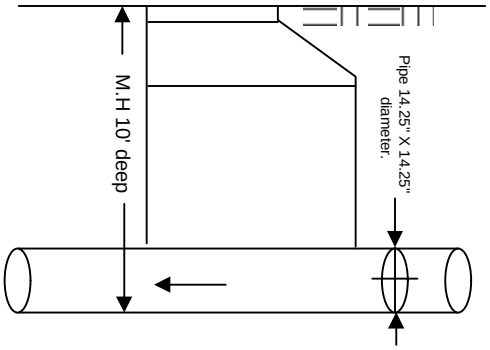
Access Map N

Site Map N

Investigation Information:

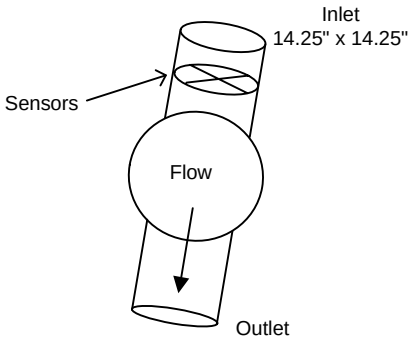
Date/Time of Investigation:	04/01/15 @ 12:29	**Manhole Depth:**	10'
Site Hydraulics:	Small waves and moderate velocity	**Manhole Material / Condition**	Concrete / Good
Upstream Input: (L/S, P/S)	Not influenced	**Pipe Material / Condition:**	PVC/ Good
Upstream Manhole:	1 inlet / 1outlet	**Mini System Character:**	Residential [X] Commercial [ ] Industrial [ ] Trunk [X]
Downstream Manhole:	1 inlet / 1 outlet	**Telephone Information:**	Does not apply
Depth of Flow:	3.00" +/- 0.38"	**Access Pole #:**	Does not apply
Range (Air DOF):	11.25" +/- 0.38"	**Distance From Manhole:**	Does not apply Feet
Peak Velocity:	1.16 fps	**Road Cut Length:**	Does not apply Feet
Silt:	0.00"	**Trench Length:**	Does not apply Feet

Other Information:



N

Cross Section



Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_LM	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name	EagleSwrDst.CH2M.TFM.ID15	**Site ID:**	TWI_002	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards outside the norm found at this site

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this location

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a traffic control Plan

☐ Standard Traffic Control Plan is to be used at this work site

☐ This site requires a special Traffic Control Plan which is attached

Approved		**Reviewed**	
Field Mgr Name:	Sean Winder	Project Mgr Name:	Mike Pina
Signature:	*Sean Winder*	Signature:	*Mike Pina*
Date:	4/1/15	Date:	4/1/15

SCATTERGRAPH REPORT

TWI_002

Flow Monitor

TWI_002

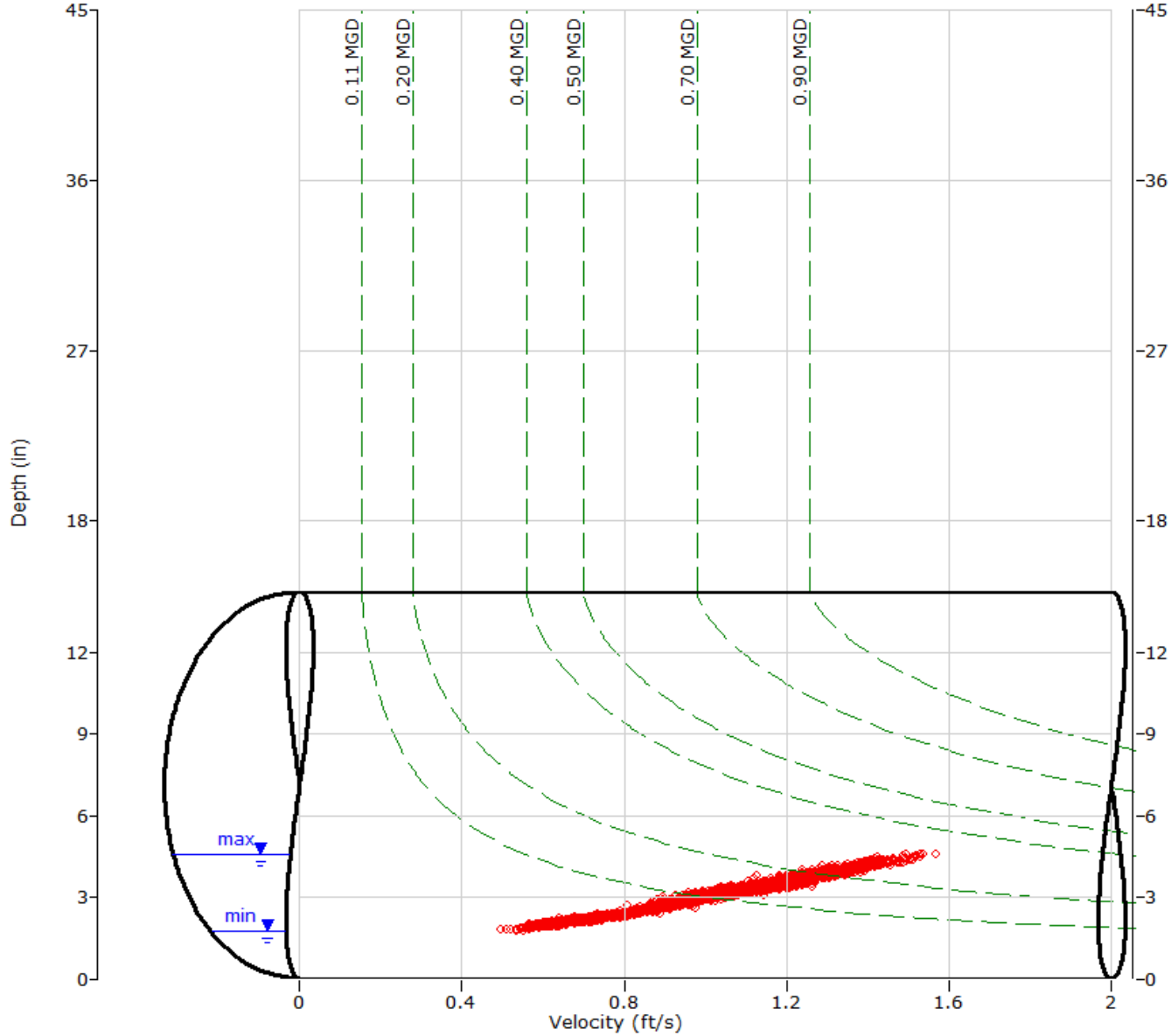
Pipe Height
14.25 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

TWI_002

Flow Monitor

TWI_002

Pipe Height
14.25 in

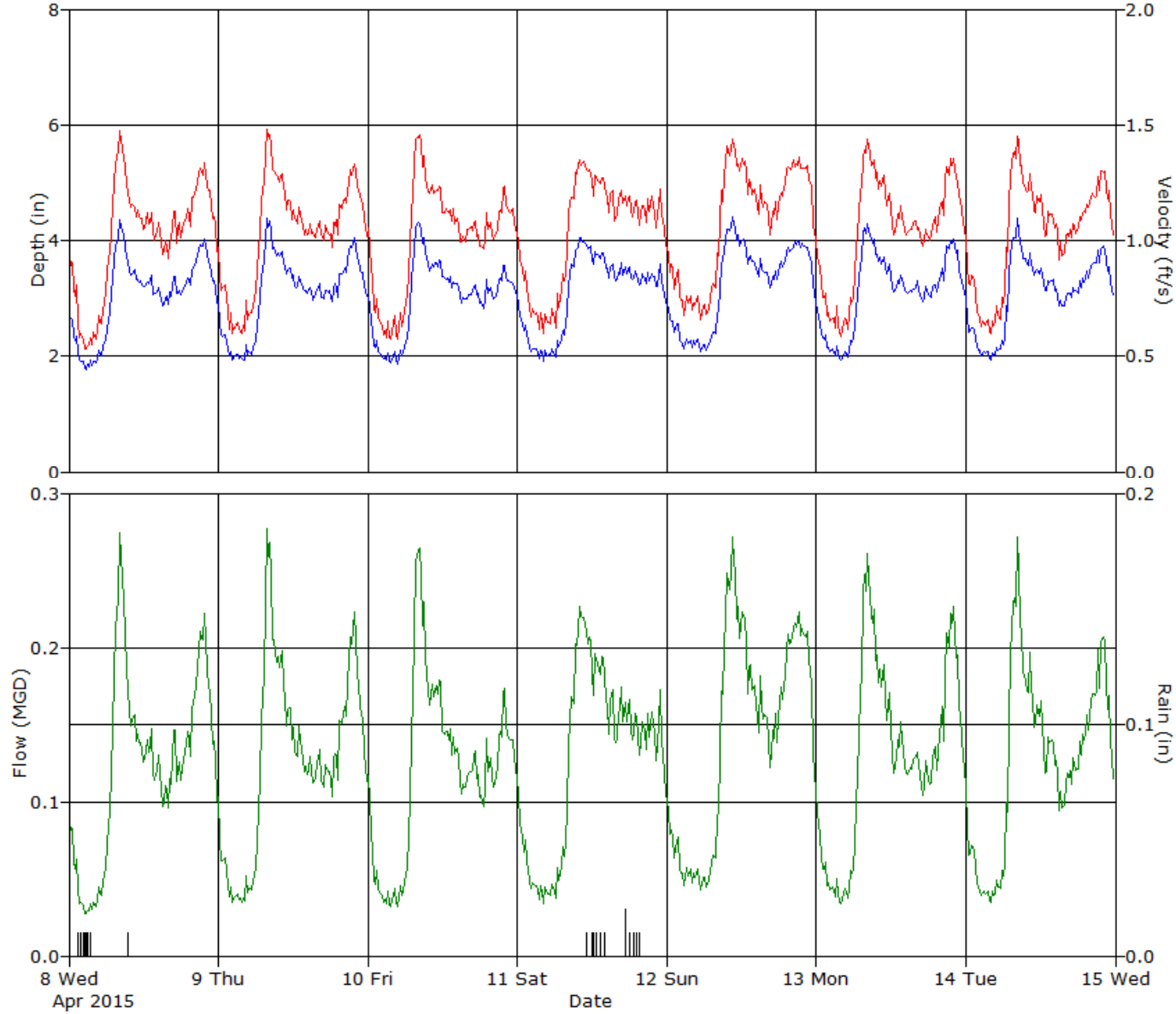
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

TWI_002

Flow Monitor

TWI_002

Pipe Height
14.25 in

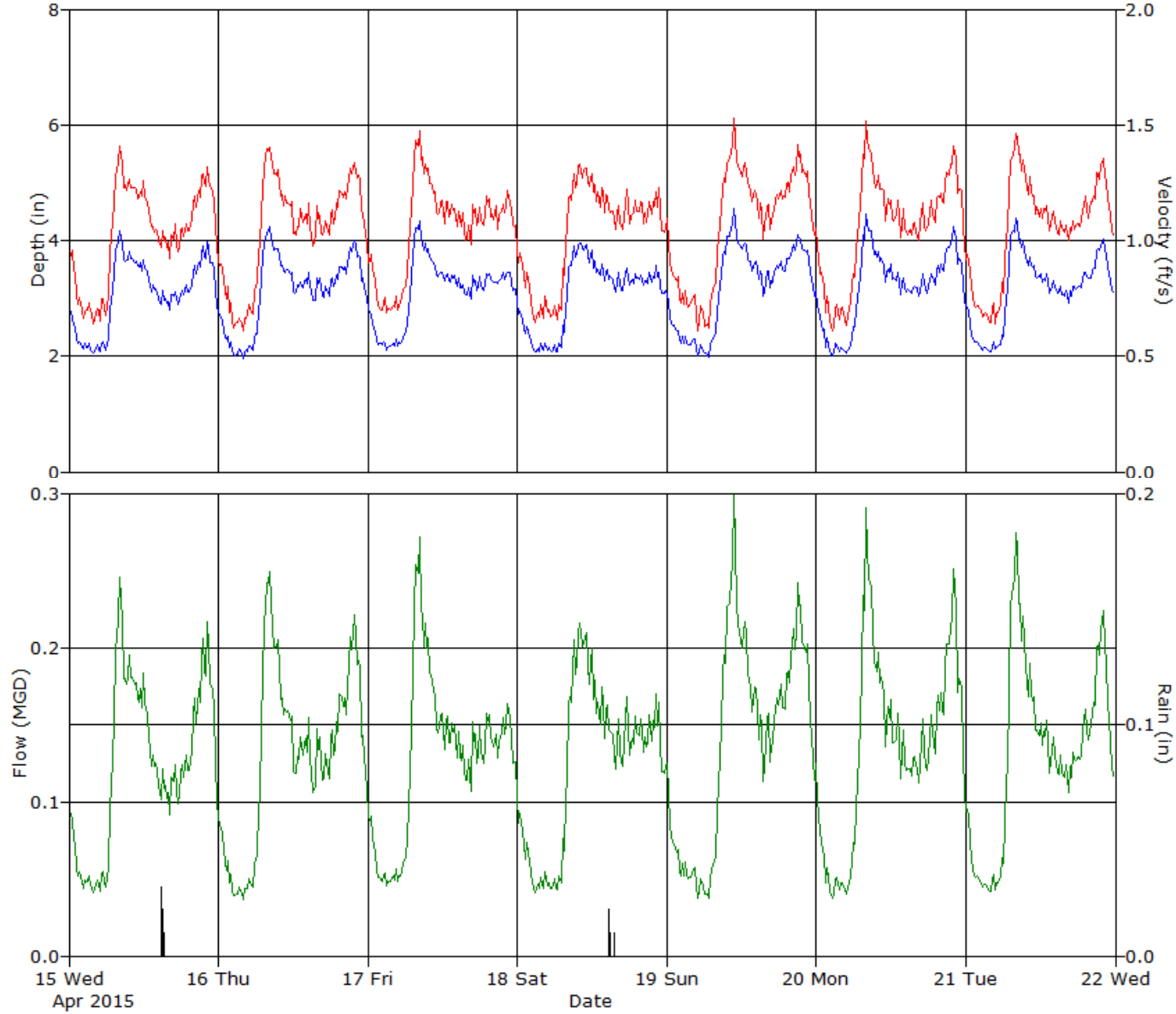
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_ML



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

TWI_002, Pipe Height: 14.25 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	02:55	1.75	08:15	4.46	3.05	02:40	0.50	08:15	1.53	1.01	02:40	0.026	08:15	0.293	0.123	0.123	0.08
4/9/2015	04:00	1.91	07:45	4.47	3.09	02:45	0.57	07:45	1.52	1.03	03:50	0.033	07:45	0.292	0.127	0.127	
4/10/2015	04:50	1.83	08:10	4.39	3.02	03:00	0.56	08:10	1.50	1.01	04:50	0.031	08:10	0.280	0.120	0.120	
4/11/2015	04:25	1.86	10:05	4.11	3.10	04:25	0.58	10:55	1.39	1.04	04:25	0.032	10:55	0.237	0.128	0.128	0.12
4/12/2015	05:35	2.07	10:30	4.51	3.24	05:35	0.65	10:30	1.49	1.08	05:35	0.042	10:30	0.289	0.143	0.143	
4/13/2015	03:50	1.91	07:40	4.36	3.13	03:55	0.57	08:25	1.48	1.04	04:05	0.033	08:25	0.273	0.131	0.131	
4/14/2015	04:10	1.92	08:25	4.46	3.10	04:00	0.59	08:15	1.46	1.03	04:05	0.034	08:20	0.273	0.127	0.127	
4/15/2015	04:05	2.05	08:20	4.25	3.08	02:30	0.62	08:20	1.46	1.03	04:05	0.040	08:20	0.261	0.124	0.124	0.06
4/16/2015	04:00	1.94	08:00	4.28	3.12	03:05	0.60	08:00	1.44	1.04	04:10	0.036	08:00	0.261	0.130	0.130	
4/17/2015	03:10	2.08	08:15	4.44	3.12	02:30	0.65	08:15	1.51	1.05	02:30	0.043	08:15	0.288	0.129	0.129	
4/18/2015	06:25	2.02	09:10	4.03	3.07	03:00	0.62	10:55	1.38	1.03	02:55	0.040	10:55	0.224	0.124	0.124	0.04
4/19/2015	05:10	1.93	10:50	4.59	3.21	05:10	0.56	10:50	1.54	1.07	05:10	0.033	10:50	0.306	0.140	0.140	
4/20/2015	02:40	1.94	08:10	4.57	3.18	02:40	0.59	08:05	1.57	1.06	02:40	0.035	08:05	0.309	0.135	0.135	
4/21/2015	05:00	2.03	08:10	4.58	3.15	04:10	0.61	08:10	1.54	1.05	04:10	0.039	08:10	0.305	0.132	0.132	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			1.814	0.30
Avg	3.12	1.04	0.130	

Site Commentary

Site Information

WRP_002	
Pipe Height (in)	19.5
Silt Level (in)	0.00

Overview

Site WRP_002 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review of hydrograph data for location WRP_002 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	3.68	0.76	0.138
Minimum	2.83	0.43	0.056
Maximum	4.83	1.09	0.269
Time of Minimum	4/15/2015 4:05 AM	4/12/2015 5:50 AM	4/12/2015 7:05 AM
Time of Maximum	4/20/2015 10:20 AM	4/9/2015 10:25 AM	4/20/2015 9:00 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

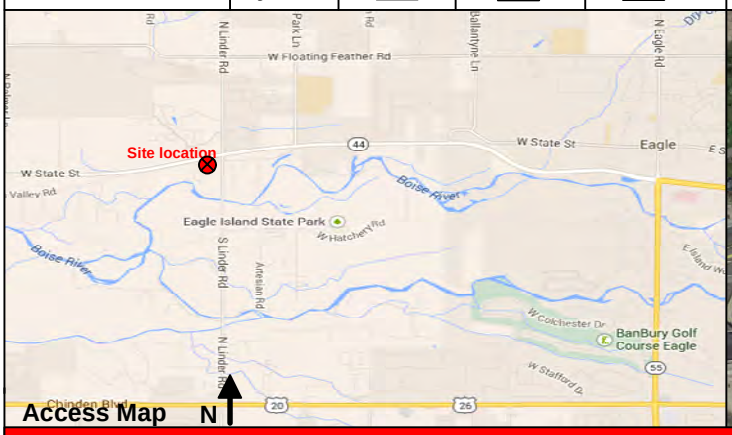
A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below:

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
WRP002	0.219	0.143	0.132	0.143	0.132	1.53	1.66	0.060	0.049

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	WRP_002	**Monitor Series:**	5000-AG	**Monitor S/N:**	16016
Address/Location:	Old Valley Rd W of N. Linder Rd			**Manhole #**	WRP-002
				GPS	43.693379°; -116.414681°
				Pipe Height:	19.50"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	19.50"
				IP Address:	166.219.49.5



Access Map

Site Map

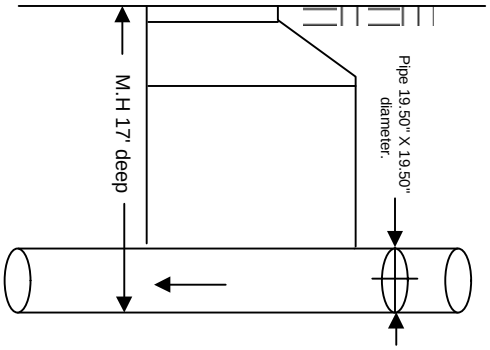
Investigation Information:

Date/Time of Investigation:	03/31/15 @ 08:29
Site Hydraulics:	Smooth and slow flow
Upstream Input: (L/S, P/S)	Not influenced
Upstream Manhole:	2 inlets / 1 outlet
Downstream Manhole:	Liftstation Wetwell
Depth of Flow:	8.00" +/- 0.38"
Range (Air DOF):	11.50" +/- 0.38"
Peak Velocity:	0.50 fps
Silt:	0.00"

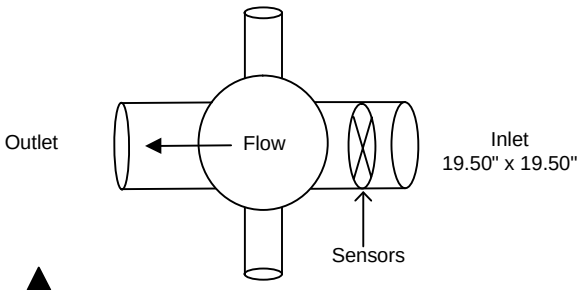
Manhole Information:

Manhole Depth:	17'			
Manhole Material / Condition	Concrete / Good			
Pipe Material / Condition:	PVC/ Good			
Mini System Character:	Residential [X]	Commercial [X]	Industrial [ ]	Trunk [X]
Telephone Information:	Does not apply			
Access Pole #:	Does not apply			
Distance From Manhole:	Does not apply	Feet		
Road Cut Length:	Does not apply	Feet		
Trench Length:	Does not apply	Feet		

Other Information:



Cross Section



Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_OV	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** WRP_002	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway.	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards outside of norm found at this site

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this location

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a traffic control Plan
☐ Standard Traffic Control Plan is to be used at this work site
☐ This site requires a special Traffic Control Plan which is attached

Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: *Sean Winder*	Signature: *Mike Pina*
Date: 3/31/15	Date: 3/31/15

SCATTERGRAPH REPORT

WRP_002

Flow Monitor

WRP_002

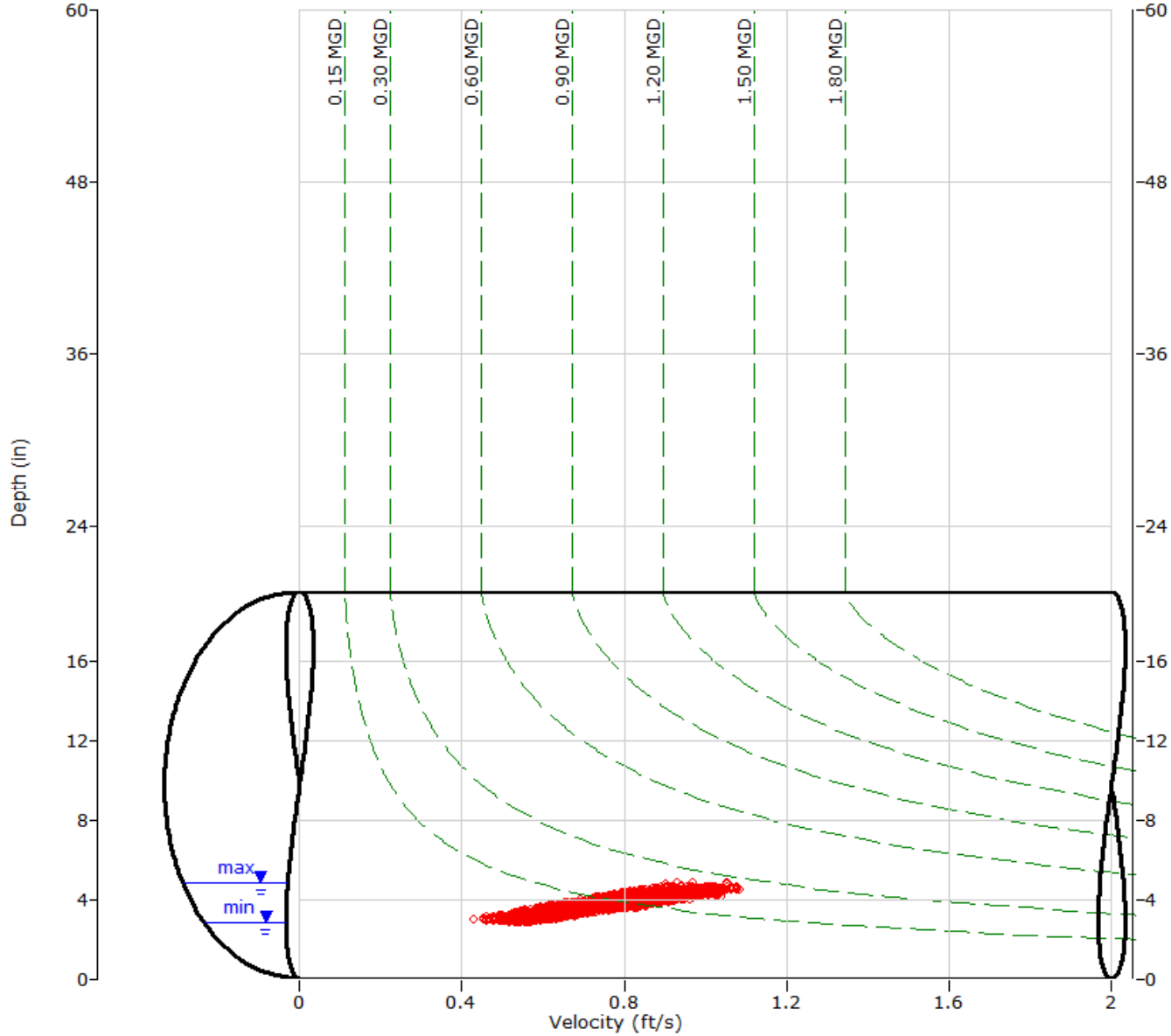
Pipe Height
19.50 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

WRP_002

Flow Monitor

WRP_002

Pipe Height
19.50 in

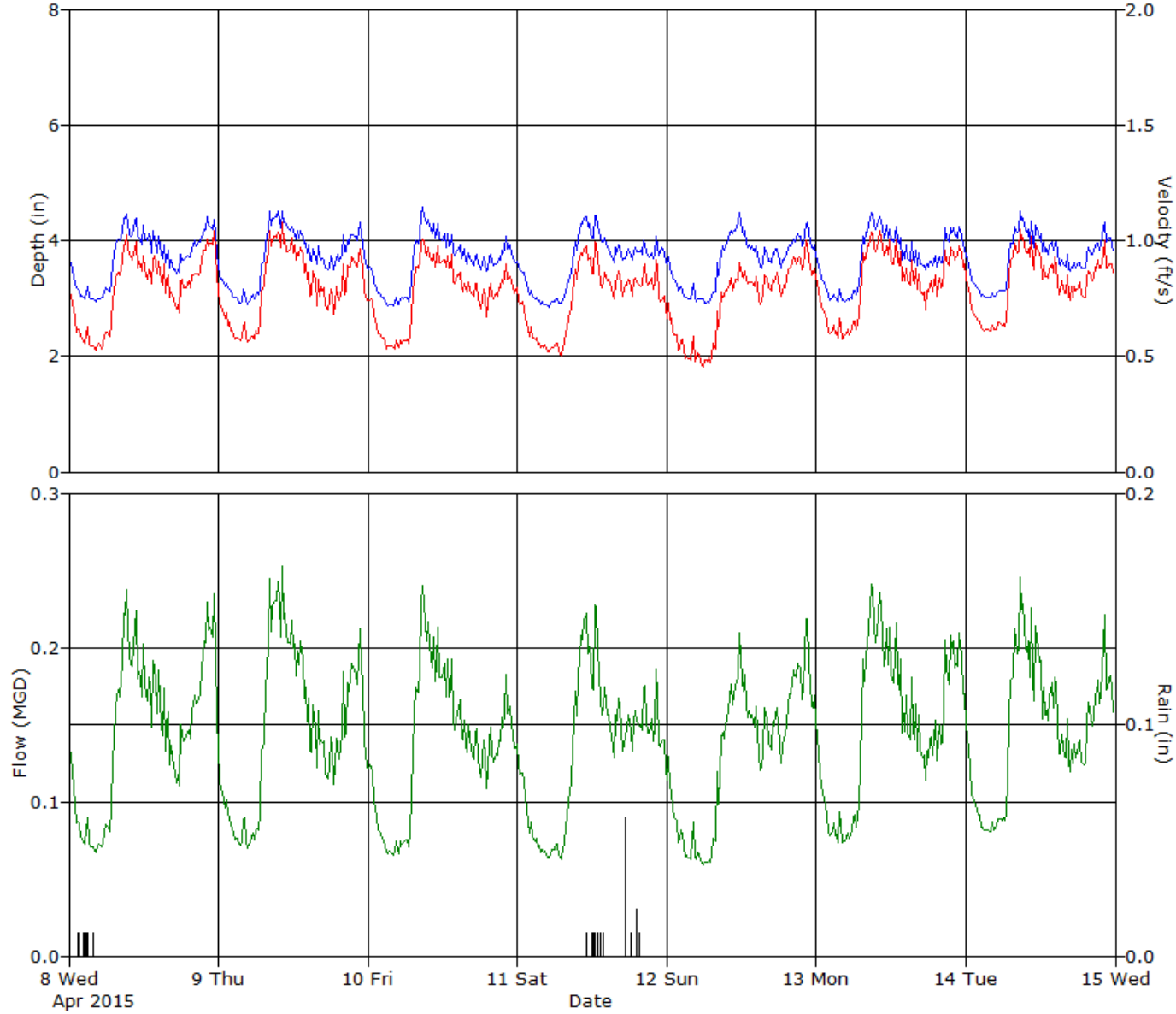
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_OV



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

WRP_002

Flow Monitor

WRP_002

Pipe Height
19.50 in

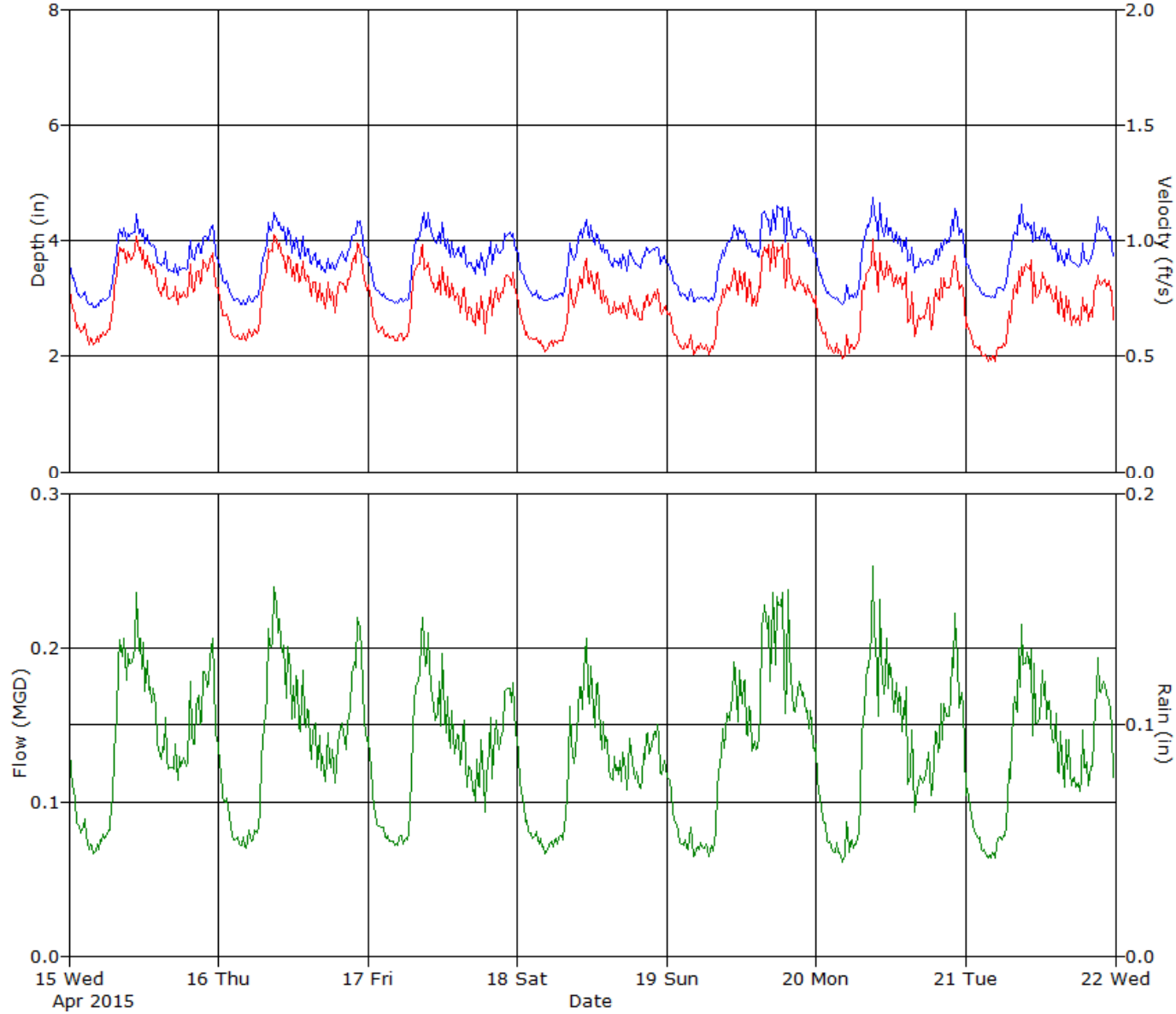
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_OV



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

WRP_002, Pipe Height: 19.5 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	04:30	2.93	08:55	4.52	3.72	04:25	0.50	23:20	1.08	0.79	04:25	0.064	23:20	0.248	0.146	0.146	0.07
4/9/2015	04:45	2.87	08:15	4.59	3.72	02:45	0.54	10:25	1.09	0.80	03:50	0.069	08:15	0.259	0.148	0.148	
4/10/2015	03:20	2.85	08:50	4.58	3.63	04:25	0.50	08:35	1.05	0.77	05:00	0.063	08:35	0.247	0.137	0.137	
4/11/2015	05:10	2.84	11:00	4.54	3.62	07:05	0.46	12:40	1.03	0.75	07:05	0.058	12:40	0.242	0.133	0.133	0.17
4/12/2015	06:30	2.90	11:45	4.54	3.64	05:50	0.43	22:25	1.02	0.73	07:05	0.056	22:40	0.230	0.132	0.132	
4/13/2015	03:40	2.88	08:50	4.54	3.70	03:40	0.56	08:55	1.06	0.82	03:40	0.069	08:55	0.247	0.150	0.150	
4/14/2015	03:25	2.99	08:50	4.58	3.69	03:00	0.59	08:55	1.06	0.81	03:00	0.078	08:50	0.253	0.147	0.147	
4/15/2015	04:05	2.83	10:50	4.57	3.62	03:20	0.52	10:50	1.02	0.79	04:05	0.062	10:50	0.245	0.139	0.139	
4/16/2015	04:20	2.87	09:10	4.59	3.65	04:40	0.54	09:10	1.06	0.79	04:40	0.067	09:10	0.256	0.141	0.141	
4/17/2015	04:15	2.86	09:55	4.58	3.65	05:45	0.54	08:50	1.02	0.73	05:45	0.069	08:50	0.231	0.131	0.131	
4/18/2015	04:35	2.95	11:05	4.39	3.58	04:35	0.52	13:00	0.93	0.69	04:35	0.066	11:05	0.209	0.120	0.120	
4/19/2015	04:25	2.92	19:40	4.64	3.77	02:10	0.48	16:55	1.07	0.74	06:45	0.060	16:55	0.254	0.140	0.140	
4/20/2015	04:10	2.88	10:20	4.83	3.74	04:25	0.46	09:00	1.05	0.72	04:25	0.058	09:00	0.269	0.135	0.135	
4/21/2015	03:55	2.98	09:00	4.72	3.74	03:30	0.45	09:55	0.98	0.70	03:30	0.060	09:55	0.228	0.130	0.130	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			1.930	0.24
Avg	3.68	0.76	0.138	

Site Commentary

Site Information

YRD_004	
Pipe Height (in)	22.75
Silt Level (in)	0.00

Overview

Site YRD_004 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing.

Observations

A review of hydrograph data for location YRD_004 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	3.73	1.12	0.255
Minimum	1.52	0.33	0.018
Maximum	6.21	1.80	0.668
Time of Minimum	4/8/2015 4:25 AM	4/9/2015 5:00 AM	4/9/2015 5:00 AM
Time of Maximum	4/21/2015 10:10 PM	4/9/2015 10:10 AM	4/21/2015 9:25 PM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

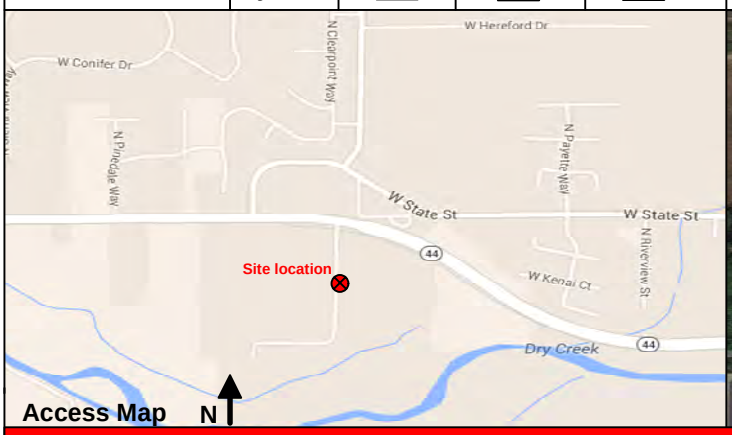
A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below. Note that due to the very large subtraction of the upstream meters the net calculations of this site is considered less accurate due to the large percentage of error.

Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
YRD004	0.391	0.266	0.266	0.067	0.072	1.47	1.47	0.010	0.025

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW
Site Name:	YRD_004	**Monitor Series:**	5000-AG	**Monitor S/N:**	21706
Address/Location:	W State Rd, drive way to ESD Headworks			**Manhole #**	YRD-004
				GPS	43.693851°; -116.379904°
				Pipe Height:	23.75"
Access:	Drive	**Type of System:**	Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	24.00"
				IP Address:	166.219.8.98



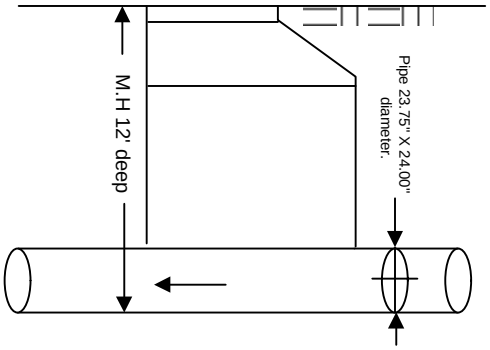
Investigation Information:

Date/Time of Investigation:	03/31/15 @ 10:22	**Site Hydraulics:**	Waves with moderate velocity
Upstream Input: (L/S, P/S)	Lift Station	**Upstream Manhole:**	1 inlet / 1 outlet
Downstream Manhole:	1 inlet / 1outlet	**Depth of Flow:**	3.75" +/- 0.38"
Range (Air DOF):	20.00" +/- 0.38"	**Peak Velocity:**	1.10 fps
Silt:	0.00"		

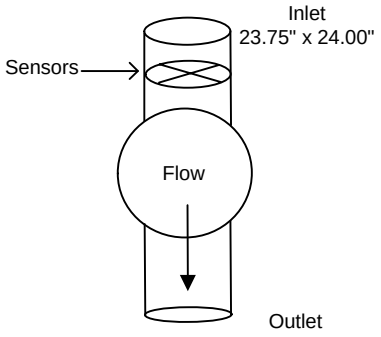
Manhole Information:

Manhole Depth:	12'				
Manhole Material / Condition	Concrete / Good				
Pipe Material / Condition:	PVC/ Good				
Mini System Character:	Residential [X]	Commercial [ ]	Industrial [ ]	Trunk [X]	
Telephone Information:	Does not apply				
Access Pole #:	Does not apply				
Distance From Manhole:	Does not apply	Feet			
Road Cut Length:	Does not apply	Feet			
Trench Length:	Does not apply	Feet			

Other Information:



Cross Section



Planar N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_OV	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

Need to contact RJ w/ the district at 208-941-5382 at least 24hrs prior to access so he can let you in the gate to WWTP (doesn't open until 7AM)

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** YRD_004	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☒
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

H2S has been present at this site (between 3-10PPM), prefer to access ealry morning between 7AM-9AM. Make sure to use blower during entry and if need be open lid 1 MH upstream for circulation of air. Reference FSSM 2-37 to 2-3.9 for ADS ventilation practice.

*** Site Classification**

	Class	Description
☐	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☒	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

If 1 MH upstream needs to open for ventilation need a 3rd man or assistance from ESD

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a traffic control Plan
☐ Standard Traffic Control Plan is to be used at this work site
☐ This site requires a special Traffic Control Plan which is attached

Approved		**Reviewed**	
Field Mgr Name:	Sean Winder	Project Mgr Name:	Mike Pina
Signature:	*Sean Winder*	Signature:	*Mike Pina*
Date:	3/31/15	Date:	3/31/15

SCATTERGRAPH REPORT

YRD_004

Flow Monitor

YRD_004

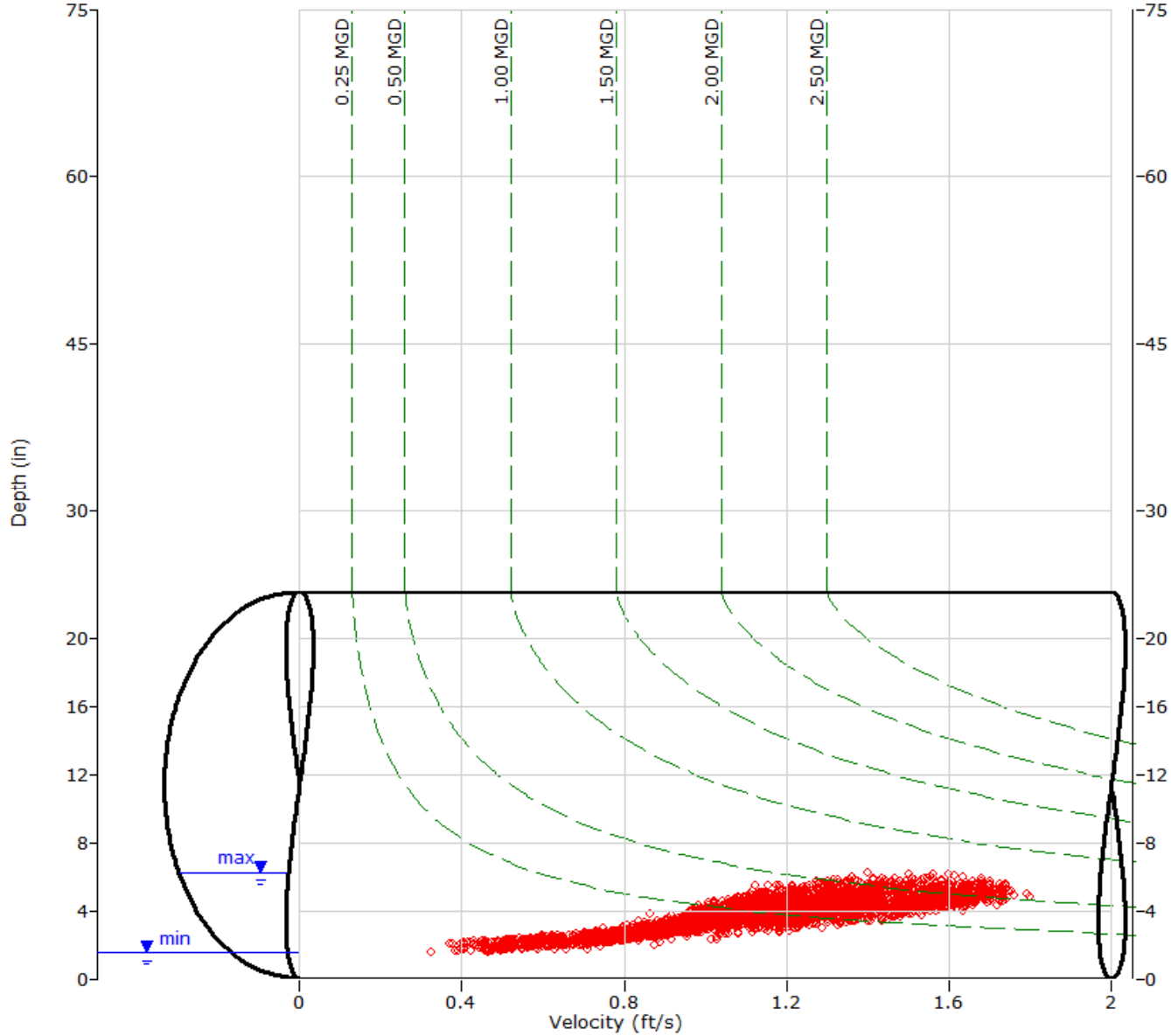
Pipe Height
22.75 in

Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



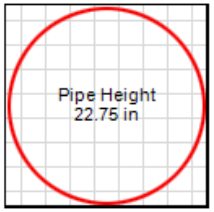
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

YRD_004

Flow Monitor

YRD_004



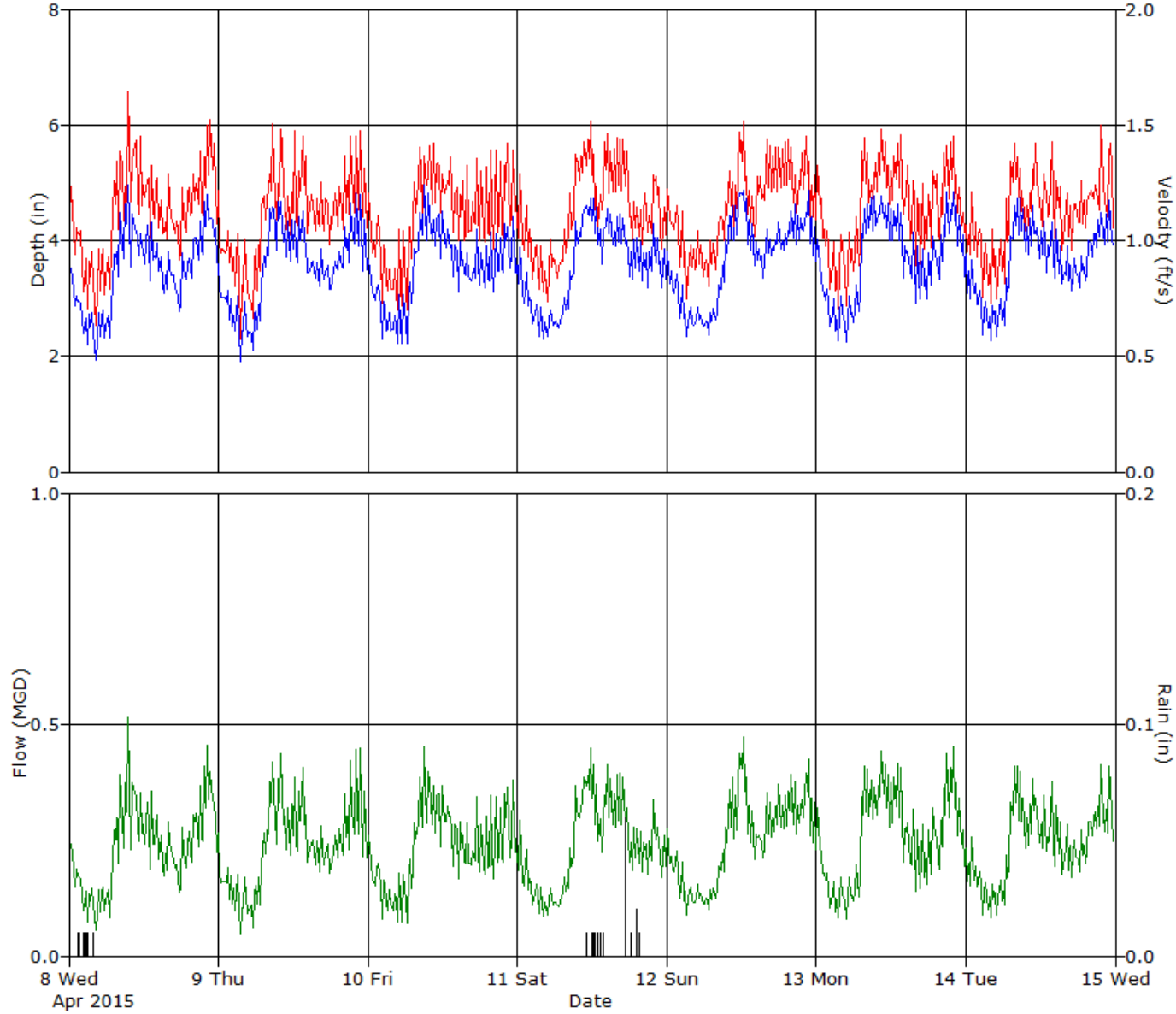
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_OV



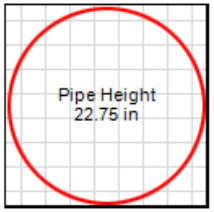
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

YRD_004

Flow Monitor

YRD_004



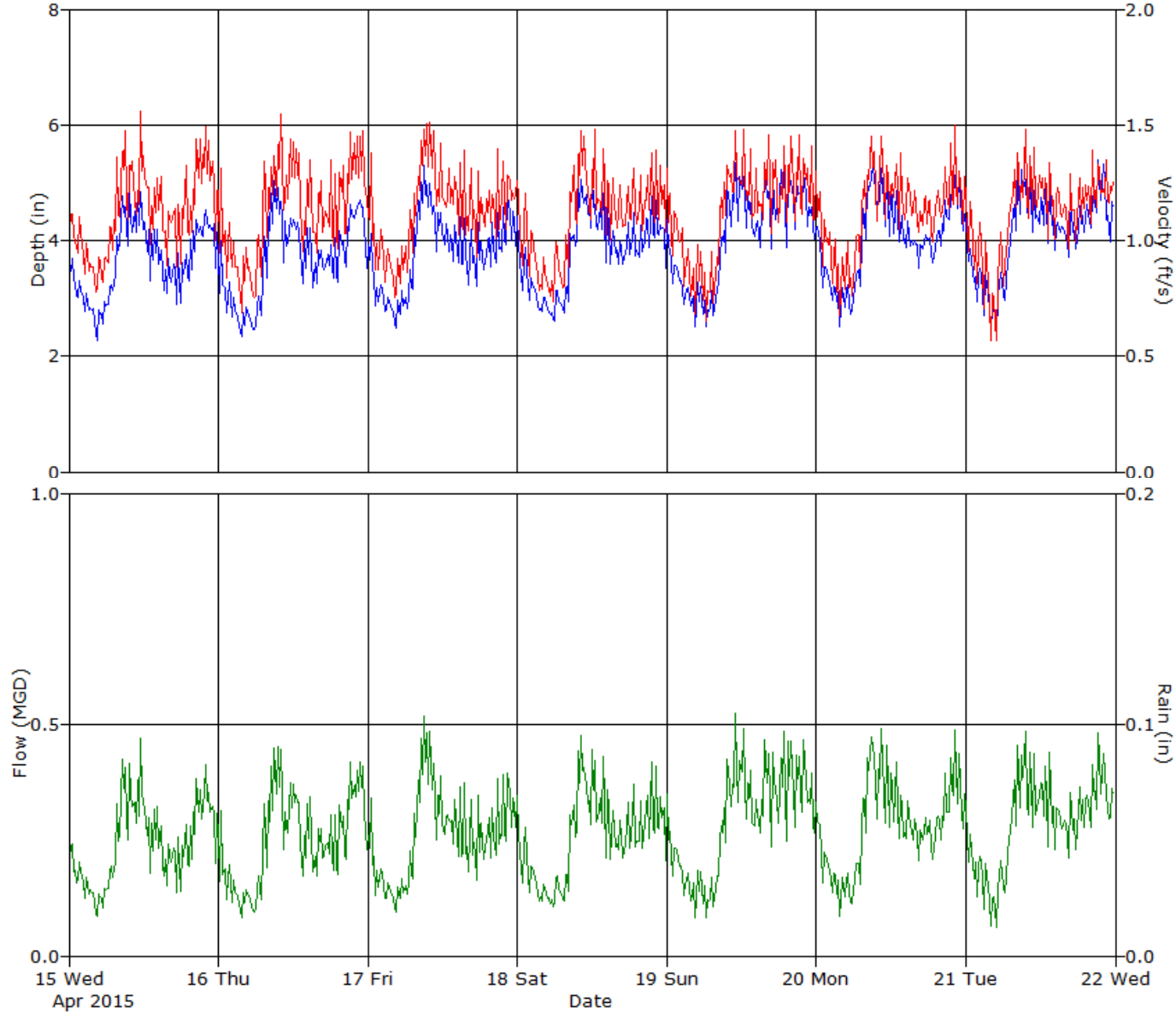
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_OV



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

YRD_004, Pipe Height: 22.75 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	04:25	1.52	09:30	5.56	3.49	05:00	0.46	09:40	1.74	1.12	04:25	0.026	09:30	0.601	0.236	0.236	0.07
4/9/2015	05:00	1.54	09:50	5.65	3.54	05:00	0.33	10:10	1.80	1.11	05:00	0.018	09:50	0.563	0.238	0.238	
4/10/2015	03:30	1.72	09:00	5.70	3.54	03:30	0.40	08:25	1.71	1.11	03:30	0.027	09:10	0.567	0.236	0.236	
4/11/2015	03:40	1.71	12:45	5.41	3.56	04:45	0.45	11:55	1.73	1.13	04:45	0.031	11:55	0.551	0.238	0.238	0.17
4/12/2015	06:55	1.66	22:45	5.48	3.65	03:40	0.46	22:25	1.73	1.15	06:55	0.029	12:15	0.578	0.250	0.250	
4/13/2015	03:30	1.74	22:20	5.43	3.69	03:30	0.47	21:40	1.72	1.14	03:30	0.031	21:00	0.581	0.256	0.256	
4/14/2015	04:00	1.77	09:05	5.39	3.62	05:00	0.49	21:45	1.69	1.12	04:00	0.034	21:45	0.546	0.242	0.242	
4/15/2015	04:35	1.74	11:00	5.47	3.65	04:00	0.50	08:50	1.75	1.12	03:30	0.041	08:40	0.578	0.244	0.244	
4/16/2015	04:25	1.76	09:20	5.84	3.68	03:45	0.41	10:10	1.69	1.13	03:45	0.029	09:20	0.601	0.252	0.252	
4/17/2015	04:30	1.95	09:10	5.75	3.79	04:15	0.44	09:30	1.74	1.13	04:15	0.035	09:10	0.642	0.261	0.261	
4/18/2015	06:10	1.97	12:00	5.76	3.81	05:10	0.43	12:30	1.75	1.10	05:55	0.035	10:05	0.615	0.258	0.258	
4/19/2015	05:50	2.09	12:05	6.03	4.07	07:30	0.41	10:05	1.72	1.12	07:30	0.037	12:05	0.659	0.290	0.290	
4/20/2015	03:55	2.01	22:05	5.88	4.03	03:20	0.43	10:20	1.74	1.12	04:30	0.038	08:35	0.661	0.282	0.282	
4/21/2015	04:50	2.04	22:10	6.21	4.11	04:30	0.37	21:35	1.74	1.11	04:30	0.032	21:25	0.668	0.288	0.288	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			3.570	0.24
Avg	3.73	1.12	0.255	

Site Commentary

Site Information

YRD_010	
Pipe Height (in)	30
Silt Level (in)	0.00

Overview

Site YRD_010 functioned under normal conditions during the period Wednesday, April 08, 2015 to Tuesday, April 21, 2015 . Flow depth and velocity measurements recorded by the flow monitor are consistent with field confirmations conducted to date and support the relative accuracy of the flow monitor at this location. No backwater conditions were experienced by this line as flows remained free flowing. Velocity incorrectly dropping out in minimum flows were reconstituted to levels consitent with field confirmation.

Observations

A review of hydrograph data for location YRD_010 indicates a repeatable diurnal pattern on weekdays and on weekends from Friday, Wednesday, April 08, 2015 through Tuesday, April 21, 2015.
Average flow depth, velocity, and quantity data observed during Wednesday, April 08, 2015 to Tuesday, April 21, 2015, along with observed minimum and maximum data, are provided in the following table. The maximum and minimum flow rate recorded in the table herein may vary from those recorded in the enclosed Excel data files. The minimum and maximum rates recorded in the table are based on 5-minute data intervals whereas the data provided in the Excel files are 15-minute averaged data.

Observed Flow Conditions			
Item	Depth (in)	Velocity (f/s)	Quantity (mgd)
Average	5.49	3.84	1.567
Minimum	3.64	2.97	0.675
Maximum	7.32	4.55	2.619
Time of Minimum	4/12/2015 7:05 AM	4/15/2015 5:05 AM	4/12/2015 7:05 AM
Time of Maximum	4/14/2015 9:10 AM	4/9/2015 9:00 AM	4/16/2015 9:20 AM

Data Quality

Data uptime observed beginning with the official project start date of Wednesday, April 08, 2015 to Tuesday, April 21, 2015 is provided in the table below. Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Percent Uptime	
Depth (in)	100
Velocity (f/s)	100
Quantity (mgd)	100

Dry Weather Analysis

A dry weather analysis was conducted on the site to determine the Net Basin Average Flow for the site on Weekdays and Weekends, Hourly Average peaking factor to Average Dry day flow ratios, and Net Base Infiltration (BI) based on the Stevens/Schutzbach method. The data is presented in the table below. Note that due to the very large subtraction of the upstream meters the net calculations of this site is considered less accurate due to the large percentage of error.

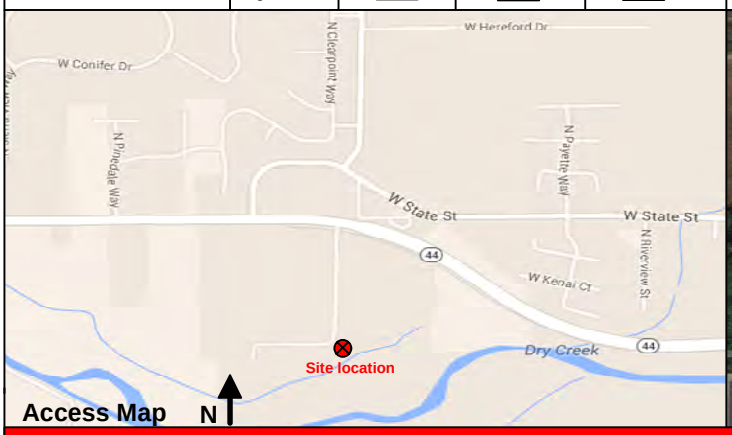
Site	Hourly Gross Peak Flow (mgd)	Gross Average Weekday Flow (mgd)	Gross Average Weekend Flow (mgd)	Net Average Weekday Flow (mgd)	Net Average Weekend Flow (mgd)	Hourly Average Peak/Dry Weekday	Hourly Average Peak/Dry Weekend	Net BI WeekDay (mgd)	Net BI Weekend (mgd)
YRD010	2.367	1.565	1.613	0.067	0.051	1.51	1.47	0.003	0.000

ADS Site Report

Quality Form

Project Name:	EagleSwrDst.CH2M.TFM.ID15	**City / State:**	Eagle, ID	**FM Initials:**	SW

Site Name: YRD_010	**Monitor Series:** 5000-AG	**Monitor S/N:**	21783
Address/Location: W State Rd behind ESD Headworks		**Manhole #**	YRD-010
		GPS	43.691695°; -116.377806°
		Pipe Height:	30.00"
Access: Drive	**Type of System:** Sanitary [X] Storm [ ] Combined [ ]	**Pipe Width:**	30.00"
		IP Address:	166.213.163.129



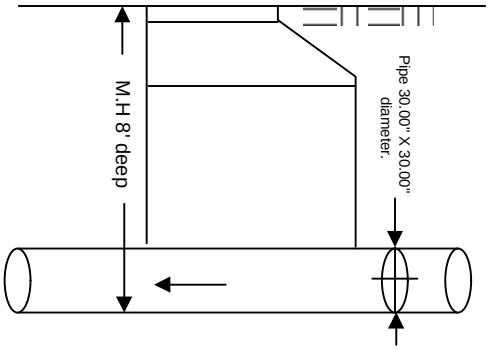
Investigation Information:

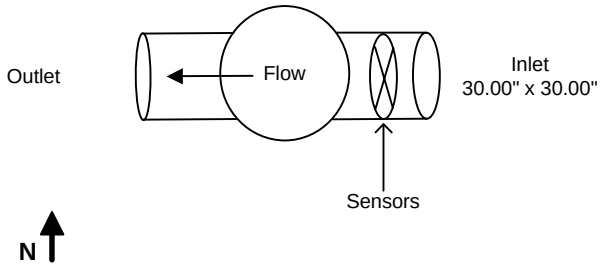
Date/Time of Investigation:	03/31/15 @ 11:50
Site Hydraulics:	Fast moving flow with waves
Upstream Input: (L/S, P/S)	Not influenced
Upstream Manhole:	1 inlet / 1 outlet
Downstream Manhole:	1 inlet / 1 outlet
Depth of Flow:	6.00" +/- 0.38"
Range (Air DOF):	24.00" +/- 0.38"
Peak Velocity:	4.89 fps
Silt:	0.00"

Manhole Information:

Manhole Depth:	8'			
Manhole Material / Condition	Concrete / Good			
Pipe Material / Condition:	Concrete/ Good			
Mini System Character:	Residential [X]	Commercial [X]	Industrial [ ]	Trunk [X]
Telephone Information:	Does not apply			
Access Pole #:	Does not apply			
Distance From Manhole:	Does not apply	Feet		
Road Cut Length:	Does not apply	Feet		
Trench Length:	Does not apply	Feet		

Other Information:





Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Ultrasonic, Velocity, Pressure	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	0 Feet	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	RG_OV	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

Need to contact RJ w/ the district at 208-941-5382 at least 24hrs prior to access so he can let you in the gate to WWTP (doesn't open until 7AM)

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** YRD_010	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards outside of norm found at this site

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this location

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a traffic control Plan
☐ Standard Traffic Control Plan is to be used at this work site
☐ This site requires a special Traffic Control Plan which is attached

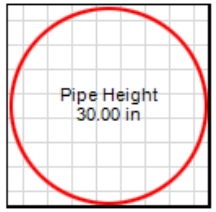
Approved	**Reviewed**
Field Mgr Name: Sean Winder	Project Mgr Name: Mike Pina
Signature: *Sean Winder*	Signature: *Mike Pina*
Date: 3/31/15	Date: 3/31/15

SCATTERGRAPH REPORT

YRD_010

Flow Monitor

YRD_010

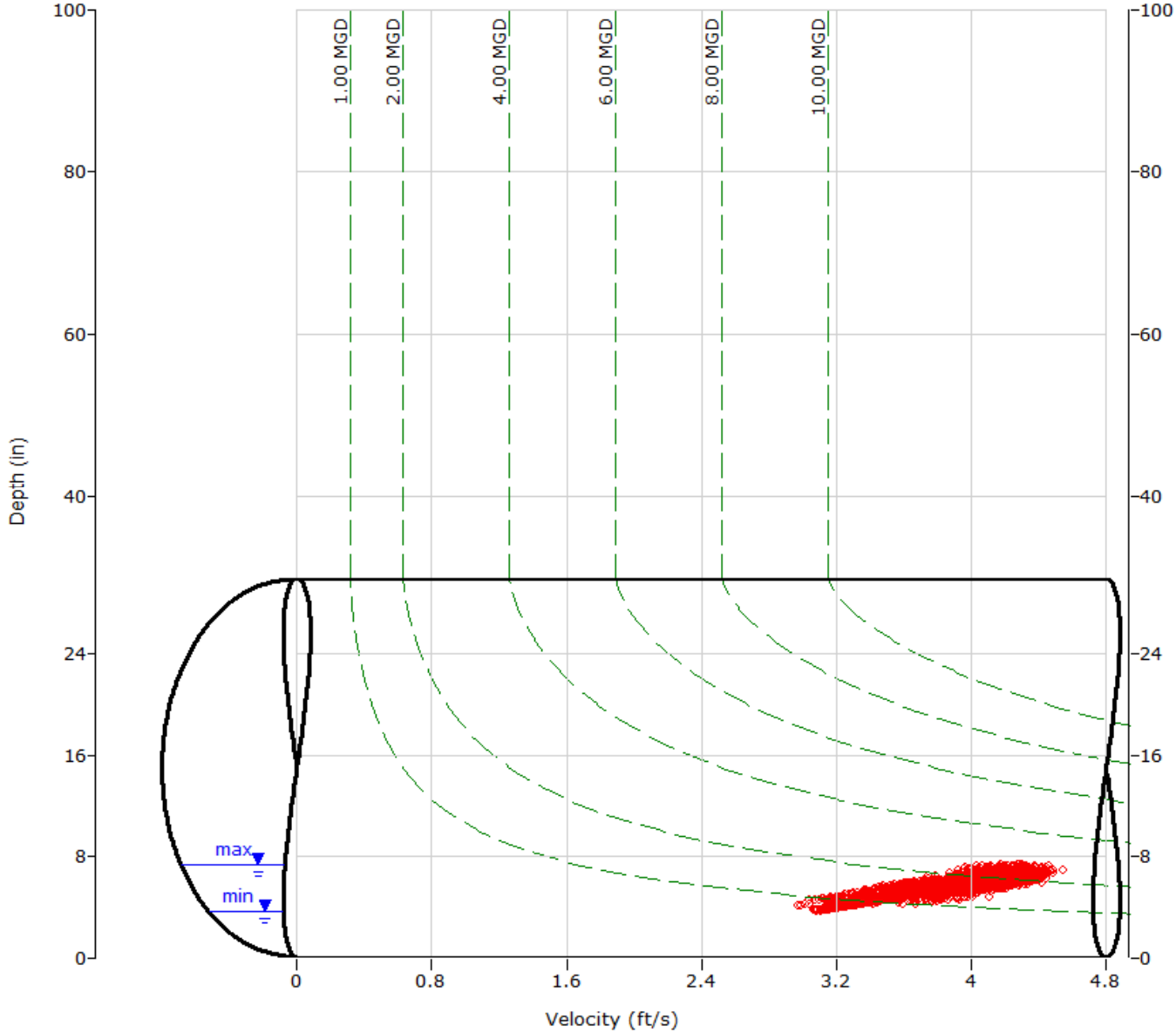


Report Period

4/8/2015
To
4/21/2015

Legend

- Depth - Velocity
- Iso-Q™
- Silt
- Min-Max Depth



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

YRD_010

Flow Monitor

YRD_010

Pipe Height
30.00 in

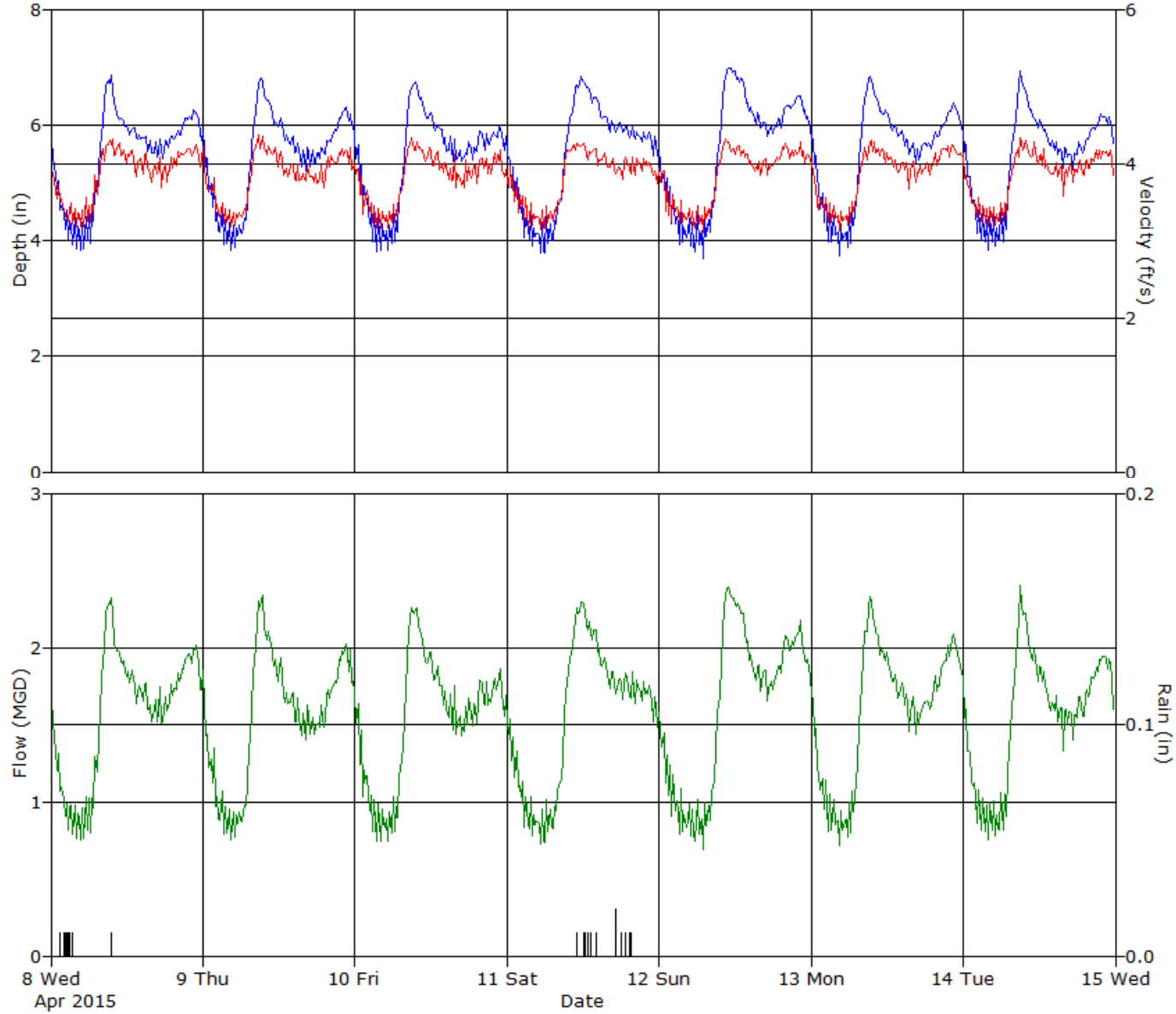
Report Period

4/8/2015
To
4/14/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_LM



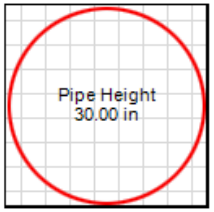
ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

YRD_010

Flow Monitor

YRD_010



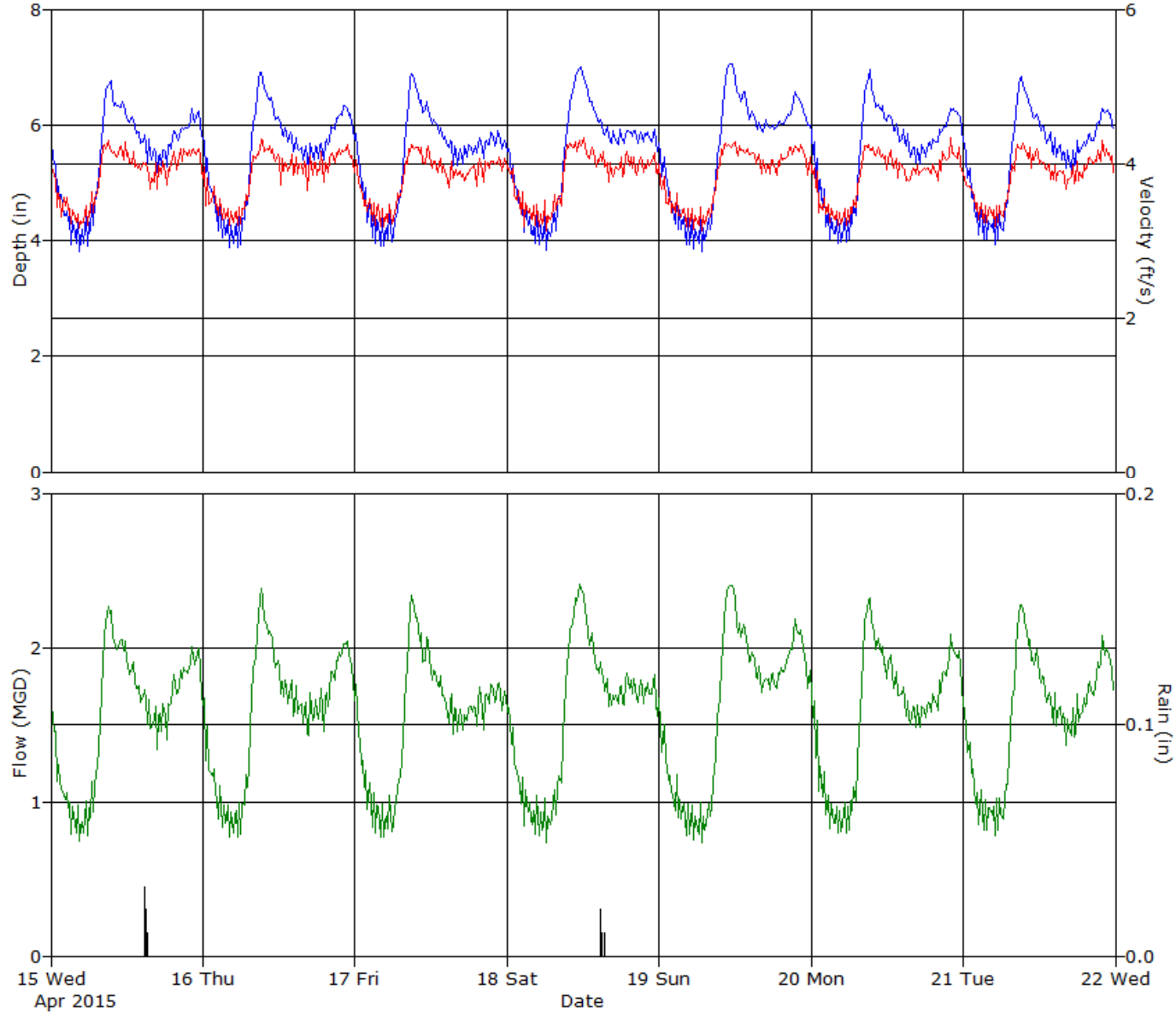
Report Period

4/15/2015
To
4/21/2015

Legend

- Depth
- Velocity
- Quantity
- Rain

*RG_LM



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

YRD_010, Pipe Height: 30 in

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015	05:20	3.75	09:35	7.18	5.48	05:20	3.13	08:55	4.44	3.87	05:20	0.717	09:20	2.536	1.570	1.570	0.08
4/9/2015	05:10	3.74	08:55	7.12	5.46	05:10	3.13	09:00	4.55	3.84	05:10	0.713	09:00	2.490	1.549	1.549	
4/10/2015	04:15	3.75	09:30	7.14	5.43	04:15	3.13	09:05	4.45	3.82	04:15	0.717	09:30	2.489	1.532	1.532	
4/11/2015	06:05	3.69	11:50	7.14	5.47	03:20	2.99	11:05	4.47	3.81	06:05	0.694	12:05	2.537	1.551	1.551	0.12
4/12/2015	07:05	3.64	11:55	7.25	5.59	07:05	3.08	10:40	4.47	3.84	07:05	0.675	10:50	2.583	1.616	1.616	
4/13/2015	04:35	3.71	09:15	7.22	5.52	01:55	3.08	10:10	4.39	3.86	04:35	0.702	09:15	2.545	1.584	1.584	
4/14/2015	04:05	3.75	09:10	7.32	5.47	02:05	3.13	09:00	4.48	3.84	04:05	0.717	09:10	2.503	1.554	1.554	
4/15/2015	04:40	3.73	09:35	7.08	5.48	05:05	2.97	21:10	4.45	3.85	04:40	0.709	09:20	2.465	1.562	1.562	0.06
4/16/2015	04:25	3.77	09:20	7.21	5.51	04:25	3.14	09:20	4.46	3.86	04:25	0.725	09:20	2.619	1.578	1.578	
4/17/2015	04:45	3.77	09:05	7.15	5.45	04:45	3.11	09:40	4.41	3.82	04:45	0.717	09:05	2.484	1.534	1.534	
4/18/2015	06:30	3.74	11:50	7.27	5.48	02:45	3.01	12:00	4.46	3.84	06:30	0.703	11:55	2.505	1.563	1.563	0.04
4/19/2015	06:55	3.71	11:20	7.31	5.57	06:55	3.07	10:35	4.42	3.84	06:55	0.691	10:50	2.563	1.611	1.611	
4/20/2015	05:00	3.84	09:20	7.17	5.52	05:00	3.14	08:55	4.48	3.83	05:00	0.743	09:05	2.465	1.573	1.573	
4/21/2015	05:10	3.87	09:25	7.24	5.49	05:10	3.15	22:10	4.44	3.83	05:10	0.756	09:10	2.497	1.555	1.554	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Depth (in)	Velocity (ft/s)	Quantity (MGD - Total MG)	Rain (in)
Total			21.931	0.30
Avg	5.49	3.84	1.567	

Site Commentary

Overview

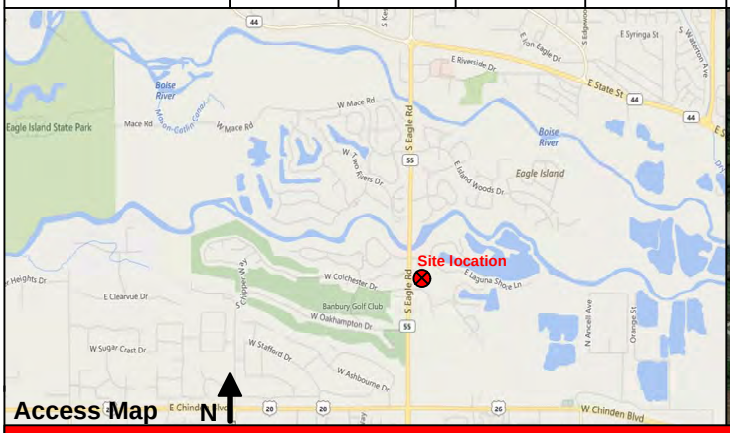
RG_LM	
Total Rainfall	0.30 "

A review of the hydrograph indicates that RG_LM functioned under normal conditions during the period Wednesday, April 08, 2015 through Tuesday, April 21, 2015 .

ADS Site Report

Quality Form

Project Name: EagleSwrDst.CH2M.TFM.ID15	**City / State:** Navy Yard City, WA	**FM Initials:** SW	
Site Name: RG_LM	**Monitor Series:** 5000 AG	**Monitor S/N:**	21805
Address/Location: 2430 S. Eagle Rd (Mace Lift Station)		**Manhole #**	NA
		GPS	43.672734°; -116.353761°
		Location:	Located in northeast section of station
Access: Drive	**Type of System:** Sanitary [X] Storm [ ] Combined [ ]	**Tipping Bucket Dia.**	8.00"
		IP Address:	166.219.48.113



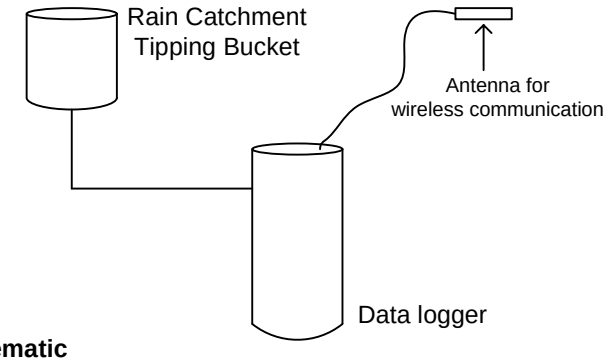
Investigation Information:

Date/Time of Investigation:	04/01/15 @ 10:30
Site Hydraulics:	NA
Upstream Input: (L/S, P/S)	NA
Upstream Manhole:	NA
Downstream Manhole:	NA
Depth of Flow:	NA
Range (Air DOF):	NA
Peak Velocity:	NA
Silt:	NA

Manhole Information:

Manhole Depth:	NA			
Manhole Material / Condition	NA			
Pipe Material / Condition:	NA			
Mini System Character:	Residential [X]	Commercial [X]	Industrial [ ]	Trunk [ ]
Telephone Information:	Does not apply			
Access Pole #:	Does not apply			
Distance From Manhole:	Does not apply	Feet		
Road Cut Length:	Does not apply	Feet		
Trench Length:	Does not apply	Feet		

Other Information:



Schematic

Access View N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Tipping Bucket	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	NA	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	Mace Lift Station	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

Need to contact RJ w/ the district at 208-941-5382 at least 24hrs prior to access.

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** RG_LM	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards found at this site outside the norm

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this location

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a Traffic Control Plan

☐ Standard Traffic Control Plan is to be used at this work site

☐ This site requires a special Traffic Control Plan which is attached

Approved		**Reviewed**	
Field Mgr Name:	Sean Winder	Project Mgr Name:	Mike Pina
Signature:	*Sean Winder*	Signature:	*Mike Pina*
Date:	4/1/15	Date:	4/1/15

HYDROGRAPH REPORT

RG_LM

Flow Monitor

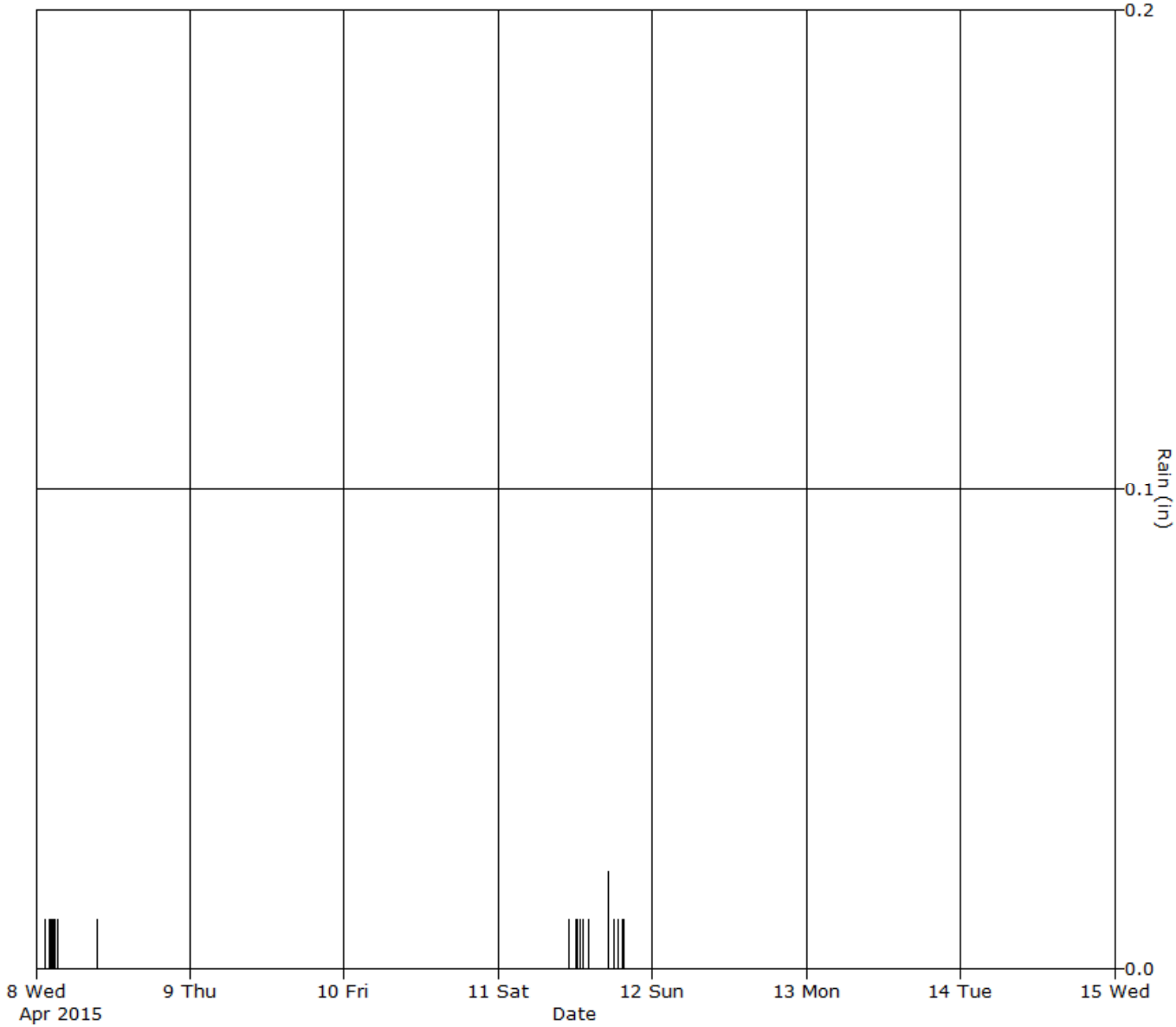
RG_LM

Report Period

4/8/2015
To
4/14/2015

Legend

Rain



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

RG_LM

Flow Monitor

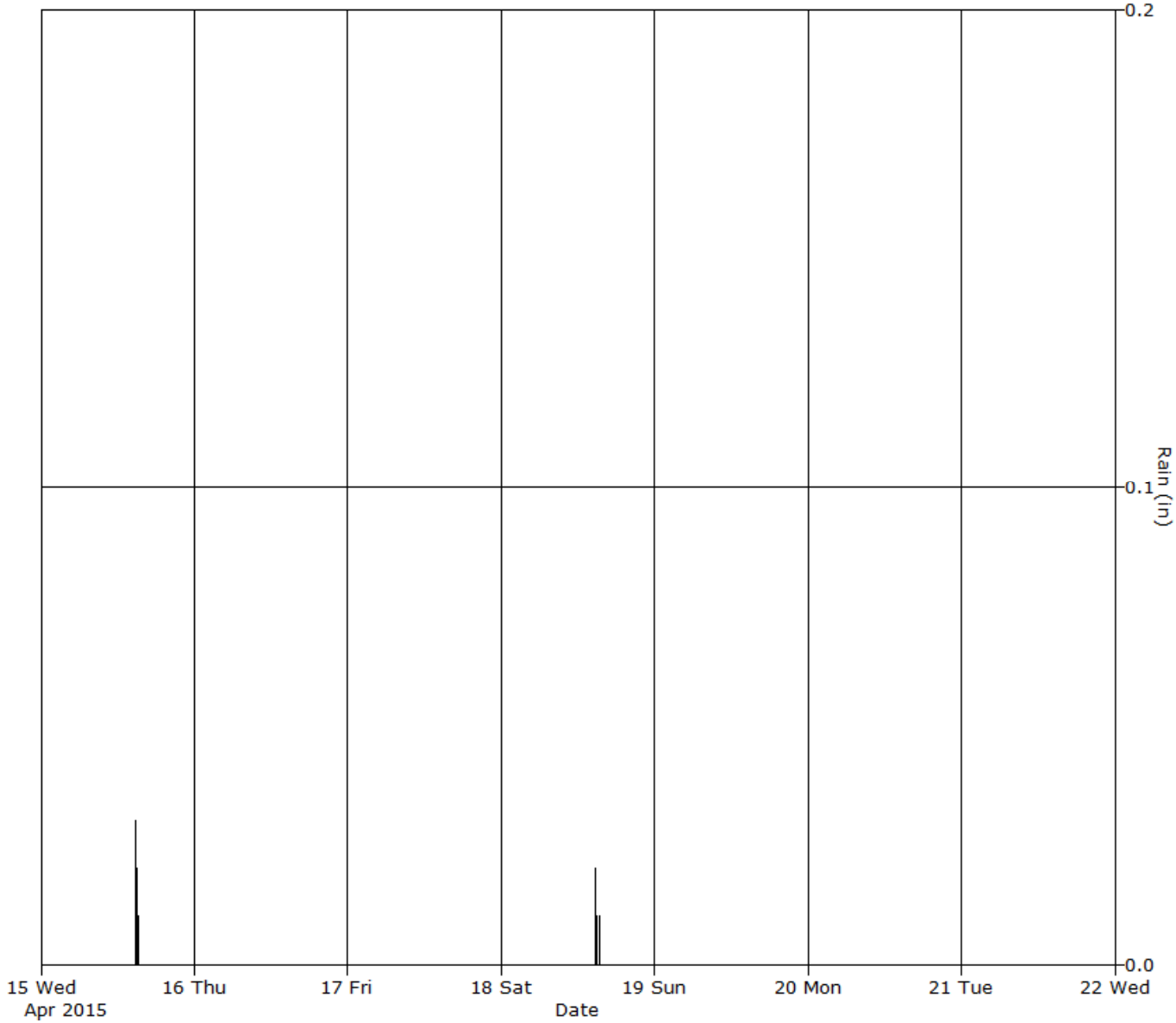
RG_LM

Report Period

4/15/2015
To
4/21/2015

Legend

Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

RG_LM, Pipe Height:

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015																	0.08
4/9/2015																	
4/10/2015																	
4/11/2015																	0.12
4/12/2015																	
4/13/2015																	
4/14/2015																	
4/15/2015																	0.06
4/16/2015																	
4/17/2015																	
4/18/2015																	0.04
4/19/2015																	
4/20/2015																	
4/21/2015																	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Rain (in)
Total	0.30
Avg	

Site Commentary

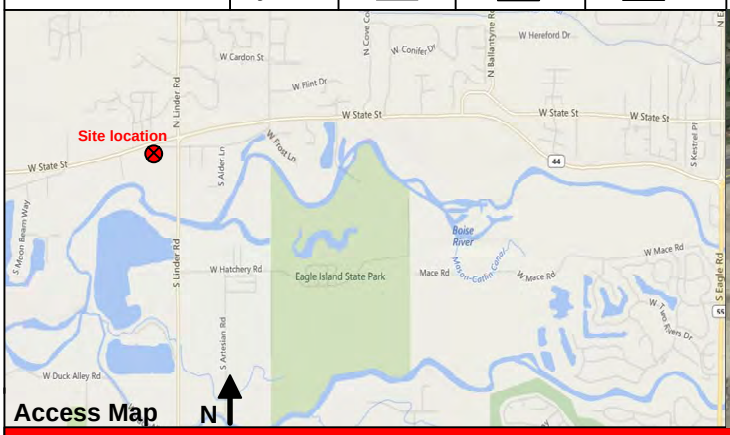
Overview

RG_OV	
Total Rainfall	0.24 "

A review of the hydrograph indicates that RG_OV functioned under normal conditions during the period Wednesday, April 08, 2015 through Tuesday, April 21, 2015 .

ADS Site Report — Quality Form

Project Name: EagleSwrDst.CH2M.TFM.ID15	**City / State:** Eagle, ID	**FM Initials:** SW	
Site Name: RG_OV	**Monitor Series:** 5000 AG	**Monitor S/N:**	20946
Address/Location: 52 S. Baxter Way (Old Valley Lift Station)		**Manhole #**	NA
		GPS	43.693282°; -116.415922°
		Location:	Located in northeast section of station
Access: Drive	**Type of System:** Sanitary [X] Storm [ ] Combined [ ]	**Tipping Bucket Dia.**	8.00"
		IP Address:	166.219.169.192



Access Map

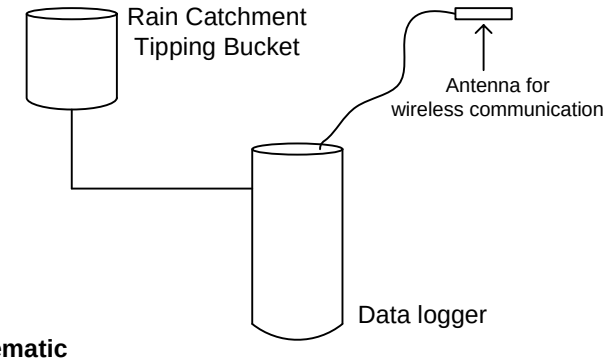
Investigation Information:

Date/Time of Investigation:	03/31/15 @ 10:00
Site Hydraulics:	NA
Upstream Input: (L/S, P/S)	NA
Upstream Manhole:	NA
Downstream Manhole:	NA
Depth of Flow:	NA
Range (Air DOF):	NA
Peak Velocity:	NA
Silt:	NA

Manhole Information:

Manhole Depth:	NA			
Manhole Material / Condition	NA			
Pipe Material / Condition:	NA			
Mini System Character:	Residential [X]	Commercial [X]	Industrial [ ]	Trunk [ ]
Telephone Information:	Does not apply			
Access Pole #:	Does not apply			
Distance From Manhole:	Does not apply	Feet		
Road Cut Length:	Does not apply	Feet		
Trench Length:	Does not apply	Feet		

Other Information:



Schematic

Access View N

Installation Information		Backup	Yes	No	?	Distance
Installation Type:	Standard	Trunk	[ ]	[X]	[ ]	
Sensors Devices:	Tipping Bucket	Lift / Pump Station	[ ]	[X]	[ ]	
Surcharge Height:	NA	WWTP	[ ]	[X]	[ ]	
Rain Guage Zone:	Mace Lift Station	Other	[ ]	[X]	[ ]	

Additional Site Information / Comments:

Need to contact RJ w/ the district at 208-941-5382 at least 24hrs prior to access.

ADS ENVIRONMENTAL SERVICES

ADS Site Report

Quality Form

Flow Monitoring Site Safety Plan

Project Name: EagleSwrDst.CH2M.TFM.ID15	**Site ID:** RG_OV	**Site Classification:** (see below)

Note: Class 5 Site Safety Plans must be approved by the Corporate Safety Manager

*** Hazards found at this site (Discuss checked items below)**

Type	#	Special Hazard	
Communications	1	The site is in a communications "Dead-Zone"	☐
Traffic	2	The site is located in or adjacent to an intersection	☐
	3	The site is located on hill, curve, or where motorists visibility of the site or other vehicles is reduced	☐
	4	The site is located ina high speed (>45MPH) or high density roadway	☐
	5	Site traffic is congested at peak hours	☐
Access	6	Site has access obstacles (rough terrain, fences, deep easement, etc.)	☐
Worksite	7	Worksite contains hazards (terrain, slope, obstructions, etc.)	☐
	8	Elevated work requiring a ladder / work near an unguarded edge. Raised manhole (indicate height below)	☐
	9	Pedestrian control necessary as the site is located in or near a walkway, school, playground, etc.	☐
	10	Work may be performed during darkness; requiring additional site lighting	☐
	11	Site is located in a high crime area (check with client & local authorities if unsure)	☐
Confined Space	12	Confined Space does not have useable rungs	☐
	13	Confined Space depth is greater than 50 feet	☐
	14	Confined Space has internal platforms, weirs or other obstructions that interfere with or prevent unobstructed vertical retrieval	☐
	15	Work requires lateral movement that would interfere with or prevent unobstructed vertical retrieval	☐
	16	Flow is hazardous due to depth, velocity, pipe diameter, or is industrial process flow	☐
	17	Confined Space subject to surcharge during / after a rain event	☐
	18	CO, H2S, low O2 or other toxic / flammable gases present or anticipated	☐
	19	Confined Space has active drop connections	☐

*** Hazards found at this site (Discuss checked items below)**

No hazards found at this site outside the norm

*** Site Classification**

	Class	Description
☒	1	2-person crew. Standard procedures and equipment. No special requirements
☐	2	Worksite (non-traffic) with access obstacles and or worksite hazards
☐	3	Traffic site requiring special scheduling, additional personnel and / or traffic control equipment, or outsourcing
☐	4	Confined Space Entry requiring special scheduling, additional personnel and / or safety equipment
☐	5	Special Operation requiring a separate safety plan. *Must be approved by Corporate Safety Manager*

*** Site Specific Safety Requirements. Must Complete for any site Class 2 & Above**

No site specific safety requirements for this location

Traffic Control Plan

Note: All worksites located in a roadway or immediately adjacent to a roadway, where the operation may impede the normal flow of traffic, are required to have a Traffic Control Plan. Standard Traffic Control Plans are to be carried in the vehicle and referred to when setting up the worksite. Special Traffic Control Plans are to be are to be developed when required by clients or regulating agencies or when a standard Traffic Control Plan is not sufficient to control traffic at the worksite.

☒ This worksite does NOT require a Traffic Control Plan

☐ Standard Traffic Control Plan is to be used at this work site

☐ This site requires a special Traffic Control Plan which is attached

Approved		**Reviewed**	
Field Mgr Name:	Sean Winder	Project Mgr Name:	Mike Pina
Signature:	*Sean Winder*	Signature:	*Mike Pina*
Date:	3/31/15	Date:	3/31/15

HYDROGRAPH REPORT

RG_OV

Flow Monitor

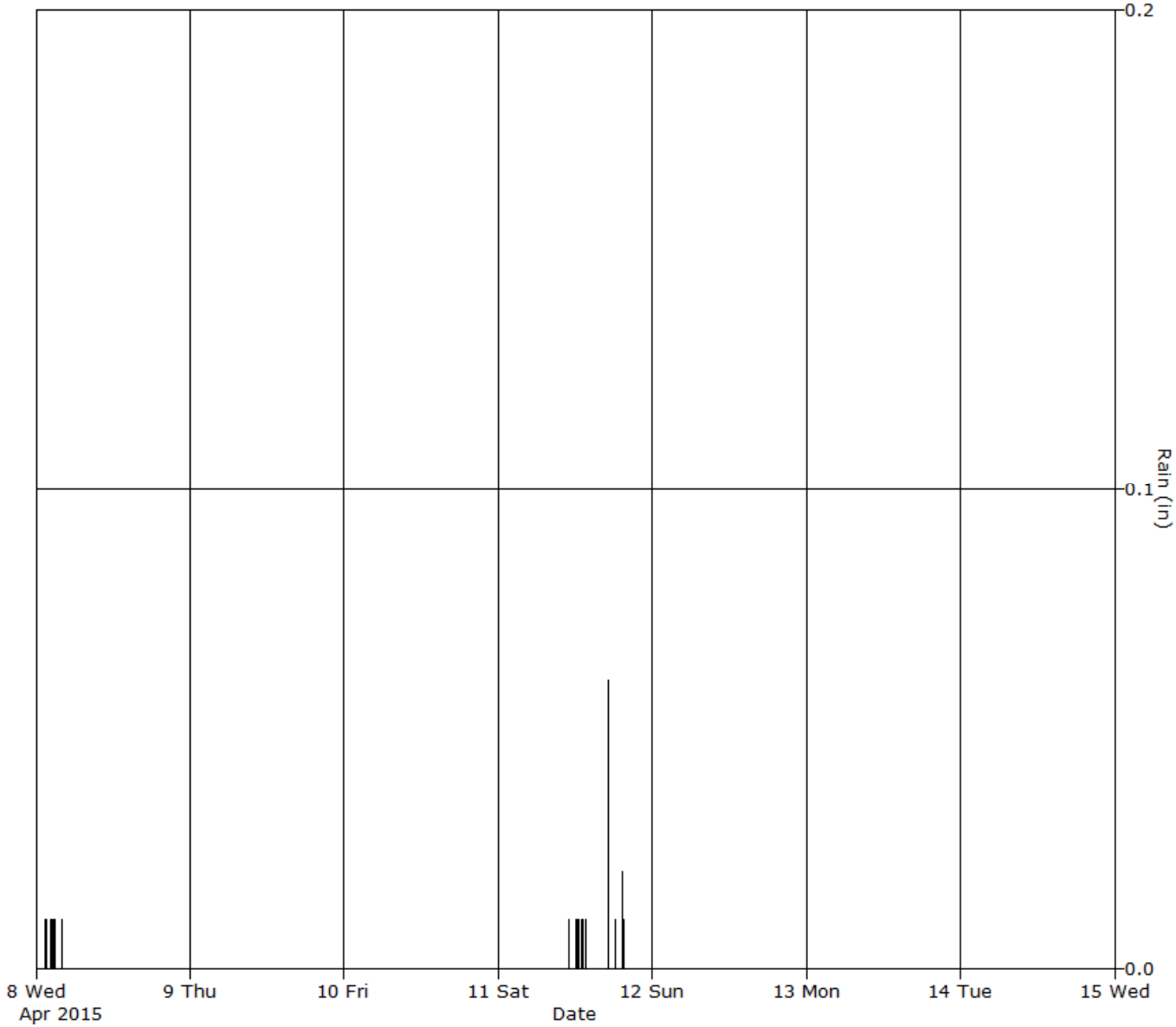
RG_OV

Report Period

4/8/2015
To
4/14/2015

Legend

Rain



ADS ENVIRONMENTAL SERVICES

HYDROGRAPH REPORT

RG_OV

Flow Monitor

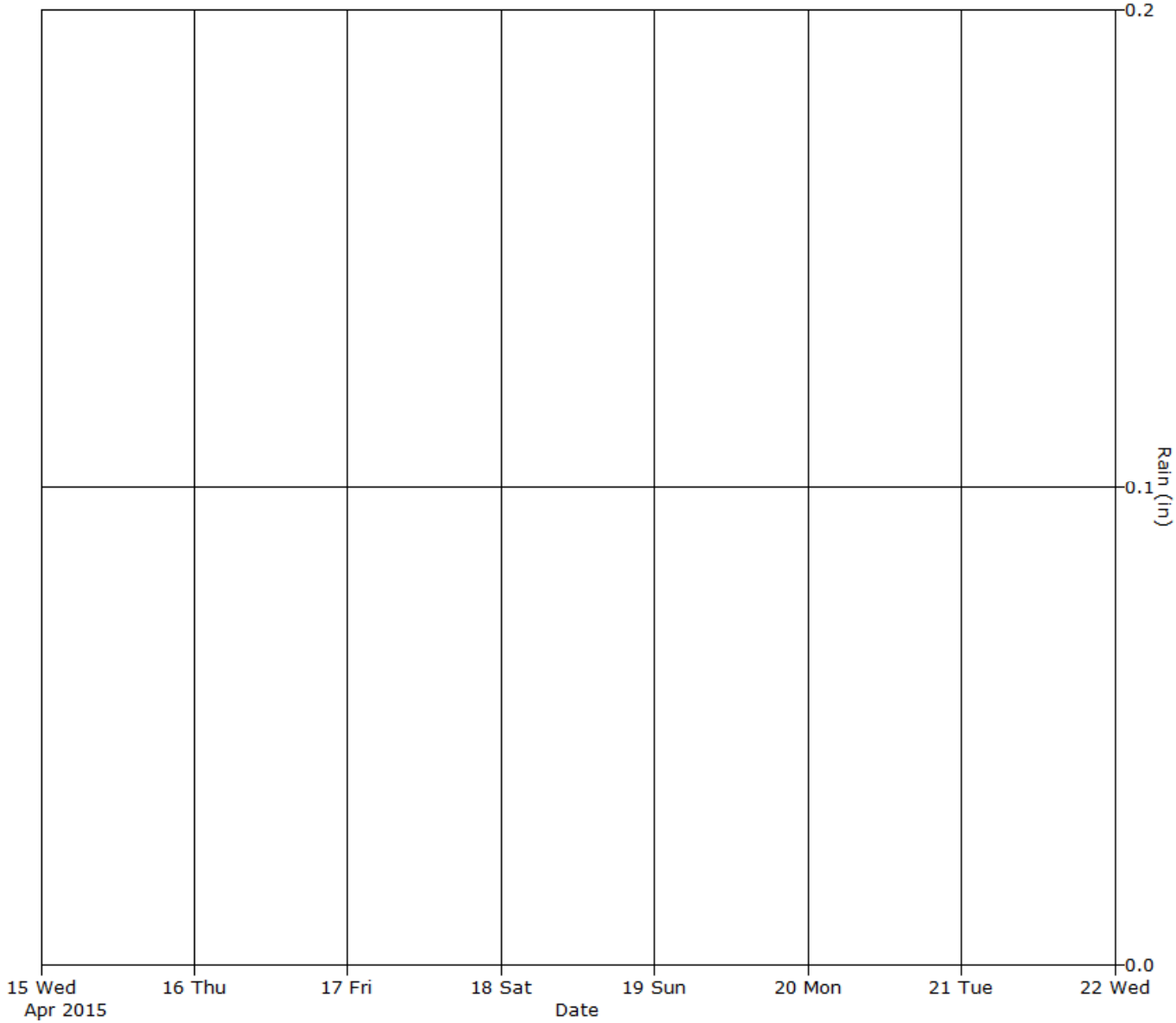
RG_OV

Report Period

4/15/2015
To
4/21/2015

Legend

Rain



ADS ENVIRONMENTAL SERVICES

Daily Tabular Report For The Period 4/8/2015 - 4/21/2015

RG_OV, Pipe Height:

Daily Tabular Report

Date	Depth (in)					Velocity (ft/s)					Quantity (MGD - Total MG)						Rain (in)
	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
4/8/2015																	0.07
4/9/2015																	
4/10/2015																	
4/11/2015																	0.17
4/12/2015																	
4/13/2015																	
4/14/2015																	
4/15/2015																	
4/16/2015																	
4/17/2015																	
4/18/2015																	
4/19/2015																	
4/20/2015																	
4/21/2015																	

Report Summary For The Period 4/8/2015 - 4/21/2015

	Rain (in)
Total	0.24
Avg	

Appendix E
Dry Weather Flow Patterns

Dry Weather Average Flows & Flow Patterns

To support, model calibration data from each flow monitoring location was analyzed to identify representative diurnal patterns (defined by 24 hourly flow averages) for each basin. Distinct patterns were developed for both weekdays and for weekends. The results of a basin analysis is presented in Figure 7-3 below. “Measured” denotes the flow measured at the site and “Net Basin” is the basin’s discrete contribution into the system. For terminal basins, the two flows are equivalent; however, for flow monitors located downstream of another basin, the net basin flow is calculated by subtracting out upstream flows. In short, the net basin is used for flow distribution within the model.

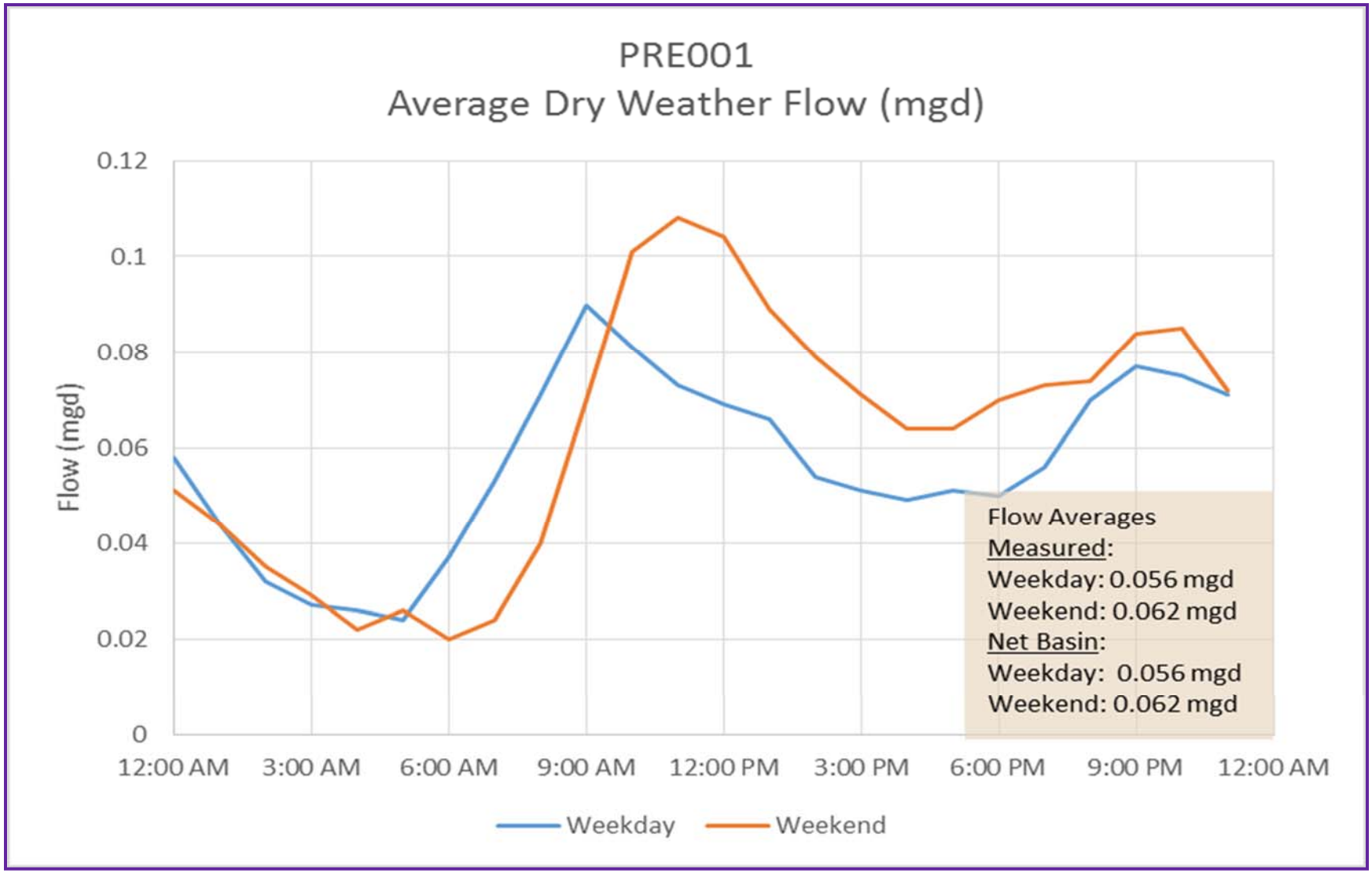


Figure 1. Diurnal Curves for Flow Meter Basin PRE-001

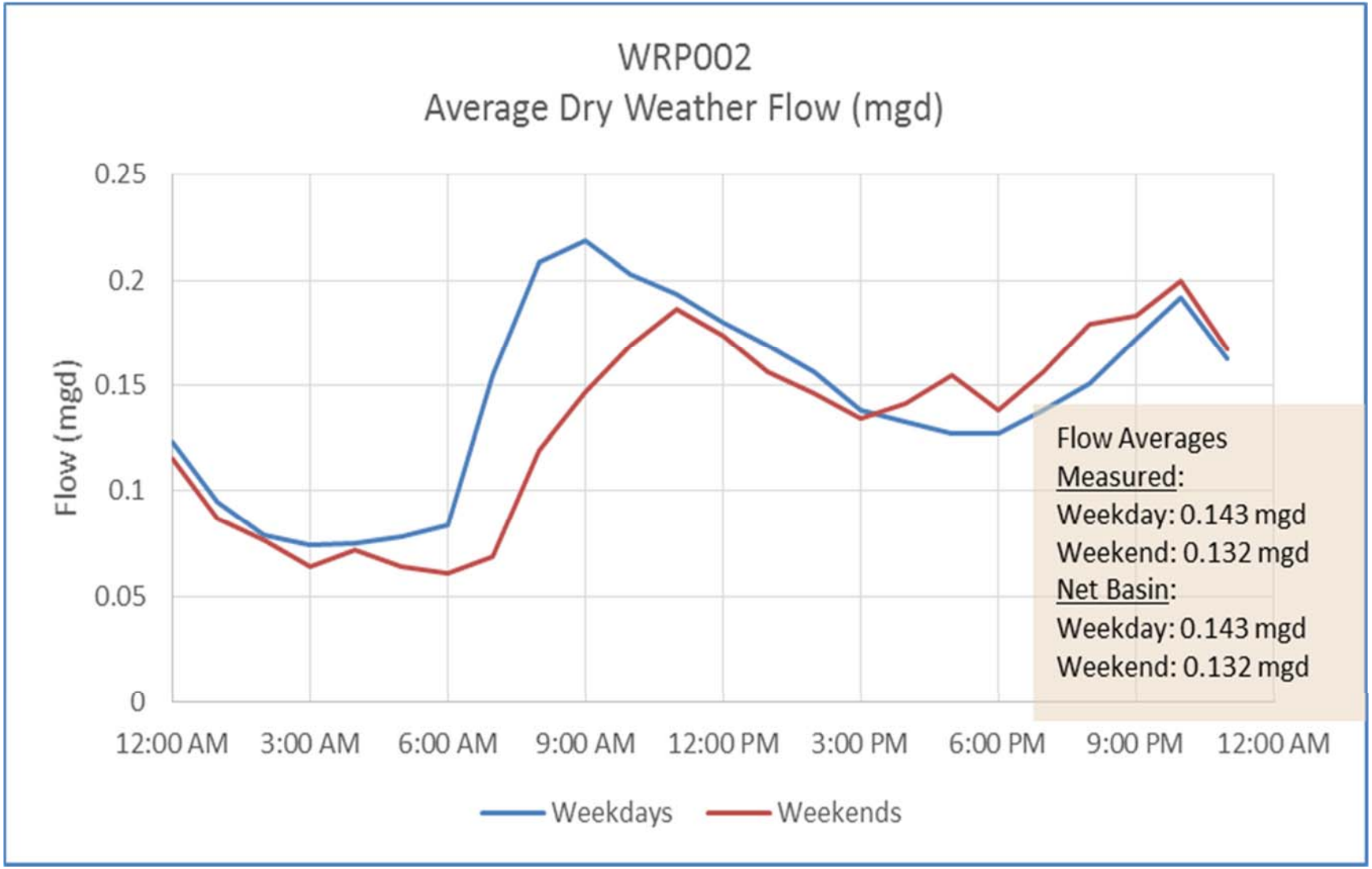


Figure 2. Diurnal Curves for Flow Meter Basin WRP-002

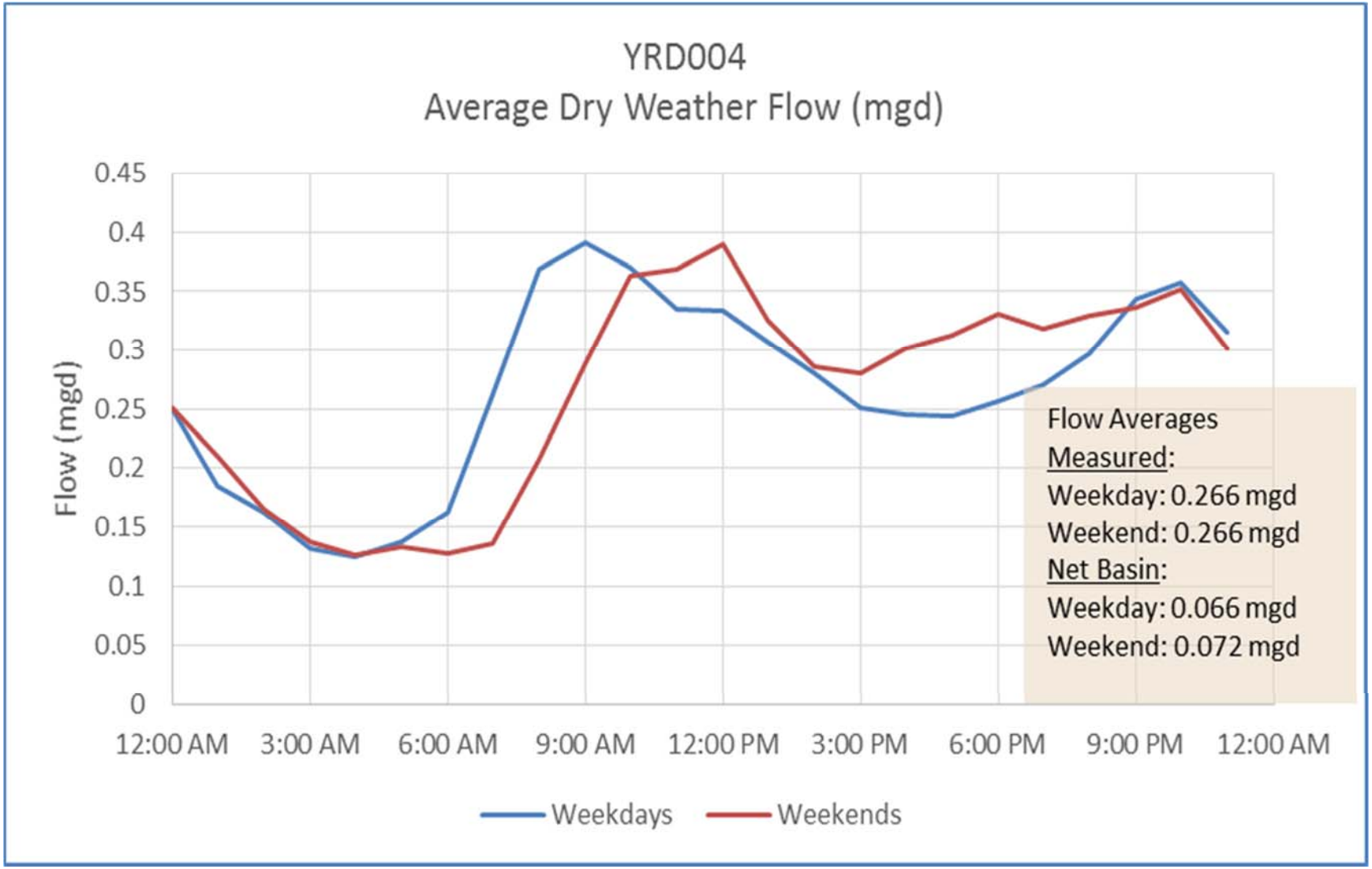


Figure 3. Diurnal Curves for Flow Meter Basin YRD-004

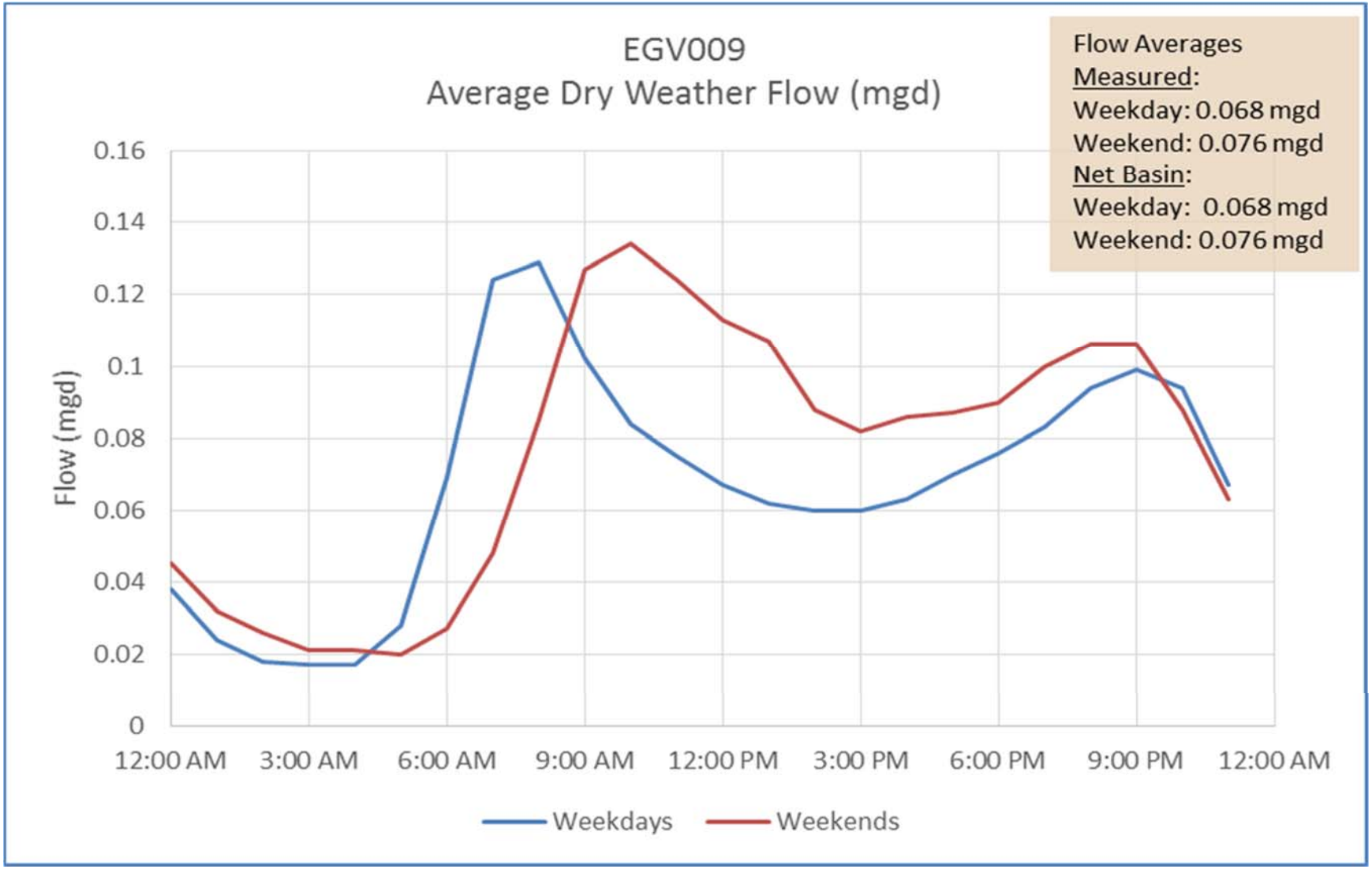


Figure 4. Diurnal Curves for Flow Meter Basin EGV-009

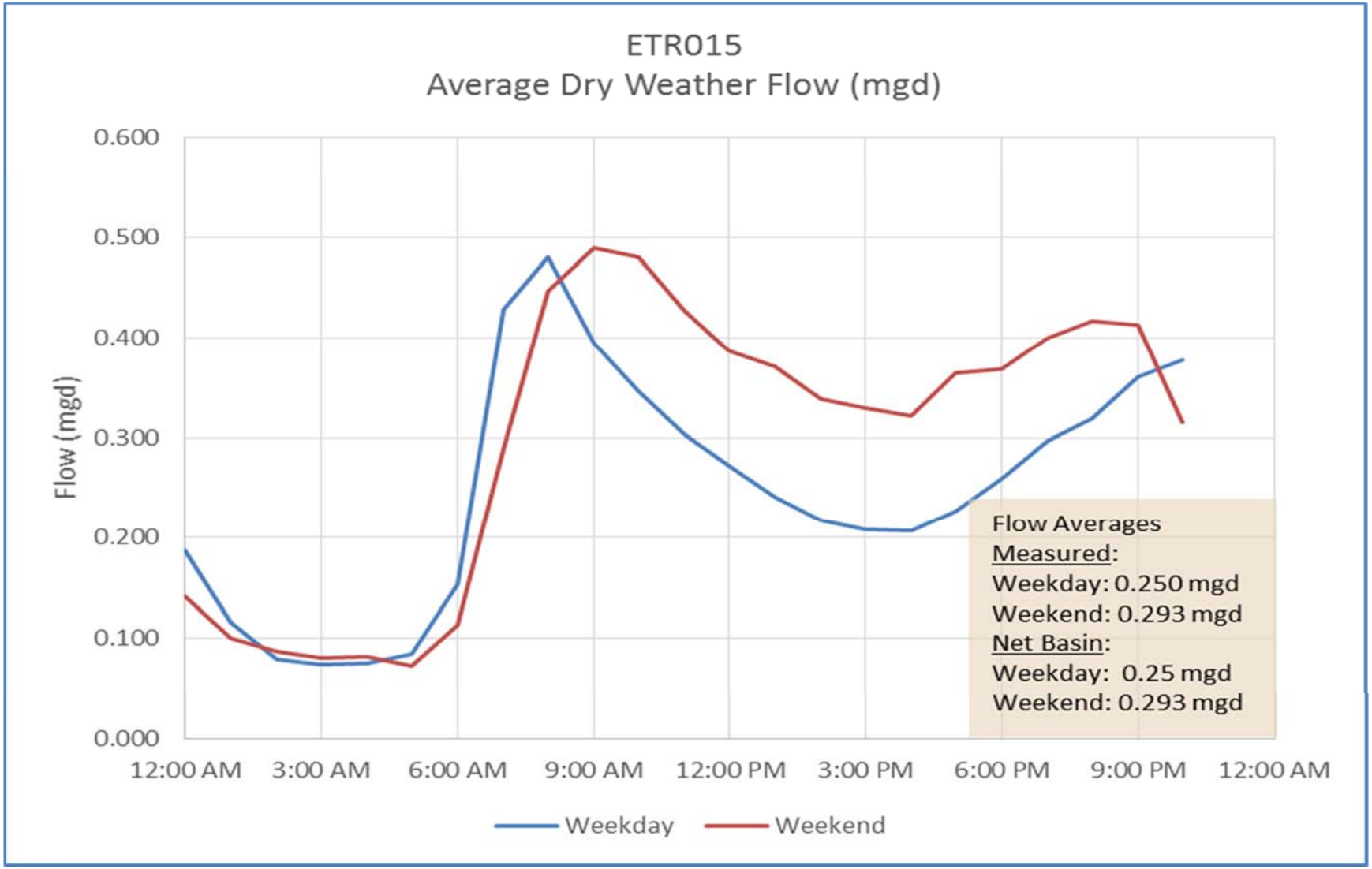


Figure 5. Diurnal Curves for Flow Meter Basin ETR-015

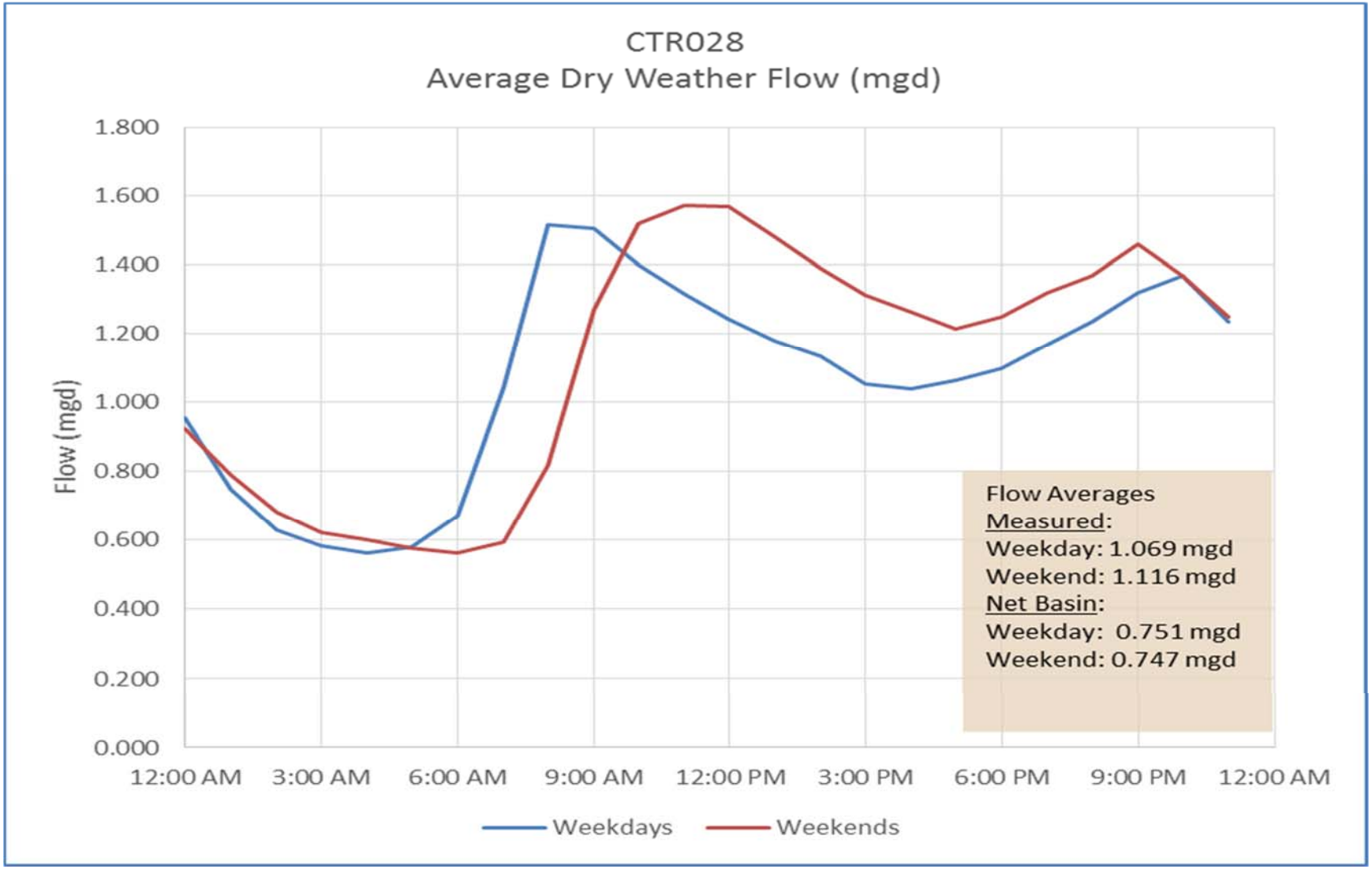


Figure 6. Diurnal Curves for Flow Meter Basin CTR-028

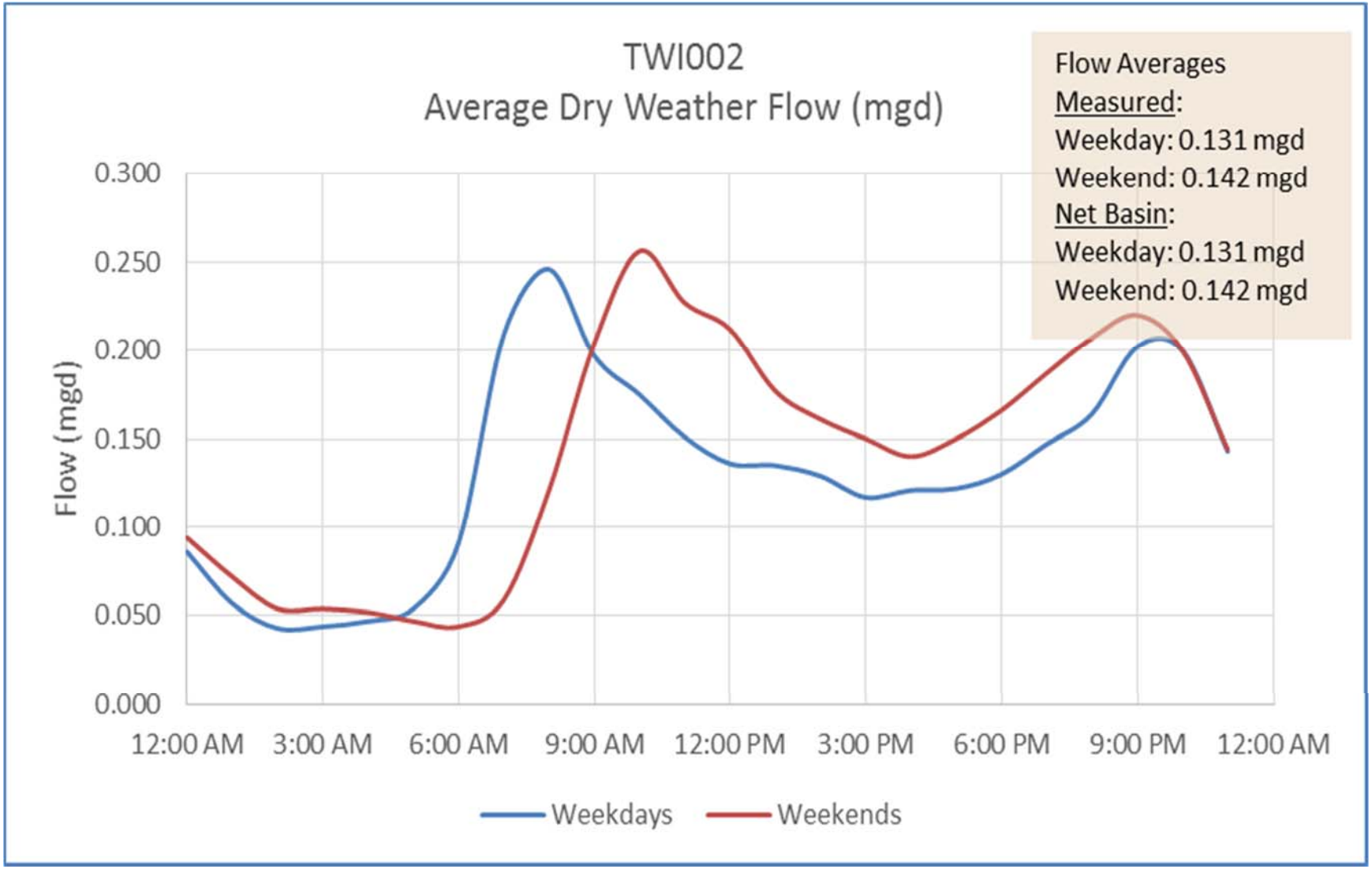


Figure 7. Diurnal Curves for Flow Meter Basin TWI-002

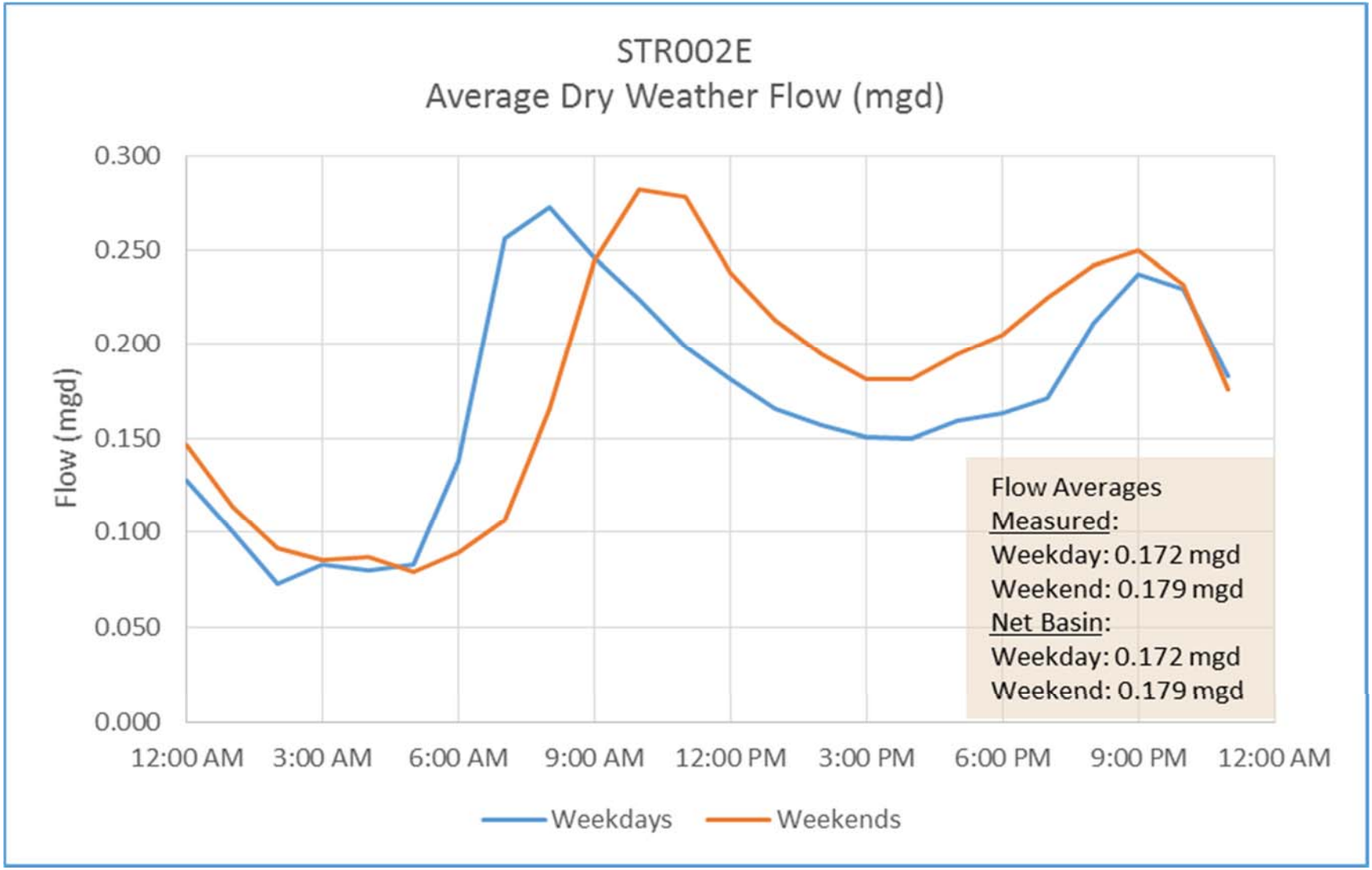


Figure 8. Diurnal Curves for Flow Meter Basin STR-002 East Pipe

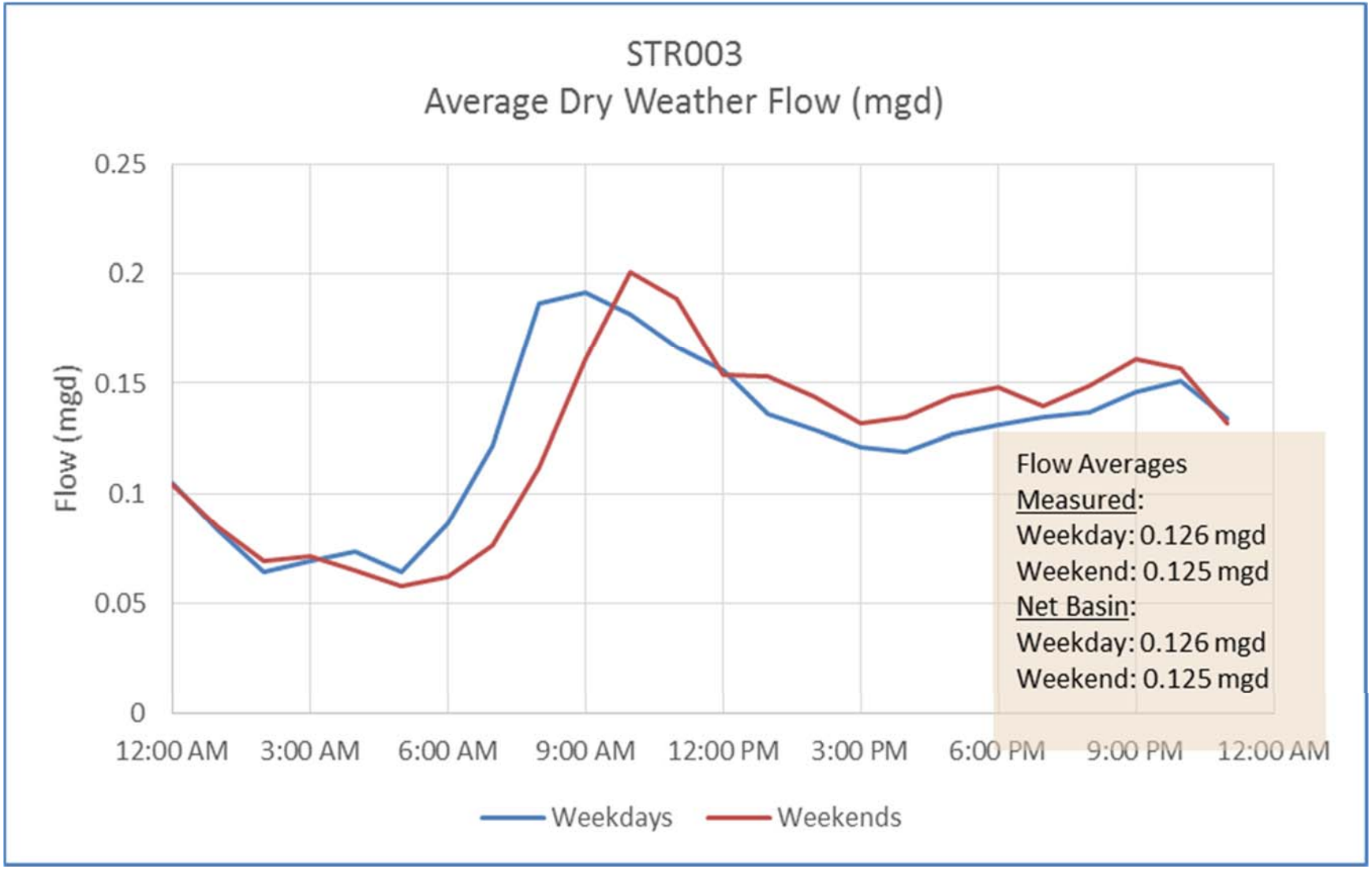


Figure 9. Diurnal Curves for Flow Meter Basin STR-003

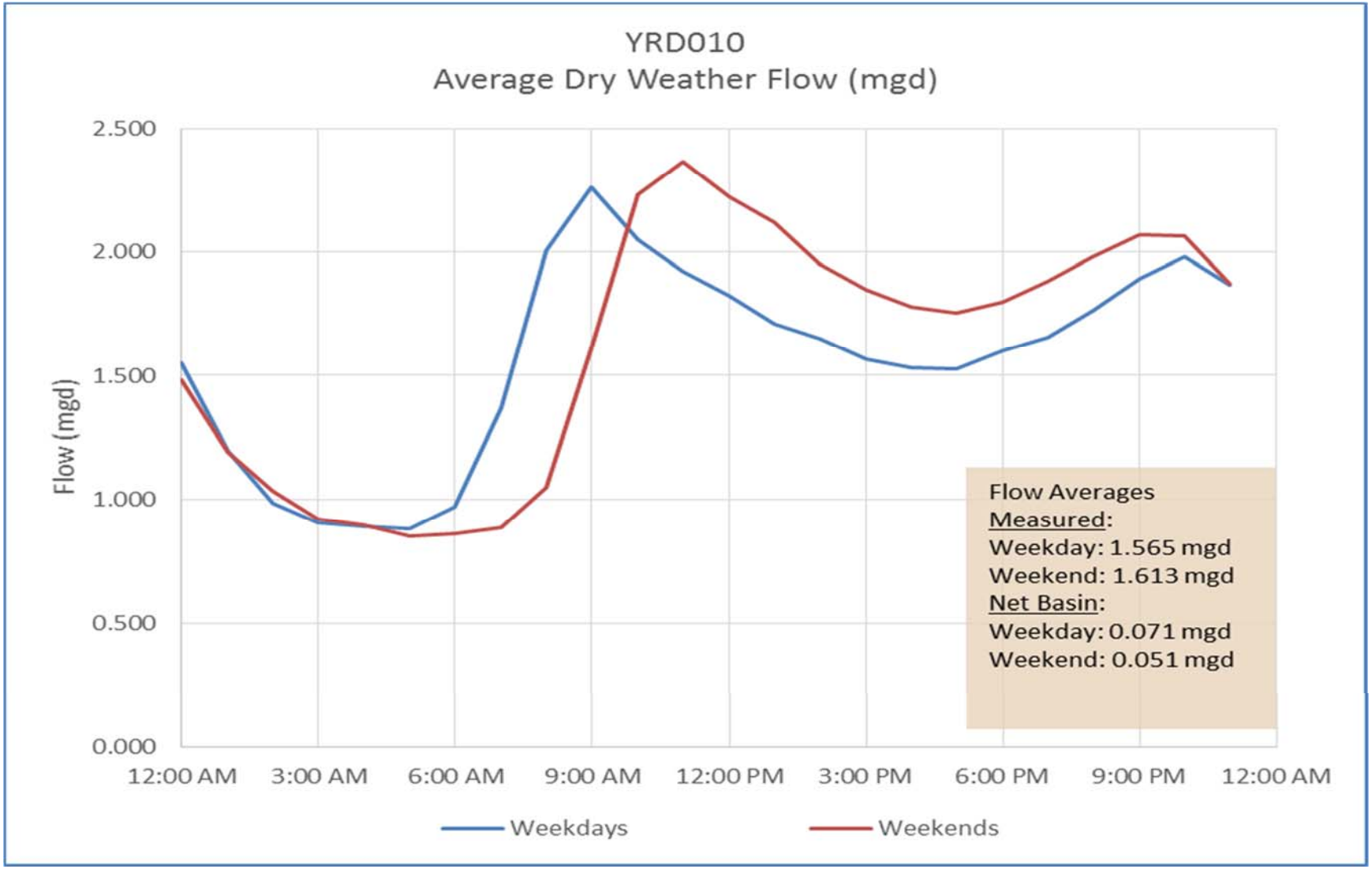


Figure 10. Diurnal Curves for Flow Meter Basin YRD-010

Appendix F
Flow Loading Summary

2015 Manhole Flow Loading Protocol

- Using Spreadsheet TAZ_FM-Basin_08-13-2015.xlsx
  - GIS information included each flow meter basin (Layer File Name: Basins) and TAZ Zone information (Layer File Name: EageTAZ). Using GIS, percentage was calculated to get the percentage of the flow meter basin that was located within the TAZ zone (Layer File Name: TAZ_Basins, column PCT_TAZ).
  - The percentage of population that contributed to the flow meter basin was calculated using the PCT_TAZ data and the TOT15POP data. This is the number of people contributing to flow meter basin.
  - Based upon the total number of people within the flow meter basin, a per person flow rate was calculated for each basin (see Flow Rate Info Tab in spreadsheet) using the average weekday flow rate from the flow monitoring results from ADS (see spreadsheet Dry day hourly average.xlsx).
- Determining the Number of flow Loading Manholes:
  - Work completed for each TAZ zone (column TZONES) in each flow meter basin. The number of flow loading manholes was typically based upon the number of deadend manholes within the TZONE. This was done to insure there were no empty pipes in the model.
  - Layer file July 2015 Manholes was updated with a “Yes” to show which manholes were “Flow Load” Manholes.
  - The “Total Flow in TAZ Area (gpm)” was then distributed evenly amongst the “Flow Load” manholes. This flow rate was then inputted in the InfoSWMM Model as a dry weather average flow.
- Inputting DWF into InfoSWMM:
  - For each flow meter basin, the weekday diurnal pattern was inputted in “Pattern 1” in InfoSWMM and the weekend pattern (NOT the weekend diurnal pattern, see spreadsheet Dry day hourly average.xlsx) was inputted in “Pattern 2.” To estimate the flow over throughout the weekends the following equation was used:

$$Q_{weekend} = Q_{Weekday} \times Pattern1 \times Pattern2$$

2040 Manhole Flow Loading Protocol

- Using Spreadsheet TAZ_FM-Basin_08-13-2015.xlsx to update the flow rates to the 2040 rates located within the flow meter basins:
  - 2040 TAZ population projection was added to the spreadsheet and the percent increase/decrease from 2015 was calculated.
  - The per person flow rate for 2015 was maintained for each flow meter basin (see Flow Rate Info Tab in spreadsheet).
  - The 2040 individual flow rate per manhole (column “2040 Flow per MH”) was calculated multiplying the 2015 individual flow rate per manhole (column “2015 Flow per MH”) by that rate at which the population increased/decreased.
- Using Spreadsheet TAZ_FM-Basin_08-13-2015.xlsx to add TAZ population projections for areas projected to be developed or projected to be connected to the ESD system:
  - The TAZ population projections for the areas projected to be developed or projected to be connected to the ESD system (see figure on the following page created by Keller Associates and modified by CH2M) were documented.
  - A per capita flow rate of 100 gpd/person was used to estimate the 2040 flow rate by multiplying the population project by 100 gpd/person for each zone.
  - Land use data was evaluated in the areas projected to be developed or projected to be connected to the ESD system to see area where there are projected commercial areas. Four areas were identified: New Village Center, Business Park, Commercial, Professional office.
    - The acreage was calculated for each zone.
    - For the commercial and the New Village Center areas a per acreage flow rate of 1500 gpd/acre was used to estimate the flow contribution (Metcalf and Eddy 4th edition)
    - For the Business Park and the Professional Office areas a per acreage flow rate of 560 gpd/acre was used to estimate the flow contribution (ESD 2008 Facility Plan, Keller Associates)
- Inputting DWF into InfoSWMM:
  - The new 2040 DWF loads within the flow meter basins were updated within the InfoSWMM model.
  - The new 2040 DWF loads for the areas projected to be developed or projected to be connected to the ESD system were inputted into the InfoSWMM Model at seven new loading points.

Existing (2015) and Future (2040) Traffic Area Zone (TAZ) Analysis

FID	Flow Meter Basin Description	Traffic Area Zone (TAZ)	2010 Population	2040 Population	2015 to 2040 Population Change	2015 Percent TAZ	2040 Percent TAZ	2015 Population in TAZ Based upon %TAZ	2040 Population in TAZ Based upon %TAZ	2015 to 2040 Population Change in TAZ	2015 Total Flow in TAZ Area (gpm)	No. of Flow Loading MHs in Basin	2015 Flow per MH (gpm)	2040 Flow per MH (gpm)	MH Names	2040 Notes
0	EGV-009 Flow Meter Basin	716	492	646	1.312	0	0	0	0	#DIV/0!	0	0	0	#DIV/0!	N/A	
1	EGV-009 Flow Meter Basin	717	1,132	1127	0.996	0.06	0.06	68	68	0.996	3.07	3	1.024	1.020	BKW-161, CRP-011, CRP-008	Land percentage unchanged from 2015
2	EGV-009 Flow Meter Basin	718	1,071	1017	0.949	0.28	0.28	300	285	0.949	13.56	7	1.938	1.839	EHW-020, EHW-022, EHW-042, EHW-038, EHW-035, EHW 016, EHW-011	Land percentage unchanged from 2015
3	EGV-009 Flow Meter Basin	720	448	453	1.011	0.19	0.19	85	86	1.011	3.85	4	0.963	0.973	EGV-017, EGV-014, EGV-035, EGV-020	Land percentage unchanged from 2015
4	EGV-009 Flow Meter Basin	721	258	370	1.435	0.11	0.11	28	41	1.435	1.28	3	0.428	0.614	EGV-021, EGV-018, EGV-010	Land percentage unchanged from 2015
5	EGV-009 Flow Meter Basin	755	2,383	2403	1.009	0.08	0.08	191	192	1.009	8.62	7	1.232	1.242	BKW-177, BKW-181, BKW-168, CRP-023, CRP-017, CRP-021, CRP-013	Land percentage unchanged from 2015
6	EGV-009 Flow Meter Basin	719	1,283	1260	0.982	0.29	0.29	372	365	0.982	16.83	14	1.202	1.180	EAR-039, EAR-053, EAR-051, EAR-047, EGR-003 (EGR-004 in model), EAR-044, EAR-043, EAR-042, EGR-006 (EGR-008 in model), EGR-007 (EGR-009 in model), EAR-027, EAR-031, EAR-023, EAR-036	Land percentage unchanged from 2015
7	CTR-028 Flow Meter Basin	712	619	575	0.928	0.01	0.01	6	6	0.928	0.8658048	0	0.000	0.000	Combined with TAZ 719 at MH RLH-001 (Model TUE-001)	Land percentage unchanged from 2015
8	CTR-028 Flow Meter Basin	718	1,071	1017	0.949	0.43	0.43	461	437	0.949	64.415035	15	4.294	4.076	EHW-046, EHW-048, EHW-051, EHW-058, EHW-061, EHW 062, EHW-068, EHW-071, EHW-073, EHW-074, EHW-078, EHW-084, ERI-004 (Model ERE-004), ERI-006 (Model ERE-006), ERI-007 (Model ERE-007)	Land percentage unchanged from 2015
9	CTR-028 Flow Meter Basin	720	448	453	1.011	0.79	0.79	354	358	1.011	49.503331	10	4.950	5.005	EGV-007, LRA-005, LRA-007, LRA-008, LRA-014, LRA-017 (Model EGR-001), WND-011, WND-014, WND-017, WND-021	Land percentage unchanged from 2015
10	CTR-028 Flow Meter Basin	721	258	370	1.435	0.89	0.89	230	329	1.435	32.1173	9	3.569	5.120	OLD-013 (Model CEN-011), OLD-010 (Model CEN-010), OLD-022 (CEN-014), OLD-025 (CEN-021), OLD-015 (MIS-001), EGV-024, EGV-028, EGV-033, EGV-034	Land percentage unchanged from 2015
11	CTR-028 Flow Meter Basin	723	570	617	1.082	0.13	0.13	74	80	1.082	10.36448	1	10.364	11.211	ERR-007	Land percentage unchanged from 2015
12	CTR-028 Flow Meter Basin	730	290	595	2.050	1	1	290	595	2.050	40.562743	5	8.113	16.634	CEN-024 (Model JCT-1208), MER-005, OLD-006 (Model CEN-027), PAD-004, PAD-005	Land percentage unchanged from 2015
13	CTR-028 Flow Meter Basin	735	400	618	1.545	0.55	1	220	618	2.809	30.771736	9	3.419	9.605	RDI-008 (Model JCT-1216), RDI-011 (Model JCT-1210), RDI-013 (Model JCT-898), RDI-014 (Model JCT-900), RDI-018 (Model JCT-1214), RDI-021 (Model JCT-1212), RDI-023 (Model JCT-914), REA-006 (Model JCT-1176), REA-007 (Model JCT-1178)	Land percentage updated to 100%.
14	CTR-028 Flow Meter Basin	736	20	335	16.761	0	0	0	0	#DIV/0!	0	0	0.000	0.000	N/A	What is the future plan for Lakeland Estates? Discharge straight to West Boise WWTF?
15	CTR-028 Flow Meter Basin	753	1,429	1519	1.063	0.92	0.92	1315	1398	1.063	183.8863	40	4.597	4.888	EDW-010, EDW-014, EDW-016, EDW-022, EDW-018, EDW 027, EDW-032, CHM-004, CHM-003, CHM-018, CHM-027, CHM-021, CHM-024, CHM-028, GLA-003, GLA-005, RAA-008, RAA-013, RAA-018, RAA-020, RAA-030, RAA-025, RAA-028, GTS-021, GTS-019, GTS-016, GTS-031, GTS-010, GTS-012, GTS-025, GTS-032, GTS-035, GTS-037, GTS-052, GTS-044, GTS-050, GTS-048, GTS-055, PIC-010, GTS-059	Land percentage unchanged from 2015
16	CTR-028 Flow Meter Basin	715	358	575	1.605	0.17	0.17	61	98	1.605	8.5125812	3	2.838	4.555	JPA-007 (Model JPA-003), JPA-011 (Model JPA-007), JPA-013 (Model JPA-009)	Land percentage unchanged from 2015
17	CTR-028 Flow Meter Basin	719	1,283	1260	0.982	0.06	0.06	77	76	0.982	10.76731	1	11.633	11.374	RLH-001 (Model TUE-001)	Land percentage unchanged from 2015
18	CTR-028 Flow Meter Basin	722	111	574	5.168	0.88	0.88	98	505	5.168	13.662651	7	1.952	10.087	EMP-004, EMP-012, EMP-013, EMP-015, WND-029, WND-035 (Model JCT-1190), WND-038 (Model JCT-1198)	Land percentage unchanged from 2015
19	CTR-028 Flow Meter Basin	726	0	58	#DIV/0!	0	0.64	0	37	#DIV/0!	0	0	0	5.180	No flow for 2015 DWF. Flow added to HIL-003 (Model PIC-001) for 2040 DWF.	Land percentage updated to 67% to account for remaining land from ETR-015.
20	CTR-028 Flow Meter Basin	727	60	88	1.463	1	1	60	88	1.463	8.3922917	3	2.797	4.093	HOM-005 (Model PAC-009), HOM-008 (Model PAC-005), MER-021 (MER-017)	Land percentage unchanged from 2015
21	CTR-028 Flow Meter Basin	728	29	29	1.009	1	1	29	29	1.009	4.0562743	1	4.056	4.093	OLD-020 (Model CEN-034)	Land percentage unchanged from 2015
22	CTR-028 Flow Meter Basin	729	122	268	2.200	1	1	122	268	2.200	17.064326	10	1.706	3.754	MXU-001 (Model MXU-008), MXU-005 (Model MXU-037), MXU-011 (Model MXU-033), MXU-016 (Model MXU-013), MXU-017 (Model MXU-014), MXU-021 (Model MXU-018), MXU-029 (Model MXU-023), MXU-044 (Model MXU-034), MXU-045 (Model MXU-036), NCS-005 (Model NCS-004)	Land percentage unchanged from 2015
23	CTR-028 Flow Meter Basin	731	153	150	0.978	1	1	153	150	0.978	21.400344	5	4.280	4.187	RAA-045, RAA-037, RAA-034, ANC-004, ANC-006 (Model ANC-007)	Land percentage unchanged from 2015
24	CTR-028 Flow Meter Basin	732	111	100	0.898	1	1	111	100	0.898	15.52574	4	3.881	3.485	MER-009 (Model MER-010), MER-013 (Model MER-020), MER-023 (Model MER-022), MER-026 (Model MER-025)	Land percentage unchanged from 2015
25	CTR-028 Flow Meter Basin	733	3	298	99.438	0.23	1	1	99	144.112	0.0965114	1	0.097	13.908	RDI Area undeveloped in aerial photo. RDI-027 (Model JCT-922)	Land percentage updated to 100%.
26	CTR-028 Flow Meter Basin	734	0	0		0.45	1	0	0		0	0	0.000	0.000	See TAZ Zone 729 (All flow Shifted to TAZ 737 and TAZ 734)	Land percentage updated to 100%.

27	CTR-028 Flow Meter Basin	737	0	0		1	1	0	0		0	0	0.000	0.000	See TAZ Zone 729 (All flow Shifted to TAZ 737 and TAZ 734)	Land percentage updated to 100%.
28	CTR-028 Flow Meter Basin	742	430	365	0.849	0.14	0.14	60	51	0.849	8.420266	1	8.420	7.151	JPA-001 (Model CEN-005)	Land percentage unchanged from 2015
29	CTR-028 Flow Meter Basin	743	0	0		0.4		0			0	0	0	0	See TAZ Zone 729 (All flow Shifted to TAZ 737 and TAZ 734)	
30	CTR-028 Flow Meter Basin	754	19	19	0.998	0.43	1	8	19	2.320	1.1427504	4	0.286	0.663	TCO-007 (Model YES-008), TCO-009 (Model YES-010), TCO-013 (Model YES-013), TCO-015 (Model YES-015)	Land percentage updated to 100%.
31	STR-003 Flow Meter Basin	744	1,222	1682	1.376	0.11	0.11	134	185	1.376	10.077325	5	2.015	2.774	SHO-008, SHO-015, SHO-027, SHO-029 (Model SH2-002), SHO-035 (Model JCT-1032)	Land percentage unchanged from 2015
32	STR-003 Flow Meter Basin	745	903	927	1.026	0.03	0.03	27	28	1.026	2.0309086	1	2.031	2.085	CHL-007	What is the future plan for Banbury Meadows? Chinden? Castlebury West? Spyglass?
33	STR-003 Flow Meter Basin	746	397	1013	2.551	0.58	1	230	1013	4.398	17.262348	27	0.639	2.812	ASH-007 (Model JCT-600), ASH-013 (Model JCT-598), ASH-015 (Model JCT-572), ASH-019 (Model JCT-580), ASH-027 (Model JCT-596), ASH-039 (Model JCT-668), ASH-043 (Model JCT-666), ASH-054 (Model JCT-630), ASH-059 (Model JCT-640), ASH-063 (Model JCT-648), ASH-064 (Model JCT-672), CWB-009, CWB-010, CWB-012 (Model JCT-676), FOX-003 (Model JCT-782), FOX-006 (Model JCT-726), FOX-014 (Model JCT-750), FOX-015 (Model JCT-740), FOX-016 (Model JCT-748), FOX-023 (Model JCT-776), FOX-028 (Model JCT-764), FOX-031 (Model JCT-770), FOX-037 (Model JCT-794), FOX-042 (Model JCT-804), FOX-046 (Model JCT-1238), FOX-053 (Model JCT-1244), FOX-057 (Model JCT-1230)	Land percentage updated to 100%.
34	STR-003 Flow Meter Basin	749	986	1057	1.072	0.65	1	641	1057	1.649	48.047595	24	2.002	3.300	BBM-005, BBM-008, BBM-010, BBM-021, BBM-024, BBM-026, BBM-029, BBM-032, BBM-033, BBM-034 (Model BBM-035), BBM-047, BBM-055 (Model BBM-071), BBM-062 (Model BBM-078), BBM-063 (Model BBM-079), BBM-066 (Model BBM-082), BBM-067 (Model BBM-083), BBM-068 (Model BBM-091), BBM-093 (Model BBM-066), CCR-010 (Model FRC-011), STR-032 (Model STR-028), STR-042 (Model STR-016), WES-011 (Model WES-013), WES-017 (Model WES-019), WES-018 (Model WES-020)	Land percentage updated to 100%.
35	STR-003 Flow Meter Basin	750	439	529	1.205	0.26	0.26	114	137	1.205	8.556955	7	1.222	1.472	CAW-007, CAW-008, CAW-015, CAW-018, CAW-023, CAW-025, CAW-027	What's the future plan for Sugarberry? Clearvue Estates? Creighton Heights?
36	STR-003 Flow Meter Basin	747	42	39	0.922	0.06	1	3	39	15.368	0.1889217	1	0.189	2.903	EIM-007 (Model JCT-696)	Land percentage updated to 100%.
37	STR-003 Flow Meter Basin	748	18	15	0.832	0.99	1	18	15	0.841	1.3359465	6	0.223	0.187	EIM-002 (Modl JCT-706), EIM-005 (Model JCT-700), EIM-012 (Model JCT-686), EIM-015 (Model JCT-678), EIM-017 (Model JCT-710), EIM-021 (Model JCT-716)	Land percentage updated to 100%.
38	ETR-015 Flow Meter Basin	716	492	646	1.312	0	0	0	0.00	#DIV/0!	0					
39	ETR-015 Flow Meter Basin	717	1,132	1127	0.996	0.01	0.01	11.32	11.27	0.996	0.3716514	0	0	0	Added to TAZ 718	Land percentage unchanged from 2015
40	ETR-015 Flow Meter Basin	718	1,071	1017	0.949	0.21	0.21	224.91	213.50	0.949	7.3841094	6	1.293	1.230	EGP-006, EGP-008, EGP-014, EGP-021, EGP-026, EGP-029	Land percentage unchanged from 2015
41	ETR-015 Flow Meter Basin	720	448	453	1.011	0.01	0.01	4.48	4.53	1.011	0.1470847	1	0.147	0.149	ETR-021	Land percentage unchanged from 2015
42	ETR-015 Flow Meter Basin	723	570	617	1.082	0.79	0.79	450.3	487.10	1.082	14.783978	11	1.344	1.454	EGP-033, EGP-037, EHE-009, EHE-013, EHE-004 (Model EVA-027), ECH-022, ARR-012 (Model ARR-009), ARR-015 (Model ARR-002), EVA-024 (Model EVA-023), EVA-011 (Model EVA-010), EVA-016 (Model EVA-015)	Land percentage unchanged from 2015
43	ETR-015 Flow Meter Basin	724	572	522	0.912	1	1	572	521.80	0.912	18.779559	12	1.565	1.428	ADD-004, ADD-006, ADD-008, SHV-005, SHV-014, SHV-010, SHR-004 (Model SHR-020), SHR-001 (Model SHR-022), SHR-018 (Model SHR-013), SHR-016 (Model SHR-011), SHR-024 (Model SHR-025), HIV-010 (Model HIV-009)	Land percentage unchanged from 2015
44	ETR-015 Flow Meter Basin	725	745	704	0.945	1	1	745	704.38	0.945	24.45939	21	1.165	1.101	EGP-040, EGP-043, EGP-046, EGP-060, EGP-050, EGP-055, EGP-056, EGP-082, EGP-087, EGP-069, EGP-093, EGP-089, EGP-078, YKS-004, BER-007, BER-004, ECH-017, ECH-021, ECH-019, ECH-020, ECH-013	Land percentage unchanged from 2015
45	ETR-015 Flow Meter Basin	753	1,429	1519	1.063	0.08	0.08	114.32	121.56	1.063	3.7532852	1	3.753	3.991	EDW-035 (Model EDW-034)	Land percentage unchanged from 2015
46	ETR-015 Flow Meter Basin	755	2,383	2403	1.009	0.75	0.92	1787.25	2211.19	1.237	58.677913	60	0.978	1.210	LHS-010, LHS-015, LHS-019, LHS-022, LHS-024, LHS-030, LHS-036, LHS-039, LHS-042, LHS-046, LHS-047, LHS-051, LHS-055, LHS-060, LHS-063, LHS-068, LHS-076, LHS-078, LHS-086, LHS-090, LHS-093, LHS-096, LHS-099, LHS-104, LHS-112, LHS-114, LHS-122, LHS-125, LHS-128, LHS-130, LHS-136, LHS-138, LHS-140, LHS-148, LHS-153, LHS-160, LHS-174, LHS-175, LHS-181, LHS-187, LHS-192, LHS-193, LHS-203, LHS-207, LHS-215, LHS-219, LHS-225, LHS-228, LHS-230, LHS-234, LHS-238, LHS-241, LHS-250, LHS-254, LHS-258, LHS-263, LHS-266, LHS-273, LHS-279, LHS-280	EGV-009 Basin had 8% of basin, to include 100% of basin land percentage updated to 92% in ETR-015.
47	ETR-015 Flow Meter Basin	632	114	215	1.882	0.38	0.38	43.32	102.34	2.363	1.4222561	1	1.422	3.360	BON-003	Land percentage unchanged from 2015

48	ETR-015 Flow Meter Basin	636	916	849	0.927	0.84	1	769.44	849.04	1.103	25.26179	16	1.579	1.742	BON-006, BON-013, BON-014, ESP-003 (Model BRE-003), ESP-012 (Model BRE-012), ESP-014 (Model BRE-014), ESP-018 (Model BRE-018), ESP-020 (Model BRE-020), ESP-024 (Model BRE-024), ESP-035 (Model BRE-035), ESP-040 (Model BRE-040), ESP-041 (Model BRE-041), ESP-050 (Model BRE-050), ESP-057 (Model BRE-057), ESP-060 (Model BRE-060), ESP-070 (Model BRE-069)	Land percentage updated to 100%.
49	ETR-015 Flow Meter Basin	722	111	574	5.168	0.11	0.11	12.21	63.10	5.168	0.4008714	1	0.401	2.072	ETR-019	Land percentage unchanged from 2015
50	ETR-015 Flow Meter Basin	726	0	58	#DIV/0!	0.36	0.36	0	20.83	#DIV/0!	0	0	0.000		Zero flow for 2015 DWF. Flow added to TAZ 632 for 2040.	Land percentage unchanged from 2005
51	ETR-015 Flow Meter Basin	756	559	547	0.978	0.99	1	553.41	546.74	0.988	18.169223	10	1.817	1.795	ECR-010 (Model TRC-010), ECR-015 (Model TRC-016), ECR 019 (Model TRC-020), ECR-026 (Model TRC-017), ECR-041 (Model TRC-042), ECR-045 (Model TRC-046), EGC-003, EGC-005, EGC-009, VEL-009 (Model JCT-470)	
52	WRP-002 Flow Meter Basin	697	351	335	0.955	0.02	0.02	7.02	6.70	0.955	0.3093617	1	0.309	0.295	HFO-084 (Model SHA-084)	Land percentage remained unchanged from 2015
53	WRP-002 Flow Meter Basin	698	914	851	0.931	0.69	0.69	630.66	587.22	0.931	27.792317	15	1.853	1.725	COL-003, COL-010, COL-012, COL-017, COL-021, COL-024, COL-026, COL-034, CSE-034, CTL-004 (Model JCT-398), RWC-027, RWC-036 (Model RWC-021), TIM-004, TIM-013, TIM-014	Land percentage remained unchanged from 2015
54	WRP-002 Flow Meter Basin	699	171	164	0.957	0.05	0.5	8.55	81.81	9.569	0.3767867	1	0.377	3.605	SCR-008 (Model JCT-262)	Land percentage updated to 50%
55	WRP-002 Flow Meter Basin	700	799	1734	2.170	0.91	0.91	727.09	1577.94445	2.170	32.041855	15	2.136	4.636	COP-005, COP-015, COP-016, ECK-023, KAT-004, KAT-007, SED-010, SED-013, SED-017, SED-022, SEN-005 (Model JCT-346), SEN-008 (Model JCT-352), SEN-011 (Model JCT-362), SEN-021 (Model JCT-380), SEN-022 (Model JCT-360)	Land percentage remained unchanged from 2015
56	WRP-002 Flow Meter Basin	701	276	170	0.615	1	1	276	169.60922	0.615	12.16294	11	1.106	0.679	HFO-021 (Model SHA-021), HFO-027 (Model SHA-025), HFO-033 (Model SHA-033), HFO-041 (Model SHA-041), HFO-050 (Model SHA-050), HFO-063 (Model SHA-063), HFO-065 (Model SHA-065), HFO-072 (Model SHA-072), HFO-078 (Model SHA-078), HFO-081 (Model SHA-081), HFO-086 (Model SHA-029)	Land percentage remained unchanged from 2015
57	WRP-002 Flow Meter Basin	702	399	1172	2.938	1	1	399	1172.30	2.938	17.58338	9	1.954	5.740	AWT-013 (Model JCT-62), AWT-018 (Model JCT-52), AWT-021 (Model JCT-44), AWT-025 (Model JCT-54), AWT-027 (Model JCT-42), CRW Manholes (including 4 Flow Loading MHs) removed from Model (I.E. not correct) therefore flow load MH moved to PKL-013 with a total flow of 7.816 gpm	Land percentage remained unchanged from 2015
58	WRP-002 Flow Meter Basin	703	273	335	1.228	0.49	0.49	133.77	164.26	1.228	5.8950596	3	1.965	2.413	PKL-019 (Model SHA-006), SCR-004 (Model JCT-264), SCR-010 (Model JCT-260)	Land percentage remained unchanged from 2015
59	WRP-002 Flow Meter Basin	704	76	397	5.225	0.49	1	37.24	397.09	10.663	1.6411155	3	0.547	5.833	LOC-010 (Model JCT-300), LOC-011 (Model JCT-302), LOC-015 (Model JCT-294)	Land percentage updated to 100%
60	WRP-002 Flow Meter Basin	705	156	344	0.000	0	0	0	0.00	0.000	0	0	0.000	0.000	N/A	
61	WRP-002 Flow Meter Basin	757	483	1813	3.753	0.04	0.2	19.32	362.56	18.766	0.8514058	3	0.284	5.326	CAB-004 (Model JCT-336), FXG-005 (Model JCT-242), FXG-006 (Model JCT-244)	Land percentage updated to 20%
62	WRP-002 Flow Meter Basin	768	354	1616		0		0			0	0	0.000	0.000	N/A	
63	WRP-002 Flow Meter Basin	771	122	178		0		0			0	0	0	0	N/A	
64	WRP-002 Flow Meter Basin	707	42	288	6.865	0.29	1	12.18	288	23.673	0.5367558	1	0.537	12.707	WRP-007	Land percentage updated to 100%
65	WRP-002 Flow Meter Basin	740	26	27	1.036	0.1	1	2.6	27	10.361	0.1145784	2	0.057	0.594	WRP-021 (Model WRP-020), WRP-028 (Model WRP-027)	Land percentage updated to 100%
66	WRP-002 Flow Meter Basin	799	100	114		0		0			0	0	0		N/A	
67	WRP-002 Flow Meter Basin	800	200	300		0		0			0	0	0		N/A	
68	PRE-001 Flow Meter Basin	699	171	164	0.957	0.02	0.5	3.42	81.81151	23.921	0.1739608	1	0.174	4.161	LIN-031 (Model BLT-036)	Land percentage updated to 50%
69	PRE-001 Flow Meter Basin	700	799	1734	2.170	0.08	0.08	63.92	138.7203912	2.170	3.2513378	1	3.251	7.056	LIN-022 (Model BLT-004)	Land percentage remained unchanged from 2015
70	PRE-001 Flow Meter Basin	703	273	335	1.228	0.51	0.51	139.23	170.9660964	1.228	7.0820363	7	1.012	1.242	BLT-005 (Model BLT-016), BLT-012 (Model BLT-024), BLT-019 (Model BLT-031), BLT-023 (Model BLT-035), BLT-042 (Model JCT-842), BLT-043 (Model JCT-840), BLT-045 (Model JCT-846)	Land percentage remained unchanged from 2015
71	PRE-001 Flow Meter Basin	757	483	1813		0.47	0.8	227.01	1450.25864	6.389	11.54703	23	0.502	3.207	CAB-005 (Model JCT-1140), PRE-009 (Model EFE-009), PRE-010 (Model EFE-010), PRE-022 (Model EFE-022), PRE-027 (Model EFE-027), PRE-040 (Model EFE-040), PRE-047 (Model EFE-047), PRE-053 (Model EFE-053), PRE-082 (Model JCT-230), PRE-087 (Model EFE-057), PRE-092 (Model JCT-1042), PRE-093 (Model JCT-1142), PRE-096 (Model EFE-070), PRE-099 (Model JCT-1040), PRE-111 (Model JCT-1090), PRE-119 (Model JCT-1084), PRE-123 (Model JCT-1074), PRE-125 (Model JCT-1128), Pre-127 (Model JCT-1124), PRE-131 (Model JCT-1110), PRE-133 (Model JCT-1108), PRE-138 (Model JCT-1120), PRE-139 (Model JCT-1220)	Land percentage updated to 80%
72	PRE-001 Flow Meter Basin	764	8	6	0.749	0.23	1	1.84	5.9934	3.257	0.093593	4	0.023	0.076	SYR-011 (Model JCT-106), SYR-012 (Model JCT-108), SYR-018 (Model JCT-90), SYR-019 (Model JCT-94)	Land percentage updated to 100%

73	PRE-001 Flow Meter Basin	768	354	1616		0.92	1	325.68	1616.27614	4.963	16.565953	21	0.789	3.915	LEG-008 (Model MSC-008), LEG-010 (Model MSC-010), LEG-017 (Model MSC-017), LEG-020 (Model MSC-020), LEG-028 (Model MSC-028), LEG-030 (Model MSC-030), LEG-035 (Model MSC-035), LEG-045 (Model MSC-045), LEG-053 (Model MSC-053), LEG-056 (Model MSC-056), LEG-063 (Model MSC-063), LEG-070 (Model MSC-070), LEG-084 (Model MSC-084), LEG-095 (Model JCT-136), LEG-101 (Model JCT-114), LEG-114 (Model JCT-212), LEG-122 (Model JCT-150), LEG-125 (Model JCT-156), LEG-143 (Model JCT-1096), LEG-145 (Model JCT-1100), LEG-155 (Model JCT-1102)	Land percentage updated to 100%
74	PRE-001 Flow Meter Basin	761	9	630		0		0			0	0	0.000		N/A	
75	PRE-001 Flow Meter Basin	763	7	680		0		0			0	0	0.000		N/A	
76	PRE-001 Flow Meter Basin	765	8	726	90.791	0.28	1	2.24	726.32656	324.253	0.1139392	1	0.114	36.945	LAN-010 (Model JCT-826)	Land percentage updated to 100%
77	PRE-001 Flow Meter Basin	769	12	1274	106.172	0.1	0.1	1.2	127.406459	106.172	0.0610389	2	0.031	3.240	LEG-134 (Model JCT-194), LEG-140 (Model JCT-206)	
78	TWI-002 Flow Meter Basin	712	619	575	0.928	0.49	1	303	575	1.895	14.270	10	1.427	2.704	CCC-015, CCC-016, CCC-029, CCC-027, SPR-003 (Model JCT-438), CCC-030 (JCT-428), CCC-020, CCC-018, CCC-006, CCC-009	Land percentage updated to 100%.
79	TWI-002 Flow Meter Basin	716	492	646	1.312	0.16	1	79	646	8.200	3.704	3	1.235	10.124	VIZ-022, VIZ-010, VIZ-012	Land percentage updated to 100%.
80	TWI-002 Flow Meter Basin	717	1,132	1127	0.996	0.61	1	691	1127	1.633	32.488	38	0.855	1.396	BKW-156, BKW-153, BKW-159, BKW-160, BKW-147, BKW-109, BKW-139, BKW-128, BKW-106, BKW-130, BKW-101, BKW-102, BKW-133, BKW-099, BKW-087, KBW-088, BKW-083, BKW-120, FFE-006 (Model JCT-450), BKW-012, BKW-017, BKW-015, BKW-005, BKW-020, BKW-023, BKW-029, BKW-032, BKW-036, BKW-038, BKW-042, BKW-046, BKW-050, BKW-053, BKW-057, BKW-061, BKW-165, BKW-070, BKW-076	Land percentage updated to 100%.
81	TWI-002 Flow Meter Basin	718	1,071	1017	0.949	0.03	0.03	32	30	0.949	1.512	1	1.512	1.435	EKN-008 (Model SEP-008)	Land percentage unchanged from 2015
82	TWI-002 Flow Meter Basin	777	66	238	3.613	0	1	0	238	#DIV/0!	0.000	0	0		N/A	
83	TWI-002 Flow Meter Basin	710	55	49	0.889	0.06	0.06	3	3	0.889	0.155	1	2.176	3.383	DRY-026 (Model JCT-412) - High School or Junior High Connection.	Land percentage remained unchanged from 2015
84	TWI-002 Flow Meter Basin	715	358	575	1.605	0.12	0.12	43	69	1.605	2.021	0	0	0	Reallocated flow to DRY-026 because of the High School/Junior High that is served in that area.	Land percentage remained unchanged from 2015
85	TWI-002 Flow Meter Basin	719	1,283	1260	0.982	0.61	0.61	783	768	0.982	36.822	16	2.301	2.259	EKN-012 (Model SEP-012), RLH-037 (Model TUE-037), RLH-039 (Model TUE-039), EAR-021, EAR-019, RLH-033 (Model TUE-033), EAR-017, RLH-052 (Model TUE-052), EAR-013, EAR-007, EAR-010, EAR-055, RLH-028 (Model TUE-028), RLH-019 (Model TUE-019), RLH-045 (Model TUE-045), RLH-043 (Model TUE-043)	Land percentage remained unchanged from 2015
86	STR-001 (East Pipe) Flow Meter Basin	738	977	939	0.961	0.37	1	361	939	2.597	59.935811	25	2.397	6.226	HID-006, ISW-008, ISW-010, ISW-016, ISW-021, ISW-023, ISW-028, ISW-035, ISW-041, ISW-046, ISW-049, ISW-054, ISW-059, ISW-065, ISW-074, ISW-080, ISW-088, REN-015, REN-021, REN-022, REN-025 (Model REN-046), REN-028, REN-033 (Model REN-044), REN-035 (Model REN-045), REN-044 (Model REN-040)	Land percentage updated to 100%.
87	STR-001 (East Pipe) Flow Meter Basin	744	1,222	1682	1.376	0.28	0.28	342	471	1.376	56.730856	26	2.182	3.003	MRR-010 (Model JCT-532), MRR-012 (Model JCT-538), MRR-018 (Model JCT-534), MRR-020 (Model JCT-522), MRR-023 (Model JCT-480), MRR-031 (Model JCT-502), MRR-032 (Model JCT-504), MRR-033 (Model JCT-478), TWR-010, TWR-011, TWR-028, TWR-035, TWR-041, TWR-053, TWR-061, TWR-064, TWR-070, TWR-072, TWR-081, TWR-097, TWR-111, TWR-121, TWR-127, TWR-137, TWR-143, TWR-148	Land percentage remained unchanged from 2015
88	STR-001 (East Pipe) Flow Meter Basin	749	986	1057		0		0			0	0	0		N/A	
89	YRD-010 Flow Meter Basin	713	273	289.33338	1.060	0.01	0.01	2.73	2.8933338	1.060	0.1487898	1	0.149	0.158	PRA-012 (Model VE1-012)	Land percentage remained unchanged from 2015
90	YRD-010 Flow Meter Basin	739	373	380.1242	1.019	0.83	0.83	309.59	315.503086	1.019	16.873198	9	1.875	1.911	ALW-005, ALW-007, ALW-008 (Model WSS-008), PRI-002 (Model VE2-002), PRI-005 (Model VE2-005), PRI-006 (Model VE2-006), PRI-008 (Model VE2-008), PRI-010 (Model VE2-010), WSS-003 (Model WSS-001)	Land percentage remained unchanged from 2015
91	YRD-010 Flow Meter Basin	744	1,222	1682	1.376	0.02	0.02	24.44	33.64	1.376	1.3320228	1	1.332	1.833	CTR-007 (JCT-1046)	Land percentage remained unchanged from 2015
92	YRD-010 Flow Meter Basin	714	107	113.73795		0.58	0.97	62.06	110.3258115	1.778	3.3823788	5	0.676	1.203	PRA-004 (Model VE1-004), PRA-006 (Model VE1-006), PRA-008 (Model VE1-008), PRA-009 (Model VE1-009), PRA-013 (Model VE1-013)	Land percentage updated to 97%
93	YRD-010 Flow Meter Basin	715	358	574.67596		0.38	0.71	136.04	408.0199316	2.999	7.4144184	5	1.483	4.448	COB-004, DEL-003, OUS-007, OUS-009, WSS-008 (Model WSS-010)	Land percentage updated to 71%
94	YRD-010 Flow Meter Basin	741	0	0	0.000	0.58	0.58	0	0	0	0	0	0.000	0.000	N/A	Land percentage remained unchanged from 2015
95	YRD-010 Flow Meter Basin	742	430	365.15868	0.849	0.86	0.86	369.8	314.0364648	0.849	20.154748	13	1.550	1.317	RRR-002, RRR-009, RRR-011, RRR-007, RRR-005, WSS-017 (Model WSS-019), BSV-011 (Model BSV-012), BSV-014 (Model BSV-015), BSV-015 (Model BSV-016), BSV-008 (Model BSV-007), EGW-005, KSC-008, KSC-012	Land percentage remained unchanged from 2015
96	YRD-010 Flow Meter Basin	743	0	0	0.000	0.05	0.05	0	0	0	0	0	0.000	0.000	N/A	
97	YRD-004 Flow Meter Basin	697	351	335.22764	0.955	0	0	0	0		0	0	0.000	0.000	N/A	

98	YRD-004 Flow Meter Basin	698	914	851.03923	0.931	0.31	0.31	283.34	263.8221613	0.931	16.945804	10	1.695	1.578	CSE-005, CSE-006, CSE-009, CSE-014 (TAZ 714 flow added), CSE-017, CSE-021, CSE-027, LGT-003 (Model JCT-324), LGT-011 (Model JCT-322), WTR-014 (Model WTR-016)	Land percentage remained unchanged from 2015
99	YRD-004 Flow Meter Basin	708	369	451.9587	1.225	0.68	1	250.92	451.9587	1.801	15.006851	7	2.236	3.995	CBE-018 (Model CB1-013), CBE-025 (Model CB2-006), CBE 032 (Model CB2-013), CBE-040 (Model CB2-021), CBE-041 (Model CB2-022), CBE-045 (Model CB2-026), CBE-049 (Model CB2-030)	Land percentage updated to 100%
100	YRD-004 Flow Meter Basin	709	266	438.98858	1.650	0.03	0.03	7.98	13.1696574	1.650	0.4772623	0	0.000	0.000	Moved flow to TAZ 708	Land percentage remained unchanged from 2015
101	YRD-004 Flow Meter Basin	711	194	247.42993	1.275	0	0	0			0	0	0.000	0.000	N/A	
102	YRD-004 Flow Meter Basin	712	619	574.67596	0.928	0.02	0.02	12.38	11.4935192	0.928	0.7404145	0	0.000		Moved flow to TAZ 713	Land percentage remained unchanged from 2015
103	YRD-004 Flow Meter Basin	713	273	289.33338	1.060	0.57	1	155.61	289.33338	1.859	9.3066158	6	1.675	2.999	LOK-005, LOK-019 (Model JCT-1218), COH-006, COH-009, COH-018, COH-022	Land percentage updated to 100%
104	YRD-004 Flow Meter Basin	739	373	380.1242	1.019	0.12	0.12	44.76	45.614904	1.019	2.6769753	2	1.338	1.364	WTR-010 (Model WTR-012), WTR-012 (Model WTR-014)	Land percentage remained unchanged from 2015
105	YRD-004 Flow Meter Basin	710	55	48.88736	0.889	0.05	0.05	2.75	2.444368	0.889	0.1644701	0	0.000	0.000	Moved flow to TAZ 708	Land percentage remained unchanged from 2015
106	YRD-004 Flow Meter Basin	714	107	113.73795	1.063	0.03	0.03	3.21	3.4121385	1.063	0.1919815	1	0.192	0.204	Added to CSE-014	Land percentage remained unchanged from 2015
107	YRD-004 Flow Meter Basin	740	26	26.93794	1.036	0.02	0.02	0.52	0.5387588	1.036	0.0310998	1	0.031	0.032	WTR-005 (Model	Land percentage remained unchanged from 2015
108	YRD-004 Flow Meter Basin	741	0	0	0.000	0.03	0.03	0	0	0.000	0	0	0.000	0.000	N/A	Land percentage remained unchanged from 2015
109	YRD-004 Flow Meter Basin	757	483	1812.8233	3.753	0	0	0	0	0.000	0	0	0.000	0.000	N/A	
110	YRD-004 Flow Meter Basin	771	122	177.59083	1.456	0.04	1	4.88	177.59083	36.392	0.2918597	4	0.073	2.655	RVW-007 (Model JCT-874), RVW-009 (Model JCT-872), RVW-011 (Model JCT-864), RVW-013 (Model JCT-854)	Land percentage updated to 100%
111	EGV-009 Flow Meter Basin	718	1,071	1017	0.949	0	0	0	0	#DIV/0!	0	0	0.000	#DIV/0!	N/A	
112	CTR-028 Flow Meter Basin	718	1,071	1017		0		0			0	0	0		N/A	
113	EGV-009 Flow Meter Basin	720	448	453	1.011	0	0	0	0	#DIV/0!	0	0	0	#DIV/0!	N/A	
114	CTR-028 Flow Meter Basin	720	448	453		0		0			0	0	0		N/A	
115	EGV-009 Flow Meter Basin	719	1,283	1260	0.982	0	0	0	0	#DIV/0!	0	0	0	#DIV/0!	N/A	
116	CTR-028 Flow Meter Basin	719	1,283	1260		0		0			0	0	0		N/A	
117	EGV-009 Flow Meter Basin	718	1,071	1017	0.949	0	0	0	0	#DIV/0!	0	0	0	#DIV/0!	N/A	
118	ETR-015 Flow Meter Basin	718	1,071	1017	0.949	0		0			0	0	0.000		N/A	
119	EGV-009 Flow Meter Basin	755	2,383	2403	1.009	0	0	0	0	#DIV/0!	0	0	0	#DIV/0!	N/A	
120	ETR-015 Flow Meter Basin	755	2,383	2403	1.009	0		0			0	0	0.000		N/A	
121	CTR-028 Flow Meter Basin	718	1,071	1017		0		0			0	0	0		N/A	
122	ETR-015 Flow Meter Basin	718	1,071	1017	0.949	0		0			0	0	0.000		N/A	
123	CTR-028 Flow Meter Basin	723	570	617		0		0			0	0	0		N/A	
124	ETR-015 Flow Meter Basin	723	570	617	1.082	0		0			0	0	0.000		N/A	
125	CTR-028 Flow Meter Basin	715	358	575		0		0			0	0	0		N/A	
126	YRD-010 Flow Meter Basin	715	358	574.67596		0		0			0	0	0.000		N/A	
127	CTR-028 Flow Meter Basin	742	430	365		0		0			0	0	0		N/A	
128	YRD-010 Flow Meter Basin	742	430	365.15868		0		0			0	0	0.000		N/A	
129	CTR-028 Flow Meter Basin	743	0	0		0		0			0	0	0		N/A	
130	YRD-010 Flow Meter Basin	743	0	0		0		0			0	0	0.000		N/A	
131	STR-003 Flow Meter Basin	744	1,222	1682		0		0			0	0	0		N/A	
132	STR-001 (East Pipe) Flow Meter Basin	744	1,222	1682		0		0			0	0	0.000		N/A	
133	WRP-002 Flow Meter Basin	700	799	1734		0		0			0	0	0		N/A	
134	PRE-001 Flow Meter Basin	700	799	1734		0		0			0	0	0.000		N/A	
135	WRP-002 Flow Meter Basin	757	483	1813		0		0			0	0	0		N/A	
136	PRE-001 Flow Meter Basin	757	483	1813		0		0			0	0	0.000		N/A	
137	WRP-002 Flow Meter Basin	697	351	335		0		0			0	0	0		N/A	
138	YRD-004 Flow Meter Basin	697	351	335.22764		0		0			0	0	0		N/A	
139	WRP-002 Flow Meter Basin	698	914	851		0		0			0	0	0		N/A	
140	YRD-004 Flow Meter Basin	698	914	851.03923		0		0			0	0	0		N/A	
141	WRP-002 Flow Meter Basin	740	26	27		0		0			0	0	0		N/A	
142	YRD-004 Flow Meter Basin	740	26	26.93794		0		0			0	0	0		N/A	
143	WRP-002 Flow Meter Basin	771	122	178		0		0			0	0	0		N/A	
144	YRD-004 Flow Meter Basin	771	122	177.59083		0		0			0	0	0		N/A	
145	TWI-002 Flow Meter Basin	715	358	575	1.605	0		0			0	0	0	0	N/A	
146	YRD-010 Flow Meter Basin	715	358	574.67596		0		0			0	0	0.000		N/A	

Existing (2015) and Future (2040) Traffic Area Zone (TAZ) Analysis

	2015 Flow	2040 Flow	Loading MHs in Basin	2040 Peaking Factors
EGV-009 Check	0.0680	0.0675	38	0.99
	0.0680		38	0.00
Model	0.0680	0.0675	38	0.99
TWI-002 Check	0.1310	0.2180	69	1.66
	0.1310		69	0.00
Model	0.1310	0.2180	69	1.66
ETR-015 Check	0.2500	0.2759	140	1.10
	0.2500		140	0.00
Model	0.2500	0.2759	140	1.10
CTR-028 Check	0.7510	1.0756	129	1.43
	0.7522		129	0.00
Model	0.7510	1.0754	129	1.43
YRD-010 Check	0.0710	0.0930	34	1.31
	0.0710		34	0.00
	0.0710	0.0930	34	1.31
YRD-004 Check	0.0660	0.1085	31	1.64
	0.0669		29	0.00
Model	0.0660	0.1084	29	1.64
WRP-002 Check	0.1430	0.3068	60	2.15
	0.1430		61	0.00
Model	0.1422	0.3068	60	2.16
PRE-001 Check	0.0560	0.3163	60	5.65
	0.0560		60	0.00
Model	0.0560	0.3162	60	5.65
STR-002 Check	0.1680	0.3366	51	2.00
	0.1680		51	0.00
Model	0.1680	0.3366	51	2.00
STR-003 Check	0.1260	0.2670	71	2.12
	0.1260		71	0.00
Model	0.1260	0.2670	71	2.12
2040 Additional Flow		2.1669	7	
Total Flow	1.8292	5.2318	681	2.86

Eagle Island Area TAZ Information 2015 to 2040

TRAFFIC ANALYSIS ZONE (TAZ)	ACRES	DEMOGRAPHIC AREA	COUNTY	TOTAL POPULATION (2015)	HOUSEHOLDS (2015)	TOTAL POPULATION (2040)	HOUSEHOLDS (2040)	2040 Average Daily Flow (gpm)	2040 Population
697	233	Eagle-Floating Feather	Ada	341	96	335	102		
699	164	Eagle-Floating Feather	Ada	164	44	164	45	11	164
703	160	Eagle-Floating Feather	Ada	200	49	335	101	23	335
705	230	Eagle-Floating Feather	Ada	143	46	344	115		
706	952	Eagle-South River	Ada	218	93	230	110	105.7%	118.3%
709	237	Eagle-Floating Feather	Ada	246	73	439	138		
710	198	Eagle-Floating Feather	Ada	55	16	49	18		
711	161	Eagle-Floating Feather	Ada	184	54	247	80		
736	255	Eagle-Island	Ada	23	10	335	170		
744	964	Eagle-South River	Ada	1,017	352	1,682	613	170	1026
745	429	Eagle-South River	Ada	878	284	927	300		
750	324	Eagle-South River	Ada	401	124	529	171		
758	362	Eagle/Star	Ada	22	8	1,306	452	91	1,306
759	367	Eagle/Star	Ada	0	0	0	0	0	0
760	164	Eagle/Star	Ada	2	1	578	215	40	578
761	163	Eagle/Star	Ada	151	67	630	195	44	630
762	162	Eagle/Star	Ada	8	5	15	9	1	15
763	129	Eagle/Star	Ada	7	2	680	228	47	680
765	158	Eagle/Star	Ada	134	67	726	221	50	726
766	130	Eagle/Star	Ada	12	4	202	101	14	202
767	118	Eagle/Star	Ada	8	3	245	110	17	245
769	195	Eagle/Star	Ada	12	3	1,274	413	80	1,147
770	168	Eagle/Star	Ada	37	13	1,953	746	136	1,953
773	322	Eagle/Star	Ada	60	23	795	360	55	795
774	305	Eagle/Star	Ada	11	4	22	7	2	22
776	540	East Foothills	Ada	94	31	233	86	16	233
777	671	East Foothills	Ada	69	24	238	88	17	238
778	271	East Foothills	Ada	38	18	193	78	13	193
794	801	West Foothills	Ada	58	26	2,230	731	155	2,230
795	639	West Foothills	Ada	24	12	2,443	820	170	2,443
796	463	West Foothills	Ada	187	62	140	70		
799	319	West Foothills	Ada	100	32	114	42	8	114
801	331	West Foothills	Ada	143	46	171	66		
802	324	West Foothills	Ada	141	50	120	52		

New Flow Load Location (MH Name)	Flow Rate		Zones Served
2040_NW_1	696	gpm	795, 759, 760, 763, 758, 769, New Village Center
2040_NW_2	383	gpm	767, 766, 770, 773, Business Park, Commercial, Professional Office
JCT-68	1	gpm	762
North Dummy1	206	gpm	799, 794, 761
NE Dummy1	46	gpm	777, 776, 778
WRP-004	2	gpm	774
Eagle_Island_1	170	gpm	744

New Village Center	269	gpm
	258	acres
	1,500	gpd/acre for commercial according to Metcalf and Eddy 4th edition
	387,512	gpd
Business Park	62	gpm
	161	acres
	560	gpd/acre used in WSD WW Facility Plan (2008)
	89,987	gpd
Commercial	44	gpm
	43	acres
	1,500	gpd/acre for commercial according to Metcalf and Eddy 4th edition
	63,778	gpd
Professional Office	54	gpm
	140	acres
	560	gpd/acre used in WSD WW Facility Plan (2008)
	78,280	gpd

Appendix G
Calibration Results

Eagle Sewer District – Model Calibration Data

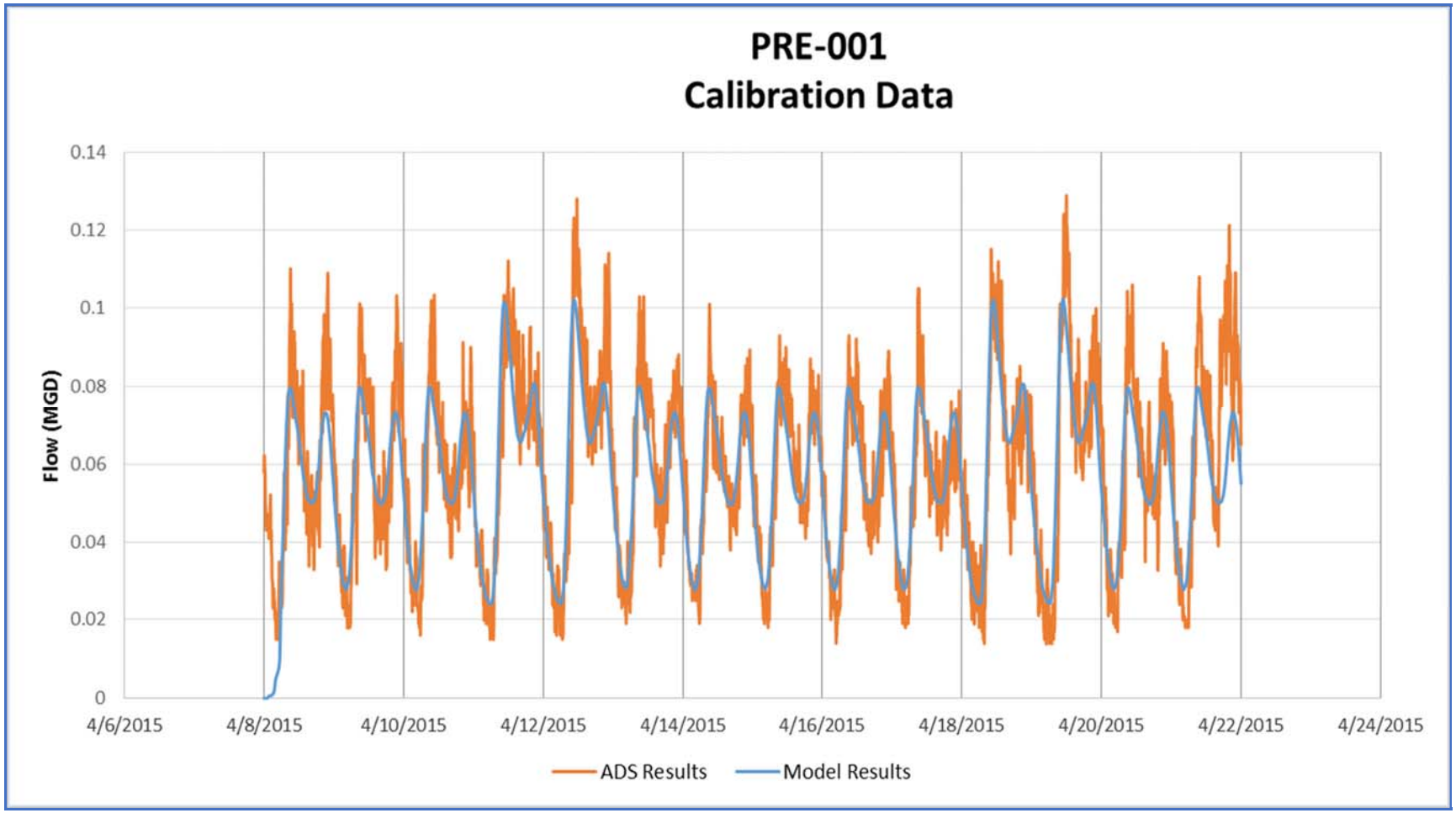


Figure 1. Dry Weather Flow Calibration of PRE-001

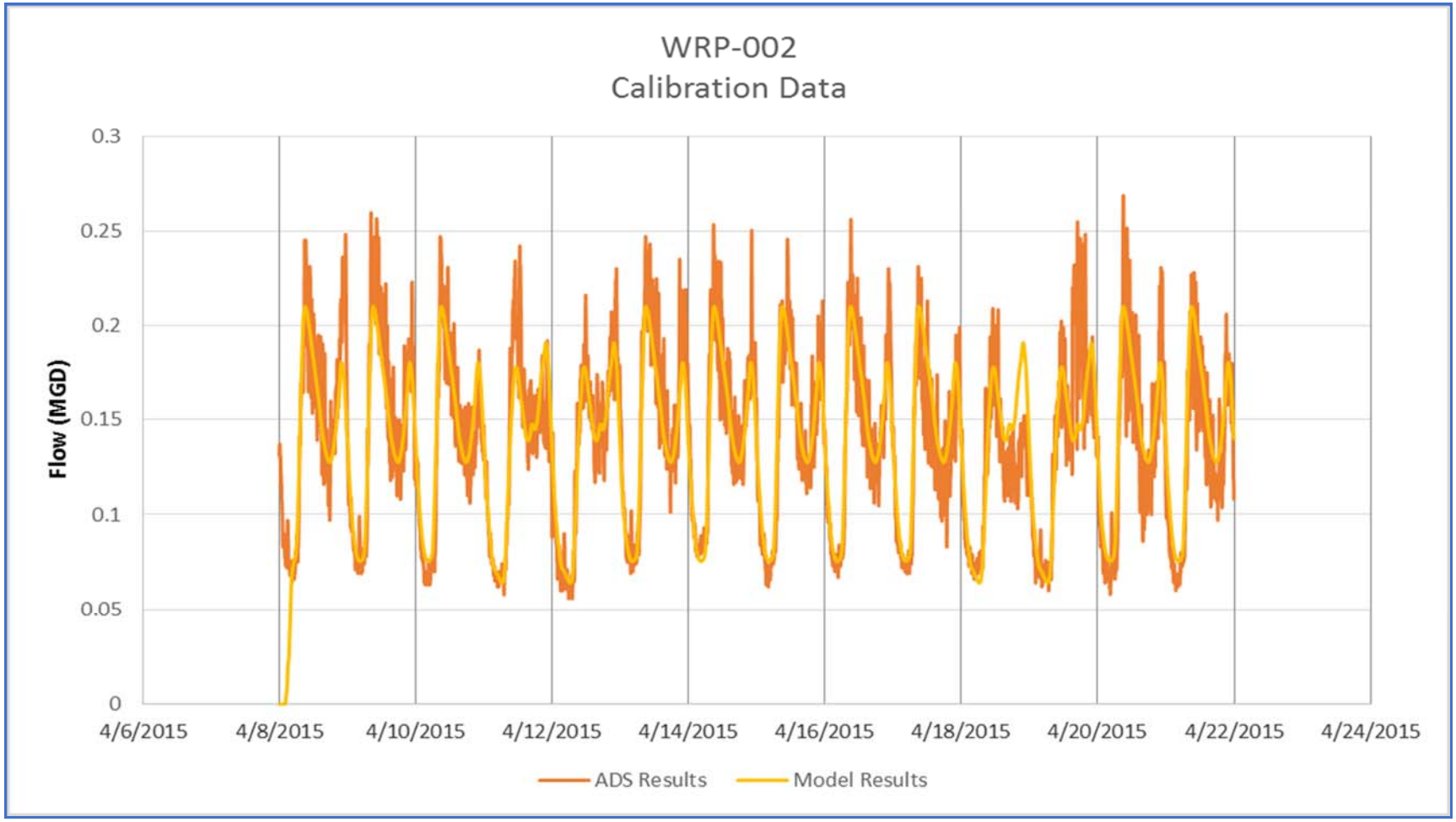


Figure 2. Dry Weather Flow Calibration of WRP-002

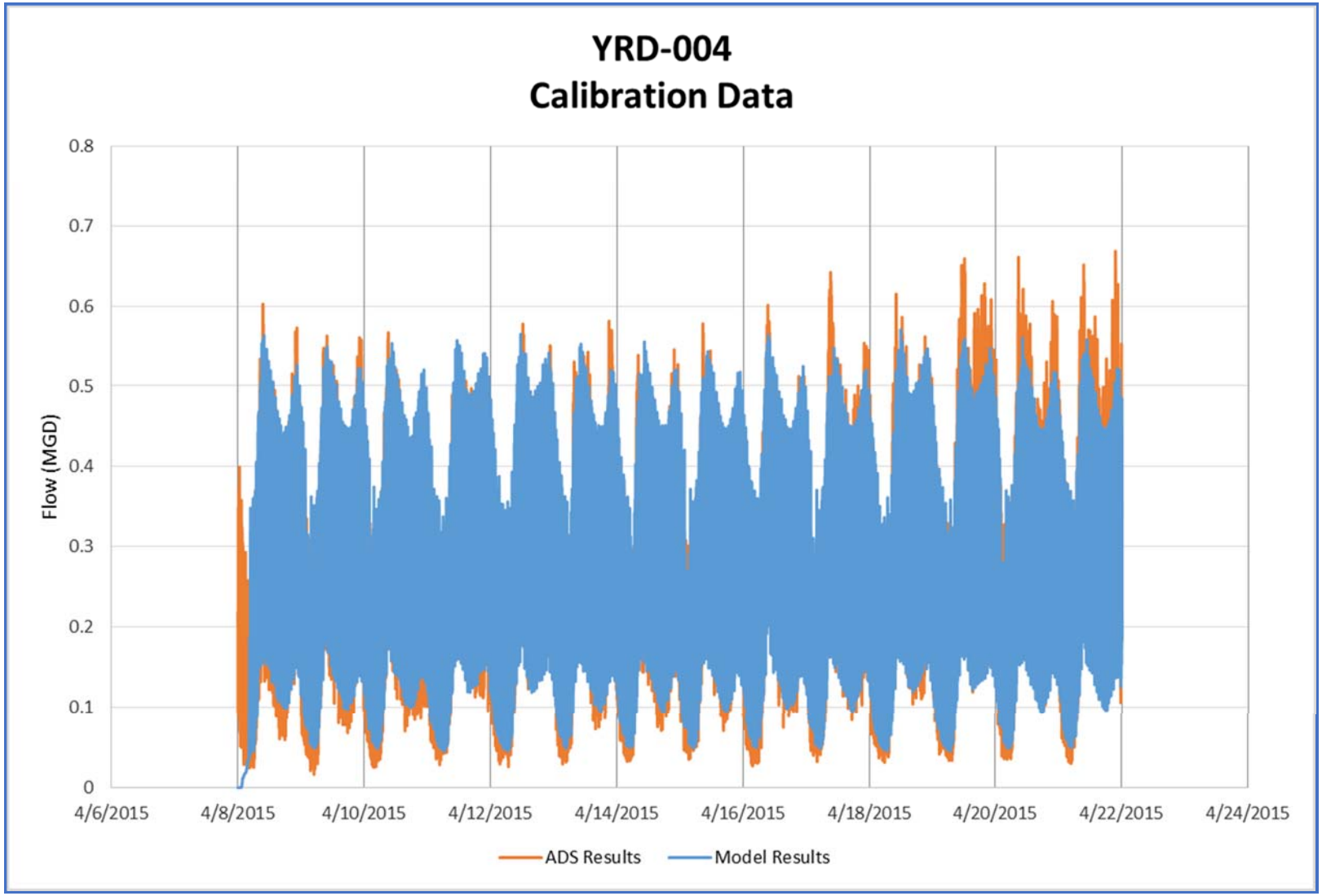


Figure 3. Dry Weather Flow Calibration of YRD-004

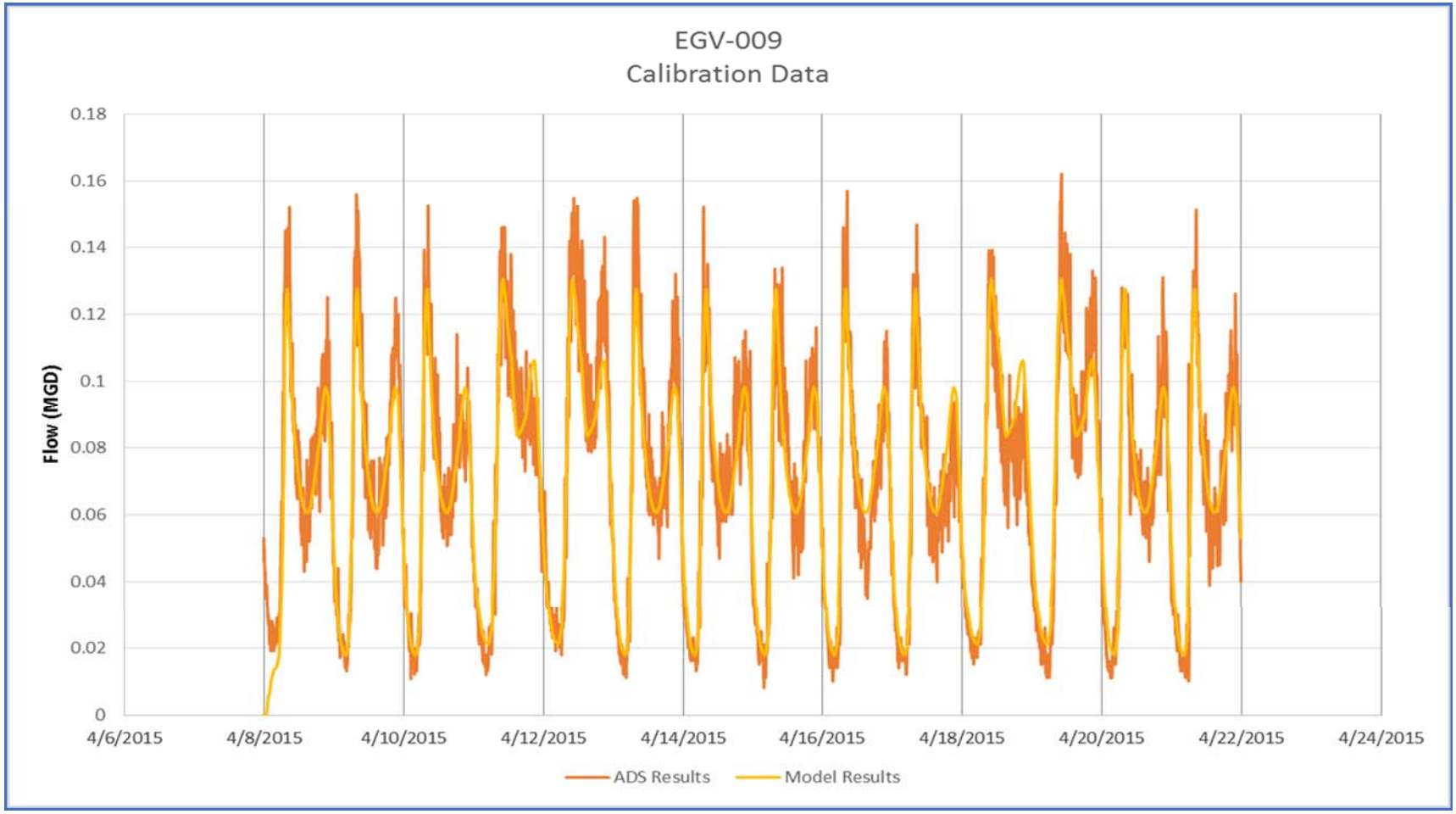


Figure 4. Dry Weather Flow Calibration of EGV-009

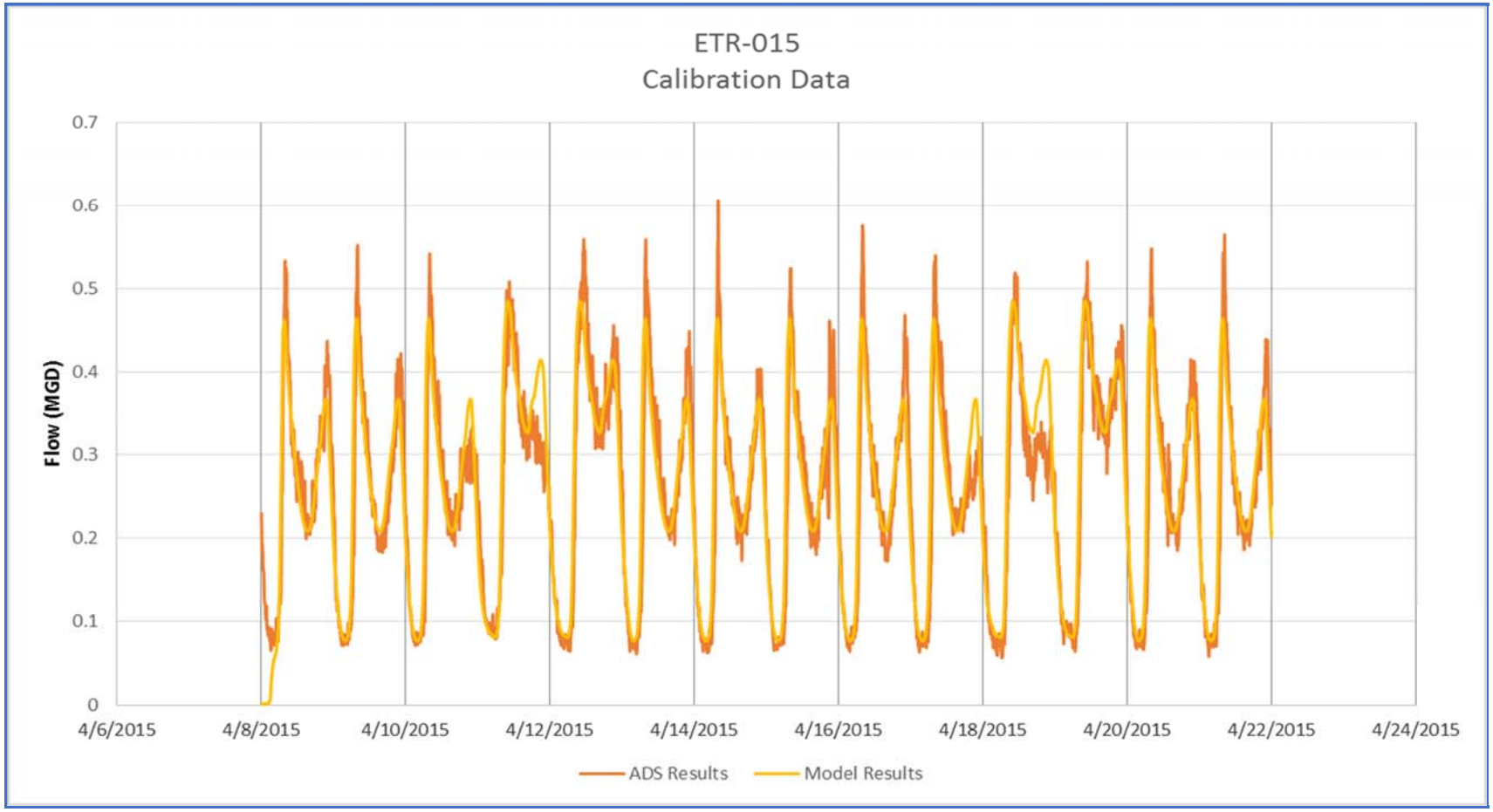


Figure 5. Dry Weather Flow Calibration of ETR-015

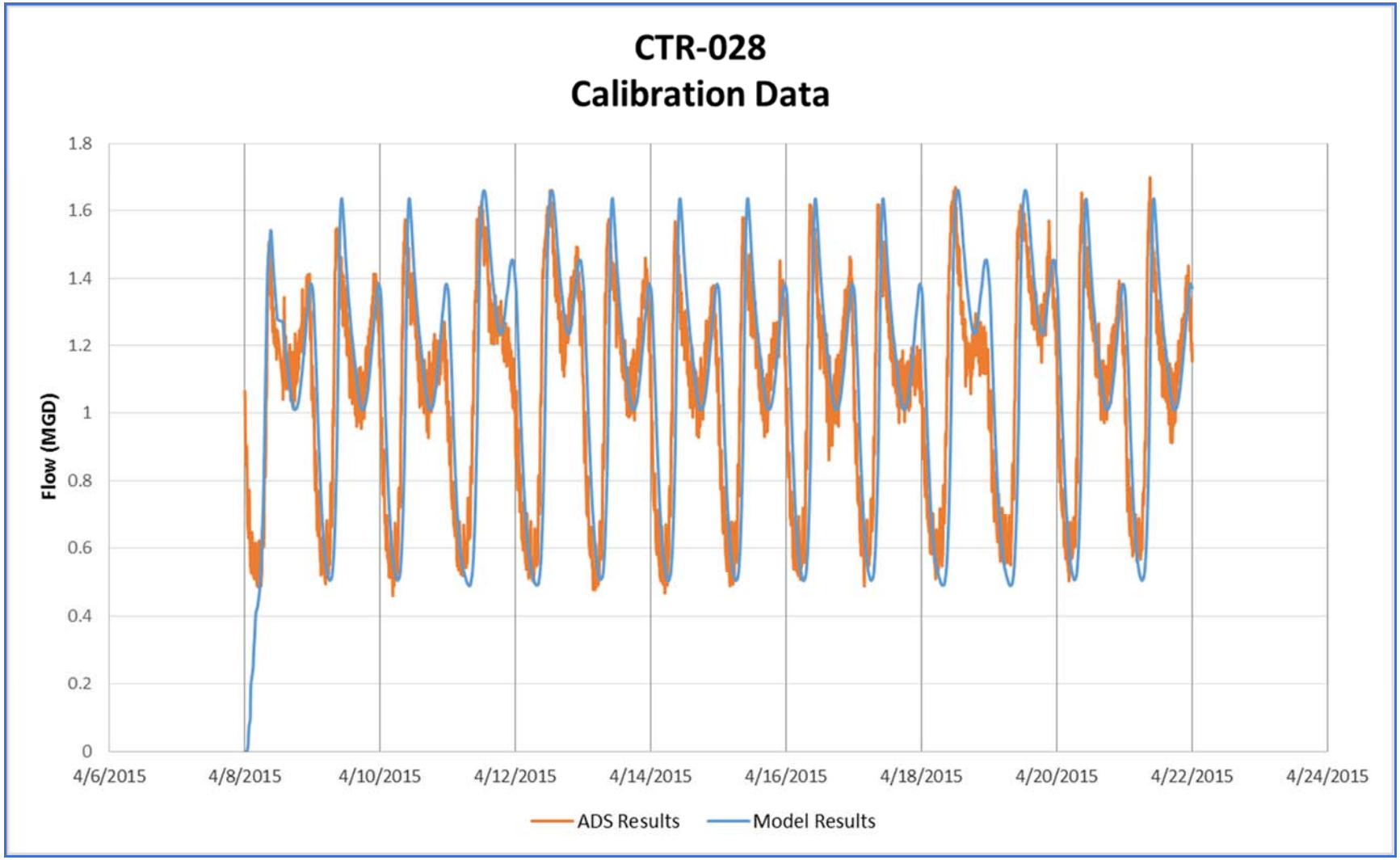


Figure 6. Dry Weather Flow Calibration of CTR-028

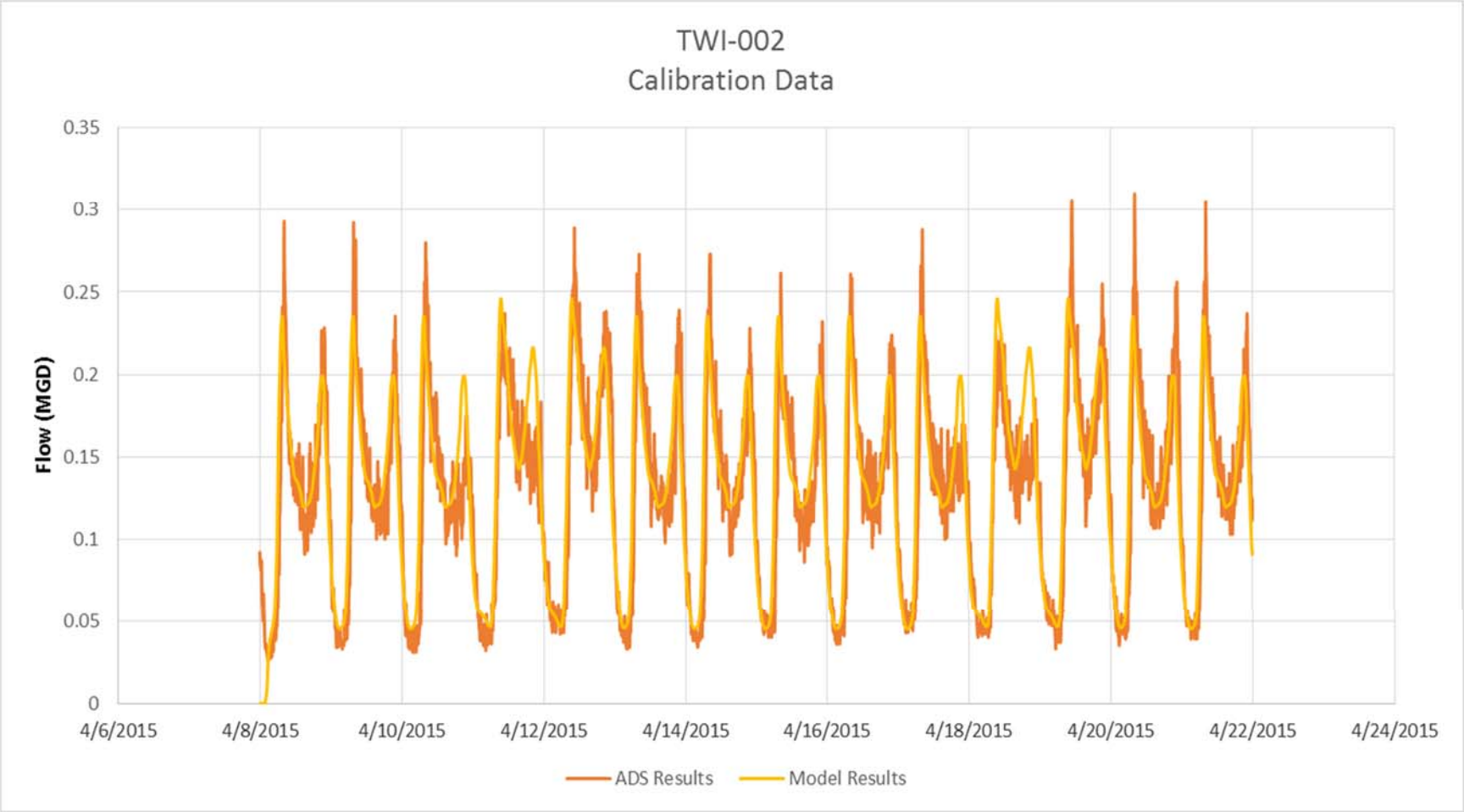


Figure 7. Dry Weather Flow Calibration of TWI-002

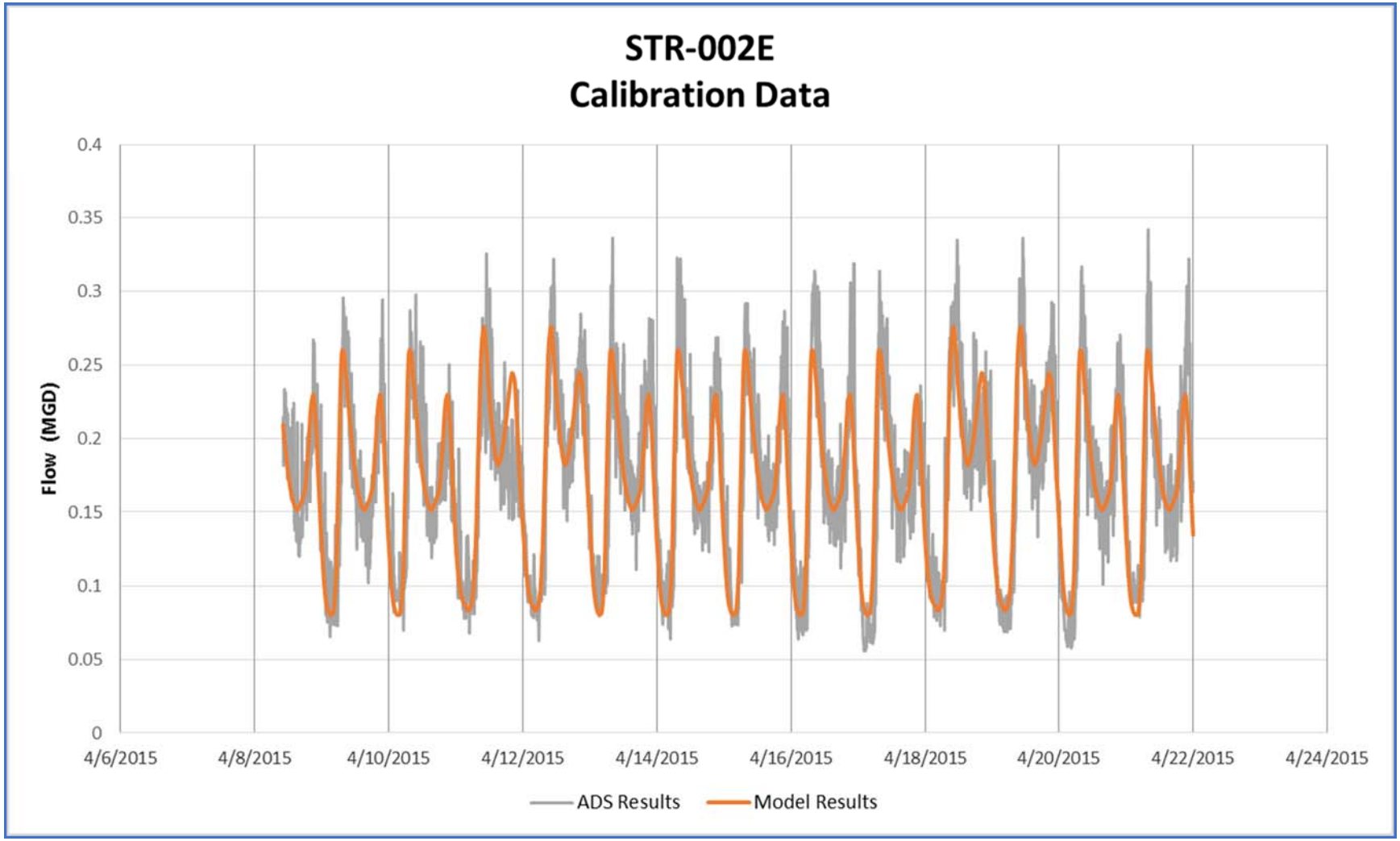


Figure 8. Dry Weather Flow Calibration of STR-002 East Pipe

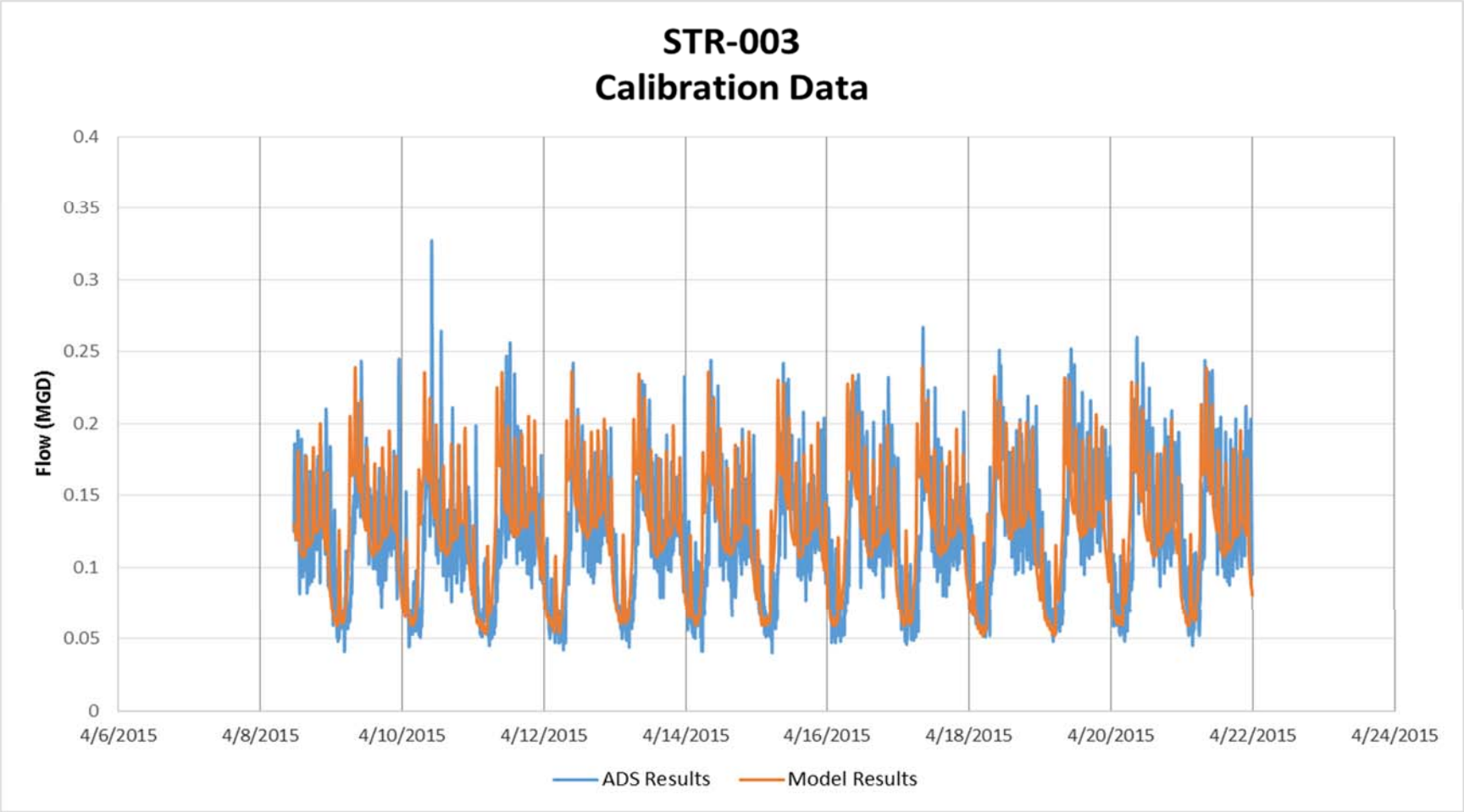


Figure 9. Dry Weather Flow Calibration of STR-003

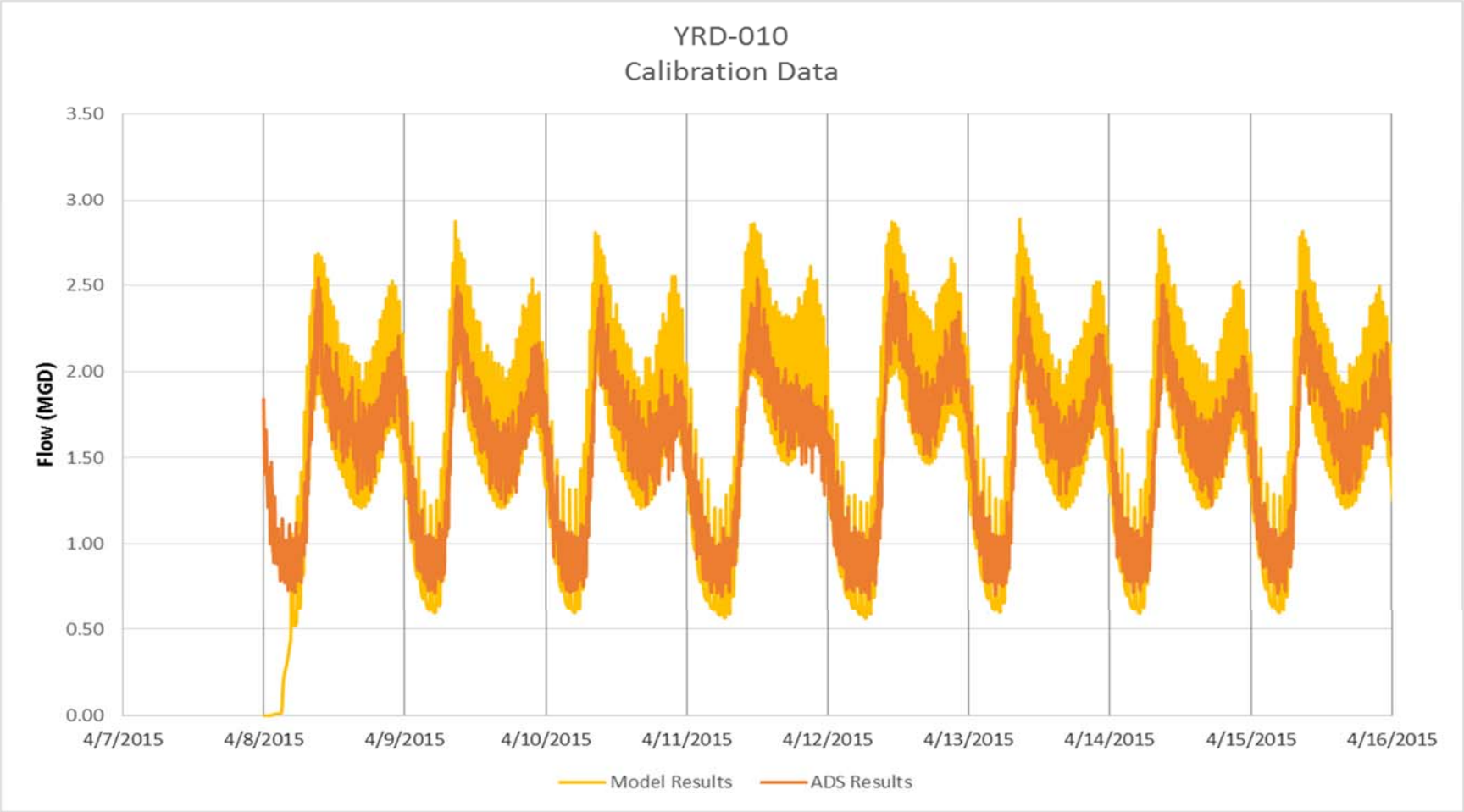


Figure 10. Dry Weather Flow Calibration of YRD-010

Appendix H
Process Modeling for Alternative Evaluations

Appendix H: Process Modeling and Analyses for Alternative Evaluations

Eagle Sewer District (ESD), Eagle, Idaho is currently performing a wastewater facility plan update and is considering upgrades to their existing lagoon wastewater treatment system for handling increasing wastewater flows and load in the planning period. An emphasis was given to maintain the agreement between ESD and the City of Boise by continuing primary and partial secondary wastewater treatment at the ESD lagoon system and effluent discharge at the West Boise WWTF if additional secondary treatment and disinfection are economically viable.

This technical memorandum documents biological wastewater treatment process analyses and modelling conducted for various alternatives. A process model was calibrated to the operations of the existing lagoon system and used to predict the capacity of the existing ESD WWTP. The model was later modified to simulate various upgrades to predict plant respective upgrade performance.

Alternatives Evaluated

Following alternatives were evaluated in detail:

1. Alternative 1 - Do nothing. The existing ESD lagoon system would be operated as is with effluent discharged to West Boise WWTF. Effluent quality would degrade with increasing flows and loads and effluent discharged to West Boise WWTF would be subject to a higher fee and surcharge.
2. Alternative 2 - Upgrade the existing ESD lagoon system by installing new aerators/diffusers to increase the oxygen transfer capacity and improve plant treatment capacity. The aerators/diffusers are sized to provide a complete mix condition in the first 2/3 of Lagoon Cell 1.
3. Alternative 3 - Expand the existing ESD lagoon system to treat the ultimate flow and load projected for design year 2040 to the current effluent target of 60 mg/L total suspended solids (TSS) and 5-day biological oxygen demand (BOD_5). The required upgrades under this scenario include a new train consisting of new cells 3 and 4, which would be identical in size to the existing ESD lagoon system. Each train includes complete mix lagoon cells in the upstream 2/3 of Lagoons Cells 1 or 3, followed by partial mix lagoon portion for solids settling in the last 1/3 of Lagoon Cells 1 or 3 as well as in Lagoon Cell 2 or 4. Any of the four lagoon cells can be taken out of service for a seepage test that lasts for weeks.
4. Alternative 4 - Expand the lagoon system and upgrade it for tertiary ammonia and phosphorus removal, treating the ultimate flow and load expected for design year 2040 to the same level as the West Boise WWTF effluent on BOD_5, TSS, and ammonia-N, and total phosphorus (TP) level similar to West Boise WWTF effluent. A TP value of 1 mg/L TP is selected for this alternative, assuming that the effluent TP threshold to trigger phosphorus surcharge would be 0.5 mg/L higher than the West Boise WWTF effluent limit of 0.5 mg/L.
5. Alternative 5 - Convert to a membrane bioreactor (MBR) plant to treat to the same ammonia-N and TP levels as the West Boise WWTF and directly discharge to a river with a NPDES permit. A MBR plant is selected because it has been proven for reaching the treatment goals and being adaptable for achieving the more stringent TP limit in the future, if needed.

This technical memorandum focuses on the first four alternatives which were evaluated through process modeling and separate analyses characterizing sludge production and related solids settling and handling. Alternative 5 was primarily developed based on a recently constructed project and is discussed

in detail in Chapter 5, Final Screening of Alternatives. If desired, Alternatives 2 through 4 are devised to achieve increasing level of treatment through phased implementation.

Process Modeling Approaches

Biowin version 4.0, a commercially available biological wastewater treatment process modelling software, was used to predict the plant performance for various upgrade alternatives under the projected flows and loads. To obtain meaningful modelling results, a Biowin process model was configured for the existing lagoon system and calibrated to historical plant operations.

A layout of the existing ESD lagoons system is shown in Figure H-1.

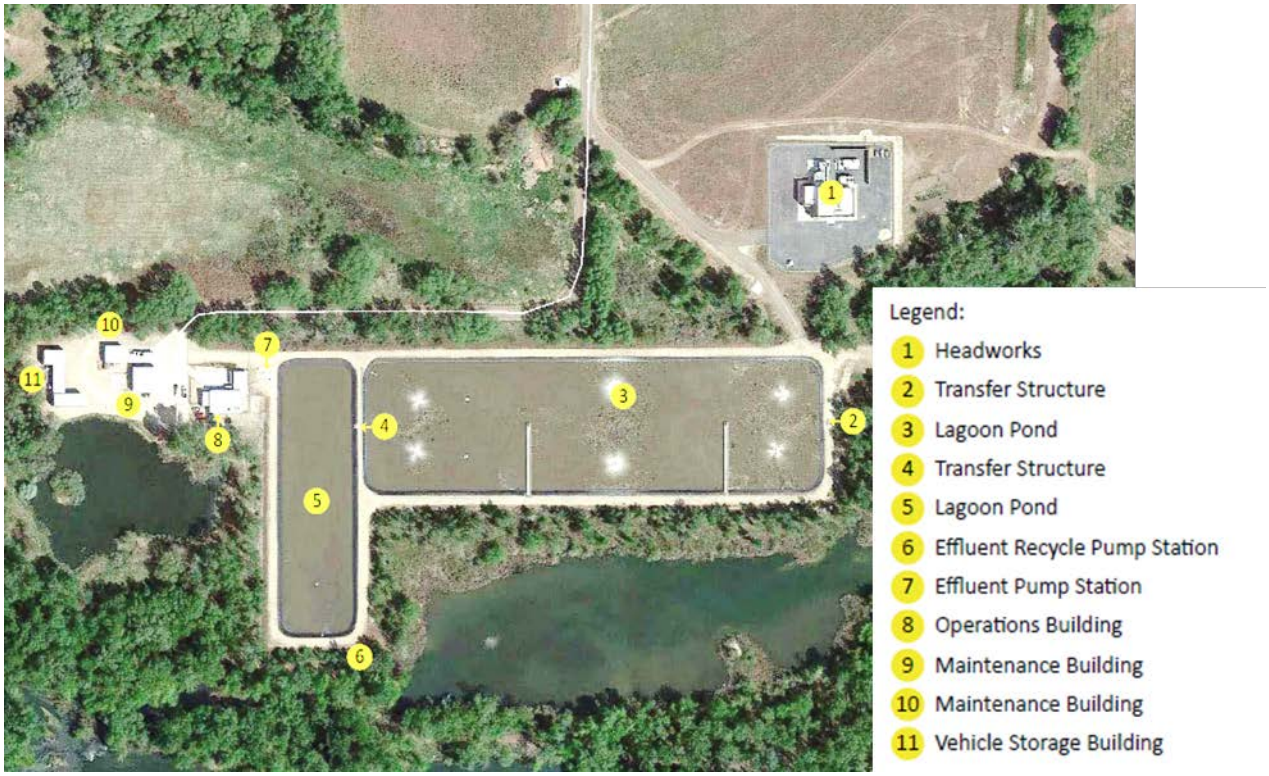


Figure H-1: Layout of ESD Wastewater Treatment Lagoon System

The existing ESD lagoon system consists of two partially mix aerated lagoons, Lagoon Cells 1 and 2. Lagoon Cell 1 is approximately 3 times larger, provided with a higher mixing/aeration energy, and is where the majority of organic matters in the wastewater is biologically degraded and converted to activated sludge. Lagoon Cell 2 is smaller, provided with limited mixing, and is where the majority of sludge settles out and separates from the lagoon effluent to achieve desired BOD_5 and TSS water quality.

The dimensions of the existing lagoons and aerator sizes are found in Appendix I: TM Eagle Sewer District WWTP Basis of Alternative Evaluation. Historical wastewater influent data, the effluent ammonia-N criteria identical to West Boise WWTF's NPDES permit limits, and projected flow increases anticipated maximum month influent strengths during the planning period are included in the Basis of Alternative Evaluation TM as well.

In a partial mix aerated lagoon, the applied mixing energy is not sufficient to keep all solids suspended. Some particulate pollutants and biosolids settle to the bottom sludge layer in the lagoon where anaerobic conditions prevail and the solids ferment and release soluble fatty acids to the upper liquid layer. In the upper liquid layer, the fatty acids released from the sludge layer combine with influent

soluble organic matters and the particulate organics that do not settle and are subject to aerobic biological degradation.

Figure H-2 shows the flow diagram of the Biowin model simulating the biological wastewater treatment process of the existing lagoon system. Lagoon Cell 1 is modelled as three cells based on a rule of thumb that the liquid layer cells which have a length to width ratio (i.e. L/R) of 1.5 to 2 behave like a continuously stirred tank reactor (CSTR). Lagoon Cell 2 was modelled as a single cell due to its significantly lower mixing intensity.

As shown in Figure H-2 each partially mixed aerated lagoon cell in the model was configured to simulate the two-phase reactions, in a similar way to what was performed for other lagoon systems (K. Fries et.al, 1999, WEFTEC Proceedings). Each lagoon cell is simulated with the following:

1. Solids separator that settles out solids in the lagoon influent. The mass transfer between the liquid and sludge layers depend on the mixing condition in the lagoon and other environmental conditions such as wind, temperature, etc. The solids removals at various lagoon cells are difficult to predict and were estimated based on the on-time sludge profile measured across the lagoon system and therefore adjusted to match the lagoon effluent TSS. The sludge profile performed in August 2015 shows minimal sludge blanket in Lagoon cell 1-1, approximately 1 foot sludge blanket in cells 1-2 and 1-3, and approximately 5 feet sludge blanket in Lagoon Cell 2. The plant has been operating for approximately 7 years since the last lagoon sludge dredging in 2008. Correspondingly, TSS percentage removals selected for Lagoon cells 1-1, 1-2, 1-3, and Lagoon Cell 2 are 0, 10, 10, and 47 percent, respectively.
2. Liquid layer bioreactor where the aerobic degradation of the effluent from the solids separator occurs. Model calibration indicated that the maximum specific growth rate for heterotrophs and ammonia oxidizing bacteria need to be lowered from the 3.2 d^{-1} and 1.2 d^{-1} to anticipated values 0.9 d^{-1} and 0.5 d^{-1}, respectively, to reasonably match measured effluent BOD_5 and ammonia concentrations. The slower growth rates are likely caused by the mass transfer limitations due to partial mix, and lower substrate and biomass concentrations than a typical activated sludge process. The reduction is consistent with practices of using lower first-order reaction kinetic rates for partial mix lagoons compared with complete mix aerated lagoons.
3. Sludge layer bioreactor where the solids settled out from the Solids separator are subjected to anaerobic fermentation. Default modelling parameters were used and provided sufficient agreement with actual measured results. Note that for the purpose of this alternative evaluation the model was not calibrated to reflect actual solids accumulations in the bottom of the lagoon. The accumulation of solids for various alternatives are estimated separately using spreadsheets based on assumptions that, 1) volatile suspended solids (VSS) is degraded at approximately 60% per year, 2) at the end of a storage period, just prior to sludge dredging, solids in the sludge layer are thickened to approximately 15% solids.
4. Bottom solids separator: For simplicity, it is assumed that all of the solids in the effluent of the sludge layer bioreactor are captured in this separator and returned to the sludge layer bioreactor. Only the soluble organic materials generated from anaerobic fermentation pass to the liquid layer bioreactor.

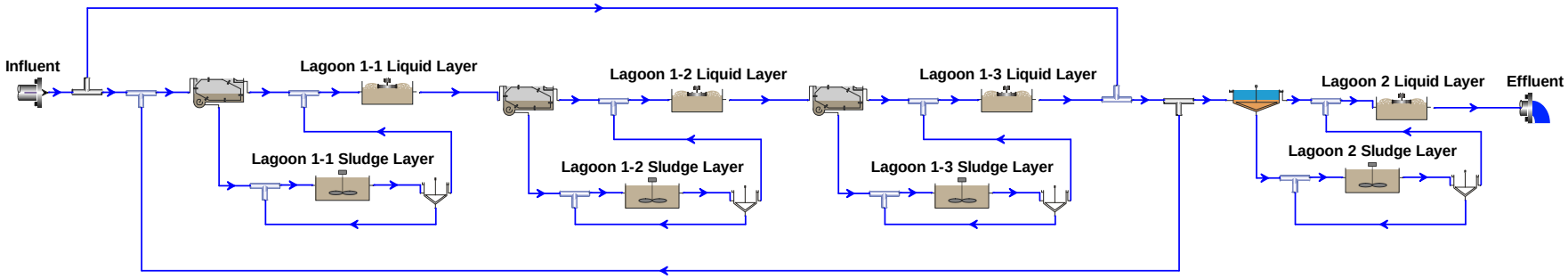


Figure H-2. Flow Diagram of Biowin Model for Existing Lagoon System

Model Development

Due to the long term nature of a lagoon's response to loads, the averages of the latest plant data available for the 3-years from 2011 to 2013 were used for model development. No apparent increase in flows and loads was observed during the 3 years.
Key model input that was used in the process model is described as follows:

1. Influent Water Quality
    a. Loads in terms of chemical oxygen demand (COD) and Total Kjeldahl Nitrogen (TKN) used were average values of the plant data recorded during 2011 to 2013. The inert suspended solids (ISS) load was calculated based on TSS data and the average VSS to TSS ratio of 83.4% as determined from 2006 samplings. The influent TP load was estimated based on the influent phosphate-P data and the average phosphate-P to TP ratio of 0.63 from 2006 samplings. The influent alkalinity concentration was not routinely monitored and was therefore assumed to be 300 mg/L as $CaCO_3$.
    b. Most COD, N and P fractionations are assumed the same as Biowin default values for typical domestic wastewater. The only exceptions are 0.018 g VFA as COD/g of readily biodegradable COD, 0.7 g NH3-N/g TKN, and 0.63 g PO4-P/g TP, based on corresponding average values determined from the 2006 sampling data.
    c. Temperature: Influent and lagoon temperature are not routinely monitored by the ESD. Limited data from the one-time measurement in March 2015 show 11 °C to 12 °C across the lagoon, and 17 °C to 18 °C in May 2015. For model calibration, an assumed average lagoon temperature of 15 °C was used. For evaluation of various upgrade alternatives, 3 °C and 20 °C were used to assess plant performance and operations in winter and summer months, respectively.
2. Lagoon system:
    a. Dimensions: the depth of the liquid layer and solids layer bioreactors are based on the 2015 sludge profile data and the total design side water depth of 10 feet. The volume of each lagoon cell was calculated based on a 2:1 side slope and lagoon dimensions shown in the as-built drawings.
    b. Surface aerators and submerged aerators:
        i. Power supply rate was entered to simulate the aeration in the lagoons, based on information on the operating units provided by the plant staff for March and May 2015 DO and temperature measuring.
        ii. Oxygen transfer capacity of aerators and aeration parameter: To match dissolved oxygen (DO) concentrations in various lagoon cells with the results from March and May 2015 samplings, the surface aerator's standard oxygen transfer rate was lowered from the default value 2.5 lb O_2 /(hp hr) to 1.0 lb O_2 /(hp hr) and the alpha value was also lowered from 0.5 to 0.32. Information on alpha values for mechanical aerators are scarce and are reported to vary between 0.3 and 1.1 (MOP 8, 2009. 5th Ed. Page 14-203). The lower than typical oxygen transfer capacity used in the modelling was necessary to match the lower than typical DO measurements.
        iii. DO: the DO data from March and May 2015 were compared to model predicted DO values to validate the calibration. The sampling results show low DO concentrations in Lagoon 1, averaging at 0.34 mg/L, 0.27 mg/L, and 0.26 mg/L respectively in Lagoon Cells 1-1, 1-2, and 1-3. The DO measurements in Lagoon Cell 2 were essentially zero.

The model is dynamic in nature due to continuous accumulation of the solids in the bottom sludge layer over time. Therefore, the dynamic model was run for approximately 100 days until the effluent quality relatively reaches steady. Figure H-3 shows the simulated lagoon effluent quality and lagoon DO.

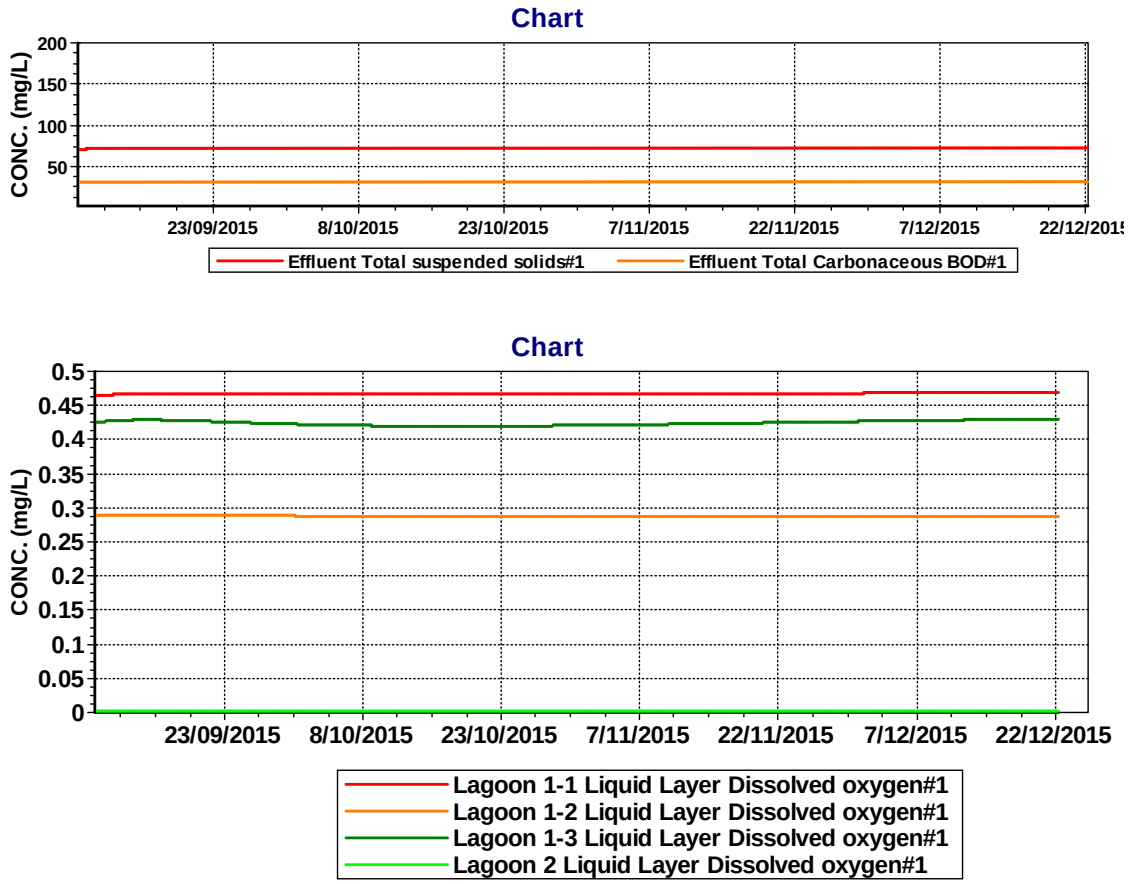


Figure H-3. Model Predictions of Lagoon DO and Effluent Water Quality

The predicted DO concentrations in different lagoon cells generally agree with the limited measured DO data. The predicted effluent TSS and carbonaceous BOD_5 ($cBOD_5$) match well with the 3-year averages of 77 gm/L and 27 mg/L, respectively.

Model Calibration

The developed model is then calibrated to the 2013 operations, through a dynamic run with separate, 24 hour average flows and loads that were available for the year.

Figure H-4 compares the model predicted effluent TSS, $cBOD_5$, ammonia-N, and phosphate-P (in lines) with plant effluent data (in dots). Note the start date of the simulated period was automatically taken as the date when the model was run, and actually corresponds to January 1 2013.

Overall the effluent water quality predictions match reasonably well with the recorded plant data. The actual effluent ammonia-N was higher than that predicted by the model for summer months which is likely due to actual higher summer lagoon water temperature and accelerated the solids decomposition.

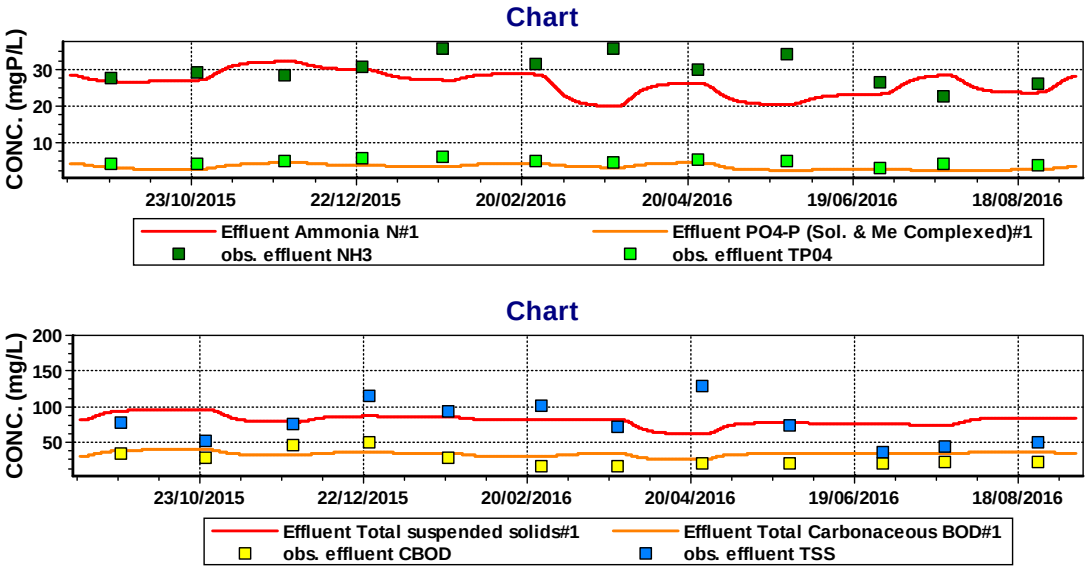


Figure H-4. Comparisons of Model Predicted Effluent TSS, $cBOD_5$, Ammonia-N, and Phosphate-P (in Lines) and Plant Effluent Data (in Dots)

Figure H-5 compares the model input for influent flow and loads (in lines) with plant influent data (in dots). Most parameters shown in the charts are direct input based on plant data. The influent TSS and BOD_5 are calculated input to the model based on the input for ISS and COD respectively, and influent fractionations. As shown in the charts, the calculated influent input closely match the recorded plant data.

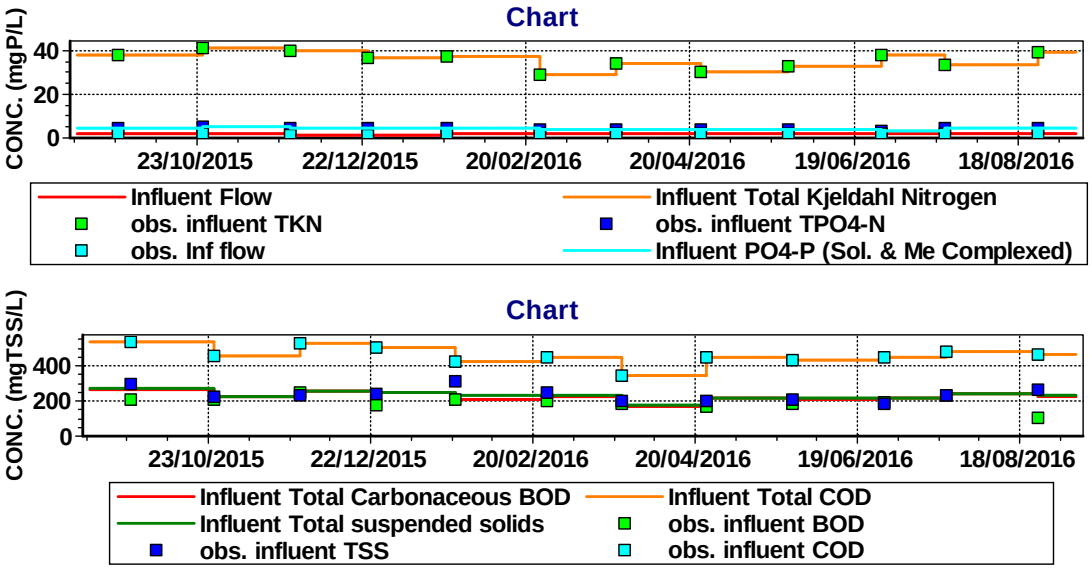


Figure H-5. Comparisons of Model Input for Influent Flow and Loads (in Lines) with Plant Influent Data (in Dots).

Analyses for Various Upgrades Alternatives

The calibrated Biowin model was then used to size and predict performance of various alternatives.

An anticipated winter lagoon temperature of 3 ºC was used to evaluate the lagoon wastewater treatment system's capability targeting BOD_5 and ammonia removal in winter. The anticipated ammonia nitrogen permit limits for Alternative 4 is lower in winter than in summer. Achieving the desired effluent

quality goals in winter at the low lagoon temperature would ensure meeting the effluent goals year-round since ammonia levels can be reduced more easily at higher water temperatures.

The solids removal in a partial mix lagoon (primarily Lagoon Cell 2 where majority of the settling occurs) would vary depending on flow rates, sludge blanket depth, and seasonally varying physical conditions such as temperature and wind. For simplicity, a single solids removal in Lagoon Cell 2 was used in all modelling alternatives. The anticipated effluent TSS and $cBOD_5$ levels were estimated based on following assumptions:

1. A TSS concentration of 60 mg/L would be achieved based on historical data if 1-day or greater retention time in the liquid layer of partial mix aerated lagoons is available for solids settling prior to sludge dredging. A minimum of 1-day retention is typically recommended for solids removal in earthen sedimentation basins. The liquid layer volume was calculated by excluding the estimated solids layer depth accumulated prior to sludge dredging. Solids accumulation in solids layer at the bottom of lagoon was estimated based on solids degradation rate and sludge layer solids concentrations previously described.
2. When the influent flows and loads exceed a minimum 1-day retention time in the partial mix lagoon prior to the sludge dredging, poor settling may occur due to settled solids being scoured up and carried out in the effluent. In this case the effluent TSS is assumed to fall in the range between 60 mg/L TSS and an estimate peak TSS of 150 mg/L. For purposes of calculating the surcharge associated with a higher TSS load in lagoon effluent discharge to West Boise WWTF, an average TSS concentration of 105 mg/L was used for this circumstance.
3. Effluent $cBOD_5$ corresponding to the anticipated effluent TSS was estimated based on the rule of thumb which assumes that for every gram of the effluent TSS approximately 0.5 g of $cBOD_5$ is exerted.

Separate spreadsheets were used to estimate the solids accumulation in the lagoon system, determine mixing and aeration demands, check the retention time in the liquid layer of the partial mix lagoon, estimate effluent TSS and BOD_5, and determine the frequency for sludge dredging required for maintaining a minimum of 1-day retention time for solids settling in the partial mix lagoons. The following criteria were used for solids accumulation estimate:

1. First order kinetics was used to estimate lagoon effluent BOD_5 concentration prior to solids settling in the partial mix lagoon cells. For complete mix lagoon cells, a 20 ºC temperature rate constant of 1.5 d^{-1} was used based on the reported range of 0.5 d^{-1} to 1.5 d^{-1} (Metcalf & Eddy, 4th edition, 2003). For partial mix lagoon cells, a typical 20 ºC rate constant of 0.276 d^{-1} was used.
2. Sludge production in each lagoon cell was estimated based on BOD_5 removal in the cell, typical sludge yield, decay rate, and inert fraction of the decay product. The mixed liquor suspended solids (MLSS) entering the partial mix settling lagoon was estimated based on the total sludge production and the influent flow rate. The resulting MLSS concentrations tend to be lower than what Biowin model predicts for same loading conditions. Therefore, a safety factor of 1.35 was applied to the MLSS concentrations calculated using first order rate kinetics to be consistent with Biowin predictions and more conservative in solids production estimate.
3. As the sludge layer depth increases in lagoon cells over time, a minimum liquid layer depth of 4 feet to 5 feet was used as the threshold to trigger sludge dredging. If the liquid depth further decreases due to delayed sludge dredging, odor may become an issue, especially in warmer months. In addition, TSS scouring in the settling lagoon may occur and deteriorate effluent water quality.
4. Temperature in each lagoon cell was estimated based on ambient temperature, lagoon cell influent temperature, and lagoon cell surface area. Respective winter and summer ambient temperature of -1.1 ºC and 26.7 ºC were used, based on historical minimum and maximum monthly averages. The

plant influent wastewater temperature was assumed 3 ºC in winter and 18 ºC in summer in Lagoon Cell 1-3.

Maximum month influent wastewater strength and average wastewater flows were used to simulate the anticipated maximum month loadings. Influent flow and concentrations for year 2040 maximum month loading condition are presented in Table H-1 and used for model development. The COD concentration was calculated based on the 351 mg/L maximum monthly influent BOD_5 and the COD to BOD5 ratio of 2.16 averaged from the 2011 to 2013 historical data. This BOD load is very conservative since the annual average of the historical data is 211 mg/L.

Table H-1. Maximum Month Influent Characteristics

Name	Units	Value
Flow	MGD	5.25
Total COD	mgCOD/L	758.06
Total Kjeldahl Nitrogen	mgN/L	48
Total P	mgP/L	9.4
Nitrate N	mgN/L	0
pH		7.3
Alkalinity	mmol/L	6
ISS Influent	mgISS/L	56.4
Calcium	mg/L	80
Magnesium	mg/L	15
Dissolved oxygen	mg/L	0

Key findings for various upgrades alternatives are summarized in Table H-2 at the end.

Alternative 1 –Do Nothing

The Biowin model flow diagram for Alternative 1 is the same as that for model development.

Capacity of Existing Lagoon System

If no upgrades are constructed, the oxygen transfer capacity of the aerators would limit the capacity of the existing lagoon system to approximately 2.6 mgd influent flow at the annual average influent strength, or 4,575 lb/d BOD_5. The effluent soluble $cBOD_5$ (sBOD5) concentration is predicted to be approximately 30 mg/, according to Biowin modelling results. This $sBOD_5$ level would allow the effluent to meet 60 mg/L BOD_5, since the anticipated effluent TSS concentration would be approximately 60 mg/l based on the greater than 1-day retention time in the settling lagoon.

Performance Prediction for Future Flows and Loads

If the influent loadings increases further, more $sBOD_5$ would remain untreated in the effluent, resulting in effluent BOD_5 greater than the 60 mg/L target. At the 2040 flow, the effluent sBOD5 is predicted to be approximately 195 mg/L, according to Biowin modelling results. The effluent TSS concentration is expected to exceed 60 mg/L due to the short retention time in the settling lagoons, and estimated at 105 mg/L. The corresponding effluent BOD_5 concentration is anticipated to be 215 mg/L. The allowable years of operation without sludge dredging is estimated at 2.5 years, even if the settling pond performs better than expected at the short retention time where approximately 60 mg/L effluent TSS is produced allowing more solids to settle to the sludge layer.

Biowin models were set up and run for two more intermediate influent flow rates. The allowable years of operations without requiring sludge dredging is estimated assuming they are proportional to the influent flow rates.

Alternative 2 – Convert Cells 1-1 and 1-2 to Complete Mix Lagoons with New Aerators/Diffusers

The flow diagram of Biowin model for Alternative 2 is shown in Figure H-6.

The surface and submerged aerators have likely reached the end of their useful life, as suggested by significantly lower than typical oxygen transfer capability. In this alternative, it is assumed that surface aerators are replaced by new and more efficient aerators or diffusers. If new surface aerators are used, typical oxygen transfer capacity of low speed surface aerators with the following parameters is assumed:

1. standard oxygen transfer rate: 2.5 lb O_2 /(hp hr)
2. Alpha value: 0.8

Capacity of Upgraded Lagoon System

With new aerator/diffusers to provide sufficient mixing in Lagoon cells 1-1 and 1-2 to make them complete mix lagoon cells, the mass transfer limitation due to insufficient mixing would no longer be an issue. Therefore, for complete mix lagoon cells, assuming Biowin default specific growth rates for heterotrophs and ammonia oxidizing bacteria, were used. A higher degradation rate of organic matters is achieved as a result. This, combining with the higher mixing energy and oxygen transfer capacity, significantly increases the plant capacity. According to Biowin modelling results, the plant is able to treat the design maximum month loading and produce an effluent $sBOD_5$ concentration of approximately 15 mg/L. This effluent $sBOD_5$ level corresponds with a total effluent BOD_5 lower than 60 mg/L target assuming the effluent TSS can be within 60 mg/L.

The plant capacity is, however, limited in its ability to properly settle the biomass and produce effluent TSS below 60 mg/L. With the Lagoon cells 1-1 and 1-2 converted to complete mix lagoon cells, the available partial mix lagoon volume available for solids settling is significantly reduced. Approximately 0.8 day of retention time is available at the liquid layer of the partial mix lagoon, just before the sludge dredging is required. The effluent TSS at such a short retention time is expected to be between 60 and 150 mg/L, corresponding to an effluent BOD_5 likely above 60 mg/L.

A 3.5 mgd influent flow was determined as the maximum flow allowing a 1-day minimum retention time in the partial mix lagoon or lagoon cells and achieve an acceptable effluent TSS of 60 mg/L. The corresponding effluent BOD_5 concentration was estimated to be 30 mg/L, given that minimal $sBOD_5$ is expected in the effluent.

Performance Prediction for Future Flows and Loads

At the 2040 maximum month loading, the lagoon system would be able to adequately degrade the organic materials in the influent but unable to properly settle out the biosolids from the effluent in the partial mix lagoons. The effluent TSS concentration is expected to be greater than 60 mg/L, with a corresponding effluent BOD_5 concentration also above 60 mg/L. At assumed 105 mg/L effluent TSS concentration, an effluent BOD_5 concentration of 66 mg/L was estimated.

At the design flow and loading and depending on the actual effluent TSS concentration, Alternative 2 would have 1 year to 1.5 years of sludge storage before sludge dredging is required.

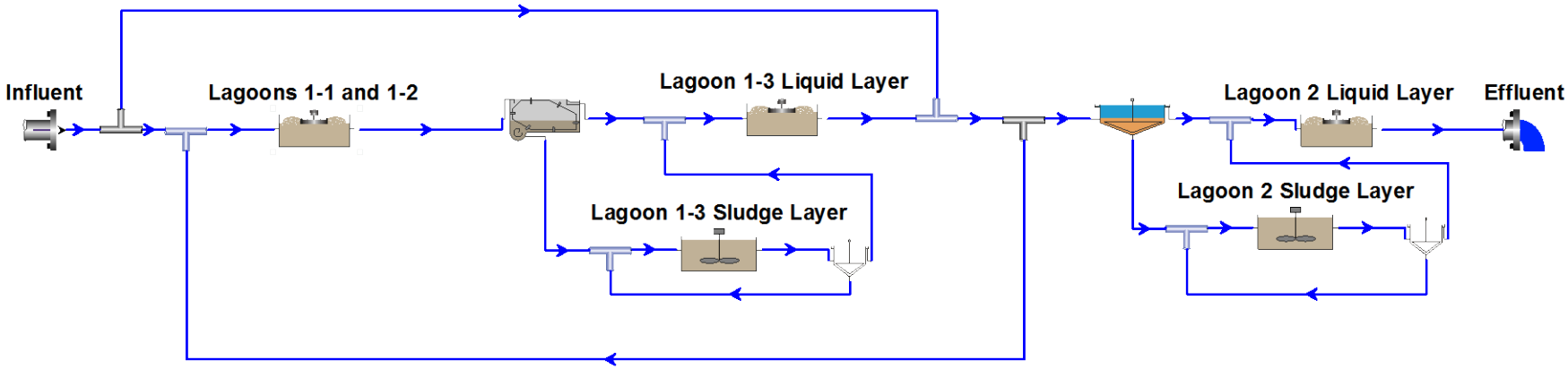


Figure H-6. Biowin Model Process Flow Diagram for Alternative 2

Alternative 3 – Convert Lagoon Cells 1-1 and 1-2 to Complete Mix with New Aerators/Diffusers and Expand Lagoons with an Identical Train

The modifications to the existing lagoons in this alternative are the same as in Alternative 2. In addition, a new lagoon train identical in size to existing Lagoons 1 and 2 would be constructed. To provide redundancy and allow any of the four lagoons to be taken out of service for seepage testing, required periodically by the regulatory agency for the lagoon liner, bypass piping would be installed with the new lagoons.

The flow diagram of Biowin model for Alternative 3 is the same as that for Alternative 2. The sizes of the lagoons were simply increased to reflect lagoon expansion with the new second train.

Once the plant influent flow and loading exceeds the capacity of one lagoon train (i.e., 3.54 mgd at the maximum month strength) the second lagoon would need to be brought online. The two trains would operate in parallel, each treating half of the total flow. The lagoon effluent from both trains is pumped from a respective lagoon effluent pump station discharging to a common force main to transfer the total combined effluent to West Boise WWTF.

If a lagoon cell is taken out of service for a seepage test or for maintenance the associated train will need to be taken out of service. The retention time in the partial mix lagoon may fall slightly shorter than the minimum desired 1-day retention and potentially result in higher than 60 mg/L effluent TSS concentration. However, the surcharge due to effluent TSS exceedance during the seepage test is expected to be significantly less expensive than the cost of adding interconnecting pipes between lagoon cells to direct flow to remaining lagoons in service to ensure effluent BOD_5 and TSS concentrations remain below 60 mg/L.

To minimize the potential surcharge, it is recommended that seepage test be conducted in summer and shortly following the sludge dredging. In summer, higher lagoon water temperature would allow less complete-mix lagoon volume and thus more partial mix volume for solids settling. The retention time in the settling lagoon would likely remain greater than 1 day and produce effluent with an acceptable TSS level.

Alternative 4 – Lagoon Expansion plus Tertiary Clarifiers, MBBRs and Filters for N and P removal, and Sludge Dewatering

Figure H-7 shows the Biowin model process flow diagram for Alternative 4. Alternative 4 was envisioned as one that adds to Alternative 3 to achieve approximately same effluent quality as West Boise WWTF to minimize the cost charged by the City of Boise for additional secondary treatment. The modifications to and the expansion of the lagoon system are the same as Alternative 3, with necessary bypass pipes added.

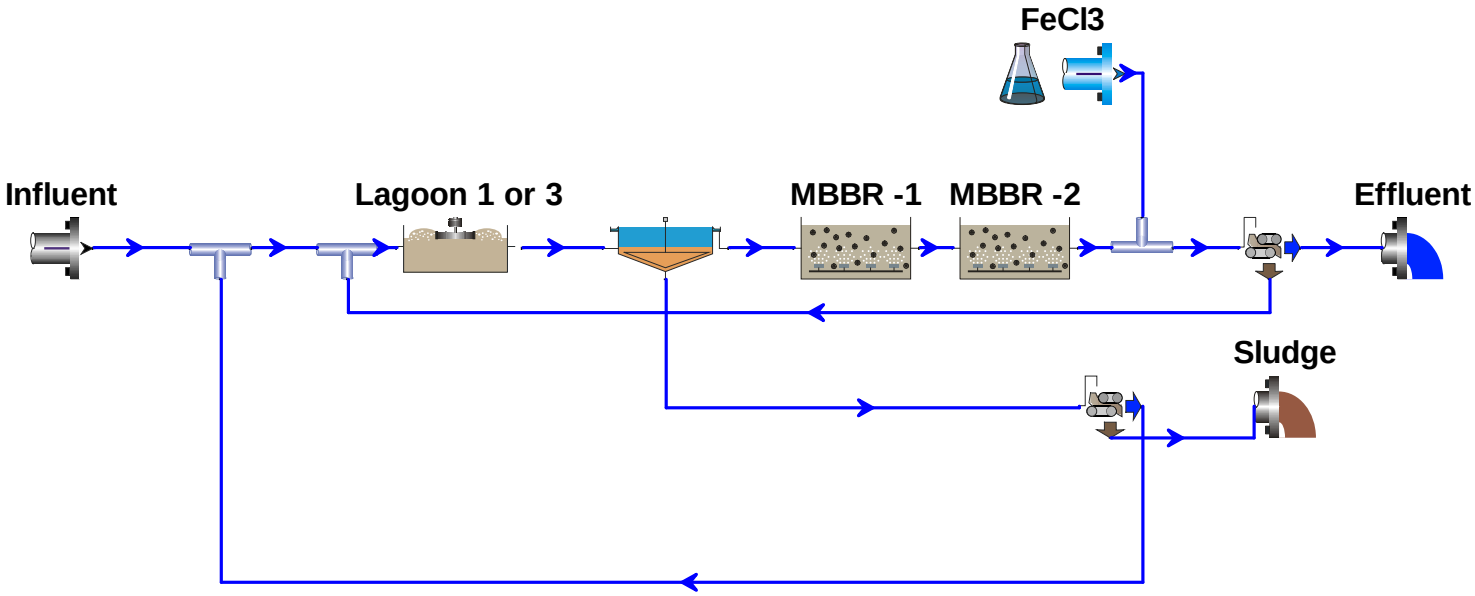


Figure H-7. Biowin Model Process Flow Diagram for Alternative 4

To reliably achieve the effluent ammonia-N limit of 0.4 mg/L in winter, the aeration/mixing condition in the entire Lagoon 1 or Lagoon 3 will have to be upgraded to become a complete mix, flow through lagoon to accomplish the majority of the nitrification. In addition, two moving bed biofilm reactors (MBBRs) have to be added in series to further reduce the ammonia level to meet the concentration target.

Lagoons 2 and 4 will no longer be needed for liquid stream processes. Bypass pipes will be installed in these lagoons to bypass from Lagoons 1 and 3 to respective lagoon effluent pump stations. The effluent from complete mix Lagoons 1 or 3 would flow to clarifiers, where the waste activated sludge (WAS) is wasted. The WAS would be dewatered and truck hauled.

A general schematic for a MBBR option is shown in Figure H-8.

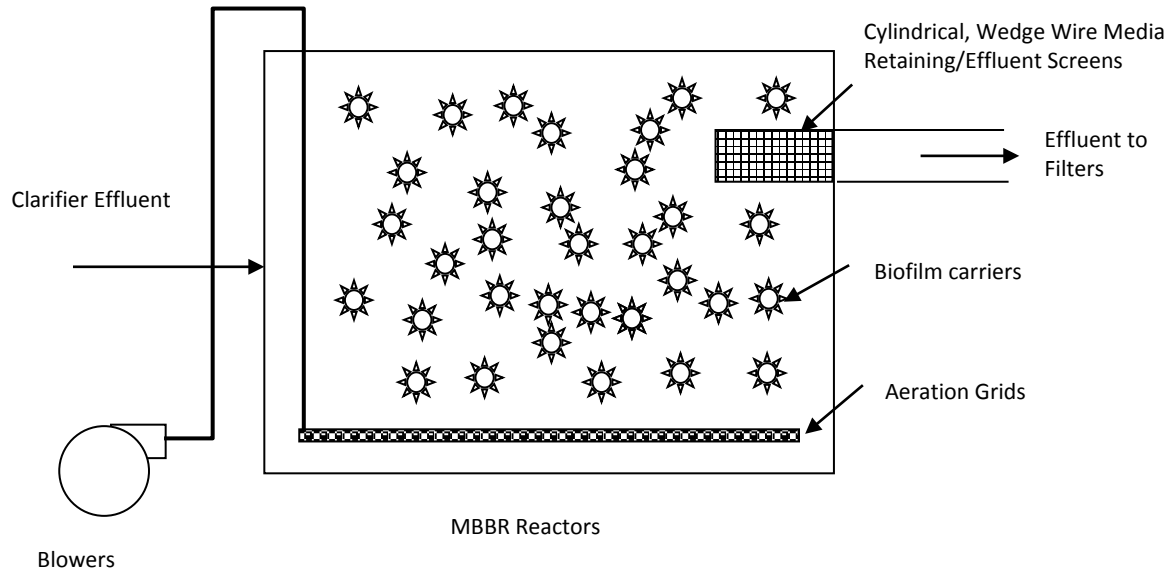


Figure H-8. General Schematic of a MBBR

A MBBR is a reactor partially filled (up to 67%) with specially designed buoyant carrier media which support biofilm growth. The media is designed to provide a large protected surface area for biofilm growth. Perforated plates or sieves located at the effluent end of the reactor retain the carrier media yet allow treated effluent to pass. Diffused aeration provides oxygen required for BOD_5 polishing and ammonia reduction. MBBRs are a continuous flow stand-alone biofilm process which does not need backwashing or return activated sludge (RAS) from downstream clarifiers. If necessary, additional nitrification capacity can be achieved by adding more media.

Typical operation and maintenance activities involved with the MBBR reactors include regular operation and maintenance of aeration blowers. No periodic replacement of media is required.

Two new clarifiers are located upstream of the MBBR tanks to reduce solids loading to MBBR tanks and prevent the carrier media surface area being reduced due to solids adsorbing to the media. No RAS is needed because the biomass concentration of approximately 400 mg/L would be sufficient to achieve the required BOD_5 removal.

The clarifiers remove the TSS in the clarifier effluent to less than 30 mg/L. The effluent TSS from the downstream MBBR tanks is predicted to be slightly lower by Biowin model due to the slow growth of nitrifiers and decay of the solids due to the long retention time in the MBBR tanks.

The MBBR effluent TP concentration is predicted to be approximately 1.5 mg/L, requiring tertiary filters and chemical addition to polish the TP less than 1 mg/L in the final effluent. Approximately 5 mg/L ferric chloride dose is anticipated to be adequate.

A proposal from the MBBR supplier Infilco Degrement Inc. (IDI) was received. The proposed total tankage is 1.8 million gallons (MG), larger than the 1.4 MG as determined by Biowin modelling as adequate to achieve the required effluent ammonia level. To be conservative, a total tank volume of 1.8 MG was used for the capital cost estimate. The MBBR tank volume can be optimized during the design if the alternative is selected.

WAS from the clarifiers would be dewatered using high solids centrifuges or 3-belt belt filter presses to a minimum of 15% solids. The cost estimate was based on 3-belt belt filter presses.

Use of sludge dewatering process instead of solids sedimentation and storage in lagoons would eliminate the need for periodical sludge dredging and associated sludge accumulation in a dynamic nature. Therefore the model used a steady state solution to analyze this alternative.

The dewatering facility was sized to operate 9 hours per day, 5 days per week at maximum. WAS would be wasted when dewatering facility operates. On weekends, WAS would be not wasted and allowed to build up in clarifiers. At the design loading, the sludge blanket depth in clarifiers is expected to be approximately 4 feet at maximum after the weekends. The sludge blanket depth is slightly higher than the typically desired depth of a couple of feet, but it is still expected to result in an acceptable clarifier effluent quality, due to the low clarifier influent MLSS concentration and solids loading. Alternatively, the lagoon cell 1 effluent can flow through Lagoon cell 2 or cell 4 for solids settling in weekends, prior to entering clarifier. However, such operation would eventually require sludge dredging in Lagoons 2 and 4.

References

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Table H-2. Summary of Alternatives 1 through 4

	Option 1 - Do Nothing, Aerator Performance Per DO Data			Option 2 (System Upgrades)		Option 3 (Lagoon Expansion)	Option 4 (Lagoon Expansion Plus Ammonia And P Removal)
	Capacity	**Intermediate Year 2**	**2040 MM Condition**	**Capacity**	**2040 MM Condition**		
Descriptions	DO limiting the capacity.	DO limiting the capacity.	DO limiting the capacity.	Install new low speed aerators to provide complete mix in the first 2/3 of Lagoon 1 to increase capacity. Beyond year 2030, effluent may not reliably meet 60 mg/L TSS due to short HRT in partial mix lagoon portions.		Add a new identical train of Lagoons 3 and 4. 2 trains of complete mix lagoon cells (first 2/3 of Lagoons 1 and 3) followed by partial mix lagoon for solids settling (in last 1/3 of Lagoons 1 and 3, plus Lagoon 2 and 4). Any one of the lagoon can be OOS for seepage test for redundancy. Effluent to meet 60 mg/L BOD and TSS.	Complete mix A.S. in entire Lagoons 1 and 3, followed by clarifier to remove TSS to less than 25 mg/L, and tertiary MBBRs for ammonia removal. The resulting TSS will be still within 30 mg/L TSS, due to slow growth of nitrifiers. filters and chemical add1tion will be included to remove TP to within 1 mg/L.
Flow, mgd	2.6	2.9	5.3	3.54	5.25	5.25	5.25
BOD5, mg/L	211	351	352	351	351	351	351
BOD5, lb/d	4,575	8,519	15,412	10,363	15,369	15,369	15,369
Corresponding Flow at average WW strength (based on 211 mg/L BOD averaged from 2011 to 2014), mgd	-	4.8	8.8	5.9	8.7	8.7	8.7
Sludge Storage							
Sludge storage lagoon	mostly in Lagoon 2; some in Lagoon 1	mostly in Lagoon 2; some in Lagoon 1	mostly in Lagoon 2; some in Lagoon 1	In last 1/3 of Lagoons 1, plus in Lagoons 2	In last 1/3 of Lagoons 1, plus in Lagoons 2	In last 1/3 of Lagoons 1 and 3, plus in Lagoons 2 and 4	Typically send lagoon 1 and/or 3 effluent to clarifier, with the WAS dewatered for truck hauling. Lagoon 2 and 4 can be used as polishing lagoon before clarifier if desired, but will require sludge dredging.
Settling lagoon volume (Partial Mix)	14.2	14.2	14.2	7.2	7.2	14.3	up to 14.3 if choose to use Lagoons 2 and 4 for additional solids settling
Estimated No. of Years between dredging (at MM loading)	7	4	2	approximately 1.5 yrs	1 to 1.5 yrs	approximately 2 yrs	Approximately 2 yrs, if choose to use Lagoons 2 and 4 for additional solids settling. Otherwise the sludge will be dewatered and hauled offsite.
Liquid Stream							
Final Effluent Ammonia-N, mg/L	34	33	35	27	33	35	0.31
Clarifier eff. Ammonia-N, mg/L	-	-	-	-	-	-	17
eff. BOD, mg/L	30	156	215	30	66	33	2
eff. TSS, mg/L	60	60	105	60	105	60	5
model predicted eff. TP, mg/L	7	6	6	5	6	7	0.71
model predicted eff. TPO4, mg/L	5	5	6	3	5	6	0.79
New aerators*	-	-	-	(7 duty + 1) * 60 hp surface aerators in the upstream 7 MG of Lagoon 1; 4 * 10 hp aerators in remaining 3.9 MG in lagoon 1, and 4 * 5 hp aerators in Lagoons 2		(7 duty + 1) * 60 hp aerators in each upstream 7 MG of Lagoon 1 and new Lagoon 3, for complete mix; 4 * 10 hp aerators in each of the remaining 3.9 MG in lagoon 1 and new Lagoon 3, and 4 * 5 hp aerators in each of Lagoons 2 and 4, for partial mix.	Complete mix Lagoons 1 and 3: 14 * 60 hp aerators in the lagoon 1 and new Lagoon 3. If choose to allow solids to settle out in partial mix Lagoons 2 and 4, 4 * 5 hp aerators in each of Lagoons 2 and 4, to provide partial mix.
No. of New external clarifiers	-	-	-	-		-	2
New external clarifier dia., ft	-	-	-	-		-	80
Lagoon effluent TSS upstream of settling Lagoon	<500	<500	<500	<500		<500	<500
New RAS/WAS pump station	-	-	-	-		-	Yes

Table H-2. Summary of Alternatives 1 through 4

	Option 1 - Do Nothing, Aerator Performance Per DO Data			Option 2 (System Upgrades)		Option 3 (Lagoon Expansion)	Option 4 (Lagoon Expansion Plus Ammonia And P Removal)
	Capacity	Intermediate Year 2	2040 MM Condition	Capacity	2040 MM Condition		
MBBR reactor volume, MG	-	-	-	-		-	1.8
FeCl3 dose, mg/L							5
Advantages	1. No capital investment required.	1. No capital investment required.	1. No capital investment required.	1. Treat to current level of 60 mg/L effluent BOD and TSS at the 2030 maximum month flow with relatively inexpensive upgrades. Algae growth is not a issue because the HRT will not be excessive. 2. Additional upgrades can be implemented in future (e.g. adding of a new train and installing additional new aerators) to provide required treatment and redundancy.		1. Treat effluent to the same BOD and TSS level as West Boise plant effluent, which may allow for negotiation with West Boise for some discharge credit or discharge to river. Algae growth is not an issue because the HRT will not be excessive. 2. No need for new clarifiers or dewatering facility. 3. Redundancy for seepage test is provided, which should be conducted soon after sludge dredging when the sludge depth in Lagoon is within 7 feet. 4. lower capital and O&M cost than Option 4.	1. Treat effluent to the same level as West Boise plant effluent (including P removal to 1 mg/L), which may allow for negotiation with West Boise for some discharge credit or discharge to river. Algae growth is not a issue because the HRT will not be excessive. 2. Dewatering facility can be added when the required sludge dredging becomes too frequent. It can be a part of future solids handling facility to produce class A biosolids, if producing class A biosolids is selected. 3. Greater market competition available for biofilm media for in-tank installations, compared to in-lagoon media addition. 4. Redundancy for seepage test is provided.
Disadvantages		1. Capacity is deficient for the flow and loading. 2. Lower level of treatment will result in surcharges. 3. No redundancy for seepage tests.		1. Hydraulic retention time is on the low side, making treatment performance susceptible to negative impact of possible short circuiting and scouring of the settled solids into the effluent. 2. More frequent hauling due to limited sludge storage in the partial mix Lagoon and Lagoon cell. 3. Redundancy for seepage test is not available other than sending untreated or less treated wastewater to West Boise, which will be subject to surcharges. 4. Require additional upgrades for 2040 flows and loads. 5. No redundancy for seepage tests.		1. No ammonia and P removal is achievable.	1. Dewatering facility, new MBBR systems, and clarifiers and associated WAS pumping are needed. 2. More frequent hauling may be needed as the sludge decomposition and reduction at partial mix polishing Lagoons is not normally used. 3. Higher capital and O&M cost than Option 3.

*: aerator horsepower is estimated based on 40 hp/MG for complete mix lagoons. Actual horsepower may vary depending on aerators' ability to keep solids suspended while meeting oxygen requirements, and should be confirmed with equipment suppliers during design.

Appendix I
Basis of Alternative Evaluation

TECHNICAL MEMORANDUM

Eagle Sewer District WWTP Basis of Alternative Evaluation

PREPARED FOR:	Vendors
COPY TO:	William Leaf – CH2M Stacey Lamer – CH2M
PREPARED BY:	Neil Jenkins – CH2M
DATE:	September 2, 2015
PROJECT NUMBER:	656599

Eagle Sewer District (ESD), Eagle, Idaho is currently performing a wastewater facility plan update. ESD is considering upgrades to their existing lagoon wastewater treatment system for implementation during the planning period. Figure 1 gives is a site plan of the existing site. ESD has approximately 10 acres where improvements could be constructed. The existing dimensions of the lagoon system are given in Table 1. Table 2 includes historical wastewater influent data as well as design criteria for scenario 2. Table 3 gives the anticipated flow increases during the planning period.

Two scenarios are being considered for upgrades.

1. Maintain the existing effluent characteristics of <60 mg/L 5-day BOD and <60 mg/L TSS as flows increase.
2. Reduce the effluent loading as much as possible to reduce discharge fee (BOD, TSS, P04). This scenario also needs to take into account flow increases over time and is anticipated to include a phased approach to improvements.

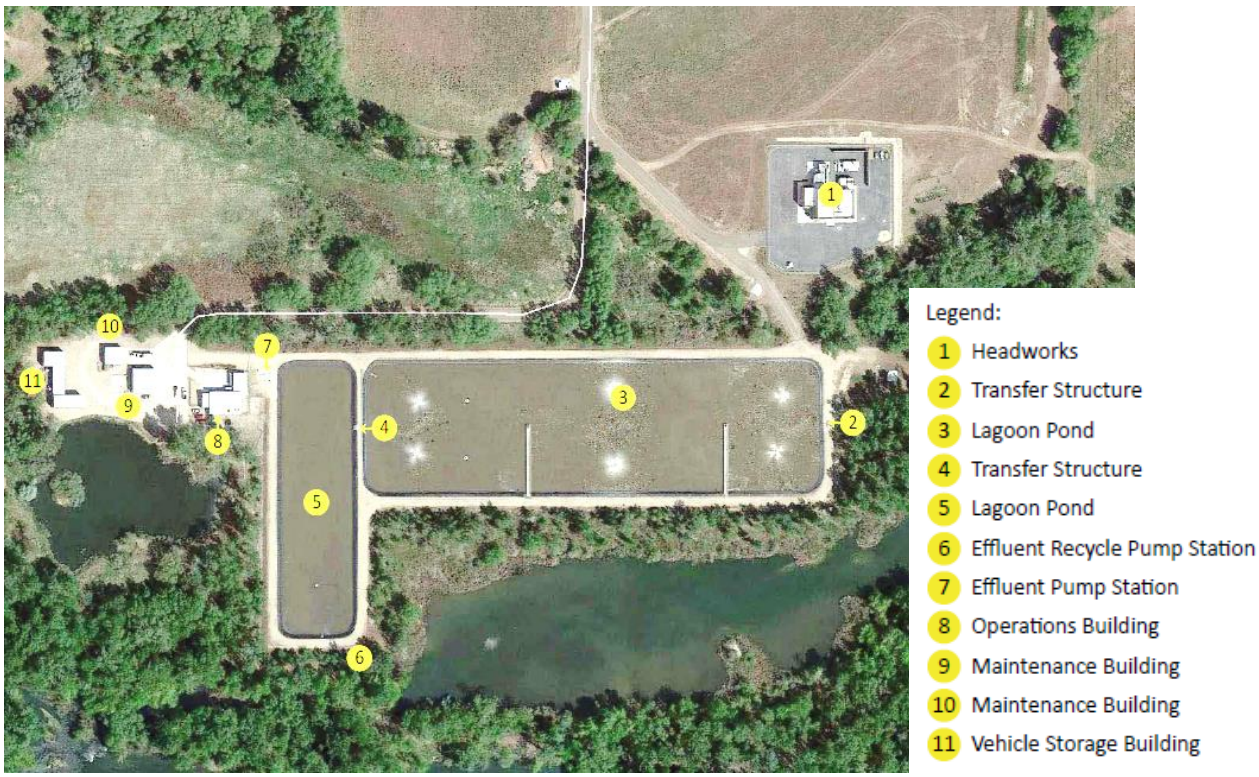

Table 1. Eagle Sewer District WWTP: Summary of Existing Unit Processes

Unit Process	Existing and New Facilities	Treatment Criteria	Equipment Capacity	Remarks
Secondary Treatment				
Lagoon 1	10 feet deep normal water depth 3.4 acre surface area	<60 mg/L BOD	11.1 MG nominal volume	
Surface aerator	Number = 8 Type = mechanical		(4) 20 hp (4) 10 hp	
Submerged aerator	Number = 2 Type = turbine		20 hp	Air supplied by (2) 15 hp blowers, 160 scfm @ 4.35 psi
Lagoon 2	10 feet deep normal water depth 1.3 acre surface area	<60 mg/L TSS	4.2 MG nominal volume	
Surface aerator	Number = 1 Type = mechanical		5 hp	
Effluent recycle pump	Number = 1 Type = submersible		700 gpm	Continuous

NOTES:
gpd = gallons per day
gph = gallons per hour
gpm = gallons per minute
hp = horsepower
MG = million gallons
scfm = standard cubic feet per minute

Table 2

Eagle Sewer District WWTP Influent Data and Design Criteria

Parameter	Influent Average (Max Month)*	Effluent Average Monthly Design Criteria
Flow (MGD)	1.89	
5-day BOD (mg/L)	351	20
TSS (mg/L)	332	30
TKN (mg/L)	48	-
NH3-N (µg/L) (May-Oct)	-	788
NH3-N (µg/L) (Oct-May)	-	398
Total P (mg/L)	5.9	-
Total P (µg/L)	-	70

*These data are from 2011-2014 sampling activities

Table 3

Eagle Sewer District WWTP Projected Flowrates

Date	Annual Average Flow (MGD)
2015	1.86
2020	2.39
2025	2.91
2030	3.54
2035	4.31
2040	5.25

Appendix J
Projections of Cash Flow

Eagle Sewer District
Projections of Cash Flow
Facilities Plan - Wastewater Management Alternative 3 and Collection System Improvements

Scenario 1: No Rate Increase, Discontinue Depreciation Funding

Table 1 - Operating Fund Cash Flow

Line No.	Description	2015 Budget	2016 Projected	2017 Projected	2018 Projected	2019 Projected	2020 Projected	2021 Projected	2022 Projected	2023 Projected	2024 Projected	2025 Projected
1	Service Revenue	$ 3,345,600	$ 3,460,000	$ 3,574,000	$ 3,688,000	$ 3,803,000	$ 3,917,000	$ 4,047,000	$ 4,178,000	$ 4,308,000	$ 4,439,000	$ 4,570,000
2	Other Operating Revenue	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
2	Additional Revenue Required		-	-	-	-	-	-	-	-	-	-
3	Total Operating Revenue	3,441,600	3,556,000	3,670,000	3,784,000	3,899,000	4,013,000	4,143,000	4,274,000	4,404,000	4,535,000	4,666,000
4	Operation and Maintenance Expense	2,301,645	3,590,000	2,815,000	3,024,000	3,150,000	3,221,000	4,566,000	3,531,000	3,699,000	3,877,000	5,410,000
5	**Net Revenue Available for Debt Service**	**1,139,955**	**(34,000)**	**855,000**	**760,000**	**749,000**	**792,000**	**(423,000)**	**743,000**	**705,000**	**658,000**	**(744,000)**
6												
7	**Debt Service**											
8	Proposed	-	-	-	-	-	-	-	-	-	-	-
9	Total Debt Service	-	-	-	-	-	-	-	-	-	-	-
10												
11	**Net Revenue After Debt Service**	**1,139,955**	**(34,000)**	**855,000**	**760,000**	**749,000**	**792,000**	**(423,000)**	**743,000**	**705,000**	**658,000**	**(744,000)**
12												
13	**Other Cash Inflows (Outflows)**											
14	Account Interest	-	-	1,779	1,303	1,248	1,464	-	1,218	1,028	792	-
15	Funded Depreciation	(639,955)										
16	Transfer Out to Bond Bank Loan	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)
17	Investment Revenue to Capital Fund	(2,300,000)										
18	Depreciation Investment to Capital Fund	(1,151,500)										
19	Transfer Out to other Loan Funds											
20	**Total Other Cash Inflows (Outflows)**	**(4,591,455)**	**(500,000)**	**(498,221)**	**(498,697)**	**(498,752)**	**(498,536)**	**(500,000)**	**(498,782)**	**(498,972)**	**(499,208)**	**(500,000)**
21	Annual Surplus/(Deficiency)	(3,451,500)	(534,000)	356,779	261,303	250,248	293,464	(923,000)	244,218	206,028	158,792	(1,244,000)
22	Beginning Cash Balance	(586,190)	3,276,917	2,742,917	3,099,696	3,361,000	3,611,248	3,904,711	2,981,711	3,225,930	3,431,957	3,590,749
23	Ending Balance	**$ 3,276,917**	**$ 2,742,917**	**$ 3,099,696**	**$ 3,361,000**	**$ 3,611,248**	**$ 3,904,711**	**$ 2,981,711**	**$ 3,225,930**	**$ 3,431,957**	**$ 3,590,749**	**$ 2,346,749**

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenue Increase Required		**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Cumulative Revenue Increase		**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Operating Reserves	$ 3,276,917	$ 2,742,917	$ 3,099,696	$ 3,361,000	$ 3,611,248	$ 3,904,711	$ 2,981,711	$ 3,225,930	$ 3,431,957	$ 3,590,749	$ 2,346,749

Eagle Sewer District
Projections of Cash Flow
Facilities Plan - Wastewater Management Alternative 3 and Collection System Improvements

Scenario 1: No Rate Increase, Discontinue Depreciation Funding

Table 2 - Capital Fund Cash Flow

Line No.	Description	2015 Budget	2016 Projected	2017 Projected	2018 Projected	2019 Projected	2020 Projected	2021 Projected	2022 Projected	2023 Projected	2024 Projected	2025 Projected
	Cash Inflows (Outflows)											
1	Connection Fees Revenue	1,105,200										
2	Connection fees - Boise	303,300										
3	Connection Fees Revenue from Growth		1,314,600	1,314,600	1,314,600	1,314,600	1,314,600	1,502,400	1,502,400	1,502,400	1,502,400	1,502,400
4	Additional Revenue Required		-	-	-	-	-	-	-	-	-	-
5	Transfer from General Fund (Investments)	2,300,000	-	-	-	-	-	-	-	-	-	-
6	Transfer from General Fund (Depreciation)	1,151,500	-	-	-	-	-	-	-	-	-	-
7	Loan/Bond Proceeds											
8	Bond Issuance Costs	-	-	-	-	-	-	-	-	-	-	-
9	Annual Capital Improvements Program	(4,860,000)	(1,070,460)	(1,225,344)	(344,526)	(8,459,507)	(3,675,650)	(428,395)	(460,674)	(495,388)	(532,724)	(908,857)
10	Transfer from (to) Other											
11	Annual Surplus/(Deficiency)	-	244,140	89,256	970,074	(7,144,907)	(2,361,050)	1,074,005	1,041,726	1,007,012	969,676	593,543
12	Beginning Cash Balance	-	9,187,176	9,431,316	9,520,571	10,490,646	3,345,739	984,689	2,058,694	3,100,420	4,107,432	5,077,108
13	Ending Cash Balance	$ 9,187,176	$ 9,431,316	$ 9,520,571	$ 10,490,646	$ 3,345,739	$ 984,689	$ 2,058,694	$ 3,100,420	$ 4,107,432	$ 5,077,108	$ 5,670,651
	Total ESD Cash Reserves Available	**$ 12,464,093**	**$ 12,174,233**	**$ 12,620,268**	**$ 13,851,645**	**$ 6,956,987**	**$ 4,889,401**	**$ 5,040,405**	**$ 6,326,350**	**$ 7,539,389**	**$ 8,667,857**	**$ 8,017,400**

Eagle Sewer District
Projections of Cash Flow
Facilities Plan - Wastewater Management Alternative 3 and Collection System Improvements

Scenario 2: Rate Increase, Continue Depreciation Funding

Table 3 - Operating Fund Cash Flow

Line No.	Description	2015 Budget	2016 Projected	2017 Projected	2018 Projected	2019 Projected	2020 Projected	2021 Projected	2022 Projected	2023 Projected	2024 Projected	2025 Projected
1	Service Revenue	$ 3,345,600	$ 3,460,000	$ 3,574,000	$ 3,688,000	$ 3,803,000	$ 3,917,000	$ 4,047,000	$ 4,178,000	$ 4,308,000	$ 4,439,000	$ 4,570,000
2	Other Operating Revenue	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
2	Additional Revenue Required		-	894,000	922,000	951,000	979,000	1,012,000	1,045,000	1,077,000	1,110,000	1,143,000
3	Total Operating Revenue	3,441,600	3,556,000	4,564,000	4,706,000	4,850,000	4,992,000	5,155,000	5,319,000	5,481,000	5,645,000	5,809,000
4	Operation and Maintenance Expense	2,301,645	2,616,000	1,801,000	1,935,000	1,982,000	1,968,000	3,221,000	2,087,000	2,150,000	2,215,000	3,625,000
5	**Net Revenue Available for Debt Service**	**1,139,955**	**940,000**	**2,763,000**	**2,771,000**	**2,868,000**	**3,024,000**	**1,934,000**	**3,232,000**	**3,331,000**	**3,430,000**	**2,184,000**
6												
7	**Debt Service**											
8	Proposed	-	-	-	-	-	-	-	-	-	-	-
9	Total Debt Service	-	-	-	-	-	-	-	-	-	-	-
10												
11	**Net Revenue After Debt Service**	**1,139,955**	**940,000**	**2,763,000**	**2,771,000**	**2,868,000**	**3,024,000**	**1,934,000**	**3,232,000**	**3,331,000**	**3,430,000**	**2,184,000**
12												
13	**Other Cash Inflows (Outflows)**											
14	Account Interest	-	2,206	5,078	5,118	5,604	6,386	7,188	7,429	7,925	8,421	8,441
15	Funded Depreciation	(639,955)										
16	Transfer Out to Bond Bank Loan	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)	(500,000)
17	Investment Revenue to Capital Fund	(2,300,000)										
18	Depreciation Investment to Capital Fund	(1,151,500)		(1,250,000)	(1,250,000)	(1,250,000)	(1,250,000)		(1,250,000)	(1,250,000)	(1,250,000)	
19	Transfer Out to other Loan Funds											
20	**Total Other Cash Inflows (Outflows)**	**(4,591,455)**	**(497,794)**	**(1,744,922)**	**(1,744,882)**	**(1,744,396)**	**(1,743,614)**	**(492,812)**	**(1,742,571)**	**(1,742,075)**	**(1,741,579)**	**(491,559)**
21	Annual Surplus/(Deficiency)	(3,451,500)	442,206	1,018,078	1,026,118	1,123,604	1,280,386	1,441,188	1,489,429	1,588,925	1,688,421	1,692,441
22	Beginning Cash Balance	(586,190)	3,276,917	3,719,123	4,737,200	5,763,318	6,886,922	8,167,308	9,608,496	11,097,925	12,686,849	14,375,270
23	Ending Balance	**$ 3,276,917**	**$ 3,719,123**	**$ 4,737,200**	**$ 5,763,318**	**$ 6,886,922**	**$ 8,167,308**	**$ 9,608,496**	**$ 11,097,925**	**$ 12,686,849**	**$ 14,375,270**	**$ 16,067,711**

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenue Increase Required		**0%**	**25%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Cumulative Revenue Increase		**0%**	**25%**	**25%**	**25%**	**25%**	**25%**	**25%**	**25%**	**25%**	**25%**
Operating Reserves	$ 3,276,917	$ 3,719,123	$ 4,737,200	$ 5,763,318	$ 6,886,922	$ 8,167,308	$ 9,608,496	$ 11,097,925	$ 12,686,849	$ 14,375,270	$ 16,067,711

Eagle Sewer District
Projections of Cash Flow
Facilities Plan - Wastewater Management Alternative 3 and Collection System Improvements

Scenario 2: Rate Increase, Continue Depreciation Funding

Table 4 - Capital Fund Cash Flow

Line No.	Description	2015 Budget	2016 Projected	2017 Projected	2018 Projected	2019 Projected	2020 Projected	2021 Projected	2022 Projected	2023 Projected	2024 Projected	2025 Projected
	Cash Inflows (Outflows)											
1	Connection Fees Revenue	1,105,200										
2	Connection fees - Boise	303,300										
3	Connection Fees Revenue from Growth		1,314,600	1,314,600	1,314,600	1,314,600	1,314,600	1,502,400	1,502,400	1,502,400	1,502,400	1,502,400
4	Additional Revenue Required		-	-	-	-	-	-	-	-	-	-
5	Transfer from General Fund (Investments)	2,300,000	-	-	-	-	-	-	-	-	-	-
6	Transfer from General Fund (Depreciation)	1,151,500	-	1,250,000	1,250,000	1,250,000	1,250,000	-	1,250,000	1,250,000	1,250,000	-
7	Loan/Bond Proceeds											
8	Bond Issuance Costs	-	-	-	-	-	-	-	-	-	-	-
9	Annual Capital Improvements Program	(4,860,000)	#VALUE!	(904,948)	(0)	(8,089,032)	(3,277,274)	#VALUE!	(0)	(0)	(0)	(335,988)
10	Transfer from (to) Other											
11	Annual Surplus/(Deficiency)	-	#VALUE!	1,659,652	2,564,600	(5,524,432)	(712,674)	#VALUE!	2,752,400	2,752,400	2,752,400	1,166,412
12	Beginning Cash Balance	-	9,187,176	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
13	Ending Cash Balance	$ 9,187,176	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
	Total ESD Cash Reserves Available	**$ 12,464,093**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**	**#VALUE!**