# Full Drainage Report
# Stormwater Wetland Project
# City of Arlington
# Snohomish County, Washington

January 11, 2010

Prepared for

**City of Arlington**
**Arlington, Washington**

11 JAN '10

KELLEY E. WRIGG
35715

LANDAU
ASSOCIATES
130 2nd Avenue South
Edmonds, WA 98020
(425) 778-0907

# EXECUTIVE SUMMARY

The City of Arlington (City), in Washington State, is proposing to construct a water quality treatment wetland (project) to treat City-derived stormwater prior to discharging it into the Stillaguamish River. The project is funded by a grant from the Washington State Department of Ecology's Stormwater Management Implementation Grant program. The City contracted Landau Associates to design the project. This report summarizes the design considerations that form the basis of the design (Table 1), including the methods and results for the stormwater modeling. The design plans are presented as Appendix B. This report also presents the methods and results of investigations related to soils, groundwater and flood hazards, and summarizes results of the critical area study (Landau Associates 2009). Key information and conclusions are listed below:

- The project is located on a portion of a 21.9-acre City-owned property, also known as the Hammer Property (property), at 201 West Cox Street (Parcel 31050200300200) in Arlington, Snohomish County, Washington (Figure 1).

- The design avoids impacts to critical areas, floodway, and historic sites.

- The stormwater wetland will receive year-round stormwater from the Old Town catchment area (171 acres in size), which was delineated and modeled by URS Corporation (URS 2008).

- The flows from the new stormwater wetland will exit the property at the same location as they do currently, via the Butler outfall pipe, which drains directly to the Stillaguamish River.

- The total size of the stormwater wetland project (grading area limits) is approximately 8.7 acres.

- The average retention time ranges from a few hours to several days, depending on storm events and their frequency.

- Between 9 and 99 percent of the stormwater will be infiltrated into soils depending on the size of the rainfall event. It is likely this water will return to the river hyporehiec zone.

- The project is expected to: improve the quality of the stormwater discharged to the Stillaguamish River; help achieve the goals and requirements of the Stillaguamish Total Maximum Daily Load Plan and National Pollutant Discharge Elimination System permit; offer habitat for aquatic-dependant and associated wildlife (fish not included); provide educational opportunities for residents, students, and visitors to learn how urban and natural areas can coexist in a balanced ecosystem; provide wildlife viewing opportunities; and reduce peak stormwater flows.

# TABLE OF CONTENTS

## TABLES

## PHOTOS

## CHARTS

# FIGURES

# APPENDICES

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| BGS | Below Ground Surface |
| cfs | Cubic Feet per Second |
| City | City of Arlington, Washington |
| DAHP | Washington State Department of Archaeology and Historic Preservation |
| DNR | Washington State Department of Natural Resources |
| DO | Dissolved Oxygen |
| Ecology | Washington State Department of Ecology |
| FAC | Facultative |
| FACU | Facultative Upland |
| FACW | Facultative Wetland |
| FEMA | Federal Emergency Management Agency |
| ft | Feet |
| ft$^2$ | Square Feet |
| ft$^3$ | Cubic Feet |
| GIS | Geographic Information System |
| HGM | Hydrogeomorphic |
| HMP | Habitat Management Plan |
| NAVD88 | North American Vertical Datum of 1988 |
| NGPA | Native Growth Protection Area |
| NGVD29 | National Geodetic Vertical Datum of 1929 |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | Natural Resources Conservation Service |
| OBL | Obligate |
| OHWM | Ordinary High Water Mark |
| PEM | Palustrine Emergent |
| PFO | Palustrine Forested |
| PHS | Priority Habitats and Species |
| PSS | Palustrine Scrub-Shrub |
| RMF | Redoxymorphic Feature |
| SMP | Shoreline Master Program |
| SR | State Route |
| TMDL | Total Maximum Daily Load |
| TP | Test Pit |
| UDC | Snohomish County Unified Development Code |
| UPL | Obligate Upland |
| USACE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| UTM | Universal Transverse Mercator |
| WDFW | Washington Department of Fish and Wildlife |
| WDNR | Washington State Department of Natural Resources |
| WSDOT | Washington State Department of Transportation |
| WRF | Wastewater Reclamation Facility |
| WWTP | Wastewater Treatment Plant |
| yd$^3$ | Cubic Yards |

# 1.0 INTRODUCTION

In the late 1990s, the City of Arlington (City) became aware that there was a growing problem with water quality in the Stillaguamish River and that the City's stormwater discharge could be a contributing factor. As a result, the City is proposing to construct a stormwater wetland project (project) to treat City stormwater prior to discharging it into the Stillaguamish River. The project is funded by a grant from the Washington State Department of Ecology's (Ecology) Stormwater Management Implementation Grant program.

Landau Associates has been contracted by the City to assist with design and documentation related to the project. This report presents the methods and results of investigations related to soils (Appendix A); discusses groundwater and flood hazards; summarizes the results of the critical areas study (Landau Associates 2009); and summarizes the drainage considerations that form the basis of the design (Table 1; design sheets in Appendix B), including the methods and results for the stormwater modeling (model information is presented in Appendices C, D, and E). Specifically, this report includes information on the following project aspects:

- Design elements, including water input rates
- Design results, including grading plan and conveyance routes
- Results of hydrologic modeling, including weir and pipe sizing, and predicted changes in water retention time under various flow regimes.

Note that the river gages and Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM) datum are related to National Geodetic Vertical Datum of 1929 (NGVD29). The site plans and the calculations in this report are based on North American Vertical Datum of 1988 (NAVD88). The conversion for the project location is to add 3.69 feet (ft) in elevation to the NGVD29 elevation to obtain the NAVD88 elevation. All discussions of elevations in this report reference the NAVD88 datum, unless otherwise noted.

## 1.1 PROJECT DESCRIPTION

The project is located in Water Resource Inventory Area 11, Stillaguamish (Hydrological Unit Code 17110008). The project site is located in the southeastern portion of a 21.9-acre City-owned parcel (Parcel 31050200300200; property), also known as the Hammer Property, at 201 West Cox Street in Section 2, Township 31 North, Range 5 East, Quarter SW, in Snohomish County, Washington (Figure 1). The project area is bordered to the east by State Route (SR) 9, to the south by SR 530, to the west by Dike Road, and to the north by the Stillaguamish River (Figure 2). A portion of the property legal description is occupied by the Stillaguamish River, a shoreline of the state. New stormwater piping will be located within the Washington State Department of Transportation (WSDOT) right-of-way associated with SR 9 (see Figure 1). The upstream sub-basin, which will contribute stormwater to the wetland, is shown on Figure 3. The Wastewater Treatment Plant (WWTP) currently serving the City is located east of the property, on the east side of SR 9, at 108 West Haller in Arlington (see Figure 3).

Water quality in the Stillaguamish River downstream of the City has been impaired for multiple parameters, resulting in listings under Section 303(d) of the Clean Water Act (CWA) in 1996, 1998, and 2004 for dissolved oxygen (DO), temperature, and fecal coliform (Arlington, City of 2007). Currently, stormwater effluent from the downtown basin of Arlington is discharged to the Stillaguamish River untreated, with no flow control (Arlington, City of 2007). The proposed project is designed to reduce pathogens, to remove nutrients that are understood to result in lower instream DO, and to lower water temperature before reaching the river. The project is designed to reduce peak stormwater flows to the river. The project will also provide a wildlife benefit and opportunity for public education and community outreach.

A water reclamation facility (WRF) is planned with an anticipated start-up date as early as September 2010 (Arlington, City of 2007). The City will upgrade and expand its WWTP to a WRF using a membrane bioreactor facility with aerobic digestion, in order to meet the projected growth within the existing urban growth area and additional annexations, and to meet expected regulatory requirements through 2025 (Kennedy/Jenks 2007).

The stormwater wetland will receive year-round stormwater from the Old Town catchment area [identified as the Downtown Basin in the working draft of the City of Arlington Draft Stormwater Comprehensive Plan (Arlington, City of undated)] via gravity flow. Eventually, during the dry season (predicted to be between June 15 and September 15), the stormwater wetland may receive reclaimed water from the WRF via a controlled pump system, based on the results of real time continual monitoring of temperature and DO levels within the Stillaguamish River. This would be part of a separate project to be permitted in the future.

The total size of the stormwater wetland (area of site disturbance) is approximately 9.8 acres, including approximately 5.5 acres of created wetland area, consisting of four cells, separated by weirs (described in Section 2.3.1). Benefits of the project are expected to include the following:

- Improve the quality of stormwater discharged into the Stillaguamish River
- Meet the goals and requirements of the Stillaguamish Total Maximum Daily Load (TMDL) Plan and National Pollutant Discharge Elimination System (NPDES), Phase 2
- Offer habitat for aquatic dependant and associated wildlife

- Provide educational opportunities for residents in Arlington and Snohomish County, students, and visitors to learn how urban and natural areas can coexist in a balanced ecosystem
- Provide recreational leisure activities and wildlife viewing
- Reduce peak stormwater flows discharged to the Stillaguamish River from the catchment area.

## 1.2 DRAINAGE SUMMARY FORM

Project Name: **City of Arlington Stormwater Wetland Project**

Project Engineer: **Landau Associates**

Project Applicant: **City of Arlington**

Project Total Area: **21+ Acres**

Project Development Area**: 8.7 Acres** Number of Lots (if applies): **1**

**Table 1**
**Drainage Summary**

| **Drainage Basin Information** | | **City of Arlington Downtown Basin** |
|---|---|---|
| Sub-basin Area (acres) | | **180.7** |
| Type of Storage Proposed | | **Wetland** |
| Approximate Storage Volume [cubic ft ($ft^3$)] | | **275,000** |
| Soil Type(s) | | **Puget Silty Clay Loam and Puyallup Fine Sandy Loam** |
| **Pre-Developed Runoff Rates** | | **At Butler Outfall** |
| Flow (Q) [$ft^3$ per second (cfs)] | Weekly | **6.35** |
| | 6 mo. | **33.93** |
| | 2 yr. | **50.83** |
| | 10 yr. | **75.06** |
| | 100 yr. | **86.12** |
| | | |
| **Post-Development Runoff Rates** | | |
| Q (cfs) | Weekly | **0.12** |
| | 6 mo. | **14.68** |
| | 2 yr. | **28.63** |
| | 10 yr. | **50.41** |
| | 100 yr. | **68.08** |
| | | |
| **Offsite Upstream Area** | | |
| Number of Acres | | **171** |
| **Offsite Downstream Flow** | | |
| Q (cfs) | 100 yr. | **N/A** |

## 1.3 SITE LAYOUT AND INFRASTRUCTURE

A site plan showing critical areas and other site features is presented on the drawings in Appendix B. The property is bound to the northwest by the Stillaguamish River; to the northeast by SR 9 (and the adjacent WSDOT bioswale) and smaller parcels that contain agricultural buildings and a residence, the “round house;” to the southeast by WSDOT Wetland 4 (WSDOT wetland) (see Figure 2); and to the southwest by Dike Road and undeveloped land. The property is currently developed as a farm and is used for agricultural purposes (hay field). The site will continue to provide agricultural uses, including harvesting of cattail from the wetland. Existing structures are located on the parcel, including a home, barn, and sheds. This parcel is served by power (Snohomish County Public Utility District), water (City of Arlington) and an individual septic system.

A groundwater well is located on the property, which is connected to the irrigation system located on adjacent property to the north. A septic system is located east of the house, which requires a 100-foot setback from surface water per WAC 246-272A-0210. One historic site is documented as existing on the property, consisting of an old privy/outhouse. The protection area for this historic site is shown on the drawings in Appendix B. No excavation will occur within the protection area.

### 1.3.1 STORMWATER SYSTEM AND BASIN

A City-owned stormwater pipe bisects the northeastern corner of the site. Stormwater collected from the Downtown Basin portion of the City's municipal storm sewer system is conveyed to the Stillaguamish River via the Butler outfall, which is located north of the property (see the drawings in Appendix B). The outlet of this 36-inch concrete pipe is collapsing (see photo below) and will likely be repaired in the future as part of a separate project.

Photo 1: Butler outfall; note damage to pipe outlet.

The existing upstream basin and conveyance system is shown on Figure 2 of Appendix C, URS Calculation No. HM-1 (URS 2008). The calculation was a capacity analysis of the upstream basin piping. The upstream basin for the treatment wetland, referred to as the Downtown Basin, is composed of piping and catch basins which collect water from the entire basin and convey it to the project area before discharging to the Stillaguamish River via the Butler outfall. The basin is predominantly composed of a mixture of commercial and residential properties located on a river hillside/terrace.

## 1.4 SOILS INVESTIGATION

A soils investigation was conducted to help determine soil properties and infiltration rates which are pertinent to the project design and modeling tasks. An investigation was conducted by Landau Associates with assistance by City staff on May 27, 2008. Three backhoe test pits (TPs) were excavated within the proposed wetland area, and a description of the soils encountered is presented in Appendix A. A representative sample was collected from TP 2 at 3.5 ft below ground surface (BGS) and analyzed for grain size distribution and to determine the U.S. Department of Agriculture (USDA) textural classification. Infiltration rates used are based on rates stated in the USDA Natural Resource Conservation Service (NRCS) online database for the soil type present (NRCS website 2008).

Additional information on site soils was collected as part of a cultural resources assessment conducted for the project (Northwest Archaeological Associates, Inc. 2008) and from soil descriptive information acquired from the NRCS *Web Soil Survey* (NRCS website 2008).

The soils on the property are identified by the NRCS database as being either a Puget Silty Clay Loam (eastern one-fifth of the property) or a Puyallup Fine Sandy Loam (western four-fifths of the property). The cultural resources investigation excavated over 80 TPs and 10 investigational trenches on the property. The City of Arlington dug three additional TPs. Taken together, these investigations provide a detailed profile of the subsurface soils at the property. The alluvial soils in the wetland area are intermixed river deposits and vary in relatively short distances between sandy silt and silty sand. These soils will allow for infiltration of water from the saturated areas of the wetland. The infiltration rate for the sandy silt could be as low as 0.2 inches/hour and could range as high as 6 inches/hour for the silty sand. Cells 1 and 2 of the planned wetland are dominated by the sandy silt material (less than 20 percent of that area is silty sand). Cell 3 is also dominated by the sandy silt material but as much as 40 percent of that area is silty sand. For modeling purposes, the infiltration rate of Cells 1 and 2 was set at 0.25 inches/hour and the infiltration rate of Cell 3 was set at 0.5 inches/hour. These rates take into account long-term degradation of the infiltration rate expected due to fines accumulation in the wetland soils over time.

## 1.5 GROUNDWATER INVESTIGATION

City staff conducted a groundwater investigation in order to determine grading depths for the treatment wetland that would result in water storage and infiltration without interference with groundwater. Water levels were monitored within the City-owned well located on the project site (shown on Figure 2) in spring 2008 (date unavailable). River stage was also recorded by the City at the Haller Park boat ramp, located several hundred feet upstream of the site. Landau Associates compared the two data sets to determine the relationship between river stage and groundwater levels within the project area. In addition, three TPs were excavated by the City and Landau Associates in May 2008. Sacha Maxwell of Landau Associates and Bill Blake conducted a site reconnaissance on September 18, 2009 to confirm the location of an outlet from the offsite WSDOT wetland.

Groundwater was first investigated on the site in early March 2008, when water tables were assumed to be highest. Water levels in four backhoe excavation pits (see Figure 2) were below 6.8 ft BGS across the site. Specifically, groundwater was not encountered in three of the four excavation pits; however, groundwater was encountered at 6.8 ft BGS in TP 1, located in the eastern portion of the project area (the area for proposed treatment Cell 1) (City of Arlington 2008a). In late May 2008, groundwater was not encountered in TPs 1 through 3, which ranged from 7 to 8 ft BGS (see Figure 2). Ten backhoe trenches and 88 shovel TPs were excavated as part of the cultural resources investigation in March 2008 (Northwest Archaeological Associates, Inc. 2008; these are not shown on Figure 2). Six of the trenches were located within proposed wetland areas. No groundwater was encountered to the depth of the trench (approximately 5 ft BGS) and all TPs were dry with the exception of those located near the WSDOT bioswale/location of proposed Cell 1, which contained saturated soil at approximately 3 to 4 ft BGS (Northwest Archaeological Associates, Inc. 2008).

Results of the water level monitoring at the City well located within the project area show that water levels were near 10 to 10.8 ft BGS in June and July 2008, while river stage was near 54.2 ft NAVD88 (this generally represents low flow conditions). Groundwater elevation is understood to fluctuate with river stage; however, a complete evaluation of this relationship is not available.

Analysis of alluvial aquifer groundwater elevations for the areas of exposed river alluvium associated with the Stillaguamish River show the contours decrease from 60 ft elevation (NAVD88) in the western portion of the property in a west/northwest direction toward the river to approximately 55 ft (extrapolated from 10-ft contour intervals as mapped) near the western portion of the property (Pacific Groundwater Group 2007).

Over time, City staff has observed the property during and after flood events. In each case, water drained from the property within 24 hours of the ending of flooding. This draining occurs, even though there are low points of the property that retain 1-2 ft of water. During flooding events, it is likely that the flood water completely charges the relatively shallow aquifer with river water to the ground surface. The fact that the site soils can drain that water away so rapidly is indicative of the aquifer's ability to discharge groundwater rapidly to the river as the river level drops. This also means that it is likely that, as the river level rises, the water table also rises fairly quickly on the property.

## 1.6 CULTURAL RESOURCES

The cultural resources assessment report, conducted by Northwest Archaeological Associates, Inc. (Northwest Archaeological Associates, Inc. 2008), was reviewed to help estimate soils data applicable to project design and permitting.

## 1.7 CRITICAL AREAS INVESTIGATION

A Critical Areas Report (Landau Associates 2009) is being submitted separately to Snohomish County and the City for the project, and that report should be referenced for a summary of the critical areas investigation results.

### 1.7.1 RIVER, FLOODPLAIN/FLOODWAY, AND SHORELINE

The property is floodplain, with approximately the northwestern third of the property mapped as floodway, and the remaining two-thirds of the property mapped as floodway fringe (FEMA website 2009; Snohomish County 2008a; see Figure 2). The river is diked by a continuous levee (referred to as the Dike Road Dike) on both banks upstream and downstream of the property. The portion of the dike along the northern extent of the property is referred to as the Johnson levee. The Johnson levee dike was breached in 2002 (R2 Resource Consultants 2005) and during winter 2008-2009 flooding events, and has since been repaired.

Adjacent to the property, the river flood stage is 65.4 ft and bankfull stage is 64.2 ft (NAVD88; NOAA website 2009). The top of dike elevation is approximately 68 to 69 ft and the river level during a 100-year event is approximately 71 ft (NAVD88; NOAA website 2009), such that the river overtops the dike during a 100-year event (NOAA website 2009).

Based on observations by the City during these and other flooding events, and modeling and analysis conducted by R2 Resource Consultants to assess avulsion risk in the Stillaguamish River within the vicinity of the project area, floodwaters on the site flow southwest, bypassing the treatment wetland project site, and overtop a dike associated with Dike Road to continue southwest in a "split flow channel" (R2 Resource Consultants 2005). Dike Road Dike overtops during flood events that exceed approximately 19 ft at Arlington (flood stage is 14 ft at Arlington).

According to the R2 study:

> Of the six dike locations, the Johnson Dike location…was considered to be of lowest relative risk of erosion leading to avulsion in the vicinity of a breach. There is an existing breach at Location 1 that is approximately 3 feet deep and 10 feet wide, but the invert of the breach appears to be around 2 feet or so higher than the adjacent floodplain, which is relatively level. In addition, Dike Road forms a downstream grade control (elevation ~61.1 ft, NAVD88) that may restrict the flow rate through the existing breach which should prevent the breach from becoming significantly larger. The Dike Road surface is not substantially elevated above the floodplain and the downstream side slope of the road prism is gentle. These topographic factors contribute to a relatively low risk of avulsion in the vicinity of the dike because they limit the erosive forces locally in the vicinity of the dike and the road.

During the 2-, 5-, and 100-year flood events, the simulated water depths range from 0 ft (near the levee) to approximately 8 ft deep at the southern property boundary and reach up to approximately 10 ft within the WSDOT wetland (R2 Resource Consultants 2005). Flow velocity on the majority of the property, including the project site, is modeled as being in the range of 0 to 1 cfs (R2 Resource Consultants 2005).

## 1.8 WATER QUALITY REGULATORY REQUIREMENTS

The City has required new development and redevelopment to comply with Ecology Stormwater Management Manual for Western Washington guidelines since the mid-1990s. However, the largest contiguous storm drainage catchment in the City, 286 acres of Old Town Arlington, predates the manual's technical requirements, and most of the stormwater runoff from this area discharges untreated to the Stillaguamish River at the Butler outfall.

TMDL Plans and Arlington's NPDES permit require the City to implement actions to improve water quality. Wastewater discharge limits are defined in the City's NPDES permit. The WWTP currently discharges treated municipal wastewater into the Stillaguamish River, in accordance with NPDES Permit No. WA-002256-0; modification #1, October 13, 2006. The discharge is released through an outfall whose placement is permitted in Washington State Department of Natural Resources (WDNR) Aquatic Lands Outfall Easement No. 51-070281, October 2002, renewal in 2008.

The City is required under its NPDES Phase II stormwater permit to fully implement the requirements of the Stillaguamish River TMDL Plan. Essential elements of the Plan include: 1) treatment of stormwater from Old Town; and 2) eventual treatment of reclaimed water from the future WRF via the proposed treatment wetland. The timing of diversion of reclaimed water through the treatment wetland will depend on water quality parameters within the Stillaguamish River. TMDL parameters for the Stillaguamish River are summarized in Table 2 below.

## Table 2
## Stillaguamish River TMDL Parameters

| TMDL Target in Stillaguamish River | | | Parameter | | | |
|---|---|---|---|---|---|---|
| | | | Temperature (°C) | DO | Conductivity (µmhos/cm) | Fecal Coliform (Col/100 ml) |
| Aquatic | Reference Condition | Recreation | (Maximum) | (Minimum) | (Maximum) | (Maximum) |
| Class A | Higher | Class A | 18 | 8.0 | 200 | 100 |
| Non-core | NA | Secondary | 17.5 | 8.0 | 100 | 200 |
| Core | NA | Primary | 16 | 9.5 | 75 | 100 |
| Char | Lower | Extraordinary | 12 | 9.5 | 50 | 50 |

Source: Ecology 2005a.
µmhos/cm = microhos per centimeter.
Col = Colonies.
N/A = Not applicable.

# 2.0 METHODS FOR TREATMENT WETLAND DESIGN

The design of the treatment wetland began with developing goals and objectives (see Table 3 below). Landau Associates and the City gathered information regarding critical areas and cultural resources present in the vicinity of the project area in order to avoid and/or minimize impacts to these areas. We gathered geotechnical information on soils and groundwater, and conducted conceptual hydrologic modeling of the wetland to determine potential residence time and discharges for stormwater and reclaimed water. We then reviewed water quality parameters to assess treatment efficacy of the planned constructed stormwater wetland, and conducted water quality analysis to determine the potential efficacy of the treatment wetland for treating pollutants of concern.

**Table 3**
**Project Goals, Objectives, and Design Aspects**

| | |
|---|---|
| **Goal 1:** Meet NPDES permit requirements for water quality in effluent at the Butler outfall and provide additional treatment | |
| Objectives: | A) Reduce water temperatures in street runoff, stormwater, and/or reclaimed water effluent |
| | B) Increase DO content in stormwater and effluent |
| | C) Reduce nutrient concentration and biological oxygen demand in stormwater |
| Design Aspects: | A) Provide settling area for suspended solids and associated nutrients and toxicants |
| | B) Provide forested canopy cover to shade water and lower temperature |
| | C) Provide aeration of effluent |
| | D) Provide increased retention time and interaction with soils and vegetation for nutrient cycling |
| | E) Provide sink for trace metals (copper, zinc, etc.) via chemisorption with organic matter |
| | F) Reduce bacterial loads through deposition of sediments and infiltration |
| **Goal 2:** Reduce peak flows at outfall from stormwater and wastewater sources. | |
| Objectives: | A) Provide water storage to reduce peak flows to the river |
| | B) Provide alternative discharge location for reclaimed wastewater from City WWTP |
| Design Aspects: | A) Provide large area for water storage |
| | B) Provide long, sinuous route for water travel during low flows |
| | C) Provide inlets for stormwater and for reclaimed water, including bypass mechanisms |
| | D) Allow for periodic river flooding during storm events |
| **Goal 3:** Provide wildlife habitat within wetland and buffer area. | |
| Objective: | A) Provide multiple habitat types |
| | B) Provide connectivity to other habitats (shoreline corridor) |
| Design Aspects: | A) Created areas with varying water depths |
| | B) Install habitat features, such as bird nesting boxes, snags, rock piles and amphibian refuge |
| | C) Provide contiguous buffer corridor between wetland habitats and river |
| | D) Maintain water movement to prevent mosquito breeding |
| **Goal 4:** Provide recreational and education opportunities. | |
| Objectives: | A) Provide shoreline access, recreation and wildlife viewing opportunities |
| | B) Provide educational opportunities |
| Design Aspects: | A) Create public access trail along the river and through the wetland |
| | B) Install informational signs and viewing areas |
| | C) Designing functional elements like fountain and waterfall to be aesthetically pleasing |
| | D) Provide structure for volunteers to collect donations / sell harvested cattail bouquets |
| | E) Retain open space and existing buildings for future public use |

## 2.1 SOURCES OF INFRASTRUCTURE INFORMATION

Existing infrastructure on the property and surrounding area (as shown on the drawings in Appendix B) was surveyed and documented. The following primary sources of information were used:

- AutoCAD survey data files created for the project (Huey Surveying and Land Consulting 2008)
- City Geographic Information System (GIS) maps showing storm and wastewater conveyance infrastructure (Arlington, City of 2008b)
- As-Built Plans and Designs related to SR 9, bioswales, and wetlands (WSDOT 1997)
- Snohomish County Permit Planning and Zoning Map (Snohomish County 2008a).

## 2.2 UPSTREAM AND DOWNSTREAM ANALYSIS

The upstream basin for the new stormwater wetland is the Old Town catchment area (Downtown Basin) in Arlington and the downstream area for the wetland is the Stillaguamish River.

### 2.2.1 UPSTREAM BASIN ANALYSIS

The upstream basin is the Downtown Basin, as identified in the City's Stormwater Comprehensive Plan (Arlington, City of undated). The Downtown Basin was delineated and modeled in Calculation No. HM-1 by URS in March of 2008 (URS 2008; see Appendix C). The basin's physical parameters were derived directly from the URS report to create the upstream basin model used in the calculations in this report. The pipe names and other identifiers for the two models are the same. The Downtown Basin is approximately 171 acres in size and is shown on Figure 1 of Calculation No. HM-1 in Appendix C. This area includes about 12.2 acres along West Avenue where stormwater is infiltrated and does not contribute to the Butler outfall (sub-basins W-07, W-10, and W-13). Basin BD-13, which is mentioned in the URS report, was representative of a different piping layout, and although listed in the URS calculation, is not actually used in the model (Talich, C., 2008, personal communication).

Because the URS calculation used a different modeling program (XP-SWMM) than the software used for the calculations in this report (Stormshed 3G), the flow rates at selected locations were checked against the URS modeled flow rates for identical storm events after the upstream model was created. The flow rates of the two models generally agreed, with differences within the range of approximately 5 to 10 percent.

Both models tend to over-predict the observed flow rates at identified flooding locations. Observed flooding is generally less severe than that predicted by the models. Through discussions with

URS and the City, it was generally agreed that the likely reason for this discrepancy is that the existing pipe system contains areas which are older and in a state of disrepair. These pipe segments pass through soils which have a relatively high permeability, and it is likely that significant water loss occurs from leaky pipes in the existing system.

No attempt to correct the model for this water loss was made, because the City plans to repair some of these pipes, and future water loss may be much lower than present. The stormwater wetland project was designed for peak flows from the upstream basin without any adjustment for water loss from leaky pipes.

### 2.2.2 DOWNSTREAM ANALYSIS

The flows from the new stormwater wetland will exit the property at the same location as they do currently, via the Butler outfall pipe, which drains directly to the Stillaguamish River. As a result, the project is exempt from flow control requirements. The creation of the wetland will result in peak flows to the river being diminished. The flows are *de minimis* to the overall river flows and no downstream impacts are expected.

## 2.3 DESIGN ELEMENTS

The stormwater wetland is designed to meet accepted removal efficiencies for the common parameters affecting the TMDLs, as found in the regional literature using best available science and all known, available, and reasonable methods of prevention, control, and treatment (AKART) procedures for constructed wetlands (Arlington, City of 2007). Design of the wetland was completed based on the project goals and objectives (see Table 3), critical areas, site infrastructure, and TMDLs (see Table 4 below). Grading plans were created (see Appendix B) and were used to create the hydrologic model (described in Section 3.0).

**Table 4**
**Pollutants, Total Maximum Daily Load Parameters, Sources, and Mechanisms for Treatment**

| Pollutant(s) | TMDL Parameter | Source(s) | Treatment Mechanisms |
|---|---|---|---|
| Heat | Temperature | Stormwater, Reclaimed Water | Shading with trees and woody shrubs; infiltration through soil |
| Phosphorus (P) | DO | Stormwater, Reclaimed Water | Particulate P - sediment deposition in Cell 1 (settling pond); dissolved P - uptake by plants |
| Nitrogen | DO | Stormwater, Reclaimed Water | Cycling in wetlands – uptake by plants and denitrification in seasonally saturated areas |
| Pathogens | Fecal coliform (FC) | Stormwater | Sediment deposition; wetland discharge to groundwater, with secondary discharge via ephemeral channel |
| Oil and grease | None; can affect DO | Stormwater | Retention of free and dispersed floatable oil in baffled stilling basin (oil/water separator); deposition of sediments as for TSS |
| TSS | DO and FC | Stormwater | Sediment deposition in baffled stilling basin, bioswales, and wet pond cell |
| Metals | None | Stormwater | Settling associated with TSS and/or uptake by emergent vegetation (removal via harvest) |
| Gross solids | None | Stormwater | Filtration in influent bioswales and baffled stilling basin |

Source: City of Arlington 2007.

### 2.3.1 STORMWATER WETLAND DESIGN FEATURES

Based on the project goals, objectives, and site constraints (critical areas, protection areas, topography, and existing infrastructure), a number of key elements are included in the design of the treatment wetland. The grading plan and profile and depths of cut and fill are shown on the drawings in Appendix B.

The total size of the stormwater wetland project (grading area limits) is about 8.7 acres. The wetland consists of four cells, separated by weirs, as shown on the drawings in Appendix B and as summarized on Table 5 below. Proposed habitat and public access features are also illustrated on the drawings in Appendix B. Important design features include:

- The design avoids the historic area; the historic area may be used for viewing or interpretive signage and/or for sale of harvested cattail.
- The design avoids critical area impacts, except for trail and/or planting.
- An underground pipe from Cell 4 to the Butler outfall will be installed to avoid the septic system protection area.
- A truck access road (15 ft wide) will be constructed to connect to the existing site access road (under SR 9), will span the entire length of Cell 1 and continue to the existing groundwater well (and turnaround location), and will also allow access to the wetland piping and structures (catch basins).

- The total size of the treatment wetland (area of site disturbance) is approximately 8.7 acres, including approximately 6.0 acres of created wetland area, consisting of four cells, separated by weirs (Appendix B).

- Approximately 900 cubic yards ($yd^3$) of imported gravel material will be required to construct the road and trails.

- The grading excavation volume is approximately 29,600 $yd^3$.

    - 14,400 $yd^3$ of native soils will be exported from the site, and the net cut is 14,400 $yd^3$ (8.9 acre-ft), which will provide 8.9 acre-ft of additional storage for surface water.

    - 4,500 $yd^3$ of the remaining volume will consist of structural material (free of organics) which will be used for berms and for underneath the roadway.

    - 9,800 $yd^3$ of the remaining volume will consist of the upper sod layer (upper 1 foot) and will be used as replacement of topsoil (after over-excavation) in order to provide a planting medium in the wetland cells and adjacent upland areas.

- A trail will be constructed around and through the wetland that is approximately 6 ft wide at the top elevation and will include viewing points.

- The design incorporates connectivity to future public access space, the proposed dike trail, the existing round house, and parking areas.

- Prefabricated footbridges are to be installed over the weirs to increase trail connectivity and access.

- The wetland will function at multiple water inflow rates while maintaining a relatively long residence time.

- The design includes multiple habitat types and public access and educational features.

## Table 5
## Treatment Wetland Design Characteristics by Cell

| Characteristic | Cell | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Primary Purpose | Settling | Storage and Treatment | Storage and Treatment | Conveyance |
| Water Storage Volume (Approximate) | 35,000 $ft^3$ (to elevation 64 ft) | 116,000 $ft^3$ (to elevation 63 ft) | 123,000 $ft^3$ (to elevation 62 ft) | None |
| Bottom Elevation | 59 ft | 60 ft | 60.25 ft | Exit at elevation 57.5 ft; Butler outfall invert at elevation 51.7 ft |
| Weir Information | Weir notch at elevation 63.0 ft; notch 10 ft wide and 2.5 ft deep; top of weir at elevation 65.5 ft | Two weir notches: Lower notch is at elevation 61.0 ft and is 0.5 ft deep and 2 ft wide; the upper notch is at elevation 61.5 ft and is 11 ft wide and 2 ft deep; top of weir at elevation 63.5 ft | Weir notch at elevation 60.25 ft; notch is 8 ft wide and 2.75 ft deep; top of weir at elevation 63.0 ft | N/A |
| Water Drop Over Weir | Water drop into Cell 2 is 1.5 ft. | Water drop from the lower notch into Cell 3 is 1 ft. | Water drop into Cell is 1.05 ft. | N/A |
| Primary Water Quality Treatment Parameters | TSS, Garbage, Oils and Grease | Nutrients and Toxicants | Temperature; Nutrients and Toxicants | DO |
| Key Water Quality Characteristic | Can be Dredged | Emergent, Shrub Vegetation, Infiltration | Tree Canopy Cover, Infiltration | Waterfall and Rough Channel Surface |
| Weekly (Typical) Depth of Storage | 4.2 ft | 1.21 ft | 0.17 ft (2 inches) | None |
| Maximum (100-year Storm Event) Depth of Storage | 5.92 ft | 2.87 ft* | 2.16 ft* | 5.75 ft** |
| Other Key Features | Accessible by Truck and Foot | Slower Infiltration Rate (0.25 inch/hr) | Increased Infiltration Rate (0.5 inch/hr | Rounded Cobble Lined Channel |
| Dominant Habitat Types | PEM | PEM, PSS | PEM, PSS, PFO (some UPL) | Unconsolidated Bottom/PSS |

* = Controlled by lowest point in berm (overflow).
** = Occurs when there is backwater from river during high river stage and/or storm events.
TSS = Total Suspended Solids.
PEM = Palustrine Emergent.
PFO = Palustrine Forested.
PSS = Palustrine Scrub-Shrub.
UPL = Upland.

# 3.0 HYDRAULIC MODELING

The primary purposes of the hydraulic modeling are to:

- Determine the necessary capacity for piping into and out of the wetland to adequately convey the maximum design flow.
- Determine weir sizing.
- Predict performance of the wetland for reducing peak flow rates to the river, and estimate residence time and discharge/infiltration under various storm events.

The following primary resources were reviewed:

- Stormwater Modeling Data: Calculation No. HM-1 for the City of Arlington Stormwater Comprehensive Plan (URS 2008) (see Appendix C).
- City Wastewater Treatment Plant Engineering Report (Kennedy/Jenks 2007).

The conveyance capacity of the Downtown Basin stormwater system was modeled by URS, and the results of the calculations were provided to the City as Calculation No. HM-1. A Landau Associates civil/stormwater engineer created a streamlined version of the stormwater system model using Stormshed 3G, Version 10.0.3603.18924. The type of storm event assumed and modeled was a standard Soil Conservation Service (SCS) 24-hour Type 1A storm hyetograph, which is a storm event of peak intensity. The model was based on the existing upstream model data provided by URS (URS 2008), and the grading plan created in AutoCAD, including proposed pipes, weirs, channels, and wetland cells developed by Landau Associates based on a cooperative effort with the City.

For the stormwater source, the following five rainfall events were modeled, which are similar to those used in the URS calculations:

- Weekly event – 0.38 inches
- 6-month event – 1.26 inches
- 2-year event – 1.8 inches
- 10-year event – 2.75 inches
- 100-year event – 3.75 inches.

The weekly event was derived from rainfall data from the NOAA Hourly Precipitation Data for March 2008 (NOAA 2008). During that month, the largest event for each week was selected from the Everett data (NOAA 2008). The exception was a 1.2-inch rainfall during the fourth week, which was identified as a rainfall event nearly equal to a 6 month event and was therefore excluded. The next largest rainfall that week (a 0.7-inch event) was selected instead. The four events selected were 0.3 inches, 0.2 inches, 0.3 inches and 0.7 inches, which averaged to 0.38 inches for an average weekly rainfall event.

## 3.1 ASSUMPTIONS & LIMITATIONS

The following key assumptions were used in the modeling effort:

- The data presented in URS Calculation No. HM-1 is assumed to be correct and accurate.
- Using SCS curve numbers for pervious land cover (68) and impervious land cover (98) is assumed to generate rainfall amounts that are representative of stormwater flows from the Downtown Basin after the planned stormwater-related improvements are implemented. The SCS curve numbers selected were taken from Table 2.2 in Volume III of the *Stormwater Management Manual for Western Washington* (Ecology 2005b).
- The Stormshed model developed assumes that the storm drain piping is completely repaired and does not leak. Actual storm runoff flow rates currently measured for known rainfall events appear to be lower than the flow rates given by the model, and it is assumed that the difference is due to leaks in the City storm drain piping.
- Modeling groups of existing pipes by their average physical characteristics (e.g., pipe diameter, pipe material) is assumed to provide similar results to modeling each pipe individually.
- Infiltration rates for Cell 1 and Cell 2 are assumed (based on field investigation and accounting for long-term clogging of the soils by fine sediment) to be 0.25 inches per hour and the infiltration rate for Cell 3 is assumed to be 0.5 inches per hour.

### 3.1.1 QUALITY CONTROL

Because the URS calculation used a different modeling program (XP-SWMM) than the software used in the calculations contained herein (Stormshed 3G), the flow rates at selected locations were checked against the URS modeled flow rates for identical storm events after the upstream model was created (see Calculation No. HM-1 in Appendix C). The input data used in the model and the model results are presented in Appendices D and E. The flow rates of the two models were generally in agreement, and the differences were within the range of approximately 5 to 10 percent. Both models tend to over-predict the observed flow rates at identified flooding locations. Through discussions with URS and the City, it was generally agreed that the likely reason for this discrepancy is that the existing pipe system contains areas which are older and in a state of disrepair. These pipe segments pass through soils with relatively high permeability. It is likely that significant water loss occurs from leaky pipes in the existing system. No attempt to correct the model for this water loss was made because the City plans to repair some of these pipes. Future water loss may be much lower than present.

## 3.2 BASIS OF DESIGN

There are several primary factors in determining the effectiveness of a wetland to improve water quality on an overall basis; however, the most important is retention time. In terms of bacteria reduction, two factors that are of key importance are light and temperature (EPA 2006). All three of these factors were considered in the design of the constructed wetland. In general, more light is better for bacteria reduction; ultraviolet radiation (which is present even in indirect light) helps reduce the amount of bacteria. More shade is beneficial for temperature control during spring and summer months as warmer temperatures tend to encourage bacteria growth. Retention time is of primary importance for sedimentation and influences many of the other beneficial treatment aspects of the wetland. Increased retention time means more contact time with soils for better cation exchange (e.g., dissolved metals removal), more light exposure for bacteria reduction, more time in the shade for temperature reduction, and more time for predation of bacteria within the wetland.

The one area of concern for the Stillaguamish River which is not impacted by additional retention time is DO. The wetland has several features designed to improve the DO level in the stormwater. The stormwater entering the wetland system will pass over a rock spillway which will act to increase the DO of the water as it splashes around and over the rock. Each of the weirs has a vertical elevation drop of 0.9 to 1.5 ft for water to splash/mix into the next cell. At each of these locations, the splashing action will tend to raise the DO level of the stormwater.

The above factors were all considered as the wetland was designed. In order to provide for some temperature control, trees are to be planted in portions of the wetland area. However, other portions of the wetland will remain exposed to sunlight to encourage bacteria reduction by ultraviolet radiation exposure. Sedimentation is being encouraged in two ways. The wetland is being built as large as possible within the available area to encourage as much retention time as possible. An additional benefit of maximizing the wetland area is that infiltration into the native soils is also maximized. As water infiltrates into the soil within the wetland, a significant portion of the sediment will be filtered out and deposited. The amount deposited will vary by storm event; however, in general, the smaller the storm event, the greater the percentage of the sediment load that will be deposited and retained within the wetland. The amount of water infiltrated for each storm event is summarized in Table 6 below (also see Model Results in Appendices D and E).

**Table 6**

**Anticipated Stormwater Infiltration and Event Volume**

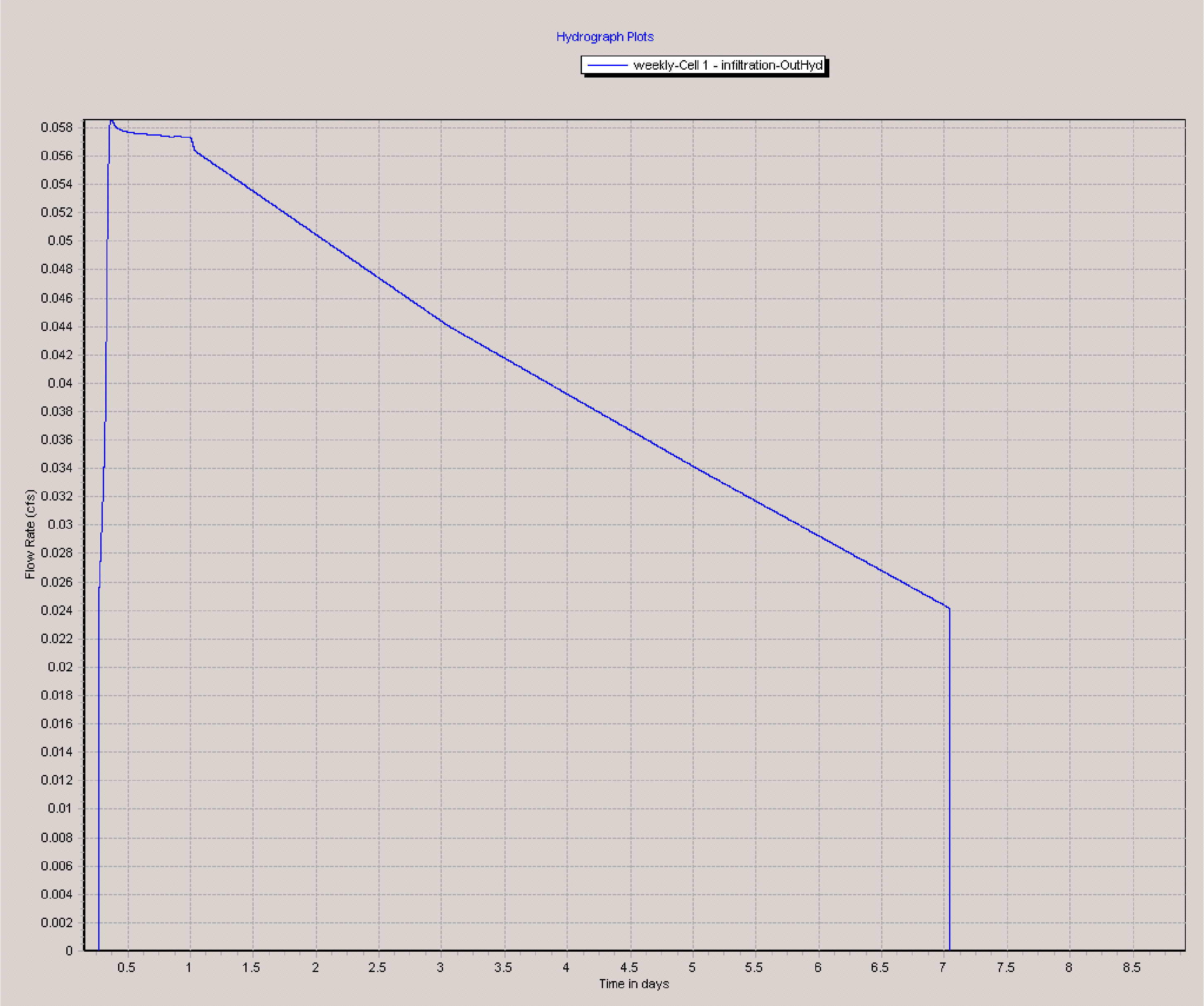
| Storm Event | Infiltration Volume - Cell 1 ($ft^3$) | Infiltration Volume - Cell 2 ($ft^3$) | Infiltration Volume - Cell 3 ($ft^3$) | Discharge Volume to River ($ft^3$) | Total Volume ($ft^3$) | Percent Infiltrated |
|---|---|---|---|---|---|---|
| Weekly | 24,145 | 56,149 | 25,888 | 177 | 106,359 | 99% |
| 6 Month | 25,196 | 82,370 | 65,940 | 376,076 | 549,582 | 32% |
| 2 Year | 25,503 | 86,783 | 71,934 | 690,148 | 874,368 | 21% |
| 10 Year | 25,863 | 91,768 | 79,633 | 1,320,003 | 1,517,267 | 13% |
| 100 Year | 26,138 | 95,175 | 85,703 | 2,007,003 | 2,214,019 | 9% |

## 3.3 TREATMENT TIME MODEL RESULTS

### 3.3.1 WEEKLY EVENT

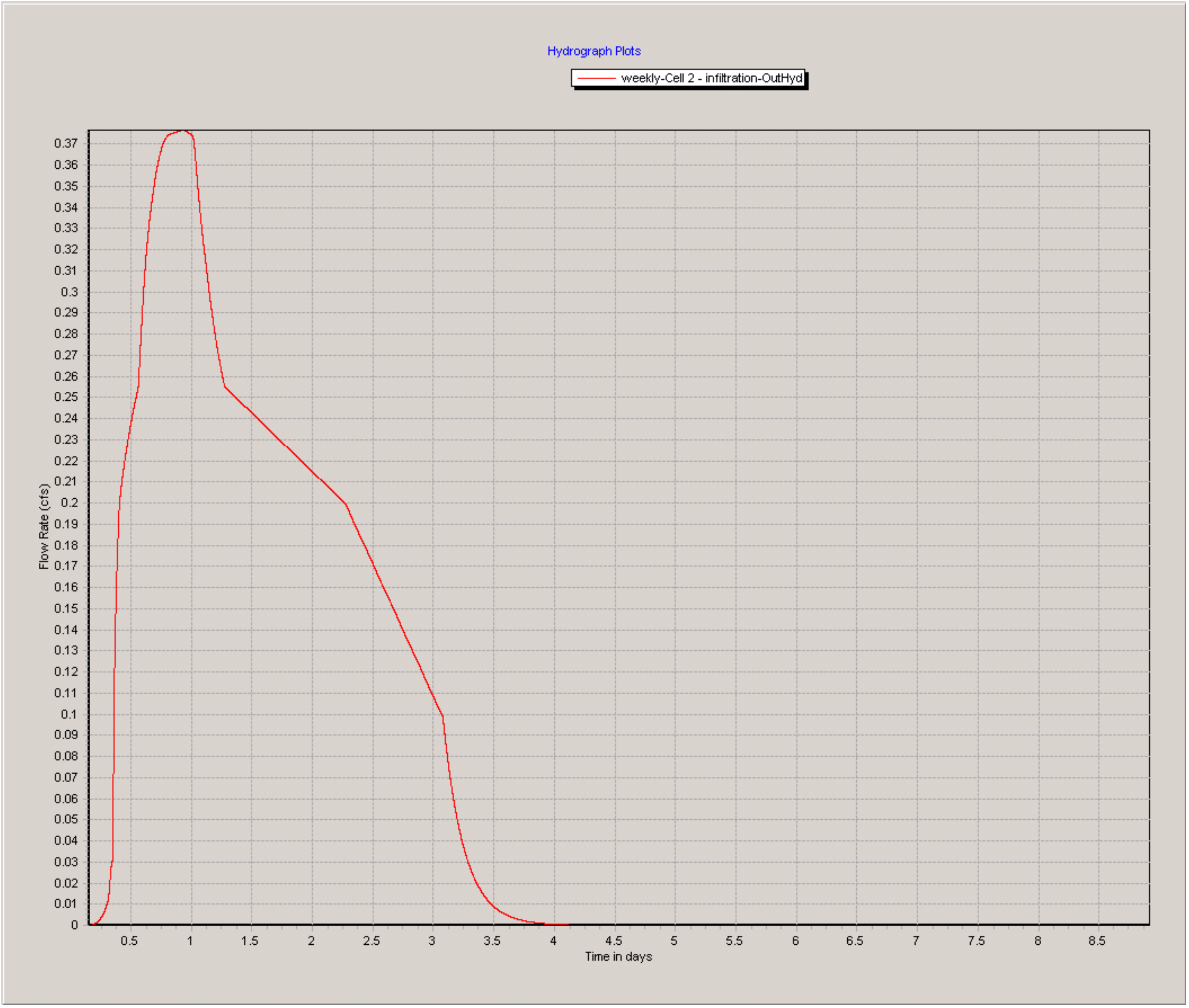
The weekly and smaller storm events represent the majority (over 90 percent) of all anticipated rainfall events. Water storage within the wetland under various size storm events (examples used consist of the weekly and 10-year storm events) are illustrated on Figures 4, 5, and 6. For the weekly event (0.38 inches of rainfall), almost all of the water which previously flowed from the Downtown Basin into the Stillaguamish River will typically be infiltrated in the wetland cells. The treatment time for this event is largely based on the amount of time it takes water to infiltrate in Cells 2 and 3. Cell 2 has a longer treatment time and stores/infiltrates approximately 50 percent of the stormwater during the smaller storm events. In addition, almost all of the water that enters Cell 3 is passed through Cell 2. The treatment time for each cell is defined primarily by the amount of time water stays in the wetland cells before it is infiltrated. Charts indicating the modeled infiltration rate over time in each of the wetland cells for a weekly event (0.38 inches of rain in 24 hours) are presented below.

Chart 1: Cell 1 Weekly Event



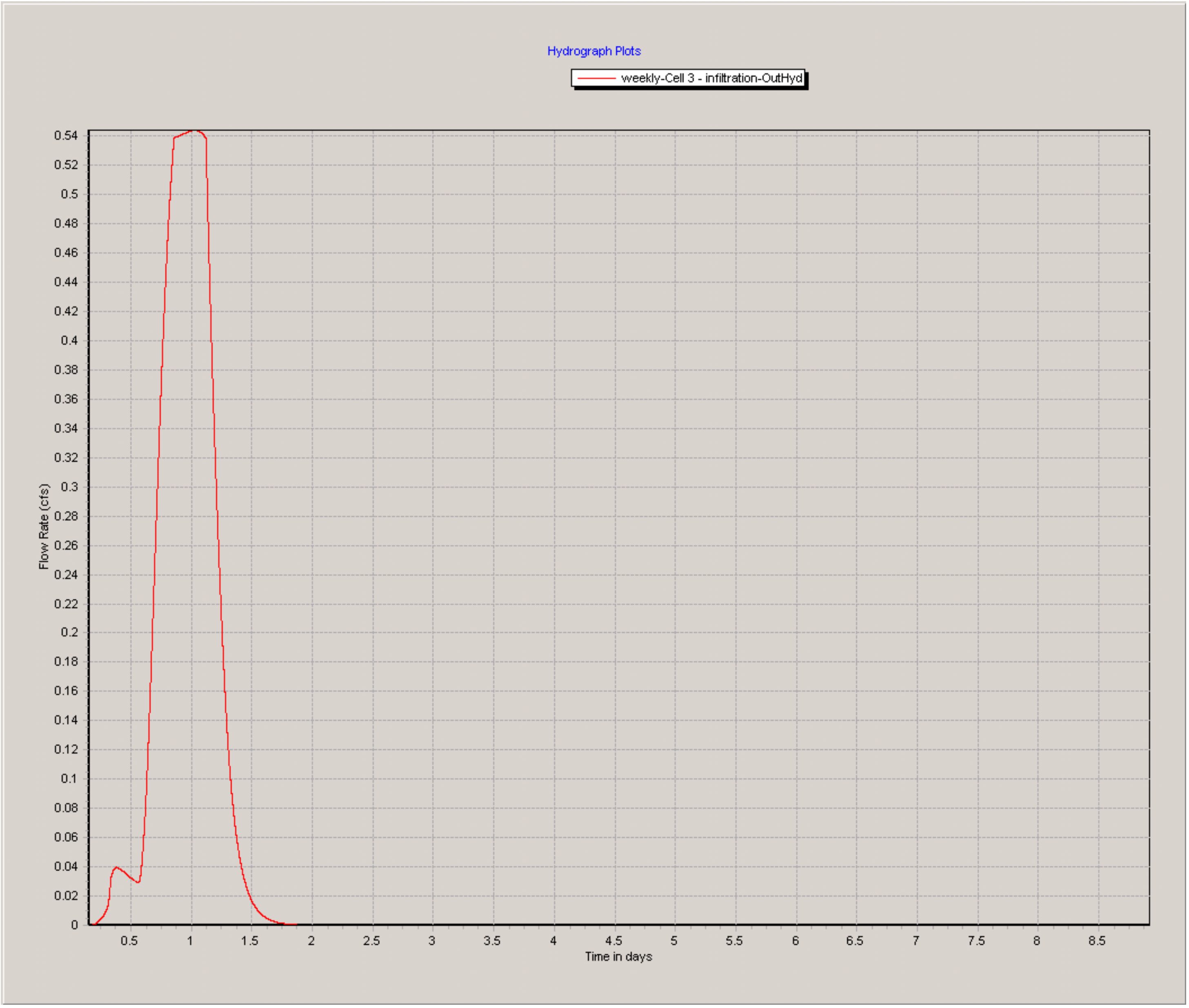
Cell 1 fills fairly rapidly with several feet of water, and then maintains a relatively steady infiltration rate (based on the relatively steady water elevation) until the stormwater runoff into Cell 1 and the flow over the Cell 1 weir stops; after it stops, the retained water is slowly infiltrated over time. The infiltration drop-off shown on day 7 is when the Stormshed model stopped calculating the infiltration and is not a true representation of infiltration conditions. During the winter, Cell 1 likely refills with water from a follow-on storm event before it completely drains. About 25 percent of the water flow entering Cell 1 never leaves Cell 1 from a weekly event when Cell 1 begins the event empty. If Cell 1 starts the event partially saturated, then more water will be passed into Cells 2 and 3.

Chart 2: Cell 2 Weekly Event



For the weekly storm event, water is anticipated to be stored in Cell 2 for almost 4 days. Some of the water in Cell 2 is infiltrated immediately, but the average treatment time for the majority of the water is likely to be approximately 1 to 2 days.

Chart 3: Cell 3 Weekly Event



For the weekly storm event, Cell 3 stores water for only about a half of a day after the rain event stops, and thus, the average treatment time for this portion of the water flow (about 25 percent) is approximately a half of a day.

#### 3.3.1.1 Comparison to Existing Conditions

For the weekly storm event, all of the stormwater from the Downtown Basin is currently routed without treatment through the Butler outfall to the Stillaguamish River. After project completion, all of the stormwater from the weekly event will be routed to the constructed wetland where it will be treated and infiltrated adjacent to the Stillaguamish River.

#### 3.3.1.2 Treatment Summary

For the weekly storm event, the wetland stores water in each of the three cells after the rain event ends for periods ranging from approximately one-half day to several days. This treatment time will serve to provide initial treatment for fecal coliform and temperature. DO will be increased by the flows over the spillway and weir drops.

Infiltrated water will have some additional treatment time in the soil before reaching the existing shallow aquifer, which will provide additional treatment for fecal coliform. It is also expected that the temperature of the infiltrated water will change to match the surrounding soil temperature at the same time.

During the winter months, rain typically falls every few days; thus, it is expected that the bottom of the wetland will typically be saturated with stormwater during the winter months. During the late spring to early fall, rainfall is much less frequent, and it is expected that the bottom of the wetland will not typically be saturated during this period. Overall treatment effectiveness for smaller storm events is expected to be similar regardless of the time of year.

### 3.3.2 6-MONTH AND LARGER EVENTS

The larger storm events occur much less frequently than the smaller storm events and the primary treatment differences between the smaller events and the larger events are the percentage of water infiltrated and the amount of water which flows through the wetland (see Table 6 and Figures 5 and 6).

Even for the 6-month event, which is the most common of the larger storm events, the site will infiltrate only about a third of the stormwater. The remaining stormwater is retained in the wetland for a varying period of time. The average retention time could be as short as a few hours, or as long as a few days. In general, larger storm events will have shorter average retention times, as once the wetland fills with water (about 400,000 $ft^3$ of water), the rest of the flow is passed through the wetland. Retention time will be increased when backwater effects from the river are occurring (see Section 3.7).

#### 3.3.2.1 Comparison to Existing Conditions

For the larger storm events, all of the stormwater from the Downtown Basin is currently routed without treatment through the Butler outfall to the Stillaguamish River. Some of the stormwater is flooded during larger storm events either onto the property/WSDOT wetland or out catch basins on the east side of SR 9.

After project completion, all of the water from the larger storm events will be routed to the constructed wetland, where it will be treated, and between about 9 and 32 percent of the stormwater will be infiltrated adjacent to the Stillaguamish River. Most of the treated stormwater will be released through the Butler outfall to the Stillaguamish River. Some of the stormwater will be flooded during larger storm events either onto the property/WSDOT wetland and/or out catch basins on the east side of SR 9.

### 3.3.2.2 Treatment Summary

For the larger storm events, the wetland typically stores a portion of the runoff from the event for several days after the rain event ends. This treatment time will serve to provide initial treatment for fecal coliform and temperature. DO in the runoff will be increased by the flows over the spillway and weir drops.

Infiltrated water will have some additional treatment time in the soil before reaching the existing shallow aquifer, which will provide additional treatment for fecal coliform. It is also expected that the temperature of the infiltrated water will change to match the surrounding soil temperature at the same time.

## 3.4 WEIR SIZING

The design basis for the weirs was avoidance of downstream interference of the functionality of the weirs during the design storm events (weekly to year storm events). Therefore, each weir was sized so that, for the weekly and year storm event, the peak water storage level behind a weir would be less than the weir elevation upstream of it, or, in the case of Weir 1, the elevation of the water flowing into the settling pond behind Weir 1. The weirs are free of interference up to the 2-year storm event, with the exception of Weir 3, which is interfered with slightly by the inlet capacity of the downstream culvert. During the larger storm events, the weirs are intended to allow backwater to occur back through the wetland so that flooding can mimic pre-existing conditions (see Section 3.7).

The weir widths were interactively changed in the model until the maximum desired storage elevation was achieved behind each weir for the design storm events. The weir widths, bottom elevations, and top elevations selected and modeled are presented in Table 7 below.

**Table 7**
**Weir Summary**

| Weir | Notch Width | Notch Elevation | Top Elevation | Peak Water Elevation | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Weekly Storm | 6 Mo. Storm | 2 Yr. Storm | 10 Yr. Storm | 100 Yr. Storm |
| Weir 1 | 10 | 63.0 | 65.5 | 63.21 | 64.02 | 64.34 | 64.75 | 64.92 |
| Weir 2 Lower | 2 | 61.0 | 63.5 | 61.21 | 62.00 | 62.29 | 62.65 | 62.87 |
| Weir 2 Upper | 11 | 61.5 | 63.5 | N/A | 62.00 | 62.29 | 62.65 | 62.87 |
| Weir 3 | 8 | 60.25 | 62.5 | 60.18 | 60.94 | 61.51 | 61.81 | 62.16 |

The functionality of Weir 3 is interfered with by backwater effects from the downstream culvert entrance in all events larger than the 2-year storm event. The Stormshed software shows that a weir width of 8 ft is sufficient to pass the peak flow through this weir at a depth less than the maximum depth of the weir. The same is true for Weir 2. Weir 2 is similarly interfered with by backwater effects by 10-year and larger storm events. See Section 3.7 for a more complete discussion of backwater effects from the pipe system and high river levels.

## 3.5 SPILLWAY SIZING

There are two spillways associated with the project. One is at the west end of the bore pipe under SR 9 as the stormwater flow enters into the wetland. The other is a spillway from Cell 2 into the WSDOT wetland.

### 3.5.1 BORE PIPE SPILLWAY

The bore pipe spillway is designed based on the 100-year flows into the wetland from the 48-inch diameter pipe to be installed under SR 9. The model calculates the peak 100-year flow out of this pipe to be approximately 86.12 cfs, flowing at a velocity of 9.5 ft per second.

The proposed design is for a riprap-lined spillway that is 2 ft deep, including 0.5 ft of freeboard. The spillway is designed to be a minimum of 10 ft wide at the base and have a horizontal to vertical ratio (H:V) of 5H:1V interior side slopes. With these constraints, the spillway will pass the 100-year flow, as shown by the following equation.

$Q_{100} = 3.21(LH^{3/2} + 4H^{5/2})$ For a discharge coefficient C= 0.6 and 5H:1V side slopes.

Using a length (L) of 10 ft and a flow depth (H) depth of 1.5 ft, the flow capacity of the spillway is:

$$Q_{100} = 3.21((10)(1.5)^{3/2} + 4(1.5)^{5/2})$$

$Q_{100} = 94.35$ cfs, which is more than the calculated 100-year flow rate of 86.12 cfs (see Appendix D, Figure D-6); therefore, a spillway with 5H:1V side slopes, 1.5 ft of flow depth, and a 10-ft-wide channel bottom is sufficient.

#### 3.5.1.1 Spillway Rock Sizing

Because portions of the bore pipe spillway channel are within the WSDOT right-of-way, guidance from the WSDOT *Highway Runoff Manual* was used to size the rock (WSDOT 2008). From Table 5.4.3, Rock Protection at Outfalls, the rock thickness must be 2 ft thick with a geotextile fabric between the rock and the native soils in the spillway channel (WSDOT 2008). The rock will be riprap, which is reasonably well graded, with a gradation as follows:

| | |
|---|---|
| Maximum stone size: | 24 inches (nominal diameter) |
| Median stone size: | 16 inches |
| Minimum stone size: | 4 inches |

### 3.5.2 WSDOT WETLAND SPILLWAY

The culvert beneath SR 530 that drains the WSDOT wetland has not been surveyed; however, based on observation by Kelley Wrigg, Landau Associates, the culvert appears to be a 24-inch-diameter corrugated metal pipe. The invert of the outlet on the north side of SR 530 appears to be at an elevation close to 59 ft.

This culvert does not appear to have the capacity to be the primary relief flow direction when these properties are flooded. It likely does not have the capacity to pass the flow volumes which can pass over the top of the dike during river flooding events. Instead, flood elevations on the property are controlled by the height water builds up as it flows over Dike Road to the west. No modeling has been performed to attempt to predict these flow depths. During flood events in January 2009, water filled to an elevation of about 66 ft on the property and the WSDOT property. This would appear to be typical of small flood events from when the river elevation exceeds the river dike elevation. At this water surface elevation, water is flowing approximately 4 ft deep over the top of Dike Road at the west side of the property. The water is about 7 ft deep (about 3.5 culvert diameters) at the 24-inch culvert under SR 530.

A nomograph, shown on Figure 7, is adapted from Figure 4.3.1.C of the King County *Surface Water Design Manual* (King County 2005). From the nomograph, for the projecting section pipe inlet, the flow that the 24-inch pipe inlet would support is about 33 cfs.

In order to mimic pre-existing conditions to the extent possible, the spillway from Cell 2 to the WSDOT wetland has been sized to provide as much flow as the culvert has been estimated to be able to pass (33 cfs). The spillway bottom elevation is set at an elevation of 62.5 ft, and the flow depth (H) will be only 0.5 ft. The spillway side slopes will be at 5H:1V.

The length (L) of the spillway channel required to pass a flow (Q) of 33 cfs was determined using the following equation:

$$L = [\frac{Q}{3.21H^{3/2}}] - 4H \text{ , or}$$

$$L = [\frac{33}{3.21(0.5)^{3/2}}] - 4(0.5) \text{ , or}$$

L = 27.1 ft. Therefore, the WSDOT wetland spillway width has been set at 28 ft, as shown on the drawings in Appendix B.

#### 3.5.2.1 Spillway Rock Sizing

The spillway rock will be quarry spalls with a geotextile fabric between the rock and the Cell 2 berm soils. The rock thickness will be 1 ft, with a gradation of the quarry spalls, as follows:

Passing 8-inch-square sieve: 100%
Passing 3-inch-square sieve: 40% to 60% maximum
Passing 0.75-inch-square sieve: 0 to 10%

## 3.6 PIPE SIZING

The basis for the wetland project pipe sizing was that the pipes be able to pass the 25-year storm event, and also be analyzed for the 100-year storm event. As noted earlier, the storm flows modeled in this report and by URS appear to generate flows which are larger than those actually observed. This is believed to be the result of water loss in the system through leaking conveyance pipes. The pipe calculations reflect no system water loss and represent a maximum flow rate analysis.

The capacities of all the new pipes in the system were modeled for the 100-year storm event as the pipe segments are proposed to be installed. The model of the upstream system is a representative model and each reach (pipe link) often represents several pipes, where the physical properties have either been totaled (length), averaged (slope), or assumed worst case (manning's number or pipe diameter). It is not the purpose of the model to identify upstream deficiencies, but rather to create a representative flow to the new wetland system in order to model the wetland as accurately as possible. There are some upstream deficiencies, which have been noted by previous studies and which this model also identifies. No recommendations for these pipes are made as part of this drainage report because the City has already identified these issues and is working on solutions.

All of the new proposed pipes have the capacity to pass not only the 25-year storm event, but the 100-year storm event as well. The pipe with the lowest remaining capacity is the 48-inch pipe DM5A to Cell 1 to be installed beneath SR 9. This pipe is at 80 percent capacity during the modeled 100-year storm event peak flow (see Model Results in Appendices D and E).

## 3.7 FLOODING, BACKWATER, FLOOD HAZARD, AND ZERO RISE ANALYSIS

Note that the river gages and FEMA FIS and FIRM datum are related to NGVD29. The site plans and the calculations in this report are based on NAVD88. The conversion for the project location is to add 3.69 ft in elevation to the NGVD29 elevation to obtain the NAVD88 elevation. All discussions of elevations in this report reference the NAVD88 datum, unless otherwise noted.

Elevation references:

- The river stage varies between 58 ft (0 flow) and 71 ft (100-year flow).
- The dike along the river is between 68 ft and 72 ft.
- The Butler outfall invert is at an elevation of 51.7 ft (URS 2008).
- The WSDOT bioswale edge has an elevation of about 65 ft.
- To convert the river gage at SR9 to project datum (NAVD88), add 51.7 ft to the river gage reading.

### 3.7.1 FLOODING AND BACKWATER

Currently, when the river elevation rises to close to 66 ft, water flows back up the Butler outfall pipe and bubbles up in CB#6 at the east end of the Butler outfall (see photos below). In these cases, the flow begins to fill the WSDOT bioswale when the river elevation rises above 61 ft, and then spills onto the rest of the property from the bioswale when the river elevation rises above 65 ft. Water can also flood onto the property when flows in the river exceed the height of the river dike along the property's northern side. Both of these scenarios occurred during the January 2009 flooding event. There was a breach in the dike during this flood event which has since been repaired. The small flooding events which occur when river water is flowing back up the pipe system (but these flows do not exceed the existing dike height) can be prevented by the installation of a backwater prevention device (such as a flapper gate) on the Butler outfall. Because the Butler outfall pipe is currently is in need of repair, it is recommended that the installation of a backwater prevention device happen concurrently with future pipe repair activities.

After the wetland is constructed, during times in which flood water passes over the dike and onto the property, the wetland will provide little or no treatment of stormwater. However, once floodwaters subside enough so that flows can exit the property through the outfall, the wetland will again start to provide some level of treatment of not only stormwater, but the retained floodwaters as well. The deposition of silt during flooding events is not anticipated to adversely impact the wetland, as the soils which are typically deposited by flooding events are the same types of soils that will be present in the wetland. Routine maintenance of the treatment wetland will include removal of accumulated sediment in Cell 1 (the sediment basin) in order to restore original treatment wetland design elevations.

### 3.7.2 FLOOD HAZARD AND ZERO RISE

The creation of the wetland will result in about 8.9 acre-ft of soil material being removed from the site (see the grading plans in Appendix B) or the creation of about 8.9 acre-ft of additional flood storage. This additional storage will either be used by stormwater from the City before it enters the river or by the river itself when it exceeds the height of the existing dike. In either case, the additional storage provided by the wetland excavation results in lower flood elevations on the property and downstream properties than would occur under existing conditions. Thus, the proposed project provides a net loss of flood elevation, which exceeds the zero rise requirement.

Photo 2: Water back-flowing from river outfall and bubbling up through catch basin lid.

Photo 3: Previous breach in dike near western end of property.

Photo 4: Looking east across property from Dike Road during January 2009 flooding event

Photo 5: Looking at northeastern portion of property from SR 9.

### 3.7.3 POST-CONSTRUCTION FLOODING

The wetland has been designed with the intent to preserve existing flooding patterns to the extent possible. Data on exactly how much water flows, and in what directions, during flood events is not available. However, pictures of previous flood events, and elevation data gained through survey of the property and adjacent areas, help make a likely determination of flood flows possible.

#### 3.7.3.1 Existing Condition Comparison

Once flood waters flow over the dike onto the property, they start to fill the property with water and the flood flows can exit the property in two directions. The two existing exit points are at about the same elevation. One pathway is to the southeast to the WSDOT wetland property, and the other is to the south across the low point on Dike Road. Because the WSDOT wetland property is constrained by fill on two of its three sides and by the property on the other, there is only one exit for flood waters from the WSDOT wetland. That exit is through an approximately 24-inch culvert, which passes under SR 530 to the south. Surface water flowing south to north is what currently appears to help sustain the WSDOT wetland. However, during flood events, water can flow through the culvert to the south. The amount of water which can flow through the culvert is constrained by the size of the pipe (approximately 24-inches) and the head (height) of the flood flows that build up can force water through the pipe. Once the flood waters on the WSDOT property equalize with the flood waters on the property, the flow onto the WSDOT property is constrained by what flow can pass through the 24-inch pipe. Indications are that flood water depths are often less than elevation 66 ft, but could be higher during a major flood event. The 24-inch culvert inlet with 5 diameters of head (10 ft) can only pass about 40 cfs of flow, and 40 cfs is a small fraction of the amount of flow that can pass over Dike Road at the same flood elevation (about 68 ft).

To achieve this level of flow, the water elevation would have to be 68 ft over both the WSDOT and proposed wetlands (well above the wetland berm) and the impact of the overflow spillway would be negligible. For this reason, the lower headwater depth was used in the calculations of the spillway from Cell 2 to the WSDOT wetland.

#### 3.7.3.2 Wetland Filling During a Flood Event

It is assumed for the purposes of the discussion in this section that a flapper gate has been installed on the Butler outfall to prevent backwater from the river and that it rains during the river flood event.

As the river level begins to rise, the Butler outfall's ability to sustain drainage flow will diminish as the tail water in the river increases. As the river level rises, the flapper gate will be forced closed. The wetland will initially fill with water from the storm drainage system draining to the wetland. Cell 4 will fill to an elevation of 60.25 ft, and once the water level exceeds that elevation, then the operation of Weir 3 will be diminished by tail water in Cell 4 until the two cells equalize in elevation from water continuing to flow into the system. Once they equalize, the two cells will continue to fill, until the water in Cells 3 and 4 reach an elevation of 61.0 ft. At this point, the performance of the lower Weir 2 notch will begin to diminish flows from Cell 2 into Cell 3. At an elevation of 61.5 ft, the flows through the upper Weir 2 notch will begin to diminish, and eventually, at a water elevation above 61.5 ft, Cells 2, 3, and 4 will equalize in elevation and begin to rise together. The water in these cells will continue to rise until the water elevation reaches 62.5 ft. At this elevation, water will begin to flow through the overflow spillway into the WSDOT wetland. This spillway has been sized to support a flow of up to 33 cfs. If the flow into the project wetland exceeds 20 cfs for a long enough time, then the WSDOT wetland will fill to an elevation of 63 ft. At that elevation, water in the project wetland will also reach an elevation of 63 ft, and water will flow out of the project wetland on the north side of the wetland and eventually cross Dike Road.

If the river elevation exceeds the existing dike elevation, then river water will rapidly fill the project wetland and the WSDOT wetland by backwatering through the system, as described above. In the case of river flooding, the property will flood, as it flooded before the project, but with about 8.9 acre-ft of additional flood storage on the property, which will reduce flood impacts to downstream properties.

# 4.0 RECLAIMED WATER

In the future, it is the City's goal to redirect some of the reclaimed water from the Wastewater Reclamation Facility (WRF; under construction) to provide hydrologic support to the wetland during the summer months. Flows from the WRF will result in a different hydroperiod than stormwater flows in that, at a given WRF input, the wetland will fill to a maximum level (which varies depending on the pumping rate) and will remain at that level until the WRF pumps are turned off, as summarized in Table 8 below.

**Table 8**
**Hydroperiod of Stormwater and Reclaimed Water**

| Water Source | Variable | |
|---|---|---|
| | **Timing** | **Hydroperiod** |
| **Stormwater** | Year-round; primarily winter | Rises to peak and then immediately starts to diminish until the rainstorm event subsides |
| **Reclaimed water** | Primarily summer | Starts at a maximum flow rate and continues at that rate until the flow is turned off |

It is proposed that the WRF discharge reclaimed water to the wetland at least once a week in a volume equal to that predicted for the weekly storm event (about 2.4 acre-ft) to help sustain the wetland during the dry summer months. However, the WRF discharge could be limited to those weeks in which any of the monitored TMDLs for the Stillaguamish River is exceeded. The volumes of water predicted to enter the wetland from each of the design storm events is listed in Table 9 below.

**Table 9**
**Flow Volume to Wetland by Storm Event**

| Storm Event | Storm Event | | | | |
|---|---|---|---|---|---|
| | **Weekly** | **6 month** | **2 year** | **10 year** | **100 year** |
| Flow Volume to Wetland | 2.4 acre-ft | 12.1 acre-ft | 19.2 acre-ft | 33.3 acre-ft | 64.0 acre-ft |

Although the wetland will fill differently from steady state pumping than from a storm event, if the volume of water pumped is similar, the wetland should fill to approximately the same depths. The addition of the reclaimed water during the dry summer months would help sustain the wetland. The amount of water pumped should be varied based on the City's monitoring of the wetland status (more or less water based on the wetland's response to the reclaimed water). Reclaimed water should not be pumped if substantial precipitation is predicted in the next 24 hours.

# 5.0 CONCLUSIONS

The proposed treatment wetland design is expected to reduce peak stormwater flows to the Stillaguamish River, decrease the overall volume of urban stormwater runoff discharged to the river by increasing the amount of infiltration, increase the detention time of stormwater runoff prior to its discharge to the river, offer additional summer month treatment of City wastewater discharge, and thereby reduce the overall pollutant load to the river from both stormwater and wastewater. The result will be an overall improvement in the water quality of the Stillaguamish River, including, but not limited to, TMDL parameters.

The weir system for the treatment wetland was designed to hydraulically handle the 100-year 24-hour storm event, while causing less flooding than occurs in the existing conditions. The design is such that typical and floodwater hydrologic patterns will be similar under current and proposed conditions, except that there will be increased storage capacity and desynchronization of flows as a result of the proposed project. The project will also increase public access to shoreline areas by creating trails and viewing areas, and will improve habitat functions for wildlife by creating multiple wetland communities. The existing groundwater well and the historic area will be preserved and protected (see Critical Areas Report; Landau Associates 2009).

# 6.0 USE OF THIS REPORT

This report was prepared for use by the City of Arlington and applicable regulatory agencies. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project, or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk.

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.

Kelley E. Wrigg, P.E.
Associate Engineer

# 7.0 REFERENCES

Arlington, City of. Undated. Working Draft: *City of Arlington Draft Stormwater Comprehensive Plan.* Provided to Landau Associates by City of Arlington on July 17, 2008.

Arlington, City of. 2008a. Map: *Map showing locations of excavation pits and groundwater data*. PDF file provided to Landau Associates by City of Arlington in July 2008.

Arlington, City of. 2008b. Maps: *City GIS maps showing storm and wastewater conveyance infrastructure*. GIS files provided to Landau Associates by City of Arlington in July 2008.

Arlington, City of. 2008c. Data: *Monthly water quality data (temp, DO, fecals, conductivity) for the Butler outfall from 9/03 thru 12/06*. Excel file provided to Landau Associates by City of Arlington in July 2008.

Arlington. City of. 2007. *Preliminary Plan and Project Concept for the Constructed Stormwater Wetland*. Prepared by Utilities, Stormwater Department. City of Arlington, Washington. September.

DAHP. 2008. Letter: *Stormwater Wetland Project Log No. 062308-18-ECY*. From the Washington State Department of Archeology and Historic Preservation, to Mr. James Kelly, City of Arlington. June 23.

Ecology. 2005a. *Stillaguamish River Watershed Fecal Coliform, Dissolved Oxygen, pH, Arsenic, and Mercury Total Maximum Daily Load (Water Cleanup Plan) - Submittal Report.* Publications No. 05-10-044. Available at http://www.ecy.wa.gov/biblio/0510044.html. Washington State Department of Ecology. Olympia, Washington. May.

Ecology. 2005b. *Stormwater Management Manual for Western Washington: Volume III -- Hydrologic Analysis and Flow Control Design/BMPs*. Publications No. 05-10-031. Available at http://www.ecy.wa.gov/biblio/0510031.html. Washington State Department of Ecology. Olympia, Washington. April.

EPA. 2006. *Performance of Stormwater Retention Ponds and Constructed Wetlands in Reducing Microbial Concentrations*. September 2006. Available at: http://www.epa.gov/nrmrl/pubs/600r06102/600r06102.pdf. Accessed June 2009.

EPA. 1993. *Constructed Wetlands for Wastewater Treatment and Wildlife Habitat, 17 Case Studies*. EPA832-R-93-005. U.S. Environmental Protection Agency. September.

FEMA website. 2009. *Firmette.* Federal Emergency Management Agency. Accessible from Map Service Center: http://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1. Accessed August 30.

Greytag Macbeth. 1994. *Munsell Soil Color Charts*. New Windsor, New York.

Hammer, Donald. A (editor). 1989. *Constructed Wetlands for Wastewater Treatment; Municipal, Industrial and Agricultural*. Lewis Publishers, Chelsea, Michigan. Proceedings from the First International Conference on Constructed Wetlands for Wastewater Treatment held in Chattanooga, Tennessee on June 13-17, 1988.

Huey Surveying and Land Consulting. 2008. Files: *AutoCAD survey files of project area*. Provided to Landau Associates in September 2008.

Kennedy/Jenks. 2008. *WWTP Engineering Report, City of Arlington: Appendix H*. Kennedy/Jenks Consultants. Federal Way, Washington. June.

Kennedy/Jenks. 2007. *City of Arlington, Washington, Wastewater Treatment Plan Engineering Report.* Prepared for the City of Arlington, Washington. Kennedy Jenks Consultants. Federal Way, Washington. June.

King County. 2005. *Surface Water Design Manual.* King County Department of Natural Resources. January 24.

Landau Associates. 2009. *Critical Areas Report, Stormwater Treatment Wetland, Snohomish County, Washington.* Prepared for the City of Arlington. December 4.

Landau Associates. 2008. *Sampling and Analysis Plan/Quality Assurance Project Plan; City of Arlington Stormwater Treatment Wetland, Arlington, Washington*. Prepared for the City of Arlington. August 21.

NOAA. 2008. *Hourly Precipitation Data, Washington, March 2008, Volume 58, Number 3.* National Oceanic and Atmospheric Administration. March.

NOAA website. 2009. *National Weather Service Northwest River Forecast Center*. http://www.nwrfc.noaa.gov/. For Arlington, Washington. Accessed October 20, 2009.

Northwest Archaeological Associates, Inc. 2008. *Cultural Resources Assessment for the Arlington Constructed Stormwater Wetland.* May 29.

NRCS website. 2008. *Web Soil Survey.* Natural Resources Conservation Service, United States Department of Agriculture. Available at http://websoilsurvey.nrcs.usda.gov/. Accessed August 30, 2009.

Pacific Groundwater Group. 2007. *City of Arlington, Hydrogeologic Conceptual Model Summary Report*. Prepared for City of Arlington. July.

R2 Resource Consultants. 2005. Technical Memorandum: *Stillaguamish River − Summary Assessment of Avulsion Risk Factors between RM 13 and SR 9*. Prepared for City of Arlington. July 12.

Snohomish County. 2008a. *Snohomish County Permit Planning and Zoning Map*. Available at: http://gis.co.snohomish.wa.us/maps/permits/index.htm. Accessed on July 1.

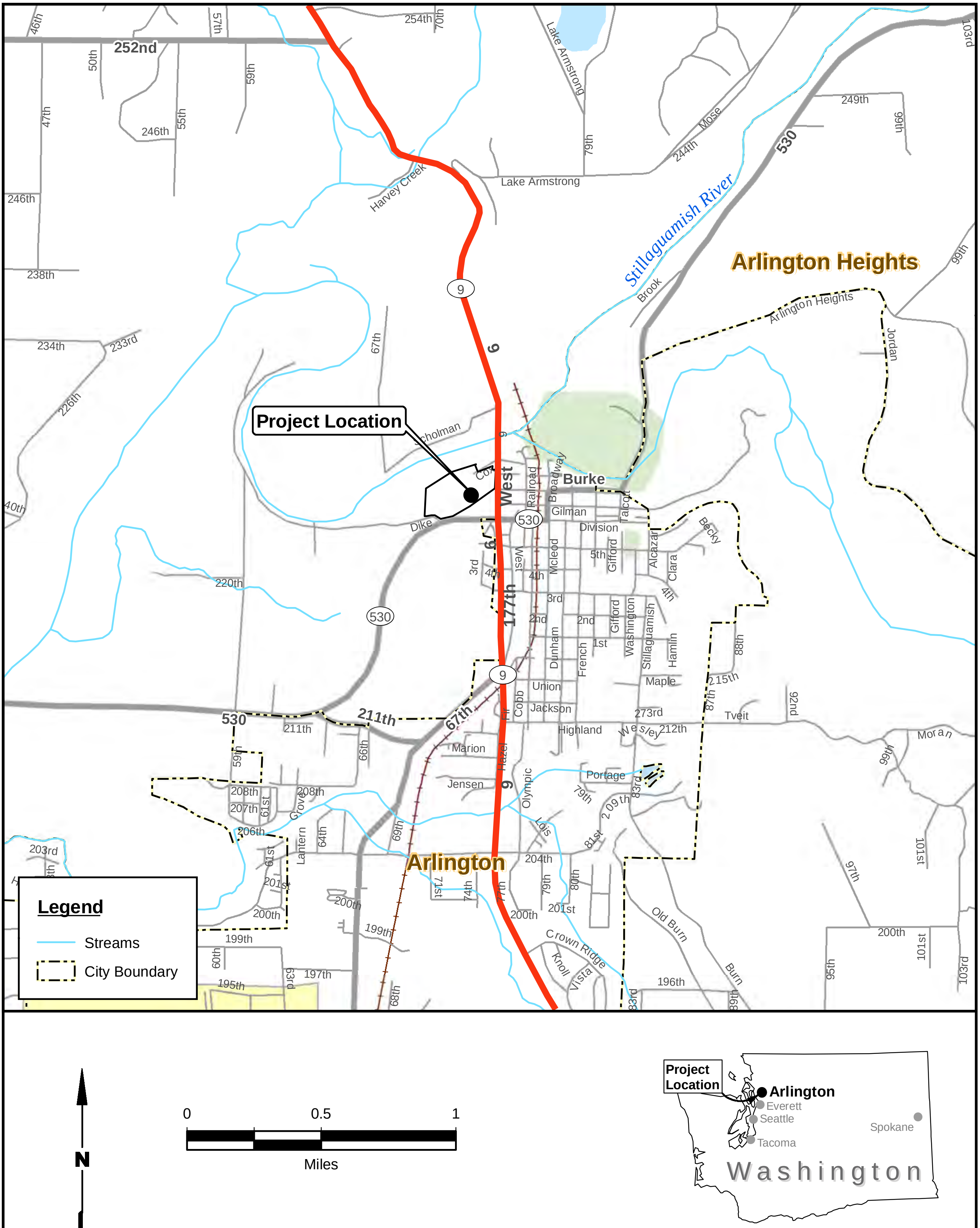
Snohomish County. 2008b. *Unified Development Code (UDC) / Chapter 30 of the Snohomish County Code (SCC)*. Available at: http://www1.co.snohomish.wa.us/County_Services/county_code.htm. Accessed on July 1.

Talich, C. 2008. Personal communication (telephone conversation with Kelley Wrigg, Associate Engineer, Landau Associates). Carla Talich, Project Engineer, URS Corporation, Seattle, Washington. Re: *Model Results of the Calculation No. HM-1 for XP-SWMMM.* September.

URS. 2008. *Memorandum and Data: Calculation No. HM-1 for XP-SWMMM*. Prepared for the City of Arlington for the Stormwater Comprehensive Plan. URS Corporation. Seattle, Washington. April.

WSDOT. 2008. *Highway Runoff Manual.* M 31-16.01. Washington State Department of Transportation. June.

WSDOT. 1997. Drawing Sheets: *sheets related to SR-9 and Haller Bridge Construction, including Wetland Mitigation Plans*. Washington State Department of Transportation. Provided by the City of Arlington to Landau Associates in July 2008.



*Data Source: ESRI 2006*

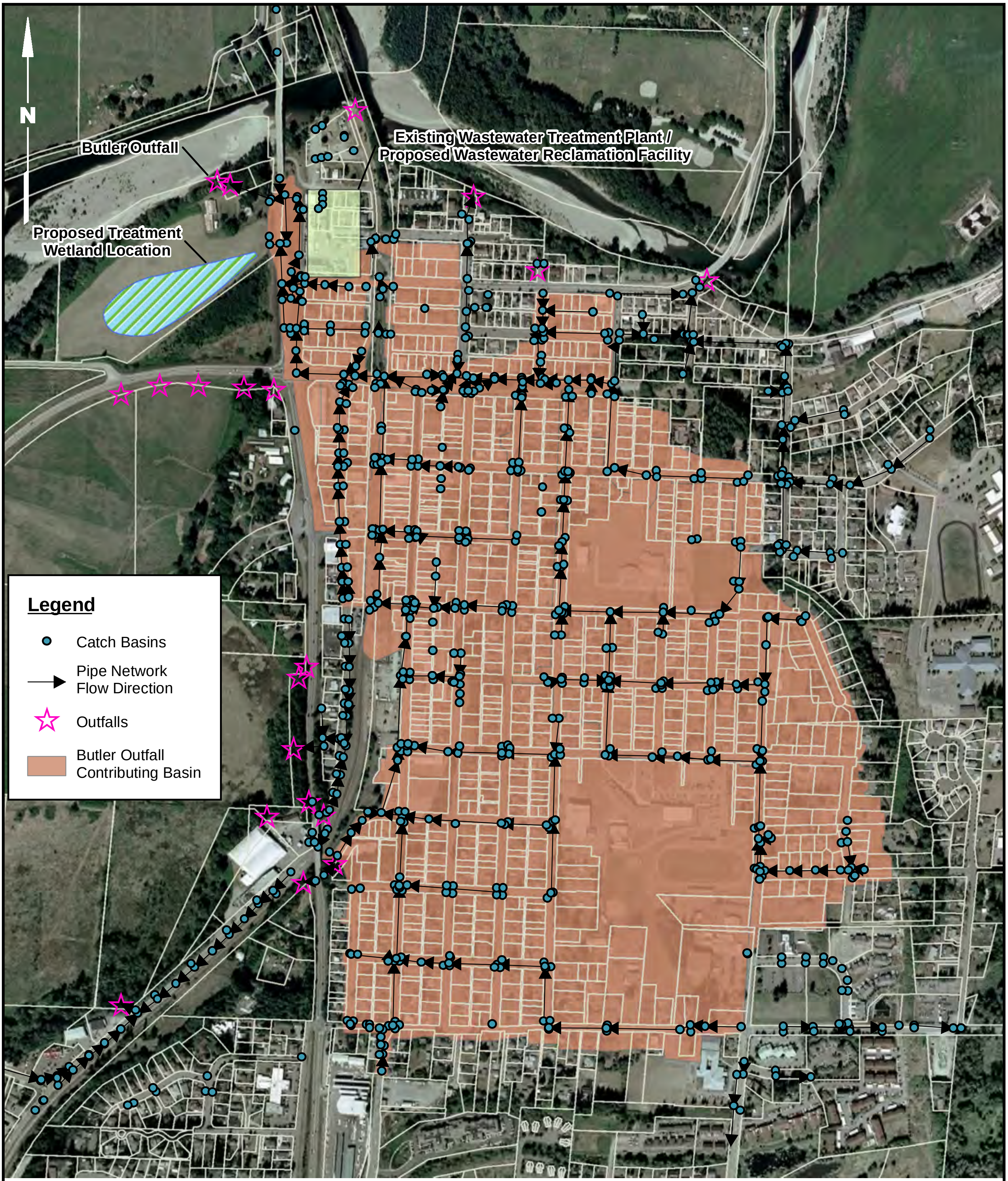
City of Arlington
Stormwater Wetland Project
Snohomish County, Washington

## Vicinity Map

Figure
1

LANDAU ASSOCIATES

Y:\Projects\1097001\010\MapDocs\Fig1 Wetland.mxd 12/11/2009



*Data Source: City of Arlington; ESRI Image Server*

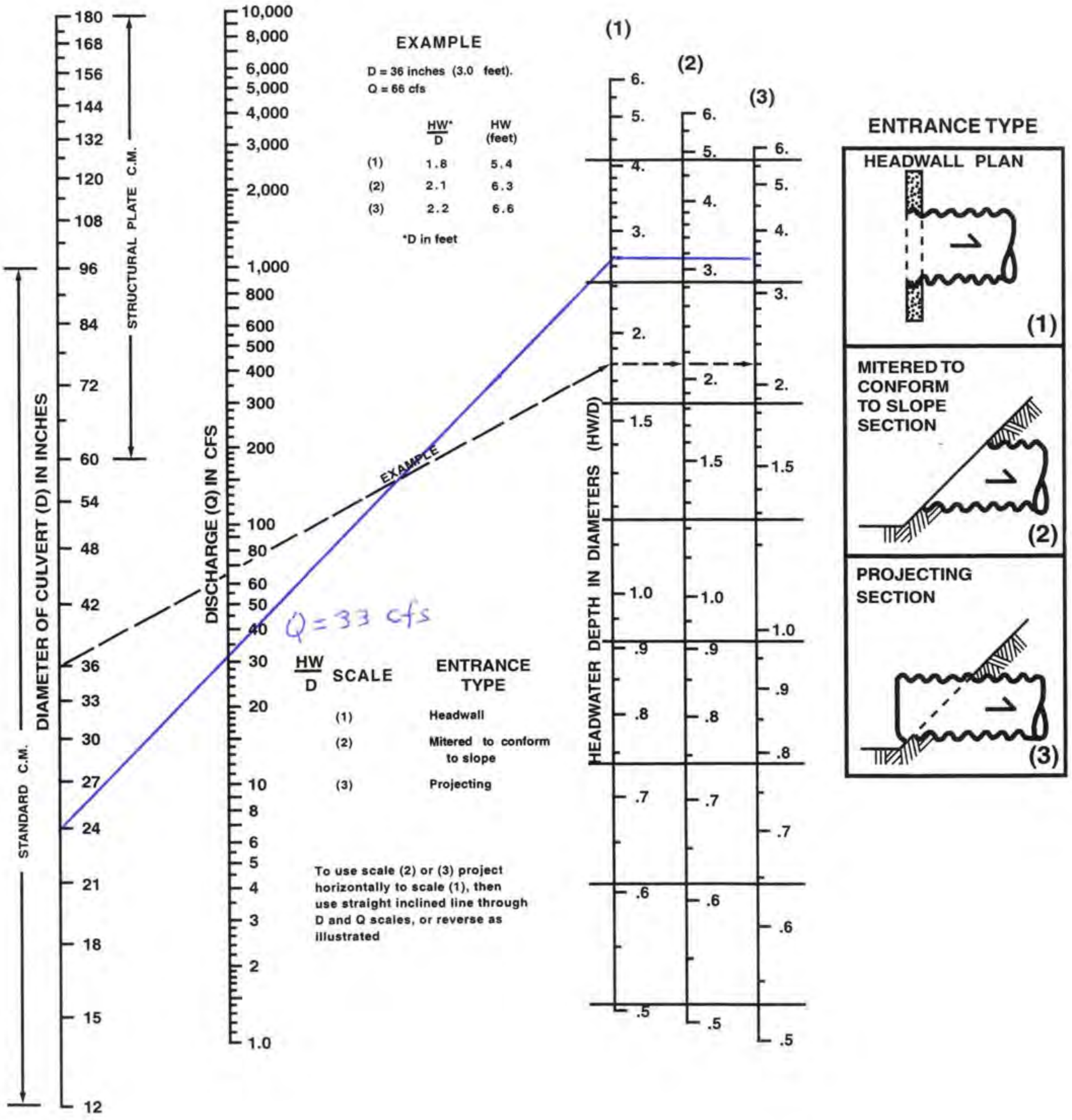
Y:\Projects\1097001\010\MapDocs\ButlerOutfallBasins_9_25.mxd 12/2/2009

LANDAU
ASSOCIATES

City of Arlington
Stormwater Wetland Project
Snohomish County, Washington

**Stormwater Basin**

Figure
3



EXAMPLE

D = 36 inches (3.0 feet).
Q = 66 cfs

| | $\frac{HW^*}{D}$ | HW (feet) |
|---|---|---|
| (1) | 1.8 | 5.4 |
| (2) | 2.1 | 6.3 |
| (3) | 2.2 | 6.6 |

*D in feet

| $\frac{HW}{D}$ SCALE | ENTRANCE TYPE |
|---|---|
| (1) | Headwall |
| (2) | Mitered to conform to slope |
| (3) | Projecting |

To use scale (2) or (3) project horizontally to scale (1), then use straight inclined line through D and Q scales, or reverse as illustrated

*Adapted from: Figure 4.3.1.C of King County 2005 Surface Water Design Manual*

12/10/09 P:\1097\001\FileRm\R\Drainage Report\Figures\Fig 7.doc

LANDAU ASSOCIATES

City of Arlington
Stormwater Wetland Project
Snohomish County, WA

## Headwater Depth for Corrugated Pipe Culverts with Inlet Control

Figure
7

APPENDIX A

# Soil Logs and Laboratory Analysis and Soil Descriptions from the Natural Resources Conservation Service

# Soil Classification System

| MAJOR DIVISIONS | | | GRAPHIC SYMBOL | USCS LETTER SYMBOL$^{(1)}$ | TYPICAL DESCRIPTIONS $^{(2)(3)}$ |
|---|---|---|---|---|---|
| COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size) | GRAVEL AND GRAVELLY SOIL<br>(More than 50% of coarse fraction retained on No. 4 sieve) | CLEAN GRAVEL<br>(Little or no fines) | ⁘ | **GW** | Well-graded gravel; gravel/sand mixture(s); little or no fines |
| | | | ⁘ | **GP** | Poorly graded gravel; gravel/sand mixture(s); little or no fines |
| | | GRAVEL WITH FINES<br>(Appreciable amount of fines) | ▥ | **GM** | Silty gravel; gravel/sand/silt mixture(s) |
| | | | ▨ | **GC** | Clayey gravel; gravel/sand/clay mixture(s) |
| | SAND AND SANDY SOIL<br>(More than 50% of coarse fraction passed through No. 4 sieve) | CLEAN SAND<br>(Little or no fines) | ░ | **SW** | Well-graded sand; gravelly sand; little or no fines |
| | | | ░ | **SP** | Poorly graded sand; gravelly sand; little or no fines |
| | | SAND WITH FINES<br>(Appreciable amount of fines) | ▥ | **SM** | Silty sand; sand/silt mixture(s) |
| | | | ▨ | **SC** | Clayey sand; sand/clay mixture(s) |
| FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size) | SILT AND CLAY<br>(Liquid limit less than 50) | | ▥ | **ML** | Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity |
| | | | ▨ | **CL** | Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay |
| | | | ≋ | **OL** | Organic silt; organic, silty clay of low plasticity |
| | SILT AND CLAY<br>(Liquid limit greater than 50) | | ▥ | **MH** | Inorganic silt; micaceous or diatomaceous fine sand |
| | | | ▨ | **CH** | Inorganic clay of high plasticity; fat clay |
| | | | ▦ | **OH** | Organic clay of medium to high plasticity; organic silt |
| | HIGHLY ORGANIC SOIL | | ≋ | **PT** | Peat; humus; swamp soil with high organic content |

| OTHER MATERIALS | GRAPHIC SYMBOL | LETTER SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|---|---|
| PAVEMENT | ■ ⁘ | **AC** or **PC** | Asphalt concrete pavement or Portland cement pavement |
| ROCK | ▧ | **RK** | Rock (See Rock Classification) |
| WOOD | ≋ | **WD** | Wood, lumber, wood chips |
| DEBRIS | ◇ | **DB** | Construction debris, garbage |

Notes:
1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the Standard Test Method for Classification of Soils for Engineering Purposes, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

   Primary Constituent: > 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
   Secondary Constituents: > 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
   > 15% and ≤ 30% - "gravelly," "sandy," "silty," etc.
   Additional Constituents: > 5% and ≤ 15% - "with gravel," "with sand," "with silt," etc.
   ≤ 5% - "with trace gravel," "with trace sand," "with trace silt," etc., or not noted.

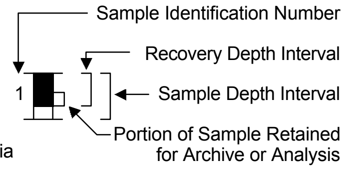
4. Soil density or consistency descriptions are based on judgement using a combination of sampler penetration blow counts, drilling or excavating conditions, field tests, and laboratory tests, as appropriate.

## Drilling and Sampling Key

SAMPLER TYPE

| Code | Description |
|---|---|
| a | 3.25-inch O.D., 2.42-inch I.D. Split Spoon |
| b | 2.00-inch O.D., 1.50-inch I.D. Split Spoon |
| c | Shelby Tube |
| d | Grab Sample |
| e | Single-Tube Core Barrel |
| f | Double-Tube Core Barrel |
| g | 2.50-inch O.D., 2.00-inch I.D. WSDOT |
| h | 3.00-inch O.D., 2.375-inch I.D. Mod. California |
| i | Other - See text if applicable |
| 1 | 300-lb Hammer, 30-inch Drop |
| 2 | 140-lb Hammer, 30-inch Drop |
| 3 | Pushed |
| 4 | Vibrocore (Rotosonic/Geoprobe) |
| 5 | Other - See text if applicable |

SAMPLE NUMBER & INTERVAL



## Field and Lab Test Data

| Code | Description |
|---|---|
| PP = 1.0 | Pocket Penetrometer, tsf |
| TV = 0.5 | Torvane, tsf |
| PID = 100 | Photoionization Detector VOC screening, ppm |
| W = 10 | Moisture Content, % |
| D = 120 | Dry Density, pcf |
| -200 = 60 | Material smaller than No. 200 sieve, % |
| GS | Grain Size - See separate figure for data |
| AL | Atterberg Limits - See separate figure for data |
| GT | Other Geotechnical Testing |
| CA | Chemical Analysis |

## Groundwater

▽ Approximate water level at time of drilling (ATD)
▼ Approximate water level at time other than ATD

LANDAU ASSOCIATES

City of Arlington Stormwater
Treatment Wetland
Snohomish County, Washington

Soil Classification System and Key

Figure
A-1

# TP-1

Excavation Method: Rubber-tired Backhoe
Ground Elevation (ft):
Excavated By: None
Logged By: MWB

| Depth (ft) | Elevation (ft) | Sample Number & Interval | Sampler Type | Test Data | Graphic Symbol | USCS Symbol | Soil Profile | Groundwater |
|---|---|---|---|---|---|---|---|---|
| | | S-1 | | | | ML | Dark brown (2.5 y 4/3), SILT with trace roots (stiff, moist)<br>**ALLUVIUM** | Groundwater not encountered. |
| | | S-2 | | | | ML | Light brown to orange (2.5 y 5/3), fine sandy SILT with trace roots (stiff, moist)<br>-A-horizon ends at 1.5 feet<br>-Redox at 2.5 feet | |
| | | S-3 | | | | ML | Light brown to orange (2.5 y 5/3), fine sandy SILT (stiff, moist to wet) | |
| | | S-4 | | | | ML | Light brown to orange (2.5 y 4/3), fine sandy SILT (stiff, wet) | |

Test Pit Completed 06/27/08
Total Depth of Test Pit = 8.5 ft.

# TP-2

Excavation Method: Rubber-tired Backhoe
Ground Elevation (ft):
Excavated By: None
Logged By: MWB

| Depth (ft) | Elevation (ft) | Sample Number & Interval | Sampler Type | Test Data | Graphic Symbol | USCS Symbol | Soil Profile | Groundwater |
|---|---|---|---|---|---|---|---|---|
| | | S-1 | | | | ML | Dark Brown (2.5 y 4/4), mottled with brownish black, SILT with trace fine sand and trace roots (stiff, moist)<br>**ALLUVIUM** | Groundwater not encountered. |
| | | S-2 | | W = 31<br>GS | | ML | Brown (2.5 y 4/3), mottled with brownish black, SILT with trace fine sand (stiff, moist) | |
| | | S-3 | | | | ML | Dark Brown (2.5 y 4/4), mottled with blackish gray, SILT with trace fine sand (stiff, moist) | |

Test Pit Completed 06/27/08
Total Depth of Test Pit = 8.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

City of Arlington Stormwater
Treatment Wetland
Snohomish County, Washington

Log of Test Pits

Figure
A-2

# TP-3

Excavation Method: Rubber-tired Backhoe
Ground Elevation (ft):
Excavated By: None
Logged By: MWB

| SAMPLE DATA | | | | | SOIL PROFILE | | | GROUNDWATER |
|---|---|---|---|---|---|---|---|---|
| Depth (ft) | Elevation (ft) | Sample Number & Interval | Sampler Type | Test Data | Graphic Symbol | USCS Symbol | | |
| 0<br>2 | | S-1 | | | ▥ | ML | Dark brown (2.5 y 4/2), SILT with trace sand and trace roots, (stiff, moist)<br>**ALLUVIUM** | Groundwater not encountered. |
| 4<br>6 | | S-2<br>S-3 | | | ▨ | ML/ CL | Light brown to orange (2.5 y 5/3), silty CLAY (stiff, moist)<br>-Increased clay at 3.5 feet | |
| 8 | | S-4 | | | ▨ | ML/ CL | Light brown to orange (2.5 y 5/3), silty CLAY (stiff, wet) | |

Test Pit Completed 06/27/08
Total Depth of Test Pit = 8.0 ft.

10

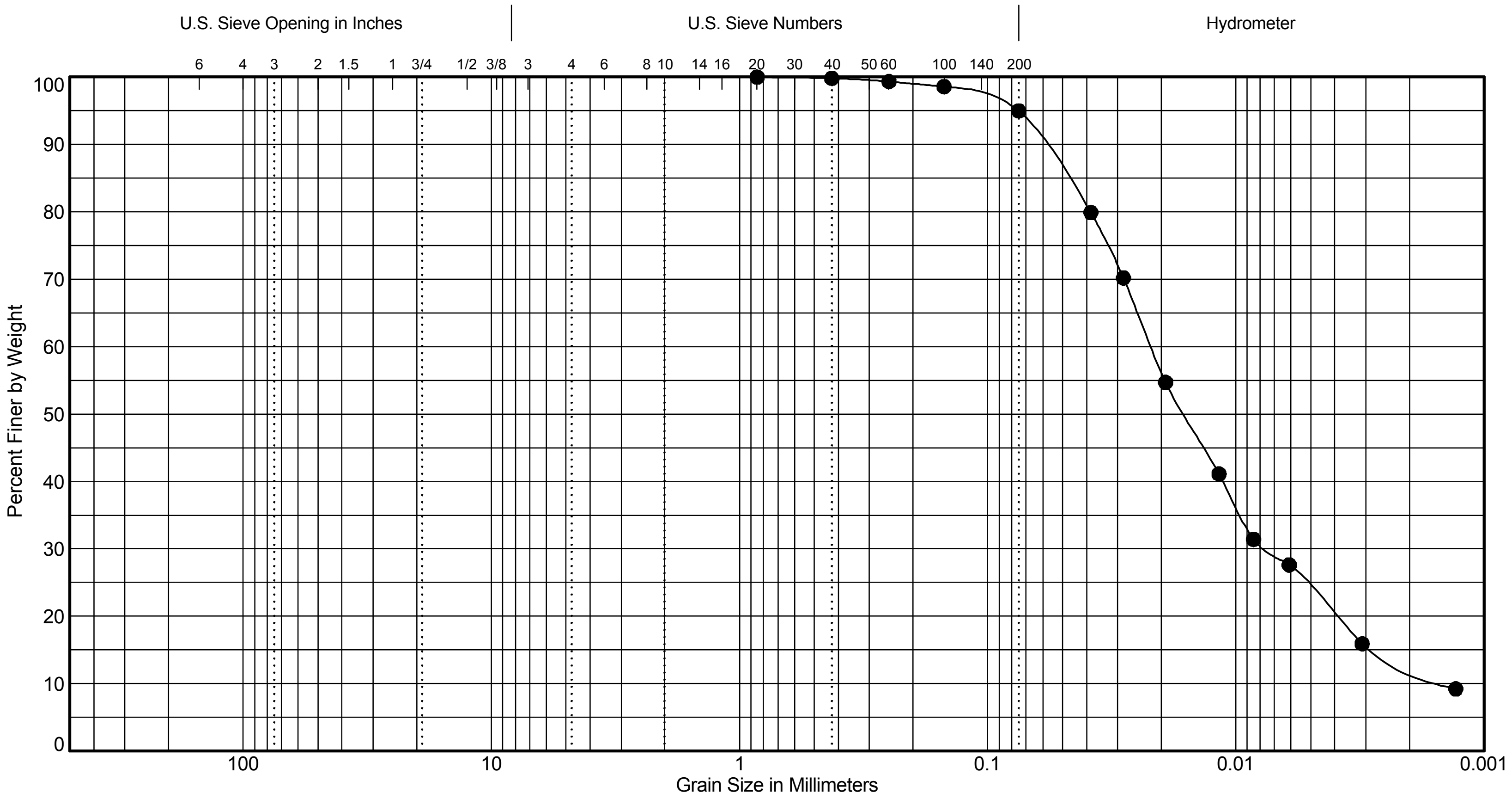
Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

LANDAU ASSOCIATES

City of Arlington Stormwater
Treatment Wetland
Snohomish County, Washington

Log of Test Pits

Figure
A-3



| Cobbles | Gravel | | Sand | | | Silt or Clay |
|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | |

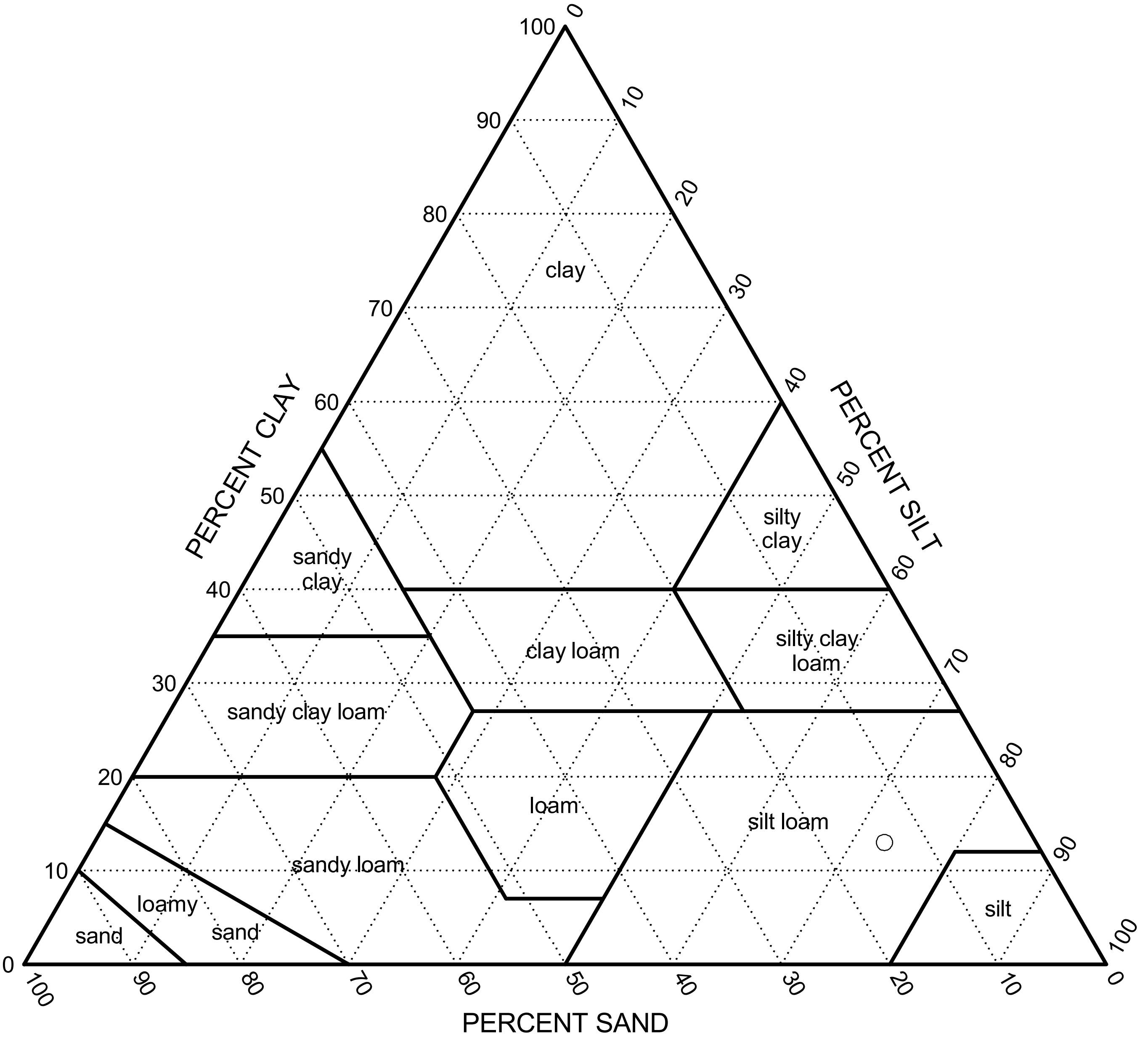
| Symbol | Exploration Number | Sample Number | Depth (ft) | Natural Moisture (%) | Soil Description | Unified Soil Classification |
|---|---|---|---|---|---|---|
| ● | TP-2 | | 3.5 | 31 | | |

**Landau Associates**

City of Arlington Stormwater
Treatment Wetland
Snohomish County, Washington

## Grain Size Distribution

Figure
A-4



| | Exploration Number | Sample Number | Depth (ft) | Natural Moisture (%) | USDA Textural Classification | USCS Classification |
|---|---|---|---|---|---|---|
| ○ | TP-2 | | 3.5 | 31 | SILT LOAM | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

LANDAU ASSOCIATES

City of Arlington Stormwater
Treatment Wetland
Snohomish County, Washington

USDA Textural Classification Chart

Figure
A-5

# APPENDIX A
# SOIL DESCRIPTIONS AND PROPERTIES

LOCATION PUGET WA
Established Series
Rev. DES/RJE/TDT
05/2000

## PUGET SERIES

The Puget series consists of very deep, poorly drained soils that formed in recent alluvium on floodplains and low river terraces. Slopes are 0 to 3 percent. The average annual precipitation is about 40 inches. The mean annual temperature is about 50 degrees F.

**TAXONOMIC CLASS:** Fine-silty, mixed, superactive, nonacid, mesic Fluvaquentic Endoaquepts

**TYPICAL PEDON:** Puget silty clay loam - pasture. (Colors are for moist soil unless otherwise noted.)

**Al**--0 to l inches; very dark grayish brown (2.5Y 3/2) silt loam, moderate thin platy structure; hard, firm, slightly sticky and slightly plastic; many roots; moderately acid (pH 6.0); abrupt smooth boundary. (l to 7 inches thick)

**A2**--l to 7 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light gray (2.5Y 7/2) dry; common fine prominent dark brown (7.5YR 4/4) redox concentrations; moderate very coarse prismatic structure; hard, firm, moderately sticky and moderately plastic; many roots; moderately acid (pH 6.0); clear smooth boundary. (0 to 7 inches thick)

**Bg1**--7 to l7 inches; dark grayish brown (2.5Y 5/2) silty clay loam, light olive gray (2.5Y 7/2) dry; common medium prominent strong brown (7.5YR 5/6, 5/8) redox concentrations; moderate medium prismatic structure; hard, firm, moderately sticky and moderately plastic; many roots; slightly acid (pH 6.2); clear smooth boundary. (5 to l2 inches thick)

**Bg2**--l7 to 25 inches; grayish brown (2.5Y 5/2) silty clay loam, light olive gray (5Y 6/2) dry; many medium prominent yellowish red (5YR 5/8, 4/8) redox concentrations; strong very coarse prismatic structure; very hard, firm, moderately sticky and moderately plastic; common roots; slightly acid (pH 6.4); abrupt smooth boundary. (0 to l2 inches thick)

**Bg3**--25 to 3l inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (5Y 7/2) dry; many medium prominent dark yellowish brown (l0YR 3/6) and yellowish red (5YR 5/8, 4/6) redox concentrations; moderate medium angular blocky structure; hard, firm, moderately sticky and moderately plastic; few roots; moderately acid (pH 6.0); abrupt wavy boundary. (0 to 6 inches thick)

**Bg4**--3l to 40 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (5Y 7/l) dry; common fine prominent strong brown (7.5YR 5/6) and yellowish red (5YR 4/8) redox concentrations;

strong very coarse prismatic structure; hard, firm, moderately sticky and moderately plastic; few roots; moderately acid (pH 5.8); clear smooth boundary. (0 to l0 inches thick)

**Cg1**--40 to 45 inches; greenish gray (5GY 5/l) silty clay loam, light gray (5Y 7/l) and white (5Y 8/l) dry; common fine prominent strong brown (7.5YR 5/6) and brown (7.5YR 4/4) redox concentrations; massive; hard, firm, moderately sticky and moderately plastic; moderately acid (pH 5.8); clear smooth boundary. (0 to 6 inches thick)

**Cg2**--45 to 60 inches; gray (5Y 5/l) silty clay, light gray (5Y 7/l) dry; few fine prominent yellowish red (5YR 4/8, 5/8) and common medium distinct light olive brown (2.5Y 5/4) redox concentrations; massive; very hard, firm, moderately sticky and moderately plastic, moderately acid (pH 6.0).

**TYPE LOCATION:** King County, Washington; 1/2 mile southwest of Carnation; 2,640 feet north and 600 feet east of the southwest corner of sec. 2l, T. 25 N., R. 7 E.

**RANGE IN CHARACTERISTICS:** The mean annual soil temperature is 47 to 52 degrees F. The particle-size control section lacks coarse fragments, has less than l5 percent fine and coarser sand, and l8 to 35 percent clay.

The A horizon has hue of 10YR or 2.5Y, value of 3 through 5 moist, 4 through 7 dry and chroma of l or 2 moist and dry. Subhorizons with a value of 3 moist are less than 7 inches thick. It is moderately acid to neutral.

The Bg horizon has hue of l0YR or 2.5Y, value of 4 or 5 moist, 6 or 7 dry and chroma of 2 moist, l or 2 dry. It is silt loam or silty clay loam. Some pedons have thin strata (less than 2 inches thick) or sand or loamy sand. This horizon is slightly acid to very strongly acid.

The Cg horizon has hue of l0YR, 2.5Y, 5Y, or 5GY, value of 4 or 5 moist, 6 or 7 dry and chroma of 0 to 2 moist and dry. It is silt loam, silty clay loam or silty clay and has strata of sand or loamy sand. It is slightly acid to very strongly acid.

**COMPETING SERIES:** This is the Aetna series. Aetna soils have a buried mollic epipedon that is 10 to 24 inches thick.

**GEOGRAPHIC SETTING:** The Puget soils are on flood plains at elevations ranging from l0 to 650 feet. They formed in recent alluvium. Slopes are 0 to 3 percent. The soils are in a mild marine climate. Average annual precipitation ranges from 35 to 55 inches, most of which falls as rain during the winter. Snow is infrequent. The average January temperature is about 38 degrees F.; average July temperature is about 64 degrees F.; and mean annual temperature is about 50 degrees F. The frost-free season is about l50 to l90 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the Briscot, Nooksack, Oridia, Puyallup, and Sultan soils. Briscot soils are coarse-loamy. Nooksack, Puyallup, and Sultan soils have a xeric moisture regime. In addition, Nooksack and Puyallup soils have a mollic epipedon. Oridia soils are coarse-silty.

**DRAINAGE AND PERMEABILITY:** Poorly drained; slow to ponded runoff; moderately slow permeability. These soils are subject to occasional periods of flooding from December to March. An apparent water table is as high as 1 foot over the surface to 1 foot below the surface at times from November to April unless the soil is drained.

**USE AND VEGETATION:** Most of the Puget soil has been cleared and drained for use as cropland. Seeded grass pasture, grass-legume hay, oats, and green-chop are the major crops. The natural vegetation is red alder, black cottonwood, western redcedar, and willow with an understory of trailing blackberry, salmonberry, Oregon-grape, western swordfern, Indian plum, hardhack, willow, and rush.

**DISTRIBUTION AND EXTENT:** The Puget Sound Basin of Western Washington; MLRA 2. The series is of moderate extent.

**MLRA OFFICE RESPONSIBLE:** Portland, Oregon

**SERIES ESTABLISHED:** Eastern part of Puget Sound Basin, Reconnaissance, l909.

**REMARKS:** Laboratory data are available on this series NSSL #S74WA61-7- 341-345. Diagnostic horizons and features recognized in this pedon are an ochric epipedon and a cambic horizon from 17 to 40 inches. The sediments have more than 0.2 percent organic carbon to a depth of 60 inches or more.

---

National Cooperative Soil Survey

U.S.A.

## Snohomish County Area, Washington Version date: 12/12/2006 10:53:45 PM

### 55—Puget silty clay loam (east portion of site)

### Map Unit Setting

- *Elevation:* 10 to 650 feet
- *Mean annual precipitation:* 35 to 55 inches
- *Mean annual air temperature:* 48 to 50 degrees F
- *Frost-free period:* 160 to 180 days

### Map Unit Composition

- *Puget, drained, and similar soils:* 85 percent
- *Minor components:* 6 percent

## Description of Puget, Drained

### Setting

- *Landform:* Flood plains
- *Parent material:* Alluvium

### Properties and qualities

- *Slope:* 0 to 2 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Poorly drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
- *Depth to water table:* About 24 to 48 inches
- *Frequency of flooding:* Rare
- *Frequency of ponding:* None
- *Available water capacity:* High (about 12.0 inches)

### Interpretive groups

- *Land capability classification (irrigated):* 3w
- *Land capability (nonirrigated):* 3w

### Typical profile

- *0 to 9 inches:* Silty clay loam
- *9 to 38 inches:* Silty clay loam
- *38 to 60 inches:* Silty clay loam

### Minor Components

### Snohomish

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

### Sumas

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

`LOCATION PUYALLUP WA`
Established Series
Rev. RJE
10/2002

# PUYALLUP SERIES

The Puyallup series consists of deep, well drained soils formed in recent alluvium. Puyallup soils are on floodplains and low terraces. Slopes are 0 to 3 percent. The mean annual temperature is about 50 F. The average annual precipitation is about 45 inches.

**TAXONOMIC CLASS:** Coarse-loamy over sandy or sandy-skeletal, isotic over mixed, mesic Vitrandic Haploxerolls

**TYPICAL PEDON:** Puyallup fine sandy loam - cultivated. (Colors are for moist soil unless otherwise stated.)

**Ap**--0 to 4 inches; very dark brown (l0YR 2/2) fine sandy loam, dark grayish brown (l0YR 4/2) dry; moderate medium and coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; slightly acid (pH 6.2); abrupt smooth boundary. (3 to 8 inches thick)

**A2**--4 to 8 inches; very dark grayish brown (l0YR 3/2) loam, dark grayish brown (l0YR 4/2) dry; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; moderately acid (pH 6.0); clear smooth boundary. (3 to 5 inches thick)

**A3**--8 to l8 inches; dark brown (l0YR 3/3) fine sandy loam, grayish brown (l0YR 5/2) dry; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots; many fine and medium and few large pores; slightly acid (pH 6.3); abrupt wavy boundary. (8 to 20 inches thick)

**2Cl**--l8 to 27 inches; dark brown (l0YR 3/3) loamy sand, grayish brown (l0YR 5/2) dry; single grained; loose; few fine roots; slightly acid (pH 6.4); abrupt wavy boundary. (8 to l5 inches thick)

**2C2**--27 to 60 inches; very dark grayish brown (2.5Y 3/2) gravelly sand, grayish brown (2.5Y 5/2) dry; single grained; loose; 20 percent pebbles; neutral (pH 6.8).

**TYPE LOCATION:** Clark County, Washington; along Lower East Fork Lewis River Road about 2,240 feet north and 600 feet west of the southeast corner of sec. l9, T. 4 N., R. 2 E.

**RANGE IN CHARACTERISTICS:** Depth to the 2C horizon is l5 to 30 inches. The mollic epipedon is 10 to 20 inches thick. Estimated mean annual soil temperature at a depth of 20 inches ranges from 47 to 53 degrees F. These soils are usually moist, but they are dry in all parts between depths of 7 and 20 inches for 60 to 75 consecutive days. The upper part of the particle-size control section has 5 to l5 percent clay and includes fine sandy loam or loam. The lower part has 0 to 5 percent clay. The soil ranges from neutral to moderately acid. The A horizon has hue of l0YR or 2.5Y, value of 2 or 3 moist, 3 to 5 dry, and chroma of l through 3 moist and dry. Below 10 inches it is loam or fine sandy loam. Some pedons have a B or C horizon.

The 2C horizon has hue of l0YR or 2.5Y, value of 32through 5 moist, 4 through 7 dry, and chroma of 1 through 4 moist and dry. It is sand, loamy sand, or gravelly sand and has 0 to 20 percent pebbles.

**COMPETING SERIES:** These are the Boesel, Chamokane, Newberg, and Snakelum series in other families. Boesel soils are frigid. Chamokane soils have a mollic epipedon more than 20 inches thick. Newberg soils lack contrasting textures within the l0- to 40-inch control section. Snakelum soils lack a mollic epipedon and have a regular decrease in organic matter content as depth increases.

**GEOGRAPHIC SETTING:** These soils are on floodplains and low stream terraces at elevations of 20 to 650 feet. The soils formed in mixed recent alluvium. The climate is humid; summers are cool and dry, and winters are mild and moist. Average annual precipitation is 35 to 60 inches. Mean January temperature is 37 degrees F, mean July temperature is 62 degrees F, mean annual temperature is about 50 degrees F, and frost-free season is l70 to 200 days.

**GEOGRAPHICALLY ASSOCIATED SOILS:** These are the Briscot, Mt. Vernon, Oridia, Pilchuck, Puget, and Sultan soils. Briscot, Oridia, and Puget soils have an aquic moisture regime. Pilchuck soils are sandy throughout. Mt. Vernon soils are medial over loamy. Sultan soils are fine-silty and have an ochric epipedon.

**DRAINAGE AND PERMEABILITY:** Well drained; very slow runoff; moderately rapid permeability in the upper part of the control section and rapid below. These soils are subject to occasional brief periods of flooding from November to April unless protected.

**USE AND VEGETATION:** Used for cropland. Principal crops are hay, pasture, and row crops. Native vegetation is Douglas-fir, western redcedar, bigleaf maple, black Cottonwood, western hemlock, and red alder, with an understory of trailing blackberry, salmonberry, Oregon-grape, western swordfern, vine maple, and western brackenfern.

**DISTRIBUTION AND EXTENT:** Western Washington and possibly western Oregon. The series is of moderate extent.

**MLRA OFFICE RESPONSIBLE:** Portland, Oregon

**SERIES ESTABLISHED:** Snohomish County, Washington, l936.

**REMARKS:** Classification only updated 3/94 because of recent amendments to Soil Taxonomy. Diagnostic horizons and features recognized in this pedon are a mollic epipedon from the surface to 18 inches and a textural change to sandy material at 18 inches. Organic carbon content is assumed to decrease irregularly with depth.

---

National Cooperative Soil Survey

U.S.A.

## Snohomish County Area, Washington Version date: 12/12/2006 10:53:45 PM

## 56—Puyallup fine sandy loam (west portion of site)

### Map Unit Setting

- *Mean annual precipitation:* 35 to 60 inches
- *Mean annual air temperature:* 50 degrees F
- *Frost-free period:* 170 to 200 days

### Map Unit Composition

- *Puyallup and similar soils:* 85 percent
- *Minor components:* 6 percent

### Description of Puyallup

### Setting

- *Landform:* Terraces
- *Parent material:* Alluvium

### Properties and qualities

- *Slope:* 0 to 3 percent
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 5.95 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* Rare
- *Frequency of ponding:* None
- *Available water capacity:* Moderate (about 6.3 inches)

### Interpretive groups

- *Land capability classification (irrigated):* 2w
- *Land capability (nonirrigated):* 2s

### Typical profile

- *0 to 10 inches:* Fine sandy loam
- *10 to 30 inches:* Fine sandy loam
- *30 to 60 inches:* Sand

## Minor Components

### Puget

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

### Sumas

- *Percent of map unit:* 3 percent
- *Landform:* Flood plains

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Component name (percent) | Rating reasons (rating values) | Acres in AOI | Percent of AOI |
|---|---|---|---|---|---|---|
| 55 | Puget silty clay loam | Somewhat limited | Puget, Drained (85%) | Depth to saturated zone (0.95)<br>Cutbanks cave (0.10) | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | Very limited | Puyallup (85%) | Cutbanks cave (1.00) | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | | | 17.8 | 100.0% |

## Tables — Shallow Excavations — Summary by Rating Value

### Summary by Rating Value

| Rating | Acres in AOI | Percent of AOI |
|---|---|---|
| Very limited | 12.3 | 69.1% |
| Somewhat limited | 5.5 | 30.9% |
| Totals for Area of Interest (AOI) | 17.8 | 100.0% |

## Description — Shallow Excavations

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

## Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | All Hydric | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | Partially Hydric | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Hydric Rating by Map Unit

This rating provides an indication of the proportion of the map unit that meets the criteria for hydric soils. Map units that are dominantly made up of hydric soils may have small areas, or inclusions, of nonhydric soils in the higher positions on the landform, and map units dominantly made up of nonhydric soils may have inclusions of hydric soils in the lower positions on the landform.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.
Federal Register. September 18, 2002. Hydric soils of the United States.
Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18.
Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation

Service. U.S. Department of Agriculture Handbook 436.
Soil Survey Staff. 2006. Keys to soil taxonomy. 10th edition. U.S. Department of Agriculture, Natural Resources Conservation Service.

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | All areas are prime farmland | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Farmland Classification

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | 3 | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | 2 | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Nonirrigated Capability Class

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations that show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels-capability class, subclass, and unit. Only class and subclass are included in this data set.

Capability classes, the broadest groups, are designated by the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 8 soils and miscellaneous areas have limitations that preclude commercial plant production and that restrict their use to recreational purposes, wildlife habitat, watershed, or esthetic purposes.

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating (centimeters) | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | 92 | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | >200 | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

## Rating Options — Depth to Water Table

**Units of Measure:** centimeters

**Aggregation Method:** Dominant Component

**Component Percent Cutoff:** *None Specified*

**Tie-break Rule:** Lower

**Interpret Nulls as Zero:** No

**Beginning Month:** January

**Ending Month:** December

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | Rare | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | Rare | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Flooding Frequency Class

Flooding is the temporary inundation of an area caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Frequency is expressed as none, very rare, rare, occasional, frequent, and very frequent.

"None" means that flooding is not probable. The chance of flooding is nearly 0 percent in any year. Flooding occurs less than once in 500 years.

"Very rare" means that flooding is very unlikely but possible under extremely unusual weather conditions. The chance of flooding is less than 1 percent in any year.

"Rare" means that flooding is unlikely but possible under unusual weather conditions. The chance of flooding is 1 to 5 percent in any year.

## Rating Options — Flooding Frequency Class

**Aggregation Method:** Dominant Condition

**Component Percent Cutoff:** *None Specified*

**Tie-break Rule:** More Frequent

**Beginning Month:** January

**Ending Month:** December

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | None | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | None | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Ponding Frequency Class

Ponding is standing water in a closed depression. The water is removed only by deep percolation, transpiration, or evaporation or by a combination of these processes. Ponding frequency classes are based on the number of times that ponding occurs over a given period. Frequency is expressed as none, rare, occasional, and frequent.

"None" means that ponding is not probable. The chance of ponding is nearly 0 percent in any year.

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | C | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | B | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | CL | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | SM | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Unified Soil Classification (Surface)

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and

Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating (centimeters per centimeter) | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | 0.20 | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | 0.10 | 12.3 | 69.1% |
| Totals for Area of Interest (AOI) | | | 17.8 | 100.0% |

## Description — Available Water Capacity

Available water capacity (AWC) refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in centimeters of water per centimeter of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure, with corrections for salinity and rock fragments. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. It is not an estimate of the quantity of water actually available to plants at any given time.

Available water supply (AWS) is computed as AWC times the thickness of the soil. For example, if AWC is 0.15 cm/cm, the available water supply for 25 centimeters of soil would be 0.15 x 25, or 3.75 centimeters of water.

For each soil layer, AWC is recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | 6.3 | 5.5 | 30.9% |

### Summary by Map Unit — Snohomish County Area, Washington

| | | | | |
|---|---|---|---|---|
| 56 | Puyallup fine sandy loam | 6.5 | 12.3 | 69.1% |

Totals for Area of Interest (AOI)17.8100.0%

## Description — pH (1 to 1 Water)

Soil reaction is a measure of acidity or alkalinity. It is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion. In general, soils that are either highly alkaline or highly acid are likely to be very corrosive to steel. The most common soil laboratory measurement of pH is the 1:1 water method. A crushed soil sample is mixed with an equal amount of water, and a measurement is made of the suspension.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

0-36 inches

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating (percent) | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 55 | Puget silty clay loam | 0 | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | 0 | 12.3 | 69.1% |

Totals for Area of Interest (AOI)17.8100.0%

## Description — Calcium Carbonate (CaCO3)

Calcium carbonate equivalent is the percent of carbonates, by weight, in the fraction of the soil less than 2 millimeters in size. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

0-36 inches

### Summary by Map Unit — Snohomish County Area, Washington

| Map unit symbol | Map unit name | Rating (milliequivalents per 100 grams) | Acres in AOI | Percent of AOI |
|---|---|---|---|---|

### Summary by Map Unit — Snohomish County Area, Washington

| | | | | |
|---|---|---|---|---|
| 55 | Puget silty clay loam | 23.0 | 5.5 | 30.9% |
| 56 | Puyallup fine sandy loam | 33.0 | 12.3 | 69.1% |

Totals for Area of Interest (AOI)17.8100.0%

## Description — Cation-Exchange Capacity (CEC-7)

Cation-exchange capacity (CEC-7) is the total amount of extractable bases that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations reduces the hazard of ground-water pollution.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

0-36 inches

## Snohomish County Area, Washington

| Map symbol and soil name | Pct. of map unit | Awm - overland flow process treatment of wastewater | | Awm - rapid infiltration disposal of wastewater | | Awm - slow rate process treatment of wastewater | |
|---|---|---|---|---|---|---|---|
| | | Rating class and limiting features | Value | Rating class and limiting features | Value | Rating class and limiting features | Value |
| 55—Puget silty clay loam | | | | | | | |
| Puget, drained | 85 | Very limited | | Very limited | | Somewhat limited | |
| | | Seepage | 1.00 | Slow water movement | 1.00 | Slow water movement | 0.96 |
| | | Depth to saturated zone | 0.43 | Depth to saturated zone | 1.00 | Depth to saturated zone | 0.43 |
| | | Flooding | 0.40 | | | | |
| Snohomish | 3 | Not rated | | Not rated | | Not rated | |
| Sumas | 3 | Not rated | | Not rated | | Not rated | |
| 56—Puyallup fine sandy loam | | | | | | | |
| Puyallup | 85 | Very limited | | Somewhat limited | | Very limited | |
| | | Seepage | 1.00 | Slow water movement | 0.32 | Filtering capacity | 0.99 |
| | | Flooding | 0.40 | | | | |
| Puget | 3 | Not rated | | Not rated | | Not rated | |
| Sumas | 3 | Not rated | | Not rated | | Not rated | |

APPENDIX B

# Construction Drawings (Landau Associates 2009)

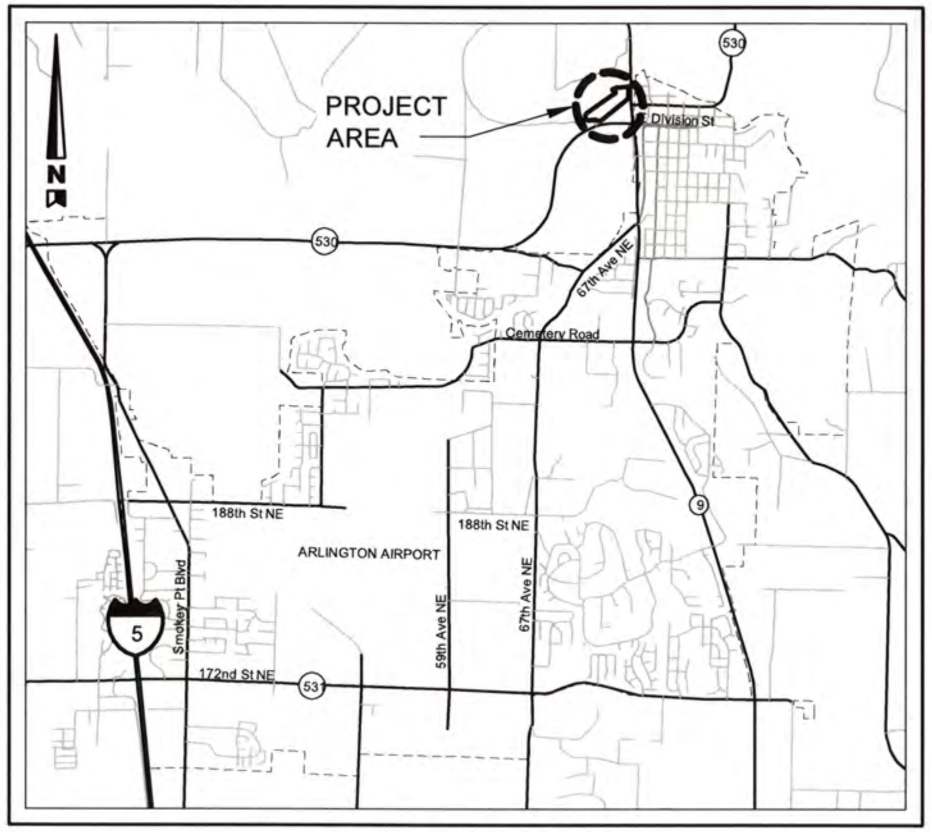
# STORMWATER WETLAND PROJECT

## 201 WEST COX

PROJECT FILE NO:

## SHEET INDEX

| SHEET NAME | SHEET # |
|---|---|
| COVER SHEET | 1 |
| HORIZONTAL CONTROL PLAN | 2 |
| TEMPORARY EROSION / SEDIMENT CONTROL PLAN | 3 |
| GENERAL NOTES & T.E.S.C. DETAILS | 4 |
| GRADING AND SHORELINE / FLOOD HAZARD PLAN | 5 |
| GRADING SECTIONS & PROFILES | 6 |
| GRADING DETAILS & SECTIONS | 7 |
| WEIR PLANS, SECTIONS & DETAILS | 8 |
| PIPING PLAN | 9 |
| PIPING DETAILS | 10 |
| SOIL AMENDMENT, PUBLIC ACCESS & SITE PROTECTION PLAN | 11 |
| PLANTING PLAN | 12 |
| PLANTING LIST & DETAILS | 13 |



## VICINITY MAP

N.T.S.

## CORE DESIGN TEAM

ENGINEERING GROUP
*JAMES KELLEY, P.E. (CITY OF ARLINGTON)*
*KELLEY WRIGG, P.E. (LANDAU ASSOCIATES, INC.)*
*DAVE PISCHER, P.E. (LANDAU ASSOCIATES, INC.)*
WETLAND SCIENTIST GROUP
*BILL BLAKE (CITY OF ARLINGTON)*
*MIKE WOLANEK (CITY OF ARLINGTON)*
*SACHA MAXWELL (LANDAU ASSOCIATES, INC.)*
*PERRY WELCH (LANDAU ASSOCIATES, INC.)*
FINANCING
*KRIS WALLACE (CITY OF ARLINGTON)*
PERMITTING
*BRENDA FECHT (CITY OF ARLINGTON)*

DAVID A. PISCHER 19771
David A. Pischer
1/11/2010

KELLEY E. WRIGG 35715
11 JAN 2010

APPROVED FOR CONSTRUCTION

PAUL ELLIS

CAPITAL IMPROVEMENT
PROJECT MANAGER

## City of Arlington Officials

DIRECTOR OF PUBLIC WORKS
*JAMES KELLY, P.E.*

MAYOR
*MARGARET LARSON*

COUNCIL MEMBERS
*STEVE BAKER*
*CHRIS RAEZER*
*SCOTT SOLLA*
*SALLY LIEN*
*MARILYN OERTLE*
*RICHARD BUTNER*
*LINDA BYRNES*

Last Saved By: btaylor Jan 11, 2010 - 5:09pm

# CITY OF ARLINGTON
# STORMWATER WETLAND PROJECT
# FULL DRAINAGE AND GRADING PLAN
## PORTION OF SW 1/4 OF SEC 2, TWP 31 N, R 5 E, W.M.

## LEGEND

| | |
|---|---|
| ▬ ▬ ▬ | PROPERTY BOUNDARY |
| —65— | PROPOSED CONTOURS (1 FT) |
| – – 64.5 – – | PROPOSED CONTOURS (.5 FT) |
| — | EXISTING CONTOURS (1 FT) |
| — – — | SECTION SUBDIVISION LINE |
| ▬ ▬ ▬ | CLEARING AND GRADING LIMITS |
| —o— | SILT FENCE |
| —F— | HIGH VISIBILITY FENCE |
| — | EXISTING WIRE FENCE |
| — – — | ROAD CENTERLINE |
| ━ | PROPOSED PIPE |
| - - - | EXISTING PIPE |
| -··-··- | N.G.P.A. / E. BOUNDARY |
| — · — · | APPROXIMATE LOCATION OF FLOODWAY BOUNDARY (SNOHOMISH COUNTY PERMIT AND ZONING MAP 2009) |
| — OHWM — | ORDINARY HIGH WATER MARK |
| — — — | WETLAND/STREAM BUFFER |
| = = = | EXISTING TRAIL |
| ▨ | EXISTING GRAVEL ROAD |
| ▭ | EXISTING PAVED ROAD |
| = = = | PROPOSED MOWED GRASS PATH |
| ▨ | PROPOSED GRAVEL PATH |
| ▨ | PROPOSED IMPROVED ROADWAY |
| ▭ | EXISTING WETLAND |
| ▨ | HISTORIC SITE PROTECTION AREA (NO GRADING) |
| ▨ | EXISTING BUILDING |
| B 5\|6 | CROSS SECTION LOCATION |

## LEGAL DESCRIPTION

SEC 02 TWP 31 RGE 05 RT-22-22B) BEG S1/4 COR TH N88*42 50W 241.8 FT TH N01*06 00W 502.4 FT TH N09* 23 00W 942.74 FT TH S89*24 30W 1452 .22 FT TO TPB TH N00*22 00E 687.43 FT THN56*42 00E 590.28 FT TH N71*34 30E 515 FT M/L TO ELY MGN VAC MARKET ST EXT NLY PLAT HALLER CITY TH SLY ALG EXT ELY MGN AFORSD MARKET ST TO NLY MGN RIVER- SIDE AVE TH ELY ALG SD NLY MGN RIVER- SIDE AVE TO WLY MGN MINOR ST TH SLY ALG SD WLY MGN MINOR ST TO NLY MGN DIV AVE TH WLY ALG SD NLY MGN DIV AVE TO TPB LESS PTN DD OR DEDICATED TO CO OR ST FOR RD SUBJ ESE PUD LESS S/HY & LESS ADDL R/W TO STATE PER SCC 97-2-07732-8

RECORDS OF SNOHOMISH COUNTY, WASHINGTON.

TAX PARCEL NUMBER: 31050200300200

SITE ADDRESS: 201 WEST COX

CONTACT PERSONS:
DAVE PISCHER, PE
SACHA MAXWELL
LANDAU ASSOCIATES
130 2ND AVE S.
EDMONDS, WA. 98020
PHONE: (425)778-0907

APPLICANT:
CITY OF ARLINGTON
BILL BLAKE
238 NORTH OLYMPIC AVE.
ARLINGTON, WA. 98223
PHONE: (360) 403-3500

## SITE INFORMATION

| | |
|---|---|
| CURRENT ZONING: | AG 10 (SNOHOMISH COUNTY) |
| GENERAL POLICY PLAN: | 111 SINGLE FAMILY RESIDENCE - DETACHED |
| PROPOSED LAND USE: | STORMWATER WETLAND CONSTRUCTION |
| GROSS SQUARE FOOTAGE: | 21.90 ACRES |
| WATER SUPPLY: | CITY OF ARLINGTON |
| SEWAGE DISPOSAL: | ON SITE SEPTIC SYSTEM |
| SCHOOL DISTRICT: | CITY OF ARLINGTON |
| FLOOD INSURANCE RATE MAP: | 53061C0384 |

## SHORELINE PERMIT INFORMATION

1. TOTAL VALUE OF CONSTRUCTION PROJECT IS ESTIMATED TO BE $900,000.
2. THIS PROJECT LOCATION IS NECESSARY AS IT IS LOCATED IMMEDIATELY DOWNSTREAM OF STORMWATER INPUT SOURCES AND IMMEDIATELY UPSTREAM OF THE EXISTING STORMWATER OUTFALL. THE PROJECT IS IN COMPLIANCE WITH CURRENT SHORELINE MANAGEMENT ACT POLICIES BECAUSE IT PRESERVES AND ENHANCES SHORELINE HABITAT, IMPROVES WATER QUALITY IN WATER OF THE STATE / SHORELINE OF THE STATE RIVER, AND IT INCREASES PUBLIC ACCESS, EDUCATION, AND RECREATION OPPORTUNITIES WITHIN THE SHORELINE ENVIRONMENT.
3. PERMITS FOR THIS PROJECT INCLUDE:

| JURISDICTION | PERMIT/CERTIFICATION/APPROVAL |
|---|---|
| SNOHOMISH COUNTY | SHORELINE PERMIT<br>FLOODPLAIN MANAGEMENT / FLOOD HAZARD<br>CLEARING AND GRADING PERMIT |
| WASHINGTON STATE DEPARTMENT OF ECOLOGY | WATER QUALITY CERTIFICATION<br>GENERAL CONSTRUCTION STORMWATER NPDES PERMIT |
| WASHINGTON STATE DEPARTMENT OF ARCHAEOLOGY AND HISTORIC PRESERVATION | FINDING OF "NO CULTURAL RESOURCE IMPACT" |
| CITY OF ARLINGTON (LEAD AGENCY) | STATE ENVIRONMENTAL POLICY ACT (SEPA) DNS |
| WASHINGTON STATE DEPARTMENT OF TRANSPORTATION / CITY OF ARLINGTON | RIGHT OF WAY USE PERMITS |

## SOURCES

A. NOT SURVEYED / APPROXIMATE (FROM AS-BUILTS)
B. SNOHOMISH COUNTY PERMITS PLANNING AND ZONING MAP 2009 / FEMA FIRM
C. NORTHWEST ARCHAEOLOGICAL ASSOCIATES, INC. 2006
D. WSDOT 1998

## MISC. NOTES

1. THERE IS AN EXISTING WSDOT BIOSWALE LOCATED WITHIN 15' OF THE PROPERTY IN THE WSDOT RIGHT OF WAY EAST OF THE ROUND HOUSE SITE.
2. THE STORMWATER POLLUTION SOURCE CONTROL B.M.P.'S BEING PROPOSED AT THIS SITE ARE GOOD HOUSEKEEPING.
3. THE PERMANENT WATER QUALITY AND QUANTITY CONTROL FACILITY BEING PROPOSED IS A CREATED WETLAND.
4. THE TEMPORARY B.M.P.'S BEING PROPOSED ON THIS SITE SHALL CONSIST OF THE INSTALLATION OF SILT FENCES, A CONSTRUCTION ENTRANCE AND ONSITE INFILTRATION OF CONSTRUCTION STORMWATER.

## CALL 48 HOURS BEFORE YOU DIG
## 1-800-424-5555

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES APPROVED FOR CONSTRUCTION

By: ______________ Date: ______________

R/W PERMIT NO. ______________ PFN ______________

## SITE CONDITIONS

SOILS: ACCORDING TO THE NRCS SOIL SURVEY OF SNOHOMISH COUNTY THE EASTERN TWO- FIFTHS OF THE ON-SITE SOILS CONSIST OF THE PUGET SILTY CLAY LOAM AND THE WESTERN THREE-FIFTHS ARE PUYALLUP FINE SANDY LOAM . BOTH SOILS CAN BE FOUND ON OUTWASH PLAINS AND THE PERMEABILITY RANGES FROM LOW TO MODERATE. WATER CAPACITY OF THESE SOILS IS LOW TO MODERATELY HIGH. ONSITE INVESTIGATIONS INDICATED THAT THESE SOILS WERE NOT SEPARATED AS SHOWN ON THE SCS MAP BUT RATHER INTERMIXED THROUGHOUT THE SITE. THE SOILS ARE INTERMIXED VERTICALLY AS WELL AS HORIZONTALLY. IN GENERAL THE PERMEABILITY AND WATER CAPACITY OF THE SOILS IS HIGHER IN THE NORTHERN PORTION OF THE PROPOSED WETLAND AREA THAN IN THE SOUTHERN PORTION.

## SIGNIFICANT LANDSCAPING FEATURES AND NATIVE VEGETATION

ALL VEGETATION BEYOND THE LIMITS OF DISTURBANCE SHALL REMAIN.

### VEGETATION:

THE MAJORITY OF THE SITE IS DOMINATED BY GRASSES AND FORBS INCLUDING VELVETGRASS, BENTGRASSES, CREEPING BUTTERCUP AND WHITE CLOVER. THE RIPARIAN AREA IS VEGETATED WITH SHRUBS AND TREES INCLUDING DOUGLAS FIR, RED ALDER, WESTERN RED CEDAR, WILLOWS AND HIMALAYAN BLACKBERRY. AFTER CONSTRUCTION IS COMPLETED, THE WETLAND AND BERMS WILL BE RE-VEGETATED WITH A MIX OF WETLAND AND UPLAND PLANTS (SEE THE WETLAND PLANTING PLAN)

### DRAINAGE:

CURRENTLY THE RAINFALL THAT LANDS ON THE SITE TENDS TO INFILTRATE INTO THE NATIVE SOILS. DURING FLOODING EVENTS, THE ENTIRE PROPERTY CAN BECOME FLOODED WITH A FEW FEET OF WATER, AND FLOW CAN EXIT THE PROPERTY ACROSS DIKE ROAD TO THE WEST, AND UNDER SR 530 VIA A CULVERT. AFTER FLOOD LEVELS FALL BELOW THE LEVEL OF THE OUTLETS, ALL THE REMAINING FLOOD WATER INFILTRATES INTO THE SOILS.

AFTER GRADING, THE RAINFALL WILL CONTINUE TO INFILTRATE IN AREAS WITHIN AND OUTSIDE OF THE PROPOSED WETLAND. THE WETLAND AREA WILL DRAIN THROUGH PIPING TO THE RIVER AFTER COMPLETION OF WORK.

### RISK ASSESSMENT

SLOPE: THE SITE HAS GENTLE SLOPES THAT GENERALLY DRAIN TO A LOW AREA IN THE CENTER OF THE PROPERTY. RAINFALL UPON THE PROPERTY INFILTRATES INTO THE NATIVE SOILS.

SOURCE OF WATER EROSION:
RAINFALL AND FLOOD EVENTS

SOILS: RIVER DEPOSITS, MAPPED AS PUYALLUP FINE SANDY LOAM, AND PUGET SILTY CLAY LOAM.

CONCLUSION: SIGNIFICANT EROSION/SILTATION IMPACT IS LOW FOR THE FOLLOWING REASONS: 1. PROPOSED AREAS OF DEVELOPMENT ARE IN GENTLE SLOPE AREAS; 2. THE SOIL PERMEABILITY IS MODERATE; 3. AVAILABLE WATER CAPACITY OF THE SOIL IS MODERATE; 4. WATER EROSION IS SLIGHT (RUNOFF IS SLOW); 5. EROSION CONTROL MEASURES AND GOOD CONSTRUCTION SITE MANAGEMENT IS TO BE FOLLOWED AS NOTED HEREIN.

DAVID A. PISCHER
1/11/2010

KELLEY E. WRIGG
35715
11 JAN 2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

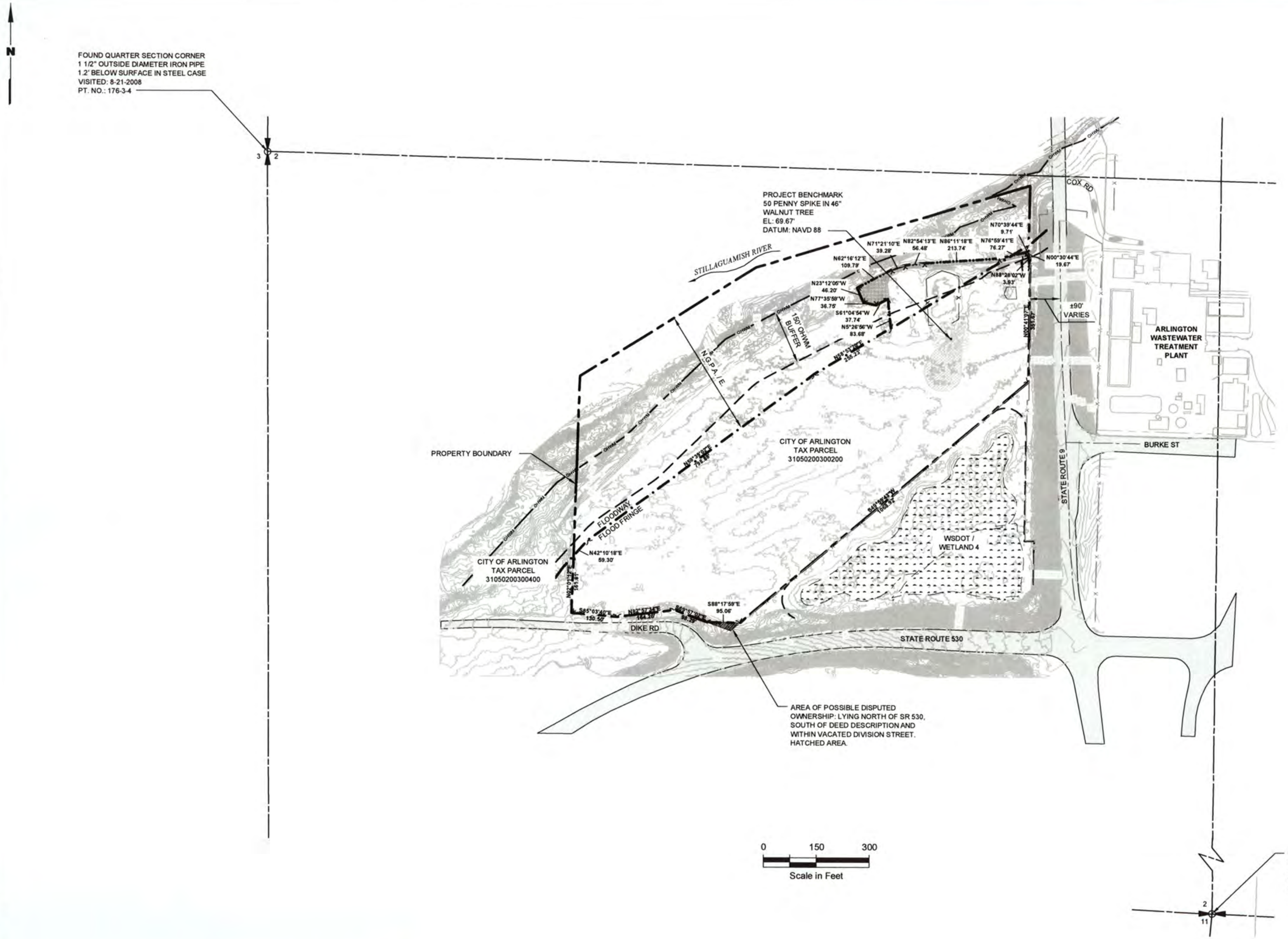
| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

COVER SHEET

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 1 OF 13
DRAWING NO. 1



FOUND QUARTER SECTION CORNER
1 1/2" OUTSIDE DIAMETER IRON PIPE
1.2' BELOW SURFACE IN STEEL CASE
VISITED: 8-21-2008
PT. NO.: 176-3-4

PROJECT BENCHMARK
50 PENNY SPIKE IN 46"
WALNUT TREE
EL: 69.67'
DATUM: NAVD 88

PROPERTY BOUNDARY

CITY OF ARLINGTON
TAX PARCEL
31050200300400

AREA OF POSSIBLE DISPUTED OWNERSHIP: LYING NORTH OF SR 530, SOUTH OF DEED DESCRIPTION AND WITHIN VACATED DIVISION STREET. HATCHED AREA.

FOUND QUARTER SECTION CORNER
2 1/2" OUTSIDE DIAMETER IRON PIPE WITH BRASS
NAIL TIP 0.7' BELOW SURFACE IN STEEL CASE
VISITED: 8-21-2008
PT. NO.: 176-3-1=21-35-1

## LEGEND

| | |
|---|---|
| ▬ ▬ ▬ | PROPERTY BOUNDARY |
| ── - ── | SECTION SUBDIVISION LINE |
| ── x ── | EXISTING WIRE FENCE |
| ── - ── | ROAD CENTERLINE |
| ▬··▬··▬ | N.G.P.A. / E. BOUNDARY |
| ▬ · ▬ · ▬ | APPROXIMATE LOCATION OF FLOODWAY BOUNDARY (SNOHOMISH COUNTY PERMIT AND ZONING MAP 2009) |
| ── OHWM ── | ORDINARY HIGH WATER MARK |
| — — — — | WETLAND/STREAM BUFFER |
| - - - - | EXISTING TRAIL |
| ▨ | GRAVEL ROAD |
| ═ | PAVED ROAD |
| ⁚⁚⁚ | EXISTING WETLAND |

## NOTE

PROPERTY DIMENSIONS PER TOPOGRAPHIC SURVEY MAP BY HUEY AND ASSOCIATES (2008). COORDINATES ON THIS PLAN SET PROVIDED FOR CONSTRUCTION PURPOSES ONLY, AND ARE NOT INTENDED TO REPRESENT A BOUNDARY SURVEY OF ANY KIND.

## SURVEY NOTES

### DATUM

DATUM: NAVD 88

### BENCH MARK

PROJECT BENCHMARK
50 PENNY SPIKE IN 46" WALNUT TREE
EL: 69.67'
DATUM: NAVD 88

TOPOGRAPHIC SURVEY FOR: THE CITY OF ARLINGTON

IN THE SOUTHWEST 1/4 OF SECTION 2, TOWNSHIP 31 NORTH, RANGE 5 EAST, W.M., SNOHOMISH COUNTY, WASHINGTON

HUEY SURVEYING & LAND CONSULTING, INC.
18933 59TH AVENUE NORTHEAST, SUITE 115
ARLINGTON, WASHINGTON 98223
TEL: (360) 474-9945; FAX: (360) 435-7360

METHOD OF SURVEY: COMBINATION CLOSED G.P.S. TRAVERSE USING TOPCON HIPERLITE SURVEY GRADE G.P.S. EQUIPMENT AND CONVENTIONAL RANDOM TRAVERSE USING TOPCON ITS-1 1" TOTAL STATION INSTRUMENT & GEODIMETER 600 3" ROBOTIC INSTRUMENT .

THIS SURVEY MEETS OR EXCEEDS THE REQUIREMENTS OF W.A.C. 332-130-090 AND THE STATE SURVEY RECORDING ACT. THIS SURVEY DOES NOT PURPORT TO SHOW ALL EASEMENTS, RESTRICTIONS, RESERVATIONS, OR ENCUMBRANCES OF RECORD OR NOT OF RECORD.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________________ Date: ____________________

R/W PERMIT NO. ____________________ PFN ____________________

DAVID A. PISCHER 19727
David A. Pischer
1/11/2010

KELLEY E. WRIGG 35715
K E Wrigg
11 JAN 2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

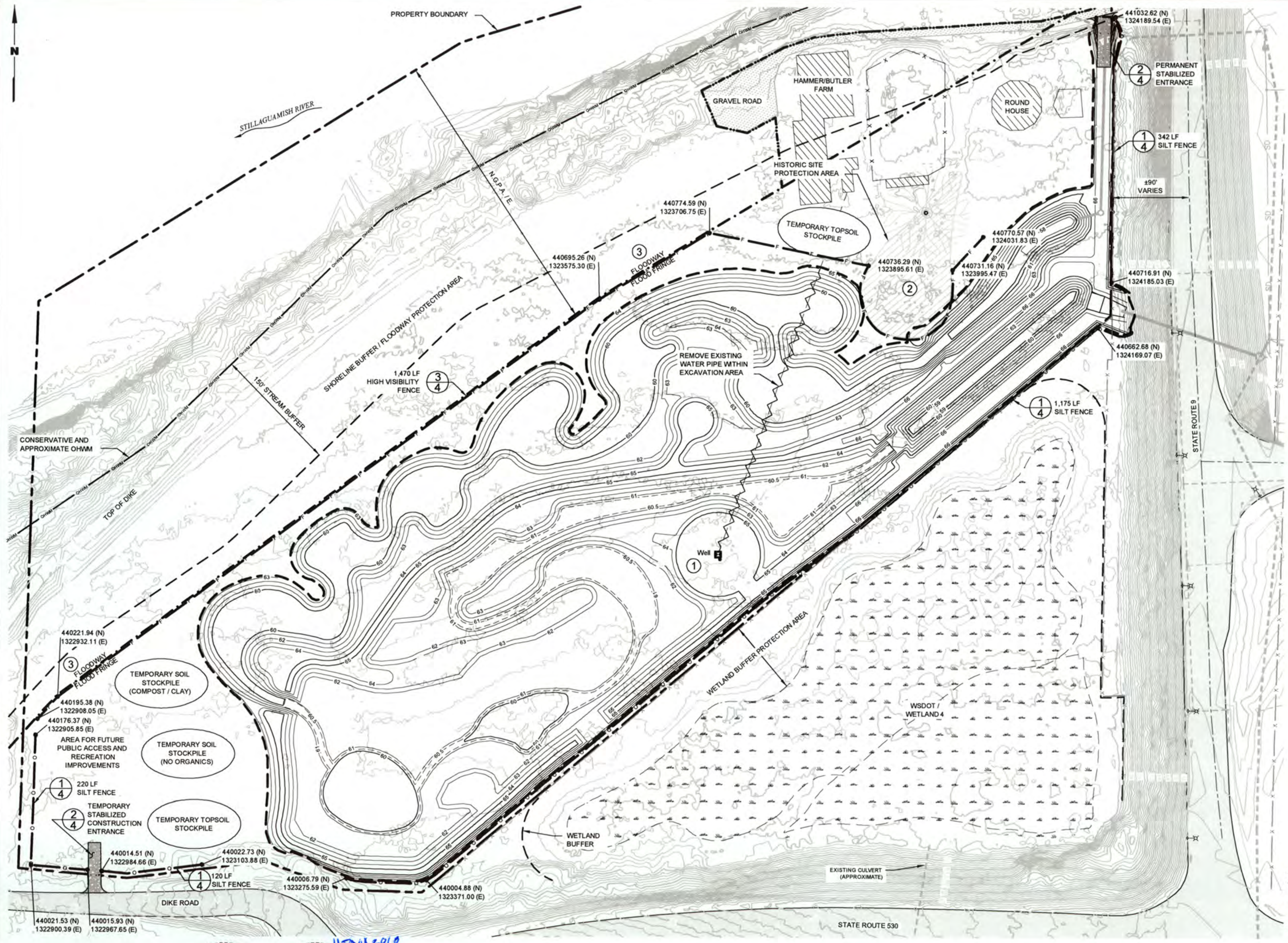
| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

HORIZONTAL CONTROL PLAN

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 2 OF 13
DRAWING NO. 2



## LEGEND

PROPERTY BOUNDARY
65 PROPOSED CONTOURS (1 FT)
64.5 PROPOSED CONTOURS (.5 FT)
EXISTING CONTOURS (1 FT)
CLEARING AND GRADING LIMITS
O SILT FENCE
F HIGH VISIBILITY FENCE
EXISTING WIRE FENCE
ROAD CENTERLINE
PROPOSED PIPE
EXISTING PIPE
N.G.P.A. / E. BOUNDARY
APPROXIMATE LOCATION OF FLOODWAY BOUNDARY (SNOHOMISH COUNTY PERMIT AND ZONING MAP 2009)
OHWM ORDINARY HIGH WATER MARK
WETLAND/STREAM BUFFER
EXISTING GRAVEL ROAD
EXISTING PAVED ROAD
EXISTING WETLAND

## KEY NOTES

① CONTRACTOR TO FLAG AND PROTECT EXISTING WELL. EXISTING WELL PIPE TO BE REMOVED. PROTECT AREA SURROUNDING WELL.

② NO EXCAVATION TO OCCUR WITHIN HISTORIC SITE PROTECTION AREA.

③ NO EARTHWORK TO OCCUR WITHIN FLOODWAY, EXCEPT FOR ACCESS TRAILS.

## CONSTRUCTION SEQUENCING NOTES

WORK IS EXPECTED TO BE CONDUCTED AS FOLLOWS UNLESS IT WILL CAUSE INEFFICIENCIES. THE GOAL OF THE SCHEDULE BELOW IS TO INCREASE LIKELIHOOD FOR PROJECT SUCCESS AND FACILITATE APPROVAL BY PROJECT BIOLOGIST/ENGINEER AT END OF EACH TASK.

NOTE: BORING AND PIPING WORK TO BE PHASED AT CONTRACTOR'S DISCRETION.

UPON CONTRACT AWARD:
A. CONDUCT ONSITE PRE-CONSTRUCTION MEETING WITH CITY BIOLOGISTS AND ENGINEERS.
B. SECURE MATERIALS AND PROVIDE DOCUMENTATION TO CITY FOR APPROVAL FOR ANY MODIFICATIONS OR SUBSTITUTIONS.

EARLY SUMMER (EXPECTED JUNE 2010) :
A. INSTALL EROSION CONTROLS AND STAKE GRUBBING LIMITS.
B. STOCKPILE SOILS, GRAVELS, ETC., ORDER PLANTS.
C. CLEAR ORGANIC LAYER (APPROXIMATELY 1 FOOT DEEP) AND STOCKPILE ONSITE AND STAKE ELEVATION.
D. CREATE ROUGH SUBGRADE (OVER-EXCAVATE BY 1 FT) AND STAKE ELEVATION.
E. INSTALL WEIRS, SPALLS, SPILLWAY, TRAIL, ROADWAY, AND OTHER SUCH HARD FEATURES.
F. CREATE FINAL ROUGH GRADE USING STOCKPILED ORGANIC MATERIAL AND STAKE ELEVATION.
G. INSTALL ADDITIONAL SOIL AMENDMENT AND STABILIZATION FEATURES.
H. INSTALL SIGNAGE, FENCING, TRAIL SURFACING, ETC..
I. HYDROSEED ENTIRE AREA (REFER TO SEEDING NOTES).
J. ALLOW STORMWATER TO ENTER SITE (OR AS DETERMINED BY PROJECT BIOLOGIST/ENGINEER).

NOTE: ABOVE-LISTED TASKS SHALL BE COMPLETED BY SEPTEMBER 30.

OCTOBER-NOVEMBER:
A. CONDUCT PLANTING AND WETLAND SEEDING.
B. PREPARE AND SUBMIT AS-BUILT SURVEY AND DOCUMENTATION.
C. PORTION OF PROJECT CLOSEOUT (OR AS DESCRIBED IN CONTRACT).

MAY - JUNE 2011:
A. REMOVE BMPS, RESEED, AND RECTIFY ANY SITE ISSUES, PER DIRECTION OF PROJECT BIOLOGIST/ENGINEER.

OCTOBER 2011:
A. REPLACE PLANTS, ETC. PER PROJECT WARRANTIES (SEE SPECIFICATIONS FOR DETAILS).
B. FINAL PROJECT CLOSE OUT.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________ Date: ____________

R/W PERMIT NO. ____________ PFN ____________

0 60 120
Scale in Feet

DAVID A. PISCHER
1/11/2010

35715
15JAN 2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|

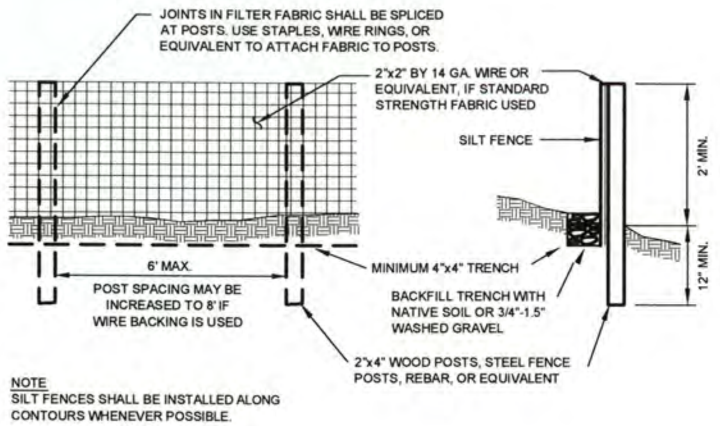
| | | | |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | INITIAL | DATE |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

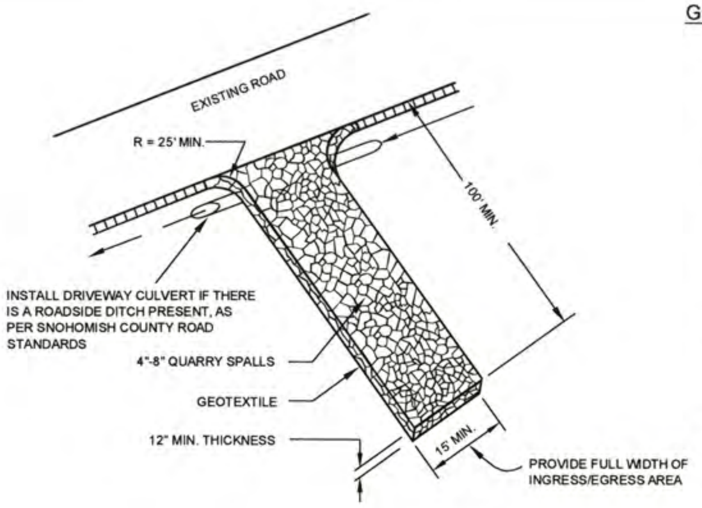
TEMPORARY EROSION /
SEDIMENT CONTROL PLAN

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 3 OF 13
DRAWING NO. 3



NOTE
SILT FENCES SHALL BE INSTALLED ALONG CONTOURS WHENEVER POSSIBLE.

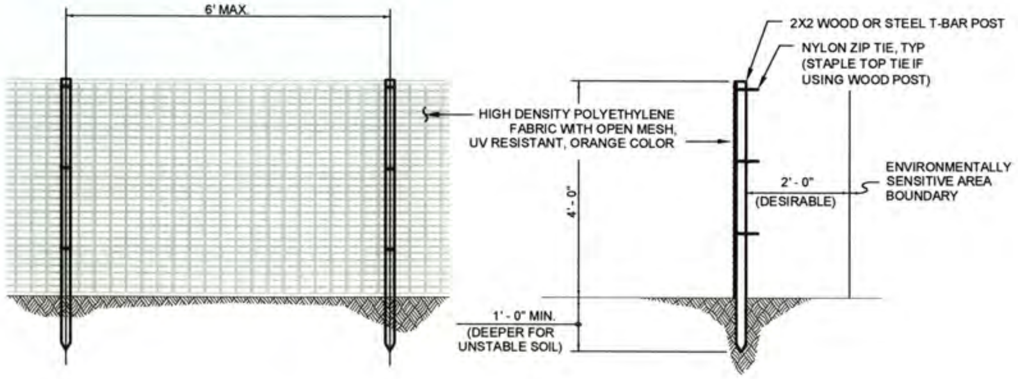
## ① SILT FENCE
3|4 NTS



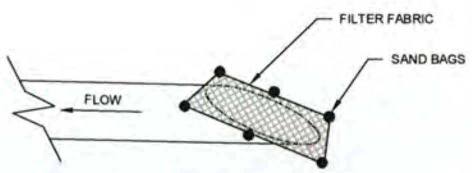
## ② STABILIZED CONSTRUCTION ENTRANCE
3|4 NTS

## SILT FENCE MAINTENANCE STANDARDS:

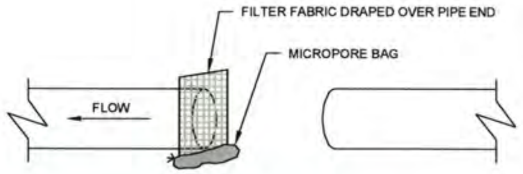
1. ANY DAMAGE SHALL BE REPAIRED IMMEDIATELY.
2. IF CONCENTRATED FLOWS ARE EVIDENT UPHILL OF THE FENCE, THEY MUST BE INTERCEPTED AND CONVEYED TO A SEDIMENT TRAP OR POND.
3. IT IS IMPORTANT TO CHECK THE UPHILL SIDE OF THE FENCE FOR SIGNS OF THE FENCE CLOGGING AND ACTING AS A BARRIER TO FLOW AND THEN CAUSING CHANNELIZATION OF FLOWS PARALLEL TO THE FENCE. IF THIS OCCURS, REPLACE THE FENCE OR REMOVE THE TRAPPED SEDIMENT.
4. SEDIMENT MUST BE REMOVED WHEN THE SEDIMENT IS 6 INCHES HIGH.
5. IF THE FILTER FABRIC (GEOTEXTILE) HAS DETERIORATED DUE TO ULTRAVIOLET BREAKDOWN, IT SHALL BE REPLACED.



## ③ HIGH VISIBILITY FENCE
3|4 NTS



TYPICAL PIPE INLET PROTECTION



TYPICAL CUT PIPE PROTECTION

## GENERAL NOTES

1. NON-COMPLIANCE WITH THE EROSION CONTROL REQUIREMENTS, WATER QUALITY REQUIREMENTS, AND CLEARING LIMITS VIOLATIONS MAY RESULT IN REVOCATION OF PROJECT PERMITS, PLAN APPROVAL, AND BOND FORECLOSURES.
2. PRIOR TO ANY SITE CONSTRUCTION TO INCLUDE CLEARING/LOGGING OR GRADING, THE SITE/LOT CLEARING LIMITS SHALL BE LOCATED AND FIELD-IDENTIFIED BY THE PROJECT SURVEYOR/ENGINEER AS REQUIRED BY THESE PLANS. THE PROJECT SURVEYOR/ENGINEERS' NAME AND TELEPHONE NUMBER ARE LANDAU ASSOCIATES INC., (425) 778-0907.
3. THE DEVELOPER/OWNER IS RESPONSIBLE FOR WATER QUALITY.
4. PRIOR TO ANY SITE WORK, THE CONTRACTOR SHALL CONTACT THE CHIEF INSPECTOR FOR LAND DEVELOPMENT DIVISION AT (425) 388-3385 TO SCHEDULE A PRECONSTRUCTION CONFERENCE. DUE TO FIELD CHANGES (REVISIONS), ENGINEERED AS-BUILTS SHALL BE REQUIRED PRIOR TO SITE APPROVAL.
5. THE TEMPORARY EROSION/SEDIMENTATION CONTROL FACILITY SHALL BE CONSTRUCTED PRIOR TO ANY GRADING OR EXTENSIVE LAND CLEARING IN ACCORDANCE WITH THE APPROVED TEMPORARY EROSION/SEDIMENTATION CONTROL PLAN. THESE FACILITIES MUST BE SATISFACTORILY MAINTAINED UNTIL CONSTRUCTION AND LANDSCAPING IS COMPLETED AND THE POTENTIAL FOR ON-SITE EROSION HAS BEEN REDUCED.
6. ALL SITE WORK MUST COMPLY TO CHAPTER 33 OF THE INTERNATIONAL BUILDING CODE AND TITLES 30.63B AND 30.63A OF THE SNOHOMISH COUNTY CODE.
7. ALL EARTHWORK SHALL BE PERFORMED IN ACCORDANCE WITH COUNTY STANDARDS. PRECONSTRUCTION SOILS INVESTIGATION MAY BE REQUIRED TO EVALUATE SOILS STABILITY.
8. T.E.S.C. MEASURES SHALL BE INSTALLED PRIOR TO ANY OTHER SITE WORK. THESE T.E.S.C. MEASURES SHALL BE CONSIDERED MINIMUM TO BE INSTALLED UNLESS DIRECTED OTHERWISE.
9. A GRADING PERMIT ISSUED PURSUANT TO TITLE 30.63B SCC AND CHAPTER 33 IBC AND APPROVAL OF THE TEMPORARY EROSION AND SEDIMENTATION CONTROL PLAN SHALL HAVE BEEN OBTAINED FROM SNOHOMISH COUNTY PDS FOR ANY ON-SITE GRADING WHICH IS NOT EXPRESSLY EXCEPTED BY SECTION SCC 30.68B.020.
10. PUBLIC STREETS ARE TO BE KEPT CLEAR OF DIRT AND DEBRIS DURING DURATION OF WORK.
11. THE SITE SOILS ARE GENERALLY CONSIDERED MOISTURE SENSITIVE AND AS SUCH ARE SUSCEPTIBLE TO DISTURBANCE BY CONSTRUCTION EQUIPMENT, PARTICULARLY DURING PERIODS OF WET WEATHER. THE GRADING CONTRACTOR SHALL TAKE ALL PRECAUTIONS TO LIMIT SURFACE DISTURBANCE AND PROTECT THE SITE GRADING AREA FROM EXCESSIVE RUNOFF EROSION.
12. SOIL STOCKPILES SHALL BE STABILIZED OR PROTECTED WITH SEDIMENT RETENTION BMP'S WITHIN 24 HOURS OF FORMATION.
13. GRADING AND CONSTRUCTION SHALL BE TIMED AND CONDUCTED IN STAGES TO MINIMIZE SOIL EXPOSURE.
14. CLEAR PLASTIC SHEETING SHALL HAVE A MIN. THICKNESS OF 6 MIL. AND MEET THE REQUIREMENTS OF WSDOT/APWA SECTION 9-14.5.
15. PLASTIC SHEETING SHOULD BE TOED IN AT THE TOP OF THE SLOPE TO PREVENT SURFACE FLOW BENEATH THE PLASTIC.
16. PLASTIC SHEETING SHALL BE ANCHORED WITH SANDBAGS OR TIRES ON ROPES WITH A MAXIMUM GRID SPACING OF 10' IN ALL DIRECTIONS.
17. WHERE POSSIBLE, NATURAL VEGETATIVE FILTER STRIPS SHOULD BE RETAINED TO LESSEN RUNOFF ON STEEP SLOPES.
18. UNVEGETATED SLOPES SHOULD BE TEMPORARILY SCARIFIED TO MINIMIZE RUNOFF. THIS MAY BE ACCOMPLISHED BY RUNNING A DOZER UP THE SLOPE TO CREATE GROOVES PERPENDICULAR TO THE SLOPE DIRECTION.
19. INLETS OF THE PERMANENT DRAINAGE SYSTEM SHALL BE PROTECTED FROM SEDIMENT INFLUX BY USE OF FILTER FABRIC, MICROPORE BAGS, AND SIMILAR FILTERING MATERIALS AND METHODS, (SEE DETAIL ON THIS SHEET).
20. THE T.E.S.C. MEASURES ARE TO BE REMOVED UPON THE COMPLETION OF SITE WORK AND/OR SITE STABILIZATION UPON APPROVAL OF THE ENGINEER.
21. CONSTRUCTION ACCEPTANCE WILL BE SUBJECT TO A WELL ESTABLISHED VEGETATION AND GROUND COVER THAT FULFILLS THE REQUIREMENT OF THE APPROVED CONSTRUCTION PLANS AND TITLE 30.63B SCC.
22. WHEN RAINFALL IS HEAVY (DEFINED AS RAINFALL HARD ENOUGH TO PRODUCE SEDIMENT RUN OFF FROM EXPOSED DIRT), ALL EXPOSED EARTHWORK SHALL BE COVERED. NO OTHER CONSTRUCTION ACTIVITY SHALL OCCUR ON PERVIOUS SURFACES DURING THESE PERIODS OF HEAVY RAIN.
23. SEDIMENT DEPOSITS SHALL BE REMOVED FROM ALL TEMP. DRAINAGE FACILITIES AND STRUCTURES UPON REACHING A DEPTH OF 6 INCHES.
24. SUFFICIENT T.E.S.C. BMP MATERIALS AND SUPPLIES TO PROTECT THE ENTIRE SITE SHALL BE STOCKPILED ON-SITE.
25. FROM OCTOBER 1 TO APRIL 30, NO SOIL MAY REMAIN EXPOSED FOR MORE THAN 2 DAYS.
26. FROM MAY 1 TO SEPTEMBER 30, NO SOIL MAY REMAIN EXPOSED FOR MORE THAN 7 DAYS.
27. DENUDED AREAS SHALL BE COVERED BY MULCH, SOD, PLASTIC, OR OTHER BMP'S AS NEEDED.
28. ALL LOCATIONS OF EXISTING UTILITIES HAVE BEEN ESTABLISHED BY FIELD SURVEY OR OBTAINED FROM AVAILABLE RECORDS AND SHOULD THEREFORE BE CONSIDERED APPROXIMATE ONLY AND NOT NECESSARILY COMPLETE. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO INDEPENDENTLY VERIFY THE ACCURACY OF ALL UTILITY LOCATIONS, AND TO FURTHER DISCOVER AND AVOID ANY OTHER UTILITIES WHICH MAY BE AFFECTED BY HIS WORK. THE CONTRACTOR SHALL CONTACT THE UTILITIES UNDERGROUND LOCATION SERVICE (1-800-424-5555) PRIOR TO CONSTRUCTION. THE OWNER OR HIS REPRESENTATIVE SHALL BE IMMEDIATELY CONTACTED IF A UTILITY CONFLICT EXISTS. A FEE OF $35.00 WILL BE CHARGED FOR EACH RE-LOCATE REQUEST.
29. ALL PIPE SHALL BE PLACED ON STABLE EARTH, OR IF IN THE OPINION OF THE ENGINEER THE EXISTING FOUNDATION IS UNSATISFACTORY, THEN IT SHALL BE EXCAVATED BELOW GRADE AND BACKFILLED TO GRADE WITH SAND-GRAVEL, CRUSHED ROCK, OR OTHER SUITABLE MATERIAL. NEVER INSTALL PIPE ON SOD, FROZEN EARTH, LARGE BOULDERS OR ROCK.
30. THE BACKFILL SHALL BE PLACED EQUALLY ON BOTH SIDES OF THE PIPE OR PIPE-ARCH IN LAYERS WITH A LOOSE AVERAGE DEPTH OF 6", MAXIMUM DEPTH 8", THOROUGHLY TAMPING EACH LAYER. THESE COMPACTED LAYERS MUST EXTEND FOR ONE DIAMETER ON EACH SIDE OF THE PIPE OR TO THE SIDE OF THE TRENCH. MATERIALS TO COMPLETE THE FILL OVER PIPE SHALL BE THE SAME AS DESCRIBED (REFER TO WSDOT STD. SPEC).
31. ALL FILLS SHALL BE COMPACTED TO A MINIMUM OF 95% OF MAXIMUM DRY DENSITY BY MODIFIED PROCTOR TEST, UNLESS OTHERWISE NOTED.
32. ALL WETLAND CELL AREAS SHALL HAVE TOPSOIL/ORGANIC SOIL THAT IS ROUGH-GRADED TO AVOID OVER-COMPACTION AND TO CREATE SMALL HUMMOCKS IN SURFACE.

### GEOTEXTILES

GEOTEXTILE USED FOR PERMANENT EROSION CONTROL BELOW SLOPE PROTECTION MATERIALS SHALL BE A WOVEN GEOTEXTILE MEETING THE REQUIREMENTS IN WSDOT STANDARD SPECIFICATION SECTION 9-33.2(1), TABLE 4 HIGH SURVIVABILITY AND TABLE 5 DRAINAGE CLASS C, AND SHALL BE INSTALLED IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION SECTION 2-12. A MINIMUM 6 INCHES OF AGGREGATE CUSHION MEETING THE REQUIREMENTS IN WSDOT STANDARD SPECIFICATION SECTION 9-33.3 SHALL BE PLACED BETWEEN THE GEOTEXTILE AND RIPRAP MATERIALS.

GEOTEXTILE USED FOR SOIL SEPARATION OR STABILIZATION BELOW FILL MATERIALS SHALL BE A NONWOVEN GEOTEXTILE MEETING THE REQUIREMENTS IN WSDOT STANDARD SPECIFICATION SECTION 9-33.2(1), TABLE 3 FOR SOIL STABILIZATION AND SHALL BE INSTALLED IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION SECTION 2-12.

### GRAVEL SURFACING FOR ROADWAYS AND TRAILS

GRAVEL SURFACING FOR ACCESS ROADS AND TRAILS SHALL MEET THE REQUIREMENTS IN WSDOT STANDARD SPECIFICATION SECTION 9-03.9(3) FOR CRUSHED SURFACING TOP COURSE, AND SHALL BE PLACED IN MAXIMUM 8 INCH LOOSE LIFTS AND COMPACTED TO A FIRM AND UNYIELDING CONDITION.

### TOPSOIL STOCKPILING AND PLACEMENT

EXISTING ORGANIC TOPSOIL WITHIN THE WORK AREA SHALL BE STRIPPED/GRUBBED AND STOCKPILED AT THE DESIGNATED LOCATIONS. THE MATERIAL SHALL BE PROCESSED (MIXED AND BLENDED) TO FORM A CONSISTENT TOPSOIL MIXTURE, AND SHALL BE PLACED IN ALL WETLAND POOL AND CHANNEL AREAS TO FORM A SURFICIAL 1 FT PLANTING LAYER. TRACK THE TOPSOIL IN PLACE AND AVOID OVER-COMPACTION OF THE SURFICIAL PLANTING LAYER. SEPARATE AND MAINTAIN THE MAXIMUM AMOUNT OF TOPSOIL/ORIGANIC MATERIAL (TURF/SOD) FROM NON-ORGANIC SOILS.

### CLAYEY SOILS AND NATIVE SOIL STOCKPILING AND PLACEMENT

NON-ORGANIC CLAY AND SILTY CLAY MATERIALS ENCOUNTERED IN EXCAVATIONS SHALL BE SEGREGATED AND STOCKPILED AS DIRECTED BY THE ENGINEER. SUCH CLAYEY MATERIALS SHALL BE PLACED AND COMPACTED WITHIN CELLS 1, 2, AND 3 AS DIRECTED BY THE ENGINEER TO HELP REDUCE SOIL INFILTRATION IN THESE CELLS.

OTHER NON-ORGANIC NATIVE MATERIALS ENCOUNTERED IN EXCAVATIONS SHALL BE SEGREGATED AND STOCKPILED AS DIRECTED BY THE ENGINEER. SUCH MATERIALS SHALL BE PLACED AND COMPACTED TO FORM THE WETLAND BERMS, WITH EXCESS MATERIAL TO BE TRANSPORTED TO AN APPROVED OFFSITE FILL AREA.

### WEIR SUBGRADE PREPARATION

IF DIRECTED BY THE ENGINEER, TEMPORARILY STOCKPILE EXCAVATED NATIVE SOIL OVER THE WEIR FOUNDATION AREA TO SURCHARGE THE SUBGRADE SOILS AND LIMIT THE POTENTIAL FOR POST-CONSTRUCTION SETTLEMENT.

EXCAVATE EXISTING SOILS TO ACHIEVE THE DESIRED SUBGRADE ELEVATION AT EACH WEIR LOCATION. REMOVE ANY DELETERIOUS MATERIAL AS DIRECTED BY THE ENGINEER. REWORK AND COMPACT THE EXPOSED SOIL SO THAT THE UPPER 1 FOOT OF THE NATIVE SUBGRADE MATERIAL IS COMPACTED TO AT LEAST 95 PERCENT OF ITS MAXIMUM DRY DENSITY AS DETERMINED BY THE ASTM D 1557 TEST PROCEDURE (MODIFIED PROCTOR). ANY AREAS OF SOFT/LOOSE SOIL OR AREAS EXHIBITING SIGNIFICANT DEFLECTION/PUMPING/WEAVING THAT CANNOT BE ADEQUATELY REWORKED AND/OR COMPACTED SHALL BE OVEREXCAVATED AND REPLACED WITH COMPACTED CRUSHED ROCK.

PLACE A SOIL STABILIZATION GEOTEXTILE OVER THE PREPARED SUBGRADE PRIOR TO PLACEMENT AND COMPACTION OF THE CRUSHED ROCK LAYER BELOW THE WEIR FOUNDATION. CRUSHED ROCK SHALL MEET THE REQUIREMENTS IN WSDOT STANDARD SPECIFICATION SECTION 9-03.9(3) FOR CRUSHED SURFACING BASE COURSE, AND SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF ITS MAXIMUM DRY DENSITY AS DETERMINED BY THE ASTM D 1557 TEST PROCEDURE (MODIFIED PROCTOR).

### BERM CONSTRUCTION

FOLLOWING STRIPPING AND GRUBBING OF ORGANIC TOPSOIL AND ANY OTHER DELETERIOUS MATERIAL WITHIN THE FOOTPRINT OF THE BERM, REWORK AND COMPACT THE EXPOSED SOIL SO THAT THE UPPER 1 FOOT OF THE NATIVE SUBGRADE MATERIAL IS COMPACTED TO AT LEAST 92 PERCENT OF ITS MAXIMUM DRY DENSITY AS DETERMINED BY THE ASTM D 1557 TEST PROCEDURE (MODIFIED PROCTOR). ANY AREAS OF SOFT/LOOSE SOIL OR AREAS EXHIBITING SIGNIFICANT DEFLECTION, PUMPING, OR WEAVING THAT CANNOT BE ADEQUATELY REWORKED AND/OR COMPACTED SHALL BE OVEREXCAVATED AND REPLACED WITH COMPACTED FILL MATERIAL.

MOISTURE CONDITION, PLACE, AND COMPACT NON-ORGANIC NATIVE FILL MATERIALS IN MAXIMUM 8 INCH LOOSE LIFTS TO CONSTRUCT THE WETLAND BERMS. COMPACT THE BERM FILL MATERIAL TO AT LEAST 95 PERCENT OF ITS MAXIMUM DRY DENSITY AS DETERMINED BY THE ASTM D 1557 TEST PROCEDURE (MODIFIED PROCTOR). IF NEEDED TO ACHIEVE ADEQUATE COMPACTION NEAR THE FACE OF MORE CRITICAL BERM AREAS, OVERBUILD AND THEN TRIM THE BERM FILL TO ITS LINES AND GRADES.

### RIPRAP AND QUARRY SPALLS

RIPRAP AND QUARRY SPALLS USED FOR SLOPE PROTECTION AND EROSION CONTROL SHALL MEET THE REQUIREMENTS IN WSDOT STANDARD SPECIFICATION SECTION 9-13.1(2) FOR LIGHT LOOSE RIPRAP, AND SHALL BE PLACED IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION SECTION 8-15.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ______________________ Date: ______________________

R/W PERMIT NO. ______________________ PFN ______________________

DAVID A. PISCHER
David A. Pischer
1/11/2010

KELLEY E. WRIGG
35715
11 JAN 2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

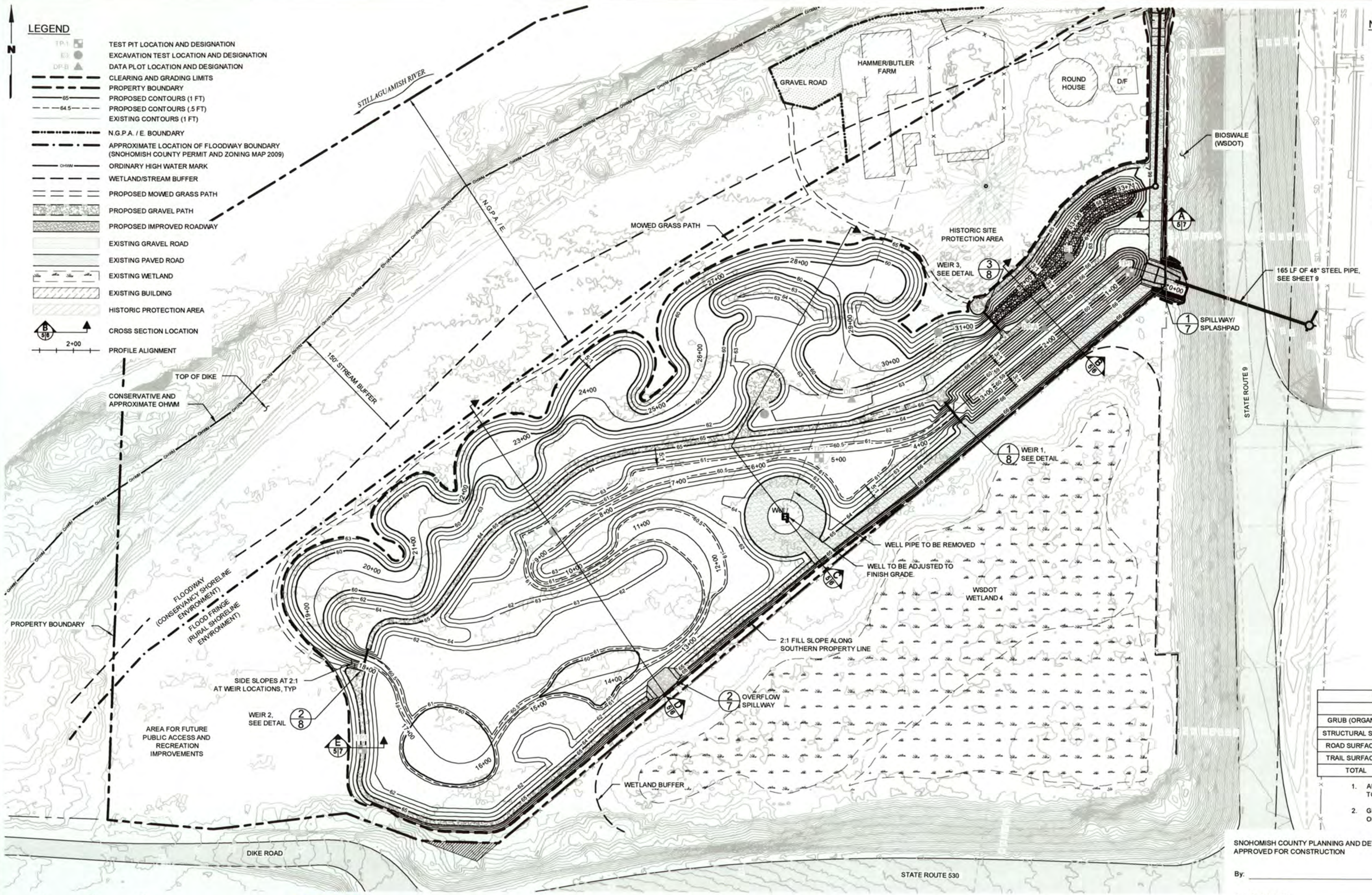
| | | | |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| | | | |
| STATUS: | | INITIAL | DATE |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

GENERAL NOTES & T.E.S.C DETAILS

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 4 OF 13
DRAWING NO. 4



## LEGEND

| | |
|---|---|
| TP-1 ▨ | TEST PIT LOCATION AND DESIGNATION |
| E3 ● | EXCAVATION TEST LOCATION AND DESIGNATION |
| DP-B ▲ | DATA PLOT LOCATION AND DESIGNATION |
| | CLEARING AND GRADING LIMITS |
| | PROPERTY BOUNDARY |
| 65 | PROPOSED CONTOURS (1 FT) |
| 64.5 | PROPOSED CONTOURS (.5 FT) |
| | EXISTING CONTOURS (1 FT) |
| | N.G.P.A. / E. BOUNDARY |
| | APPROXIMATE LOCATION OF FLOODWAY BOUNDARY (SNOHOMISH COUNTY PERMIT AND ZONING MAP 2009) |
| OHWM | ORDINARY HIGH WATER MARK |
| | WETLAND/STREAM BUFFER |
| | PROPOSED MOWED GRASS PATH |
| | PROPOSED GRAVEL PATH |
| | PROPOSED IMPROVED ROADWAY |
| | EXISTING GRAVEL ROAD |
| | EXISTING PAVED ROAD |
| | EXISTING WETLAND |
| | EXISTING BUILDING |
| | HISTORIC PROTECTION AREA |
| B 5/8 | CROSS SECTION LOCATION |
| 2+00 | PROFILE ALIGNMENT |

## NOTES

1. OVER-EXCAVATE TO AT LEAST 1.0 FT BELOW FINISHED GRADE IN CELLS 1, 2, AND 3.
2. REPLACE STOCKPILED ORGANIC TOP SOIL TO CREATE FINAL GRADE.
3. BOTH SUBGRADE AND FINAL GRADES WITHIN WETLAND CELLS SHOULD BE ROUGH GRADED, AND OVER-COMPACTION OF AREAS TO BE VEGETATED SHALL BE AVOIDED.
4. ANY SMOOTH OR SLICK-LOOKING SLOPES MUST BE SCARIFIED PERPENDICULAR TO SLOPE.
5. CONTOUR LINES SHOWN CREATED FOR MODELING PURPOSES. ACTUAL CONTOUR SHOULD BE MORE NATURALISTIC (NO SHARP EDGES).
6. NO EARTH WORK TO OCCUR IN FLOODWAY.
7. PLACE ROUNDED COBBLES TO COVER ALL BARE SURFACE (SOIL OR GRASS) TO THE 61 FT CONTOUR WITHIN CELL 4.

GRADING VOLUME SUMMARY (CY)

| | CUT | FILL | IMPORT | EXPORT |
|---|---|---|---|---|
| GRUB (ORGANIC) | 13,700 | 9,800 | | 3,900 |
| STRUCTURAL SOILS | 15,000 | 4,500 | | 10,500 |
| ROAD SURFACING | | | 750 | |
| TRAIL SURFACING | | | 150 | |
| TOTAL | 28,700 | 14,300 | 900 | 14,400 |

1. AUTOCAD GENERATED USING SURFACE TO SURFACE VOLUME COMPARISON
2. GRUBBING ASSUMED TO BE A DEPTH OF 1 FT OVER 8.72 ACRES

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________ Date: ____________

R/W PERMIT NO. ____________ PFN ____________

DAVID A. PISCHER 19777
1/11/2010

KELLEY E. WRIGG 35715
11 JAN 2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |

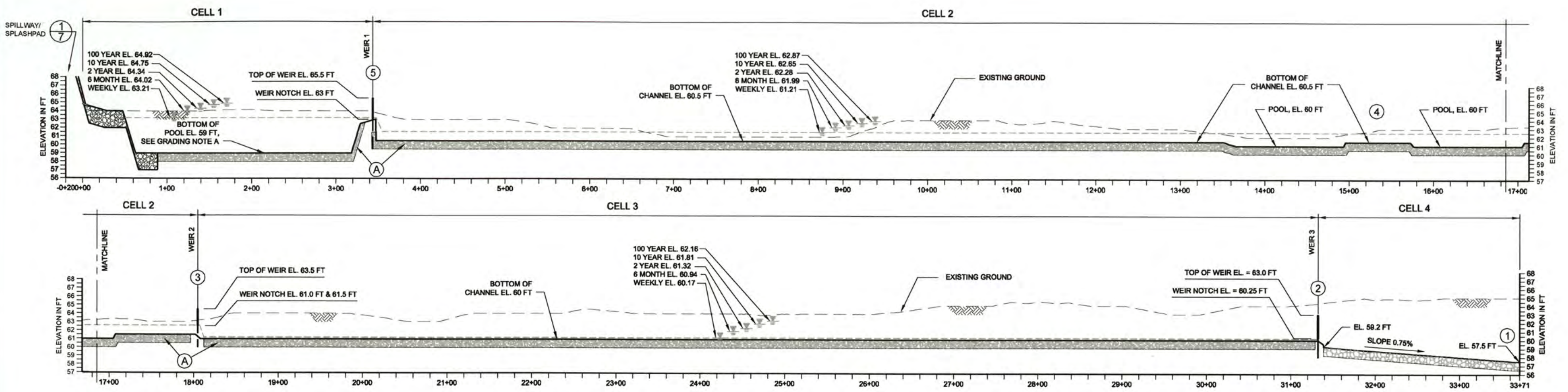
| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

GRADING AND
SHORELINE / FLOOD HAZARD PLAN

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 5 OF 13
DRAWING NO. 5



## HYDROLOGIC PROFILE

HORIZ SCALE: 1" = 60'
VERT SCALE: 1"=6'

## GRADING NOTE

Ⓐ EXISTING SUBSURFACE SOIL SHALL BE OVER EXCAVATED BY 1.0 FT IN ALL POOL & CHANNEL AREAS AND REPLACED WITH PROCESSED NATIVE TOPSOIL.

| RAINFALL SUMMARY | |
|---|---|
| WEEKLY STORM EVENT | 0.38 INCHES |
| 6 MONTH STORM EVENT | 1.26 INCHES |
| 2 YEAR STORM EVENT | 1.80 INCHES |
| 10 YEAR STORM EVENT | 2.75 INCHES |
| 100 YEAR STORM EVENT | 3.75 INCHES |

## RIVER AND PIPE BACKWATER

THE EXISTING BUTLER OUTFALL IS OFTEN INUNDATED DURING WINTER AND SPRING RIVER FLOWS. THE BUTLER OUTFALL IS OFTEN AT OR JUST ABOVE THE WATER LEVEL DURING THE SUMMER. DURING THE WINTER THE OUTFALL IS OFTEN UNDERWATER. IN THE EXISTING CONDITION THERE IS NO FLOODGATE ON THE OUTFALL PREVENTING RIVER WATER FROM FLOWING BACK TO THE PROPOSED WETLAND WHEN THE RIVER LEVEL RISES. A FLOODGATE SHOULD BE INSTALLED WHEN THE BUTLER OUTFALL IS REPAIRED AS PART OF A FUTURE PROJECT.

BACKWATER WILL OCCUR IN THE PIPING SYSTEM AND THE WETLAND WHEN THE FLOWS THROUGH THE WETLAND ARE ABOVE THE LEVEL OF A 10 YEAR STORM EVENT. IT CAN ALSO OCCUR WHEN THE RIVER LEVEL RISES HIGH ENOUGH TO PREVENT WETLAND FLOW FROM EXITING THE BUTLER OUTFALL OR RESTRICTS IT ENOUGH TO CAUSE BACKWATER CONDITIONS FOR A LOWER STORM EVENT.

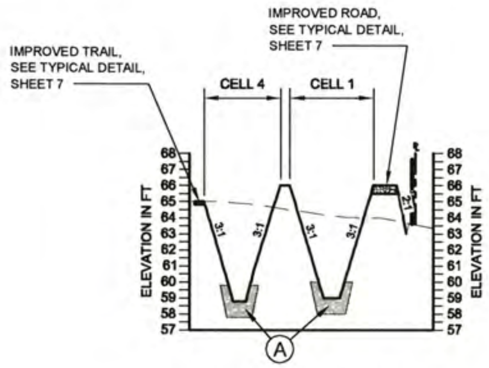
① IN THESE SITUATIONS THE BACKWATER BEGINS IN THE BUTLER OUTFALL PIPE. AS WETLAND WATER FLOWS TOWARDS THE OUTFALL AND CANNOT EXIT EITHER AS FAST AS IT ENTERS OR AT ALL, A POOL BEGINS TO FORM IN THE BUTLER OUTFALL PIPE. THIS POOL INTERFERES WITH THE PERFORMANCE OF THE NEXT PIPE IN THE SYSTEM, AND THIS CONTINUES UP THE CHAIN OF PIPE UNTIL THE WATER BEGINS TO POOL IN CELL 4.

② AFTER THE POOL IN CELL 4 REACHES AN ELEVATION OF 60.25 FT, IT WILL BEGIN TO INTERFERE WITH THE FLOWS FROM CELL 3 INTO CELL 4. EVENTUALLY CELL 3 AND CELL 4 WILL BECOME A SINGLE POOL OF WATER WHICH RISES AT THE SAME RATE.

③ AFTER THE COMBINED POOL (CELL 3 AND 4) REACHES AN ELEVATION OF 61.0 FT IT WILL BEGIN TO INTERFERE WITH THE FLOWS FROM THE LOWER WEIR 2 NOTCH INTO CELL 3. AT A BACKWATER ELEVATION OF 61.5 FT, IT WILL BEGIN TO INTERFERE WITH THE UPPER (HIGH FLOW) NOTCH FROM CELL 2 INTO CELL 3. EVENTUALLY CELLS 2, 3, AND 4 WILL BECOME A SINGLE POOL OF WATER WHICH RISES AT THE SAME RATE.

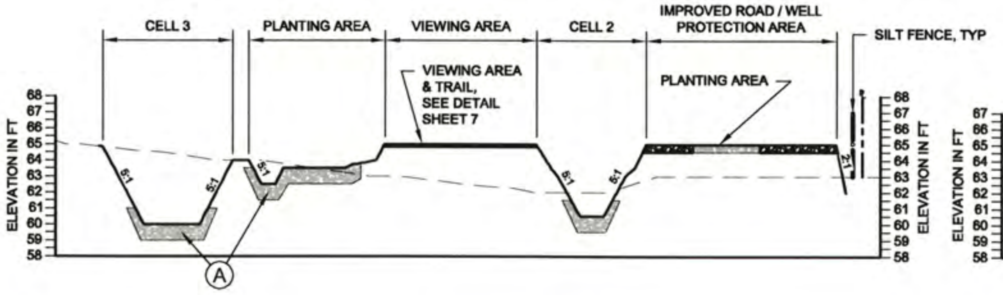
④ AT A BACKWATER ELEVATION OF 62.5 FT, FLOWS WILL BEGIN INTO THE WSDOT WETLAND THROUGH THE OVERFLOW WEIR FROM CELL 2.

⑤ AT A BACKWATER ELEVATION OF 63 FT, FLOWS WILL BEGIN TO OVERTOP THE WETLAND ON THE NORTHERN SIDE OF THE WETLAND AND FLOW OVER DIKE ROAD TO THE WEST.



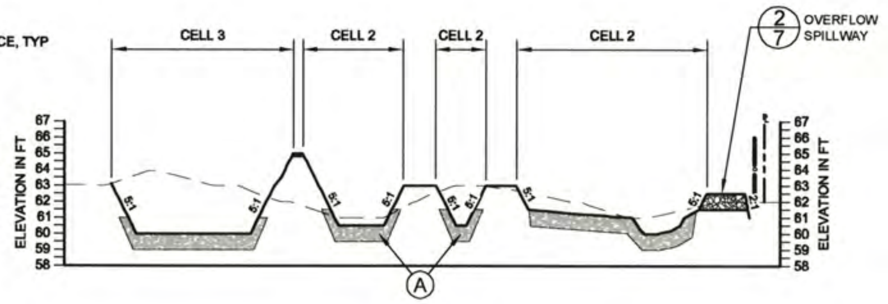
### SECTION B-B

B/5|6
HORIZ SCALE: 1" = 60'
VERT SCALE: 1" = 6'



### SECTION C-C

C/5|6
HORIZ SCALE: 1" = 60'
VERT SCALE: 1" = 6'



### SECTION D-D

D/5|6
HORIZ SCALE: 1" = 60'
VERT SCALE: 1" = 6'

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________ Date: ____________

R/W PERMIT NO. ____________ PFN ____________

DAVID A. PISCHER 19777
1/11/2010

KELLEY E. WRIGG 35715
11-JAN-2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|

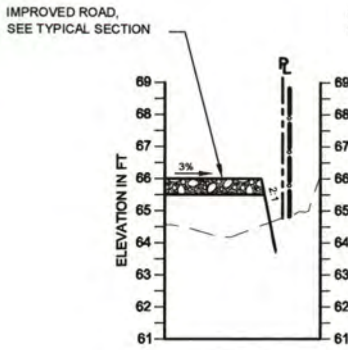
| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

GRADING SECTIONS & PROFILES

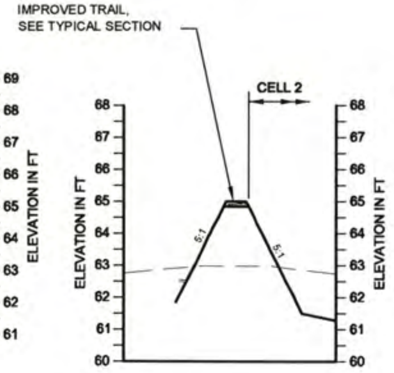
PROJECT NO 1097001.010.015
DATE 1-12-2010
SHEET 6 OF 13
DRAWING NO 6



## SECTION A-A

A 5|7

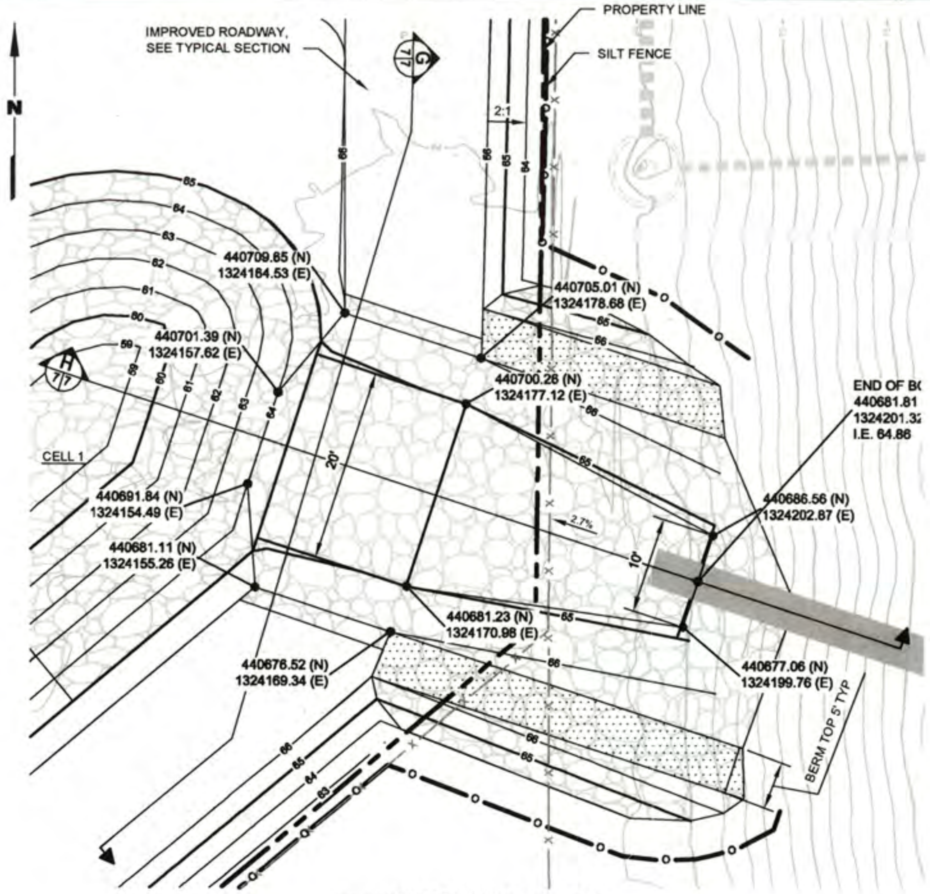
HORIZ SCALE: 1" = 30'
VERT SCALE: 1" = 3'



## SECTION E-E

E 5|7

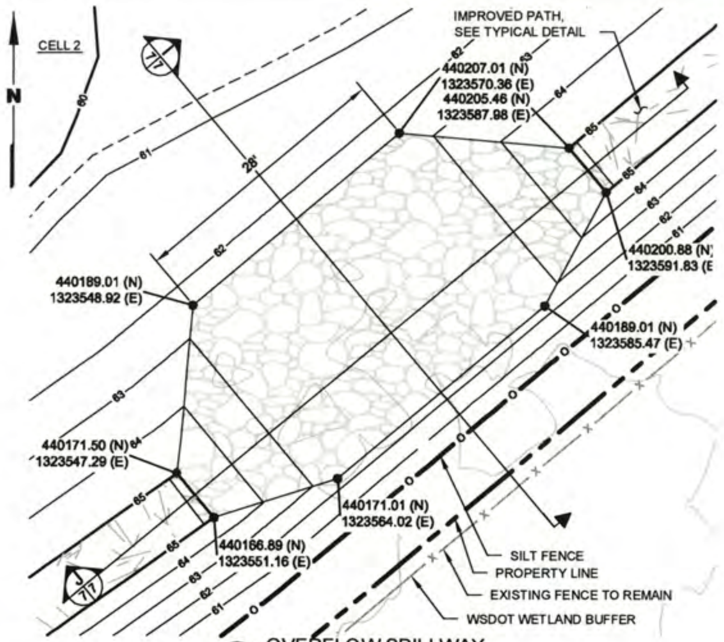
HORIZ SCALE: 1" = 30'
VERT SCALE: 1" = 3'



## SPILLWAY/SPLASHPAD

1 5|7

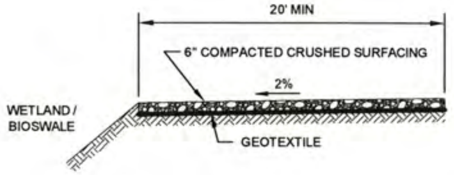
SCALE: 1" = 10'



## OVERFLOW SPILLWAY

2 5|7

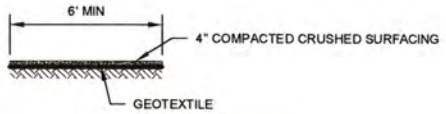
SCALE: 1" = 10'



1. ROAD SHALL BE MAINTAINED BY THE CITY OF ARLINGTON
2. SUBGRADE SHALL BE PREPARED AND COMPACTED IN A MANNER SIMILAR TO THE BERM CONSTRUCTION NOTES ON SHEET 4.

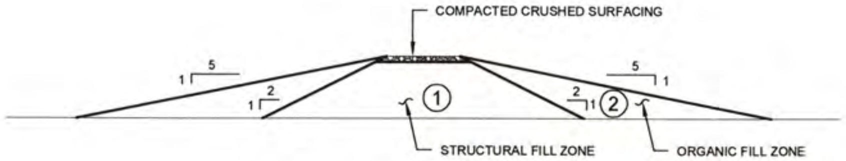
## TYPICAL IMPROVED ROAD SECTION

N.T.S.



## TYPICAL IMPROVED PATH SECTION

N.T.S.



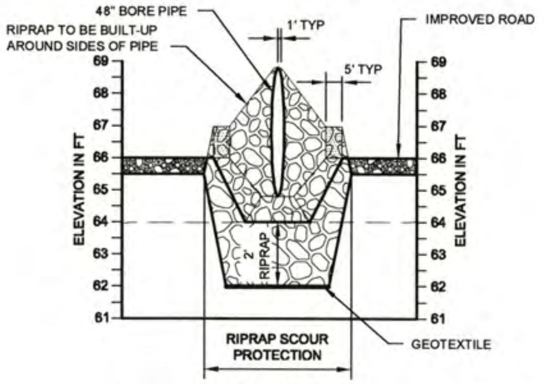
## TYPICAL BERM CONSTRUCTION SECTION

N.T.S.

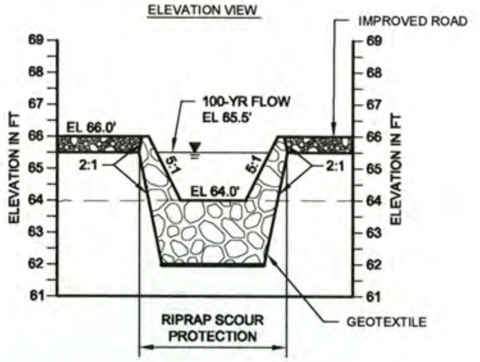
## KEY NOTES

① COMPACT, SEE NOTE 31 ON SHEET 4.

② AVOID OVER-COMPACTION, SEE NOTE 32 ON SHEET 4.



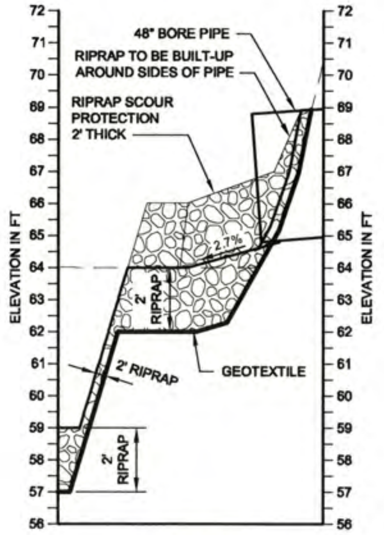
ELEVATION VIEW



## SECTION G-G

G 7|7

HORIZ SCALE: 1" = 30'
VERT SCALE: 1" = 3'

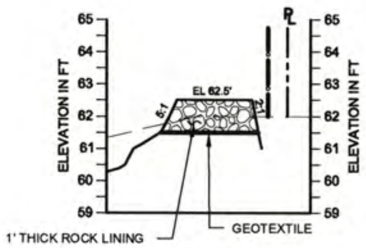


ELEVATION VIEW

## SECTION H-H

H 7|7

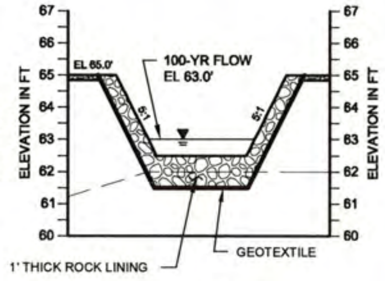
HORIZ SCALE: 1" = 30'
VERT SCALE: 1" = 3'



## SECTION I-I

I 7|7

HORIZ SCALE: 1" = 30'
VERT SCALE: 1" = 3'



## SECTION J-J

J 7|7

HORIZ SCALE: 1" = 30'
VERT SCALE: 1" = 3'

## LEGEND

| | |
|---|---|
| — — — — | CLEARING AND GRADING LIMITS |
| ——o—— | SILT FENCE |
| —— – – —— | PROPERTY BOUNDARY |
| ——65—— | PROPOSED CONTOURS (1 FT) |
| – – –64.5– – – | PROPOSED CONTOURS (.5 FT) |
| ——— | EXISTING CONTOURS (1 FT) |
| ▨ | PROPOSED GRAVEL PATH |
| ▨ | PROPOSED IMPROVED ROADWAY |
| J 7\|7 | CROSS SECTION LOCATION |

## SCOUR PROTECTION SPECIFICATIONS

ROCK LINING MUST BE QUARRY SPALLS WITH GRADATION AS FOLLOWS:
PASSING 8-INCH-SQUARE SIEVE: 100%
PASSING 3-INCH-SQUARE SIEVE: 40%-60% MAX.
PASSING 3/4"-INCH-SQUARE SIEVE: 0-10% MAX.

RIPRAP MUST BE REASONABLY WELL-GRADED WITH GRADATION AS FOLLOWS:
MAXIMUM STONE SIZE: 24-INCH (NOMINAL DIAMETER)
MEDIAN STONE SIZE: 16-INCH
MINIMUM STONE SIZE: 4-INCH

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________ Date: ____________

R/W PERMIT NO. ____________ PFN ____________

DAVID A. PISCHER 19777
1/11/2010

KELLEY E. WRIGG 35715
11 JAN 2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY | | | |
| STATUS | | | |

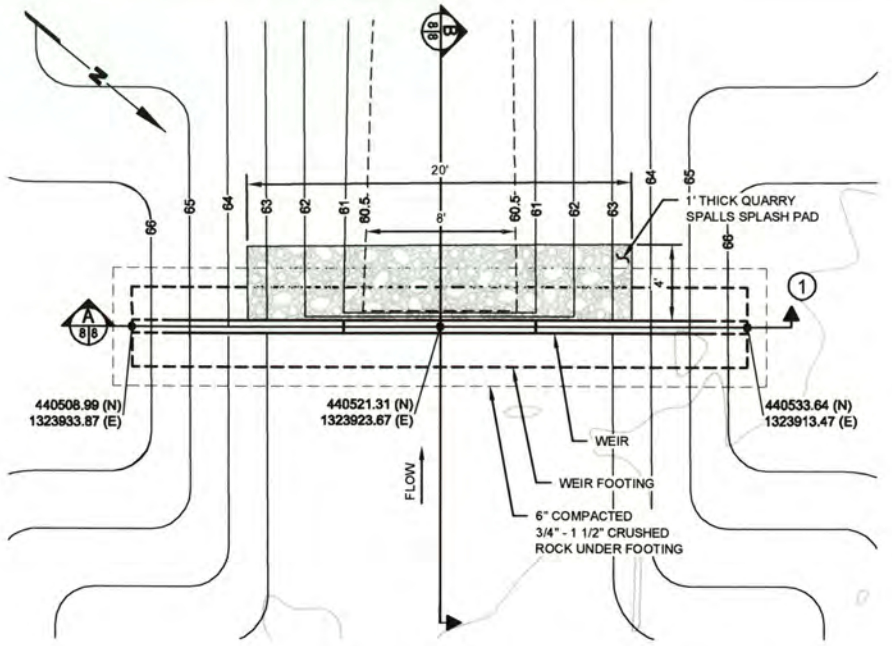
LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

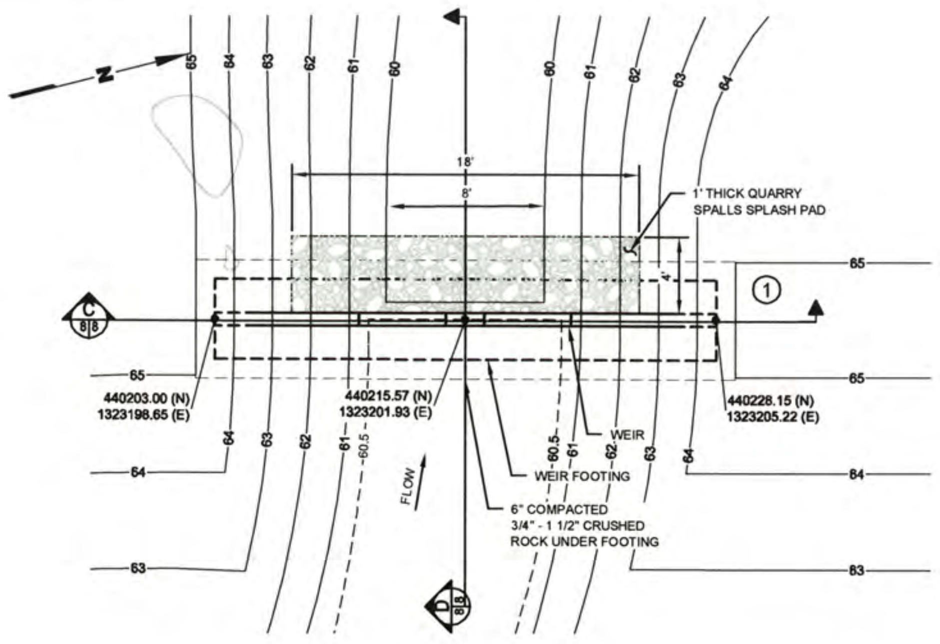
GRADING DETAILS & SECTIONS

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 7 OF 13
DRAWING NO. 7

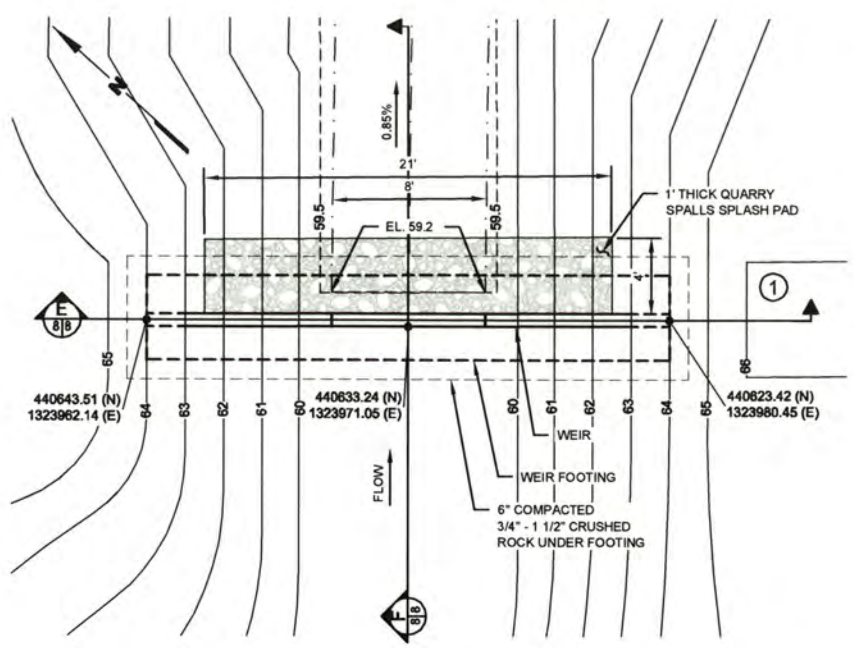
LANDAU ASSOCIATES, INC. | V:\1097\001\010\015\D\Cons R3\LAI Design R3.1.dwg



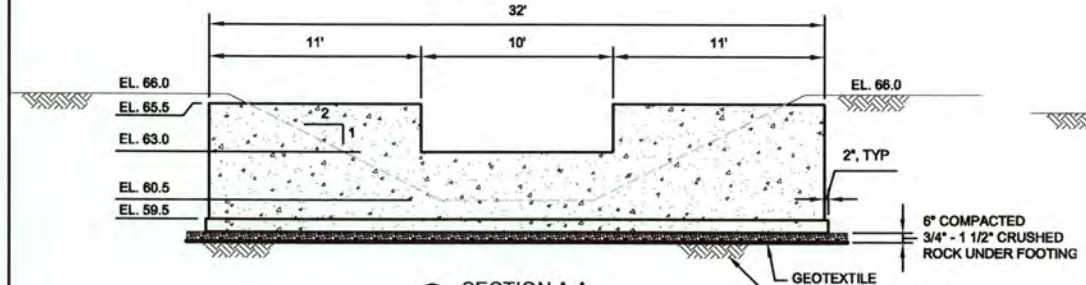
1 5|8 WEIR NO. 1
SCALE: 1" = 5'



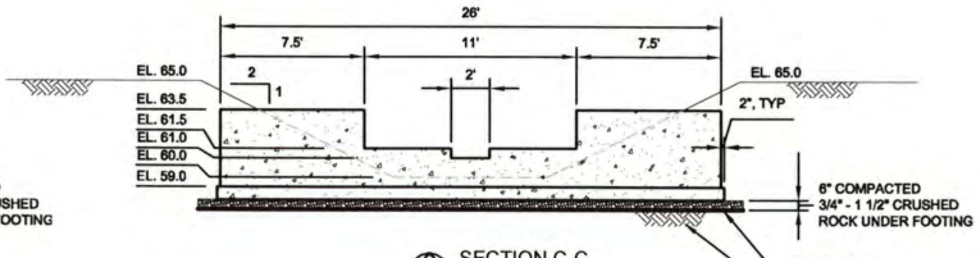
2 5|8 WEIR NO. 2
SCALE: 1" = 5'



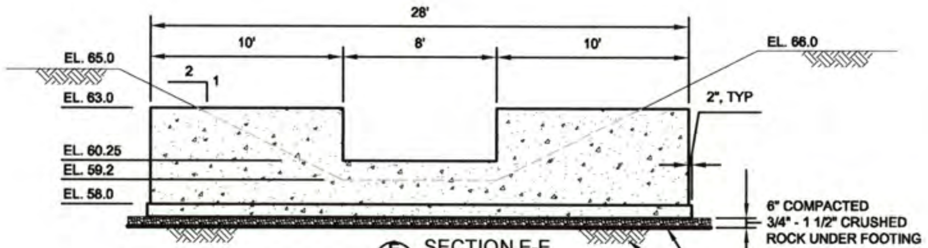
3 5|8 WEIR NO. 3
SCALE: 1" = 5'



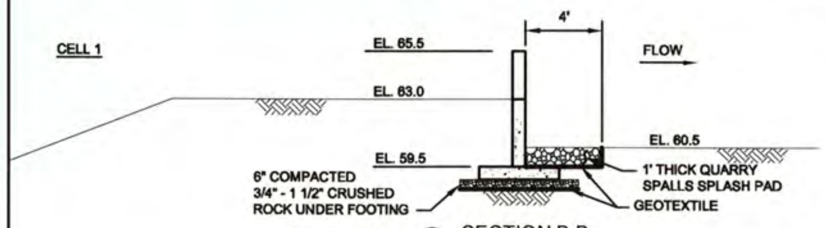
A 8|8 SECTION A-A
SCALE: 1" = 5'



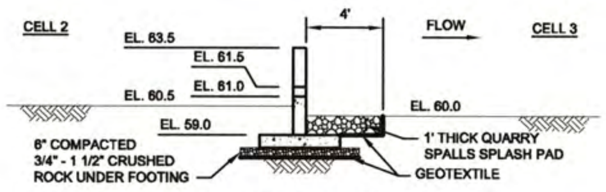
C 8|8 SECTION C-C
SCALE: 1" = 5'



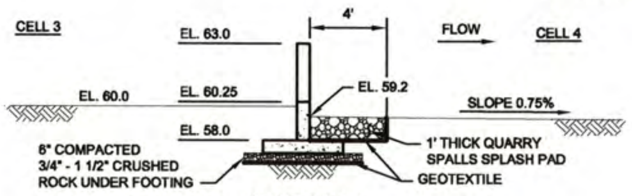
E 8|8 SECTION E-E
SCALE: 1" = 5'



B 8|8 SECTION B-B
SCALE: 1" = 5'



D 8|8 SECTION D-D
SCALE: 1" = 5'



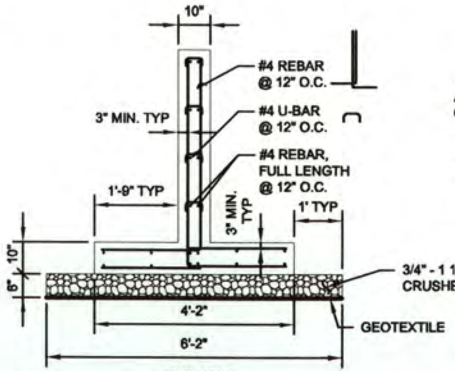
F 8|8 SECTION F-F
SCALE: 1" = 5'

## WEIR SUBGRADE PREPARATION

IF DIRECTED BY THE ENGINEER, TEMPORARILY STOCKPILE EXCAVATED NATIVE SOIL OVER THE WEIR FOUNDATION AREA TO SURCHARGE THE SUBGRADE SOILS AND LIMIT THE POTENTIAL FOR POST-CONSTRUCTION SETTLEMENT.

EXCAVATE EXISTING SOILS TO ACHIEVE THE DESIRED SUBGRADE ELEVATION AT EACH WEIR LOCATION. REMOVE ANY DELETERIOUS MATERIAL AS DIRECTED BY THE ENGINEER. REWORK AND COMPACT THE EXPOSED SOIL SO THAT THE UPPER 1 FOOT OF THE NATIVE SUBGRADE MATERIAL IS COMPACTED TO AT LEAST 95 PERCENT OF ITS MAXIMUM DRY DENSITY AS DETERMINED BY THE ASTM D 1557 TEST PROCEDURE (MODIFIED PROCTOR). ANY AREAS OF SOFT/LOOSE SOIL OR AREAS EXHIBITING SIGNIFICANT DEFLECTION/PUMPING/WEAVING THAT CANNOT BE ADEQUATELY REWORKED AND/OR COMPACTED SHALL BE OVEREXCAVATED AND REPLACED WITH COMPACTED CRUSHED ROCK.

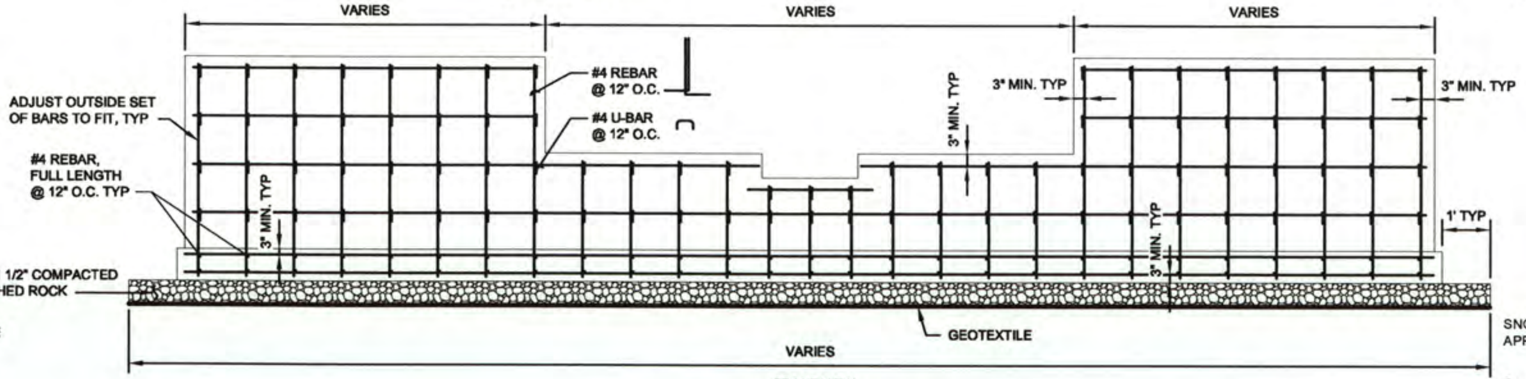
PLACE A SOIL STABILIZATION GEOTEXTILE OVER THE PREPARED SUBGRADE PRIOR TO PLACEMENT AND COMPACTION OF THE CRUSHED ROCK LAYER BELOW THE WEIR FOUNDATION. CRUSHED ROCK SHALL MEET THE REQUIREMENTS IN WSDOT STANDARD SPECIFICATION SECTION 9-03.9(3) FOR CRUSHED SURFACING BASE COURSE, AND SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF ITS MAXIMUM DRY DENSITY AS DETERMINED BY THE ASTM D 1557 TEST PROCEDURE (MODIFIED PROCTOR).



SIDE VIEW

TYPICAL WEIR REINFORCEMENT DETAIL
SCALE: 1" = 2'

11JAN2010



FRONT VIEW

TYPICAL WEIR REINFORCEMENT DETAIL
SCALE: 1" = 2'

## KEY NOTE

① CONTRACTOR TO INSTALL FOOTBRIDGES TO SPAN EACH OF THE WEIR CONSTRICTIONS. BRIDGES TO MEET THE REQUIREMENTS OF THE PROJECT SPECIFICATIONS. BOTTOM OF BRIDGE STRUCTURE TO HAVE 1 FT MINIMUM CLEARANCE FROM THE TOP OF THE WEIR WALL. BRIDGES ARE NOT TO BE CONNECTED OR ANCHORED TO THE WEIR STRUCTURE IN ANY WAY.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________ Date: ____________

R/W PERMIT NO. ____________ PFN ____________

DAVID A. PISCHER 19777
1/11/2010

KELLEY E. WRIGG 35715

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
|  |  |  |  |  |  |

|  |  | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY |  |  |  |
| STATUS |  |  |  |

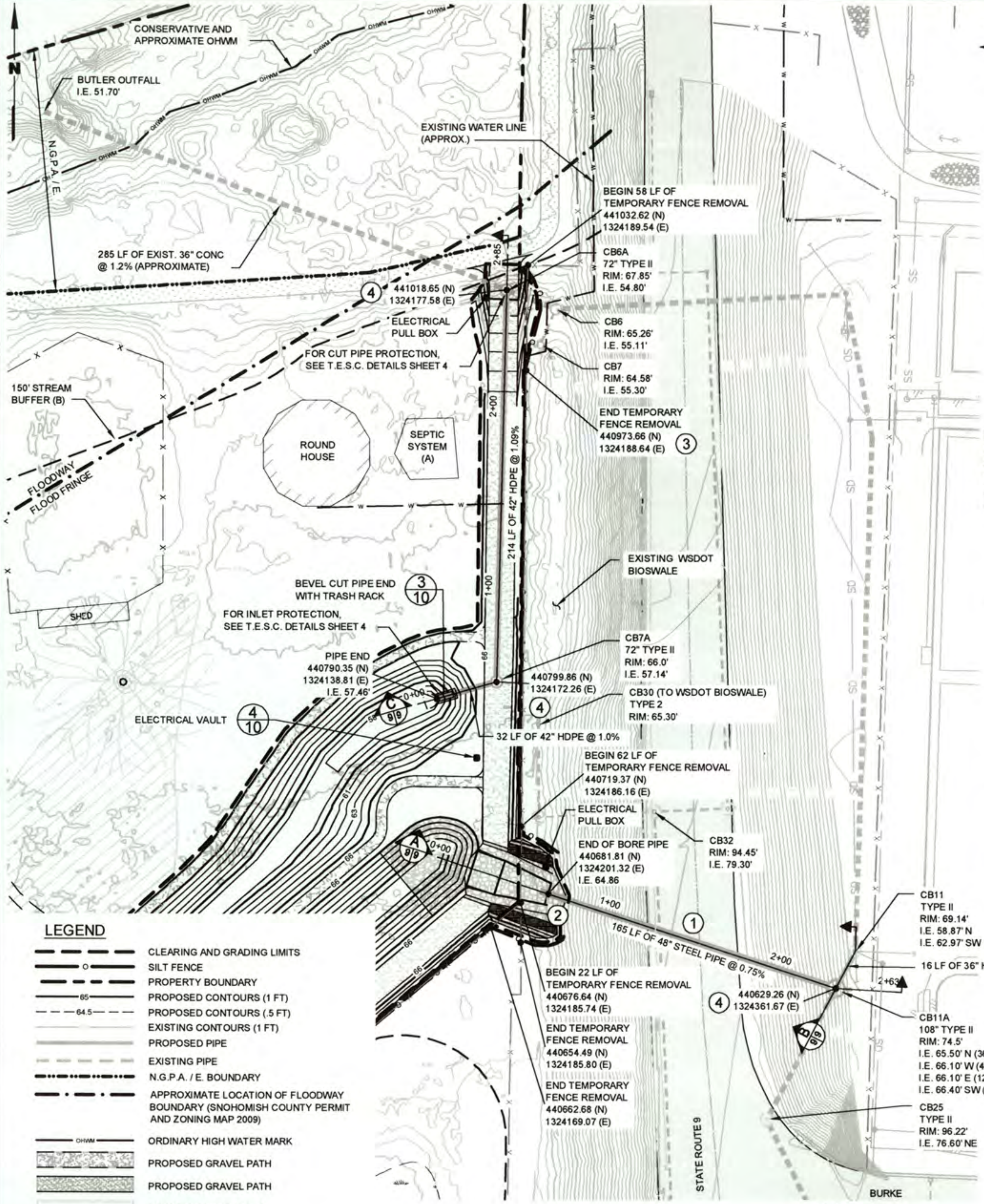
LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

WEIR PLANS, SECTIONS & DETAILS

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 8 OF 13
DRAWING NO. 8

LANDAU ASSOCIATES, INC. | V:\1097\001\010\015\Cons RSLAI Design R3.1.dwg

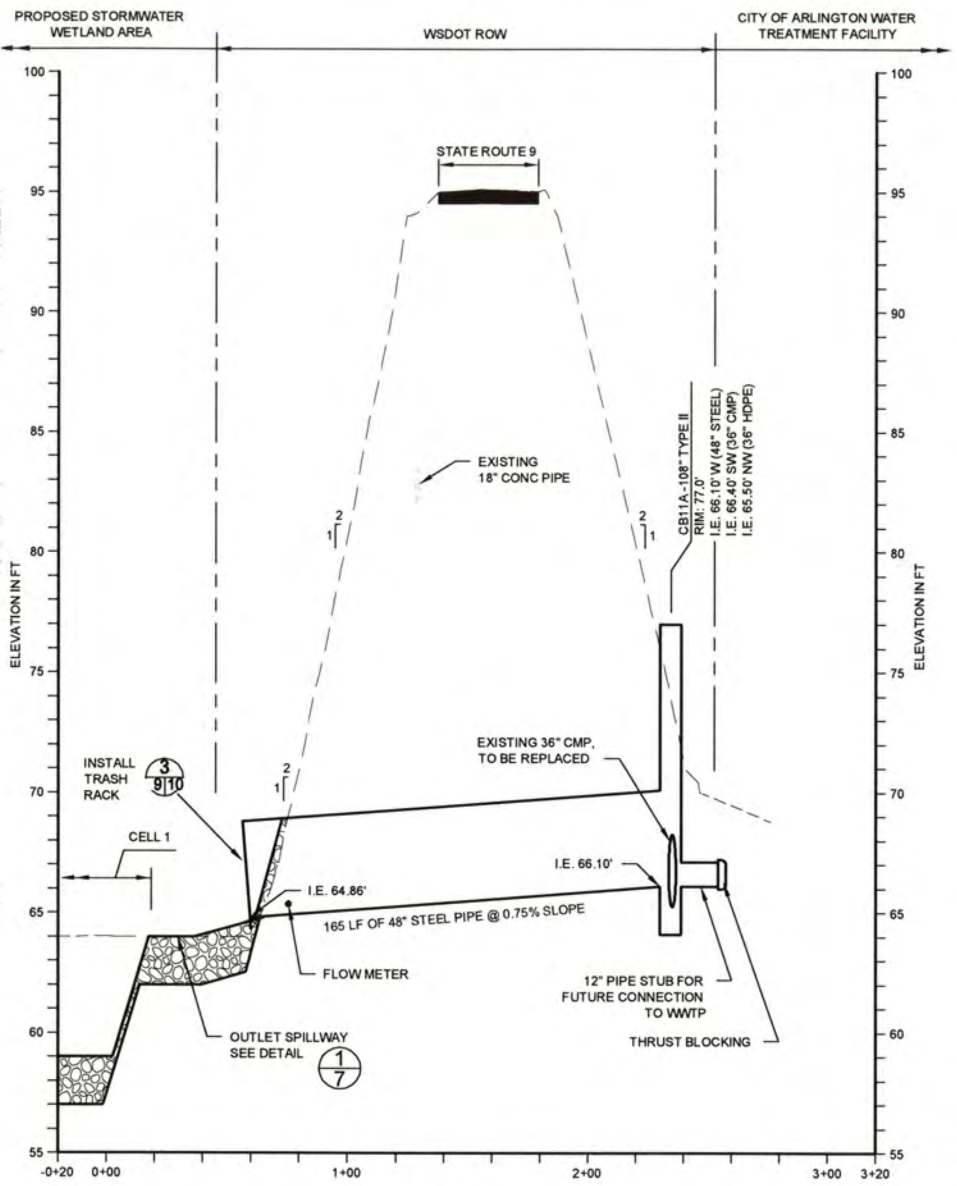


## LEGEND

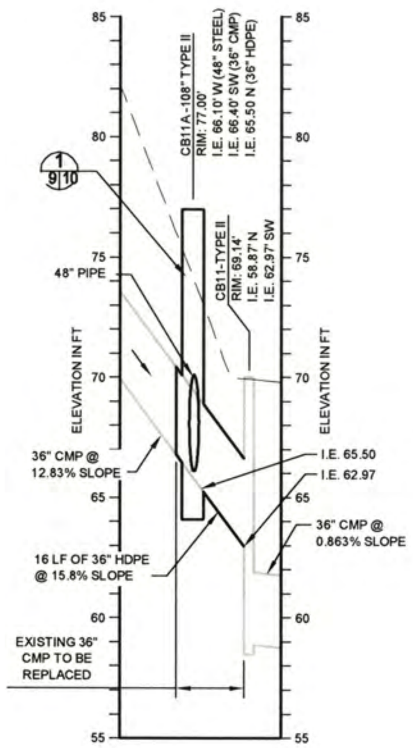
| | |
|---|---|
| — — — | CLEARING AND GRADING LIMITS |
| —○— | SILT FENCE |
| — - — | PROPERTY BOUNDARY |
| —65— | PROPOSED CONTOURS (1 FT) |
| - - 64.5 - - | PROPOSED CONTOURS (.5 FT) |
| —— | EXISTING CONTOURS (1 FT) |
| —— | PROPOSED PIPE |
| - - - | EXISTING PIPE |
| —·—·— | N.G.P.A. / E. BOUNDARY |
| —·—·— | APPROXIMATE LOCATION OF FLOODWAY BOUNDARY (SNOHOMISH COUNTY PERMIT AND ZONING MAP 2009) |
| —OHWM— | ORDINARY HIGH WATER MARK |
| ▨ | PROPOSED GRAVEL PATH |
| ▨ | PROPOSED GRAVEL PATH |
| ▨ | EXISTING GRAVEL ROAD |
| ▨ | EXISTING PAVED ROAD |
| ▨ | EXISTING WETLAND |
| ▨ | EXISTING BUILDING |
| ▨ | HISTORIC PROTECTION AREA |
| B/5/8 ▲ | CROSS SECTION LOCATION |

## PLAN

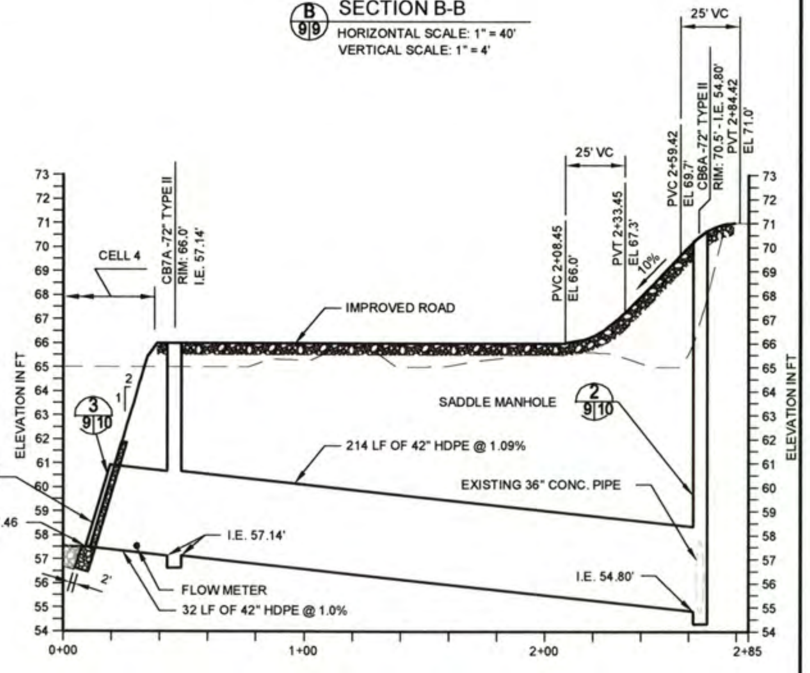
0 40 80
SCALE IN FEET



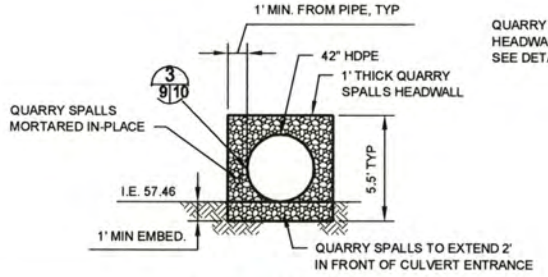
## SECTION A-A
A/9/9
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 4'



## SECTION B-B
B/9/9
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 4'



## SECTION C-C
C/9/9
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 4'



## QUARRY SPALLS HEADWALL
1/9/9
SCALE: 1" = 5'

## KEY NOTES

① PIPE TO BE INSTALLED VIA A BORE, JACK, OR TUNNELING MACHINE PER THE PROJECT SPECIFICATIONS.

② RIPRAP HEADWALL TO BE INSTALLED AROUND PIPE OUTLET, SEE DETAIL 1 SHEET 7.

③ CONTRACTOR TO REPLACE FENCE REMOVED TO INSTALL PROJECT IMPROVEMENTS. REPLACED FENCE TO GO AROUND SPILLWAY AND TO MATCH TO EXISTING FENCE MATERIALS.

④ CATCH BASIN REFERENCE LOCATIONS ARE THE CENTER OF STRUCTURE.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

BY: ____________ DATE: ____________

R/W PERMIT NO. ____________ PFN ____________

DAVID A. PISCHER 19777
KELLEY E. WRIGG 35715
11JAN2010
1/11/2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |

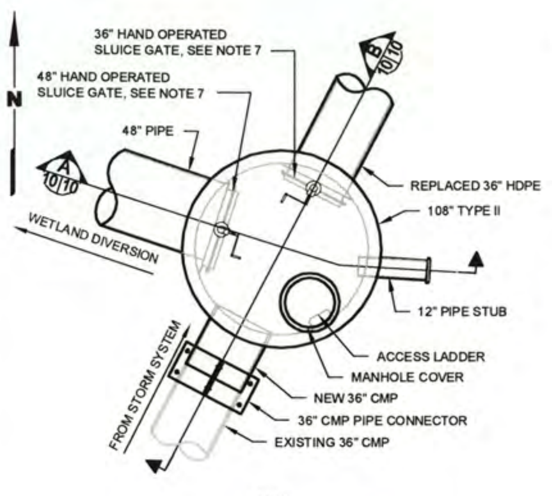
| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

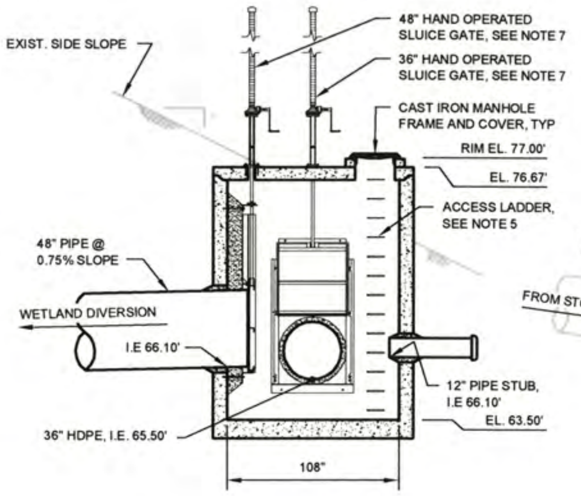
PIPING PLAN

PROJECT NO 1097001.010.015
DATE 1-12-2010
SHEET 9 OF 13
DRAWING NO 9



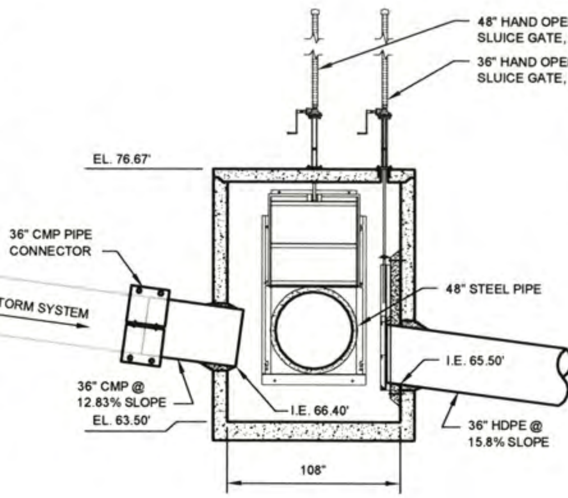
### 1 9|10 CB11A - 108" TYPE II CATCH BASIN DETAIL

SCALE: 1" = 5'



### A 10|10 CB11A - SECTION A-A

SCALE: 1" = 5'

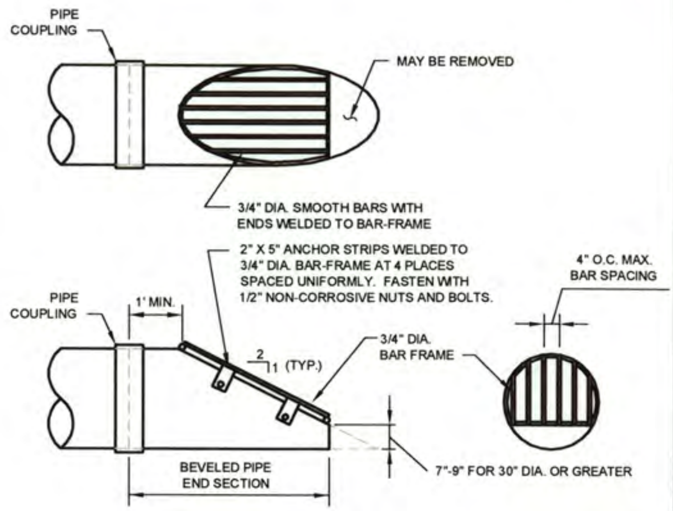


### B 10|10 CB11A - SECTION B-B

SCALE: 1" = 5'

NOTES

1. PIPE SIZES AND SLOPES: PER PLANS.
2. OUTLET CAPACITY: NOT LESS THAN COMBINED INLETS.
3. EXCEPT AS SHOWN OR NOTED, UNITS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS FOR CATCH BASIN TYPE 2, 108" MIN. DIA.
4. OUTLET SHALL BE CONNECTED TO CULVERT OR SEWER PIPE WITH A STANDARD COUPLING BAND FOR CORRUGATED METAL PIPE, OR GROUTED INTO THE BELL OF CONCRETE PIPE.
5. FRAME AND LADDER OR STEPS OFFSET S0 THAT CLIMB DOWN SPACE IS CLEAR OF RISER AND CLEANOUT GATE.
6. IF METAL OUTLET PIPE CONNECTS TO CEMENT CONCRETE PIPE: OUTLET PIPE TO HAVE SMOOTH O.D. EQUAL TO CONCRETE PIPE I.D. LESS 1/4".
7. SLUICE GATES SHALL BE STAINLESS STEEL, WALL MOUNTED, NON-SELF CONTAINED FRAME, WITH GEARED CRANK OPERATED GOLDEN HARVEST, INC. MODEL NUMBER GH-46 TYPE 304 SLIDE GATE OR APPROVED EQUAL.



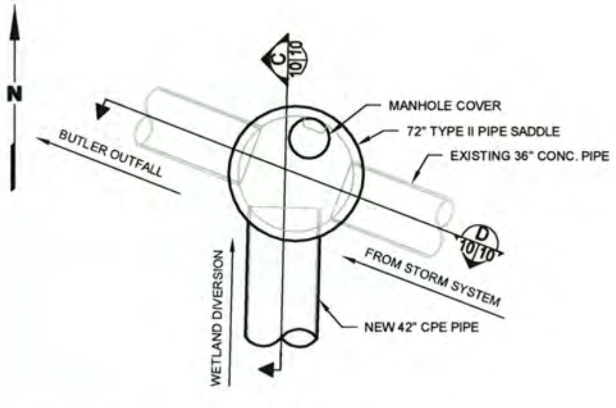
NOTES

1. SIDE SLOPE SHALL BE WARPED TO MATCH THE BEVELED PIPE END. WHEN CULVERT IS ON SKEW, BEVELED END SHALL BE ROTATED TO CONFORM TO SLOPE. IF SLOPE DIFFERS FROM 2:1, PIPE SHALL BE BEVELED TO MATCH SLOPE.
2. 3/4" DIA. BAR FRAME TO BE CAPABLE OF BOLTING TO FRAME WHEN NOT BEING ACCESSED.
3. ALL STEEL PARTS MUST BE GALVANIZED AND ASPHALT COATED (TREATMENT 1 OR BETTER).

(METAL OR PLASTIC PIPE)

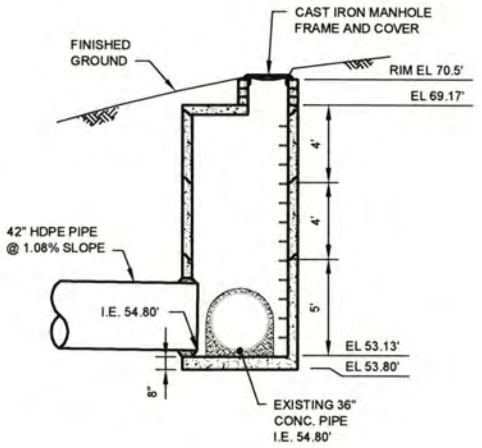
### 3 9|10 BEVELED END PIPE SECTION AND TRASH RACK

N.T.S.



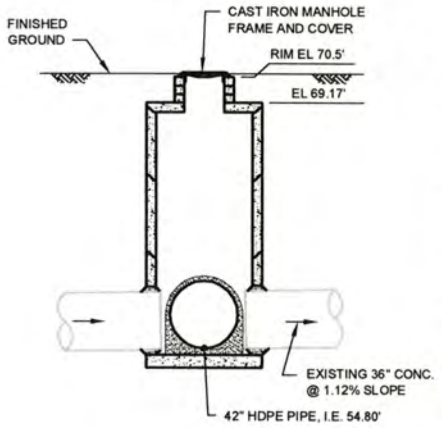
### 2 9|10 CB6A - 72" TYPE II SADDLE DETAIL

SCALE: 1" = 5'



### C 10|10 CB6A - SECTION C-C

SCALE: 1" = 5'

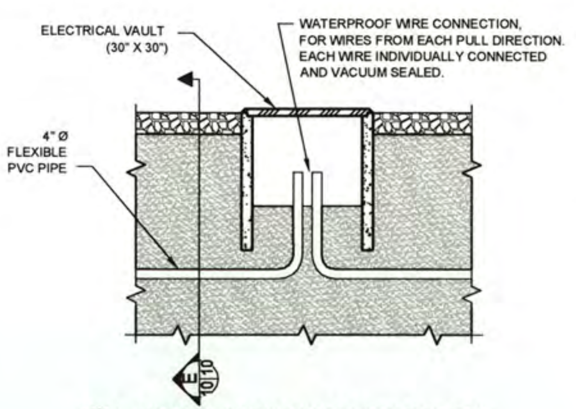


### D 10|10 CB6A - SECTION D-D

SCALE: 1" = 5'

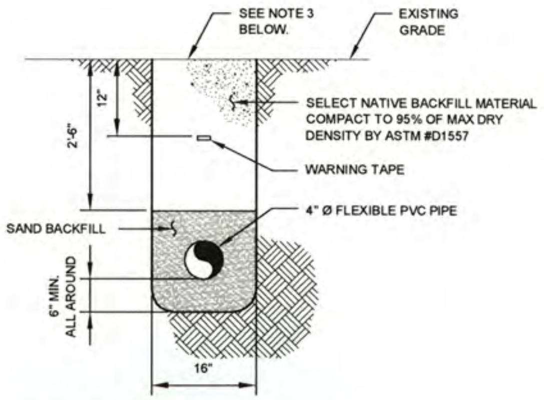
NOTES

1. PIPE SIZES AND SLOPES: PER PLANS.
2. OUTLET CAPACITY: NOT LESS THAN COMBINED INLETS.
3. EXCEPT AS SHOWN OR NOTED, UNITS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS FOR CATCH BASIN TYPE 2, 108" MIN. DIA.
4. OUTLET SHALL BE CONNECTED TO CULVERT OR SEWER PIPE WITH A STANDARD COUPLING BAND FOR CORRUGATED METAL PIPE, OR GROUTED INTO THE BELL OF CONCRETE PIPE.
5. FRAME AND LADDER OR STEPS OFFSET S0 THAT CLIMB DOWN SPACE IS CLEAR OF RISER AND CLEANOUT GATE.
6. IF METAL OUTLET PIPE CONNECTS TO CEMENT CONCRETE PIPE: OUTLET PIPE TO HAVE SMOOTH O.D. EQUAL TO CONCRETE PIPE I.D. LESS 1/4".
7. PRIOR TO CUTTING THE EXISTING STORMWATER PIPE THE CONTRACTOR SHALL HAVE EXACT MEASUREMENTS OF THE EXISTING PIPE INVERTS AND LENGTH MEASUREMENTS FOR INSTALLATION OF THE NEW MANHOLE.
8. THE CONTRACTOR'S EXCAVATION SHALL BE ADEQUATE TO INSTALL THE SADDLE MANHOLE PRIOR TO CUTTING THE EXISTING STORMWATER PIPE.
9. DOWNSTREAM INLET SHALL BE PROTECTED AT ALL TIMES FROM SEDIMENT DURING SADDLE INSTALLATION, FOR CONTROL MEASURES SEE T.E.S.C. DETAILS SHEET 4



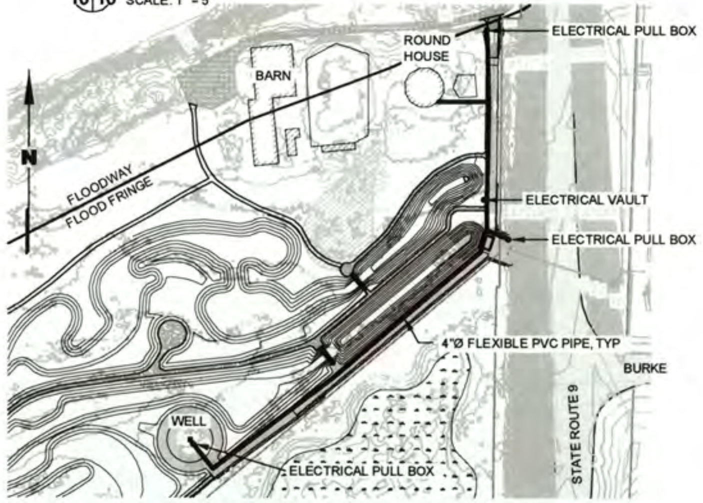
### 4 9|10 TYPICAL ELECTRICAL VAULT DETAIL

SCALE: NOT TO SCALE



### E 10|10 TYPICAL TRENCH SECTION

SCALE: 1" = 5'



FOR REFERENCE ONLY

### ELECTRICAL CONDUIT ALIGNMENT

SCALE: NOT TO SCALE

NOTE

CONTRACTOR TO PROVIDE ASBUILT SURVEY OF COMPLETED CONDUIT ALIGNMENT TO CITY OF ARLINGTON.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ______________________ Date: ______________________

R/W PERMIT NO. ______________ PFN ______________________

DAVID A. PISCHER 19777

KELLEY E. WRIGG 35715

11 JAN 2010

1/11/2010

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |

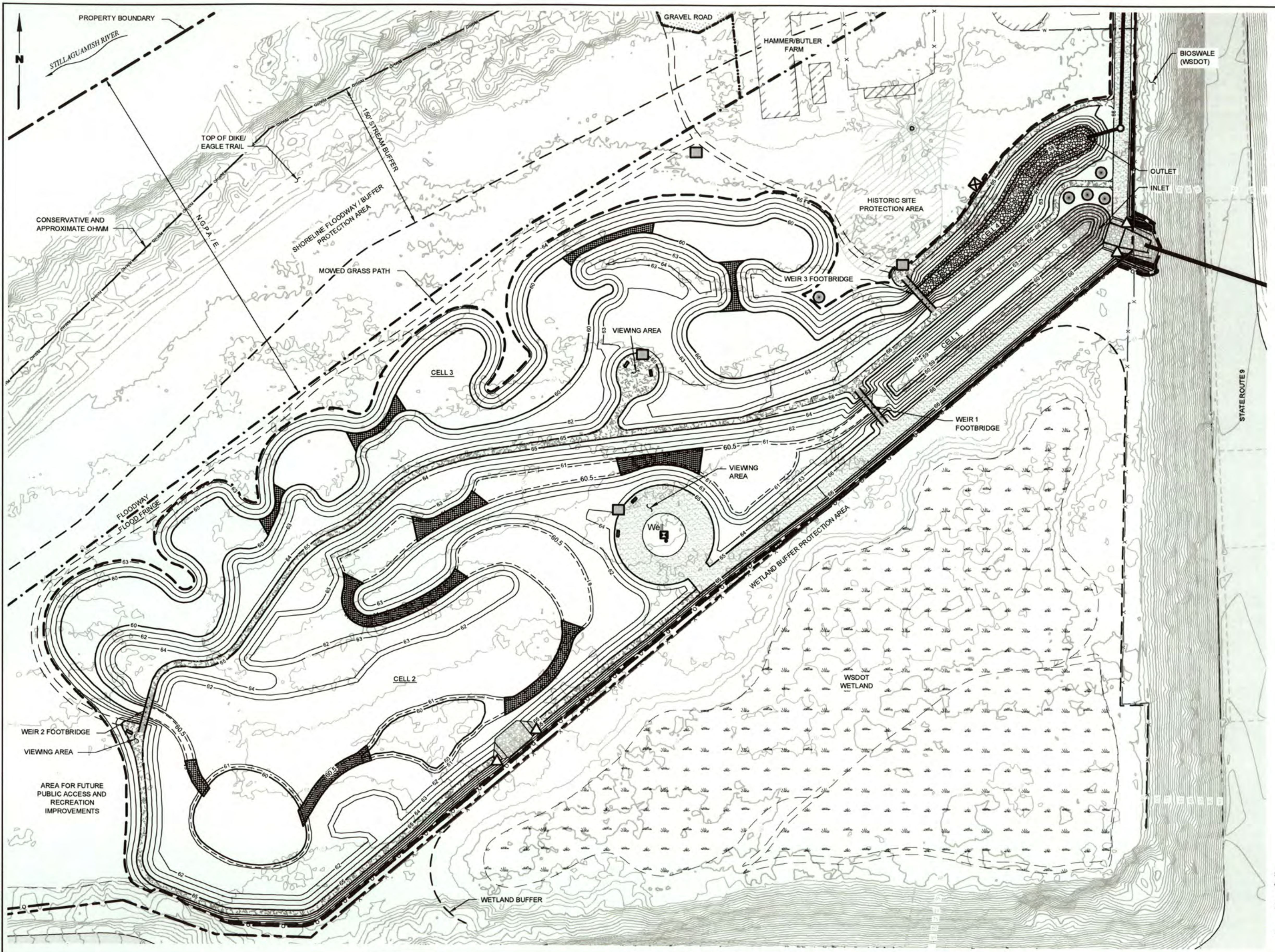
| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | B.TAYLOR | BLT | 1-12-2010 |
| DESIGNED BY: | K.WRIGG | KEW | 1-12-2010 |
| REVIEWED BY: | D.PISCHER | DAP | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

PIPING DETAILS

PROJECT NO 1097001.010.015
DATE 1-12-2010
SHEET 10 OF 13
DRAWING NO 10



0 50 100
Scale in Feet

## LEGEND

| | | |
|---|---|---|
| ■ | * | INTERPRETIVE SIGN |
| △ | | WATCH YOUR STEP SIGN |
| ◉ | * | FUTURE SCULPTURE / ART LOCATION |
| ▭ | * | BENCH, PICNIC TABLE OR KIOSK |
| ☒ | * | SHELTER |
| ▤ | | FOOTBRIDGE |
| — — — | | CLEARING AND GRADING LIMITS |
| —o— | | SILT FENCE |
| — - - — | | PROPERTY BOUNDARY |
| —65— | | PROPOSED CONTOURS (1 FT) |
| — —64.5— — | | PROPOSED CONTOURS (.5 FT) |
| —66— | | EXISTING CONTOURS (1 FT) |
| —··—··— | | N.G.P.A. / E. BOUNDARY |
| —·—·— | | APPROXIMATE LOCATION OF FLOODWAY BOUNDARY (SNOHOMISH COUNTY PERMIT AND ZONING MAP 2009) |
| —OHWM— | | ORDINARY HIGH WATER MARK |
| — — — | | WETLAND/STREAM BUFFER |
| ▩ | | COIR FIBER FABRIC |
| ▦ | | RIVER ROCK (ROUNDED COBBLES) |
| ═ ═ ═ | | PROPOSED MOWED GRASS PATH |
| ▧ | | PROPOSED GRAVEL PATH |
| ▨ | | PROPOSED IMPROVED ROADWAY |
| ═ ═ ═ | | EXISTING TRAIL |
| ░ | | EXISTING GRAVEL ROAD |
| ▭ | | EXISTING PAVED ROAD |
| ⌐ ⌐ | | EXISTING WETLAND |
| ▨ | | EXISTING BUILDING |
| ▨ | | HISTORIC PROTECTION AREA |

## FEATURE NOTE

* FEATURES TO BE DESIGNED AND / OR INSTALLED AS PART OF A FUTURE VOLUNTEER EFFORT

## NOTES

1. ALL CONSTRUCTED BERMS TO HAVE A 4 INCH THICK LAYER OF TOPSOIL (OR NATIVE ORGANIC SOIL OF AMENDED WITH COMPOST) LAID OVER NON-TRAFFIC SURFACES SO AS TO BE SUITABLE FOR PLANT ESTABLISHMENT.
2. ALL SLOPES STEEPER THAN 5:1 SHALL BE COVERED WITH JUTE / COIR FIBER FABRIC.
3. ALL BARE AREAS TO BE SEEDED WITH A HYDROSEED AND COMPOST MIXTURE PER SPECIFICATIONS.
4. GEOTEXTILE FOR SEPARATION / WEED FABRIC TO BE PLACED UNDER CRUSHED GRAVEL SURFACING.
5. FOOTBRIDGES TO BE DESIGNED AND BUILT OR PURCHASED BY CONTRACTOR.
6. REFER TO SPECIFICATIONS FOR MORE DETAILS.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________ Date: ____________

R/W PERMIT NO. ____________ PFN ____________

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | C.NELSON | CEN | 1-12-2010 |
| DESIGNED BY: | S.MAXWELL | SM | 1-12-2010 |
| REVIEWED BY: | P.WELCH | WPW | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

SOIL AMENDMENT, PUBLIC ACCESS AND SITE PROTECTION PLAN

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 11 OF 13
DRAWING NO. 11

## LEGEND

| | |
|---|---|
| ⌂ * | OSPREY NEST, WOOD DUCK OR OTHER BIRD HOUSE |
| * | BRUSH PILE |
| * | ROCK PILE |
| * | WETLAND SNAG |
| | PRE-VEGETATED COIR LOG |
| — — — — | CLEARING AND GRADING LIMITS |
| ——65—— | FINAL CONTOURS (1 FT) |
| — — 64.5 — — | FINAL CONTOURS (.5 FT) |
| ——65—— | EXISTING CONTOURS (1 FT) |
| —··—··— | N.G.P.A. / E. BOUNDARY |
| — · — · — | APPROXIMATE LOCATION OF FLOODWAY BOUNDARY (SNOHOMISH COUNTY PERMIT AND ZONING MAP 2009) |
| ——OHWM—— | ORDINARY HIGH WATER MARK |
| — — — — | WETLAND/STREAM BUFFER |
| ▨ | RIVER ROCK (ROUNDED COBBLES) |
| ═ ═ ═ ═ | PROPOSED MOWED GRASS PATH |
| ▨ | PROPOSED GRAVEL PATH |
| ▨ | PROPOSED IMPROVED ROADWAY |
| ▨ | EXISTING GRAVEL ROAD |
| ▨ | EXISTING WETLAND |
| ▨ | EXISTING BUILDING |
| ▨ | HISTORIC PROTECTION AREA |

| PLANTED AREA | | |
|---|---|---|
| AREA | SF | AC |
| ASSEMBLAGE 1 | 97,205 | 2.23 |
| ASSEMBLAGE 2 | 78,435 | 1.80 |
| ASSEMBLAGE 3 | 67,835 | 1.56 |
| ASSEMBLAGE 4 | 113,180 | 2.60 |
| ALL ASSEMBLAGES | 356,655 | 8.19 |
| TEMPORARY DISTURBANCE (SEED) | 72,215 | 1.66 |
| GRAND TOTAL | 428,870 | 9.85 |

## FEATURE NOTE

* FEATURES TO BE DESIGNED AND / OR INSTALLED AS PART OF A FUTURE VOLUNTEER EFFORT. ADDITIONAL LOG COMPLEXES TO BE INSTALLED IN CELLS 2 & 3 TO PROVIDE HABITAT STRUCTURE AND MAXIMIZE CIRCULATION OF WATER. LOGS TO BE PROVIDED BY CITY AND TO BE INSTALLED AND ANCHORED UNDER SUPERVISION OF CITY NATURAL RESOURCES MANAGER.

| PLANTING ASSEMBLAGES (ELEVATIONS IN FT) | | | | | |
|---|---|---|---|---|---|
| SYMBOL | DESIGNATION | CELL 1 | CELL 2 | CELL 3 | CELL 4 |
| ▤ | ASSEMBLAGE 1 | 59-63 (9,730 SQ FT) | 60-61 (42,055 SQ FT) | 60 (45,420 SQ FT) | NA |
| ▥ | ASSEMBLAGE 2 | 63-64 (1,890 SQ FT) | 61-62 (61,255 SQ FT) | 60-61 (15,290 SQ FT) | NA |
| ▨ | ASSEMBLAGE 3 | 64+ (6,360 SQ FT) | 62-63 (18,655 SQ FT) | 61-63 (39,590 SQ FT) | 61-63 (3,230 SQ FT) |
| ▧ | ASSEMBLAGE 4 | (2,800 SQ FT) | 63+ (47,070 SQ FT) | 63+ (55,010 SQ FT) | 63+ (8,300 SQ FT) |
| (NOT SHOWN) | SEEDING ONLY (ALL TEMPORARY DISTURBANCE AREAS) | | | | |

## GENERAL NOTES

1. ASSEMBLAGES MAY SHIFT SLIGHTLY AT DISCRETION OF THE PROJECT BIOLOGIST. PLANTING WORK MAY BE CONDUCTED BY VOLUNTEERS OR UNDER A SEPARATE CONTRACT, AT THE DISCRETION OF THE CITY.
2. INSTALL PLANTS IN FOLLOWING ORDER: 1) COIR LOGS; 2) TREES AND LARGE SHRUBS; 3) SHRUBS AND LIVE CUTTINGS; 4) EMERGENTS AND GROUNDCOVER (INCLUDING ADDITIONAL SEEDING OF DISTURBED AREAS).
3. PLANT SPACING IS AVERAGE ON CENTER. PLANTS SHOULD BE DISTRIBUTED IN A NATURALISTIC PATTERN, WHICH MAY INCLUDE CLUSTERING OF LIKE SPECIES. FINAL LOCATIONS MUST BE APPROVED BY A PROJECT BIOLOGIST PRIOR TO INSTALLATION, BASED ON FINAL TOPOGRAPHY. REFER TO DETAILS AND SPECIFICATIONS.
4. LARGE TREES SHOULD BE LOCATED AT LEAST 6 FT FROM THE EDGES OF THE TRAIL.
5. LIVE CUTTINGS (STAKES) MUST BE AT LEAST 4 FT LONG SO THAT AT LEAST 2 FT CAN BE BURIED.
6. ALL DECIDUOUS TREES AND SHRUBS (EXCLUDING STAKES) TO BE LABELED WITH SPECIES (OR ACRONYM) AND HIGH-VISIBILITY FLAGGING.
7. PROTECTIVE PLANT COLLARS ARE TO BE PLACED ON ALL WOODY VEGETATION WITHIN ASSEMBLAGES 3 AND 4.
8. COIR LOGS SHALL BE PRE-VEGETATED IF AVAILABLE, OR PLUGS SHALL BE PLANTED INTO THEM AFTER INSTALLATION.
9. REFER TO SPECIFICATIONS FOR SPECIAL PLANTING, PROTECTION, AND HANDLING INSTRUCTIONS.
10. KEY TO PLANTING DESIGNATIONS:
    - ASSEMBLAGE 1 - PERMANENTLY SATURATED, SEASONALLY INUNDATED TO 1.5 FT
    - ASSEMBLAGE 2 - PERMANENTLY TO SEASONALLY SATURATED, OCCASIONALLY INUNDATED TO 0.5 FT
    - ASSEMBLAGE 3 - SEASONALLY TO PERMANENTLY SATURATED
    - ASSEMBLAGE 4 - UPLAND/FLOODPLAIN
11. REFER TO SPECIFICATIONS FOR MORE INFORMATION.

## SEEDING NOTES

1. PHASE 1: IMMEDIATELY FOLLOWING COMPLETION OF EARTH WORK (WHICH SHALL OCCUR DURING SUMMER), OR WHENEVER SOILS WILL REMAIN UNWORKED FOR SEVEN DAYS, HYDROSEED ALL BARE AREAS WITH "DRY AREA SEED MIX". SEED ON TOP OF ANY COIR LOGS.
2. PHASE 2: DURING SEPTEMBER, HYDROSEED "WET AREA SEED MIX" TO AREAS DEDICATED FOR WETLAND PLANT ASSEMBLAGES (ALL AREAS EXCEPT FOR UPLAND/FLOODPLAIN).
3. HAND SEED EMERGENT VEGETATION SEED MIX PER PLAN AND TABLE, FOLLOWING RAIN EVENT AND UNDER DIRECTION OF PROJECT BIOLOGIST/ENGINEER. SEED ON COIR LOGS.
4. IF UNSURE WHETHER AN AREA IS DRY OR WET, OVERLAP SEED MIXES.
5. WHERE JUTE FABRIC IS PRESENT, APPLY A LAYER OF COMPOST 4 INCHES DEEP, FOLLOWED BY SEED WITH A TACKIFIER.

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ____________________ Date: ____________________

R/W PERMIT NO. ____________________ PFN ____________________

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|

| | | | |
|---|---|---|---|
| DRAFTED BY: | C.NELSON | CEN | 1-12-2010 |
| DESIGNED BY: | S.MAXWELL | SM | 1-12-2010 |
| REVIEWED BY: | P.WELCH | WPW | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | DRAFT | INITIAL | DATE |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

CITY OF ARLINGTON
STORMWATER WETLAND PROJECT
SNOHOMISH COUNTY, WASHINGTON

PLANTING AND HABITAT PLAN

PROJECT NO 1097001.010.015
DATE 1-12-2010
SHEET 12 OF 13
DRAWING NO 12

| Assemblage 1 (seasonally inundated emergent wetland to 1.5 ft) | | | | | |
|---|---|---|---|---|---|
| Species | | Form | Specifications | | |
| Scientific Name | Common Name | | Quantity | Size / Type | Density ** |
| *Salix lucida* | Pacific willow | Tree | 100 | 4' stake/ live cutting | 8' - plant on hummocks |
| *Salix sitchensis* | Sitka willow | Shrub | 100 | | |
| (Wet Area Seed Mix) | (See Seed Mix Table) | Emergent | 184 lbs | Seed | 100 lbs/ac |
| (Emergent Seed Mix) | (See Seed Mix Table) | Emergent | 184 lbs | Seed | 100 lbs/ac |

| Assemblage 2 (permanently saturated / seasonally inundated scrub-shrub wetland to 0.5 ft) | | | | | |
|---|---|---|---|---|---|
| Species | | Form | Specifications | | |
| Scientific Name | Common Name | | Quantity | Size | Density ** |
| *Fraxinus latifolia* | Oregon ash | Tree | 600 | 4' stake | 6' |
| *Salix lucida* | Pacific willow | Tree | 600 | 4' stake | 6' |
| *Cornus sericea* | Red osier dogwood | Shrub | 1500 | Bare root | 6' |
| *Rosa pisocarpa* | Swamp rose | Shrub | 420 | 1 gal | 4' |
| *Physocarpus capitatus* | Pacific ninebark | Shrub | 1500 | Bare root | 4' |
| *Salix sitchensis* | Sitka willow | Shrub | 1500 | 4' stake | 6' |
| (Wet Area Seed Mix) | (See Seed Mix Table) | Emergent | 175 lbs | Seed | 100 lbs/ac |
| (Emergent Seed Mix) | (See Seed Mix Table) | Emergent | 175 lbs | Seed | 100 lbs/ac |

| Assemblage 3 (seasonally saturated forested wetland) | | | | | |
|---|---|---|---|---|---|
| Species | | Form | Specifications | | |
| Scientific Name | Common Name | | Quantity | Size | Density ** |
| *Malus fusca* | Western crabapple | Tree | 100 | Bare root | 6' |
| *Picea sitchensis* | Sitka spruce | Tree | 100 | Bare root | 6' |
| *Populus balsamifera* | Black cottonwood | Tree | 100 | Bare root | 8' |
| *Alnus rubra* | Red Alder | Tree | 100 | Bare root | 6' |
| *Rhamnus purshiana* | Cascara | Tree | 100 | Bare root | 6' |
| *Thuja plicata* | Western red cedar | Tree | 200 | Bare root | 8' * |
| *Populus tremuloides* | Quaking aspen | Tree | 100 | 1 gal | 8' |
| *Cornus sericea* | Red osier dogwood | Shrub | 366 | Bare root | 4' |
| *Lonicera involucrata* | Black twinberry | Shrub | 366 | Bare root | 4' |
| *Physocarpus capitatus* | Pacific ninebark | Shrub | 366 | Bare root | 4' |
| *Rosa nutkana* | Nootka rose | Shrub | 366 | 1 gal | 4' |
| *Rosa pisocarpa* | Swamp rose | Shrub | 366 | 1 gal | 4' |
| *Rubus spectabilis* | Salmonberry | Shrub | 366 | Bare root | 4' |
| *Salix scouleriana* | Scouler's willow | Shrub | 366 | 4' stake | 4' |
| *Symphoricarpos albus* | Snowberry | Shrub | 366 | 1 gal | 4' |
| (Wet Area Seed Mix) | (See Seed Mix Table) | Emergent | 80 lbs | Seed | 75 lbs/ac |
| (Dry Area Seed Mix) | (See Seed Mix Table) | Herb. | 80 lbs | Seed | 75 lbs/ac |

| Assemblage 4 (upland/floodplain) | | | | | |
|---|---|---|---|---|---|
| Species | | Form | Specifications | | |
| Scientific Name | Common Name | | Quantity | Size | Density ** |
| *Acer macrophyllum* | Big leaf maple | Tree | 240 | Bare root | 8' |
| *Abies grandis* | Grand fir | Tree | 240 | Bare root | 8' |
| *Alnus rubra* | Red Alder | Tree | 240 | Bare root | 6' |
| *Pseudotsuga menziesii* | Douglas fir | Tree | 240 | Bare root | 8' |
| *Tsuga heterophylla* | Western hemlock | Tree | 240 | Bare root | 8' * |
| *Acer circinatum* | Vine maple | Tree | 240 | Bare root | 6' |
| *Amelanchier alnifolia* | Serviceberry | Shrub | 600 | Bare root | 6' |
| *Holodiscus discolor* | Oceanspray | Shrub | 600 | Bare root | 6' |
| *Mahonia aquifolium* | Tall Oregon grape | Shrub | 600 | Bare root | 5' |
| *Oemleria cerasiformis* | Indian plum | Shrub | 600 | Bare root | 5' * |
| *Ribes sanguineum* | Red flowering currant | Shrub | 600 | 1 gal | 4' |
| *Rosa nutkana* | Nootka rose | Shrub | 600 | 1 gal | 4' |
| *Symphoricarpos albus* | Snowberry | Shrub | 600 | 1 gal | 4' |
| *Gaultheria shallon* | Salal | Shrub | 210 | 1 gal | 4' * |
| *Polystichum munitum* | Sword fern | Fern | 210 | 1 gal | 4' * |
| (Dry Area Seed Mix) | (See Seed Mix Table) | Herb. | 800 lbs | Seed | 100 lbs/ac |

* Plant of northeast side of slope or other shading feature (e.g. a bushy shrub/tree, bridge, etc.).

**Density is calculated at rate of 8 feet on center for trees over area, plus 4 feet on center for shrubs over area (average density is 6 ft on center), with the exception of emergent wetland areas.

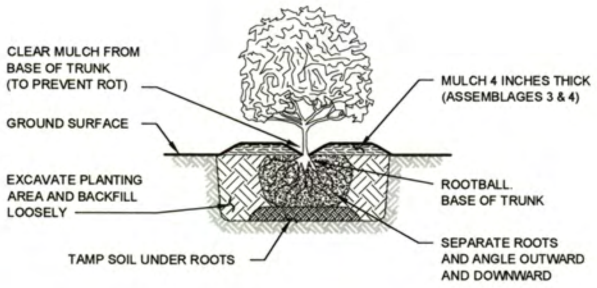
| Seed Mixes | | | |
|---|---|---|---|
| Species | | Percentage of Mix | Location, Rate, Area and Amount |
| Scientific Name | Common Name | | |
| **Dry Area Mix** | | | |
| *Bromus carinatus* | California brome | 20% | Assemblage 3 - 1.1 ac (75 lb/ac) and Assemblage 4 - 2.1 ac (100 lb/ac).<br>TOTAL 210 lbs |
| *Elymus glaucus* | Blue wildrye | 20% | |
| *Poa compressa* | Canada wildrye | 20% | |
| *Festuca rubra commutate OR Festuca longifolia* | Chewings fescue OR Hard fescue | 20% | |
| Multiple species (TBD)* | Pacific Northwest wildflower mix | 20% | |
| **Wet Area Mix** | | | |
| *Agrostis gigantea* | Redtop | 20% | Assemblages 1 and 2 - 3.6 ac (100 lb/ac) and Assemblage 3 - 1.1 ac (75 lb/ac).<br>TOTAL 360 lbs |
| *Eleocharis palustris* | Common spikerush | 20% | |
| *Glyceria occidentalis* | Western mannagrass | 20% | |
| *Deschampsia caespitosa* | Tufted hairgrass | 20% | |
| *Agrostis palutsris* | Creeping bentgrass | 20% | |
| **Emergent Mix (Pools and wettest areas)** | | | |
| *Typha latifolia* | Common cattail | 20% | Estimated to be Assemblages 1 and parts of 2 - 2 ac (100 lb/ac).<br>TOTAL 200 lbs |
| *Scirpus microcarpus* | Small-fruited bulrush | 20% | |
| *Glyceria occidentalis* | Western mannagrass | 20% | |
| *Deschampsia caespitosa* | Tufted hairgrass | 20% | |
| *Scirpus acutus* | Hardstem bulrush | 20% | |

* Species to be selected based on availability at time of planting.

** Locations to be determined based on observation of ponded areas following rain events, under direction of the Project Biologist/Engineer - likely to be Assemblage 1.

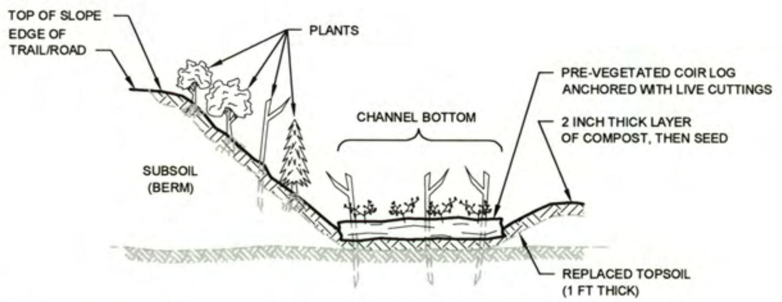
Note that Assemblage 3 has an overlapping of both Dry and Wet Area seed mixes.

| Summary Table | |
|---|---|
| Size / Type | # |
| 1 Gallon | 3,838 |
| Bare Root | 9,004 |
| Live Cutting | 3,266 |
| Seed | 1,678 lbs |
| Tree | 3,540 |
| Shrub | 12,358 |



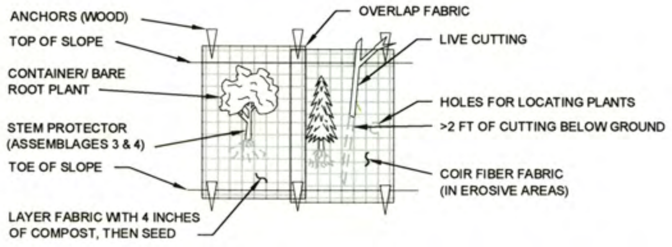
① CONTAINER/BAREROOT PLANTING

SCALE: NONE



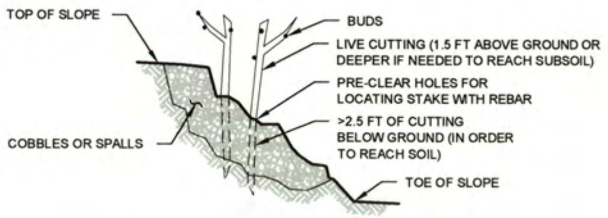
② SOIL AMENDMENT, COIR LOG INSTALLATION AND PLANTING

SCALE: NONE



③ PLANTS IN COIR FIBER NETTING

SCALE: NONE



④ PLANTING WITH RIP-RAP/COBBLE

SCALE: NONE

SNOHOMISH COUNTY PLANNING AND DEVELOPMENT SERVICES
APPROVED FOR CONSTRUCTION

By: ______________________ Date: ______________________

R/W PERMIT NO. ______________________ PFN ______________________

| NO. | DATE | REVISIONS | DESIGNED | REVIEWED | APPROVED |
|---|---|---|---|---|---|
| | | | | | |

| | | INITIAL | DATE |
|---|---|---|---|
| DRAFTED BY: | C.NELSON | CEN | 1-12-2010 |
| DESIGNED BY: | S.MAXWELL | SM | 1-12-2010 |
| REVIEWED BY: | P.WELCH | WPW | 1-12-2010 |
| APPROVED BY: | | | |
| STATUS: | DRAFT | | |

LANDAU ASSOCIATES
130 2ND AVENUE S.
EDMONDS, WASHINGTON 98020
(425) 778-0907, FAX (425) 778-6409

**CITY OF ARLINGTON**
**STORMWATER WETLAND PROJECT**
**SNOHOMISH COUNTY, WASHINGTON**

**PLANTING LISTS AND DETAILS**

PROJECT NO. 1097001.010.015
DATE 1-12-2010
SHEET 13 OF 13
DRAWING NO. 13

APPENDIX C

# Calculation No. HM-1 (Excerpt from URS 2008)

**URS**

1500 Fourth Avenue, Suite 1400
Seattle, Washington 98101
Ph (206) 438 - 2700
Fx (206) 438 - 2699

Client: **City of Arlington** Project: **Stormwater Comprehensive Plan**

Location: **Arlington, WA** Subject: **XP-SWMM Hydraulic Model**

Project No: **33757537** Calculation No: **HM-1** Revision No. **0** Sheet **1** of

*(Title of Calculations/Document)*

**STEP 1**

| | Signature | Date |
|---|---|---|
| Methodology & Assumptions Developed | | 3/20/08 |
| Methodology & Assumptions Approved | Carla Jalich | 3/20/08 |

**STEP 2**

| | | |
|---|---|---|
| Calculations Completed | | 3/24/08 |
| Calculations Checked | Carla Jalich | 3/25/08 |

**STEP 3**

| | | |
|---|---|---|
| Task Manager Approved | | |
| Project Manager Approved | | |

**COMMENTS**

***Purpose:*** Evaluate the existing stormwater conveyance system that routes flows from within the Downtown 4th tier basin to the Stillaguamish River.

***Background:*** Initial modeling was conducted using elevation data obtained via GPS surveying provided by the City of Arlington (City). The rim elevations of the manholes were measured via GPS and invert elevations were determined by measuring from the rim elevation to the pipe invert. To improve the accuracy of the elevation data, a second, more accurate survey was conducted using a total station in December 2006. The survey generated new rim elevations and new invert elevations were created based on subtracting the original measure down distances from the new survey data. This stormwater model used the most current total station survey data combined with as-built information for the Olympic stormwater line.

The focus of this evaluation was to locate potential problems within the existing Downtown Basin stormwater system. Stormwater flow routing was completed using XP-SWMM to identify necessary improvements to the stormwater drainage system.

Stormwater hydraulic problems previously identified in 1995, 1999, and 2003 assessment memos include: local flooding along First Street (between McLeod and Lenore Avenues), Lenore Avenue (between First and Third Streets), and along French Avenue (between First and Third Streets); and conveyance limitations within manholes along SR9 (north of Burke Avenue).

***Approach:*** The Downtown Basin was evaluated to determine the capacity of the existing storm drainage network under fully developed conditions. The storm drainage network is not a continuous diameter storm drain; it includes a network of pipes with diameters ranging from 2- to 36-inch pipe diameters.

The location of the Downtown Basin (a.k.a Old Town) within the City is shown in Figure 1 and Figure 2. The model area schematic is shown in Figure 3.

The hydrology was developed based on the 24-hour frequency design storm (See Attachment 1). This evaluation used the rainfall data from the 2-year, 10-year, 25-year, and 100-year 24-hour storms and identified areas where flooding would be expected during similar conditions. Areas with flooding and capacity issues are identified for future stormwater drainage system upgrades. A summary of the rainfall data is presented in Table 1.

The existing storm drainage network was modeled in XP-SWMM using 24-hour frequency design storm hydrology and fully developed conditions. Hydraulics were routed for each event using XP-SWMM. Input to the model network for the Downtown Basin is included in Attachment 2. This information includes assumed drainage area and invert elevations of storage nodes and links.

Areas of flooding observed by model results under these design conditions were identified. Several nodes throughout the drainage network were surcharged during the peak flood conditions.

***Results:*** Attachment 2 presents selected XP-SWMM model results. Based on the assumptions made for pipe geometry and precipitation, described previously, the existing network was modeled under fully developed conditions.

The model results identified surcharging problems in the following locations:

- The storm drain along Lenore Avenue, near East 2nd Street (location BE-09);
- The storm drain along First Street, between Gifford and Lenore Avenues (locations: BE-10 and BE-11);
- Trunk line along SR-9 near Burke Avenue (location: DM-05);

- The storm drain along West Division Street, near North Dunham Avenue(location: DM-17);
- The storm drain along S West Avenue , south of E 3rd Street (location: W-09); and
- The storm drain along S Olympic Avenue, north of Maple Street (location: OL-22).

See Table 2 for a summary of flooding conditions within the Downtown Basin.

Surcharging issues at BE-09, BE-10, BE-11, and DM-05 has already been identified as problems in the 1995, 1999, and 2003 assessment reports and the City has planned projects to resolve these issues. The problems at BE-09, BE-10, and BE-11 should be resolved during the completion of Projects No. 11 and 201. The problem at DM-05 should be resolved during the completion of Project No. 12. See Attachment 3 for a brief description of these projects.

The model indicated flooding issues at DM-17 during the 10-year storm event, which is a significant event. Downstream of the DM-17 manhole, the slope becomes flatter and the pipe decreases from a 24-inch to a 21-inch diameter. These two reductions in the stormwater conveyance performance potential triggered the model to detect flooding during the 10-year storm. It is recommended that the City monitor and record observations in this area during and following storm events to determine if additional modeling, and potentially upgrading the stormwater system, at this location is necessary.

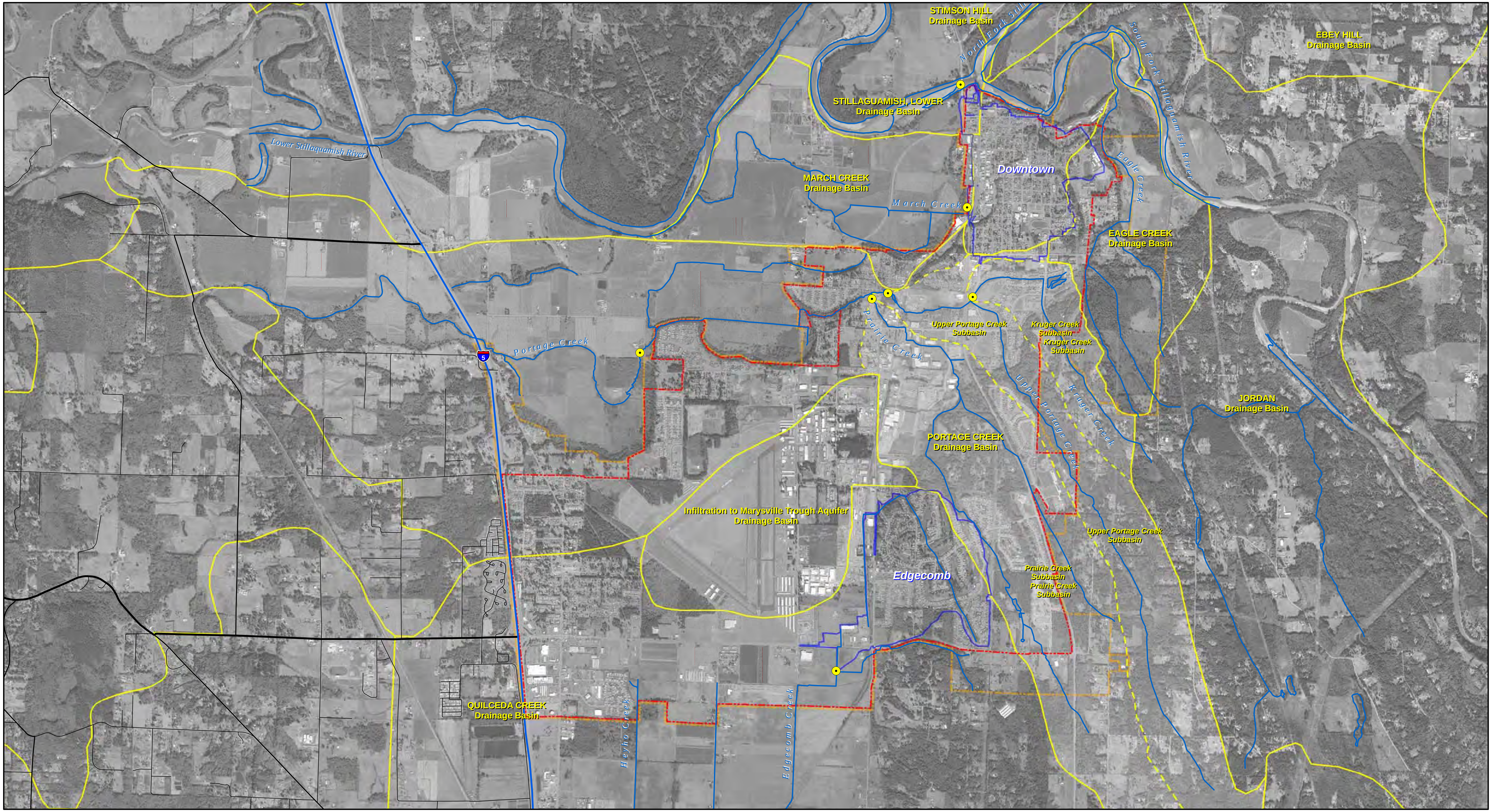
The model indicated a problem at W-09, but it is believed that these results occurred due to incorrect elevation data. According to the model, W-09 will flood during the 2-year, 24-hour storm event. A profile of the storm drain line near W-09 indicates an unusual low point at this structure. The model estimated that OL-22 will flood during the 10-year storm event. The conduits downstream of OL-22 have the same diameter and approximately the same slope, but do not produce any surcharging issues. It appears that the estimated flooding at OL-22 is a program error. Attachment 2 shows profiles of the storm drain line at W-09 and OL-22. Since the data for these two structures is believed to be flawed, upgrades are not recommended for these two areas.

***Table 1 – 24-Hour Design Rainfall***

| Return Period (years) | Rainfall Depth (inches) | Return Period (years) | Rainfall Depth (inches) |
|---|---|---|---|
| 2-year | 1.80 | 25-year | 3.20 |
| 10-year | 2.75 | 100-year | 3.75 |

***Table 2 - Flooding Summary***

| Node | 100-year Storm | | | 25-year Storm | | | 10-year Storm | | | 2-year Storm | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flooded | Flood Volume | | Flooded | Flood Volume | | Flooded | Flood Volume | | Flooded | Flood Volume | |
| | Time (min) | (cf) | (ac-ft) | Time (min) | (cf) | (ac-ft) | Time (min) | (cf) | (ac-ft) | Time (min) | (cf) | (ac-ft) |
| DM-05 | 127 | 169,408 | 3.89 | 96 | 128,582 | 2.95 | 74 | 98,538 | 2.26 | 40 | 30,966 | 0.71 |
| DM-17 | 38 | 10,460 | 0.24 | 30 | 8,000 | 0.18 | 24 | 4,687 | 0.11 | -- | -- | -- |
| BE-09 | 50 | 15,207 | 0.35 | 42 | 9,756 | 0.22 | 35 | 5,769 | 0.13 | 9 | 145 | 0 |
| BE-10 | 45 | 7,229 | 0.17 | 37 | 5,909 | 0.14 | 30 | 4,000 | 0.09 | -- | -- | -- |
| BE-11 | 26 | 1,872 | 0.04 | 19 | 708 | 0.02 | -- | -- | -- | -- | -- | -- |



## Legend

- ⊙ Drainage Basin Outfalls
- State Highway
- Arterial
- Street
- ▭ Arlington City Limits
- ▭ UGA Zones
- ▭ Drainage Basins
- ▭ Subbasins

**Figure 1**
**Arlington Drainage Basins and Subbasins**

\\Seaprojects\project\Arlington\GIS\maps\Figure 1 - Arlington Drainage Basins and Subbasins.mxd

**Figure 2**

# Old Town Arlington

0 125 250 500
Feet

## Legend

**Pipe_network_0401**

**Material**

- Unspecified
- CMP Cor Metal
- Concrete
- Ductal Iron
- HDPE Corrugated
- HDPE Smooth
- PVC Smooth
- Perforated HDPE
- Perforated PVC
- Steel
- Contour_20
- Contour_10

**Watersheds WS4**

**WS4**

- Broadway
- Butler East
- Butler West
- Centennial Trail
- Division Main
- Edgecomb
- Haller Park
- Seventh Day Adventist
- Talcott
- Utilities
- West
- West RR
- Butler DT

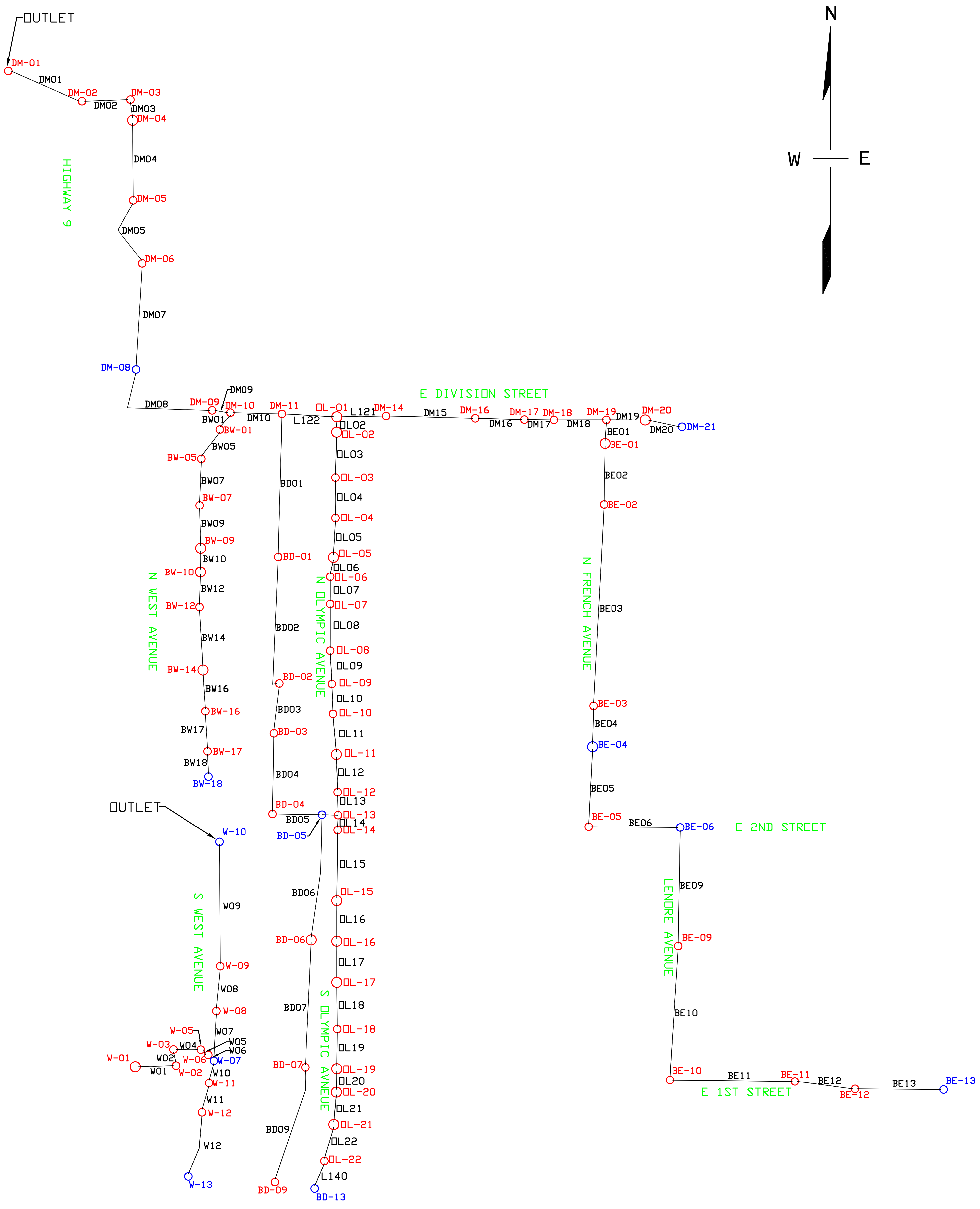


FIGURE 3
OLD TOWN BASIN STORMWATER SYSTEM SCHEMATIC

LEGEND:

| | |
|---|---|
| ○ X-# | CONVEYANCE STRUCTURE WITHOUT INLET |
| ○ X-# | CONVEYANCE STRUCTURE WITH INLET |
| — X# | PIPELINE |

# ATTACHMENT 1

## Isopluvials of 24-Hour Precipitation

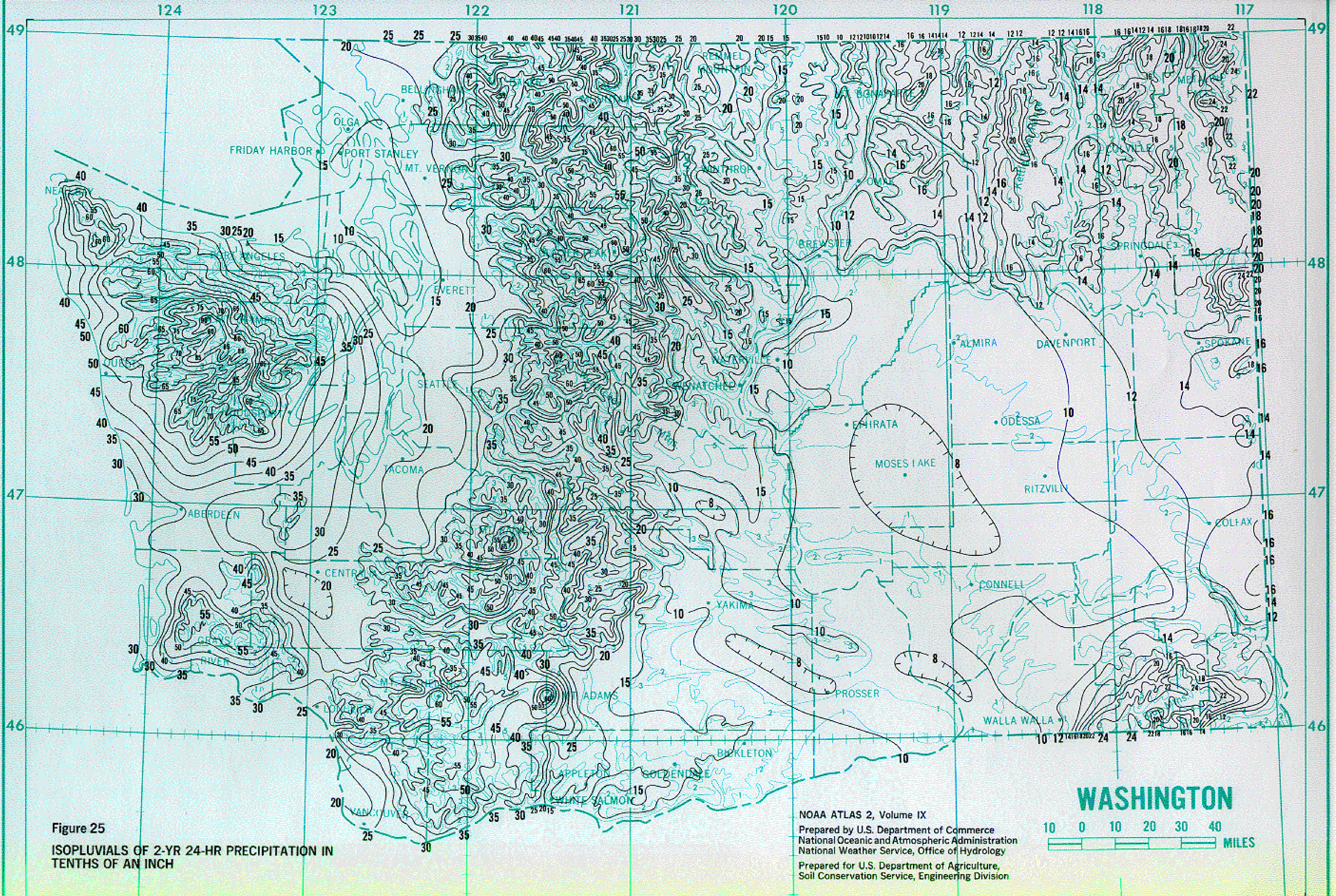


Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

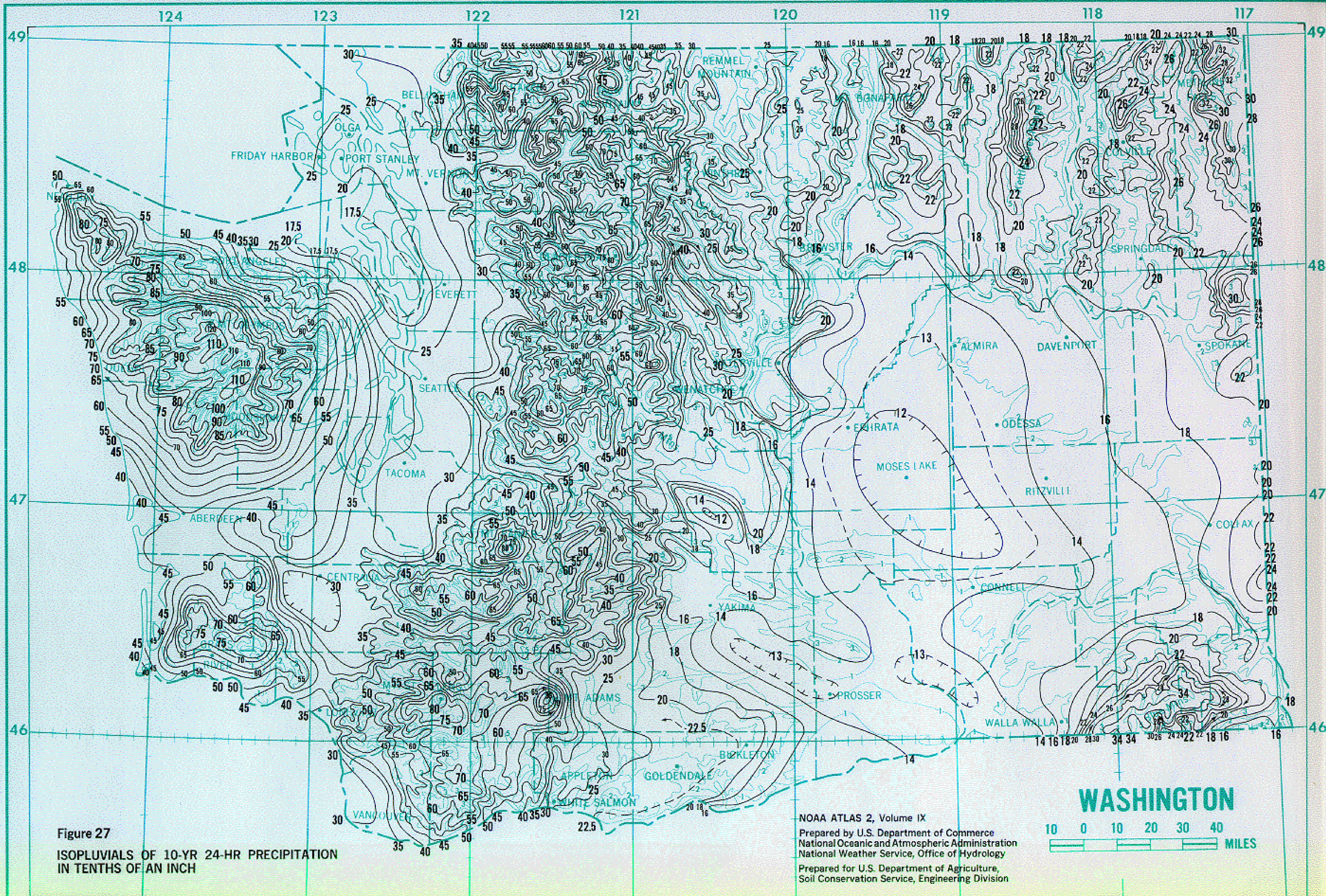


Figure 27

ISOPLUVIALS OF 10-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

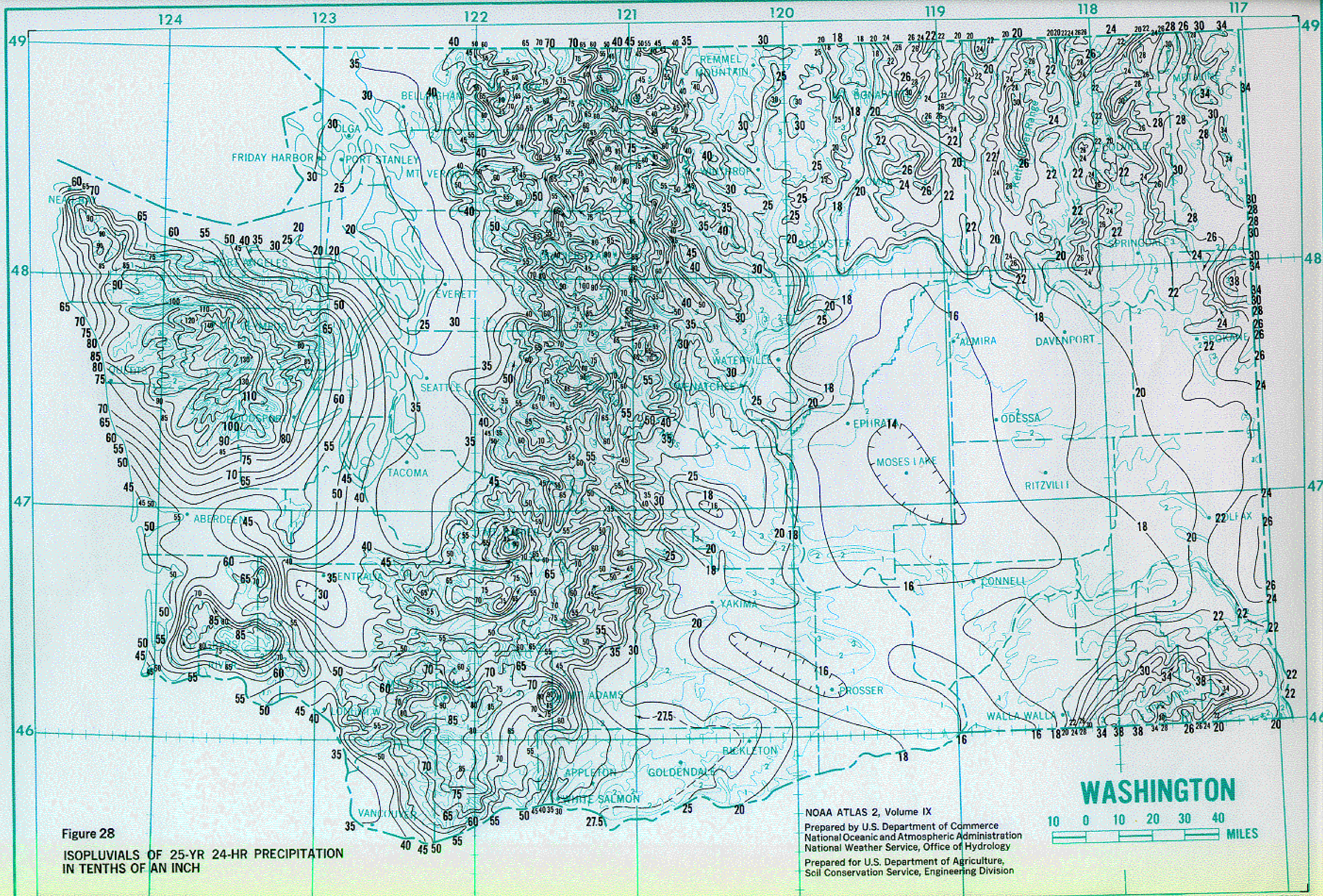


Figure 28

ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

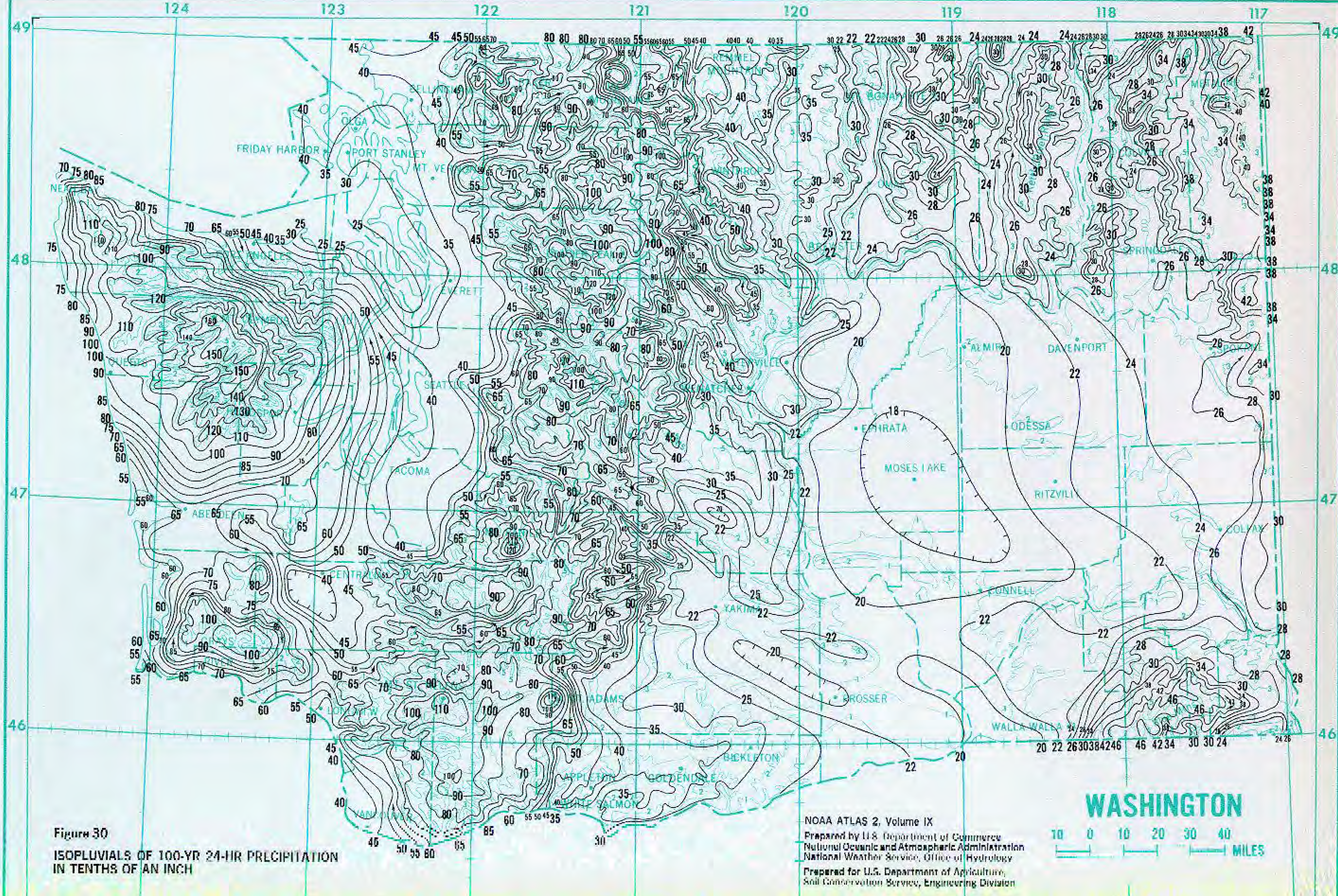


Figure 30

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume IX

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

# ATTACHMENT 2

## Summary of XP-SWMM Input & Output

Downtown Basin - Summary of Impervious Areas

| Node Name | Rainfall Reference | Width (ft) | Area (ac) | Impervious Percentage % | Slope |
|---|---|---|---|---|---|
| BW-18 | SCS Type IA | 1,140 | 5.7 | 65 | 0.004 |
| BD-13 | SCS Type IA | 2,920 | 122.3 | 53.4 | 0.022 |
| OL-13 | SCS Type IA | 1,850 | 30.5 | 53.4 | 0.048 |
| BE-13 | SCS Type IA | 1,560 | 24.2 | 51.1 | 0.073 |
| BE-06 | SCS Type IA | 1,500 | 34.8 | 51.1 | 0.019 |
| BE-04 | SCS Type IA | 1,340 | 19.3 | 51.1 | 0.033 |
| DM-21a | SCS Type IA | 1,800 | 16.1 | 64.9 | 0.021 |
| DM-21b | SCS Type IA | 870 | 8.9 | 64.9 | 0.021 |
| DM-08 | SCS Type IA | 1,260 | 19.9 | 64.9 | 0.029 |
| W-13 | SCS Type IA | 180 | 1.7 | 66.8 | 0.032 |
| W-10 | SCS Type IA | 840 | 2.9 | 66.8 | 0.015 |
| W-07 | SCS Type IA | 490 | 7.6 | 65 | 0.003 |

```
*================================================*
 |          Table E1 - Conduit Data               |
 *================================================*

                                                                                       Trapezoid
 Inp          Conduit     Length    Conduit      Area    Manning  Max Width      Depth       Side
 Num             Name       (ft)      Class    (ft^2)      Coef.       (ft)       (ft)     Slopes
---- ---------------- ---------- ----------   -------    -------  ---------      -----    -------
   1             DM01   285.2000   Circular    7.0686     0.0240     3.0000     3.0000
   2             DM07   367.5000   Circular    7.0686     0.0140     3.0000     3.0000
   3             DM05   245.1000   Circular    7.0686     0.0140     3.0000     3.0000
   4             DM04   279.4000   Circular   19.6350     0.0240     5.0000     5.0000
   5             DM02   161.8000   Circular    7.0686     0.0240     3.0000     3.0000
   6             DM08   427.6100   Circular    7.0686     0.0140     3.0000     3.0000
   7             BW18    87.5000   Circular    1.0751     0.0120     1.1700     1.1700
   8             BW17   141.8000   Circular    1.0751     0.0120     1.1700     1.1700
   9             BW14   216.1000   Circular    1.0751     0.0120     1.1700     1.1700
  10             BW12   125.2000   Circular    1.0751     0.0120     1.1700     1.1700
  11             BW10    81.6000   Circular    1.0751     0.0120     1.1700     1.1700
  12             BW07   170.6000   Circular    1.0751     0.0120     1.1700     1.1700
  13             BW05   122.0000   Circular    1.3893     0.0120     1.3300     1.3300
  14             BW01    67.3000   Circular    1.7671     0.0120     1.5000     1.5000
  15             DM09    66.9000   Circular    7.0686     0.0140     3.0000     3.0000
  16             BE01    62.1000   Circular    2.4053     0.0140     1.7500     1.7500
  17             DM20   130.4000   Circular    1.2272     0.0140     1.2500     1.2500
  18             DM19   138.1000   Circular    0.7854     0.0140     1.0000     1.0000
  19             DM17   143.4000   Circular    3.1416     0.0140     2.0000     2.0000
  20             DM15   310.9000   Circular    2.4053     0.0140     1.7500     1.7500
  21             DM10   181.3000   Circular    7.0686     0.0140     3.0000     3.0000
  22             BD02   465.0000   Circular    6.2902     0.0140     2.8300     2.8300
  23             BD01   503.0000   Circular    7.0686     0.0140     3.0000     3.0000
  24             BD09   419.2000   Circular    3.1416     0.0140     2.0000     2.0000
  25             BD07   442.3000   Circular    3.1416     0.0140     2.0000     2.0000
  26             BD06   443.7000   Circular    3.9761     0.0140     2.2500     2.2500
  27             BD05   178.3000   Circular    3.9761     0.0140     2.2500     2.2500
  28             BD03   166.9000   Circular    4.9087     0.0140     2.5000     2.5000
  29             BE10   459.5000   Circular    1.7671     0.0140     1.5000     1.5000
  30             BE09   423.0000   Circular    2.4053     0.0140     1.7500     1.7500
  31             BE06   317.8000   Circular    1.7671     0.0140     1.5000     1.5000
  32              W09   434.8000   Circular    0.7854     0.0120     1.0000     1.0000
  33              W06    32.9000   Circular    0.7854     0.0120     1.0000     1.0000
  34              W04    99.2000   Circular    0.7854     0.0120     1.0000     1.0000
  35              W02    52.3000   Circular    0.7854     0.0120     1.0000     1.0000
  36              W01   138.1000   Circular    1.7671     0.0120     1.5000     1.5000
  37              W12   228.1000   Circular    0.7854     0.0120     1.0000     1.0000
  38             DM03    80.4000   Circular    4.9087     0.0240     2.5000     2.5000
  39             BW16   142.7000   Circular    1.0751     0.0120     1.1700     1.1700
  40             BW09   142.6000   Circular    1.0207     0.0120     1.1400     1.1400
  41             BD04   278.9000   Circular    3.9761     0.0140     2.2500     2.2500
  42             DM16   170.0000   Circular    3.1416     0.0140     2.0000     2.0000
  43             DM18   144.1000   Circular    3.1416     0.0140     2.0000     2.0000
  44             BE02   238.6000   Circular    2.4053     0.0140     1.7500     1.7500
  45             BE05   268.7000   Circular    2.4053     0.0140     1.7500     1.7500
  46             BE04   155.1000   Circular    2.4053     0.0140     1.7500     1.7500
  47             BE03   698.2000   Circular    2.4053     0.0140     1.7500     1.7500
  48             BE13   320.4000   Circular    1.2272     0.0140     1.2500     1.2500
  49             BE12   189.6000   Circular    1.2272     0.0140     1.2500     1.2500
  50             BE11   445.7000   Circular    1.7671     0.0140     1.5000     1.5000
  51              W11   111.1000   Circular    0.7854     0.0120     1.0000     1.0000
  52              W10    71.5000   Circular    0.7854     0.0120     1.0000     1.0000
  53              W08   160.3000   Circular    0.7854     0.0120     1.0000     1.0000
  54              W07   180.7000   Circular    0.7854     0.0120     1.0000     1.0000
  55              W05    26.1000   Circular    0.7854     0.0120     1.0000     1.0000
  56             OL05   149.0000   Circular    7.0686     0.0140     3.0000     3.0000
  57             OL04   120.0000   Circular    7.0686     0.0140     3.0000     3.0000
  58             OL03   149.0000   Circular    7.0686     0.0140     3.0000     3.0000
  59             OL02    69.0000   Circular    7.0686     0.0140     3.0000     3.0000
  60             L121   183.0500   Circular    7.0686     0.0140     3.0000     3.0000
  61             L122   183.0500   Circular    7.0686     0.0140     3.0000     3.0000
  62             OL09    77.0000   Circular    7.0686     0.0140     3.0000     3.0000
  63             OL08   149.0000   Circular    7.0686     0.0140     3.0000     3.0000
  64             OL07   145.0000   Circular    7.0686     0.0140     3.0000     3.0000
  65             OL06    71.0000   Circular    7.0686     0.0140     3.0000     3.0000
  66             OL13    57.0000   Circular    7.0686     0.0140     3.0000     3.0000
  67             OL12   124.0000   Circular    7.0686     0.0140     3.0000     3.0000
  68             OL11   108.0000   Circular    7.0686     0.0140     3.0000     3.0000
  69             OL10   122.0000   Circular    7.0686     0.0140     3.0000     3.0000
  70             OL14    49.0000   Circular    7.0686     0.0140     3.0000     3.0000
  71             OL16    91.0000   Circular    7.0686     0.0140     3.0000     3.0000
  72             OL15   267.0000   Circular    7.0686     0.0140     3.0000     3.0000
  73             OL19    49.0000   Circular    7.0686     0.0140     3.0000     3.0000
  74             OL18   163.0000   Circular    7.0686     0.0140     3.0000     3.0000
  75             OL17   212.0000   Circular    7.0686     0.0140     3.0000     3.0000
  76             OL20    91.0000   Circular    7.0686     0.0140     3.0000     3.0000
  77             OL22   113.0000   Circular    7.0686     0.0140     3.0000     3.0000
  78             OL21   146.0000   Circular    7.0686     0.0140     3.0000     3.0000
  79             L140    73.0000   Circular    7.0686     0.0140     3.0000     3.0000
  80         Overflow   200.0000   Circular    0.7854     0.0140     1.0000     1.0000
Total length of all conduits ....     15600.7100 feet
```

```
*==================================================*
 |          Table E3a - Junction Data              |
 *==================================================*

 Inp         Junction     Ground     Crown    Invert    Qinst  Initial  Interface
 Num             Name  Elevation Elevation Elevation      cfs Depth-ft   Flow (%)
 ---  ---------------  --------- --------- --------- -------- --------  ---------
   1            DM-02    65.4400   58.1200   55.1200   0.0000   0.0000   100.0000
   2            DM-01    57.4200   54.7000   51.7000   0.0000   0.0000   100.0000
   3            DM-03    67.6900   59.0200   56.0200   0.0000   0.0000   100.0000
   4            DM-05    70.0000   63.9000   58.9000   0.0000   0.0000   100.0000
   5            DM-06    97.5200   66.1000   63.1000   0.0000   0.0000   100.0000
   6            DM-08    98.8200   88.6800   85.6800   0.0000   0.0000   100.0000
   7            DM-09   103.1100   93.5000   90.5000   0.0000   0.0000   100.0000
   8            DM-10   103.2100   94.7900   91.7900   0.0000   0.0000   100.0000
   9            BW-01   103.2300   99.5100   98.0100   0.0000   0.0000   100.0000
  10            BW-05   103.1700  100.2400   98.9100   0.0000   0.0000   100.0000
  11            BW-07   104.4600  102.0900  100.9200   0.0000   0.0000   100.0000
  12            BW-10   107.8900  104.0700  102.9000   0.0000   0.0000   100.0000
  13            BW-12   111.0900  104.8900  103.7200   0.0000   0.0000   100.0000
  14            BW-14   111.8500  105.9300  104.7600   0.0000   0.0000   100.0000
  15            BW-17   110.4500  107.3400  106.1700   0.0000   0.0000   100.0000
  16            BW-18   110.7700  107.9300  106.7600   0.0000   0.0000   100.0000
  17            DM-11   101.3000   96.0700   93.0700   0.0000   0.0000   100.0000
  18            DM-14   111.0800   99.6600   94.7000   0.0000   0.0000   100.0000
  19            DM-17   113.2000  107.0300  105.0300   0.0000   0.0000   100.0000
  20            DM-19   124.9500  122.1600  120.1600   0.0000   0.0000   100.0000
  21            BE-05   168.2000  159.2400  157.4900   0.0000   0.0000   100.0000
  22            DM-20   137.2200  130.7500  129.5000   0.0000   0.0000   100.0000
  23            DM-21   139.6700  132.6000  131.3500   0.0000   0.0000   100.0000
  24            BD-01   108.3790  101.1400   96.8200   0.0000   0.0000   100.0000
  25            BD-02   111.3980  104.3000  101.4700   0.0000   0.0000   100.0000
  26            BD-03   115.0550  105.3300  102.8300   0.0000   0.0000   100.0000
  27            BD-05   110.9320  107.3900  103.7700   0.0000   0.0000   100.0000
  28            BD-06   114.3850  107.2700  105.0100   0.0000   0.0000   100.0000
  29            BD-07   115.1780  108.5600  106.5400   0.0000   0.0000   100.0000
  30            BD-09   115.6970  109.1600  107.1000   0.0000   0.0000   100.0000
  31            BD-13   114.5000  110.6700  107.6700   0.0000   0.0000   100.0000
  32            BE-06   170.7200  163.9600  161.4600   0.0000   0.0000   100.0000
  33            BE-09   166.9400  164.6600  162.9100   0.0000   0.0000   100.0000
  34            BE-13   193.8900  189.8600  188.6100   0.0000   0.0000   100.0000
  35             W-10   110.9800  108.7200  107.7200   0.0000   0.0000   100.0000
  36             W-07   110.6480  101.4000   99.1500   0.0000   0.0000   100.0000
  37             W-13   120.7010  116.3000  115.3000   0.0000   0.0000   100.0000
  38             W-05   109.5400  100.2800   99.2300   0.0000   0.0000   100.0000
  39             W-03   107.5690  101.1000  100.0600   0.0000   0.0000   100.0000
  40             W-02   113.4460  103.8600  102.3600   0.0000   0.0000   100.0000
  41             W-01    93.1500   93.1500   91.6500   0.0000   0.0000   100.0000
  42            DM-04    68.4500   61.6000   56.5600   0.0000   0.0000   100.0000
  43            BW-16   111.0800  106.7700  105.6000   0.0000   0.0000   100.0000
  44            BW-09   105.7900  103.0600  101.8900   0.0000   0.0000   100.0000
  45            BD-04   113.4460  105.7200  103.4700   0.0000   0.0000   100.0000
  46            DM-16   112.2600  103.2600  101.2600   0.0000   0.0000   100.0000
  47            DM-18   116.7400  112.1400  110.1400   0.0000   0.0000   100.0000
  48            BE-01   140.4400  136.2700  134.5200   0.0000   0.0000   100.0000
  49            BE-02   142.1700  138.6300  136.8800   0.0000   0.0000   100.0000
  50            BE-03   164.3700  157.8700  156.1200   0.0000   0.0000   100.0000
  51            BE-04   167.2500  158.5800  156.8300   0.0000   0.0000   100.0000
  52            BE-10   170.2400  166.4200  164.9200   0.0000   0.0000   100.0000
  53            BE-11   178.9700  172.9500  171.4500   0.0000   0.0000   100.0000
  54            BE-12   183.9400  179.6200  178.3700   0.0000   0.0000   100.0000
  55             W-12   108.9280  103.7500  102.7100   0.0000   0.0000   100.0000
  56             W-11   111.1880  103.9400  102.5800   0.0000   0.0000   100.0000
  57             W-09   108.4470  106.2800  105.2600   0.0000   0.0000   100.0000
  58             W-08   112.3300  109.2600  108.1200   0.0000   0.0000   100.0000
  59             W-06   110.0000  100.2500   99.2500   0.0000   0.0000   100.0000
  60            OL-02   109.8200  105.5800  102.5800   0.0000   0.0000   100.0000
  61            OL-03   109.8300  105.8900  102.8900   0.0000   0.0000   100.0000
  62            OL-04   111.4300  106.1400  103.1400   0.0000   0.0000   100.0000
  63            OL-05   114.5700  106.4900  103.4900   0.0000   0.0000   100.0000
  64            OL-01   109.8300  105.4300   93.9300   0.0000   0.0000   100.0000
  65            OL-09   114.9800  107.3200  104.3200   0.0000   0.0000   100.0000
  66            OL-08   114.8000  107.1700  104.1700   0.0000   0.0000   100.0000
  67            OL-07   114.7000  106.8700  103.8700   0.0000   0.0000   100.0000
  68            OL-06   114.8100  106.5800  103.5800   0.0000   0.0000   100.0000
  69            OL-13   114.6700  108.1500  105.1500   0.0000   0.0000   100.0000
  70            OL-12   114.8700  108.0300  105.0300   0.0000   0.0000   100.0000
  71            OL-11   114.7400  107.7800  104.7800   0.0000   0.0000   100.0000
  72            OL-10   114.5700  107.5600  104.5600   0.0000   0.0000   100.0000
  73            OL-14   114.5100  108.2400  105.2400   0.0000   0.0000   100.0000
  74            OL-15   114.4300  108.7700  105.7700   0.0000   0.0000   100.0000
  75            OL-16   114.6700  108.9500  105.9500   0.0000   0.0000   100.0000
  76            OL-17   114.4500  109.3800  106.3800   0.0000   0.0000   100.0000
  77            OL-18   114.4400  109.7000  106.7000   0.0000   0.0000   100.0000
  78            OL-19   114.9000  109.8000  106.8000   0.0000   0.0000   100.0000
  79            OL-20   114.3400  109.9700  106.9700   0.0000   0.0000   100.0000
  80            OL-21   114.2400  110.2700  107.2700   0.0000   0.0000   100.0000
  81            OL-22   113.7600  110.5000  107.5000   0.0000   0.0000   100.0000
```

```
*===================================================*
 |           Table E4 - Conduit Connectivity         |
 *====================================================*

 Input          Conduit         Upstream       Downstream     Upstream  Downstream
Number             Name             Node             Node    Elevation   Elevation
====== =================   ==============  ===============    =========   =========
     1             DM01            DM-02            DM-01      55.1200     51.7000 No Design
     2             DM07            DM-08            DM-06      85.6800     63.1000 No Design
     3             DM05            DM-06            DM-05      63.1000     58.9000 No Design
     4             DM04            DM-05            DM-04      58.9000     56.6000 No Design
     5             DM02            DM-03            DM-02      56.0200     55.1200 No Design
     6             DM08            DM-09            DM-08      90.5000     85.6800 No Design
     7             BW18            BW-18            BW-17     106.7600    106.1700 No Design
     8             BW17            BW-17            BW-16     106.1700    105.6000 No Design
     9             BW14            BW-14            BW-12     104.7600    103.7200 No Design
    10             BW12            BW-12            BW-10     103.7200    102.9000 No Design
    11             BW10            BW-10            BW-09     102.9000    101.8900 No Design
    12             BW07            BW-07            BW-05     100.9200     98.9100 No Design
    13             BW05            BW-05            BW-01      98.9100     98.0100 No Design
    14             BW01            BW-01            DM-10      98.0100     91.7900 No Design
    15             DM09            DM-10            DM-09      91.7900     90.5000 No Design
    16             BE01            BE-01            DM-19     134.5200    120.1600 No Design
    17             DM20            DM-21            DM-20     131.3500    129.5000 No Design
    18             DM19            DM-20            DM-19     129.5000    120.1600 No Design
    19             DM17            DM-18            DM-17     110.1400    105.0300 No Design
    20             DM15            DM-16            DM-14     101.2600     97.9100 No Design
    21             DM10            DM-11            DM-10      93.0700     91.7900 No Design
    22             BD02            BD-02            BD-01     101.4700     98.3100 No Design
    23             BD01            BD-01            DM-11      96.8200     93.0700 No Design
    24             BD09            BD-09            BD-07     107.1600    106.5400 No Design
    25             BD07            BD-07            BD-06     106.5600    105.2700 No Design
    26             BD06            BD-06            BD-05     105.0100    103.7700 No Design
    27             BD05            BD-05            BD-04     103.7700    103.4700 No Design
    28             BD03            BD-03            BD-02     102.8300    101.4700 No Design
    29             BE10            BE-10            BE-09     164.9200    162.9100 No Design
    30             BE09            BE-09            BE-06     162.9100    161.4600 No Design
    31             BE06            BE-06            BE-05     162.4600    157.4900 No Design
    32              W09             W-10             W-09     107.7200    105.2800 No Design
    33              W06             W-06             W-07      99.2500     99.1500 No Design
    34              W04             W-03             W-05     100.1000     99.2300 No Design
    35              W02             W-02             W-03     102.8000    100.0700 No Design
    36              W01             W-02             W-01     102.3600     91.6500 No Design
    37              W12             W-13             W-12     115.3000    102.7100 No Design
    38             DM03            DM-04            DM-03      56.5600     56.0200 No Design
    39             BW16            BW-16            BW-14     105.6000    104.7600 No Design
    40             BW09            BW-09            BW-07     101.8900    100.9200 No Design
    41             BD04            BD-04            BD-03     103.4700    102.8300 No Design
    42             DM16            DM-17            DM-16     105.0300    101.2600 No Design
    43             DM18            DM-19            DM-18     120.1600    110.1400 No Design
    44             BE02            BE-02            BE-01     136.8800    134.5200 No Design
    45             BE05            BE-05            BE-04     157.4900    156.8300 No Design
    46             BE04            BE-04            BE-03     156.8300    156.1200 No Design
    47             BE03            BE-03            BE-02     156.1200    136.8800 No Design
    48             BE13            BE-13            BE-12     188.6100    178.3700 No Design
    49             BE12            BE-12            BE-11     178.3700    171.4500 No Design
    50             BE11            BE-11            BE-10     171.4500    164.9200 No Design
    51              W11             W-11             W-12     102.9400    102.7500 No Design
    52              W10             W-11             W-07     102.5800    100.2900 No Design
    53              W08             W-08             W-09     108.2600    105.2600 No Design
    54              W07             W-08             W-07     108.1200    100.4000 No Design
    55              W05             W-05             W-06      99.2800     99.2500 No Design
    56             OL05            OL-05            OL-04     103.4900    103.1400 No Design
    57             OL04            OL-04            OL-03     103.1400    102.8900 No Design
    58             OL03            OL-03            OL-02     102.8900    102.5800 No Design
    59             OL02            OL-02            OL-01     102.5800    102.4300 No Design
    60             L121            DM-14            OL-01      94.7000     93.9300 No Design
    61             L122            OL-01            DM-11      93.9300     93.0700 No Design
    62             OL09            OL-09            OL-08     104.3200    104.1700 No Design
    63             OL08            OL-08            OL-07     104.1700    103.8700 No Design
    64             OL07            OL-07            OL-06     103.8700    103.5800 No Design
    65             OL06            OL-06            OL-05     103.5800    103.4900 No Design
    66             OL13            OL-13            OL-12     105.1500    105.0300 No Design
    67             OL12            OL-12            OL-11     105.0300    104.7800 No Design
    68             OL11            OL-11            OL-10     104.7800    104.5600 No Design
    69             OL10            OL-10            OL-09     104.5600    104.3200 No Design
    70             OL14            OL-14            OL-13     105.2400    105.1500 No Design
    71             OL16            OL-16            OL-15     105.9500    105.7700 No Design
    72             OL15            OL-15            OL-14     105.7700    105.2400 No Design
    73             OL19            OL-19            OL-18     106.8000    106.7000 No Design
    74             OL18            OL-18            OL-17     106.7000    106.3800 No Design
    75             OL17            OL-17            OL-16     106.3800    105.9500 No Design
    76             OL20            OL-20            OL-19     106.9700    106.8000 No Design
    77             OL22            OL-22            OL-21     107.5000    107.2700 No Design
    78             OL21            OL-21            OL-20     107.2700    106.9700 No Design
    79             L140            BD-13            OL-22     107.6700    107.5000 No Design
    80         Overflow            OL-13            BD-05     106.8000    106.3900 No Design
```

```
*=================================*
 |   Conduit Convergence Criteria  |
 *=================================*

          Conduit        Full     Conduit
             Name        Flow       Slope
-----------------  ----------  ----------
             DM01     39.5627      0.0120
             DM07    153.5196      0.0614
             DM05     81.0744      0.0171
             DM04    127.9955      0.0082
             DM02     26.9451      0.0056
             DM08     65.7552      0.0113
             BW18      4.8173      0.0067
             BW17      3.7195      0.0040
             BW14      4.0698      0.0048
             BW12      4.7477      0.0065
             BW10      6.5268      0.0124
             BW07      6.3678      0.0118
             BW05      7.0920      0.0074
             BW01     34.5954      0.0924
             DM09     86.0028      0.0193
             BE01     70.7522      0.2312
             DM20      7.1447      0.0142
             DM19      8.6037      0.0676
             DM17     39.6543      0.0356
             DM15     15.2729      0.0108
             DM10     52.0399      0.0071
             BD02     43.7007      0.0068
             BD01     53.4764      0.0075
             BD09      8.0787      0.0015
             BD07     11.3446      0.0029
             BD06     15.2029      0.0028
             BD05     11.7963      0.0017
             BD03     34.3813      0.0081
             BE10      6.4512      0.0044
             BE09      8.6144      0.0034
             BE06     12.1979      0.0156
              W09      2.8914      0.0056
              W06      2.1279      0.0030
              W04      3.6146      0.0088
              W02      8.8183      0.0522
              W01     31.6905      0.0776
              W12      9.0678      0.0552
             DM03     18.2082      0.0067
             BW16      4.5010      0.0059
             BW09      4.5147      0.0068
             BD04     13.7761      0.0023
             DM16     31.2824      0.0222
             DM18     55.3931      0.0695
             BE02     14.6329      0.0099
             BE05      7.2920      0.0025
             BE04      9.9548      0.0046
             BE03     24.4243      0.0276
             BE13     10.7235      0.0320
             BE12     11.4596      0.0365
             BE11     11.8064      0.0147
              W11      1.5962      0.0017
              W10      6.9075      0.0320
              W08      5.2802      0.0187
              W07      7.9778      0.0427
              W05      1.3086      0.0011
             OL05     30.0173      0.0023
             OL04     28.2690      0.0021
             OL03     28.2500      0.0021
             OL02     28.8770      0.0022
             L121     40.1690      0.0042
             L122     42.4517      0.0047
             OL09     27.3357      0.0019
             OL08     27.7906      0.0020
             OL07     27.6978      0.0020
             OL06     22.0507      0.0013
             OL13     28.4174      0.0021
             OL12     27.8093      0.0020
             OL11     27.9531      0.0020
             OL10     27.4699      0.0020
             OL14     26.5432      0.0018
             OL16     27.5452      0.0020
             OL15     27.5939      0.0020
             OL19     27.9790      0.0020
             OL18     27.4418      0.0020
             OL17     27.8931      0.0020
             OL20     26.7691      0.0019
             OL22     27.9419      0.0020
             OL21     28.0747      0.0021
             L140     29.8878      0.0023
         Overflow      1.4979      0.0021
```

```
*=========================================================*
 |     Table E15 - SPREADSHEET INFO LIST                   |
 | Conduit Flow and Junction Depth Information for use in  |
 | spreadsheets.  The maximum values in this table are the |
 | true maximum values because they sample every time step.|
 | The values in the review results may only be the        |
 | maximum of a subset of all the time steps in the run.   |
 | Note: These flows are only the flows in a single barrel.|
 *=========================================================*

       Conduit       Maximum      Total        Maximum       Maximum   ##        Junction     Invert       Maximum
         Name           Flow       Flow       Velocity        Volume   ##         Name     Elevation     Elevation
                       (cfs)     (ft^3)         (ft/s)        (ft^3)   ##                     (ft)          (ft)  
 ---------------  ----------  ----------    ----------    ----------   ## ----------------  ---------    ---------
            DM01     53.8321 921455.2474        7.6971     1301.6345   ##            DM-02    55.1200      60.3912
            DM07     59.4382 926440.8684       18.1441      827.1731   ##            DM-01    51.7000      54.0827
            DM05     59.4403 926167.6118       10.5272     1758.4101   ##            DM-03    56.0200      63.9184
            DM04     59.4410 925887.8694        4.5321     5533.8533   ##            DM-05    58.9000      68.9497
            DM02     53.8245 921729.1583        7.5408     1186.6594   ##            DM-06    63.1000      71.1419
            DM08     54.9114 848509.5555        9.8144      514.6789   ##            DM-08    85.6800      87.0073
            BW18      1.5564  21993.4037        3.8295       35.2172   ##            DM-09    90.5000      92.8282
            BW17      1.5553  21981.5295        3.2637       52.7447   ##            DM-10    91.7900      93.7238
            BW14      1.5533  21959.0102        3.4842       42.8206   ##            BW-01    98.0100      98.2259
            BW12      1.5526  21945.4540        3.8523       21.4946   ##            BW-05    98.9100      99.3776
            BW10      1.5525  21937.7086        4.8044       14.0779   ##            BW-07   100.9200     101.3134
            BW07      1.5518  21918.4438        4.7601       14.2322   ##            BW-10   102.9000     103.2891
            BW05      1.5514  21905.2007        3.8090        8.1521   ##            BW-12   103.7200     104.1980
            BW01      1.5513  21900.7469        4.8677       21.5657   ##            BW-14   104.7600     105.2698
            DM09     54.9209 848753.6561       11.1581      357.2962   ##            BW-17   106.1700     106.7094
            BE01     16.2045 241068.6098       22.0589        3.6545   ##            BW-18   106.7600     107.2247
            DM20      6.8763  98148.4363        6.4382       42.2086   ##            DM-11    93.0700      95.4295
            DM19      6.8751  98136.4542       11.8411        8.5066   ##            DM-14    94.7000      96.8898
            DM17     22.7860 339116.1613       12.1735      295.1056   ##            DM-17   105.0300     108.6866
            DM15     22.7769 338878.9432        9.3796      364.9699   ##            DM-19   120.1600     121.0549
            DM10     53.4068 826944.5288        9.1367      975.0265   ##            BE-05   157.4900     161.2659
            BD02      1.7879   2769.0553        3.3878       29.8061   ##            DM-20   129.5000     130.1760
            BD01      1.7777   2766.4339        1.7101      859.2564   ##            DM-21   131.3500     132.4140
            BD09      0.0000      0.0000        0.0000        0.0000   ##            BD-01    96.8200      97.1942
            BD07      0.0000      0.0000        0.0000        0.0000   ##            BD-02   101.4700     101.8611
            BD06      0.0000      0.0000        0.0000       60.3624   ##            BD-03   102.8300     103.2200
            BD05      1.8175   2738.7139        2.1576      148.2528   ##            BD-05   103.7700     104.3666
            BD03      1.8126   2744.0653        3.7060       23.4612   ##            BD-06   105.0100     105.0100
            BE10      5.1976  75208.0394        3.8486      824.3614   ##            BD-07   106.5400     106.5400
            BE09      5.5003  75152.3194        2.5850     1028.2992   ##            BD-09   107.1000     107.1000
            BE06     12.1986 181762.0951        6.9669      430.7450   ##            BD-13   107.6700     109.9245
             W09      0.8315  11631.1301        1.3271      345.1237   ##            BE-06   161.4600     166.1461
             W06     -2.4043 -42995.6281       -2.9818       27.0881   ##            BE-09   162.9100     166.6361
             W04     -2.4011 -42901.1010       -2.9852       79.8526   ##            BE-13   188.6100     189.2411
             W02     -2.4014 -42809.6953       -4.1595       41.7258   ##             W-10   107.7200     108.6335
             W01      2.4014  42804.2957       10.5351        0.8141   ##             W-07    99.1500     104.3630
             W12      0.4833   6889.0408        4.1407       16.3759   ##             W-13   115.3000     115.4567
            DM03     53.8766 921951.0079       10.7302      411.2441   ##             W-05    99.2300     104.1435
            BW16      1.5543  21971.0564        3.7571       37.1898   ##             W-03   100.0600     103.7761
            BW09      1.5525  21927.3014        3.8948       20.7732   ##             W-02   102.3600     102.6397
            BD04      1.8094   2741.1031        2.3096      107.4803   ##             W-01    91.6500      91.9279
            DM16     22.7773 339055.0716        9.5606      542.0824   ##            DM-04    56.5600      68.4500
            DM18     22.8268 339167.1755       16.0350       32.5549   ##            BW-16   105.6000     106.0750
            BE02     16.2049 241089.4598        7.2157       84.0977   ##            BW-09   101.8900     102.3700
            BE05     12.2104 181649.2666        5.0417      668.9489   ##            BD-04   103.4700     104.0534
            BE04     16.2249 241380.5392        6.9864      301.4034   ##            DM-16   101.2600     106.7172
            BE03     16.2139 241263.5268       10.2402      269.5387   ##            DM-18   110.1400     111.4386
            BE13      5.2775  75356.3021        8.5613       11.1670   ##            BE-01   134.5200     135.0895
            BE12      5.2765  75329.3081        8.9368       12.8540   ##            BE-02   136.8800     140.2923
            BE11      5.2748  75275.8143        6.0900      304.8639   ##            BE-03   156.1200     157.1714
             W11     -0.4753  -6812.0952       -0.8570       91.0299   ##            BE-04   156.8300     159.4374
             W10      0.4778   6831.1722        2.6336       57.2540   ##            BE-10   164.9200     167.8494
             W08     -0.0638  -4926.4412       -0.5440      107.8410   ##            BE-11   171.4500     172.1755
             W07      0.1227   4934.3587        1.5420       61.7970   ##            BE-12   178.3700     178.9658
             W05     -2.4019 -43015.7346       -2.9827       21.4894   ##             W-12   102.7100     104.3865
            OL05     29.3720 485829.2380        5.0159      866.7627   ##             W-11   102.5800     104.3706
            OL04     29.3679 485686.4805        5.1132      676.8995   ##             W-09   105.2600     108.4470
            OL03     29.3693 485540.9568        5.3869      775.4821   ##             W-08   108.1200     108.1243
            OL02     29.3709 485397.6102        6.0677      316.9249   ##             W-06    99.2500     104.2398
            L121     22.7274 338807.5557        4.3108     1124.6544   ##            OL-02   102.5800     104.5439
            L122     51.8426 824010.0959        7.7351     1165.4548   ##            OL-03   102.8900     105.0748
            OL09     29.4240 486342.3042        4.6480      486.2503   ##            OL-04   103.1400     105.4222
            OL08     29.4070 486228.4697        4.6809      931.5218   ##            OL-05   103.4900     105.8110
            OL07     29.3886 486068.5087        4.7393      892.9928   ##            OL-01    93.9300      96.6795
            OL06     29.3772 485945.0426        4.8314      424.9280   ##            OL-09   104.3200     106.8400
            OL13     29.5320 486707.2476        4.5989      367.1550   ##            OL-08   104.1700     106.6697
            OL12     29.5043 486605.1387        4.5884      796.8924   ##            OL-07   103.8700     106.3353
            OL11     29.4714 486479.7547        4.6000      691.2720   ##            OL-06   103.5800     105.9987
            OL10     29.4459 486358.1753        4.6138      776.3718   ##            OL-13   105.1500     107.7198
            OL14     25.2944 390532.8977        3.9580      314.8309   ##            OL-12   105.0300     107.5995
            OL16     25.1776 390840.8820        4.1124      559.7434   ##            OL-11   104.7800     107.3356
            OL15     25.2296 390676.0443        4.0746     1680.6788   ##            OL-10   104.5600     107.1045
            OL19     25.2678 391244.4792        4.3432      288.3158   ##            OL-14   105.2400     107.7936
            OL18     25.2315 391144.5544        4.3042      966.6842   ##            OL-15   105.7700     108.2234
            OL17     25.1749 390981.4591        4.2265     1280.6765   ##            OL-16   105.9500     108.3740
            OL20     25.2943 391315.3035        4.3463      534.0430   ##            OL-17   106.3800     108.7413
            OL22     25.3866 391546.7305        4.4307      653.9760   ##            OL-18   106.7000     109.0344
            OL21     25.3385 391423.8357        4.3951      851.9043   ##            OL-19   106.8000     109.1228
            L140     25.4217 391627.8598        4.4939      418.5360   ##            OL-20   106.9700     109.2920
        Overflow      1.8297   2734.6641        2.5173      121.2457   ##            OL-21   107.2700     109.5664
        FREE # 1     53.8579 921451.8971        0.0000        0.0000   ##            OL-22   107.5000     109.7837
        FREE # 2      2.4014  42804.2065        0.0000        0.0000   ##
```

```
*====================================================*
|     Table E15a - SPREADSHEET REACH LIST            |
| Peak flow and Total Flow listed by Reach or those  |
|      conduits or diversions having the same        |
|      upstream and downstream nodes.                |
*====================================================*

       Upstream       Downstream    Maximum          Total
           Node             Node       Flow           Flow
                                      (cfs)         (ft^3)
--------------- ---------------- ----------      ---------
          DM-02            DM-01    53.8321      921455.247
          DM-08            DM-06    59.4382      926440.868
          DM-06            DM-05    59.4403      926167.612
          DM-05            DM-04    59.4410      925887.869
          DM-03            DM-02    53.8245      921729.158
          DM-09            DM-08    54.9114      848509.555
          BW-18            BW-17     1.5564      21993.4037
          BW-17            BW-16     1.5553      21981.5295
          BW-14            BW-12     1.5533      21959.0102
          BW-12            BW-10     1.5526      21945.4540
          BW-10            BW-09     1.5525      21937.7086
          BW-07            BW-05     1.5518      21918.4438
          BW-05            BW-01     1.5514      21905.2007
          BW-01            DM-10     1.5513      21900.7469
          DM-10            DM-09    54.9209      848753.656
          BE-01            DM-19    16.2045      241068.610
          DM-21            DM-20     6.8763      98148.4363
          DM-20            DM-19     6.8751      98136.4542
          DM-18            DM-17    22.7860      339116.161
          DM-16            DM-14    22.7769      338878.943
          DM-11            DM-10    53.4068      826944.529
          BD-02            BD-01     1.7879       2769.0553
          BD-01            DM-11     1.7777       2766.4339
          BD-05            BD-04     1.8175       2738.7139
          BD-03            BD-02     1.8126       2744.0653
          BE-10            BE-09     5.1976      75208.0394
          BE-09            BE-06     5.5003      75152.3194
          BE-06            BE-05    12.1986      181762.095
           W-10             W-09     0.8315      11631.1301
           W-06             W-07     2.4043      42995.6281
           W-03             W-05     2.4011      42901.1010
           W-02             W-03     2.4014      42809.6953
           W-02             W-01     2.4014      42804.2957
           W-13             W-12     0.4833       6889.0408
          DM-04            DM-03    53.8766      921951.008
          BW-16            BW-14     1.5543      21971.0564
          BW-09            BW-07     1.5525      21927.3014
          BD-04            BD-03     1.8094       2741.1031
          DM-17            DM-16    22.7773      339055.072
          DM-19            DM-18    22.8268      339167.176
          BE-02            BE-01    16.2049      241089.460
          BE-05            BE-04    12.2104      181649.267
          BE-04            BE-03    16.2249      241380.539
          BE-03            BE-02    16.2139      241263.527
          BE-13            BE-12     5.2775      75356.3021
          BE-12            BE-11     5.2765      75329.3081
          BE-11            BE-10     5.2748      75275.8143
           W-11             W-12     0.4753       6812.0952
           W-11             W-07     0.4778       6831.1722
           W-08             W-09     0.0638       4926.4412
           W-08             W-07     0.1227       4934.3587
           W-05             W-06     2.4019      43015.7346
          OL-05            OL-04    29.3720      485829.238
          OL-04            OL-03    29.3679      485686.480
          OL-03            OL-02    29.3693      485540.957
          OL-02            OL-01    29.3709      485397.610
          DM-14            OL-01    22.7274      338807.556
          OL-01            DM-11    51.8426      824010.096
          OL-09            OL-08    29.4240      486342.304
          OL-08            OL-07    29.4070      486228.470
          OL-07            OL-06    29.3886      486068.509
          OL-06            OL-05    29.3772      485945.043
          OL-13            OL-12    29.5320      486707.248
          OL-12            OL-11    29.5043      486605.139
          OL-11            OL-10    29.4714      486479.755
          OL-10            OL-09    29.4459      486358.175
          OL-14            OL-13    25.2944      390532.898
          OL-16            OL-15    25.1776      390840.882
          OL-15            OL-14    25.2296      390676.044
          OL-19            OL-18    25.2678      391244.479
          OL-18            OL-17    25.2315      391144.554
          OL-17            OL-16    25.1749      390981.459
          OL-20            OL-19    25.2943      391315.304
          OL-22            OL-21    25.3866      391546.731
          OL-21            OL-20    25.3385      391423.836
          BD-13            OL-22    25.4217      391627.860
          OL-13            BD-05     1.8297       2734.6641
```

```
#########################################################
# Table E16. New Conduit Information Section            #
#            Conduit Invert (IE) Elevation and Conduit  #
#            Maximum Water Surface (WS) Elevations      #
#########################################################

   Conduit Name    Upstream Node  Downstream Node     IE Up     IE Dn     WS Up     WS Dn  Conduit Type
--------------- ---------------- ---------------- --------- --------- --------- --------- -------------
           DM01            DM-02            DM-01   55.1200   51.7000   60.3901   54.0827 Circular
           DM07            DM-08            DM-06   85.6800   63.1000   87.0073   71.1419 Circular
           DM05            DM-06            DM-05   63.1000   58.9000   71.1419   68.9448 Circular
           DM04            DM-05            DM-04   58.9000   56.6000   68.9448   68.4500 Circular
           DM02            DM-03            DM-02   56.0200   55.1200   63.9186   60.3901 Circular
           DM08            DM-09            DM-08   90.5000   85.6800   92.8282   87.0073 Circular
           BW18            BW-18            BW-17  106.7600  106.1700  107.2247  106.7094 Circular
           BW17            BW-17            BW-16  106.1700  105.6000  106.7094  106.0750 Circular
           BW14            BW-14            BW-12  104.7600  103.7200  105.2698  104.1980 Circular
           BW12            BW-12            BW-10  103.7200  102.9000  104.1980  103.2891 Circular
           BW10            BW-10            BW-09  102.9000  101.8900  103.2891  102.3700 Circular
           BW07            BW-07            BW-05  100.9200   98.9100  101.3134   99.3776 Circular
           BW05            BW-05            BW-01   98.9100   98.0100   99.3776   98.2259 Circular
           BW01            BW-01            DM-10   98.0100   91.7900   98.2259   93.7238 Circular
           DM09            DM-10            DM-09   91.7900   90.5000   93.7238   92.8282 Circular
           BE01            BE-01            DM-19  134.5200  120.1600  135.0895  121.0549 Circular
           DM20            DM-21            DM-20  131.3500  129.5000  132.4140  130.1760 Circular
           DM19            DM-20            DM-19  129.5000  120.1600  130.1760  121.0549 Circular
           DM17            DM-18            DM-17  110.1400  105.0300  111.4386  108.6866 Circular
           DM15            DM-16            DM-14  101.2600   97.9100  106.7172   99.5549 Circular
           DM10            DM-11            DM-10   93.0700   91.7900   95.4295   93.7238 Circular
           BD02            BD-02            BD-01  101.4700   98.3100  101.8611   98.6964 Circular
           BD01            BD-01            DM-11   96.8200   93.0700   97.1942   95.4295 Circular
           BD09            BD-09            BD-07  107.1600  106.5400  106.5400  106.5400 Circular
           BD07            BD-07            BD-06  106.5600  105.2700  105.0100  105.0100 Circular
           BD06            BD-06            BD-05  105.0100  103.7700  105.0100  104.3666 Circular
           BD05            BD-05            BD-04  103.7700  103.4700  104.3666  104.0534 Circular
           BD03            BD-03            BD-02  102.8300  101.4700  103.2200  101.8611 Circular
           BE10            BE-10            BE-09  164.9200  162.9100  167.8494  166.6361 Circular
           BE09            BE-09            BE-06  162.9100  161.4600  166.6361  166.1461 Circular
           BE06            BE-06            BE-05  162.4600  157.4900  166.1460  161.2659 Circular
            W09             W-10             W-09  107.7200  105.2800  108.6335  108.4470 Circular
            W06             W-06             W-07   99.2500   99.1500  104.2398  104.3630 Circular
            W04             W-03             W-05  100.1000   99.2300  103.7761  104.1435 Circular
            W02             W-02             W-03  102.8000  100.0700  103.4631  103.7761 Circular
            W01             W-02             W-01  102.3600   91.6500  102.6397   91.9279 Circular
            W12             W-13             W-12  115.3000  102.7100  115.4567  104.3865 Circular
           DM03            DM-04            DM-03   56.5600   56.0200   68.4500   63.9184 Circular
           BW16            BW-16            BW-14  105.6000  104.7600  106.0750  105.2698 Circular
           BW09            BW-09            BW-07  101.8900  100.9200  102.3700  101.3134 Circular
           BD04            BD-04            BD-03  103.4700  102.8300  104.0534  103.2200 Circular
           DM16            DM-17            DM-16  105.0300  101.2600  108.6866  106.7172 Circular
           DM18            DM-19            DM-18  120.1600  110.1400  121.0549  111.4386 Circular
           BE02            BE-02            BE-01  136.8800  134.5200  140.2923  135.0895 Circular
           BE05            BE-05            BE-04  157.4900  156.8300  161.2659  159.4374 Circular
           BE04            BE-04            BE-03  156.8300  156.1200  159.4374  157.1714 Circular
           BE03            BE-03            BE-02  156.1200  136.8800  157.1714  140.2923 Circular
           BE13            BE-13            BE-12  188.6100  178.3700  189.2411  178.9658 Circular
           BE12            BE-12            BE-11  178.3700  171.4500  178.9658  172.1755 Circular
           BE11            BE-11            BE-10  171.4500  164.9200  172.1755  167.8494 Circular
            W11             W-11             W-12  102.9400  102.7500  104.3706  104.3865 Circular
            W10             W-11             W-07  102.5800  100.2900  104.3706  104.3630 Circular
            W08             W-08             W-09  108.2600  105.2600  108.3608  108.4470 Circular
            W07             W-08             W-07  108.1200  100.4000  108.1238  104.3630 Circular
            W05             W-05             W-06   99.2800   99.2500  104.1435  104.2398 Circular
           OL05            OL-05            OL-04  103.4900  103.1400  105.8110  105.4222 Circular
           OL04            OL-04            OL-03  103.1400  102.8900  105.4222  105.0748 Circular
           OL03            OL-03            OL-02  102.8900  102.5800  105.0748  104.5439 Circular
           OL02            OL-02            OL-01  102.5800  102.4300  104.5439  104.1837 Circular
           L121            DM-14            OL-01   94.7000   93.9300   96.8898   96.6795 Circular
           L122            OL-01            DM-11   93.9300   93.0700   96.6795   95.4295 Circular
           OL09            OL-09            OL-08  104.3200  104.1700  106.8400  106.6697 Circular
           OL08            OL-08            OL-07  104.1700  103.8700  106.6697  106.3353 Circular
           OL07            OL-07            OL-06  103.8700  103.5800  106.3353  105.9987 Circular
           OL06            OL-06            OL-05  103.5800  103.4900  105.9987  105.8110 Circular
           OL13            OL-13            OL-12  105.1500  105.0300  107.7198  107.5995 Circular
           OL12            OL-12            OL-11  105.0300  104.7800  107.5995  107.3356 Circular
           OL11            OL-11            OL-10  104.7800  104.5600  107.3356  107.1045 Circular
           OL10            OL-10            OL-09  104.5600  104.3200  107.1045  106.8400 Circular
           OL14            OL-14            OL-13  105.2400  105.1500  107.7936  107.7198 Circular
           OL16            OL-16            OL-15  105.9500  105.7700  108.3740  108.2234 Circular
           OL15            OL-15            OL-14  105.7700  105.2400  108.2234  107.7936 Circular
           OL19            OL-19            OL-18  106.8000  106.7000  109.1228  109.0344 Circular
           OL18            OL-18            OL-17  106.7000  106.3800  109.0344  108.7413 Circular
           OL17            OL-17            OL-16  106.3800  105.9500  108.7413  108.3740 Circular
           OL20            OL-20            OL-19  106.9700  106.8000  109.2920  109.1228 Circular
           OL22            OL-22            OL-21  107.5000  107.2700  109.7837  109.5664 Circular
           OL21            OL-21            OL-20  107.2700  106.9700  109.5664  109.2920 Circular
           L140            BD-13            OL-22  107.6700  107.5000  109.9245  109.7837 Circular
       Overflow            OL-13            BD-05  106.8000  106.3900  107.7198  106.9657 Circular
```

```
  *=====================================================*
  | Table E20 - Junction Flooding and Volume Listing.   |
  |             The maximum volume is the total volume  |
  |             in the node including the volume in the |
  |             flooded storage area. This is the max   |
  |             volume at any time. The volume in the   |
  |             flooded storage area is the total volume|
  |             above the ground elevation, where the   |
  |             flooded pond storage area starts.       |
  *=====================================================*

                                               Out of               Passed to 2D cell
                                            1D-System               OR  Volume Stored
       Junction    Surcharged   Flooded    (Flooded     Maximum    in allowed Flood
           Name    Time (min)  Time(min)     Volume)      Volume   Pond of 1D-System
---------------    ----------  ---------    ---------   ---------   -----------------
          DM-02       33.4722     0.0000       0.0000     66.2265              0.0000
          DM-01        0.0000     0.0000       0.0000     29.9405              0.0000
          DM-03       48.4444     0.0000       0.0000     99.2534              0.0000
          DM-05       32.7222     0.0000       0.0000    126.2234              0.0000
          DM-06       28.6111     0.0000       0.0000    101.0541              0.0000
          DM-08        0.0000     0.0000       0.0000     16.6787              0.0000
          DM-09        0.0000     0.0000       0.0000     29.2564              0.0000
          DM-10        0.0000     0.0000       0.0000     24.2999              0.0000
          BW-01        0.0000     0.0000       0.0000      2.7125              0.0000
          BW-05        0.0000     0.0000       0.0000      5.8759              0.0000
          BW-07        0.0000     0.0000       0.0000      4.9429              0.0000
          BW-10        0.0000     0.0000       0.0000      4.8892              0.0000
          BW-12        0.0000     0.0000       0.0000      6.0063              0.0000
          BW-14        0.0000     0.0000       0.0000      6.4056              0.0000
          BW-17        0.0000     0.0000       0.0000      6.7784              0.0000
          BW-18        0.0000     0.0000       0.0000      5.8393              0.0000
          DM-11        0.0000     0.0000       0.0000     29.6500              0.0000
          DM-14        0.0000     0.0000       0.0000     27.5166              0.0000
          DM-17       15.1944     0.0000       0.0000     45.9488              0.0000
          DM-19        0.0000     0.0000       0.0000     11.2448              0.0000
          BE-05       34.1667     0.0000       0.0000     47.4485              0.0000
          DM-20        0.0000     0.0000       0.0000      8.4946              0.0000
          DM-21        0.0000     0.0000       0.0000     13.3702              0.0000
          BD-01        0.0000     0.0000       0.0000      4.7022              0.0000
          BD-02        0.0000     0.0000       0.0000      4.9151              0.0000
          BD-03        0.0000     0.0000       0.0000      4.9008              0.0000
          BD-05        0.0000     0.0000       0.0000      7.4969              0.0000
          BD-06        0.0000     0.0000       0.0000      0.0000              0.0000
          BD-07        0.0000     0.0000       0.0000      0.0000              0.0000
          BD-09        0.0000     0.0000       0.0000      0.0000              0.0000
          BD-13        0.0000     0.0000       0.0000     28.3295              0.0000
          BE-06       22.9778     0.0000       0.0000     58.8852              0.0000
          BE-09       19.4583     0.0000       0.0000     46.8218              0.0000
          BE-13        0.0000     0.0000       0.0000      7.9309              0.0000
           W-10        0.0000     0.0000       0.0000     11.4788              0.0000
           W-07     1307.8333     0.0000       0.0000     65.5068              0.0000
           W-13        0.0000     0.0000       0.0000      1.9693              0.0000
           W-05     1323.7083     0.0000       0.0000     61.7430              0.0000
           W-03     1310.7500     0.0000       0.0000     46.6961              0.0000
           W-02        0.0000     0.0000       0.0000      3.5150              0.0000
           W-01        0.0000     0.0000       0.0000      3.4927              0.0000
          DM-04       43.6667    15.1111    3613.6406    149.4097              0.0000
          BW-16        0.0000     0.0000       0.0000      5.9695              0.0000
          BW-09        0.0000     0.0000       0.0000      6.0322              0.0000
          BD-04        0.0000     0.0000       0.0000      7.3316              0.0000
          DM-16       33.8611     0.0000       0.0000     68.5756              0.0000
          DM-18        0.0000     0.0000       0.0000     16.3178              0.0000
          BE-01        0.0000     0.0000       0.0000      7.1569              0.0000
          BE-02       26.2500     0.0000       0.0000     42.8791              0.0000
          BE-03        0.0000     0.0000       0.0000     13.2118              0.0000
          BE-04       29.5000     0.0000       0.0000     32.7648              0.0000
          BE-10       12.6500     0.0000       0.0000     36.8113              0.0000
          BE-11        0.0000     0.0000       0.0000      9.1167              0.0000
          BE-12        0.0000     0.0000       0.0000      7.4870              0.0000
           W-12       48.6667     0.0000       0.0000     21.0668              0.0000
           W-11       33.7222     0.0000       0.0000     22.5002              0.0000
           W-09     1331.0417  1225.9722    6273.7379     40.0478              0.0000
           W-08        0.0000     0.0000       0.0000      0.0476              0.0000
           W-06     1324.2917     0.0000       0.0000     62.7014              0.0000
          OL-02        0.0000     0.0000       0.0000     24.6784              0.0000
          OL-03        0.0000     0.0000       0.0000     27.4537              0.0000
          OL-04        0.0000     0.0000       0.0000     28.6782              0.0000
          OL-05        0.0000     0.0000       0.0000     29.1652              0.0000
          OL-01        0.0000     0.0000       0.0000     34.5499              0.0000
          OL-09        0.0000     0.0000       0.0000     31.6665              0.0000
          OL-08        0.0000     0.0000       0.0000     31.4112              0.0000
          OL-07        0.0000     0.0000       0.0000     30.9793              0.0000
          OL-06        0.0000     0.0000       0.0000     30.3936              0.0000
          OL-13        0.0000     0.0000       0.0000     32.2924              0.0000
          OL-12        0.0000     0.0000       0.0000     32.2883              0.0000
          OL-11        0.0000     0.0000       0.0000     32.1133              0.0000
          OL-10        0.0000     0.0000       0.0000     31.9744              0.0000
          OL-14        0.0000     0.0000       0.0000     32.0886              0.0000
          OL-15        0.0000     0.0000       0.0000     30.8297              0.0000
          OL-16        0.0000     0.0000       0.0000     30.4600              0.0000
          OL-17        0.0000     0.0000       0.0000     29.6717              0.0000
          OL-18        0.0000     0.0000       0.0000     29.3337              0.0000
          OL-19        0.0000     0.0000       0.0000     29.1885              0.0000
          OL-20        0.0000     0.0000       0.0000     29.1786              0.0000
          OL-21        0.0000     0.0000       0.0000     28.8568              0.0000
          OL-22        0.0000     0.0000       0.0000     28.6968              0.0000
```

```
 *=================================*
 |   Conduit Convergence Criteria  |
 *=================================*

         Conduit        Full     Conduit
            Name        Flow       Slope
-----------------  ----------  ----------
             DM01     39.5627      0.0120
             DM07    153.5196      0.0614
             DM05     81.0744      0.0171
             DM04     20.1580      0.0082
             DM02     26.9451      0.0056
             DM08     65.7552      0.0113
             BW18      4.8173      0.0067
             BW17      3.7195      0.0040
             BW14      4.0698      0.0048
             BW12      4.7477      0.0065
             BW10      6.5268      0.0124
             BW07      6.3678      0.0118
             BW05      7.0920      0.0074
             BW01     34.5954      0.0924
             DM09     86.0028      0.0193
             BE01     70.7522      0.2312
             DM20      7.1447      0.0142
             DM19      8.6037      0.0676
             DM17     39.6543      0.0356
             DM15     15.2729      0.0108
             DM10     52.0399      0.0071
             BD02     43.7007      0.0068
             BD01     53.4764      0.0075
             BD09      8.0787      0.0015
             BD07     11.3446      0.0029
             BD06     15.2029      0.0028
             BD05     11.7963      0.0017
             BD03     34.3813      0.0081
             BE10      3.9672      0.0044
             BE09      5.7108      0.0034
             BE06     12.1979      0.0156
              W09      2.8914      0.0056
              W06      2.1279      0.0030
              W04      3.6146      0.0088
              W02      8.8183      0.0522
              W01     31.6905      0.0776
              W12      9.0678      0.0552
             DM03     18.2082      0.0067
             BW16      4.5010      0.0059
             BW09      4.5147      0.0068
             BD04     13.7761      0.0023
             DM16     21.9106      0.0222
             DM18     55.3931      0.0695
             BE02     14.6329      0.0099
             BE05      7.2920      0.0025
             BE04      9.9548      0.0046
             BE03     24.4243      0.0276
             BE13     10.7235      0.0320
             BE12     11.4596      0.0365
             BE11      7.2605      0.0147
              W11      1.5962      0.0017
              W10      6.9075      0.0320
              W08      5.2802      0.0187
              W07      7.9778      0.0427
              W05      1.3086      0.0011
             OL05     30.0173      0.0023
             OL04     28.2690      0.0021
             OL03     28.2500      0.0021
             OL02     28.8770      0.0022
             L121     40.1690      0.0042
             L122     42.4517      0.0047
             OL09     27.3357      0.0019
             OL08     27.7906      0.0020
             OL07     27.6978      0.0020
             OL06     22.0507      0.0013
             OL13     28.4174      0.0021
             OL12     27.8093      0.0020
             OL11     27.9531      0.0020
             OL10     27.4699      0.0020
             OL14     26.5432      0.0018
             OL16     27.5452      0.0020
             OL15     27.5939      0.0020
             OL19     27.9790      0.0020
             OL18     27.4418      0.0020
             OL17     27.8931      0.0020
             OL20     26.7691      0.0019
             OL22     27.9419      0.0020
             OL21     28.0747      0.0021
             L140     29.8878      0.0023
         Overflow      1.4979      0.0021
```

```
*=========================================================*
|     Table E15 - SPREADSHEET INFO LIST                   |
| Conduit Flow and Junction Depth Information for use in  |
| spreadsheets.  The maximum values in this table are the |
| true maximum values because they sample every time step.|
| The values in the review results may only be the        |
| maximum of a subset of all the time steps in the run.   |
| Note: These flows are only the flows in a single barrel.|
*=========================================================*
      Conduit      Maximum       Total        Maximum       Maximum   ##      Junction     Invert      Maximum
       Name          Flow         Flow        Velocity       Volume   ##        Name     Elevation   Elevation
                    (cfs)        (ft^3)        (ft/s)        (ft^3)   ##                    (ft)        (ft)
---------------  ----------  ----------   ----------    ----------   ## ----------------  ---------   ---------
           DM01     38.7388 1334908.595       6.3575      951.2262   ##           DM-02    55.1200     57.5831
           DM07     79.3886 1435457.570      17.6658     1186.5141   ##           DM-01    51.7000     53.7258
           DM05     79.3909 1435099.895      11.0480     1762.2894   ##           DM-03    56.0200     59.3550
           DM04     38.8086 1335955.152       7.7481     1413.2626   ##           DM-05    58.9000     70.0000
           DM02     38.7404 1335310.010       5.3425     1098.2168   ##           DM-06    63.1000     73.8961
           DM08     71.2234 1313290.041      10.4245      873.4746   ##           DM-08    85.6800     87.4036
           BW18      2.4098  34706.8226       4.2577       53.2762   ##           DM-09    90.5000     94.4806
           BW17      2.4087  34692.0754       3.6813       87.3688   ##           DM-10    91.7900     95.3717
           BW14      2.4066  34659.8277       3.8974       74.6475   ##           BW-01    98.0100     98.2753
           BW12      2.4060  34641.4178       4.3789       37.7777   ##           BW-05    98.9100     99.4985
           BW10      2.4059  34631.2801       5.3603       24.7727   ##           BW-07   100.9200    101.4185
           BW07      2.4052  34605.8291       5.3775       24.3880   ##           BW-10   102.9000    103.3974
           BW05      2.4050  34588.3832       4.3957       13.3831   ##           BW-12   103.7200    104.3261
           BW01      2.9926  34579.2522       8.6965       53.2068   ##           BW-14   104.7600    105.4191
           DM09     71.6544 1313597.496      11.3138      490.0487   ##           BW-17   106.1700    106.8639
           BE01     18.8377 368378.2249      22.3671        6.4966   ##           BW-18   106.7600    107.3602
           DM20     10.5975 153853.8941       8.3858      163.3163   ##           DM-11    93.0700     97.5671
           DM19     10.5921 153839.6097      13.1270       14.5197   ##           DM-14    94.7000     99.8316
           DM17     29.4299 522107.8716      12.0015      459.3522   ##           DM-17   105.0300    113.2000
           DM15     25.2804 517134.9621      10.3352      442.5009   ##           DM-19   120.1600    121.3766
           DM10     69.3741 1279136.310       9.7785     1324.5795   ##           BE-05   157.4900    161.8951
           BD02      4.1159   9922.3158       4.3593       81.2042   ##           DM-20   129.5000    134.7886
           BD01      4.5803   9933.8899       2.8399     2593.4458   ##           DM-21   131.3500    138.6524
           BD09      0.0000      0.0000       0.0000        0.0000   ##           BD-01    96.8200     97.5719
           BD07      0.0000      0.0000       0.0000        0.0000   ##           BD-02   101.4700    102.0571
           BD06      0.0000      0.0000       0.0000      163.7568   ##           BD-03   102.8300    103.4152
           BD05      4.1251   9852.1318       2.7537      261.3888   ##           BD-05   103.7700    104.6793
           BD03      4.1233   9879.5421       4.7203       63.0944   ##           BD-06   105.0100    105.0100
           BE10      5.1765 113652.4288       4.1352      571.8751   ##           BD-07   106.5400    106.5400
           BE09      4.9783 107797.1125       2.7885      759.9993   ##           BD-09   107.1000    107.1000
           BE06     12.4110 275370.2713       6.9707      503.9120   ##           BD-13   107.6700    114.0600
            W09      1.2794  18288.7329       1.5641      346.8600   ##           BE-06   161.4600    166.8991
            W06     -3.7399 -63821.2022      -4.6052       27.0875   ##           BE-09   162.9100    166.9400
            W04     -3.7381 -63721.8511      -4.6239       80.2838   ##           BE-13   188.6100    189.4786
            W02     -3.7382 -63630.3091      -5.3261       41.8767   ##            W-10   107.7200    108.8978
            W01      3.7382  63624.0357      12.0164        1.3902   ##            W-07    99.1500    105.5342
            W12      0.9767  10787.7221       6.4607       33.5381   ##            W-13   115.3000    115.4787
           DM03     38.7914 1335601.348       7.8526      411.2459   ##            W-05    99.2300    105.0129
           BW16      2.4077  34677.1407       4.1886       66.7752   ##            W-03   100.0600    104.1307
           BW09      2.4058  34618.1956       4.4120       36.0705   ##            W-02   102.3600    102.7081
           BD04      4.1223   9867.5837       3.0173      282.7949   ##            W-01    91.6500     91.9971
           DM16     25.3919 517346.2122      10.3198      417.0220   ##           DM-04    56.5600     61.7770
           DM18     29.4292 522164.1985      16.0753      247.2578   ##           BW-16   105.6000    106.2123
           BE02     18.8377 368403.6957       8.3138       94.4977   ##           BW-09   101.8900    102.5022
           BE05     12.4389 275207.0558       5.1258      668.8828   ##           BD-04   103.4700    104.3431
           BE04     18.8406 368782.2101       7.9958      326.1165   ##           DM-16   101.2600    108.4716
           BE03     18.8381 368618.9573      10.5262      418.3706   ##           DM-18   110.1400    115.9326
           BE13      8.1084 117845.1502       9.3468      109.6299   ##           BE-01   134.5200    135.1365
           BE12      8.1075 117807.1861       9.1254      225.5579   ##           BE-02   136.8800    141.8503
           BE11      8.1069 117732.0751       6.4366      455.1686   ##           BE-03   156.1200    157.3479
            W11     -0.7363 -10698.4398      -1.0267       91.0294   ##           BE-04   156.8300    160.0180
            W10      0.7322  10716.8040       2.9612       57.6724   ##           BE-10   164.9200    170.2400
            W08     -0.0638  -5105.1437      -0.5440      107.8410   ##           BE-11   171.4500    177.9933
            W07      0.1214   5135.8305       1.5247       84.3550   ##           BE-12   178.3700    181.3700
            W05     -3.7386 -63838.0682      -4.6142       21.4895   ##            W-12   102.7100    105.5917
           OL05     40.4465 752931.0963       5.5679     1067.9326   ##            W-11   102.5800    105.5552
           OL04     40.4457 752761.8493       5.7810      823.2386   ##            W-09   105.2600    108.4470
           OL03     40.4455 752586.1913       6.1140      939.4317   ##            W-08   108.1200    108.1242
           OL02     40.4454 752407.7178       6.9101      383.5864   ##            W-06    99.2500    105.2431
           L121     25.3704 517041.3884       4.3171     1342.8027   ##           OL-02   102.5800    104.9252
           L122     65.6790 1269184.572       9.2490     1342.7964   ##           OL-03   102.8900    105.5877
           OL09     41.2568 753557.5807       5.8244      570.5786   ##           OL-04   103.1400    106.0913
           OL08     41.0352 753406.6389       5.7692     1104.1140   ##           OL-05   103.4900    106.7102
           OL07     40.6113 753220.7991       5.5943     1074.2887   ##           OL-01    93.9300     99.5348
           OL06     40.4759 753071.0679       5.4763      518.6864   ##           OL-09   104.3200    108.5132
           OL13     41.5342 754091.5576       5.8520      422.3792   ##           OL-08   104.1700    108.1861
           OL12     41.3620 753973.1438       5.8287      918.8602   ##           OL-07   103.8700    107.5552
           OL11     41.3553 753828.9562       5.8314      800.2974   ##           OL-06   103.5800    106.9939
           OL10     41.3071 753686.4729       5.8279      904.0374   ##           OL-13   105.1500    110.2550
           OL14     35.3799 609107.4101       4.9857      363.0972   ##           OL-12   105.0300    110.0139
           OL16     35.3445 609486.5125       4.9760      674.3248   ##           OL-11   104.7800    109.4888
           OL15     35.3642 609288.4208       4.9802     1978.4376   ##           OL-10   104.5600    109.0310
           OL19     35.6041 609982.5244       5.0068      363.0959   ##           OL-14   105.2400    110.4008
           OL18     35.4869 609851.7892       4.9907     1207.8563   ##           OL-15   105.7700    111.1945
           OL17     35.3297 609653.5920       4.9714     1570.9548   ##           OL-16   105.9500    111.4649
           OL20     35.7307 610065.9922       5.0231      674.3219   ##           OL-17   106.3800    112.0942
           OL22     36.0755 610331.8352       5.0696      837.3388   ##           OL-18   106.7000    112.5778
           OL21     35.9016 610194.0972       5.0460     1081.8815   ##           OL-19   106.8000    112.7234
           L140     39.9547 614796.6471       5.6122      540.9391   ##           OL-20   106.9700    112.9936
       Overflow      4.1344   9843.5290       5.2364      151.3494   ##           OL-21   107.2700    113.4264
       FREE # 1     38.7593 1334906.653       0.0000        0.0000   ##           OL-22   107.5000    113.7600
       FREE # 2      3.7382  63624.0266       0.0000        0.0000   ##
```

```
*=====================================================*
 |     Table E15a - SPREADSHEET REACH LIST            |
 | Peak flow and Total Flow listed by Reach or those  |
 |      conduits or diversions having the same        |
 |      upstream and downstream nodes.                |
 *=====================================================*

       Upstream       Downstream    Maximum           Total
           Node             Node       Flow            Flow
                                      (cfs)          (ft^3)
 --------------- ---------------- ----------       ---------
           DM-02            DM-01    38.7388      1334908.59
           DM-08            DM-06    79.3886      1435457.57
           DM-06            DM-05    79.3909      1435099.89
           DM-05            DM-04    38.8086      1335955.15
           DM-03            DM-02    38.7404      1335310.01
           DM-09            DM-08    71.2234      1313290.04
           BW-18            BW-17     2.4098      34706.8226
           BW-17            BW-16     2.4087      34692.0754
           BW-14            BW-12     2.4066      34659.8277
           BW-12            BW-10     2.4060      34641.4178
           BW-10            BW-09     2.4059      34631.2801
           BW-07            BW-05     2.4052      34605.8291
           BW-05            BW-01     2.4050      34588.3832
           BW-01            DM-10     2.9926      34579.2522
           DM-10            DM-09    71.6544      1313597.50
           BE-01            DM-19    18.8377      368378.225
           DM-21            DM-20    10.5975      153853.894
           DM-20            DM-19    10.5921      153839.610
           DM-18            DM-17    29.4299      522107.872
           DM-16            DM-14    25.2804      517134.962
           DM-11            DM-10    69.3741      1279136.31
           BD-02            BD-01     4.1159       9922.3158
           BD-01            DM-11     4.5803       9933.8899
           BD-05            BD-04     4.1251       9852.1318
           BD-03            BD-02     4.1233       9879.5421
           BE-10            BE-09     5.1765      113652.429
           BE-09            BE-06     4.9783      107797.113
           BE-06            BE-05    12.4110      275370.271
            W-10             W-09     1.2794      18288.7329
            W-06             W-07     3.7399      63821.2022
            W-03             W-05     3.7381      63721.8511
            W-02             W-03     3.7382      63630.3091
            W-02             W-01     3.7382      63624.0357
            W-13             W-12     0.9767      10787.7221
           DM-04            DM-03    38.7914      1335601.35
           BW-16            BW-14     2.4077      34677.1407
           BW-09            BW-07     2.4058      34618.1956
           BD-04            BD-03     4.1223       9867.5837
           DM-17            DM-16    25.3919      517346.212
           DM-19            DM-18    29.4292      522164.199
           BE-02            BE-01    18.8377      368403.696
           BE-05            BE-04    12.4389      275207.056
           BE-04            BE-03    18.8406      368782.210
           BE-03            BE-02    18.8381      368618.957
           BE-13            BE-12     8.1084      117845.150
           BE-12            BE-11     8.1075      117807.186
           BE-11            BE-10     8.1069      117732.075
            W-11             W-12     0.7363      10698.4398
            W-11             W-07     0.7322      10716.8040
            W-08             W-09     0.0638       5105.1437
            W-08             W-07     0.1214       5135.8305
            W-05             W-06     3.7386      63838.0682
           OL-05            OL-04    40.4465      752931.096
           OL-04            OL-03    40.4457      752761.849
           OL-03            OL-02    40.4455      752586.191
           OL-02            OL-01    40.4454      752407.718
           DM-14            OL-01    25.3704      517041.388
           OL-01            DM-11    65.6790      1269184.57
           OL-09            OL-08    41.2568      753557.581
           OL-08            OL-07    41.0352      753406.639
           OL-07            OL-06    40.6113      753220.799
           OL-06            OL-05    40.4759      753071.068
           OL-13            OL-12    41.5342      754091.558
           OL-12            OL-11    41.3620      753973.144
           OL-11            OL-10    41.3553      753828.956
           OL-10            OL-09    41.3071      753686.473
           OL-14            OL-13    35.3799      609107.410
           OL-16            OL-15    35.3445      609486.512
           OL-15            OL-14    35.3642      609288.421
           OL-19            OL-18    35.6041      609982.524
           OL-18            OL-17    35.4869      609851.789
           OL-17            OL-16    35.3297      609653.592
           OL-20            OL-19    35.7307      610065.992
           OL-22            OL-21    36.0755      610331.835
           OL-21            OL-20    35.9016      610194.097
           BD-13            OL-22    39.9547      614796.647
           OL-13            BD-05     4.1344       9843.5290
```

```
#########################################################
# Table E16. New Conduit Information Section            #
#            Conduit Invert (IE) Elevation and Conduit  #
#            Maximum Water Surface (WS) Elevations      #
#########################################################

   Conduit Name    Upstream Node  Downstream Node     IE Up     IE Dn     WS Up     WS Dn  Conduit Type
--------------- ---------------- ---------------- --------- --------- --------- --------- ------------
           DM01            DM-02            DM-01   55.1200   51.7000   57.5831   53.7258 Circular
           DM07            DM-08            DM-06   85.6800   63.1000   87.4036   73.8961 Circular
           DM05            DM-06            DM-05   63.1000   58.9000   73.8961   70.0000 Circular
           DM04            DM-05            DM-04   58.9000   56.6000   70.0000   61.7770 Circular
           DM02            DM-03            DM-02   56.0200   55.1200   59.3550   57.5831 Circular
           DM08            DM-09            DM-08   90.5000   85.6800   94.4806   87.4036 Circular
           BW18            BW-18            BW-17  106.7600  106.1700  107.3602  106.8639 Circular
           BW17            BW-17            BW-16  106.1700  105.6000  106.8639  106.2123 Circular
           BW14            BW-14            BW-12  104.7600  103.7200  105.4191  104.3261 Circular
           BW12            BW-12            BW-10  103.7200  102.9000  104.3261  103.3974 Circular
           BW10            BW-10            BW-09  102.9000  101.8900  103.3974  102.5022 Circular
           BW07            BW-07            BW-05  100.9200   98.9100  101.4185   99.4985 Circular
           BW05            BW-05            BW-01   98.9100   98.0100   99.4985   98.2753 Circular
           BW01            BW-01            DM-10   98.0100   91.7900   98.2753   95.3717 Circular
           DM09            DM-10            DM-09   91.7900   90.5000   95.3717   94.4806 Circular
           BE01            BE-01            DM-19  134.5200  120.1600  135.1365  121.3766 Circular
           DM20            DM-21            DM-20  131.3500  129.5000  138.6524  134.7886 Circular
           DM19            DM-20            DM-19  129.5000  120.1600  134.7886  121.3766 Circular
           DM17            DM-18            DM-17  110.1400  105.0300  115.9326  113.2000 Circular
           DM15            DM-16            DM-14  101.2600   97.9100  108.4716   99.8316 Circular
           DM10            DM-11            DM-10   93.0700   91.7900   97.5671   95.3717 Circular
           BD02            BD-02            BD-01  101.4700   98.3100  102.0571   98.8954 Circular
           BD01            BD-01            DM-11   96.8200   93.0700   97.5719   97.5671 Circular
           BD09            BD-09            BD-07  107.1600  106.5400  106.5400  106.5400 Circular
           BD07            BD-07            BD-06  106.5600  105.2700  105.0100  105.0100 Circular
           BD06            BD-06            BD-05  105.0100  103.7700  105.0100  104.6793 Circular
           BD05            BD-05            BD-04  103.7700  103.4700  104.6793  104.3431 Circular
           BD03            BD-03            BD-02  102.8300  101.4700  103.4152  102.0571 Circular
           BE10            BE-10            BE-09  164.9200  162.9100  170.2400  166.9400 Circular
           BE09            BE-09            BE-06  162.9100  161.4600  166.9400  166.8991 Circular
           BE06            BE-06            BE-05  162.4600  157.4900  166.8991  161.8951 Circular
            W09             W-10             W-09  107.7200  105.2800  108.8978  108.4470 Circular
            W06             W-06             W-07   99.2500   99.1500  105.2431  105.5342 Circular
            W04             W-03             W-05  100.1000   99.2300  104.1307  105.0129 Circular
            W02             W-02             W-03  102.8000  100.0700  103.6226  104.1307 Circular
            W01             W-02             W-01  102.3600   91.6500  102.7081   91.9971 Circular
            W12             W-13             W-12  115.3000  102.7100  115.4787  105.5917 Circular
           DM03            DM-04            DM-03   56.5600   56.0200   61.7770   59.3550 Circular
           BW16            BW-16            BW-14  105.6000  104.7600  106.2123  105.4191 Circular
           BW09            BW-09            BW-07  101.8900  100.9200  102.5022  101.4185 Circular
           BD04            BD-04            BD-03  103.4700  102.8300  104.3431  103.4152 Circular
           DM16            DM-17            DM-16  105.0300  101.2600  113.2000  108.4716 Circular
           DM18            DM-19            DM-18  120.1600  110.1400  121.3766  115.9326 Circular
           BE02            BE-02            BE-01  136.8800  134.5200  141.8503  135.1365 Circular
           BE05            BE-05            BE-04  157.4900  156.8300  161.8951  160.0180 Circular
           BE04            BE-04            BE-03  156.8300  156.1200  160.0180  157.3479 Circular
           BE03            BE-03            BE-02  156.1200  136.8800  157.3479  141.8503 Circular
           BE13            BE-13            BE-12  188.6100  178.3700  189.4786  181.3700 Circular
           BE12            BE-12            BE-11  178.3700  171.4500  181.3700  177.9933 Circular
           BE11            BE-11            BE-10  171.4500  164.9200  177.9933  170.2400 Circular
            W11             W-11             W-12  102.9400  102.7500  105.5552  105.5917 Circular
            W10             W-11             W-07  102.5800  100.2900  105.5552  105.5342 Circular
            W08             W-08             W-09  108.2600  105.2600  108.3608  108.4470 Circular
            W07             W-08             W-07  108.1200  100.4000  108.1238  105.5342 Circular
            W05             W-05             W-06   99.2800   99.2500  105.0129  105.2431 Circular
           OL05            OL-05            OL-04  103.4900  103.1400  106.7102  106.0913 Circular
           OL04            OL-04            OL-03  103.1400  102.8900  106.0913  105.5877 Circular
           OL03            OL-03            OL-02  102.8900  102.5800  105.5877  104.9252 Circular
           OL02            OL-02            OL-01  102.5800  102.4300  104.9252  104.4999 Circular
           L121            DM-14            OL-01   94.7000   93.9300   99.8316   99.5348 Circular
           L122            OL-01            DM-11   93.9300   93.0700   99.5348   97.5671 Circular
           OL09            OL-09            OL-08  104.3200  104.1700  108.5132  108.1861 Circular
           OL08            OL-08            OL-07  104.1700  103.8700  108.1861  107.5552 Circular
           OL07            OL-07            OL-06  103.8700  103.5800  107.5552  106.9939 Circular
           OL06            OL-06            OL-05  103.5800  103.4900  106.9939  106.7102 Circular
           OL13            OL-13            OL-12  105.1500  105.0300  110.2550  110.0139 Circular
           OL12            OL-12            OL-11  105.0300  104.7800  110.0139  109.4888 Circular
           OL11            OL-11            OL-10  104.7800  104.5600  109.4888  109.0310 Circular
           OL10            OL-10            OL-09  104.5600  104.3200  109.0310  108.5132 Circular
           OL14            OL-14            OL-13  105.2400  105.1500  110.4008  110.2550 Circular
           OL16            OL-16            OL-15  105.9500  105.7700  111.4649  111.1945 Circular
           OL15            OL-15            OL-14  105.7700  105.2400  111.1945  110.4008 Circular
           OL19            OL-19            OL-18  106.8000  106.7000  112.7234  112.5778 Circular
           OL18            OL-18            OL-17  106.7000  106.3800  112.5778  112.0942 Circular
           OL17            OL-17            OL-16  106.3800  105.9500  112.0942  111.4649 Circular
           OL20            OL-20            OL-19  106.9700  106.8000  112.9937  112.7234 Circular
           OL22            OL-22            OL-21  107.5000  107.2700  113.7600  113.4264 Circular
           OL21            OL-21            OL-20  107.2700  106.9700  113.4265  112.9936 Circular
           L140            BD-13            OL-22  107.6700  107.5000  114.0600  113.7600 Circular
       Overflow            OL-13            BD-05  106.8000  106.3900  110.2550  107.2477 Circular
```

```
  *=====================================================*
  | Table E20 - Junction Flooding and Volume Listing.  |
  |            The maximum volume is the total volume  |
  |            in the node including the volume in the |
  |            flooded storage area. This is the max   |
  |            volume at any time. The volume in the   |
  |            flooded storage area is the total volume|
  |            above the ground elevation, where the   |
  |            flooded pond storage area starts.       |
  *=====================================================*

                                               Out of               Passed to 2D cell
                                            1D-System               OR  Volume Stored
       Junction    Surcharged   Flooded      (Flooded     Maximum    in allowed Flood
           Name    Time (min)  Time(min)      Volume)      Volume   Pond of 1D-System
---------------    ----------  ---------    ---------   ---------   -----------------
          DM-02        0.0000     0.0000       0.0000     30.9513              0.0000
          DM-01        0.0000     0.0000       0.0000     25.4563              0.0000
          DM-03       86.8889     0.0000       0.0000     41.9081              0.0000
          DM-05      218.6667    73.9444   98537.7676    139.4826              0.0000
          DM-06      107.3056     0.0000       0.0000    135.6639              0.0000
          DM-08        0.0000     0.0000       0.0000     21.6593              0.0000
          DM-09       23.8833     0.0000       0.0000     50.0208              0.0000
          DM-10       14.8167     0.0000       0.0000     45.0076              0.0000
          BW-01        0.0000     0.0000       0.0000      3.3332              0.0000
          BW-05        0.0000     0.0000       0.0000      7.3950              0.0000
          BW-07        0.0000     0.0000       0.0000      6.2643              0.0000
          BW-10        0.0000     0.0000       0.0000      6.2499              0.0000
          BW-12        0.0000     0.0000       0.0000      7.6160              0.0000
          BW-14        0.0000     0.0000       0.0000      8.2818              0.0000
          BW-17        0.0000     0.0000       0.0000      8.7199              0.0000
          BW-18        0.0000     0.0000       0.0000      7.5416              0.0000
          DM-11       23.7333     0.0000       0.0000     56.5107              0.0000
          DM-14        6.4833     0.0000       0.0000     64.4833              0.0000
          DM-17       46.9750    23.7250    4687.1518    102.6642              0.0000
          DM-19        0.0000     0.0000       0.0000     15.2883              0.0000
          BE-05       55.3611     0.0000       0.0000     55.3542              0.0000
          DM-20       22.3500     0.0000       0.0000     66.4568              0.0000
          DM-21       31.1583     0.0000       0.0000     91.7621              0.0000
          BD-01        0.0000     0.0000       0.0000      9.4480              0.0000
          BD-02        0.0000     0.0000       0.0000      7.3776              0.0000
          BD-03        0.0000     0.0000       0.0000      7.3532              0.0000
          BD-05        0.0000     0.0000       0.0000     11.4261              0.0000
          BD-06        0.0000     0.0000       0.0000      0.0000              0.0000
          BD-07        0.0000     0.0000       0.0000      0.0000              0.0000
          BD-09        0.0000     0.0000       0.0000      0.0000              0.0000
          BD-13       32.0167     0.0000       0.0000     80.2967              0.0000
          BE-06       41.9333     0.0000       0.0000     68.3478              0.0000
          BE-09       44.4083    35.0583    5769.2928     50.6410              0.0000
          BE-13        0.0000     0.0000       0.0000     10.9147              0.0000
           W-10       27.4778     0.0000       0.0000     14.8004              0.0000
           W-07     1343.2083     0.0000       0.0000     80.2231              0.0000
           W-13        0.0000     0.0000       0.0000      2.2461              0.0000
           W-05     1354.0000     0.0000       0.0000     72.6679              0.0000
           W-03     1345.2500     0.0000       0.0000     51.1530              0.0000
           W-02        0.0000     0.0000       0.0000      4.3743              0.0000
           W-01        0.0000     0.0000       0.0000      4.3616              0.0000
          DM-04      203.4444     0.0000       0.0000     65.5563              0.0000
          BW-16        0.0000     0.0000       0.0000      7.6938              0.0000
          BW-09        0.0000     0.0000       0.0000      7.6923              0.0000
          BD-04        0.0000     0.0000       0.0000     10.9718              0.0000
          DM-16       56.7056     0.0000       0.0000     90.6211              0.0000
          DM-18       32.3667     0.0000       0.0000     72.7903              0.0000
          BE-01        0.0000     0.0000       0.0000      7.7468              0.0000
          BE-02       46.6500     0.0000       0.0000     62.4565              0.0000
          BE-03        0.0000     0.0000       0.0000     15.4295              0.0000
          BE-04       48.6861     0.0000       0.0000     40.0599              0.0000
          BE-10       48.2139    30.4500    4000.1931     66.8511              0.0000
          BE-11       34.7333     0.0000       0.0000     82.2226              0.0000
          BE-12       18.3333     0.0000       0.0000     37.6974              0.0000
           W-12       93.3056     0.0000       0.0000     36.2115              0.0000
           W-11       62.3806     0.0000       0.0000     37.3866              0.0000
           W-09     1360.1667  1331.6111   12761.0559     40.0478              0.0000
           W-08        0.0000     0.0000       0.0000      0.0476              0.0000
           W-06     1354.3750     0.0000       0.0000     75.3087              0.0000
          OL-02        0.0000     0.0000       0.0000     29.4692              0.0000
          OL-03        0.0000     0.0000       0.0000     33.8993              0.0000
          OL-04        0.0000     0.0000       0.0000     37.0858              0.0000
          OL-05       18.9250     0.0000       0.0000     40.4651              0.0000
          OL-01        0.0000     0.0000       0.0000     70.4297              0.0000
          OL-09       28.0667     0.0000       0.0000     52.6921              0.0000
          OL-08       26.5417     0.0000       0.0000     50.4668              0.0000
          OL-07       23.8000     0.0000       0.0000     46.3083              0.0000
          OL-06       21.1833     0.0000       0.0000     42.8986              0.0000
          OL-13       33.7083     0.0000       0.0000     64.1498              0.0000
          OL-12       33.1167     0.0000       0.0000     62.6271              0.0000
          OL-11       31.4083     0.0000       0.0000     59.1710              0.0000
          OL-10       29.9583     0.0000       0.0000     56.1825              0.0000
          OL-14       33.7917     0.0000       0.0000     64.8508              0.0000
          OL-15       33.5667     0.0000       0.0000     68.1644              0.0000
          OL-16       33.5000     0.0000       0.0000     69.2997              0.0000
          OL-17       32.9750     0.0000       0.0000     71.8046              0.0000
          OL-18       32.8750     0.0000       0.0000     73.8609              0.0000
          OL-19       32.7750     0.0000       0.0000     74.4335              0.0000
          OL-20       32.7667     0.0000       0.0000     75.6932              0.0000
          OL-21       32.4417     0.0000       0.0000     77.3621              0.0000
          OL-22       32.3083    16.7000    4359.1474     78.6632              0.0000
```

# 25-Year Storm – Selected XP-SWMM Results

```
 *=================================*
 |   Conduit Convergence Criteria  |
 *=================================*

          Conduit        Full     Conduit
             Name        Flow       Slope
-----------------  ----------  ----------
             DM01     39.5627      0.0120
             DM07    153.5196      0.0614
             DM05     81.0744      0.0171
             DM04     20.1580      0.0082
             DM02     26.9451      0.0056
             DM08     65.7552      0.0113
             BW18      4.8173      0.0067
             BW17      3.7195      0.0040
             BW14      4.0698      0.0048
             BW12      4.7477      0.0065
             BW10      6.5268      0.0124
             BW07      6.3678      0.0118
             BW05      7.0920      0.0074
             BW01     34.5954      0.0924
             DM09     86.0028      0.0193
             BE01     70.7522      0.2312
             DM20      7.1447      0.0142
             DM19      8.6037      0.0676
             DM17     39.6543      0.0356
             DM15     15.2729      0.0108
             DM10     52.0399      0.0071
             BD02     43.7007      0.0068
             BD01     53.4764      0.0075
             BD09      8.0787      0.0015
             BD07     11.3446      0.0029
             BD06     15.2029      0.0028
             BD05     11.7963      0.0017
             BD03     34.3813      0.0081
             BE10      3.9672      0.0044
             BE09      5.7108      0.0034
             BE06     12.1979      0.0156
              W09      2.8914      0.0056
              W06      2.1279      0.0030
              W04      3.6146      0.0088
              W02      8.8183      0.0522
              W01     31.6905      0.0776
              W12      9.0678      0.0552
             DM03     18.2082      0.0067
             BW16      4.5010      0.0059
             BW09      4.5147      0.0068
             BD04     13.7761      0.0023
             DM16     21.9106      0.0222
             DM18     55.3931      0.0695
             BE02     14.6329      0.0099
             BE05      7.2920      0.0025
             BE04      9.9548      0.0046
             BE03     24.4243      0.0276
             BE13     10.7235      0.0320
             BE12     11.4596      0.0365
             BE11      7.2605      0.0147
              W11      1.5962      0.0017
              W10      6.9075      0.0320
              W08      5.2802      0.0187
              W07      7.9778      0.0427
              W05      1.3086      0.0011
             OL05     30.0173      0.0023
             OL04     28.2690      0.0021
             OL03     28.2500      0.0021
             OL02     28.8770      0.0022
             L121     40.1690      0.0042
             L122     42.4517      0.0047
             OL09     27.3357      0.0019
             OL08     27.7906      0.0020
             OL07     27.6978      0.0020
             OL06     22.0507      0.0013
             OL13     28.4174      0.0021
             OL12     27.8093      0.0020
             OL11     27.9531      0.0020
             OL10     27.4699      0.0020
             OL14     26.5432      0.0018
             OL16     27.5452      0.0020
             OL15     27.5939      0.0020
             OL19     27.9790      0.0020
             OL18     27.4418      0.0020
             OL17     27.8931      0.0020
             OL20     26.7691      0.0019
             OL22     27.9419      0.0020
             OL21     28.0747      0.0021
             L140     29.8878      0.0023
         Overflow      1.4979      0.0021
```

```
*=========================================================*
|     Table E15 - SPREADSHEET INFO LIST                   |
| Conduit Flow and Junction Depth Information for use in  |
| spreadsheets.  The maximum values in this table are the |
| true maximum values because they sample every time step.|
| The values in the review results may only be the        |
| maximum of a subset of all the time steps in the run.   |
| Note: These flows are only the flows in a single barrel.|
*=========================================================*

      Conduit      Maximum       Total        Maximum       Maximum   ##        Junction     Invert       Maximum
        Name          Flow        Flow       Velocity        Volume   ##         Name      Elevation    Elevation
                     (cfs)      (ft^3)         (ft/s)        (ft^3)   ##                      (ft)         (ft)
---------------  ----------  ----------    ----------    ----------   ## ----------------  ---------    ---------
           DM01     38.7388 1532511.326        6.3576      951.2243   ##            DM-02    55.1200      57.5831
           DM07     81.9164 1663357.440       17.7022     1220.1678   ##            DM-01    51.7000      53.7258
           DM05     81.9169 1662950.325       11.3942     1762.2894   ##            DM-03    56.0200      59.3550
           DM04     38.7575 1533691.613        7.7379     1413.2557   ##            DM-05    58.9000      70.0000
           DM02     38.7405 1532970.741        5.3334     1098.2151   ##            DM-06    63.1000      74.1448
           DM08     72.4769 1520193.044       10.6404      902.3380   ##            DM-08    85.6800      87.4541
           BW18      2.8132  40731.9314        4.4026       59.9564   ##            DM-09    90.5000      94.6205
           BW17      2.8122  40715.0843        3.8314       98.2488   ##            DM-10    91.7900      95.5296
           BW14      2.8101  40679.8847        4.0441       91.5022   ##            BW-01    98.0100      98.2892
           BW12      2.8096  40660.5261        4.5757       46.4582   ##            BW-05    98.9100      99.5464
           BW10      2.8094  40649.6977        5.5553       30.5010   ##            BW-07   100.9200     101.4642
           BW07      2.8088  40622.0024        5.6111       29.3213   ##            BW-10   102.9000     103.4453
           BW05      2.8086  40603.8864        4.6113       15.1508   ##            BW-12   103.7200     104.3824
           BW01      3.3250  40593.9387        9.3890       57.0729   ##            BW-14   104.7600     105.4878
           DM09     72.4825 1520500.156       11.3401      490.3863   ##            BW-17   106.1700     106.9351
           BE01     19.3574 426412.6103       22.4710        6.8723   ##            BW-18   106.7600     107.4221
           DM20     11.0208 178867.3207        8.6784      164.0111   ##            DM-11    93.0700      97.8030
           DM19     10.8889 178851.5942       13.4570       14.7475   ##            DM-14    94.7000     100.1157
           DM17     30.2287 605153.8858       12.0215      459.3522   ##            DM-17   105.0300     113.2000
           DM15     25.3053 596849.8603       10.3438      496.8267   ##            DM-19   120.1600     121.4124
           DM10     69.8183 1480022.502        9.8336     1324.5971   ##            BE-05   157.4900     162.0794
           BD02      4.2688  12887.8297        4.4040       84.7777   ##            DM-20   129.5000     135.6411
           BD01      4.6164  12914.8862        2.7915     2799.5876   ##            DM-21   131.3500     139.6700
           BD09      0.0000      0.0000        0.0000        0.0000   ##            BD-01    96.8200      97.7804
           BD07      0.0000      0.0000        0.0000        0.0000   ##            BD-02   101.4700     102.0679
           BD06      0.0000      0.0000        0.0000      171.0871   ##            BD-03   102.8300     103.4250
           BD05      4.2729  12809.2484        2.7821      267.8844   ##            BD-05   103.7700     104.6965
           BD03      4.2718  12843.0698        4.7679       65.8996   ##            BD-06   105.0100     105.0100
           BE10      5.1765 131161.7380        4.1352      571.8751   ##            BD-07   106.5400     106.5400
           BE09      4.9519 121304.8264        2.7750      760.2888   ##            BD-09   107.1000     107.1000
           BE06     12.4420 317752.2606        6.9758      525.3678   ##            BD-13   107.6700     114.1726
            W09      1.4918  21444.2077        1.8927      346.8600   ##            BE-06   161.4600     166.9903
            W06     -4.3806 -73647.5215       -5.3712       27.0876   ##            BE-09   162.9100     166.9400
            W04     -4.3763 -73546.3798       -5.3972       80.5393   ##            BE-13   188.6100     191.2989
            W02     -4.3763 -73455.2881       -5.9353       41.9276   ##             W-10   107.7200     109.0914
            W01      4.3763  73448.7722       12.5772        1.6835   ##             W-07    99.1500     106.2384
            W12      0.9843  12634.7695        6.4813       44.4062   ##             W-13   115.3000     115.4800
           DM03     38.7534 1533289.118        7.8446      411.2358   ##             W-05    99.2300     105.5280
           BW16      2.8113  40698.7218        4.3359       83.1213   ##             W-03   100.0600     104.3252
           BW09      2.8094  40635.3858        4.6048       44.0856   ##             W-02   102.3600     102.7368
           BD04      4.2721  12827.7987        3.0532      294.9807   ##             W-01    91.6500      92.0258
           DM16     25.5571 597081.5863       10.3873      417.2374   ##            DM-04    56.5600      61.7770
           DM18     30.2271 605209.0863       16.1634      255.2825   ##            BW-16   105.6000     106.2751
           BE02     19.3574 426440.6415        8.5280       96.5430   ##            BW-09   101.8900     102.5609
           BE05     12.4562 317568.7664        5.1345      668.8811   ##            BD-04   103.4700     104.3589
           BE04     19.8014 427177.5737        8.3583      335.2094   ##            DM-16   101.2600     108.6164
           BE03     19.7996 426998.0883       10.5693      450.7242   ##            DM-18   110.1400     116.0822
           BE13      9.4573 137975.8353        9.4526      199.7139   ##            BE-01   134.5200     135.1455
           BE12      9.4572 137940.0772        9.2907      239.9698   ##            BE-02   136.8800     142.1700
           BE11      8.6295 137153.1890        6.8217      455.4287   ##            BE-03   156.1200     157.4183
            W11     -0.8568 -12537.2889       -1.0999       91.0294   ##            BE-04   156.8300     160.2380
            W10      0.8523  12555.7556        3.0339       57.9243   ##            BE-10   164.9200     170.2400
            W08     -0.0638  -5150.5163       -0.5440      107.8410   ##            BE-11   171.4500     178.9700
            W07      0.1219   5185.8784        1.5282       98.0569   ##            BE-12   178.3700     183.4785
            W05     -4.3776 -73662.8051       -5.3833       21.4894   ##             W-12   102.7100     106.3141
           OL05     41.0754 871263.8020        5.6012     1076.1237   ##             W-11   102.5800     106.2651
           OL04     41.0752 871080.8350        5.8206      830.3081   ##             W-09   105.2600     108.4470
           OL03     41.0751 870894.2432        6.1568      947.4887   ##             W-08   108.1200     108.1242
           OL02     41.0750 870693.6734        6.9575      386.8809   ##             W-06    99.2500     105.8416
           L121     25.2624 596752.7963        4.3066     1342.5622   ##            OL-02   102.5800     104.9458
           L122     66.2873 1467155.398        9.3338     1342.8009   ##            OL-03   102.8900     105.6193
           OL09     42.8449 871929.9568        5.9979      570.5825   ##            OL-04   103.1400     106.1591
           OL08     42.4199 871773.1579        5.9636     1104.1133   ##            OL-05   103.4900     106.7967
           OL07     41.6033 871574.4787        5.7828     1074.4737   ##            OL-01    93.9300      99.8280
           OL06     41.0756 871408.9014        5.5668      523.2431   ##            OL-09   104.3200     108.6652
           OL13     43.2187 872508.2189        6.0936      422.3783   ##            OL-08   104.1700     108.3281
           OL12     42.9428 872380.6102        6.0522      918.8578   ##            OL-07   103.8700     107.6751
           OL11     42.9956 872229.9276        6.0643      800.2976   ##            OL-06   103.5800     107.0808
           OL10     42.8444 872069.0956        6.0471      904.0400   ##            OL-13   105.1500     110.4602
           OL14     35.7116 703974.4156        5.0315      363.0981   ##            OL-12   105.0300     110.2117
           OL16     36.0011 704364.8385        5.0676      674.3248   ##            OL-11   104.7800     109.6706
           OL15     35.9726 704155.5308        5.0651     1978.4303   ##            OL-10   104.5600     109.1988
           OL19     36.4654 704863.9568        5.1277      363.0980   ##            OL-14   105.2400     110.5974
           OL18     36.4618 704732.5110        5.1281     1207.8548   ##            OL-15   105.7700     111.3444
           OL17     36.1920 704530.9352        5.0933     1570.9535   ##            OL-16   105.9500     111.5989
           OL20     36.6678 704948.3648        5.1556      674.3228   ##            OL-17   106.3800     112.1913
           OL22     37.2508 705219.6504        5.2338      837.3462   ##            OL-18   106.7000     112.6466
           OL21     36.9764 705075.1586        5.1977     1081.8838   ##            OL-19   106.8000     112.7834
           L140     46.8297 720616.5979        6.5765      540.9403   ##            OL-20   106.9700     113.0375
       Overflow      4.2745  12798.7776        5.4021      152.2544   ##            OL-21   107.2700     113.4448
       FREE # 1     38.7592 1532512.801        0.0000        0.0000   ##            OL-22   107.5000     113.7600
       FREE # 2      4.3763  73448.9474        0.0000        0.0000   ##
```

```
*====================================================*
|     Table E15a - SPREADSHEET REACH LIST            |
| Peak flow and Total Flow listed by Reach or those  |
|      conduits or diversions having the same        |
|      upstream and downstream nodes.                |
*====================================================*

       Upstream       Downstream    Maximum           Total
           Node             Node       Flow            Flow
                                      (cfs)          (ft^3)
--------------- ---------------- ----------       ---------
          DM-02            DM-01    38.7388      1532511.33
          DM-08            DM-06    81.9164      1663357.44
          DM-06            DM-05    81.9169      1662950.32
          DM-05            DM-04    38.7575      1533691.61
          DM-03            DM-02    38.7405      1532970.74
          DM-09            DM-08    72.4769      1520193.04
          BW-18            BW-17     2.8132      40731.9314
          BW-17            BW-16     2.8122      40715.0843
          BW-14            BW-12     2.8101      40679.8847
          BW-12            BW-10     2.8096      40660.5261
          BW-10            BW-09     2.8094      40649.6977
          BW-07            BW-05     2.8088      40622.0024
          BW-05            BW-01     2.8086      40603.8864
          BW-01            DM-10     3.3250      40593.9387
          DM-10            DM-09    72.4825      1520500.16
          BE-01            DM-19    19.3574      426412.610
          DM-21            DM-20    11.0208      178867.321
          DM-20            DM-19    10.8889      178851.594
          DM-18            DM-17    30.2287      605153.886
          DM-16            DM-14    25.3053      596849.860
          DM-11            DM-10    69.8183      1480022.50
          BD-02            BD-01     4.2688      12887.8297
          BD-01            DM-11     4.6164      12914.8862
          BD-05            BD-04     4.2729      12809.2484
          BD-03            BD-02     4.2718      12843.0698
          BE-10            BE-09     5.1765      131161.738
          BE-09            BE-06     4.9519      121304.826
          BE-06            BE-05    12.4420      317752.261
           W-10             W-09     1.4918      21444.2077
           W-06             W-07     4.3806      73647.5215
           W-03             W-05     4.3763      73546.3798
           W-02             W-03     4.3763      73455.2881
           W-02             W-01     4.3763      73448.7722
           W-13             W-12     0.9843      12634.7695
          DM-04            DM-03    38.7534      1533289.12
          BW-16            BW-14     2.8113      40698.7218
          BW-09            BW-07     2.8094      40635.3858
          BD-04            BD-03     4.2721      12827.7987
          DM-17            DM-16    25.5571      597081.586
          DM-19            DM-18    30.2271      605209.086
          BE-02            BE-01    19.3574      426440.641
          BE-05            BE-04    12.4562      317568.766
          BE-04            BE-03    19.8014      427177.574
          BE-03            BE-02    19.7996      426998.088
          BE-13            BE-12     9.4573      137975.835
          BE-12            BE-11     9.4572      137940.077
          BE-11            BE-10     8.6295      137153.189
           W-11             W-12     0.8568      12537.2889
           W-11             W-07     0.8523      12555.7556
           W-08             W-09     0.0638       5150.5163
           W-08             W-07     0.1219       5185.8784
           W-05             W-06     4.3776      73662.8051
          OL-05            OL-04    41.0754      871263.802
          OL-04            OL-03    41.0752      871080.835
          OL-03            OL-02    41.0751      870894.243
          OL-02            OL-01    41.0750      870693.673
          DM-14            OL-01    25.2624      596752.796
          OL-01            DM-11    66.2873      1467155.40
          OL-09            OL-08    42.8449      871929.957
          OL-08            OL-07    42.4199      871773.158
          OL-07            OL-06    41.6033      871574.479
          OL-06            OL-05    41.0756      871408.901
          OL-13            OL-12    43.2187      872508.219
          OL-12            OL-11    42.9428      872380.610
          OL-11            OL-10    42.9956      872229.928
          OL-10            OL-09    42.8444      872069.096
          OL-14            OL-13    35.7116      703974.416
          OL-16            OL-15    36.0011      704364.838
          OL-15            OL-14    35.9726      704155.531
          OL-19            OL-18    36.4654      704863.957
          OL-18            OL-17    36.4618      704732.511
          OL-17            OL-16    36.1920      704530.935
          OL-20            OL-19    36.6678      704948.365
          OL-22            OL-21    37.2508      705219.650
          OL-21            OL-20    36.9764      705075.159
          BD-13            OL-22    46.8297      720616.598
          OL-13            BD-05     4.2745      12798.7776
```

```
#########################################################
# Table E16. New Conduit Information Section            #
#            Conduit Invert (IE) Elevation and Conduit  #
#            Maximum Water Surface (WS) Elevations      #
#########################################################

   Conduit Name    Upstream Node  Downstream Node     IE Up     IE Dn     WS Up     WS Dn  Conduit Type
--------------- ---------------- ---------------- --------- --------- --------- --------- -------------
           DM01            DM-02            DM-01   55.1200   51.7000   57.5831   53.7258 Circular
           DM07            DM-08            DM-06   85.6800   63.1000   87.4541   74.1448 Circular
           DM05            DM-06            DM-05   63.1000   58.9000   74.1448   70.0000 Circular
           DM04            DM-05            DM-04   58.9000   56.6000   70.0000   61.7770 Circular
           DM02            DM-03            DM-02   56.0200   55.1200   59.3550   57.5831 Circular
           DM08            DM-09            DM-08   90.5000   85.6800   94.6205   87.4541 Circular
           BW18            BW-18            BW-17  106.7600  106.1700  107.4221  106.9351 Circular
           BW17            BW-17            BW-16  106.1700  105.6000  106.9351  106.2751 Circular
           BW14            BW-14            BW-12  104.7600  103.7200  105.4878  104.3824 Circular
           BW12            BW-12            BW-10  103.7200  102.9000  104.3824  103.4453 Circular
           BW10            BW-10            BW-09  102.9000  101.8900  103.4453  102.5609 Circular
           BW07            BW-07            BW-05  100.9200   98.9100  101.4642   99.5464 Circular
           BW05            BW-05            BW-01   98.9100   98.0100   99.5464   98.2892 Circular
           BW01            BW-01            DM-10   98.0100   91.7900   98.2892   95.5296 Circular
           DM09            DM-10            DM-09   91.7900   90.5000   95.5296   94.6205 Circular
           BE01            BE-01            DM-19  134.5200  120.1600  135.1455  121.4124 Circular
           DM20            DM-21            DM-20  131.3500  129.5000  139.6700  135.6411 Circular
           DM19            DM-20            DM-19  129.5000  120.1600  135.6411  121.4124 Circular
           DM17            DM-18            DM-17  110.1400  105.0300  116.0822  113.2000 Circular
           DM15            DM-16            DM-14  101.2600   97.9100  108.6164  100.1157 Circular
           DM10            DM-11            DM-10   93.0700   91.7900   97.8030   95.5296 Circular
           BD02            BD-02            BD-01  101.4700   98.3100  102.0679   98.9056 Circular
           BD01            BD-01            DM-11   96.8200   93.0700   97.7804   97.8030 Circular
           BD09            BD-09            BD-07  107.1600  106.5400  106.5400  106.5400 Circular
           BD07            BD-07            BD-06  106.5600  105.2700  105.0100  105.0100 Circular
           BD06            BD-06            BD-05  105.0100  103.7700  105.0100  104.6965 Circular
           BD05            BD-05            BD-04  103.7700  103.4700  104.6965  104.3589 Circular
           BD03            BD-03            BD-02  102.8300  101.4700  103.4250  102.0679 Circular
           BE10            BE-10            BE-09  164.9200  162.9100  170.2400  166.9400 Circular
           BE09            BE-09            BE-06  162.9100  161.4600  166.9400  166.9903 Circular
           BE06            BE-06            BE-05  162.4600  157.4900  166.9903  162.0794 Circular
            W09             W-10             W-09  107.7200  105.2800  109.0914  108.4470 Circular
            W06             W-06             W-07   99.2500   99.1500  105.8416  106.2384 Circular
            W04             W-03             W-05  100.1000   99.2300  104.3252  105.5280 Circular
            W02             W-02             W-03  102.8000  100.0700  103.6774  104.3252 Circular
            W01             W-02             W-01  102.3600   91.6500  102.7368   92.0258 Circular
            W12             W-13             W-12  115.3000  102.7100  115.4800  106.3141 Circular
           DM03            DM-04            DM-03   56.5600   56.0200   61.7770   59.3550 Circular
           BW16            BW-16            BW-14  105.6000  104.7600  106.2751  105.4878 Circular
           BW09            BW-09            BW-07  101.8900  100.9200  102.5609  101.4642 Circular
           BD04            BD-04            BD-03  103.4700  102.8300  104.3589  103.4250 Circular
           DM16            DM-17            DM-16  105.0300  101.2600  113.2000  108.6164 Circular
           DM18            DM-19            DM-18  120.1600  110.1400  121.4124  116.0822 Circular
           BE02            BE-02            BE-01  136.8800  134.5200  142.1700  135.1455 Circular
           BE05            BE-05            BE-04  157.4900  156.8300  162.0794  160.2380 Circular
           BE04            BE-04            BE-03  156.8300  156.1200  160.2380  157.4183 Circular
           BE03            BE-03            BE-02  156.1200  136.8800  157.4183  142.1700 Circular
           BE13            BE-13            BE-12  188.6100  178.3700  191.2989  183.4785 Circular
           BE12            BE-12            BE-11  178.3700  171.4500  183.4785  178.9700 Circular
           BE11            BE-11            BE-10  171.4500  164.9200  178.9700  170.2400 Circular
            W11             W-11             W-12  102.9400  102.7500  106.2651  106.3141 Circular
            W10             W-11             W-07  102.5800  100.2900  106.2651  106.2384 Circular
            W08             W-08             W-09  108.2600  105.2600  108.3608  108.4470 Circular
            W07             W-08             W-07  108.1200  100.4000  108.1238  106.2384 Circular
            W05             W-05             W-06   99.2800   99.2500  105.5280  105.8416 Circular
           OL05            OL-05            OL-04  103.4900  103.1400  106.7967  106.1591 Circular
           OL04            OL-04            OL-03  103.1400  102.8900  106.1591  105.6193 Circular
           OL03            OL-03            OL-02  102.8900  102.5800  105.6193  104.9458 Circular
           OL02            OL-02            OL-01  102.5800  102.4300  104.9458  104.5160 Circular
           L121            DM-14            OL-01   94.7000   93.9300  100.1157   99.8280 Circular
           L122            OL-01            DM-11   93.9300   93.0700   99.8280   97.8030 Circular
           OL09            OL-09            OL-08  104.3200  104.1700  108.6652  108.3281 Circular
           OL08            OL-08            OL-07  104.1700  103.8700  108.3281  107.6751 Circular
           OL07            OL-07            OL-06  103.8700  103.5800  107.6751  107.0808 Circular
           OL06            OL-06            OL-05  103.5800  103.4900  107.0808  106.7967 Circular
           OL13            OL-13            OL-12  105.1500  105.0300  110.4602  110.2117 Circular
           OL12            OL-12            OL-11  105.0300  104.7800  110.2117  109.6706 Circular
           OL11            OL-11            OL-10  104.7800  104.5600  109.6706  109.1988 Circular
           OL10            OL-10            OL-09  104.5600  104.3200  109.1988  108.6652 Circular
           OL14            OL-14            OL-13  105.2400  105.1500  110.5974  110.4602 Circular
           OL16            OL-16            OL-15  105.9500  105.7700  111.5989  111.3444 Circular
           OL15            OL-15            OL-14  105.7700  105.2400  111.3444  110.5974 Circular
           OL19            OL-19            OL-18  106.8000  106.7000  112.7834  112.6466 Circular
           OL18            OL-18            OL-17  106.7000  106.3800  112.6466  112.1913 Circular
           OL17            OL-17            OL-16  106.3800  105.9500  112.1913  111.5989 Circular
           OL20            OL-20            OL-19  106.9700  106.8000  113.0375  112.7834 Circular
           OL22            OL-22            OL-21  107.5000  107.2700  113.7600  113.4448 Circular
           OL21            OL-21            OL-20  107.2700  106.9700  113.4448  113.0375 Circular
           L140            BD-13            OL-22  107.6700  107.5000  114.1726  113.7600 Circular
       Overflow            OL-13            BD-05  106.8000  106.3900  110.4602  107.2591 Circular
```

```
  *=====================================================*
  | Table E20 - Junction Flooding and Volume Listing.   |
  |            The maximum volume is the total volume  |
  |            in the node including the volume in the |
  |            flooded storage area. This is the max   |
  |            volume at any time. The volume in the   |
  |            flooded storage area is the total volume|
  |            above the ground elevation, where the   |
  |            flooded pond storage area starts.       |
  *=====================================================*

                                               Out of               Passed to 2D cell
                                            1D-System               OR  Volume Stored
       Junction    Surcharged   Flooded      (Flooded      Maximum   in allowed Flood
           Name    Time (min)  Time(min)      Volume)       Volume   Pond of 1D-System
---------------    ----------  ---------    ---------    ---------   -----------------
          DM-02        0.0000     0.0000       0.0000      30.9512              0.0000
          DM-01        0.0000     0.0000       0.0000      25.4563              0.0000
          DM-03      113.5000     0.0000       0.0000      41.9082              0.0000
          DM-05      292.7222    96.4444  128581.5784     139.4826              0.0000
          DM-06      140.6111     0.0000       0.0000     138.7892              0.0000
          DM-08        0.0000     0.0000       0.0000      22.2930              0.0000
          DM-09       33.5667     0.0000       0.0000      51.7777              0.0000
          DM-10       25.2500     0.0000       0.0000      46.9922              0.0000
          BW-01        0.0000     0.0000       0.0000       3.5084              0.0000
          BW-05        0.0000     0.0000       0.0000       7.9972              0.0000
          BW-07        0.0000     0.0000       0.0000       6.8378              0.0000
          BW-10        0.0000     0.0000       0.0000       6.8519              0.0000
          BW-12        0.0000     0.0000       0.0000       8.3233              0.0000
          BW-14        0.0000     0.0000       0.0000       9.1460              0.0000
          BW-17        0.0000     0.0000       0.0000       9.6142              0.0000
          BW-18        0.0000     0.0000       0.0000       8.3203              0.0000
          DM-11       33.3250     0.0000       0.0000      59.4754              0.0000
          DM-14       18.7333     0.0000       0.0000      68.0532              0.0000
          DM-17       55.5250    30.1000    7999.7534     102.6642              0.0000
          DM-19        0.0000     0.0000       0.0000      15.7377              0.0000
          BE-05       71.0905     0.0000       0.0000      57.6702              0.0000
          DM-20       29.6250     0.0000       0.0000      77.1692              0.0000
          DM-21       37.6583    20.0000    1389.7469     104.5491              0.0000
          BD-01        0.0000     0.0000       0.0000      12.0685              0.0000
          BD-02        0.0000     0.0000       0.0000       7.5130              0.0000
          BD-03        0.0000     0.0000       0.0000       7.4774              0.0000
          BD-05        0.0000     0.0000       0.0000      11.6428              0.0000
          BD-06        0.0000     0.0000       0.0000       0.0000              0.0000
          BD-07        0.0000     0.0000       0.0000       0.0000              0.0000
          BD-09        0.0000     0.0000       0.0000       0.0000              0.0000
          BD-13       41.7417     0.0000       0.0000      81.7118              0.0000
          BE-06       49.8750     0.0000       0.0000      69.4943              0.0000
          BE-09       52.4000    42.1500    9756.0033      50.6410              0.0000
          BE-13       16.9750     0.0000       0.0000      33.7889              0.0000
           W-10       32.8583     0.0000       0.0000      17.2330              0.0000
           W-07     1352.6250     0.0000       0.0000      89.0730              0.0000
           W-13        0.0000     0.0000       0.0000       2.2614              0.0000
           W-05     1362.4583     0.0000       0.0000      79.1407              0.0000
           W-03     1354.4167     0.0000       0.0000      53.5968              0.0000
           W-02        0.0000     0.0000       0.0000       4.7347              0.0000
           W-01        0.0000     0.0000       0.0000       4.7218              0.0000
          DM-04      272.6389     0.0000       0.0000      65.5563              0.0000
          BW-16        0.0000     0.0000       0.0000       8.4830              0.0000
          BW-09        0.0000     0.0000       0.0000       8.4301              0.0000
          BD-04        0.0000     0.0000       0.0000      11.1695              0.0000
          DM-16       72.3167     0.0000       0.0000      92.4400              0.0000
          DM-18       39.6083     0.0000       0.0000      74.6698              0.0000
          BE-01        0.0000     0.0000       0.0000       7.8596              0.0000
          BE-02       55.0583    17.5583     325.1577      66.4741              0.0000
          BE-03        0.0000     0.0000       0.0000      16.3142              0.0000
          BE-04       57.6417     0.0000       0.0000      42.8251              0.0000
          BE-10       56.2167    37.4083    5909.4623      66.8511              0.0000
          BE-11       41.8833    19.1167     707.8601      94.4963              0.0000
          BE-12       26.2583     0.0000       0.0000      64.1940              0.0000
           W-12      122.3333     0.0000       0.0000      45.2888              0.0000
           W-11       79.8583     0.0000       0.0000      46.3070              0.0000
           W-09     1368.1667  1343.8889   15873.6390      40.0478              0.0000
           W-08        0.0000     0.0000       0.0000       0.0476              0.0000
           W-06     1362.8333     0.0000       0.0000      82.8295              0.0000
          OL-02        0.0000     0.0000       0.0000      29.7285              0.0000
          OL-03        0.0000     0.0000       0.0000      34.2959              0.0000
          OL-04       16.2667     0.0000       0.0000      37.9386              0.0000
          OL-05       28.5250     0.0000       0.0000      41.5516              0.0000
          OL-01        0.0000     0.0000       0.0000      74.1139              0.0000
          OL-09       37.7000     0.0000       0.0000      54.6018              0.0000
          OL-08       36.1750     0.0000       0.0000      52.2502              0.0000
          OL-07       33.4833     0.0000       0.0000      47.8143              0.0000
          OL-06       30.9083     0.0000       0.0000      43.9909              0.0000
          OL-13       43.0833     0.0000       0.0000      66.7279              0.0000
          OL-12       42.5417     0.0000       0.0000      65.1128              0.0000
          OL-11       41.0583     0.0000       0.0000      61.4550              0.0000
          OL-10       39.6167     0.0000       0.0000      58.2908              0.0000
          OL-14       43.1667     0.0000       0.0000      67.3210              0.0000
          OL-15       43.0083     0.0000       0.0000      70.0478              0.0000
          OL-16       42.9667     0.0000       0.0000      70.9837              0.0000
          OL-17       42.4583     0.0000       0.0000      73.0254              0.0000
          OL-18       42.4083     0.0000       0.0000      74.7253              0.0000
          OL-19       42.3750     0.0000       0.0000      75.1880              0.0000
          OL-20       42.3333     0.0000       0.0000      76.2439              0.0000
          OL-21       42.1000     0.0000       0.0000      77.5930              0.0000
          OL-22       42.0250    26.8583   15290.1553      78.6632              0.0000
```

```
 *=================================*
 |   Conduit Convergence Criteria  |
 *=================================*

          Conduit        Full     Conduit
             Name        Flow       Slope
-----------------  ----------  ----------
             DM01     39.5627      0.0120
             DM07    153.5196      0.0614
             DM05     81.0744      0.0171
             DM04     20.1580      0.0082
             DM02     26.9451      0.0056
             DM08     65.7552      0.0113
             BW18      4.8173      0.0067
             BW17      3.7195      0.0040
             BW14      4.0698      0.0048
             BW12      4.7477      0.0065
             BW10      6.5268      0.0124
             BW07      6.3678      0.0118
             BW05      7.0920      0.0074
             BW01     34.5954      0.0924
             DM09     86.0028      0.0193
             BE01     70.7522      0.2312
             DM20      7.1447      0.0142
             DM19      8.6037      0.0676
             DM17     39.6543      0.0356
             DM15     15.2729      0.0108
             DM10     52.0399      0.0071
             BD02     43.7007      0.0068
             BD01     53.4764      0.0075
             BD09      8.0787      0.0015
             BD07     11.3446      0.0029
             BD06     15.2029      0.0028
             BD05     11.7963      0.0017
             BD03     34.3813      0.0081
             BE10      3.9672      0.0044
             BE09      5.7108      0.0034
             BE06     12.1979      0.0156
              W09      2.8914      0.0056
              W06      2.1279      0.0030
              W04      3.6146      0.0088
              W02      8.8183      0.0522
              W01     31.6905      0.0776
              W12      9.0678      0.0552
             DM03     18.2082      0.0067
             BW16      4.5010      0.0059
             BW09      4.5147      0.0068
             BD04     13.7761      0.0023
             DM16     21.9106      0.0222
             DM18     55.3931      0.0695
             BE02     14.6329      0.0099
             BE05      7.2920      0.0025
             BE04      9.9548      0.0046
             BE03     24.4243      0.0276
             BE13     10.7235      0.0320
             BE12     11.4596      0.0365
             BE11      7.2605      0.0147
              W11      1.5962      0.0017
              W10      6.9075      0.0320
              W08      5.2802      0.0187
              W07      7.9778      0.0427
              W05      1.3086      0.0011
             OL05     30.0173      0.0023
             OL04     28.2690      0.0021
             OL03     28.2500      0.0021
             OL02     28.8770      0.0022
             L121     40.1690      0.0042
             L122     42.4517      0.0047
             OL09     27.3357      0.0019
             OL08     27.7906      0.0020
             OL07     27.6978      0.0020
             OL06     22.0507      0.0013
             OL13     28.4174      0.0021
             OL12     27.8093      0.0020
             OL11     27.9531      0.0020
             OL10     27.4699      0.0020
             OL14     26.5432      0.0018
             OL16     27.5452      0.0020
             OL15     27.5939      0.0020
             OL19     27.9790      0.0020
             OL18     27.4418      0.0020
             OL17     27.8931      0.0020
             OL20     26.7691      0.0019
             OL22     27.9419      0.0020
             OL21     28.0747      0.0021
             L140     29.8878      0.0023
         Overflow      1.4979      0.0021
```

```
*=========================================================*
|     Table E15 - SPREADSHEET INFO LIST                   |
| Conduit Flow and Junction Depth Information for use in  |
| spreadsheets.  The maximum values in this table are the |
| true maximum values because they sample every time step.|
| The values in the review results may only be the        |
| maximum of a subset of all the time steps in the run.   |
| Note: These flows are only the flows in a single barrel.|
*=========================================================*

      Conduit      Maximum       Total       Maximum       Maximum   ##        Junction     Invert      Maximum
       Name           Flow        Flow      Velocity        Volume   ##         Name      Elevation    Elevation
                     (cfs)      (ft^3)        (ft/s)        (ft^3)   ##                      (ft)         (ft)
--------------- ----------  ----------    ----------    ----------   ## --------------    ---------    ---------
           DM01    38.7388 1763369.211        6.3575      951.2262   ##            DM-02    55.1200      57.5831
           DM07    85.1342 1935329.171       17.7244     1264.8624   ##            DM-01    51.7000      53.7258
           DM05    85.1371 1934897.224       11.8348     1762.2894   ##            DM-03    56.0200      59.3550
           DM04    38.7528 1764706.060        7.7369     1413.2395   ##            DM-05    58.9000      70.0000
           DM02    38.7404 1763884.120        5.3328     1098.2168   ##            DM-06    63.1000      74.4754
           DM08    73.8449 1766523.249       10.8092      942.4657   ##            DM-08    85.6800      87.5211
           BW18     3.3058  48098.1487        4.5369       68.0700   ##            DM-09    90.5000      94.7256
           BW17     3.3048  48079.4012        3.9832      111.3943   ##            DM-10    91.7900      95.6649
           BW14     3.3028  48039.6953        4.1924      113.8851   ##            BW-01    98.0100      98.3025
           BW12     3.3023  48018.0302        4.7831       58.0084   ##            BW-05    98.9100      99.6023
           BW10     3.3021  48006.0831        5.7490       38.1844   ##            BW-07   100.9200     101.5175
           BW07     3.3018  47975.9040        5.8631       35.6340   ##            BW-10   102.9000     103.5027
           BW05     3.3016  47957.7289        4.8510       18.0452   ##            BW-12   103.7200     104.4500
           BW01     3.5435  47947.0846        9.6446       60.3124   ##            BW-14   104.7600     105.5733
           DM09    73.8524 1766848.363       11.3581      490.7403   ##            BW-17   106.1700     107.0245
           BE01    19.3574 495093.7845       22.4876        6.8737   ##            BW-18   106.7600     107.5000
           DM20    11.1630 208047.4523        8.7910      164.0145   ##            DM-11    93.0700      97.9950
           DM19    10.8853 208028.0988       13.4534       14.7495   ##            DM-14    94.7000     100.3436
           DM17    30.2316 703022.1136       11.7491      459.3522   ##            DM-17   105.0300     113.2000
           DM15    25.3168 692210.2286       10.3478      548.1480   ##            DM-19   120.1600     121.4126
           DM10    70.5753 1719024.194        9.9460     1324.5987   ##            BE-05   157.4900     162.5236
           BD02     4.4307  16767.4467        4.4509       88.6194   ##            DM-20   129.5000     135.6453
           BD01     4.7291  16793.2195        2.7712     2968.6463   ##            DM-21   131.3500     139.6700
           BD09     0.0000      0.0000        0.0000        0.0000   ##            BD-01    96.8200      97.9931
           BD07     0.0000      0.0000        0.0000        0.0000   ##            BD-02   101.4700     102.0791
           BD06     0.0000      0.0000        0.0000      179.0174   ##            BD-03   102.8300     103.4362
           BD05     4.4328  16689.2609        2.8130      274.7369   ##            BD-05   103.7700     104.7148
           BD03     4.4322  16724.4296        4.8186       68.9374   ##            BD-06   105.0100     105.0100
           BE10     5.1765 152155.8889        4.1352      571.8751   ##            BD-07   106.5400     106.5400
           BE09     4.9621 136805.1040        2.7797      761.6954   ##            BD-09   107.1000     107.1000
           BE06    12.4586 368552.6510        6.9667      570.0003   ##            BD-13   107.6700     114.3393
            W09     1.7509  25302.4407        2.2185      346.8599   ##            BE-06   161.4600     167.4339
            W06    -5.1692 -85644.6615       -6.3004       27.0883   ##            BE-09   162.9100     166.9400
            W04    -5.1623 -85540.5301       -6.3399       80.8996   ##            BE-13   188.6100     193.8900
            W02    -5.1622 -85449.4865       -6.7726       41.9977   ##             W-10   107.7200     109.3323
            W01     5.1623  85442.3848       13.1938        2.0610   ##             W-07    99.1500     107.2270
            W12     1.0169  14894.5118        6.5005       59.9654   ##             W-13   115.3000     115.4865
           DM03    38.7504 1764239.515        7.8439      411.2367   ##             W-05    99.2300     106.2544
           BW16     3.3039  48061.6517        4.4775      105.5691   ##             W-03   100.0600     104.5933
           BW09     3.3020  47990.5587        4.8069       54.5152   ##             W-02   102.3600     102.7697
           BD04     4.4324  16708.4870        3.0905      308.1345   ##             W-01    91.6500      92.0589
           DM16    25.6281 692485.2661       10.4162      417.3534   ##            DM-04    56.5600      61.7770
           DM18    30.2288 703061.1719       15.9434      255.3558   ##            BW-16   105.6000     106.3532
           BE02    19.3574 495125.0655        8.5280       96.5430   ##            BW-09   101.8900     102.6321
           BE05    12.4724 368336.8053        5.1412      668.8769   ##            BD-04   103.4700     104.3755
           BE04    21.1289 497547.7059        8.8445      348.6213   ##            DM-16   101.2600     108.6943
           BE03    21.1248 497348.9623       10.6068      456.1026   ##            DM-18   110.1400     116.0837
           BE13    10.7902 162409.6741        9.5832      218.5439   ##            BE-01   134.5200     135.1455
           BE12     9.9471 161438.3122        9.2869      239.9955   ##            BE-02   136.8800     142.1700
           BE11     8.6295 159495.6152        6.8217      455.4287   ##            BE-03   156.1200     157.5301
            W11    -1.0115 -14788.6971       -1.2599       91.0283   ##            BE-04   156.8300     160.6813
            W10     1.0111  14805.8456        3.0710       58.2783   ##            BE-10   164.9200     170.2400
            W08    -0.0638  -5190.8673       -0.5441      107.8412   ##            BE-11   171.4500     178.9700
            W07     0.1294   5250.8089        1.6349      117.7194   ##            BE-12   178.3700     183.9400
            W05    -5.1689 -85657.2049       -6.3240       21.4892   ##             W-12   102.7100     107.3383
           OL05    41.8636 1011229.484        5.6757     1080.4744   ##             W-11   102.5800     107.2697
           OL04    41.8634 1011020.822        5.8785      838.2568   ##             W-09   105.2600     108.4470
           OL03    41.8633 1010809.723        6.2117      957.3385   ##             W-08   108.1200     108.1263
           OL02    41.8633 1010586.303        7.0161      390.9975   ##             W-06    99.2500     106.6858
           L121    25.4153 692108.0870        4.2507     1342.4036   ##            OL-02   102.5800     104.9715
           L122    66.9674 1702366.374        9.4285     1342.8314   ##            OL-03   102.8900     105.6591
           OL09    43.9551 1011989.549        6.1946      570.5826   ##            OL-04   103.1400     106.2144
           OL08    43.1760 1011810.130        6.0551     1104.1139   ##            OL-05   103.4900     106.8643
           OL07    42.2700 1011581.857        5.8882     1074.4739   ##            OL-01    93.9300     100.0612
           OL06    41.8637 1011395.059        5.6896      525.4323   ##            OL-09   104.3200     108.8373
           OL13    45.1160 1012661.064        6.3568      422.3794   ##            OL-08   104.1700     108.4873
           OL12    44.5992 1012512.579        6.2865      918.8592   ##            OL-07   103.8700     107.8094
           OL11    44.4205 1012334.478        6.2650      800.2963   ##            OL-06   103.5800     107.1540
           OL10    43.8234 1012151.794        6.1799      904.0326   ##            OL-13   105.1500     110.7002
           OL14    36.1063 815608.4474        5.0864      363.0981   ##            OL-12   105.0300     110.4423
           OL16    36.8451 816055.9287        5.2012      674.3235   ##            OL-11   104.7800     109.8808
           OL15    36.1115 815818.8708        5.0850     1978.4252   ##            OL-10   104.5600     109.3911
           OL19    36.8684 816623.6450        5.1982      363.0981   ##            OL-14   105.2400     110.8274
           OL18    36.4854 816478.6226        5.1426     1207.8557   ##            OL-15   105.7700     111.5198
           OL17    36.2366 816244.2075        5.0984     1570.9546   ##            OL-16   105.9500     111.7557
           OL20    37.1136 816719.7397        5.2346      674.3243   ##            OL-17   106.3800     112.3051
           OL22    38.7854 817027.7120        5.4537      837.3452   ##            OL-18   106.7000     112.7273
           OL21    37.5273 816867.8754        5.2809     1081.8828   ##            OL-19   106.8000     112.8542
           L140    55.4272 850023.0857        7.7815      540.9403   ##            OL-20   106.9700     113.0898
       Overflow     4.4335  16676.4420        5.5893      153.2327   ##            OL-21   107.2700     113.4706
       FREE # 1    38.7593 1763371.765        0.0000        0.0000   ##            OL-22   107.5000     113.7600
       FREE # 2     5.1623  85442.5716        0.0000        0.0000   ##
```

```
*====================================================*
|     Table E15a - SPREADSHEET REACH LIST            |
| Peak flow and Total Flow listed by Reach or those  |
|      conduits or diversions having the same        |
|      upstream and downstream nodes.                |
*====================================================*

       Upstream       Downstream    Maximum          Total
           Node             Node       Flow           Flow
                                      (cfs)         (ft^3)
--------------- ---------------- ----------       ---------
          DM-02            DM-01    38.7388      1763369.21
          DM-08            DM-06    85.1342      1935329.17
          DM-06            DM-05    85.1371      1934897.22
          DM-05            DM-04    38.7528      1764706.06
          DM-03            DM-02    38.7404      1763884.12
          DM-09            DM-08    73.8449      1766523.25
          BW-18            BW-17     3.3058      48098.1487
          BW-17            BW-16     3.3048      48079.4012
          BW-14            BW-12     3.3028      48039.6953
          BW-12            BW-10     3.3023      48018.0302
          BW-10            BW-09     3.3021      48006.0831
          BW-07            BW-05     3.3018      47975.9040
          BW-05            BW-01     3.3016      47957.7289
          BW-01            DM-10     3.5435      47947.0846
          DM-10            DM-09    73.8524      1766848.36
          BE-01            DM-19    19.3574      495093.785
          DM-21            DM-20    11.1630      208047.452
          DM-20            DM-19    10.8853      208028.099
          DM-18            DM-17    30.2316      703022.114
          DM-16            DM-14    25.3168      692210.229
          DM-11            DM-10    70.5753      1719024.19
          BD-02            BD-01     4.4307      16767.4467
          BD-01            DM-11     4.7291      16793.2195
          BD-05            BD-04     4.4328      16689.2609
          BD-03            BD-02     4.4322      16724.4296
          BE-10            BE-09     5.1765      152155.889
          BE-09            BE-06     4.9621      136805.104
          BE-06            BE-05    12.4586      368552.651
           W-10             W-09     1.7509      25302.4407
           W-06             W-07     5.1692      85644.6615
           W-03             W-05     5.1623      85540.5301
           W-02             W-03     5.1622      85449.4865
           W-02             W-01     5.1623      85442.3848
           W-13             W-12     1.0169      14894.5118
          DM-04            DM-03    38.7504      1764239.51
          BW-16            BW-14     3.3039      48061.6517
          BW-09            BW-07     3.3020      47990.5587
          BD-04            BD-03     4.4324      16708.4870
          DM-17            DM-16    25.6281      692485.266
          DM-19            DM-18    30.2288      703061.172
          BE-02            BE-01    19.3574      495125.065
          BE-05            BE-04    12.4724      368336.805
          BE-04            BE-03    21.1289      497547.706
          BE-03            BE-02    21.1248      497348.962
          BE-13            BE-12    10.7902      162409.674
          BE-12            BE-11     9.9471      161438.312
          BE-11            BE-10     8.6295      159495.615
           W-11             W-12     1.0115      14788.6971
           W-11             W-07     1.0111      14805.8456
           W-08             W-09     0.0638       5190.8673
           W-08             W-07     0.1294       5250.8089
           W-05             W-06     5.1689      85657.2049
          OL-05            OL-04    41.8636      1011229.48
          OL-04            OL-03    41.8634      1011020.82
          OL-03            OL-02    41.8633      1010809.72
          OL-02            OL-01    41.8633      1010586.30
          DM-14            OL-01    25.4153      692108.087
          OL-01            DM-11    66.9674      1702366.37
          OL-09            OL-08    43.9551      1011989.55
          OL-08            OL-07    43.1760      1011810.13
          OL-07            OL-06    42.2700      1011581.86
          OL-06            OL-05    41.8637      1011395.06
          OL-13            OL-12    45.1160      1012661.06
          OL-12            OL-11    44.5992      1012512.58
          OL-11            OL-10    44.4205      1012334.48
          OL-10            OL-09    43.8234      1012151.79
          OL-14            OL-13    36.1063      815608.447
          OL-16            OL-15    36.8451      816055.929
          OL-15            OL-14    36.1115      815818.871
          OL-19            OL-18    36.8684      816623.645
          OL-18            OL-17    36.4854      816478.623
          OL-17            OL-16    36.2366      816244.207
          OL-20            OL-19    37.1136      816719.740
          OL-22            OL-21    38.7854      817027.712
          OL-21            OL-20    37.5273      816867.875
          BD-13            OL-22    55.4272      850023.086
          OL-13            BD-05     4.4335      16676.4420
```

```
#########################################################
# Table E16. New Conduit Information Section            #
#            Conduit Invert (IE) Elevation and Conduit  #
#            Maximum Water Surface (WS) Elevations      #
#########################################################

   Conduit Name    Upstream Node  Downstream Node     IE Up     IE Dn     WS Up     WS Dn  Conduit Type
--------------- ---------------- ---------------- --------- --------- --------- --------- ------------
           DM01            DM-02            DM-01   55.1200   51.7000   57.5831   53.7258 Circular
           DM07            DM-08            DM-06   85.6800   63.1000   87.5211   74.4754 Circular
           DM05            DM-06            DM-05   63.1000   58.9000   74.4754   70.0000 Circular
           DM04            DM-05            DM-04   58.9000   56.6000   70.0000   61.7770 Circular
           DM02            DM-03            DM-02   56.0200   55.1200   59.3550   57.5831 Circular
           DM08            DM-09            DM-08   90.5000   85.6800   94.7256   87.5211 Circular
           BW18            BW-18            BW-17  106.7600  106.1700  107.5000  107.0245 Circular
           BW17            BW-17            BW-16  106.1700  105.6000  107.0245  106.3532 Circular
           BW14            BW-14            BW-12  104.7600  103.7200  105.5733  104.4500 Circular
           BW12            BW-12            BW-10  103.7200  102.9000  104.4500  103.5027 Circular
           BW10            BW-10            BW-09  102.9000  101.8900  103.5027  102.6321 Circular
           BW07            BW-07            BW-05  100.9200   98.9100  101.5175   99.6023 Circular
           BW05            BW-05            BW-01   98.9100   98.0100   99.6023   98.3025 Circular
           BW01            BW-01            DM-10   98.0100   91.7900   98.3025   95.6649 Circular
           DM09            DM-10            DM-09   91.7900   90.5000   95.6649   94.7256 Circular
           BE01            BE-01            DM-19  134.5200  120.1600  135.1455  121.4126 Circular
           DM20            DM-21            DM-20  131.3500  129.5000  139.6700  135.6453 Circular
           DM19            DM-20            DM-19  129.5000  120.1600  135.6453  121.4126 Circular
           DM17            DM-18            DM-17  110.1400  105.0300  116.0837  113.2000 Circular
           DM15            DM-16            DM-14  101.2600   97.9100  108.6943  100.3436 Circular
           DM10            DM-11            DM-10   93.0700   91.7900   97.9950   95.6649 Circular
           BD02            BD-02            BD-01  101.4700   98.3100  102.0791   98.9165 Circular
           BD01            BD-01            DM-11   96.8200   93.0700   97.9931   97.9950 Circular
           BD09            BD-09            BD-07  107.1600  106.5400  106.5400  106.5400 Circular
           BD07            BD-07            BD-06  106.5600  105.2700  105.0100  105.0100 Circular
           BD06            BD-06            BD-05  105.0100  103.7700  105.0100  104.7148 Circular
           BD05            BD-05            BD-04  103.7700  103.4700  104.7148  104.3755 Circular
           BD03            BD-03            BD-02  102.8300  101.4700  103.4362  102.0791 Circular
           BE10            BE-10            BE-09  164.9200  162.9100  170.2400  166.9400 Circular
           BE09            BE-09            BE-06  162.9100  161.4600  166.9400  167.4339 Circular
           BE06            BE-06            BE-05  162.4600  157.4900  167.4339  162.5236 Circular
            W09             W-10             W-09  107.7200  105.2800  109.3323  108.4470 Circular
            W06             W-06             W-07   99.2500   99.1500  106.6858  107.2270 Circular
            W04             W-03             W-05  100.1000   99.2300  104.5933  106.2544 Circular
            W02             W-02             W-03  102.8000  100.0700  103.7235  104.5933 Circular
            W01             W-02             W-01  102.3600   91.6500  102.7697   92.0589 Circular
            W12             W-13             W-12  115.3000  102.7100  115.4865  107.3383 Circular
           DM03            DM-04            DM-03   56.5600   56.0200   61.7770   59.3550 Circular
           BW16            BW-16            BW-14  105.6000  104.7600  106.3532  105.5733 Circular
           BW09            BW-09            BW-07  101.8900  100.9200  102.6321  101.5175 Circular
           BD04            BD-04            BD-03  103.4700  102.8300  104.3755  103.4362 Circular
           DM16            DM-17            DM-16  105.0300  101.2600  113.2000  108.6943 Circular
           DM18            DM-19            DM-18  120.1600  110.1400  121.4126  116.0837 Circular
           BE02            BE-02            BE-01  136.8800  134.5200  142.1700  135.1455 Circular
           BE05            BE-05            BE-04  157.4900  156.8300  162.5236  160.6813 Circular
           BE04            BE-04            BE-03  156.8300  156.1200  160.6813  157.5301 Circular
           BE03            BE-03            BE-02  156.1200  136.8800  157.5301  142.1700 Circular
           BE13            BE-13            BE-12  188.6100  178.3700  193.8900  183.9400 Circular
           BE12            BE-12            BE-11  178.3700  171.4500  183.9400  178.9700 Circular
           BE11            BE-11            BE-10  171.4500  164.9200  178.9700  170.2400 Circular
            W11             W-11             W-12  102.9400  102.7500  107.2697  107.3383 Circular
            W10             W-11             W-07  102.5800  100.2900  107.2697  107.2270 Circular
            W08             W-08             W-09  108.2600  105.2600  108.3609  108.4470 Circular
            W07             W-08             W-07  108.1200  100.4000  108.1263  107.2270 Circular
            W05             W-05             W-06   99.2800   99.2500  106.2544  106.6858 Circular
           OL05            OL-05            OL-04  103.4900  103.1400  106.8643  106.2144 Circular
           OL04            OL-04            OL-03  103.1400  102.8900  106.2144  105.6591 Circular
           OL03            OL-03            OL-02  102.8900  102.5800  105.6591  104.9715 Circular
           OL02            OL-02            OL-01  102.5800  102.4300  104.9715  104.5362 Circular
           L121            DM-14            OL-01   94.7000   93.9300  100.3436  100.0612 Circular
           L122            OL-01            DM-11   93.9300   93.0700  100.0612   97.9950 Circular
           OL09            OL-09            OL-08  104.3200  104.1700  108.8373  108.4873 Circular
           OL08            OL-08            OL-07  104.1700  103.8700  108.4873  107.8094 Circular
           OL07            OL-07            OL-06  103.8700  103.5800  107.8094  107.1540 Circular
           OL06            OL-06            OL-05  103.5800  103.4900  107.1540  106.8643 Circular
           OL13            OL-13            OL-12  105.1500  105.0300  110.7002  110.4423 Circular
           OL12            OL-12            OL-11  105.0300  104.7800  110.4423  109.8808 Circular
           OL11            OL-11            OL-10  104.7800  104.5600  109.8808  109.3911 Circular
           OL10            OL-10            OL-09  104.5600  104.3200  109.3911  108.8373 Circular
           OL14            OL-14            OL-13  105.2400  105.1500  110.8274  110.7002 Circular
           OL16            OL-16            OL-15  105.9500  105.7700  111.7557  111.5198 Circular
           OL15            OL-15            OL-14  105.7700  105.2400  111.5198  110.8274 Circular
           OL19            OL-19            OL-18  106.8000  106.7000  112.8542  112.7273 Circular
           OL18            OL-18            OL-17  106.7000  106.3800  112.7273  112.3051 Circular
           OL17            OL-17            OL-16  106.3800  105.9500  112.3051  111.7557 Circular
           OL20            OL-20            OL-19  106.9700  106.8000  113.0898  112.8542 Circular
           OL22            OL-22            OL-21  107.5000  107.2700  113.7600  113.4706 Circular
           OL21            OL-21            OL-20  107.2700  106.9700  113.4707  113.0898 Circular
           L140            BD-13            OL-22  107.6700  107.5000  114.3393  113.7600 Circular
       Overflow            OL-13            BD-05  106.8000  106.3900  110.7002  107.2715 Circular
```

```
  *====================================================*
  | Table E20 - Junction Flooding and Volume Listing.  |
  |            The maximum volume is the total volume  |
  |            in the node including the volume in the |
  |            flooded storage area. This is the max   |
  |            volume at any time. The volume in the   |
  |            flooded storage area is the total volume|
  |            above the ground elevation, where the   |
  |            flooded pond storage area starts.       |
  *====================================================*

                                               Out of                Passed to 2D cell
                                            1D-System                OR  Volume Stored
       Junction    Surcharged    Flooded     (Flooded      Maximum    in allowed Flood
           Name    Time (min)  Time(min)      Volume)       Volume   Pond of 1D-System
---------------    ----------  ---------    ---------    ---------    ----------------
          DM-02        0.0000     0.0000       0.0000      30.9513              0.0000
          DM-01        0.0000     0.0000       0.0000      25.4563              0.0000
          DM-03      149.5556     0.0000       0.0000      41.9081              0.0000
          DM-05      398.6111   127.4722  169407.7024     139.4826              0.0000
          DM-06      231.3333     0.0000       0.0000     142.9435              0.0000
          DM-08        0.0000     0.0000       0.0000      23.1357              0.0000
          DM-09       42.9417     0.0000       0.0000      53.0990              0.0000
          DM-10       34.8583     0.0000       0.0000      48.6922              0.0000
          BW-01        0.0000     0.0000       0.0000       3.6761              0.0000
          BW-05        0.0000     0.0000       0.0000       8.7000              0.0000
          BW-07        0.0000     0.0000       0.0000       7.5078              0.0000
          BW-10        0.0000     0.0000       0.0000       7.5741              0.0000
          BW-12        0.0000     0.0000       0.0000       9.1733              0.0000
          BW-14        0.0000     0.0000       0.0000      10.2199              0.0000
          BW-17        0.0000     0.0000       0.0000      10.7376              0.0000
          BW-18        0.0000     0.0000       0.0000       9.2983              0.0000
          DM-11       42.5667     0.0000       0.0000      61.8873              0.0000
          DM-14       29.3333     0.0000       0.0000      70.9180              0.0000
          DM-17       73.3500    38.1000   10460.4053     102.6642              0.0000
          DM-19        0.0000     0.0000       0.0000      15.7399              0.0000
          BE-05       99.3250     0.0000       0.0000      63.2524              0.0000
          DM-20       36.3000     0.0000       0.0000      77.2215              0.0000
          DM-21       44.3500    26.7417    4488.9534     104.5491              0.0000
          BD-01        0.0000     0.0000       0.0000      14.7411              0.0000
          BD-02        0.0000     0.0000       0.0000       7.6536              0.0000
          BD-03        0.0000     0.0000       0.0000       7.6171              0.0000
          BD-05        0.0000     0.0000       0.0000      11.8723              0.0000
          BD-06        0.0000     0.0000       0.0000       0.0000              0.0000
          BD-07        0.0000     0.0000       0.0000       0.0000              0.0000
          BD-09        0.0000     0.0000       0.0000       0.0000              0.0000
          BD-13       51.3333     0.0000       0.0000      83.8062              0.0000
          BE-06       59.7167     0.0000       0.0000      75.0677              0.0000
          BE-09       68.4917    50.4667   15207.3600      50.6410              0.0000
          BE-13       24.9167    12.0250     181.0354      66.3485              0.0000
           W-10       37.4167     0.0000       0.0000      20.2604              0.0000
           W-07     1361.4583     0.0000       0.0000     101.4952              0.0000
           W-13        0.0000     0.0000       0.0000       2.3432              0.0000
           W-05     1370.6667     0.0000       0.0000      88.2686              0.0000
           W-03     1363.1250     0.0000       0.0000      56.9649              0.0000
           W-02        0.0000     0.0000       0.0000       5.1477              0.0000
           W-01        0.0000     0.0000       0.0000       5.1382              0.0000
          DM-04      384.0000     0.0000       0.0000      65.5563              0.0000
          BW-16        0.0000     0.0000       0.0000       9.4644              0.0000
          BW-09        0.0000     0.0000       0.0000       9.3246              0.0000
          BD-04        0.0000     0.0000       0.0000      11.3782              0.0000
          DM-16       97.5667     0.0000       0.0000      93.4199              0.0000
          DM-18       48.1417     0.0000       0.0000      74.6886              0.0000
          BE-01        0.0000     0.0000       0.0000       7.8596              0.0000
          BE-02       73.6750    25.4750    1970.1441      66.4741              0.0000
          BE-03        0.0000     0.0000       0.0000      17.7188              0.0000
          BE-04       81.0250     0.0000       0.0000      48.3957              0.0000
          BE-10       78.9000    45.2667    7229.2162      66.8511              0.0000
          BE-11       50.2333    25.6917    1871.6298      94.4963              0.0000
          BE-12       32.5750    21.3333     932.1201      69.9926              0.0000
           W-12      192.1111     0.0000       0.0000      58.1590              0.0000
           W-11      107.1881     0.0000       0.0000      58.9310              0.0000
           W-09     1376.0417  1355.0833   19695.8888      40.0478              0.0000
           W-08        0.0000     0.0000       0.0000       0.0792              0.0000
           W-06     1371.0417     0.0000       0.0000      93.4385              0.0000
          OL-02        0.0000     0.0000       0.0000      30.0519              0.0000
          OL-03        0.0000     0.0000       0.0000      34.7963              0.0000
          OL-04       22.4500     0.0000       0.0000      38.6335              0.0000
          OL-05       37.5500     0.0000       0.0000      42.4021              0.0000
          OL-01        0.0000     0.0000       0.0000      77.0448              0.0000
          OL-09       47.0833     0.0000       0.0000      56.7639              0.0000
          OL-08       45.5083     0.0000       0.0000      54.2512              0.0000
          OL-07       42.6833     0.0000       0.0000      49.5024              0.0000
          OL-06       40.0000     0.0000       0.0000      44.9106              0.0000
          OL-13       52.5000     0.0000       0.0000      69.7444              0.0000
          OL-12       51.9750     0.0000       0.0000      68.0114              0.0000
          OL-11       50.5167     0.0000       0.0000      64.0966              0.0000
          OL-10       49.0917     0.0000       0.0000      60.7076              0.0000
          OL-14       52.6000     0.0000       0.0000      70.2112              0.0000
          OL-15       52.4667     0.0000       0.0000      72.2522              0.0000
          OL-16       52.4667     0.0000       0.0000      72.9548              0.0000
          OL-17       52.0833     0.0000       0.0000      74.4546              0.0000
          OL-18       51.9000     0.0000       0.0000      75.7387              0.0000
          OL-19       51.8167     0.0000       0.0000      76.0766              0.0000
          OL-20       51.9250     0.0000       0.0000      76.9010              0.0000
          OL-21       51.7083     0.0000       0.0000      77.9184              0.0000
          OL-22       51.6083    35.9167   32876.8057      78.6632              0.0000
```

# ATTACHMENT 3

## City of Arlington Stormwater Projects

| **Problem No.:** | **1** | **Basin ID:** | **DT-B-1** |
|---|---|---|---|
| Primary Issue(s) | Local flooding | | |
| Problem Description | Apparent surcharging along First Street between McLeod and Lenore Avenues, Lenore Avenue between First and Second Streets; and along French Avenue between First and Third Streets (variable pipe diameters in French Avenue); | | |
| Information Sources | 1995, 1999, and 2003 assessments; residual areas of Project 11, Downtown Drainage System Improvements, not addressed by the Olympic Avenue renovation in 2007; also Project 201 | | |

| **Problem No.:** | **2** | **Basin ID:** | **DT-B-2** |
|---|---|---|---|
| Primary Issue(s) | Conveyance limitations | | |
| Problem Description | Trunk line along SR9 surcharges at manholes north of Burke Avenue; downstream-most pipe segment to outfall is old and outlet is crushed; requires realignment in conjunction with separate wetland treatment project | | |
| Information Sources | 1995, 1999, and 2003 assessments; residual areas of Project 12, Downtown Outfall Trunk Line | | |

## Upper Mainstem Stillaguamish Basin

**Problem Identified:**
This project is intended to addresses capacity issues along this stretch of the drainage system
**Proposed Project:**
Downtown Drainage System Improvements, provides for collection of stormwater along Olympic Avenue from Division to East First Street, then up E First Street to Lenore Avenue and within a two block section along French Avenue from E First Street to Third Street.

| ITEM NO. | ITEM | Quantity | Units | Unit Price | Total Price | 2006 Unit Price | 2006 Total Price |
|---|---|---|---|---|---|---|---|
| **11** | **Downtown Drainage System Improvements** | | | | | | |
| 1 | Traffic Safety Control Devices | 1 | LS | $20,000 | $20,000 | $22,510 | $22,510 |
| 2 | Remove Manhole | 5 | EA | $500 | $2,500 | $563 | $2,814 |
| 3 | Remove Drainage Pipe | 500 | LF | $10 | $5,000 | $11 | $5,628 |
| 4 | Sawcut Existing Pavement (RSM) | 6,580 | LF | $2.00 | $13,160 | $2 | $14,812 |
| 5 | Remove & Dispose of AC Paving* | 1,760 | SY | $3.50 | $6,160 | $4 | $6,933 |
| 6 | Roadway Excavation, w/ Haul* | 6,743 | CY | $8.50 | $57,316 | $10 | $64,509 |
| 7 | Temporary Patch | 301 | Ton | $45 | $13,545 | $51 | $15,245 |
| 8 | AC Paving Class A* | 301 | Ton | $38 | $11,438 | $43 | $12,874 |
| 9 | Controlled Density Fill* | 2,117 | CY | $65 | $137,605 | $73 | $154,876 |
| 10 | Storm Sewer Pipe (21-inch)* | 880 | LF | $30 | $26,400 | $34 | $29,713 |
| 11 | Storm Sewer Pipe (24-inch)* | 320 | LF | $40 | $12,800 | $45 | $14,407 |
| 12 | Storm Sewer Pipe (27-inch) | 990 | LF | $48 | $47,520 | $54 | $53,484 |
| 13 | Storm Sewer Pipe (30-inch)* | 0 | LF | $52 | $0 | $59 | $0 |
| 14 | Storm Sewer Pipe (36-inch)* | 2,470 | LF | $50 | $123,500 | $56 | $139,000 |
| 15 | Storm Sewer Pipe (48-inch) | 0 | LF | $85 | $0 | $96 | $0 |
| 16 | Reconnect Existing Catch Basins | 20 | EA | $500 | $10,000 | $563 | $11,255 |
| 17 | Type 2 - 54" Catch Basins* | 5 | EA | $2,500 | $12,500 | $2,814 | $14,069 |
| 18 | Type 2 - 60" Catch Basins* | 0 | EA | $3,200 | $0 | $3,602 | $0 |
| 19 | Type 2 - 72" Catch Basins* | 9 | EA | $3,800 | $34,200 | $4,277 | $38,492 |
| 20 | Type 2 - 96" Catch Basins | 0 | EA | $7,500 | $0 | $8,441 | $0 |
| 21 | Relocate Existing Utilities | 1 | LS | $10,000 | $10,000 | $11,255 | $11,255 |
| 22 | Trench Safety | 4,660 | LF | $2 | $9,320 | $2 | $10,490 |
| New Items | | | | | | | |
| 23 | SPCC Plan, Silt Fence, & TESC Measures | 4,660 | LF | $5 | $23,300 | $6 | $28 |
| 24 | Traffic Control Labor | 800 | Hours | $35 | $28,000 | $39 | $1,379 |
| | **Subtotal** | | | | **$604,264** | | **$623,772** |
| 25 | Mobilization/Demob/Overhead & Profit | 1 | LS | 10% | $60,426 | 10% | $62,377 |
| 26 | Contingency | 1 | LS | 30% | $199,407 | 30% | $205,845 |
| 27 | Sales Tax | 1 | LS | 8.5% | $73,448 | 8.5% | $75,820 |
| | **Estimated Construction Cost** | | | | **$937,545** | | **$967,814** |
| 28 | Eng'r, Permitting, Legal, Admin (25%) | 1 | LS | 25% | $234,386 | 25% | $241,953 |
| 29 | Surveying (Design, Const. & As-built) | 1 | LS | 4% | $37,502 | 4% | $38,713 |
| 30 | Construction Management (4%) | 1 | LS | 4% | $37,502 | 4% | $38,713 |
| | **CITY'S ESTIMATE (2004)** | | | | **$1,294,000** | | |
| | **TOTAL 2002 DOLLARS** | | | | **$1,246,935** | | |
| | **TOTAL 2006 DOLLARS** | | | | | | **$1,287,192** |

Notes:
1 Quantities based on previous take-off in 1995 Comprehensive Plan with New Items.
2 (*) Indicates Unit Prices from 67th Ave. NE Bid Tab opened March 15, 2001.
3 (RSM) Indicates Unit Prices from RS Means.
4 Assumes a single contractor to perform all projects in the area under one contract.
5 See accompanying text for more detailed description.

# Upper Mainstem Stillaguamish Basin

**Problem Identified:**
Listed in the 1995 Stormwater Master Plan, this project is intended to addresses capacity issues along this stretch of the drainage system.
**Proposed Project:**
The Downtown Outfall Trunk Line, includes an existing outfall to the Stillaguamish River. This outfall trunkline would be relocated (the outfall location to the river would probably not change but would be improved). The new trunk line would proceed down Division Street from Olympic due west across SR-9 to a new stormwater treatment facility.

| ITEM NO. | ITEM | Quantity | Units | Unit Price | Total Price | 2006 Unit Price | 2006 Total Price |
|---|---|---|---|---|---|---|---|
| **12** | **Outfall Trunk Line Improvements** | | | | | | |
| 1 | Traffic Safety Control Devices | 1 | LS | $7,500 | $7,500 | $8,441 | $8,441 |
| 2 | Remove Manhole | 6 | EA | $500 | $3,000 | $563 | $3,377 |
| 3 | Remove Drainage Pipe | 550 | LF | $10 | $5,500 | $11 | $6,190 |
| 4 | Sawcut Existing Pavement (RSM) | 1,100 | LF | $2.00 | $2,200 | $2 | $2,476 |
| 5 | Remove & Dispose of AC Paving* | 336 | SY | $3.50 | $1,176 | $4 | $1,324 |
| 6 | Roadway Excavation, w/ Haul* | 896 | CY | $8.50 | $7,616 | $10 | $8,572 |
| 7 | Temporary Patch | 57 | Ton | $45 | $2,565 | $51 | $2,887 |
| 8 | AC Paving Class A* | 57 | Ton | $38 | $2,166 | $43 | $2,438 |
| 9 | Controlled Density Fill* | 894 | CY | $65 | $58,110 | $73 | $65,403 |
| 10 | Storm Sewer Pipe (21-inch)* | 0 | LF | $30 | $0 | $34 | $0 |
| 11 | Storm Sewer Pipe (24-inch)* | 0 | LF | $40 | $0 | $45 | $0 |
| 12 | Storm Sewer Pipe (27-inch) | 0 | LF | $48 | $0 | $54 | $0 |
| 13 | Storm Sewer Pipe (30-inch)* | 0 | LF | $52 | $0 | $59 | $0 |
| 14 | Storm Sewer Pipe (36-inch)* | 0 | LF | $50 | $0 | $56 | $0 |
| 15 | Storm Sewer Pipe (48-inch) | 550 | LF | $85 | $46,750 | $96 | $52,618 |
| 16 | Reconnect Existing Catch Basins | 2 | EA | $500 | $1,000 | $563 | $1,126 |
| 17 | Type 2 - 54" Catch Basins* | 5 | EA | $2,500 | $12,500 | $2,814 | $14,069 |
| 18 | Type 2 - 60" Catch Basins* | 0 | EA | $3,200 | $0 | $3,602 | $0 |
| 19 | Type 2 - 72" Catch Basins* | 2 | EA | $3,800 | $7,600 | $4,277 | $8,554 |
| 20 | Type 2 - 96" Catch Basins | 0 | EA | $7,500 | $0 | $8,441 | $0 |
| 21 | Relocate Existing Utilities | 1 | LS | $2,500 | $2,500 | $2,814 | $2,814 |
| 22 | Trench Safety | 550 | LF | $2 | $1,100 | $2 | $1,238 |
| New Items | | | | | | | |
| 23 | SPCC Plan, Silt Fence, & TESC Measures | 550 | LF | $5 | $2,750 | $6 | $3,095 |
| 24 | Traffic Control Labor | 200 | Hours | $35 | $7,000 | $39 | $7,879 |
| | **Subtotal** | | | | **$171,033** | | **$192,499** |
| 25 | Mobilization/Demob/Overhead & Profit | 1 | LS | 10% | $17,103 | 10% | $19,250 |
| 26 | Contingency | 1 | LS | 30% | $56,441 | 30% | $63,525 |
| 27 | Sales Tax | 1 | LS | 8.5% | $20,789 | 8.5% | $23,398 |
| | **Estimated Construction Cost** | | | | **$265,366** | | **$298,672** |
| 28 | Eng'r, Permitting, Legal, Admin (25%) | 1 | LS | 25% | $66,342 | 25% | $74,668 |
| 29 | Surveying (Design, Const. & As-built) | 1 | LS | 4% | $10,615 | 4% | $11,947 |
| 30 | Construction Management (4%) | 1 | LS | 4% | $10,615 | 4% | $11,947 |
| | **CITY'S ESTIMATE (2004)** | | | | **$290,000** | | |
| | **TOTAL 2002 DOLLARS** | | | | **$352,937** | | |
| | **TOTAL 2006 DOLLARS** | | | | | | **$397,234** |

Notes:
1 Quantities based on previous take-off in 1995 Comprehensive Plan with New Items.
2 (*) Indicates Unit Prices from 67th Ave. NE Bid Tab opened March 15, 2001.
3 (RSM) Indicates Unit Prices from RS Means.
4 Assumes a single contractor to perform all projects in the area under one contract.
5 See accompanying text for more detailed description.

# Upper Mainstem Stillaguamish Basin

**Problem Identified:**

The storm drain system experiences surcharging in several locations during intense rainfall, resulting in localized flooding, where flows surface from catchbasins to flow down slope across roads and properties.

**Proposed Project:**

The project will upgrade pipe size and slopes trough the basin.

| ITEM NO. | ITEM | Quantity | Units | Unit Price | Total Price | 2006 Unit Price | 2006 Total Price |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **201** | **Downtown Storm Drain Facility (E Maple St, E 1st St, N Lenore Ave, N French Ave, E Division St)** | | | | | | |
| 1 | Traffic Safety Control Devices | 12 | LS | $20,000 | $240,000 | $22,510 | $270,122 |
| 2 | Remove Manhole | 5 | EA | $500 | $2,500 | $563 | $2,814 |
| 3 | Remove Drainage Pipe | 200 | LF | $10 | $2,000 | $11 | $2,251 |
| 4 | Sawcut Existing Pavement (RSM) | 2750 | LF | $2.00 | $5,500 | $2 | $6,190 |
| 5 | Remove & Dispose of AC Paving* | 900 | SY | $3.50 | $3,150 | $4 | $3,545 |
| 6 | Roadway Excavation, w/ Haul* | 4000 | CY | $8.50 | $34,000 | $10 | $38,267 |
| 7 | Temporary Patch | 180 | Ton | $45 | $8,100 | $51 | $9,117 |
| 8 | AC Paving Class A* | 180 | Ton | $38 | $6,840 | $43 | $7,698 |
| 9 | Controlled Density Fill* | 1500 | CY | $65 | $97,500 | $73 | $109,737 |
| 10 | Storm Sewer Pipe (21-inch)* | 0 | LF | $30 | $0 | $34 | $0 |
| 11 | Storm Sewer Pipe (24-inch)* | 0 | LF | $40 | $0 | $45 | $0 |
| 12 | Storm Sewer Pipe (27-inch) | 2250 | LF | $48 | $108,000 | $54 | $121,555 |
| 13 | Storm Sewer Pipe (30-inch)* | 0 | LF | $52 | $0 | $59 | $0 |
| 14 | Storm Sewer Pipe (36-inch)* | 500 | LF | $50 | $25,000 | $56 | $28,138 |
| 15 | Storm Sewer Pipe (48-inch) | 0 | LF | $85 | $0 | $96 | $0 |
| 16 | Reconnect Existing Catch Basins | 9 | EA | $500 | $4,500 | $563 | $5,065 |
| 17 | Type 2 - 54" Catch Basins* | 0 | EA | $2,500 | $0 | $2,814 | $0 |
| 18 | Type 2 - 60" Catch Basins* | 0 | EA | $3,200 | $0 | $3,602 | $0 |
| 19 | Type 2 - 72" Catch Basins* | 0 | EA | $3,800 | $0 | $4,277 | $0 |
| 20 | Type 2 - 96" Catch Basins | 0 | EA | $7,500 | $0 | $8,441 | $0 |
| 21 | Relocate Existing Utilities | 1 | LS | $10,000 | $10,000 | $11,255 | $11,255 |
| 22 | Trench Safety | 2,750 | LF | $2 | $5,500 | $2 | $6,190 |
| 23 | SPCC Plan, Silt Fence, & TESC Measures | 3,000 | LF | $5 | $15,000 | $6 | $16,883 |
| 24 | Traffic Control Labor | 350 | Hours | $35 | $12,250 | $39 | $13,787 |
| | **Subtotal** | | | | **$579,840** | | **$652,615** |
| 25 | Mobilization/Demob/Overhead & Profit | 1 | LS | 10% | $57,984 | 10% | $65,262 |
| 26 | Contingency | 1 | LS | 30% | $191,347 | 30% | $215,363 |
| 27 | Sales Tax | 1 | LS | 8.5% | $70,480 | 8.5% | $79,325 |
| | **Estimated Construction Cost** | | | | **$899,651** | | **$1,012,565** |
| 28 | Eng'r, Permitting, Legal, Admin (15%) | 1 | LS | 15% | $134,948 | 15% | $151,885 |
| 29 | Surveying (Property, Design & Const.) | 1 | LS | 4% | $35,986 | 4% | $40,503 |
| 30 | Construction Management (4%) | 1 | LS | 4% | $35,986 | 4% | $40,503 |
| | **CITY'S ESTIMATE (2003)** | | | | | | |
| | **TOTAL 2002 DOLLARS** | | | | **$1,106,570** | | |
| | **TOTAL 2006 DOLLARS** | | | | | | **$1,245,455** |

Notes:

1 Quantities based on discussions with City of Arlington staff 12/10/2002.
2 (*) Indicates Unit Prices from 67th Ave. NE Bid Tab opened March 15, 2001.
3 (RSM) Indicates Unit Prices from RS Means.
4 Assumes a single contractor to perform all projects in the area under one contract.
5 See accompanying text for more detailed description.

APPENDIX D

# Hydraulic Model: Existing Conditions

# APPENDIX D
# EXISTING STORMWATER MODEL RESULTS FOR ARLINGTON CONSTRUCTED WETLAND

## TABLE OF CONTENTS

# LIST OF FIGURES

# Stormwater Model

Below is a diagram of the stormwater model showing the labels of various pipes, catch basins, and wetland cells. Note that DM-01 is the Butler outfall. This figure applies to Figures D-2 though D-6.

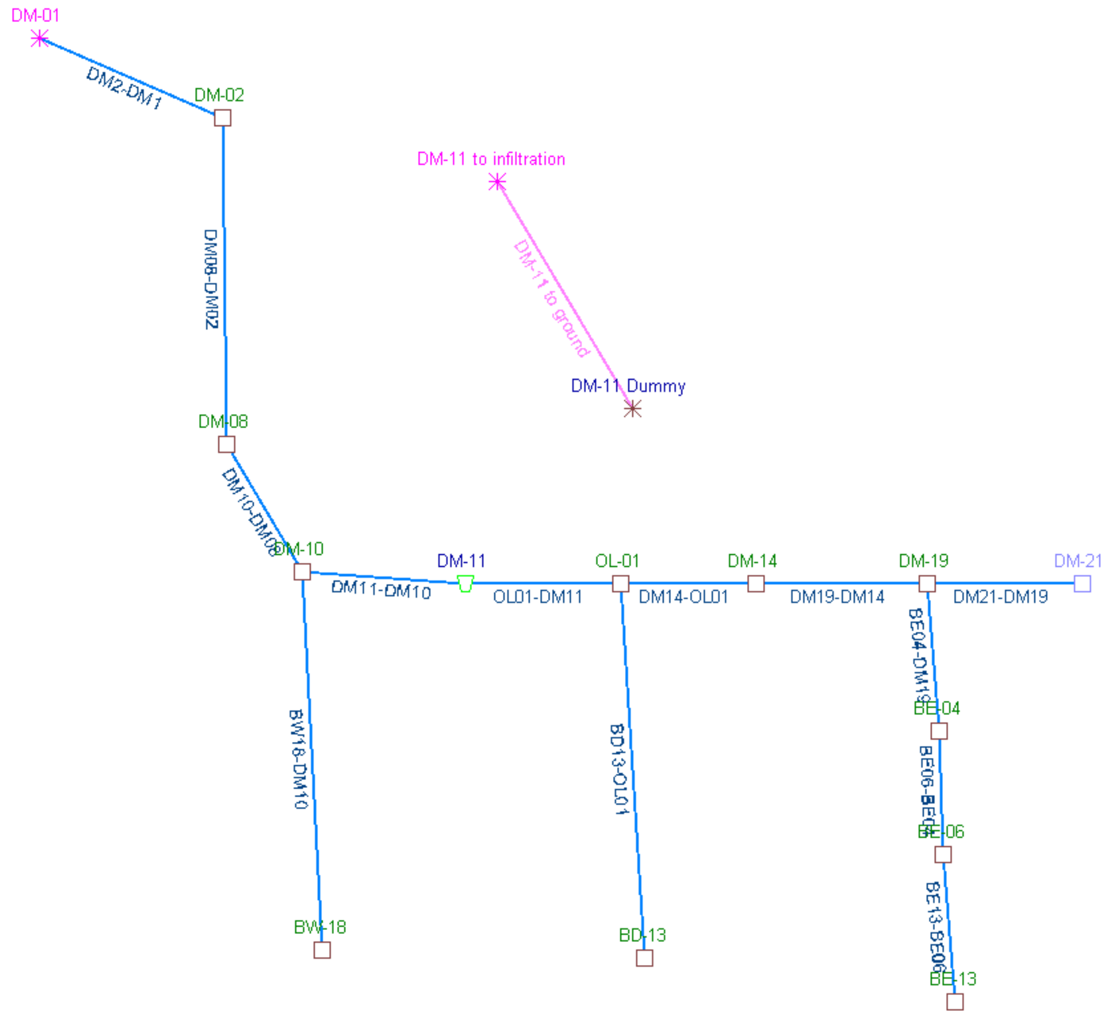
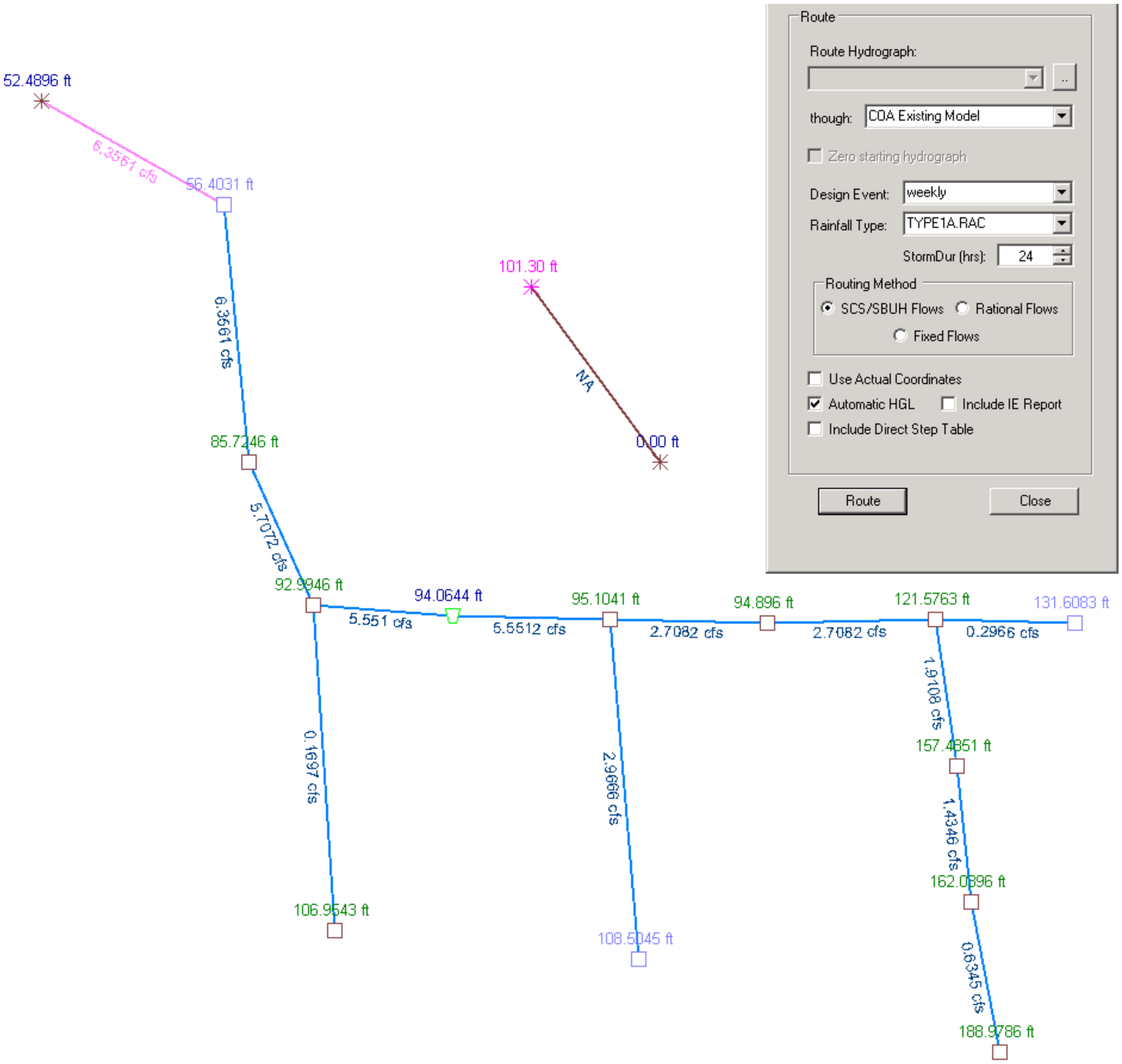


Figure D-1. Stormwater Model

# Weekly Event – 0. 38 inches of Rain



Route

Route Hydrograph:

though: COA Existing Model

☐ Zero starting hydrograph

Design Event: weekly

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

Figure D-2. Peak Flow Rate Results from Weekly Event Model

**Appended on: Friday, November 13, 2009 2:59:15 PM**

ROUTEHYD [] THRU [COA Existing Model] USING [weekly] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

**Gravity Analysis using 24 hr duration storm**

<table>
<tr><th>Reach ID</th><th>Area (ac)</th><th>Flow (cfs)</th><th>Full Q (cfs)</th><th>Full ratio</th><th>nDepth (ft)</th><th>Depth ratio</th><th>Size</th><th>nVel (ft/s)</th><th>fVel (ft/s)</th><th>Infil Vol (cf)</th><th>CBasin / Hyd</th></tr>
<tr><td>BE13-BE06</td><td>24.20</td><td>0.6345</td><td>15.7042</td><td>0.0404</td><td>0.2401</td><td>0.1372</td><td>21 in Diam</td><td>3.193</td><td>6.529</td><td>0.00</td><td>BE-13</td></tr>
<tr><td>BE06-BE04</td><td>57.50</td><td>1.4346</td><td>11.4736</td><td>0.125</td><td>0.4179</td><td>0.2388</td><td>21 in Diam</td><td>3.2553</td><td>4.7701</td><td>0.00</td><td>BE-06</td></tr>
<tr><td>BE04-DM19</td><td>76.80</td><td>1.9108</td><td>23.0196</td><td>0.083</td><td>0.3404</td><td>0.1945</td><td>21 in Diam</td><td>5.8066</td><td>9.5704</td><td>0.00</td><td>BE-04</td></tr>
<tr><td>DM21-DM19</td><td>8.90</td><td>0.2966</td><td>10.7468</td><td>0.0276</td><td>0.143</td><td>0.1144</td><td>15 in Diam</td><td>3.8137</td><td>8.7572</td><td>0.00</td><td>DM-21b</td></tr>
<tr><td>DM19-DM14</td><td>101.80</td><td>2.7082</td><td>31.3855</td><td>0.0863</td><td>0.3969</td><td>0.1984</td><td>24 in Diam</td><td>6.1228</td><td>9.9903</td><td>0.00</td><td>DM-21a</td></tr>
<tr><td>DM14-OL01</td><td>101.80</td><td>2.7082</td><td>35.2153</td><td>0.0769</td><td>0.5619</td><td>0.1873</td><td>36 in Diam</td><td>2.9564</td><td>4.9819</td><td>0.00</td><td></td></tr>
<tr><td>BD13-OL01</td><td>122.30</td><td>2.9666</td><td>24.3008</td><td>0.1221</td><td>0.7084</td><td>0.2361</td><td>36 in Diam</td><td>2.3269</td><td>3.4379</td><td>0.00</td><td>BD-13</td></tr>
<tr><td>OL01-DM11</td><td>224.10</td><td>5.5512</td><td>37.2525</td><td>0.149</td><td>0.7804</td><td>0.2601</td><td>36 in Diam</td><td>3.7984</td><td>5.2701</td><td>0.00</td><td></td></tr>
<tr><td colspan="11"><b>LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event</b><table><tr><th>Event</th><th>Match Q (cfs)</th><th>Peak Q (cfs)</th><th>Max Depth (ft)</th><th>Vol (cf)</th><th>Vol (acft)</th><th>Time to Empty</th></tr><tr><td>weekly</td><td>5.5512</td><td>5.551</td><td>0.5129</td><td>6.4475</td><td>0.0001</td><td>0.0107</td></tr></table></td><td></td></tr>
<tr><td colspan="11"><b>Routing split hyd [DM-11 outlet] through DM11-DM10</b></td><td></td></tr>
<tr><td>DM11-DM10</td><td>0.00</td><td>5.551</td><td>45.7863</td><td>0.1212</td><td>0.7062</td><td>0.2354</td><td>36 in Diam</td><td>4.3736</td><td>6.4774</td><td>0.00</td><td></td></tr>
<tr><td>BW18-DM10</td><td>5.70</td><td>0.1697</td><td>12.2362</td><td>0.0139</td><td>0.124</td><td>0.0827</td><td>18 in Diam</td><td>2.4405</td><td>6.9243</td><td>0.00</td><td>BW-18</td></tr>
</table>

|  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM10-DM08 | 5.70 | 5.7072 | 60.5086 | 0.0943 | 0.6225 | 0.2075 | 36 in Diam | 5.3804 | 8.5602 | 0.00 |  |
| DM08-DM02 | 25.60 | 6.3561 | 232.00 | 0.0274 | 0.57 | 0.114 | 60 in Diam | 5.1336 | 11.8157 | 0.00 | DM-08 |
| DM2-DM1 | 25.60 | 6.3561 | 86.5813 | 0.0734 | 0.5498 | 0.1833 | 36 in Diam | 7.1588 | 12.2487 | 0.00 |  |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  | 55.912 |
| No approach losses at node DM-08 because inverts and/or crowns are offset. |  |  |  |  |  |  |  |
| DM-02 | DM-01 | 52.7597 | ------ | 0.2210 | ------ | 52.9807 | 65.4400 |
| DM-08 | DM-02 | 86.5381 | ------ | 0.0446 | ------ | 86.5827 | 98.8200 |
| DM-10 | DM-08 | 92.7913 | ------ | 0.1957 | 0.0076 | 92.9946 | 103.2100 |
| DM-11 | DM-10 | 94.0644 | --na-- | --na-- | --na-- | 94.0644 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. |  |  |  |  |  |  |  |
| OL-01 | DM-11 | 94.2225 | 0.0841 | 0.0980 | 0.0437 | 94.2801 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. |  |  |  |  |  |  |  |
| DM-14 | OL-01 | 94.6965 | 0.5821 | 0.0066 | ------ | 94.1210 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. |  |  |  |  |  |  |  |
| DM-19 | DM-14 | 98.6553 | ------ | 0.5969 | 0.0636 | 99.3158 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. |  |  |  |  |  |  |  |
| BE-04 | DM-19 | 120.8204 | ------ | 0.0018 | ------ | 120.8221 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. |  |  |  |  |  |  |  |
| BE-06 | BE-04 | 158.4034 | ------ | 0.0031 | ------ | 158.4066 | 170.7200 |
| BE-13 | BE-06 | 161.8098 | ------ | ------ | ------ | 161.8098 | 193.8900 |
| DM-21 | DM-19 | 120.4063 | ------ | ------ | ------ | 120.4063 | 139.6700 |
| BD-13 | OL-01 | 103.2645 | ------ | ------ | ------ | 103.2645 | 114.5000 |
| BW-18 | DM-10 | 91.9823 | ------ | ------ | ------ | 91.9823 | 110.7700 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 1.0621 | 0.3540 | 6.36 | 0.7920 | 0.7920 | 0.5498 | SuperCrit flow, Inlet end controls |
| DM08-DM02 | 0.8581 | 0.1716 | 6.36 | 0.6781 | 0.6781 | 0.5700 | SuperCrit flow, Inlet end controls |
| DM10-DM08 | 1.0013 | 0.3338 | 5.71 | 0.9047 | 0.7495 | 0.6225 | SuperCrit flow, Inlet end controls |
| DM11-DM10 | 0.9944 | 0.3315 | 5.55 | 1.2028 | 0.7387 | 0.7062 | SuperCrit flow, Inlet end controls |
| OL01-DM11 | 1.1165 | 0.3722 | 5.55 | 0.7804 | 0.7387 | 0.7804 | Outlet Control M1 Backwater |
| DM14-OL01 | 0.7655 | 0.2552 | 2.71 | 0.5619 | 0.5119 | 0.5619 | Outlet Control M2 Backwater |
| DM19-DM14 | 0.7558 | 0.3779 | 2.71 | 0.5736 | 0.5736 | 0.3969 | SuperCrit flow, Inlet end controls |
| BE04-DM19 | 0.6534 | 0.3734 | 1.91 | 0.4980 | 0.4980 | 0.3404 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 0.5764 | 0.3294 | 1.43 | 0.4297 | 0.4297 | 0.4179 | SuperCrit flow, Inlet end controls |
| BE13-BE06 | 0.3688 | 0.2108 | 0.63 | 0.2831 | 0.2831 | 0.2401 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 0.2583 | 0.2066 | 0.30 | 0.2107 | 0.2107 | 0.1430 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 0.8345 | 0.2782 | 2.97 | 0.7084 | 0.5369 | 0.7084 | Outlet Control M1 Backwater |
| BW18-DM10 | 0.1943 | 0.1295 | 0.17 | 0.1510 | 0.1510 | 0.1240 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground**DM-11 to ground: No flow to route | | | | | | | | | | | |

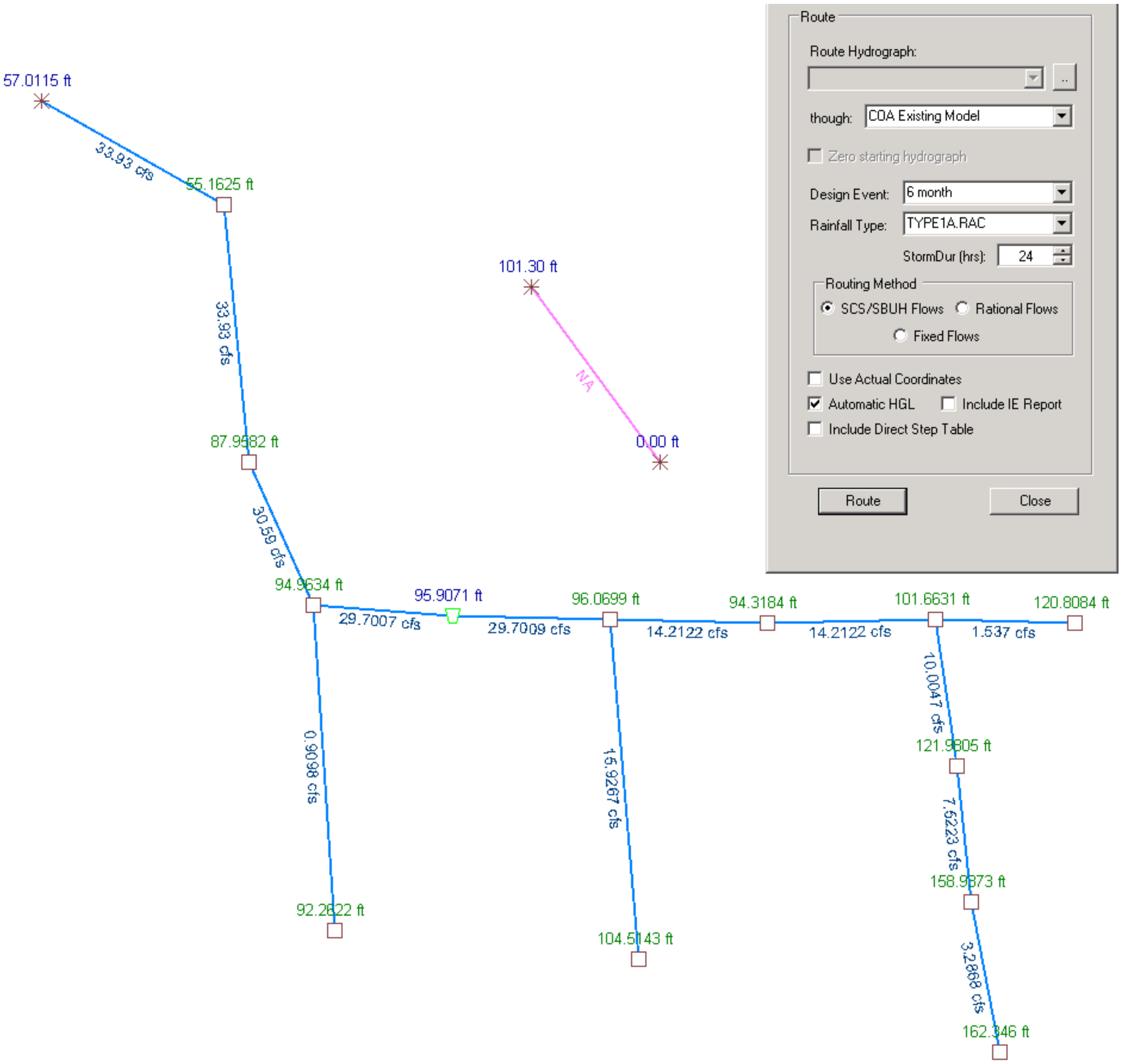
### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.30 |
| DM-11 Dummy | DM-11 to infiltration | 0.0000 | --na-- | --na-- | --na-- | 0.0000 | 103.0000 |

Flow does not exceed capacity in any pipes.

The peak flow to the river is at 6.35 cfs (out the Butler outfall).

# 6 Month Event – 1.26 inches of Rain



Route

Route Hydrograph:

though: COA Existing Model

☐ Zero starting hydrograph

Design Event: 6 month

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

**Figure D-3 – Peak Flow Rate Results from 6 Month Event Model**

**Appended on: Friday, November 13, 2009 3:14:50 PM**

ROUTEHYD [] THRU [COA Existing Model] USING [6 month] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

**Gravity Analysis using 24 hr duration storm**

<table>
<tr><th>Reach ID</th><th>Area (ac)</th><th>Flow (cfs)</th><th>Full Q (cfs)</th><th>Full ratio</th><th>nDepth (ft)</th><th>Depth ratio</th><th>Size</th><th>nVel (ft/s)</th><th>fVel (ft/s)</th><th>Infil Vol (cf)</th><th>CBasin / Hyd</th></tr>
<tr><td>BE13-BE06</td><td>24.20</td><td>3.2868</td><td>15.7042</td><td>0.2093</td><td>0.5435</td><td>0.3106</td><td>21 in Diam</td><td>5.1618</td><td>6.529</td><td>0.00</td><td>BE-13</td></tr>
<tr><td>BE06-BE04</td><td>57.50</td><td>7.5223</td><td>11.4736</td><td>0.6556</td><td>1.0333</td><td>0.5905</td><td>21 in Diam</td><td>5.0887</td><td>4.7701</td><td>0.00</td><td>BE-06</td></tr>
<tr><td>BE04-DM19</td><td>76.80</td><td>10.0047</td><td>23.0196</td><td>0.4346</td><td>0.8072</td><td>0.4613</td><td>21 in Diam</td><td>9.2286</td><td>9.5704</td><td>0.00</td><td>BE-04</td></tr>
<tr><td>DM21-DM19</td><td>8.90</td><td>1.537</td><td>10.7468</td><td>0.143</td><td>0.3188</td><td>0.2551</td><td>15 in Diam</td><td>6.2276</td><td>8.7572</td><td>0.00</td><td>DM-21b</td></tr>
<tr><td>DM19-DM14</td><td>101.80</td><td>14.2122</td><td>31.3855</td><td>0.4528</td><td>0.9441</td><td>0.472</td><td>24 in Diam</td><td>9.741</td><td>9.9903</td><td>0.00</td><td>DM-21a</td></tr>
<tr><td>DM14-OL01</td><td>101.80</td><td>14.2122</td><td>35.2153</td><td>0.4036</td><td>1.3273</td><td>0.4424</td><td>36 in Diam</td><td>4.7102</td><td>4.9819</td><td>0.00</td><td></td></tr>
<tr><td>BD13-OL01</td><td>122.30</td><td>15.9267</td><td>24.3008</td><td>0.6554</td><td>1.771</td><td>0.5903</td><td>36 in Diam</td><td>3.6672</td><td>3.4379</td><td>0.00</td><td>BD-13</td></tr>
<tr><td>OL01-DM11</td><td>224.10</td><td>29.7009</td><td>37.2525</td><td>0.7973</td><td>2.025</td><td>0.675</td><td>36 in Diam</td><td>5.8506</td><td>5.2701</td><td>0.00</td><td></td></tr>
<tr><td colspan="11"><b>LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event</b><br><table><tr><th>Event</th><th>Match Q (cfs)</th><th>Peak Q (cfs)</th><th>Max Depth (ft)</th><th>Vol (cf)</th><th>Vol (acft)</th><th>Time to Empty</th></tr><tr><td>6 month</td><td>29.7009</td><td>29.7007</td><td>1.5704</td><td>19.7401</td><td>0.0005</td><td>0.0107</td></tr></table></td><td></td></tr>
<tr><td colspan="11"><b>Routing split hyd [DM-11 outlet] through DM11-DM10</b></td><td></td></tr>
<tr><td>DM11-DM10</td><td>0.00</td><td>29.7007</td><td>45.7863</td><td>0.6487</td><td>1.7594</td><td>0.5865</td><td>36 in Diam</td><td>6.8936</td><td>6.4774</td><td>0.00</td><td></td></tr>
<tr><td>BW18-DM10</td><td>5.70</td><td>0.9098</td><td>12.2362</td><td>0.0744</td><td>0.2765</td><td>0.1844</td><td>18 in Diam</td><td>4.0641</td><td>6.9243</td><td>0.00</td><td>BW-18</td></tr>
</table>

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM10-DM08 | 5.70 | 30.59 | 60.5086 | 0.5055 | 1.5102 | 0.5034 | 36 in Diam | 8.5807 | 8.5602 | 0.00 | |
| DM08-DM02 | 25.60 | 33.93 | 232.00 | 0.1463 | 1.289 | 0.2578 | 60 in Diam | 8.465 | 11.8157 | 0.00 | DM-08 |
| DM2-DM1 | 25.60 | 33.93 | 86.5813 | 0.3919 | 1.3056 | 0.4352 | 36 in Diam | 11.4913 | 12.2487 | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 57.0115 |
| No approach losses at node DM-08 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 | DM-01 | 54.5617 | ------ | 0.6008 | ------ | 55.1625 | 65.4400 |
| DM-08 | DM-02 | 87.8448 | ------ | 0.1133 | ------ | 87.9582 | 98.8200 |
| DM-10 | DM-08 | 94.4584 | ------ | 0.4862 | 0.0188 | 94.9634 | 103.2100 |
| DM-11 | DM-10 | 95.9071 | --na-- | --na-- | --na-- | 95.9071 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 95.9283 | 0.2088 | 0.2435 | 0.1070 | 96.0699 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 95.7750 | 1.4734 | 0.0167 | ------ | 94.3184 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 99.9962 | ------ | 1.5078 | 0.1591 | 101.6631 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 121.9762 | ------ | 0.0043 | ------ | 121.9805 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 159.3429 | 0.4137 | 0.0082 | ------ | 158.9373 | 170.7200 |
| BE-13 | BE-06 | 162.3460 | ------ | ------ | ------ | 162.3460 | 193.8900 |
| DM-21 | DM-19 | 120.8084 | ------ | ------ | ------ | 120.8084 | 139.6700 |
| BD-13 | OL-01 | 104.5143 | ------ | ------ | ------ | 104.5143 | 114.5000 |
| BW-18 | DM-10 | 92.2622 | ------ | ------ | ------ | 92.2622 | 110.7700 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 2.8641 | 0.9547 | 33.93 | 1.8915 | 1.8915 | 1.3056 | SuperCrit flow, Inlet end controls |
| DM08-DM02 | 2.1648 | 0.4330 | 33.93 | 1.6203 | 1.6203 | 1.2890 | SuperCrit flow, Inlet end controls |
| DM10-DM08 | 2.6684 | 0.8895 | 30.59 | 2.2802 | 1.7930 | 1.5102 | SuperCrit flow, Inlet end controls |
| DM11-DM10 | 4.1243 | 1.3748 | 29.70 | 3.1716 | 1.7658 | 1.7594 | Outlet Control |
| OL01-DM11 | 2.8223 | 0.9408 | 29.70 | 2.0250 | 1.7658 | 2.0250 | Outlet Control M1 Backwater |
| DM14-OL01 | 1.8440 | 0.6147 | 14.21 | 1.3699 | 1.2014 | 1.3273 | Outlet Control M1 Backwater |
| DM19-DM14 | 2.0967 | 1.0483 | 14.21 | 1.3585 | 1.3585 | 0.9441 | SuperCrit flow, Inlet end controls |
| BE04-DM19 | 1.8092 | 1.0338 | 10.00 | 1.1784 | 1.1784 | 0.8072 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 1.5159 | 0.8662 | 7.52 | 1.0333 | 1.0164 | 1.0333 | Outlet Control M2 Backwater |
| BE13-BE06 | 0.9050 | 0.5171 | 3.29 | 0.6593 | 0.6593 | 0.5435 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 0.6604 | 0.5284 | 1.54 | 0.4912 | 0.4912 | 0.3188 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 2.0843 | 0.6948 | 15.93 | 1.7710 | 1.2743 | 1.7710 | Outlet Control M2 Backwater |
| BW18-DM10 | 0.4742 | 0.3161 | 0.91 | 0.3553 | 0.3553 | 0.2765 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground**DM-11 to ground: No flow to route | | | | | | | | | | | |

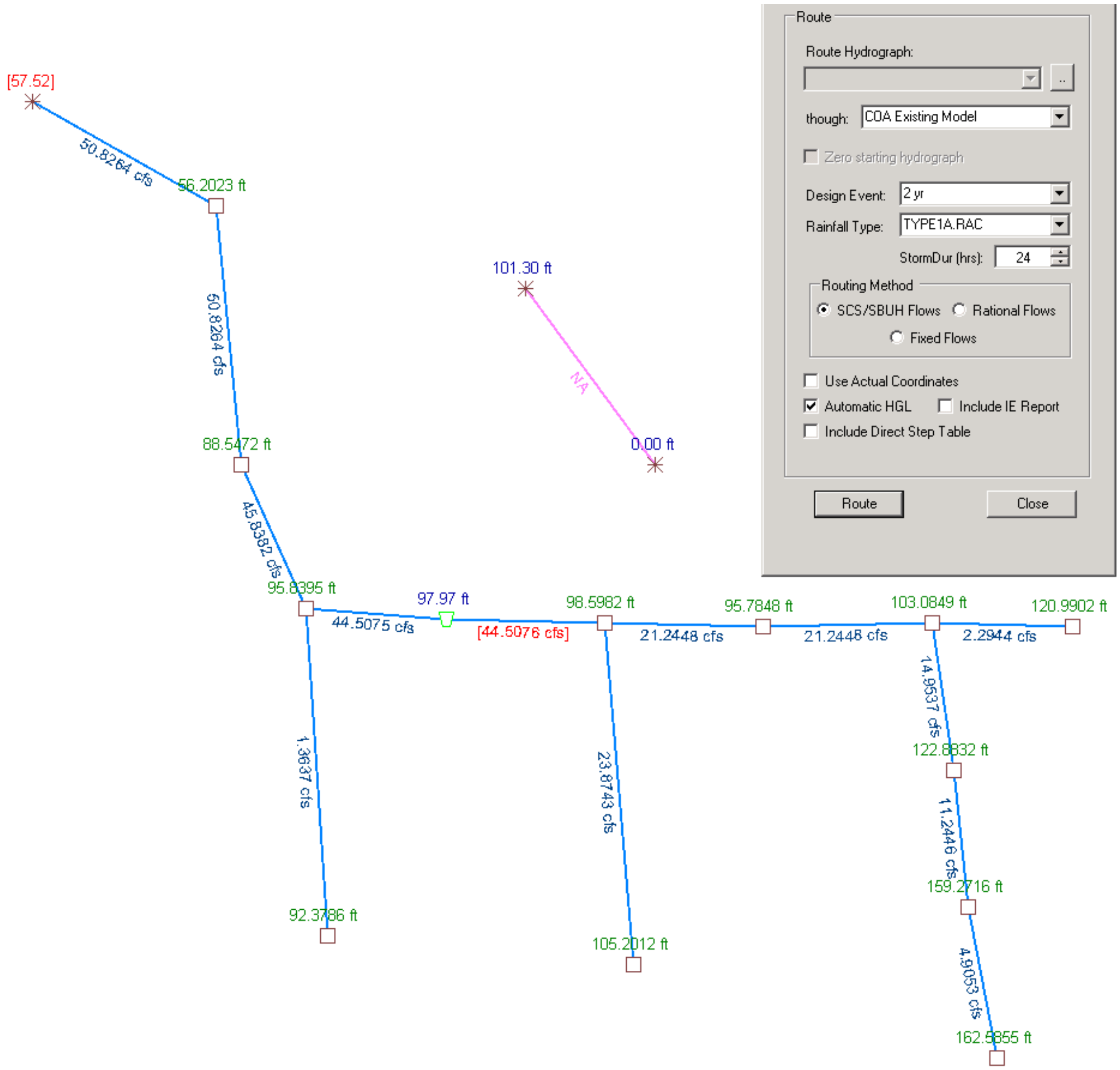
### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.30 |
| DM-11 Dummy | DM-11 to infiltration | 0.0000 | --na-- | --na-- | --na-- | 0.0000 | 103.0000 |

Flow does not exceed capacity in any pipes.

The peak flow to the river is at 29.35 cfs (out the Butler outfall).

## 2 Year Event – 1.80 inches of Rain



Route

Route Hydrograph:

though: COA Existing Model

☐ Zero starting hydrograph

Design Event: 2 yr

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

**Figure D-4 – Peak Flow Rate Results from 2 Year Event Model**

## Appended on: Friday, November 13, 2009 3:19:59 PM

ROUTEHYD [] THRU [COA Existing Model] USING [2 yr] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

### Gravity Analysis using 24 hr duration storm

<table>
<tr><th>Reach ID</th><th>Area (ac)</th><th>Flow (cfs)</th><th>Full Q (cfs)</th><th>Full ratio</th><th>nDepth (ft)</th><th>Depth ratio</th><th>Size</th><th>nVel (ft/s)</th><th>fVel (ft/s)</th><th>Infil Vol (cf)</th><th>CBasin / Hyd</th></tr>
<tr><td>BE13-BE06</td><td>24.20</td><td>4.9053</td><td>15.7042</td><td>0.3124</td><td>0.67</td><td>0.3829</td><td>21 in Diam</td><td>5.79</td><td>6.529</td><td>0.00</td><td>BE-13</td></tr>
<tr><td>BE06-BE04</td><td>57.50</td><td>11.2446</td><td>11.4736</td><td>0.98</td><td>1.4046</td><td>0.8026</td><td>21 in Diam</td><td>5.4343</td><td>4.7701</td><td>0.00</td><td>BE-06</td></tr>
<tr><td>BE04-DM19</td><td>76.80</td><td>14.9537</td><td>23.0196</td><td>0.6496</td><td>1.0272</td><td>0.587</td><td>21 in Diam</td><td>10.1886</td><td>9.5704</td><td>0.00</td><td>BE-04</td></tr>
<tr><td>DM21-DM19</td><td>8.90</td><td>2.2944</td><td>10.7468</td><td>0.2135</td><td>0.3923</td><td>0.3139</td><td>15 in Diam</td><td>6.9609</td><td>8.7572</td><td>0.00</td><td>DM-21b</td></tr>
<tr><td>DM19-DM14</td><td>101.80</td><td>21.2448</td><td>31.3855</td><td>0.6769</td><td>1.2066</td><td>0.6033</td><td>24 in Diam</td><td>10.7242</td><td>9.9903</td><td>0.00</td><td>DM-21a</td></tr>
<tr><td>DM14-OL01</td><td>101.80</td><td>21.2448</td><td>35.2153</td><td>0.6033</td><td>1.6813</td><td>0.5604</td><td>36 in Diam</td><td>5.2111</td><td>4.9819</td><td>0.00</td><td></td></tr>
<tr><td>BD13-OL01</td><td>122.30</td><td>23.8743</td><td>24.3008</td><td>0.9824</td><td>2.4139</td><td>0.8046</td><td>36 in Diam</td><td>3.9168</td><td>3.4379</td><td>0.00</td><td>BD-13</td></tr>
<tr><td>OL01-DM11</td><td>224.10</td><td>44.5076</td><td>37.2525</td><td>1.1948</td><td>-----</td><td>na</td><td>36 in Diam</td><td>6.2965</td><td>5.2701</td><td>0.00</td><td></td></tr>
<tr><td colspan="11"><b>LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event</b>
<table>
<tr><th>Event</th><th>Match Q (cfs)</th><th>Peak Q (cfs)</th><th>Max Depth (ft)</th><th>Vol (cf)</th><th>Vol (acft)</th><th>Time to Empty</th></tr>
<tr><td>2 yr</td><td>44.5076</td><td>44.5075</td><td>2.0566</td><td>25.8517</td><td>0.0006</td><td>0.0107</td></tr>
</table></td><td></td></tr>
<tr><td colspan="11"><b>Routing split hyd [DM-11 outlet] through DM11-DM10</b></td><td></td></tr>
<tr><td>DM11-DM10</td><td>0.00</td><td>44.5075</td><td>45.7863</td><td>0.9721</td><td>2.3877</td><td>0.7959</td><td>36 in Diam</td><td>7.378</td><td>6.4774</td><td>0.00</td><td></td></tr>
<tr><td>BW18-DM10</td><td>5.70</td><td>1.3637</td><td>12.2362</td><td>0.1115</td><td>0.3383</td><td>0.2255</td><td>18 in Diam</td><td>4.567</td><td>6.9243</td><td>0.00</td><td>BW-18</td></tr>
</table>

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM10-DM08 | 5.70 | 45.8382 | 60.5086 | 0.7575 | 1.9519 | 0.6506 | 36 in Diam | 9.4137 | 8.5602 | 0.00 | |
| DM08-DM02 | 25.60 | 50.8264 | 232.00 | 0.2191 | 1.591 | 0.3182 | 60 in Diam | 9.4562 | 11.8157 | 0.00 | DM-08 |
| DM2-DM1 | 25.60 | 50.8264 | 86.5813 | 0.587 | 1.6527 | 0.5509 | 36 in Diam | 12.7337 | 12.2487 | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 57.4399 |
| No approach losses at node DM-08 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 | DM-01 | 55.4525 | ------ | 0.7498 | ------ | 56.2023 | 65.4400 |
| DM-08 | DM-02 | 88.4107 | ------ | 0.1364 | ------ | 88.5472 | 98.8200 |
| DM-10 | DM-08 | 95.4182 | ------ | 0.4056 | 0.0157 | 95.8395 | 103.2100 |
| DM-11 | DM-10 | 97.9699 | --na-- | --na-- | --na-- | 97.9699 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 98.4369 | 0.2382 | 0.2777 | 0.1218 | 98.5982 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 97.5504 | 1.7858 | 0.0203 | ------ | 95.7848 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 101.0533 | ------ | 1.8378 | 0.1937 | 103.0849 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 122.8783 | ------ | 0.0049 | ------ | 122.8832 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 159.7818 | 0.5206 | 0.0103 | ------ | 159.2716 | 170.7200 |
| BE-13 | BE-06 | 162.5855 | ------ | ------ | ------ | 162.5855 | 193.8900 |
| DM-21 | DM-19 | 120.9902 | ------ | ------ | ------ | 120.9902 | 139.6700 |
| BD-13 | OL-01 | 105.2012 | ------ | ------ | ------ | 105.2012 | 114.5000 |
| BW-18 | DM-10 | 92.3786 | ------ | ------ | ------ | 92.3786 | 110.7700 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 3.7549 | 1.2516 | 50.83 | 2.3199 | 2.3199 | 1.6527 | SuperCrit flow, Inlet end controls |
| DM08-DM02 | 2.7307 | 0.5461 | 50.83 | 1.9995 | 1.9995 | 1.5910 | SuperCrit flow, Inlet end controls |
| DM10-DM08 | 3.6282 | 1.2094 | 45.84 | 2.8692 | 2.2066 | 1.9519 | SuperCrit flow, Inlet end controls |
| DM11-DM10 | 6.1872 | 2.0624 | 44.51 | 4.0477 | 2.1749 | 2.3877 | Outlet Control |
| OL01-DM11 | 6.1915 | 2.0638 | 44.51 | 4.0399 | 2.1749 | >D | Outlet Control |
| DM14-OL01 | 4.3884 | 1.4628 | 21.24 | 3.8982 | 1.4815 | 1.6813 | Outlet Control |
| DM19-DM14 | 3.1538 | 1.5769 | 21.24 | 1.6503 | 1.6503 | 1.2066 | SuperCrit flow, Inlet end controls |
| BE04-DM19 | 2.7113 | 1.5493 | 14.95 | 1.4331 | 1.4331 | 1.0272 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 1.9548 | 1.1171 | 11.24 | 1.4046 | 1.2504 | 1.4046 | Outlet Control M1 Backwater |
| BE13-BE06 | 1.1445 | 0.6540 | 4.91 | 0.8121 | 0.8121 | 0.6700 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 0.8422 | 0.6737 | 2.29 | 0.6054 | 0.6054 | 0.3923 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 2.7712 | 0.9237 | 23.87 | 2.4139 | 1.5750 | 2.4139 | Outlet Control M1 Backwater |
| BW18-DM10 | 0.5906 | 0.3937 | 1.36 | 0.4376 | 0.4376 | 0.3383 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground**DM-11 to ground: No flow to route | | | | | | | | | | | |

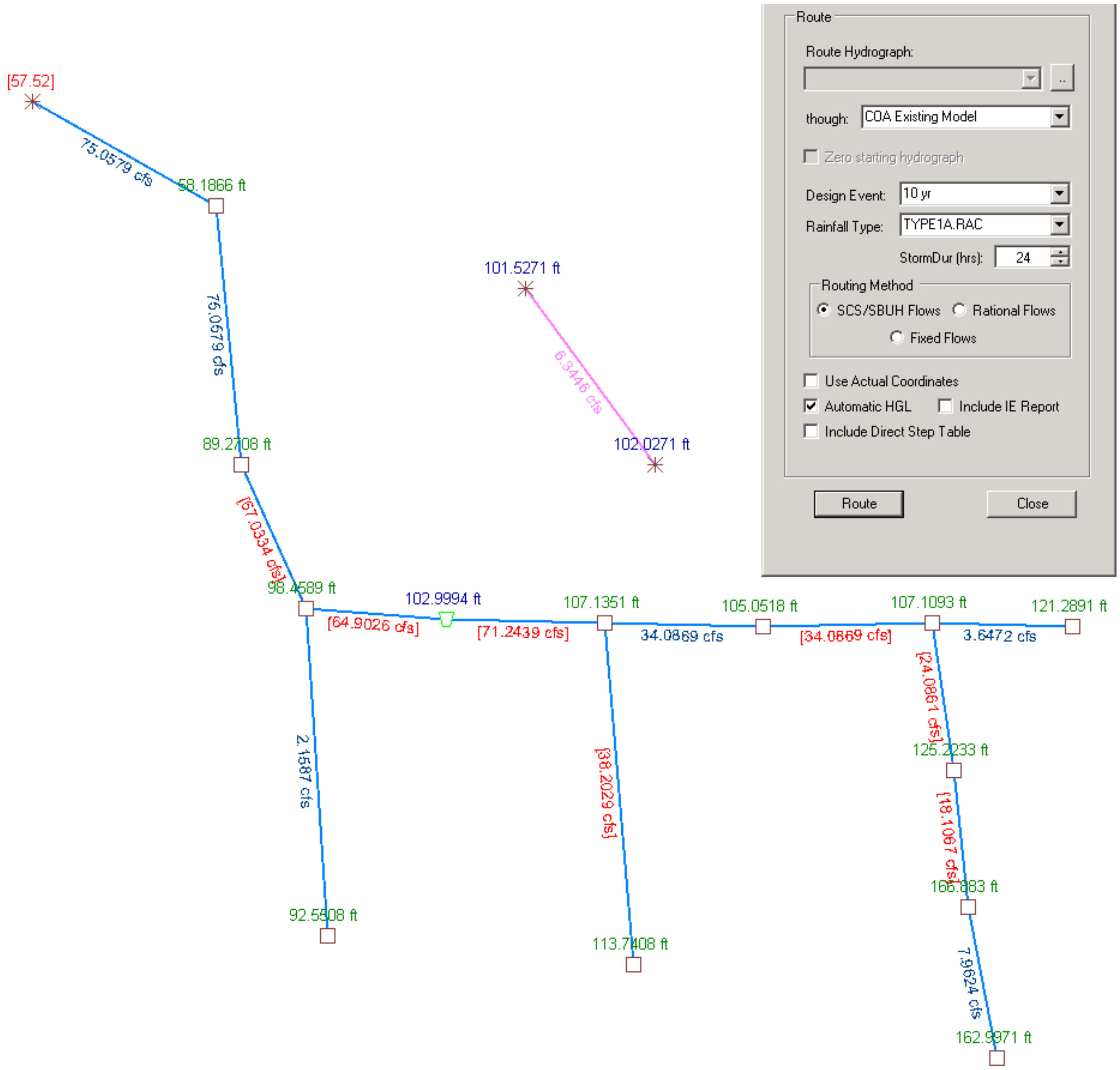
### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.30 |
| DM-11 Dummy | DM-11 to infiltration | 0.0000 | --na-- | --na-- | --na-- | 0.0000 | 103.0000 |

Flow does exceed capacity in one of the upstream pipes; however, that pipe is an existing condition which is already identified by the City of Arlington as a possible future improvement.

The peak flow to the river is at 50.82 cfs (out the Butler outfall).

# 10 Year Event – 2.75 inches of Rain



Route

Route Hydrograph:

though: COA Existing Model

☐ Zero starting hydrograph

Design Event: 10 yr

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

Figure D-5 – Peak Flow Rate Results from 10 Year Event Model

**Appended on: Friday, November 13, 2009 3:23:50 PM**

ROUTEHYD [] THRU [COA Existing Model] USING [10 yr] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

**Gravity Analysis using 24 hr duration storm**

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BE13-BE06 | 24.20 | 7.9624 | 15.7042 | 0.507 | 0.8825 | 0.5043 | 21 in Diam | 6.5492 | 6.529 | 0.00 | BE-13 |
| BE06-BE04 | 57.50 | 18.1067 | 11.4736 | 1.5781 | ----- | na | 21 in Diam | 7.5279 | 4.7701 | 0.00 | BE-06 |
| BE04-DM19 | 76.80 | 24.0861 | 23.0196 | 1.0463 | 1.5205 | 0.8689 | 21 in Diam | 10.8536 | 9.5704 | 0.00 | BE-04 |
| DM21-DM19 | 8.90 | 3.6472 | 10.7468 | 0.3394 | 0.5019 | 0.4016 | 15 in Diam | 7.9154 | 8.7572 | 0.00 | DM-21b |
| DM19-DM14 | 101.80 | 34.0869 | 31.3855 | 1.0861 | ----- | na | 24 in Diam | 10.8502 | 9.9903 | 0.00 | DM-21a |
| DM14-OL01 | 101.80 | 34.0869 | 35.2153 | 0.968 | 2.3773 | 0.7924 | 36 in Diam | 5.6743 | 4.9819 | 0.00 | |
| BD13-OL01 | 122.30 | 38.2029 | 24.3008 | 1.5721 | ----- | na | 36 in Diam | 5.4046 | 3.4379 | 0.00 | BD-13 |
| OL01-DM11 | 224.10 | 71.2439 | 37.2525 | 1.9125 | ----- | na | 36 in Diam | 10.0789 | 5.2701 | 0.00 | |

**LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 10 yr | 71.2439 | 71.2473 | 3.5178 | 44.2192 | 0.001 | 0.0107 |

**Routing split hyd [DM-11 outlet] through DM11-DM10**

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM11-DM10 | 0.00 | 64.9026 | 45.7863 | 1.4175 | ----- | na | 36 in Diam | 9.1818 | 6.4774 | 0.00 | |
| BW18-DM10 | 5.70 | 2.1587 | 12.2362 | 0.1764 | 0.4259 | 0.284 | 18 in Diam | 5.226 | 6.9243 | 0.00 | BW-18 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM10-DM08 | 5.70 | 67.0334 | 60.5086 | 1.1078 | ----- | na | 36 in Diam | 9.4833 | 8.5602 | 0.00 | |
| DM08-DM02 | 25.60 | 75.0579 | 232.00 | 0.3235 | 1.9411 | 0.3882 | 60 in Diam | 10.6522 | 11.8157 | 0.00 | DM-08 |
| DM2-DM1 | 25.60 | 75.0579 | 86.5813 | 0.8669 | 2.16 | 0.72 | 36 in Diam | 13.776 | 12.2487 | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 57.84 |
| No approach losses at node DM-08 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 | DM-01 | 57.2352 | ------ | 0.9514 | ------ | 58.1866 | 65.4400 |
| DM-08 | DM-02 | 89.1324 | ------ | 0.1384 | ------ | 89.2708 | 98.8200 |
| DM-10 | DM-08 | 98.8693 | 1.3091 | 0.8625 | 0.0363 | 98.4589 | 103.2100 |
| DM-11 | DM-10 | 102.9994 | --na-- | --na-- | --na-- | 102.9994 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 106.8276 | 0.4536 | 0.5288 | 0.2323 | 107.1351 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 106.8591 | 1.8281 | 0.0208 | ------ | 105.0518 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 106.6358 | 1.8292 | 2.0856 | 0.2172 | 107.1093 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 125.2139 | ------ | 0.0094 | ------ | 125.2233 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 167.5358 | 0.6660 | 0.0132 | ------ | 166.8830 | 170.7200 |
| BE-13 | BE-06 | 162.9971 | ------ | ------ | ------ | 162.9971 | 193.8900 |
| DM-21 | DM-19 | 121.2891 | ------ | ------ | ------ | 121.2891 | 139.6700 |
| BD-13 | OL-01 | 113.7408 | ------ | ------ | ------ | 113.7408 | 114.5000 |
| BW-18 | DM-10 | 92.5508 | ------ | ------ | ------ | 92.5508 | 110.7700 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 5.5376 | 1.8459 | 75.06 | 2.7200 | 2.7200 | 2.1600 | SuperCrit flow, Inlet end controls |
| DM08-DM02 | 3.4524 | 0.6905 | 75.06 | 3.0506 | 2.4501 | 1.9411 | SuperCrit flow, Inlet end controls |
| DM10-DM08 | 13.2111 | 4.4037 | 67.03 | 3.5928 | 2.6166 | >D | Outlet Control |
| DM11-DM10 | 11.2166 | 3.7389 | 64.90 | 6.6671 | 2.5841 | >D | Outlet Control |
| OL01-DM11 | 14.5822 | 4.8607 | 71.24 | 9.0694 | 2.6742 | >D | Outlet Control |
| DM14-OL01 | 13.6971 | 4.5657 | 34.09 | 12.4351 | 1.8961 | 2.3773 | Outlet Control |
| DM19-DM14 | 31.0199 | 15.5099 | 34.09 | 2.0000 | 1.9117 | >D | Outlet Control |
| BE04-DM19 | 5.0469 | 2.8840 | 24.09 | 1.7500 | 1.6689 | 1.5205 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 14.3422 | 8.1955 | 18.11 | 1.7500 | 1.5482 | >D | Outlet Control |
| BE13-BE06 | 1.5561 | 0.8892 | 7.96 | 1.0468 | 1.0468 | 0.8825 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 1.1411 | 0.9129 | 3.65 | 0.7724 | 0.7724 | 0.5019 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 16.4988 | 5.4996 | 38.20 | 3.0000 | 2.0123 | >D | Outlet Control |
| BW18-DM10 | 0.7628 | 0.5085 | 2.16 | 0.5549 | 0.5549 | 0.4259 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground** | | | | | | | | | | | |
| DM-11 to ground | 0.00 | 6.3446 | ---- | 0.00 | 0.103 | ---- | Ditch | 5.9736 | ----- | 0.00 | |

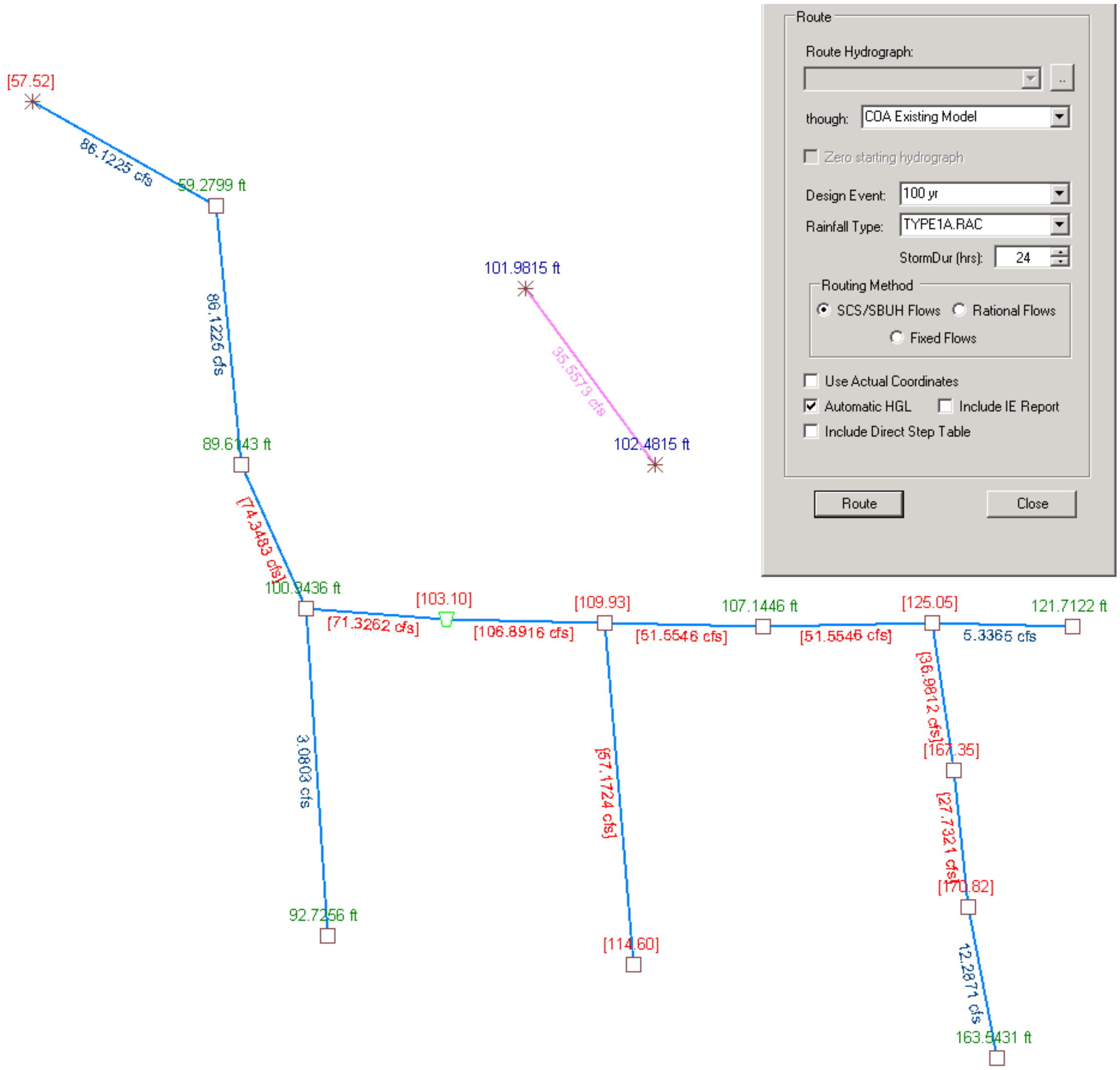
### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.5271 |
| DM-11 Dummy | DM-11 to infiltration | 102.0271 | --na-- | --na-- | --na-- | 102.0271 | 103.0000 |

Flow does exceed capacity in some of the upstream conveyance system; however, that upstream conveyance system is an existing condition which is already identified by the City of Arlington as a future improvement.

The peak flow to the river is at 75.06 cfs (out the Butler outfall).

# 100 Year Event – 3.75 inches of Rain



Route

Route Hydrograph:

though: COA Existing Model

☐ Zero starting hydrograph

Design Event: 100 yr

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

Figure D-6 – Peak Flow Rate Results from 100 Year Event Model

## Appended on: Friday, November 13, 2009 3:33:07 PM

ROUTEHYD [] THRU [COA Existing Model] USING [100 yr] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

### Gravity Analysis using 24 hr duration storm

<table>
<tr><th>Reach ID</th><th>Area (ac)</th><th>Flow (cfs)</th><th>Full Q (cfs)</th><th>Full ratio</th><th>nDepth (ft)</th><th>Depth ratio</th><th>Size</th><th>nVel (ft/s)</th><th>fVel (ft/s)</th><th>Infil Vol (cf)</th><th>CBasin / Hyd</th></tr>
<tr><td>BE13-BE06</td><td>24.20</td><td>12.2871</td><td>15.7042</td><td>0.7824</td><td>1.1655</td><td>0.666</td><td>21 in Diam</td><td>7.2216</td><td>6.529</td><td>0.00</td><td>BE-13</td></tr>
<tr><td>BE06-BE04</td><td>57.50</td><td>27.7321</td><td>11.4736</td><td>2.417</td><td>-----</td><td>na</td><td>21 in Diam</td><td>11.5297</td><td>4.7701</td><td>0.00</td><td>BE-06</td></tr>
<tr><td>BE04-DM19</td><td>76.80</td><td>36.9812</td><td>23.0196</td><td>1.6065</td><td>-----</td><td>na</td><td>21 in Diam</td><td>15.375</td><td>9.5704</td><td>0.00</td><td>BE-04</td></tr>
<tr><td>DM21-DM19</td><td>8.90</td><td>5.3365</td><td>10.7468</td><td>0.4966</td><td>0.6226</td><td>0.4981</td><td>15 in Diam</td><td>8.7403</td><td>8.7572</td><td>0.00</td><td>DM-21b</td></tr>
<tr><td>DM19-DM14</td><td>101.80</td><td>51.5545</td><td>31.3855</td><td>1.6426</td><td>-----</td><td>na</td><td>24 in Diam</td><td>16.4103</td><td>9.9903</td><td>0.00</td><td>DM-21a</td></tr>
<tr><td>DM14-OL01</td><td>101.80</td><td>51.5545</td><td>35.2153</td><td>1.464</td><td>-----</td><td>na</td><td>36 in Diam</td><td>7.2935</td><td>4.9819</td><td>0.00</td><td></td></tr>
<tr><td>BD13-OL01</td><td>122.30</td><td>57.1724</td><td>24.3008</td><td>2.3527</td><td>-----</td><td>na</td><td>36 in Diam</td><td>8.0882</td><td>3.4379</td><td>0.00</td><td>BD-13</td></tr>
<tr><td>OL01-DM11</td><td>224.10</td><td>106.89</td><td>37.2525</td><td>2.8694</td><td>-----</td><td>na</td><td>36 in Diam</td><td>15.1221</td><td>5.2701</td><td>0.00</td><td></td></tr>
<tr><td colspan="11"><b>LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event</b><table><tr><th>Event</th><th>Match Q (cfs)</th><th>Peak Q (cfs)</th><th>Max Depth (ft)</th><th>Vol (cf)</th><th>Vol (acft)</th><th>Time to Empty</th></tr><tr><td>100 yr</td><td>106.8917</td><td>106.8834</td><td>4.2487</td><td>53.4056</td><td>0.0012</td><td>0.0107</td></tr></table></td><td></td></tr>
<tr><td colspan="11"><b>Routing split hyd [DM-11 outlet] through DM11-DM10</b></td><td></td></tr>
<tr><td>DM11-DM10</td><td>0.00</td><td>71.3262</td><td>45.7863</td><td>1.5578</td><td>-----</td><td>na</td><td>36 in Diam</td><td>10.0906</td><td>6.4774</td><td>0.00</td><td></td></tr>
<tr><td>BW18-DM10</td><td>5.70</td><td>3.0803</td><td>12.2362</td><td>0.2517</td><td>0.5129</td><td>0.342</td><td>18 in Diam</td><td>5.7684</td><td>6.9243</td><td>0.00</td><td>BW-18</td></tr>
</table>

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM10-DM08 | 5.70 | 74.3483 | 60.5086 | 1.2287 | ----- | na | 36 in Diam | 10.5181 | 8.5602 | 0.00 | |
| DM08-DM02 | 25.60 | 86.1225 | 232.00 | 0.3712 | 2.1102 | 0.422 | 60 in Diam | 10.934 | 11.8157 | 0.00 | DM-08 |
| DM2-DM1 | 25.60 | 86.1225 | 86.5813 | 0.9947 | 2.4453 | 0.8151 | 36 in Diam | 13.9599 | 12.2487 | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 57.9406 |
| No approach losses at node DM-08 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 | DM-01 | 58.2774 | ------ | 1.0025 | ------ | 59.2799 | 65.4400 |
| DM-08 | DM-02 | 89.4440 | ------ | 0.1703 | ------ | 89.6143 | 98.8200 |
| DM-10 | DM-08 | 101.4264 | 1.5811 | 1.0417 | 0.0566 | 100.9436 | 103.2100 |
| DM-11 | DM-10 | 106.4291 | --na-- | --na-- | --na-- | 106.4291 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 117.1544 | 1.0158 | 1.1843 | 0.5240 | 109.9300 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 111.2788 | 4.1817 | 0.0475 | ------ | 107.1446 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 143.9984 | 3.6707 | 4.1852 | 0.4168 | 125.0500 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 185.4115 | 2.0642 | 0.0220 | ------ | 167.3500 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 188.6221 | 0.8098 | 0.0160 | ------ | 170.8200 | 170.7200 |
| BE-13 | BE-06 | 163.5431 | ------ | ------ | ------ | 163.5431 | 193.8900 |
| DM-21 | DM-19 | 121.7122 | ------ | ------ | ------ | 121.7122 | 139.6700 |
| BD-13 | OL-01 | 130.4745 | ------ | ------ | ------ | 114.6000 | 114.5000 |
| BW-18 | DM-10 | 92.7256 | ------ | ------ | ------ | 92.7256 | 110.7700 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 6.5798 | 2.1933 | 86.12 | 2.8206 | 2.8206 | 2.4453 | SuperCrit flow, Inlet end controls |
| DM08-DM02 | 3.7640 | 0.7528 | 86.12 | 4.1439 | 2.6331 | 2.1102 | SuperCrit flow, Inlet end controls |
| DM10-DM08 | 15.7682 | 5.2561 | 74.35 | 3.9363 | 2.7120 | >D | Outlet Control |
| DM11-DM10 | 14.6464 | 4.8821 | 71.33 | 9.1518 | 2.6753 | >D | Outlet Control |
| OL01-DM11 | 24.9090 | 8.3030 | 106.89 | 12.4991 | 2.9177 | >D | Outlet Control |
| DM14-OL01 | 18.1168 | 6.0389 | 51.55 | 15.2300 | 2.3358 | >D | Outlet Control |
| DM19-DM14 | 68.3825 | 34.1913 | 51.55 | 2.0000 | >D | >D | Outlet Control |
| BE04-DM19 | 101.9417 | 58.2524 | 36.98 | 1.7500 | >D | >D | Outlet Control |
| BE06-BE04 | 35.4284 | 20.2448 | 27.73 | 5.8900 | 1.7017 | >D | Outlet Control |
| BE13-BE06 | 2.1021 | 1.2012 | 12.29 | 1.3068 | 1.3068 | 1.1655 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 1.5642 | 1.2513 | 5.34 | 0.9368 | 0.9368 | 0.6226 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 33.2325 | 11.0775 | 57.17 | 3.0000 | 2.4497 | >D | Outlet Control |
| BW18-DM10 | 0.9376 | 0.6251 | 3.08 | 0.6677 | 0.6677 | 0.5129 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground** | | | | | | | | | | | |
| DM-11 to ground | 0.00 | 35.5573 | ---- | 0.00 | 0.2866 | ---- | Ditch | 11.426 | ----- | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.9815 |
| DM-11 Dummy | DM-11 to infiltration | 102.4815 | --na-- | --na-- | --na-- | 102.4815 | 103.0000 |

Flow does exceed capacity in some of the upstream conveyance system; however, that upstream conveyance system is an existing condition which is already identified by the City of Arlington as a future improvement.

The peak flow to the river is at 86.12 cfs (out the Butler outfall).

# Layout Report: COA Existing Model

| Event | Precip (in) |
|---|---|
| weekly | 0.38 |
| 6 month | 1.26 |
| 2 yr | 1.80 |
| 10 yr | 2.75 |
| 25 yr | 3.20 |
| 100 yr | 3.75 |

### *Reach Records*

Record Id: BD13-OL01

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | OL-01 | **UpNode** | BD-13 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 2594.00 ft | **Slope** | 0.20% |
| **Up Invert** | 102.43 ft | **Dn Invert** | 107.67 ft |

**Conduit Constraints**

| Min Vel | Max Vel | Min Slope | Max Slope | Min Cover |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: BE04-DM19

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-19 | **UpNode** | BE-04 |
| **Material** | unspecified | **Size** | 21 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 1154.00 ft | **Slope** | 3.18% |
| **Up Invert** | 120.167 ft | **Dn Invert** | 156.83 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: BE06-BE04

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | BE-04 | **UpNode** | BE-06 |
| **Material** | unspecified | **Size** | 21 in Diam |
| **Ent Losses** | Groove End Projecting | | |
| **Length** | 586.50 ft | **Slope** | 0.79% |
| **Up Invert** | 157.827 ft | **Dn Invert** | 161.46 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: BE13-BE06

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | BE-06 | **UpNode** | BE-13 |
| **Material** | unspecified | **Size** | 21 in Diam |
| **Ent Losses** | Groove End w/Headwall | | |
| **Length** | 1838.20 ft | **Slope** | 1.48% |
| **Up Invert** | 161.441 ft | **Dn Invert** | 188.61 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: BW18-DM10

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-10 | **UpNode** | BW-18 |
| **Material** | unspecified | **Size** | 18 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 1297.40 ft | **Slope** | 1.15% |
| **Up Invert** | 91.788 ft | **Dn Invert** | 106.76 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: DM08-DM02

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.024 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-02 | **UpNode** | DM-08 |
| **Material** | unspecified | **Size** | 60 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 1134.20 ft | **Slope** | 2.69% |
| **Up Invert** | 85.68 ft | **Dn Invert** | 55.136 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: DM10-DM08

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-08 | **UpNode** | DM-10 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 494.50 ft | **Slope** | 1.24% |
| **Up Invert** | 91.79 ft | **Dn Invert** | 85.678 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: DM-11 to ground

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | | DM-11 overflow |
| **DnNode** | DM-11 to infiltration | **UpNode** | DM-11 Dummy |
| **Length** | 10.00 ft | **Slope** | 5.00% |
| **Bottom Width** | 10.00 ft | **Top of Bank** | 3.00 ft |
| **SS1** | 3.00v:1h | **SS2** | 3.00v:1h |
| **Up Invert** | 101.80 ft | **Dn Invert** | 101.30 ft |

Record Id: DM11-DM10

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | | DM-11 outlet |
| **DnNode** | DM-10 | **UpNode** | DM-11 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 181.30 ft | **Slope** | 0.71% |
| **Up Invert** | 93.07 ft | **Dn Invert** | 91.7918 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: DM14-OL01

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | OL-01 | **UpNode** | DM-14 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 183.10 ft | **Slope** | 0.42% |
| **Up Invert** | 93.931 ft | **Dn Invert** | 94.70 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: DM19-DM14

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-14 | **UpNode** | DM-19 |
| **Material** | unspecified | **Size** | 24 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 768.40 ft | **Slope** | 2.90% |
| **Up Invert** | 97.8995 ft | **Dn Invert** | 120.16 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: DM21-DM19

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-19 | **UpNode** | DM-21 |
| **Material** | unspecified | **Size** | 15 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 268.50 ft | **Slope** | 4.17% |
| **Up Invert** | 120.148 ft | **Dn Invert** | 131.35 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: DM2-DM1

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.011 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-01 | **UpNode** | DM-02 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Groove End w/Headwall | | |
| **Length** | 285.20 ft | **Slope** | 1.20% |
| **Up Invert** | 51.6976 ft | **Dn Invert** | 55.12 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

Record Id: OL01-DM11

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-11 | **UpNode** | OL-01 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 183.10 ft | **Slope** | 0.47% |
| **Up Invert** | 93.106 ft | **Dn Invert** | 93.93 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

***Node Records***

Record Id: BD-13

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 107.67 ft | Max El. | 114.50 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: BE-04

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 156.83 ft | Max El. | 167.25 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: BE-06

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 161.46 ft | Max El. | 170.72 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: BE-13

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 188.61 ft | Max El. | 193.89 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: BW-18

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 106.76 ft | Max El. | 110.77 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: DM-01

| | | | |
|---|---|---|---|
| Descrip: | Butler Outfall | Increment | 0.10 ft |
| Start El. | 51.70 ft | Max El. | 57.42 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

Record Id: DM-02

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 55.12 ft | Max El. | 65.44 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: DM-08

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 85.68 ft | Max El. | 98.82 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 2-60 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 19.634 sf |
| MH/CB Type Node | | | |

Record Id: DM-10

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 91.79 ft | Max El. | 103.21 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 2-60 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 19.634 sf |
| MH/CB Type Node | | | |

Record Id: DM-11

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 93.07 ft | Max El. | 103.00 ft |
| Void Ratio | 100.00 | | |
| Storage Node | DM-11 Combo | Discharge Structure | DM-11 Storage |
| Detention Pond Type Node | | | |

Record Id: DM-11 Storage

| | | | |
|---|---|---|---|
| Descrip: | pipe end | Increment | 0.10 ft |
| Start El. | 93.07 ft | Max El. | 103.00 ft |
| Void Ratio | 100.00 | | |
| **Stage (ft)** | **Area (sf)** | | |
| 0.00 | 12.57 | | |
| 4.93 | 12.57 | | |
| 8.23 | 12.57 | | |
| 8.43 | 80.00 | | |
| 9.73 | 160.00 | | |
| 9.93 | 180.00 | | |
| Stage-Storage Type Node | | | |

Record Id: DM-11 Dummy

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 101.80 ft | Max El. | 103.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

Record Id: DM-11 to infiltration

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 101.30 ft | Max El. | 104.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

Record Id: DM-14

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 94.70 ft | Max El. | 111.08 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: DM-19

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 120.16 ft | Max El. | 124.95 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: DM-21

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 131.35 ft | Max El. | 139.67 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

Record Id: OL-01

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 93.93 ft | Max El. | 109.83 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

***Discharge Records***

Record Id: DM-11 Combo

| Combination Discharge Structure | | | |
|---|---|---|---|
| **Descrip:** | combined pipe outlet and curb overflow | **Increment** | 0.10 ft |
| **Start El.** | 93.07 ft | **Max El.** | 103.00 ft |
| **List of Controls** | | DM-11 outlet<br>DM-11 overflow | |

Record Id: DM-11 outlet

| Vertical Orifice | | | |
|---|---|---|---|
| **Descrip:** | combine infiltration and weir | **Increment** | 0.10 ft |
| **Start El.** | 93.07 ft | **Max El.** | 103.00 ft |
| **Weir Area** | 7.069 sf | **Weir Coeff** | 0.61 |

Record Id: DM-11 overflow

| Broad Crested Weir | | | |
|---|---|---|---|
| **Descrip:** | combine infiltration and weir | **Increment** | 0.10 ft |
| **Start El.** | 96.25 ft | **Max El.** | 103.00 ft |
| **Length** | 10.00 ft | **cd** | 3.216 |

## *Contributing Drainage Areas*

Record Id: BD-13

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 11.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 57.00 ac | **DCIA** | 65.30 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 40.0494 min | **DC TC** | 25.0767 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 57.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.2% | 0.41 | 0.00 in | 16.1453 min |
| Shallow | gutter flow | 200.00 ft | 2.2% | 0.0118 | | 0.8261 min |
| Sheet | pipe conveyance | 2670.00 ft | 2.2% | 0.012 | 1.80 in | 23.078 min |
| Pervious TC | | | | | | 40.0494 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 65.30 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | Smooth Surfaces. | 50.00 ft | 2.2% | 0.011 | 1.80 in | 0.8932 min |
| Shallow | Paved | 200.00 ft | 2.2% | 0.01 | | 1.1055 min |
| Sheet | pipe system | 2670.00 ft | 2.2% | 0.012 | 1.80 in | 23.078 min |
| Pervious TC | | | | | | 25.0767 min |

Record Id: BE-04

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |

| | | | |
|---|---|---|---|
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 11.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 9.90 ac | **DCIA** | 9.40 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 23.9905 min | **DC TC** | 11.0219 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 9.90 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 3.3% | 0.41 | 0.00 in | 13.7281 min |
| Shallow | gutter flow | 200.00 ft | 3.3% | 0.01189 | | 0.6796 min |
| Sheet | pipe conveyance | 1090.00 ft | 3.3% | 0.012 | 1.80 in | 9.5828 min |
| Pervious TC | | | | | | 23.9905 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 9.40 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 3.3% | 0.011 | 0.00 in | 0.7594 min |
| Shallow | gutter flow | 200.00 ft | 3.3% | 0.01189 | | 0.6796 min |
| Sheet | pipe system | 1090.00 ft | 3.3% | 0.012 | 1.80 in | 9.5828 min |
| Pervious TC | | | | | | 11.0219 min |

Record Id: BE-06

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 11.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 17.00 ac | **DCIA** | 16.30 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 31.3508 min | **DC TC** | 15.1775 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 17.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 1.9% | 0.41 | 0.00 in | 17.1204 min |
| Shallow | gutter flow | 200.00 ft | 1.9% | 0.01189 | | 0.8957 min |
| Sheet | pipe conveyance | 1250.00 ft | 1.9% | 0.012 | 1.80 in | 13.3347 min |
| Pervious TC | | | | | | 31.3508 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 16.30 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 1.9% | 0.011 | 0.00 in | 0.9471 min |
| Shallow | gutter flow | 200.00 ft | 1.9% | 0.01189 | | 0.8957 min |
| Sheet | pipe system | 1250.00 ft | 1.9% | 0.012 | 1.80 in | 13.3347 min |
| Pervious TC | | | | | | 15.1775 min |

Record Id: BE-13

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |

| | | | |
|---|---|---|---|
| **Storm Duration** | 11.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 11.80 ac | **DCIA** | 12.40 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 18.5304 min | **DC TC** | 9.0904 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 11.80 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 7.3% | 0.41 | 0.00 in | 9.9928 min |
| Shallow | gutter flow | 200.00 ft | 7.3% | 0.01189 | | 0.4569 min |
| Sheet | pipe conveyance | 1310.00 ft | 7.3% | 0.012 | 1.80 in | 8.0806 min |
| Pervious TC | | | | | | 18.5304 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 12.40 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 7.3% | 0.011 | 0.00 in | 0.5528 min |
| Shallow | gutter flow | 200.00 ft | 7.3% | 0.01189 | | 0.4569 min |
| Sheet | pipe system | 1310.00 ft | 7.3% | 0.012 | 1.80 in | 8.0806 min |
| Pervious TC | | | | | | 9.0904 min |

Record Id: BW-18

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 2.00 ac | **DCIA** | 3.70 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 54.1477 min | **DC TC** | 23.9846 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 2.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 0.4% | 0.41 | 0.00 in | 31.9295 min |
| Shallow | gutter flow | 200.00 ft | 0.4% | 0.01189 | | 2.5927 min |
| Sheet | pipe conveyance | 890.00 ft | 0.4% | 0.012 | 1.80 in | 18.9516 min |
| Pervious TC | | | | | | 53.4738 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 3.70 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 0.4% | 0.011 | 0.00 in | 1.7664 min |
| Shallow | gutter flow | 200.00 ft | 0.4% | 0.01189 | | 2.5927 min |
| Sheet | pipe system | 890.00 ft | 0.4% | 0.012 | 1.80 in | 18.9516 min |
| Pervious TC | | | | | | 23.3107 min |

Record Id: DM-08

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |

| | | | |
|---|---|---|---|
| **Storm Duration** | 11.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 7.00 ac | **DCIA** | 12.90 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 24.7356 min | **DC TC** | 11.0791 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 7.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.9% | 0.41 | 0.00 in | 14.4563 min |
| Shallow | gutter flow | 200.00 ft | 2.9% | 0.01189 | | 0.725 min |
| Sheet | pipe conveyance | 1010.00 ft | 2.9% | 0.0121 | 0.00 in | 2.3535 min |
| Pervious TC | | | | | | 17.5348 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 12.90 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 2.9% | 0.011 | 0.00 in | 0.7997 min |
| Shallow | gutter flow | 200.00 ft | 2.9% | 0.01189 | | 0.725 min |
| Sheet | pipe system | 1010.00 ft | 2.9% | 0.0121 | 0.00 in | 2.3535 min |
| Pervious TC | | | | | | 3.8782 min |

Record Id: DM-21a

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 11.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 5.70 ac | **DCIA** | 10.40 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 32.6143 min | **DC TC** | 17.0757 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 5.70 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.1% | 0.41 | 0.00 in | 16.4486 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe conveyance | 1550.00 ft | 2.1% | 0.0121 | 0.00 in | 4.2445 min |
| Pervious TC | | | | | | 21.545 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 10.40 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 2.1% | 0.011 | 0.00 in | 0.9099 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe system | 1550.00 ft | 2.1% | 0.0121 | 0.00 in | 4.2445 min |
| Pervious TC | | | | | | 6.0063 min |

Record Id: DM-21b

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |

| | | | |
|---|---|---|---|
| **Storm Duration** | 11.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 3.10 ac | **DCIA** | 5.80 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 24.658 min | **DC TC** | 9.1194 min |

**Pervious CN Calc**

| Description | SubArea | Sub cn |
|---|---|---|
| LAWN - SCS A | 3.10 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| Type | Description | Length | Slope | Coeff | Misc | TT |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.1% | 0.41 | 0.00 in | 16.4486 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe conveyance | 620.00 ft | 2.1% | 0.0121 | 0.00 in | 1.6978 min |
| Pervious TC | | | | | | 18.9983 min |

**DCI - CN Calc**

| Description | SubArea | Sub cn |
|---|---|---|
| Pavement and rooftops | 5.80 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| Type | Description | Length | Slope | Coeff | Misc | TT |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 2.1% | 0.011 | 0.00 in | 0.9099 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe system | 620.00 ft | 2.1% | 0.0121 | 0.00 in | 1.6978 min |
| Pervious TC | | | | | | 3.4597 min |

APPENDIX E

# Hydraulic Model: Post-Project Conditions

# APPENDIX E
# DEVELOPED STORMWATER MODEL RESULTS FOR ARLINGTON CONSTRUCTED WETLAND

## TABLE OF CONTENTS

# LIST OF FIGURES

# Developed Stormwater Model

Below is a diagram of the stormwater model showing the labels of various pipes, catch basins, and wetland cells. Note that DM-01 PD is the Butler outfall and that DM-02 PD is the proposed Catch Basin 6A. This note applies to Figures E-2 though E-6.

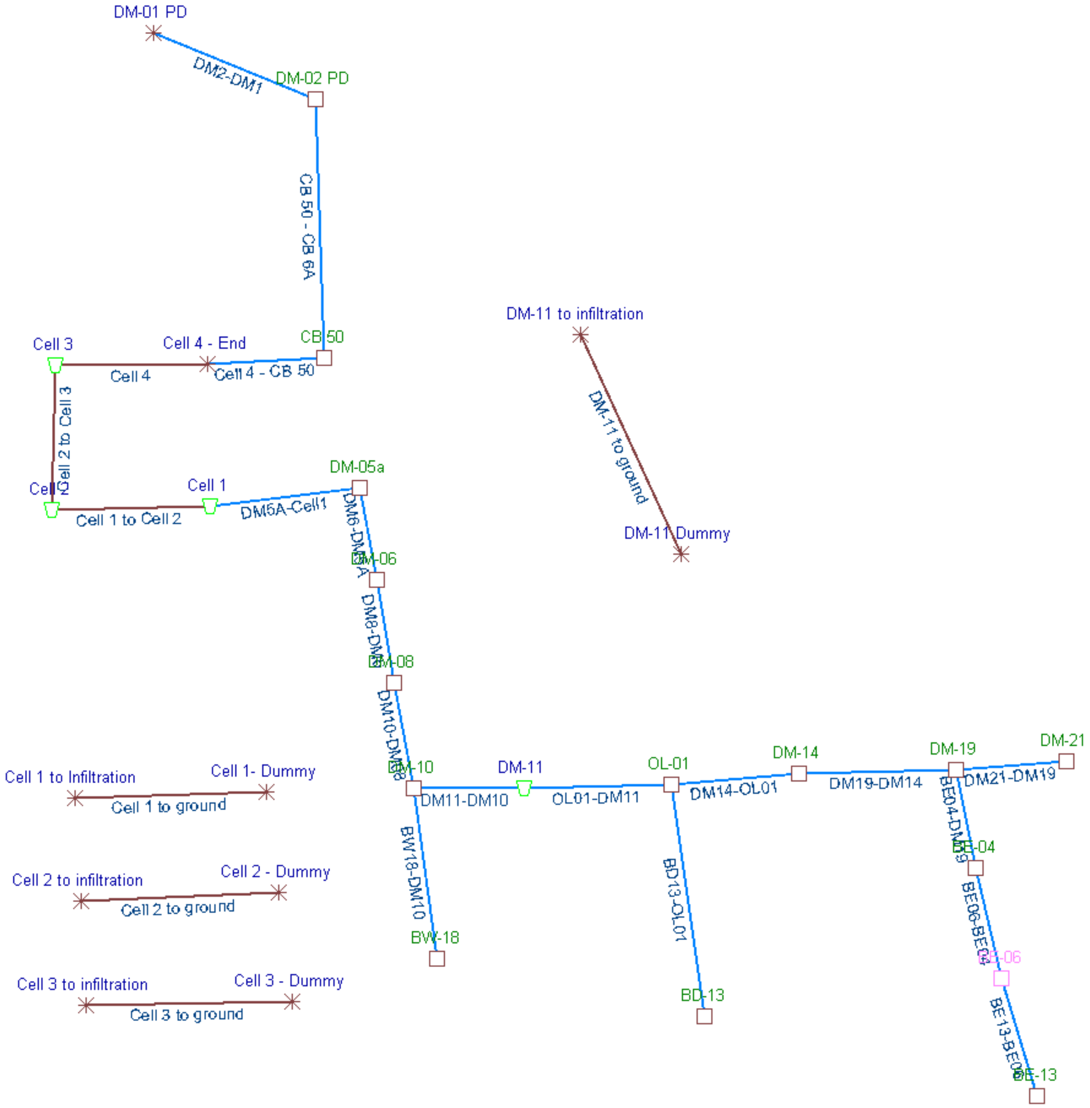
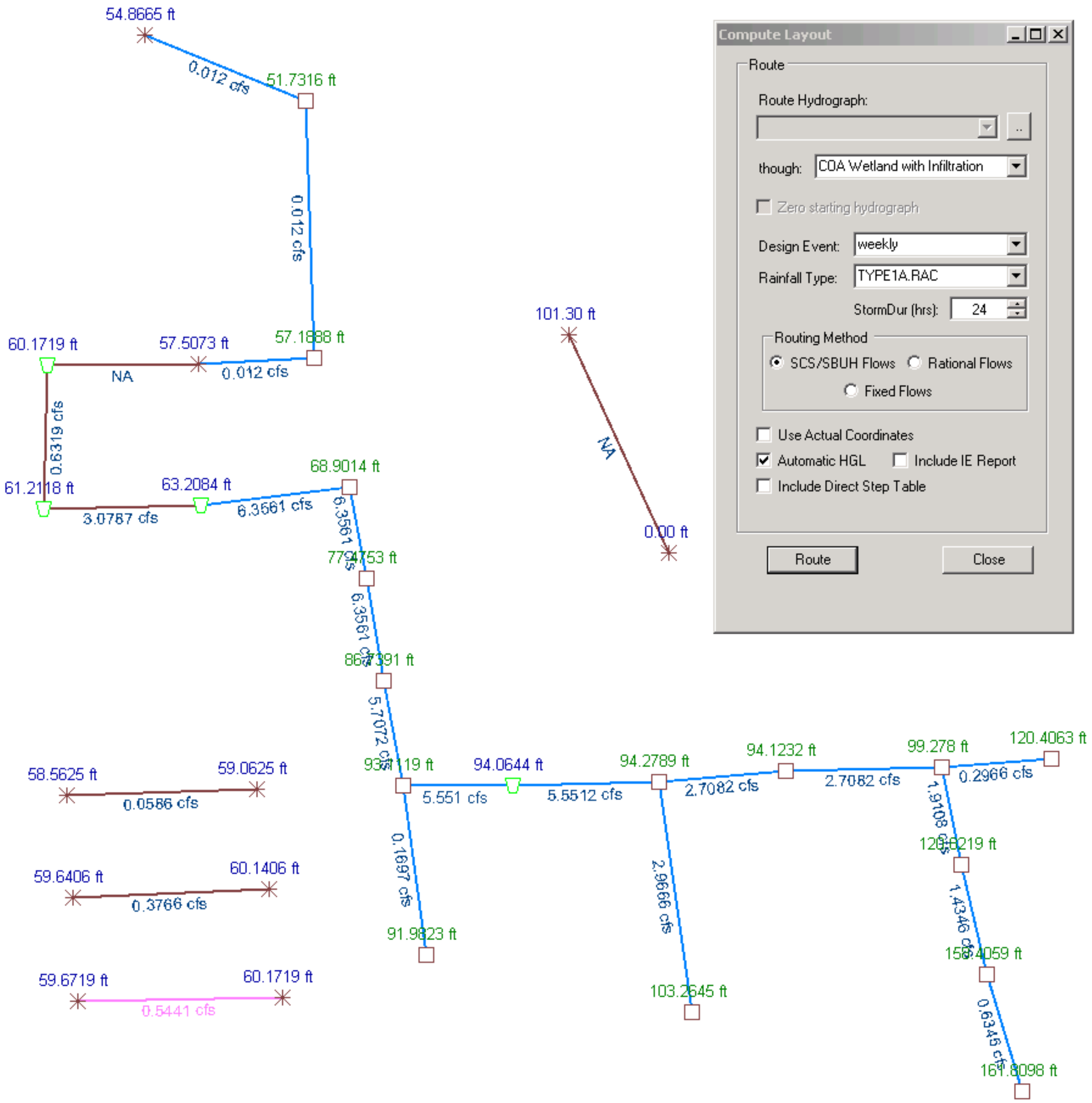


Figure E-1. Stormwater Model

# Developed Weekly Event – 0.38 inches of Rain



Route Hydrograph:

though: COA Wetland with Infiltration

☐ Zero starting hydrograph

Design Event: weekly

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

**Figure E-2. Peak Flow Rate Results from Weekly Event Model**

**Appended on: Monday, November 16, 2009 1:58:33 PM**

ROUTEHYD [] THRU [COA Wetland with Infiltration] USING [weekly] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

### Gravity Analysis using 24 hr duration storm

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BE13-BE06 | 24.20 | 0.6345 | 15.7042 | 0.0404 | 0.2401 | 0.1372 | 21 in Diam | 3.193 | 6.529 | 0.00 | BE-13 |
| BE06-BE04 | 57.50 | 1.4346 | 11.4736 | 0.125 | 0.4179 | 0.2388 | 21 in Diam | 3.2553 | 4.7701 | 0.00 | BE-06 |
| BE04-DM19 | 76.80 | 1.9108 | 23.0196 | 0.083 | 0.3404 | 0.1945 | 21 in Diam | 5.8066 | 9.5704 | 0.00 | BE-04 |
| DM21-DM19 | 8.90 | 0.2966 | 10.7468 | 0.0276 | 0.143 | 0.1144 | 15 in Diam | 3.8137 | 8.7572 | 0.00 | DM-21b |
| DM19-DM14 | 101.80 | 2.7082 | 31.3855 | 0.0863 | 0.3969 | 0.1984 | 24 in Diam | 6.1228 | 9.9903 | 0.00 | DM-21a |
| DM14-OL01 | 101.80 | 2.7082 | 35.2153 | 0.0769 | 0.5619 | 0.1873 | 36 in Diam | 2.9564 | 4.9819 | 0.00 | |
| BD13-OL01 | 122.30 | 2.9666 | 24.3008 | 0.1221 | 0.7084 | 0.2361 | 36 in Diam | 2.3269 | 3.4379 | 0.00 | BD-13 |
| OL01-DM11 | 224.10 | 5.5512 | 37.2525 | 0.149 | 0.7804 | 0.2601 | 36 in Diam | 3.7984 | 5.2701 | 0.00 | |

**LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| weekly | 5.5512 | 5.551 | 0.5129 | 6.4475 | 0.0001 | 0.0107 |

**Routing split hyd [DM-11 outlet] through DM11-DM10**

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM11-DM10 | 0.00 | 5.551 | 45.7863 | 0.1212 | 0.7062 | 0.2354 | 36 in Diam | 4.3736 | 6.4774 | 0.00 | |
| BW18-DM10 | 5.70 | 0.1697 | 12.2362 | 0.0139 | 0.124 | 0.0827 | 18 in Diam | 2.4405 | 6.9243 | 0.00 | BW-18 |
| DM10- | 5.70 | 5.7072 | 60.5086 | 0.0943 | 0.6225 | 0.2075 | 36 in | 5.3804 | 8.5602 | 0.00 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM08 | | | | | | | Diam | | | | |
| DM8-DM6 | 25.60 | 6.3561 | 45.8221 | 0.1387 | 0.7543 | 0.2514 | 36 in Diam | 4.5623 | 6.4825 | 0.00 | DM-08 |
| DM6-DM5A | 25.60 | 6.3561 | 134.57 | 0.0472 | 0.4432 | 0.1477 | 36 in Diam | 9.7745 | 19.038 | 0.00 | |
| DM5A-Cell1 | 25.60 | 6.3561 | 108.10 | 0.0588 | 0.6578 | 0.1645 | 48 in Diam | 4.7067 | 8.6025 | 0.00 | |

**LPOOLCOMPUTE [Cell 1] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| weekly | 6.3686 | 3.1372 | 4.2084 | 25479.3152 | 0.5849 | 188.9544 |

**Routing split hyd [Cell 1- weir] through Cell 1 to Cell 2**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 1 to Cell 2 | 0.00 | 3.0787 | ---- | 0.00 | 0.0327 | ---- | Ditch | 15.4319 | ----- | 0.00 | Cell 1 |

**LPOOLCOMPUTE [Cell 2] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| weekly | 3.1407 | 1.0085 | 1.2118 | 43070.6923 | 0.9888 | 0.0059 |

**Routing split hyd [Cell 2 - weir; Cell 2 -weir - lower] through Cell 2 to Cell 3**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 2 to Cell 3 | 0.00 | 0.6319 | ---- | 0.00 | 0.0142 | ---- | Ditch | 7.3852 | ----- | 0.00 | Cell 2 |

**LPOOLCOMPUTE [Cell 3] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| weekly | 0.6488 | 0.5441 | 0.1294 | 5965.838 | 0.137 | 0.0059 |

**Routing split hyd [Cell 3 - weir] through Cell 4**Cell 4: No flow to route

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 4 - CB 50 | 0.41 | 0.012 | 109.29 | 0.0001 | 0.041 | 0.0117 | 42 in Diam | 0.5819 | 11.3591 | 0.00 | Cell 4 |
| CB 50 - CB 6A | 0.41 | 0.012 | 113.57 | 0.0001 | 0.0408 | 0.0116 | 42 in Diam | 0.5867 | 11.8047 | 0.00 | |
| DM2-DM1 | 0.41 | 0.012 | 86.5813 | 0.0001 | 0.0365 | 0.0122 | 36 in Diam | 0.7487 | 12.2487 | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 54.8665 |
| No approach losses at node CB 50 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 PD | DM-01 PD | 51.7329 | 0.0053 | 0.0040 | ------ | 51.7316 | 67.8500 |
| CB 50 | DM-02 PD | 57.1872 | 0.0053 | 0.0068 | ------ | 57.1888 | 66.0000 |
| Cell 4 - End | CB 50 | 57.5073 | --na-- | --na-- | --na-- | 57.5073 | 63.0000 |
| Cell 3 | Cell 4 - End | 0.0000 | --na-- | --na-- | --na-- | 60.1719 | 63.5000 |
| Cell 2 | Cell 3 | 60.0684 | --na-- | --na-- | --na-- | 61.2118 | 63.5000 |
| Cell 1 | Cell 2 | 63.1948 | --na-- | --na-- | --na-- | 63.2084 | 65.5000 |
| DM-05a | Cell 1 | 67.0718 | ------ | 1.8295 | ------ | 68.9014 | 77.0000 |
| DM-06 | DM-05a | 77.4731 | ------ | 0.0022 | ------ | 77.4753 | 96.2200 |
| DM-08 | DM-06 | 86.7361 | ------ | 0.0029 | ------ | 86.7391 | 98.8200 |
| DM-10 | DM-08 | 92.7913 | ------ | 0.3130 | 0.0076 | 93.1119 | 103.2100 |
| DM-11 | DM-10 | 94.0644 | --na-- | --na-- | --na-- | 94.0644 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 94.2225 | 0.0841 | 0.0967 | 0.0437 | 94.2789 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 94.6965 | 0.5821 | 0.0089 | ------ | 94.1232 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 98.6553 | ------ | 0.5591 | 0.0636 | 99.2780 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 120.8204 | ------ | 0.0015 | ------ | 120.8219 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 158.4034 | ------ | 0.0025 | ------ | 158.4059 | 170.7200 |
| BE-13 | BE-06 | 161.8098 | ------ | ------ | ------ | 161.8098 | 193.8900 |
| DM-21 | DM-19 | 120.4063 | ------ | ------ | ------ | 120.4063 | 139.6700 |
| BD-13 | OL-01 | 103.2645 | ------ | ------ | ------ | 103.2645 | 114.5000 |
| BW-18 | DM-10 | 91.9823 | ------ | ------ | ------ | 91.9823 | 110.7700 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 0.0469 | 0.0156 | 0.01 | 0.0365 | 0.0336 | 0.0365 | Outlet Control M1 Backwater |
| CB 50 - CB 6A | 0.0472 | 0.0135 | 0.01 | 0.0408 | 0.0000 | 0.0408 | Outlet Control M2 Backwater |
| Cell 4 - CB 50 | 0.0473 | 0.0135 | 0.01 | 0.0488 | 0.0000 | 0.0410 | Outlet Control M1 Backwater |
| Cell 2 to Cell 3 | 0.0684 | na | 0.6319 | 0.0684 | 0.0684 | 0.0142 | Supercritical flow, dc at up node |
| Cell 1 to Cell 2 | 0.1948 | na | 3.0787 | 0.1948 | 0.1948 | 0.0327 | Supercritical flow, dc at up node |
| DM5A-Cell1 | 0.9718 | 0.2430 | 6.36 | 0.7313 | 0.7313 | 0.6578 | SuperCrit flow, Inlet end controls |
| DM6-DM5A | 0.8731 | 0.2910 | 6.36 | 2.6514 | 0.7920 | 0.4432 | SuperCrit flow, Inlet end controls |
| DM8-DM6 | 1.0561 | 0.3520 | 6.36 | 0.8785 | 0.7920 | 0.7543 | SuperCrit flow, Inlet end controls |
| DM10-DM08 | 1.0013 | 0.3338 | 5.71 | 1.0611 | 0.7495 | 0.6225 | SuperCrit flow, Inlet end controls |
| DM11-DM10 | 0.9944 | 0.3315 | 5.55 | 1.3201 | 0.7387 | 0.7062 | SuperCrit flow, Inlet end controls |
| OL01-DM11 | 1.1165 | 0.3722 | 5.55 | 0.7804 | 0.7387 | 0.7804 | Outlet Control M1 Backwater |
| DM14-OL01 | 0.7655 | 0.2552 | 2.71 | 0.5619 | 0.5119 | 0.5619 | Outlet Control M2 Backwater |
| DM19-DM14 | 0.7558 | 0.3779 | 2.71 | 0.5736 | 0.5736 | 0.3969 | SuperCrit flow, Inlet end controls |
| BE04-DM19 | 0.6534 | 0.3734 | 1.91 | 0.4980 | 0.4980 | 0.3404 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 0.5764 | 0.3294 | 1.43 | 0.4297 | 0.4297 | 0.4179 | SuperCrit flow, Inlet end controls |
| BE13-BE06 | 0.3688 | 0.2108 | 0.63 | 0.2831 | 0.2831 | 0.2401 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 0.2583 | 0.2066 | 0.30 | 0.2107 | 0.2107 | 0.1430 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 0.8345 | 0.2782 | 2.97 | 0.7084 | 0.5369 | 0.7084 | Outlet Control M1 Backwater |
| BW18-DM10 | 0.1943 | 0.1295 | 0.17 | 0.1510 | 0.1510 | 0.1240 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground**DM-11 to ground: No flow to route | | | | | | | | | | | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.30 |
| DM-11 Dummy | DM-11 to infiltration | 0.0000 | --na-- | --na-- | --na-- | 0.0000 | 103.0000 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Routing split hyd [Cell 1 - infiltration] through Cell 1 to ground | | | | | | | | | | | |
| Cell 1 to ground | 0.00 | 0.0586 | ---- | 0.00 | 0.0244 | ---- | Ditch | 2.2353 | ----- | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 58.5625 |
| Cell 1-Dummy | Cell 1 to Infiltration | 59.0625 | --na-- | --na-- | --na-- | 59.0625 | 65.5000 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 1 to ground | 0.0625 | na | 0.0586 | 0.0625 | 0.0625 | 0.0244 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Routing split hyd [Cell 2 - infiltration] through Cell 2 to ground | | | | | | | | | | | |
| Cell 2 to ground | 0.00 | 0.3766 | ---- | 0.00 | 0.0728 | ---- | Ditch | 4.2495 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.6406 |
| Cell 2 - Dummy | Cell 2 to infiltration | 60.1406 | --na-- | --na-- | --na-- | 60.1406 | 63.5000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 2 to ground | 0.1406 | na | 0.3766 | 0.1406 | 0.1406 | 0.0728 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 3 - infiltration] through Cell 3 to ground** | | | | | | | | | | | |
| Cell 3 to ground | 0.00 | 0.5441 | ---- | 0.00 | 0.1479 | ---- | Ditch | 2.5469 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.6719 |
| Cell 3 - Dummy | Cell 3 to infiltration | 60.1719 | --na-- | --na-- | --na-- | 60.1719 | 62.0000 |

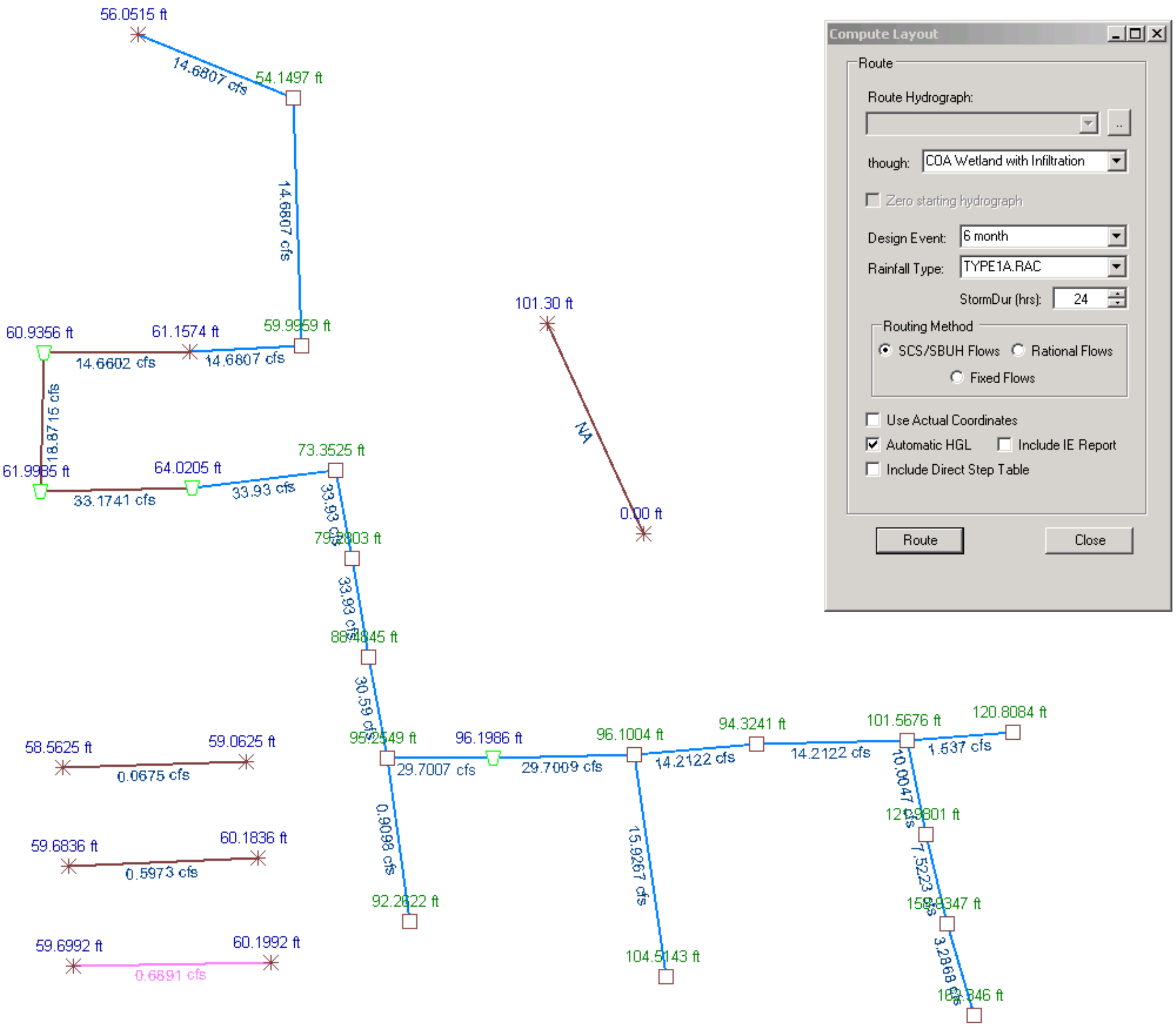
### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 3 to ground | 0.1719 | na | 0.5441 | 0.1719 | 0.1719 | 0.1479 | Supercritical flow, dc at up node |

Flow does not exceed capacity in any pipes (any pipe in a surcharge state would have its flow contained in brackets on the graphic).

The depth of the peak water storage in Cell 1 is 0.21 feet above the weir notch (63.21). The depth of the peak water storage in Cell 2 is 0.21 feet above the lower weir notch (61.21). This equates to 1.21 feet of water storage in the channel areas and 1.71 feet of water storage in the pool areas. The depth of the water storage in Cell 3 is 1 inch below the weir notch (2 inches deep). The peak flow to the river is reduced from 6.36 cfs (coming into the wetland) to 0.12 cfs (out the Butler outfall). The water discharged out the Butler outfall is as a result of the rainwater which falls on Cell 4.

# Developed 6 Month Event – 1.26 inches of Rain



though: COA Wetland with Infiltration

☐ Zero starting hydrograph

Design Event: 6 month

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

Figure E-3 – Peak Flow Rate Results from 6 Month Event Model

**Appended on: Friday, November 20, 2009 11:01:32 AM**

ROUTEHYD [] THRU [COA Wetland with Infiltration] USING [6 month] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

**Gravity Analysis using 24 hr duration storm**

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BE13-BE06 | 24.20 | 3.2868 | 15.7042 | 0.2093 | 0.5435 | 0.3106 | 21 in Diam | 5.1618 | 6.529 | 0.00 | BE-13 |
| BE06-BE04 | 57.50 | 7.5223 | 11.4736 | 0.6556 | 1.0333 | 0.5905 | 21 in Diam | 5.0887 | 4.7701 | 0.00 | BE-06 |
| BE04-DM19 | 76.80 | 10.0047 | 23.0196 | 0.4346 | 0.8072 | 0.4613 | 21 in Diam | 9.2286 | 9.5704 | 0.00 | BE-04 |
| DM21-DM19 | 8.90 | 1.537 | 10.7468 | 0.143 | 0.3188 | 0.2551 | 15 in Diam | 6.2276 | 8.7572 | 0.00 | DM-21b |
| DM19-DM14 | 101.80 | 14.2122 | 31.3855 | 0.4528 | 0.9441 | 0.472 | 24 in Diam | 9.741 | 9.9903 | 0.00 | DM-21a |
| DM14-OL01 | 101.80 | 14.2122 | 35.2153 | 0.4036 | 1.3273 | 0.4424 | 36 in Diam | 4.7102 | 4.9819 | 0.00 | |
| BD13-OL01 | 122.30 | 15.9267 | 24.3008 | 0.6554 | 1.771 | 0.5903 | 36 in Diam | 3.6672 | 3.4379 | 0.00 | BD-13 |
| OL01-DM11 | 224.10 | 29.7009 | 37.2525 | 0.7973 | 2.025 | 0.675 | 36 in Diam | 5.8506 | 5.2701 | 0.00 | |

**LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 6 month | 29.7009 | 29.7007 | 1.5704 | 19.7401 | 0.0005 | 0.0107 |

**Routing split hyd [DM-11 outlet] through DM11-DM10**

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM11-DM10 | 0.00 | 29.7007 | 45.7863 | 0.6487 | 1.7594 | 0.5865 | 36 in Diam | 6.8936 | 6.4774 | 0.00 | |
| BW18-DM10 | 5.70 | 0.9098 | 12.2362 | 0.0744 | 0.2765 | 0.1844 | 18 in Diam | 4.0641 | 6.9243 | 0.00 | BW-18 |
| DM10- | 5.70 | 30.59 | 60.5086 | 0.5055 | 1.5102 | 0.5034 | 36 in | 8.5807 | 8.5602 | 0.00 | |

|  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM08 |  |  |  |  |  |  | Diam |  |  |  |  |
| DM8-DM6 | 25.60 | 33.93 | 45.8221 | 0.7405 | 1.9232 | 0.6411 | 36 in Diam | 7.0882 | 6.4825 | 0.00 | DM-08 |
| DM6-DM5A | 25.60 | 33.93 | 134.57 | 0.2521 | 1.0267 | 0.3422 | 36 in Diam | 15.8671 | 19.038 | 0.00 |  |
| DM5A-Cell1 | 25.60 | 33.93 | 108.10 | 0.3139 | 1.5343 | 0.3836 | 48 in Diam | 7.6463 | 8.6025 | 0.00 |  |

**LPOOLCOMPUTE [Cell 1] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 6 month | 34.0107 | 33.2416 | 5.0205 | 34322.5243 | 0.7879 | 187.6782 |

**Routing split hyd [Cell 1- weir] through Cell 1 to Cell 2**

|  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 1 to Cell 2 | 0.00 | 33.1741 | ---- | 0.00 | 0.1352 | ---- | Ditch | 38.3078 | ----- | 0.00 | Cell 1 |

**LPOOLCOMPUTE [Cell 2] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 6 month | 33.7305 | 19.4688 | 1.9985 | 114971.9152 | 2.6394 | 0.0059 |

**Routing split hyd [Cell 2 - weir; Cell 2 -weir - lower] through Cell 2 to Cell 3**

|  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 2 to Cell 3 | 0.00 | 18.8715 | ---- | 0.00 | 0.1089 | ---- | Ditch | 27.378 | ----- | 0.00 | Cell 2 |

**LPOOLCOMPUTE [Cell 3] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 6 month | 19.1558 | 15.3214 | 0.9356 | 48940.4635 | 1.1235 | 0.0059 |

**Routing split hyd [Cell 3 - weir] through Cell 4**

|  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 4 | 0.00 | 14.6601 | ---- | 0.00 | 0.5811 | ---- | Ditch | 2.7538 | ----- | -56059.99 | Cell 3 |
| Cell 4 - CB 50 | 0.41 | 14.6806 | 109.29 | 0.1343 | 0.8662 | 0.2475 | 42 in Diam | 7.9172 | 11.3591 | 0.00 | Cell 4 |
| CB 50 - CB 6A | 0.41 | 14.6806 | 113.57 | 0.1293 | 0.8494 | 0.2427 | 42 in Diam | 8.1388 | 11.8047 | 0.00 |  |
| DM2-DM1 | 0.41 | 14.6806 | 86.5813 | 0.1696 | 0.8342 | 0.2781 | 36 in Diam | 9.1489 | 12.2487 | 0.00 |  |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 56.0515 |
| No approach losses at node CB 50 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 PD | DM-01 PD | 53.3810 | ------ | 0.7687 | ------ | 54.1497 | 67.8500 |
| CB 50 | DM-02 PD | 58.7306 | ------ | 1.2653 | ------ | 59.9959 | 66.0000 |
| Cell 4 - End | CB 50 | 61.1574 | --na-- | --na-- | --na-- | 61.1574 | 63.0000 |
| Cell 3 | Cell 4 - End | 59.7911 | --na-- | --na-- | --na-- | 60.9356 | 63.5000 |
| Cell 2 | Cell 3 | 60.6064 | --na-- | --na-- | --na-- | 61.9985 | 63.5000 |
| Cell 1 | Cell 2 | 63.8469 | --na-- | --na-- | --na-- | 64.0205 | 65.5000 |
| DM-05a | Cell 1 | 68.5313 | ------ | 4.8212 | ------ | 73.3525 | 77.0000 |
| DM-06 | DM-05a | 79.2751 | ------ | 0.0052 | ------ | 79.2803 | 96.2200 |
| DM-08 | DM-06 | 88.7734 | 0.2908 | 0.0019 | ------ | 88.4845 | 98.8200 |
| DM-10 | DM-08 | 94.4584 | ------ | 0.7776 | 0.0188 | 95.2549 | 103.2100 |
| DM-11 | DM-10 | 96.1985 | --na-- | --na-- | --na-- | 96.1985 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 95.9620 | 0.2088 | 0.2403 | 0.1070 | 96.1004 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 95.7750 | 1.4734 | 0.0225 | ------ | 94.3241 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 99.9962 | ------ | 1.4123 | 0.1591 | 101.5676 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 121.9762 | ------ | 0.0039 | ------ | 121.9801 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 159.3429 | 0.4137 | 0.0056 | ------ | 158.9347 | 170.7200 |
| BE-13 | BE-06 | 162.3460 | ------ | ------ | ------ | 162.3460 | 193.8900 |
| DM-21 | DM-19 | 120.8084 | ------ | ------ | ------ | 120.8084 | 139.6700 |
| BD-13 | OL-01 | 104.5143 | ------ | ------ | ------ | 104.5143 | 114.5000 |
| BW-18 | DM-10 | 92.2622 | ------ | ------ | ------ | 92.2622 | 110.7700 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 1.6950 | 0.5650 | 14.68 | 1.2215 | 1.2215 | 0.8342 | SuperCrit flow, Inlet end controls |
| CB 50 - CB 6A | 1.5906 | 0.4544 | 14.68 | 1.1668 | 1.1668 | 0.8494 | SuperCrit flow, Inlet end controls |
| Cell 4 - CB 50 | 3.6974 | 1.0564 | 14.68 | 2.8559 | 1.1668 | 0.8662 | Outlet Control M1 Backwater |
| Cell 4 | 0.5811 | na | 14.6602 | 3.6953 | 0.4526 | 0.5811 | M1 curve, step from twdepth down to dnDirect Step Backwater Calc |
| Cell 2 to Cell 3 | 0.6064 | na | 18.8715 | 0.6064 | 0.6064 | 0.1089 | Supercritical flow, dc at up node |
| Cell 1 to Cell 2 | 0.8469 | na | 33.1741 | 0.8469 | 0.8469 | 0.1352 | Supercritical flow, dc at up node |
| DM5A-Cell1 | 2.4313 | 0.6078 | 33.93 | 1.7318 | 1.7318 | 1.5343 | SuperCrit flow, Inlet end controls |
| DM6-DM5A | 2.6751 | 0.8917 | 33.93 | 7.1025 | 1.8915 | 1.0267 | SuperCrit flow, Inlet end controls |
| DM8-DM6 | 3.0934 | 1.0311 | 33.93 | 2.6835 | 1.8915 | 1.9232 | Outlet Control M1 Backwater |
| DM10-DM08 | 2.6684 | 0.8895 | 30.59 | 2.8065 | 1.7930 | 1.5102 | SuperCrit flow, Inlet end controls |
| DM11-DM10 | 4.4158 | 1.4719 | 29.70 | 3.4631 | 1.7658 | 1.7594 | Outlet Control |
| OL01-DM11 | 2.8560 | 0.9520 | 29.70 | 2.2685 | 1.7658 | 2.0250 | Outlet Control M1 Backwater |
| DM14-OL01 | 1.8440 | 0.6147 | 14.21 | 1.4004 | 1.2014 | 1.3273 | Outlet Control M1 Backwater |
| DM19-DM14 | 2.0967 | 1.0483 | 14.21 | 1.3585 | 1.3585 | 0.9441 | SuperCrit flow, Inlet end controls |
| BE04-DM19 | 1.8092 | 1.0338 | 10.00 | 1.1784 | 1.1784 | 0.8072 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 1.5159 | 0.8662 | 7.52 | 1.0333 | 1.0164 | 1.0333 | Outlet Control M2 Backwater |
| BE13-BE06 | 0.9050 | 0.5171 | 3.29 | 0.6593 | 0.6593 | 0.5435 | SuperCrit flow, Inlet end controls |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DM21-DM19 | 0.6604 | 0.5284 | 1.54 | 0.4912 | 0.4912 | 0.3188 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 2.0843 | 0.6948 | 15.93 | 1.7710 | 1.2743 | 1.7710 | Outlet Control M2 Backwater |
| BW18-DM10 | 0.4742 | 0.3161 | 0.91 | 0.3553 | 0.3553 | 0.2765 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground**DM-11 to ground: No flow to route | | | | | | | | | | | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.30 |
| DM-11 Dummy | DM-11 to infiltration | 0.0000 | --na-- | --na-- | --na-- | 0.0000 | 103.0000 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 1 - infiltration] through Cell 1 to ground** | | | | | | | | | | | |
| Cell 1 to ground | 0.00 | 0.0675 | ---- | 0.00 | 0.0269 | ---- | Ditch | 2.3252 | ----- | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 58.5625 |
| Cell 1-Dummy | Cell 1 to Infiltration | 59.0625 | --na-- | --na-- | --na-- | 59.0625 | 65.5000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 1 to ground | 0.0625 | na | 0.0675 | 0.0625 | 0.0625 | 0.0269 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Routing split hyd [Cell 2 - infiltration] through Cell 2 to ground | | | | | | | | | | | |
| Cell 2 to ground | 0.00 | 0.5973 | ---- | 0.00 | 0.0942 | ---- | Ditch | 4.9412 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.6836 |
| Cell 2 - Dummy | Cell 2 to infiltration | 60.1836 | --na-- | --na-- | --na-- | 60.1836 | 63.5000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 2 to ground | 0.1836 | na | 0.5973 | 0.1836 | 0.1836 | 0.0942 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Routing split hyd [Cell 3 - infiltration] through Cell 3 to ground | | | | | | | | | | | |
| Cell 3 to ground | 0.00 | 0.6891 | ---- | 0.00 | 0.1675 | ---- | Ditch | 2.7386 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.6992 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cell 3 - Dummy | Cell 3 to infiltration | 60.1992 | --na-- | --na-- | --na-- | 60.1992 | 62.0000 |

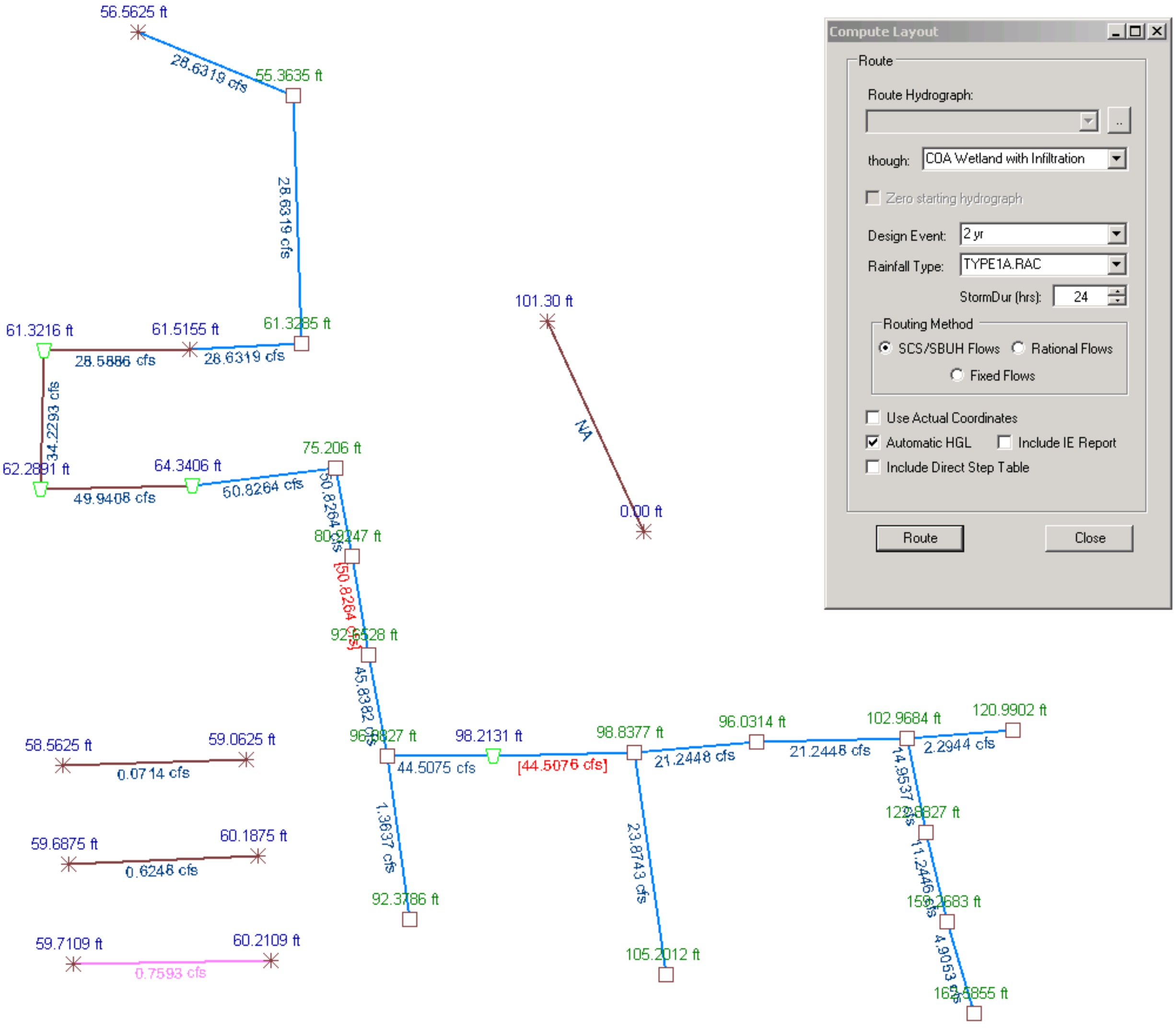
**Conduit Notes**

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 3 to ground | 0.1992 | na | 0.6891 | 0.1992 | 0.1992 | 0.1675 | Supercritical flow, dc at up node |

Flow does not exceed capacity in any pipes.

The depth of the peak water storage in Cell 1 is 1.02 feet above the weir notch (64.02). The depth of the peak water storage in Cell 2 is 1.0 feet above the lower weir notch and 0.5 feet above the upper weir notch (62.00). This peak storage elevation equates to 2.0 feet of water storage in the channel areas and 2.5 feet of water storage in the pool areas. The depth of the water storage in Cell 3 is 0.17 feet (2 inches). The peak flow to the river is reduced from 33.93 cfs (coming into the wetland) to 14.68 cfs (out the Butler outfall).

# Developed 2 Year Event – 1.80 inches of Rain



Route Hydrograph:

though: COA Wetland with Infiltration

☐ Zero starting hydrograph

Design Event: 2 yr

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

**Figure E-4 – Peak Flow Rate Results from 2 Year Event Model**

**Appended on: Friday, November 20, 2009 11:33:27 AM**

ROUTEHYD [] THRU [COA Wetland with Infiltration] USING [2 yr] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

**Gravity Analysis using 24 hr duration storm**

<table>
<tr><th>Reach ID</th><th>Area (ac)</th><th>Flow (cfs)</th><th>Full Q (cfs)</th><th>Full ratio</th><th>nDepth (ft)</th><th>Depth ratio</th><th>Size</th><th>nVel (ft/s)</th><th>fVel (ft/s)</th><th>Infil Vol (cf)</th><th>CBasin / Hyd</th></tr>
<tr><td>BE13-BE06</td><td>24.20</td><td>4.9053</td><td>15.7042</td><td>0.3124</td><td>0.67</td><td>0.3829</td><td>21 in Diam</td><td>5.79</td><td>6.529</td><td>0.00</td><td>BE-13</td></tr>
<tr><td>BE06-BE04</td><td>57.50</td><td>11.2446</td><td>11.4736</td><td>0.98</td><td>1.4046</td><td>0.8026</td><td>21 in Diam</td><td>5.4343</td><td>4.7701</td><td>0.00</td><td>BE-06</td></tr>
<tr><td>BE04-DM19</td><td>76.80</td><td>14.9537</td><td>23.0196</td><td>0.6496</td><td>1.0272</td><td>0.587</td><td>21 in Diam</td><td>10.1886</td><td>9.5704</td><td>0.00</td><td>BE-04</td></tr>
<tr><td>DM21-DM19</td><td>8.90</td><td>2.2944</td><td>10.7468</td><td>0.2135</td><td>0.3923</td><td>0.3139</td><td>15 in Diam</td><td>6.9609</td><td>8.7572</td><td>0.00</td><td>DM-21b</td></tr>
<tr><td>DM19-DM14</td><td>101.80</td><td>21.2448</td><td>31.3855</td><td>0.6769</td><td>1.2066</td><td>0.6033</td><td>24 in Diam</td><td>10.7242</td><td>9.9903</td><td>0.00</td><td>DM-21a</td></tr>
<tr><td>DM14-OL01</td><td>101.80</td><td>21.2448</td><td>35.2153</td><td>0.6033</td><td>1.6813</td><td>0.5604</td><td>36 in Diam</td><td>5.2111</td><td>4.9819</td><td>0.00</td><td></td></tr>
<tr><td>BD13-OL01</td><td>122.30</td><td>23.8743</td><td>24.3008</td><td>0.9824</td><td>2.4139</td><td>0.8046</td><td>36 in Diam</td><td>3.9168</td><td>3.4379</td><td>0.00</td><td>BD-13</td></tr>
<tr><td>OL01-DM11</td><td>224.10</td><td>44.5076</td><td>37.2525</td><td>1.1948</td><td>-----</td><td>na</td><td>36 in Diam</td><td>6.2965</td><td>5.2701</td><td>0.00</td><td></td></tr>
<tr><td colspan="11"><b>LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event</b>
<table>
<tr><th>Event</th><th>Match Q (cfs)</th><th>Peak Q (cfs)</th><th>Max Depth (ft)</th><th>Vol (cf)</th><th>Vol (acft)</th><th>Time to Empty</th></tr>
<tr><td>2 yr</td><td>44.5076</td><td>44.5075</td><td>2.0566</td><td>25.8517</td><td>0.0006</td><td>0.0107</td></tr>
</table></td><td></td></tr>
<tr><td colspan="11"><b>Routing split hyd [DM-11 outlet] through DM11-DM10</b></td><td></td></tr>
<tr><td>DM11-DM10</td><td>0.00</td><td>44.5075</td><td>45.7863</td><td>0.9721</td><td>2.3877</td><td>0.7959</td><td>36 in Diam</td><td>7.378</td><td>6.4774</td><td>0.00</td><td></td></tr>
<tr><td>BW18-DM10</td><td>5.70</td><td>1.3637</td><td>12.2362</td><td>0.1115</td><td>0.3383</td><td>0.2255</td><td>18 in Diam</td><td>4.567</td><td>6.9243</td><td>0.00</td><td>BW-18</td></tr>
<tr><td>DM10-</td><td>5.70</td><td>45.8382</td><td>60.5086</td><td>0.7575</td><td>1.9519</td><td>0.6506</td><td>36 in</td><td>9.4137</td><td>8.5602</td><td>0.00</td><td></td></tr>
</table>

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM08 | | | | | | | Diam | | | | |
| DM8-DM6 | 25.60 | 50.8264 | 45.8221 | 1.1092 | ----- | na | 36 in Diam | 7.1905 | 6.4825 | 0.00 | DM-08 |
| DM6-DM5A | 25.60 | 50.8264 | 134.57 | 0.3777 | 1.2785 | 0.4262 | 36 in Diam | 17.696 | 19.038 | 0.00 | |
| DM5A-Cell1 | 25.60 | 50.8264 | 108.10 | 0.4702 | 1.9301 | 0.4825 | 48 in Diam | 8.4656 | 8.6025 | 0.00 | |

**LPOOLCOMPUTE [Cell 1] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 2 yr | 50.9666 | 50.0122 | 5.3405 | 38164.0644 | 0.8761 | 187.8495 |

**Routing split hyd [Cell 1- weir] through Cell 1 to Cell 2**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 1 to Cell 2 | 0.00 | 49.9408 | ---- | 0.00 | 0.1724 | ---- | Ditch | 44.4417 | ----- | 0.00 | Cell 1 |

**LPOOLCOMPUTE [Cell 2] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 2 yr | 50.8731 | 34.8541 | 2.2891 | 145665.0711 | 3.344 | 0.0059 |

**Routing split hyd [Cell 2 - weir; Cell 2 -weir - lower] through Cell 2 to Cell 3**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 2 to Cell 3 | 0.00 | 34.2293 | ---- | 0.00 | 0.1553 | ---- | Ditch | 34.0796 | ----- | 0.00 | Cell 2 |

**LPOOLCOMPUTE [Cell 3] SUMMARY using Puls, 24 hr Storm Event**

| Event | Match Q (cfs) | Peak Q (cfs) | Max Depth (ft) | Vol (cf) | Vol (acft) | Time to Empty |
|---|---|---|---|---|---|---|
| 2 yr | 34.756 | 29.3168 | 1.3216 | 73086.7271 | 1.6778 | 0.0059 |

**Routing split hyd [Cell 3 - weir] through Cell 4**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 4 | 0.00 | 28.5886 | ---- | 0.00 | 0.8548 | ---- | Ditch | 3.4445 | ----- | -63011.23 | Cell 3 |
| Cell 4 - CB 50 | 0.41 | 28.6319 | 109.29 | 0.262 | 1.2223 | 0.3492 | 42 in Diam | 9.5697 | 11.3591 | 0.00 | Cell 4 |
| CB 50 - CB 6A | 0.41 | 28.6319 | 113.57 | 0.2521 | 1.1978 | 0.3422 | 42 in Diam | 9.8382 | 11.8047 | 0.00 | |
| DM2-DM1 | 0.41 | 28.6319 | 86.5813 | 0.3307 | 1.1807 | 0.3936 | 36 in Diam | 11.0815 | 12.2487 | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 56.5625 |
| No approach losses at node CB 50 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 PD | DM-01 PD | 54.2402 | ------ | 1.1233 | ------ | 55.3635 | 67.8500 |
| CB 50 | DM-02 PD | 59.4799 | ------ | 1.8486 | ------ | 61.3285 | 66.0000 |
| Cell 4 - End | CB 50 | 61.5155 | --na-- | --na-- | --na-- | 61.5155 | 63.0000 |
| Cell 3 | Cell 4 - End | 60.0648 | --na-- | --na-- | --na-- | 61.3216 | 63.5000 |
| Cell 2 | Cell 3 | 60.8627 | --na-- | --na-- | --na-- | 62.2891 | 63.5000 |
| Cell 1 | Cell 2 | 64.0715 | --na-- | --na-- | --na-- | 64.3406 | 65.5000 |
| DM-05a | Cell 1 | 69.2093 | ------ | 5.9966 | ------ | 75.2060 | 77.0000 |
| DM-06 | DM-05a | 80.9193 | ------ | 0.0054 | ------ | 80.9247 | 96.2200 |
| DM-08 | DM-06 | 93.3015 | 0.6530 | 0.0043 | ------ | 92.6528 | 98.8200 |
| DM-10 | DM-08 | 95.4182 | ------ | 0.6487 | 0.0157 | 96.0827 | 103.2100 |
| DM-11 | DM-10 | 98.2131 | --na-- | --na-- | --na-- | 98.2131 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 98.6800 | 0.2382 | 0.2741 | 0.1218 | 98.8377 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 97.7899 | 1.7858 | 0.0273 | ------ | 96.0314 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 101.0533 | ------ | 1.7214 | 0.1937 | 102.9684 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 122.8783 | ------ | 0.0044 | ------ | 122.8827 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 159.7818 | 0.5206 | 0.0070 | ------ | 159.2683 | 170.7200 |
| BE-13 | BE-06 | 162.5855 | ------ | ------ | ------ | 162.5855 | 193.8900 |
| DM-21 | DM-19 | 120.9902 | ------ | ------ | ------ | 120.9902 | 139.6700 |
| BD-13 | OL-01 | 105.2012 | ------ | ------ | ------ | 105.2012 | 114.5000 |
| BW-18 | DM-10 | 92.3786 | ------ | ------ | ------ | 92.3786 | 110.7700 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 2.5542 | 0.8514 | 28.63 | 1.7325 | 1.7325 | 1.1807 | SuperCrit flow, Inlet end controls |
| CB 50 - CB 6A | 2.3399 | 0.6685 | 28.63 | 1.6512 | 1.6512 | 1.1978 | SuperCrit flow, Inlet end controls |
| Cell 4 - CB 50 | 4.3755 | 1.2501 | 28.63 | 4.1885 | 1.6512 | 1.2223 | Outlet Control |
| Cell 4 | 0.8548 | na | 28.5886 | 4.0534 | 0.6918 | 0.8548 | M1 curve, step from twdepth down to dnDirect Step Backwater Calc |
| Cell 2 to Cell 3 | 0.8627 | na | 34.2293 | 0.8627 | 0.8627 | 0.1553 | Supercritical flow, dc at up node |
| Cell 1 to Cell 2 | 1.0715 | na | 49.9408 | 1.0715 | 1.0715 | 0.1724 | Supercritical flow, dc at up node |
| DM5A-Cell1 | 3.1093 | 0.7773 | 50.83 | 2.1404 | 2.1404 | 1.9301 | SuperCrit flow, Inlet end controls |
| DM6-DM5A | 4.3193 | 1.4398 | 50.83 | 8.9560 | 2.3199 | 1.2785 | SuperCrit flow, Inlet end controls |
| DM8-DM6 | 16.7047 | 5.5682 | 50.83 | 4.3279 | 2.3199 | >D | Outlet Control |
| DM10-DM08 | 3.6282 | 1.2094 | 45.84 | 6.9748 | 2.2066 | 1.9519 | SuperCrit flow, Inlet end controls |
| DM11-DM10 | 6.4303 | 2.1434 | 44.51 | 4.2909 | 2.1749 | 2.3877 | Outlet Control |
| OL01-DM11 | 6.4346 | 2.1449 | 44.51 | 4.2831 | 2.1749 | >D | Outlet Control |
| DM14-OL01 | 4.6279 | 1.5426 | 21.24 | 4.1377 | 1.4815 | 1.6813 | Outlet Control |
| DM19-DM14 | 3.1538 | 1.5769 | 21.24 | 1.6503 | 1.6503 | 1.2066 | SuperCrit flow, Inlet end controls |
| BE04-DM19 | 2.7113 | 1.5493 | 14.95 | 1.4331 | 1.4331 | 1.0272 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 1.9548 | 1.1171 | 11.24 | 1.4046 | 1.2504 | 1.4046 | Outlet Control M1 Backwater |
| BE13-BE06 | 1.1445 | 0.6540 | 4.91 | 0.8121 | 0.8121 | 0.6700 | SuperCrit flow, Inlet end controls |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DM21-DM19 | 0.8422 | 0.6737 | 2.29 | 0.6054 | 0.6054 | 0.3923 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 2.7712 | 0.9237 | 23.87 | 2.4139 | 1.5750 | 2.4139 | Outlet Control M1 Backwater |
| BW18-DM10 | 0.5906 | 0.3937 | 1.36 | 0.4376 | 0.4376 | 0.3383 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground**DM-11 to ground: No flow to route | | | | | | | | | | | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.30 |
| DM-11 Dummy | DM-11 to infiltration | 0.0000 | --na-- | --na-- | --na-- | 0.0000 | 103.0000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 1 - infiltration] through Cell 1 to ground** | | | | | | | | | | | |
| Cell 1 to ground | 0.00 | 0.0714 | ---- | 0.00 | 0.0273 | ---- | Ditch | 2.4142 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 58.5625 |
| Cell 1-Dummy | Cell 1 to Infiltration | 59.0625 | --na-- | --na-- | --na-- | 59.0625 | 65.5000 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 1 to ground | 0.0625 | na | 0.0714 | 0.0625 | 0.0625 | 0.0273 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 2 - infiltration] through Cell 2 to ground** | | | | | | | | | | | |
| Cell 2 to ground | 0.00 | 0.6248 | ---- | 0.00 | 0.0962 | ---- | Ditch | 5.0405 | ----- | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.6875 |
| Cell 2 - Dummy | Cell 2 to infiltration | 60.1875 | --na-- | --na-- | --na-- | 60.1875 | 63.5000 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 2 to ground | 0.1875 | na | 0.6248 | 0.1875 | 0.1875 | 0.0962 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 3 - infiltration] through Cell 3 to ground** | | | | | | | | | | | |
| Cell 3 to ground | 0.00 | 0.7593 | ---- | 0.00 | 0.1763 | ---- | Ditch | 2.8176 | ----- | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.7109 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cell 3 - Dummy | Cell 3 to infiltration | 60.2109 | --na-- | --na-- | --na-- | 60.2109 | 62.0000 |

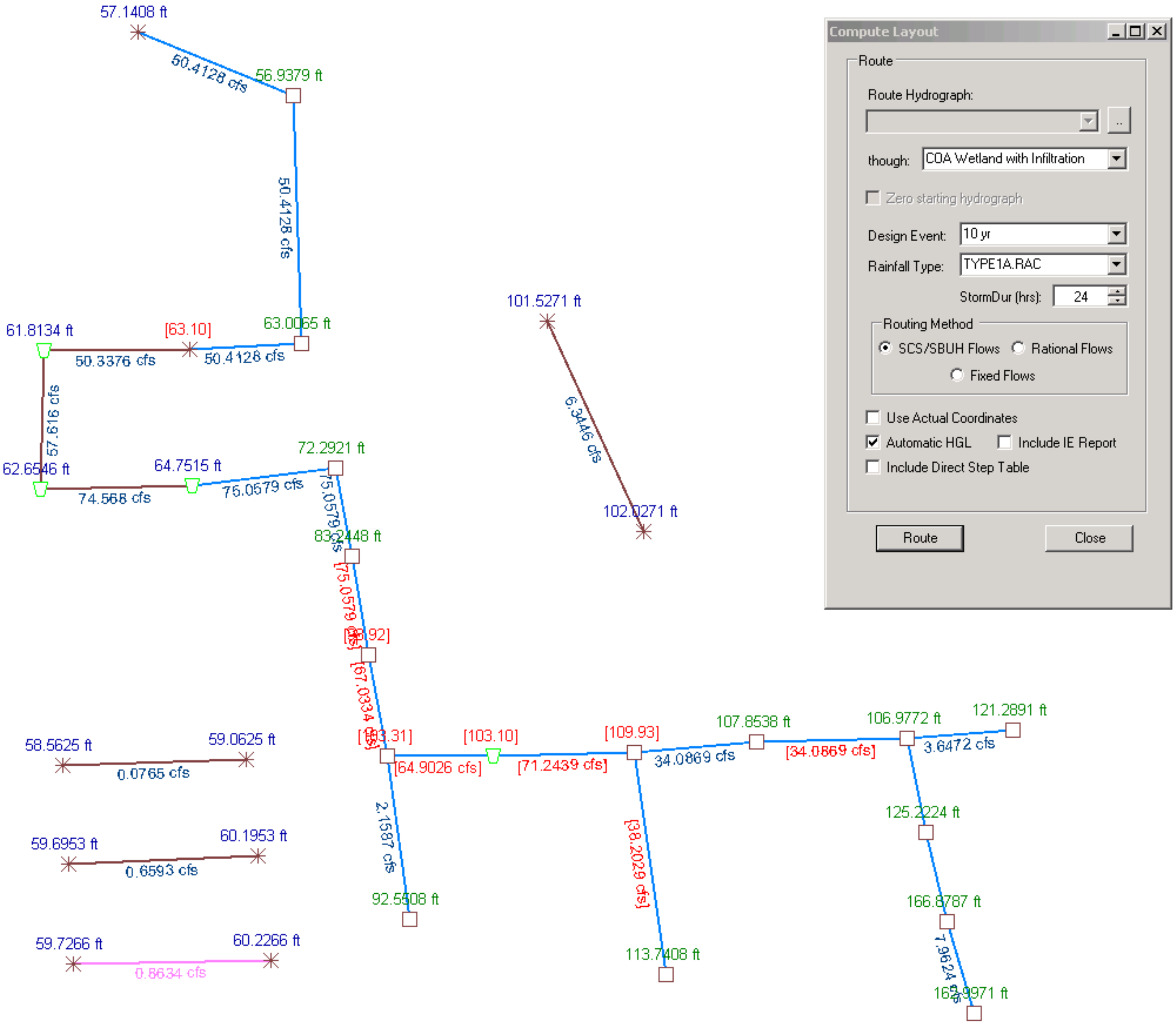
### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 3 to ground | 0.2109 | na | 0.7593 | 0.2109 | 0.2109 | 0.1763 | Supercritical flow, dc at up node |

Flow does exceed capacity in some of the upstream basin pipes.  These are known deficiencies that the City of Arlington has previously identified for future repair/upgrade.  All the proposed project piping is sufficient.  A small backwater effect is present from the inlet to the piping draining to the wetland to the weir from Cell 3.  The backwater rises to a peak of 0.25’ above the weir notch 60. As a result, water levels in Cell 3 may rise to a level slightly higher than modeled but no higher than the peak backwater elevation (60.52’).  For a brief time during the peak flows, the two cells (3 and 4) may act like one pond (they would maintain the same elevation), until such time as the backwater effect decreased and regular flow through weir 3 resumes.

The depth of the peak water storage in Cell 1 is 1.34 feet above the weir notch (64.34).  The depth of the peak water storage in Cell 2 is 1.29 feet above the lower weir notch and 0.79 feet above the upper weir notch (62.29).  This peak storage elevation equates to 2.29 feet of water storage in the channel areas and 2.79 feet of water storage in the pool areas.  The peak depth of the water storage in Cell 3 is 1.32 to 1.52’ feet.  The peak flow to the river is reduced from 50.83 cfs (coming into the wetland) to 28.63 cfs (out the Butler outfall).

# Developed 10 Year Event – 2.75 inches of Rain



though: COA Wetland with Infiltration

☐ Zero starting hydrograph

Design Event: 10 yr

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

Figure E-5 – Peak Flow Rate Results from 10 Year Event Model

**Appended on: Friday, November 20, 2009 11:56:31 AM**

ROUTEHYD [] THRU [COA Wetland with Infiltration] USING [10 yr] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

### Gravity Analysis using 24 hr duration storm

<table>
<tr><th>Reach ID</th><th>Area (ac)</th><th>Flow (cfs)</th><th>Full Q (cfs)</th><th>Full ratio</th><th>nDepth (ft)</th><th>Depth ratio</th><th>Size</th><th>nVel (ft/s)</th><th>fVel (ft/s)</th><th>Infil Vol (cf)</th><th>CBasin / Hyd</th></tr>
<tr><td>BE13-BE06</td><td>24.20</td><td>7.9624</td><td>15.7042</td><td>0.507</td><td>0.8825</td><td>0.5043</td><td>21 in Diam</td><td>6.5492</td><td>6.529</td><td>0.00</td><td>BE-13</td></tr>
<tr><td>BE06-BE04</td><td>57.50</td><td>18.1067</td><td>11.4736</td><td>1.5781</td><td>-----</td><td>na</td><td>21 in Diam</td><td>7.5279</td><td>4.7701</td><td>0.00</td><td>BE-06</td></tr>
<tr><td>BE04-DM19</td><td>76.80</td><td>24.0861</td><td>23.0196</td><td>1.0463</td><td>1.5205</td><td>0.8689</td><td>21 in Diam</td><td>10.8536</td><td>9.5704</td><td>0.00</td><td>BE-04</td></tr>
<tr><td>DM21-DM19</td><td>8.90</td><td>3.6472</td><td>10.7468</td><td>0.3394</td><td>0.5019</td><td>0.4016</td><td>15 in Diam</td><td>7.9154</td><td>8.7572</td><td>0.00</td><td>DM-21b</td></tr>
<tr><td>DM19-DM14</td><td>101.80</td><td>34.0869</td><td>31.3855</td><td>1.0861</td><td>-----</td><td>na</td><td>24 in Diam</td><td>10.8502</td><td>9.9903</td><td>0.00</td><td>DM-21a</td></tr>
<tr><td>DM14-OL01</td><td>101.80</td><td>34.0869</td><td>35.2153</td><td>0.968</td><td>2.3773</td><td>0.7924</td><td>36 in Diam</td><td>5.6743</td><td>4.9819</td><td>0.00</td><td></td></tr>
<tr><td>BD13-OL01</td><td>122.30</td><td>38.2029</td><td>24.3008</td><td>1.5721</td><td>-----</td><td>na</td><td>36 in Diam</td><td>5.4046</td><td>3.4379</td><td>0.00</td><td>BD-13</td></tr>
<tr><td>OL01-DM11</td><td>224.10</td><td>71.2439</td><td>37.2525</td><td>1.9125</td><td>-----</td><td>na</td><td>36 in Diam</td><td>10.0789</td><td>5.2701</td><td>0.00</td><td></td></tr>
<tr><td colspan="11"><b>LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event</b><table><tr><th>Event</th><th>Match Q (cfs)</th><th>Peak Q (cfs)</th><th>Max Depth (ft)</th><th>Vol (cf)</th><th>Vol (acft)</th><th>Time to Empty</th></tr><tr><td>10 yr</td><td>71.2439</td><td>71.2473</td><td>3.5178</td><td>44.2192</td><td>0.001</td><td>0.0107</td></tr></table></td><td></td></tr>
<tr><td colspan="11"><b>Routing split hyd [DM-11 outlet] through DM11-DM10</b></td><td></td></tr>
<tr><td>DM11-DM10</td><td>0.00</td><td>64.9026</td><td>45.7863</td><td>1.4175</td><td>-----</td><td>na</td><td>36 in Diam</td><td>9.1818</td><td>6.4774</td><td>0.00</td><td></td></tr>
<tr><td>BW18-DM10</td><td>5.70</td><td>2.1587</td><td>12.2362</td><td>0.1764</td><td>0.4259</td><td>0.284</td><td>18 in Diam</td><td>5.226</td><td>6.9243</td><td>0.00</td><td>BW-18</td></tr>
<tr><td>DM10-</td><td>5.70</td><td>67.0334</td><td>60.5086</td><td>1.1078</td><td>-----</td><td>na</td><td>36 in</td><td>9.4833</td><td>8.5602</td><td>0.00</td><td></td></tr>
</table>

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM08 | | | | | | | Diam | | | | |
| DM8-DM6 | 25.60 | 75.0579 | 45.8221 | 1.638 | ----- | na | 36 in Diam | 10.6185 | 6.4825 | 0.00 | DM-08 |
| DM6-DM5A | 25.60 | 75.0579 | 134.57 | 0.5578 | 1.6023 | 0.5341 | 36 in Diam | 19.541 | 19.038 | 0.00 | |
| DM5A-Cell1 | 25.60 | 75.0579 | 108.10 | 0.6943 | 2.4537 | 0.6134 | 48 in Diam | 9.2869 | 8.6025 | 0.00 | |

**LPOOLCOMPUTE [Cell 1] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| 10 yr | 75.3004 | 74.6445 | 5.7515 | 43614.4512 | 1.0013 | 188.0268 |

**Routing split hyd [Cell 1- weir] through Cell 1 to Cell 2**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 1 to Cell 2 | 0.00 | 74.568 | ---- | 0.00 | 0.2182 | ---- | Ditch | 51.354 | ----- | 0.00 | Cell 1 |

**LPOOLCOMPUTE [Cell 2] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| 10 yr | 76.2708 | 58.2753 | 2.6546 | 186228.8399 | 4.2752 | 0.0059 |

**Routing split hyd [Cell 2 - weir; Cell 2 -weir - lower] through Cell 2 to Cell 3**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 2 to Cell 3 | 0.00 | 57.616 | ---- | 0.00 | 0.2109 | ---- | Ditch | 41.1935 | ----- | 0.00 | Cell 2 |

**LPOOLCOMPUTE [Cell 3] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| 10 yr | 58.5072 | 51.1662 | 1.8134 | 107447.4306 | 2.4667 | 0.0059 |

**Routing split hyd [Cell 3 - weir] through Cell 4**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 4 | 0.00 | 50.3376 | ---- | 0.00 | 1.1789 | ---- | Ditch | 4.1224 | ----- | -72668.93 | Cell 3 |
| Cell 4 - CB 50 | 0.41 | 50.4128 | 109.29 | 0.4613 | 1.6702 | 0.4772 | 42 in Diam | 11.1251 | 11.3591 | 0.00 | Cell 4 |
| CB 50 - CB 6A | 0.41 | 50.4128 | 113.57 | 0.4439 | 1.6334 | 0.4667 | 42 in Diam | 11.4499 | 11.8047 | 0.00 | |
| DM2-DM1 | 0.41 | 50.4128 | 86.5813 | 0.5823 | 1.6442 | 0.5481 | 36 in Diam | 12.7102 | 12.2487 | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 57.1408 |
| No approach losses at node CB 50 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 PD | DM-01 PD | 55.4164 | ------ | 1.5215 | ------ | 56.9379 | 67.8500 |
| CB 50 | DM-02 PD | 60.5081 | ------ | 2.4984 | ------ | 63.0064 | 66.0000 |
| Cell 4 - End | CB 50 | 63.5861 | --na-- | --na-- | --na-- | 63.1000 | 63.0000 |
| Cell 3 | Cell 4 - End | 60.3889 | --na-- | --na-- | --na-- | 61.8134 | 63.5000 |
| Cell 2 | Cell 3 | 61.1618 | --na-- | --na-- | --na-- | 62.6546 | 63.5000 |
| Cell 1 | Cell 2 | 64.3406 | --na-- | --na-- | --na-- | 64.7515 | 65.5000 |
| DM-05a | Cell 1 | 70.1330 | ------ | 2.1592 | ------ | 72.2921 | 77.0000 |
| DM-06 | DM-05a | 83.2331 | ------ | 0.0117 | ------ | 83.2448 | 96.2200 |
| DM-08 | DM-06 | 110.2360 | 1.3965 | 0.0092 | ------ | 98.9200 | 98.8200 |
| DM-10 | DM-08 | 108.5184 | 1.3091 | 1.3795 | 0.0363 | 103.3100 | 103.2100 |
| DM-11 | DM-10 | 107.8504 | --na-- | --na-- | --na-- | 107.8504 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 111.6787 | 0.4536 | 0.5219 | 0.2323 | 109.9300 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 109.6540 | 1.8281 | 0.0279 | ------ | 107.8538 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 106.6358 | 1.8292 | 1.9535 | 0.2172 | 106.9772 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 125.2139 | ------ | 0.0085 | ------ | 125.2224 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 167.5358 | 0.6660 | 0.0089 | ------ | 166.8787 | 170.7200 |
| BE-13 | BE-06 | 162.9971 | ------ | ------ | ------ | 162.9971 | 193.8900 |
| DM-21 | DM-19 | 121.2891 | ------ | ------ | ------ | 121.2891 | 139.6700 |
| BD-13 | OL-01 | 113.7408 | ------ | ------ | ------ | 113.7408 | 114.5000 |
| BW-18 | DM-10 | 92.5508 | ------ | ------ | ------ | 92.5508 | 110.7700 |

**Conduit Notes**

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 3.7304 | 1.2435 | 50.41 | 2.3108 | 2.3108 | 1.6442 | SuperCrit flow, Inlet end controls |
| CB 50 - CB 6A | 3.3681 | 0.9623 | 50.41 | 2.2192 | 2.2192 | 1.6334 | SuperCrit flow, Inlet end controls |
| Cell 4 - CB 50 | 6.4461 | 1.8417 | 50.41 | 5.8664 | 2.2192 | 1.6702 | Outlet Control |
| Cell 4 | 1.1789 | na | 50.3376 | 5.6379 | 0.9824 | 1.1789 | M1 curve, step from twdepth down to dnDirect Step Backwater Calc |
| Cell 2 to Cell 3 | 1.1618 | na | 57.616 | 1.1618 | 1.1618 | 0.2109 | Supercritical flow, dc at up node |
| Cell 1 to Cell 2 | 1.3406 | na | 74.568 | 1.3406 | 1.3406 | 0.2182 | Supercritical flow, dc at up node |
| DM5A-Cell1 | 4.0330 | 1.0082 | 75.06 | 2.6221 | 2.6221 | 2.4537 | SuperCrit flow, Inlet end controls |
| DM6-DM5A | 6.6331 | 2.2110 | 75.06 | 6.0421 | 2.7200 | 1.6023 | SuperCrit flow, Inlet end controls |
| DM8-DM6 | 33.6392 | 11.2131 | 75.06 | 6.6480 | 2.7200 | >D | Outlet Control |
| DM10-DM08 | 22.8602 | 7.6201 | 67.03 | 13.2420 | 2.6166 | >D | Outlet Control |
| DM11-DM10 | 16.0677 | 5.3559 | 64.90 | 11.5182 | 2.5841 | >D | Outlet Control |
| OL01-DM11 | 19.4332 | 6.4777 | 71.24 | 13.9204 | 2.6742 | >D | Outlet Control |
| DM14-OL01 | 16.4920 | 5.4973 | 34.09 | 15.2300 | 1.8961 | 2.3773 | Outlet Control |
| DM19-DM14 | 31.0199 | 15.5099 | 34.09 | 2.0000 | 1.9117 | >D | Outlet Control |
| BE04-DM19 | 5.0469 | 2.8840 | 24.09 | 1.7500 | 1.6689 | 1.5205 | SuperCrit flow, Inlet end controls |
| BE06-BE04 | 14.3422 | 8.1955 | 18.11 | 1.7500 | 1.5482 | >D | Outlet Control |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BE13-BE06 | 1.5561 | 0.8892 | 7.96 | 1.0468 | 1.0468 | 0.8825 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 1.1411 | 0.9129 | 3.65 | 0.7724 | 0.7724 | 0.5019 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 16.4988 | 5.4996 | 38.20 | 3.0000 | 2.0123 | >D | Outlet Control |
| BW18-DM10 | 0.7628 | 0.5085 | 2.16 | 0.5549 | 0.5549 | 0.4259 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground** | | | | | | | | | | | |
| DM-11 to ground | 0.00 | 6.3446 | ---- | 0.00 | 0.103 | ---- | Ditch | 5.9736 | ----- | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.5271 |
| DM-11 Dummy | DM-11 to infiltration | 102.0271 | --na-- | --na-- | --na-- | 102.0271 | 103.0000 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM-11 to ground | 0.2271 | na | 6.3446 | 0.2271 | 0.2271 | 0.103 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 1 - infiltration] through Cell 1 to ground** | | | | | | | | | | | |
| Cell 1 to ground | 0.00 | 0.0765 | ---- | 0.00 | 0.0288 | ---- | Ditch | 2.4443 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 58.5625 |
| Cell 1- Dummy | Cell 1 to Infiltration | 59.0625 | --na-- | --na-- | --na-- | 59.0625 | 65.5000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 1 to ground | 0.0625 | na | 0.0765 | 0.0625 | 0.0625 | 0.0288 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 2 - infiltration] through Cell 2 to ground** | | | | | | | | | | | |
| Cell 2 to ground | 0.00 | 0.6593 | ---- | 0.00 | 0.0991 | ---- | Ditch | 5.1269 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.6953 |
| Cell 2 - Dummy | Cell 2 to infiltration | 60.1953 | --na-- | --na-- | --na-- | 60.1953 | 63.5000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 2 to ground | 0.1953 | na | 0.6593 | 0.1953 | 0.1953 | 0.0991 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 3 - infiltration] through Cell 3 to ground** | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 3 to ground | 0.00 | 0.8634 | ---- | 0.00 | 0.189 | ---- | Ditch | 2.9162 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.7266 |
| Cell 3 - Dummy | Cell 3 to infiltration | 60.2266 | --na-- | --na-- | --na-- | 60.2266 | 62.0000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 3 to ground | 0.2266 | na | 0.8634 | 0.2266 | 0.2266 | 0.189 | Supercritical flow, dc at up node |

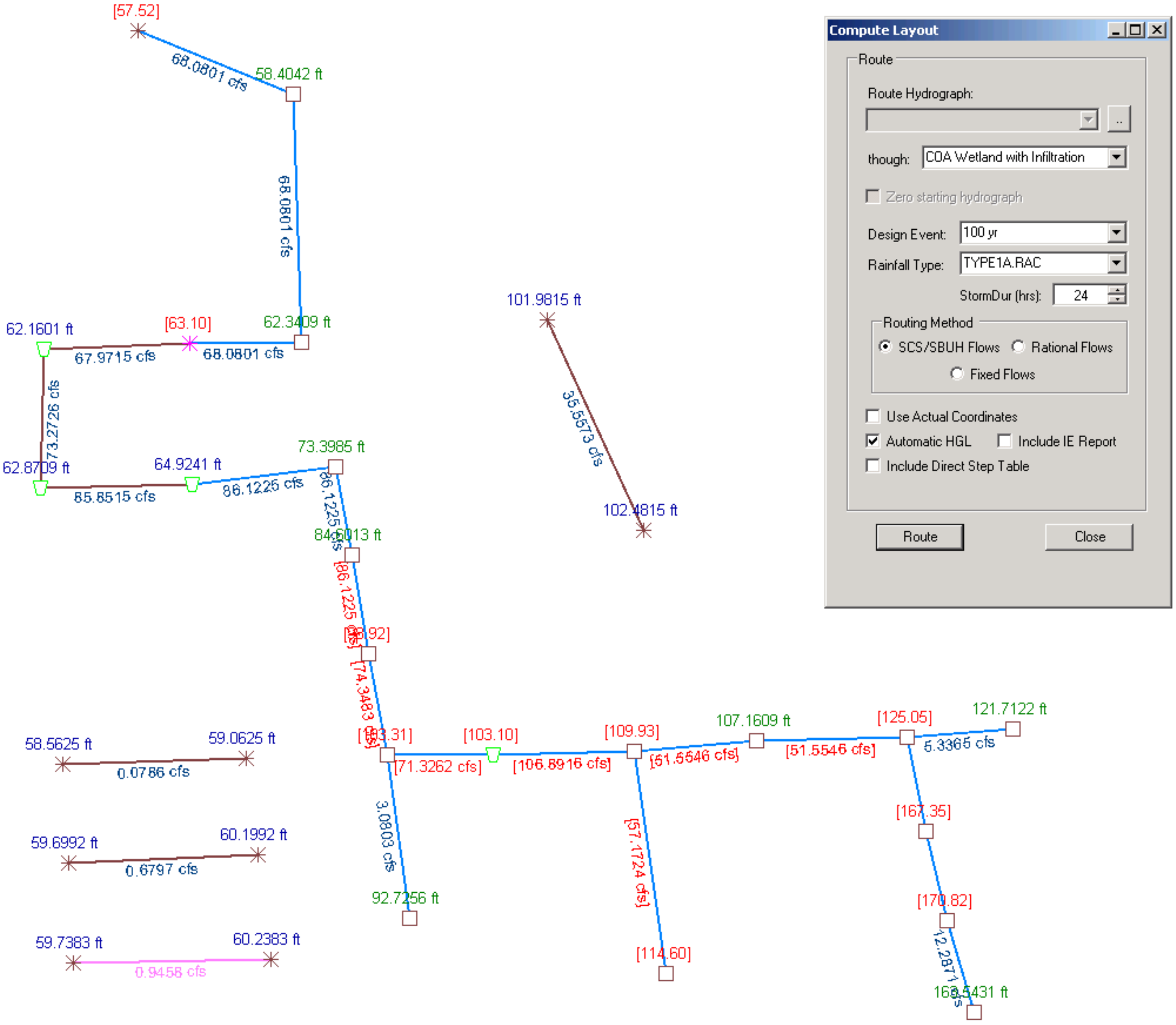
Flow does exceed capacity in some of the upstream basin pipes. These are known deficiencies that the City of Arlington has previously identified for future repair/upgrade. All the proposed project piping passes the peak storm flows. A backwater effect is present from the piping draining the wetland to the river. The software limitations prevent modeling the backwater situation accurately beyond the outfall piping. See section 3.1.6 for a full discussion of how backwater from the river outfall occurs.

The actual depths of water stored in the Cells will depend largely on how fast the river rises and falls in relation to the storm event. However, for large storm events, it is more likely than not the backwater will occur from the wetland discharge piping to the river, and that discharge to the WSDOT wetland through the overflow spillway will occur. This is similar to what occurs in the existing condition, when stormwater flows exceed the piping capacity of the Butler outfall or the river is up, and the stormwater flow coming from the downtown basin is largely discharged onto the surface of the subject property from the WSDOT bioswale and CB 6. The stormwater then flows over the surface of the property south to the WSDOT wetland. Allowing the wetland to backwater and flood to the WSDOT wetland when necessary mimics the existing condition to a certain extent. Since the creation of the wetland adds 9 acre feet of additional water storage to the property, it takes more water to create flow to the WSDOT wetland than in the existing condition.

The model gives the following results; however, they do not reflect the backwater from the outfall as discussed above. It is likely that during peak discharge Cells 2, 3, and 4 will all fill to an elevation slightly above 62.5 and that stormwater will be discharged to the WSDOT wetland. The model gives depth of the peak water storage in Cell 1 is 1.75 feet above the weir notch (64.75).

This cell is unaffected by the backwater effects. The depth of the peak water storage in Cell 2 is modeled at 1.65 feet above the lower weir notch and 1.15 feet above the upper weir notch (62.65). This peak storage elevation equates to 2.65 feet of water storage in the channel areas and 3.15 feet of water storage in the pool areas. At an elevation of 62.5, discharge will begin into the WSDOT wetland. The peak depth of the water storage in Cell 3 is 1.81 to 3 feet. The peak flow to the river is modeled as being reduced from 75.05 cfs (coming into the wetland) to 50.41 cfs (out the Butler outfall). Actual peak discharge flows to the river are likely to be lower due to backwater effects. Some of the peak discharge reduction is additional storage in the wetlands and some is discharge to the WSDOT wetland.

# Developed 100 Year Event – 3.75 inches of Rain



**Compute Layout**

Route

Route Hydrograph:

though: COA Wetland with Infiltration

☐ Zero starting hydrograph

Design Event: 100 yr

Rainfall Type: TYPE1A.RAC

StormDur (hrs): 24

Routing Method

● SCS/SBUH Flows ○ Rational Flows

○ Fixed Flows

☐ Use Actual Coordinates

☑ Automatic HGL ☐ Include IE Report

☐ Include Direct Step Table

Figure E-6 – Peak Flow Rate Results from 100 Year Event Model

**Appended on: Friday, November 20, 2009 2:40:22 PM**

ROUTEHYD [] THRU [COA Wetland with Infiltration] USING [100 yr] AND [TYPE1A.RAC] NOTZERO RELATIVE SCS/SBUH

**Gravity Analysis using 24 hr duration storm**

<table>
<tr><th>Reach ID</th><th>Area (ac)</th><th>Flow (cfs)</th><th>Full Q (cfs)</th><th>Full ratio</th><th>nDepth (ft)</th><th>Depth ratio</th><th>Size</th><th>nVel (ft/s)</th><th>fVel (ft/s)</th><th>Infil Vol (cf)</th><th>CBasin / Hyd</th></tr>
<tr><td>BE13-BE06</td><td>24.20</td><td>12.2871</td><td>15.7042</td><td>0.7824</td><td>1.1655</td><td>0.666</td><td>21 in Diam</td><td>7.2216</td><td>6.529</td><td>0.00</td><td>BE-13</td></tr>
<tr><td>BE06-BE04</td><td>57.50</td><td>27.7321</td><td>11.4736</td><td>2.417</td><td>-----</td><td>na</td><td>21 in Diam</td><td>11.5297</td><td>4.7701</td><td>0.00</td><td>BE-06</td></tr>
<tr><td>BE04-DM19</td><td>76.80</td><td>36.9812</td><td>23.0196</td><td>1.6065</td><td>-----</td><td>na</td><td>21 in Diam</td><td>15.375</td><td>9.5704</td><td>0.00</td><td>BE-04</td></tr>
<tr><td>DM21-DM19</td><td>8.90</td><td>5.3365</td><td>10.7468</td><td>0.4966</td><td>0.6226</td><td>0.4981</td><td>15 in Diam</td><td>8.7403</td><td>8.7572</td><td>0.00</td><td>DM-21b</td></tr>
<tr><td>DM19-DM14</td><td>101.80</td><td>51.5545</td><td>31.3855</td><td>1.6426</td><td>-----</td><td>na</td><td>24 in Diam</td><td>16.4103</td><td>9.9903</td><td>0.00</td><td>DM-21a</td></tr>
<tr><td>DM14-OL01</td><td>101.80</td><td>51.5545</td><td>35.2153</td><td>1.464</td><td>-----</td><td>na</td><td>36 in Diam</td><td>7.2935</td><td>4.9819</td><td>0.00</td><td></td></tr>
<tr><td>BD13-OL01</td><td>122.30</td><td>57.1724</td><td>24.3008</td><td>2.3527</td><td>-----</td><td>na</td><td>36 in Diam</td><td>8.0882</td><td>3.4379</td><td>0.00</td><td>BD-13</td></tr>
<tr><td>OL01-DM11</td><td>224.10</td><td>106.89</td><td>37.2525</td><td>2.8694</td><td>-----</td><td>na</td><td>36 in Diam</td><td>15.1221</td><td>5.2701</td><td>0.00</td><td></td></tr>
<tr><td colspan="11"><b>LPOOLCOMPUTE [DM-11] SUMMARY using Puls, 24 hr Storm Event</b><table><tr><th>Event</th><th>Match Q (cfs)</th><th>Peak Q (cfs)</th><th>Max Depth (ft)</th><th>Vol (cf)</th><th>Vol (acft)</th><th>Time to Empty</th></tr><tr><td>100 yr</td><td>106.8917</td><td>106.8834</td><td>4.2487</td><td>53.4056</td><td>0.0012</td><td>0.0107</td></tr></table></td><td></td></tr>
<tr><td colspan="11"><b>Routing split hyd [DM-11 outlet] through DM11-DM10</b></td><td></td></tr>
<tr><td>DM11-DM10</td><td>0.00</td><td>71.3262</td><td>45.7863</td><td>1.5578</td><td>-----</td><td>na</td><td>36 in Diam</td><td>10.0906</td><td>6.4774</td><td>0.00</td><td></td></tr>
<tr><td>BW18-DM10</td><td>5.70</td><td>3.0803</td><td>12.2362</td><td>0.2517</td><td>0.5129</td><td>0.342</td><td>18 in Diam</td><td>5.7684</td><td>6.9243</td><td>0.00</td><td>BW-18</td></tr>
<tr><td>DM10-</td><td>5.70</td><td>74.3483</td><td>60.5086</td><td>1.2287</td><td>-----</td><td>na</td><td>36 in</td><td>10.5181</td><td>8.5602</td><td>0.00</td><td></td></tr>
</table>

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DM08 | | | | | | | Diam | | | | |
| DM8-DM6 | 25.60 | 86.1225 | 45.8221 | 1.8795 | ----- | na | 36 in Diam | 12.1838 | 6.4825 | 0.00 | DM-08 |
| DM6-DM5A | 25.60 | 86.1225 | 134.57 | 0.64 | 1.7443 | 0.5814 | 36 in Diam | 20.1981 | 19.038 | 0.00 | |
| DM5A-Cell1 | 25.60 | 86.1225 | 108.10 | 0.7967 | 2.6985 | 0.6746 | 48 in Diam | 9.5487 | 8.6025 | 0.00 | |

**LPOOLCOMPUTE [Cell 1] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| 100 yr | 86.4777 | 85.9302 | 5.9241 | 45988.5482 | 1.0558 | 188.1391 |

**Routing split hyd [Cell 1- weir] through Cell 1 to Cell 2**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 1 to Cell 2 | 0.00 | 85.8515 | ---- | 0.00 | 0.2365 | ---- | Ditch | 54.1008 | ----- | 0.00 | Cell 1 |

**LPOOLCOMPUTE [Cell 2] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| 100 yr | 88.5068 | 73.9523 | 2.8709 | 211250.301 | 4.8496 | 0.0059 |

**Routing split hyd [Cell 2 - weir; Cell 2 -weir - lower] through Cell 2 to Cell 3**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 2 to Cell 3 | 0.00 | 73.2726 | ---- | 0.00 | 0.2432 | ---- | Ditch | 44.7651 | ----- | 0.00 | Cell 2 |

**LPOOLCOMPUTE [Cell 3] SUMMARY using Puls, 24 hr Storm Event**

| **Event** | **Match Q (cfs)** | **Peak Q (cfs)** | **Max Depth (ft)** | **Vol (cf)** | **Vol (acft)** | **Time to Empty** |
|---|---|---|---|---|---|---|
| 100 yr | 74.5313 | 68.8799 | 2.1601 | 134531.1823 | 3.0884 | 0.0059 |

**Routing split hyd [Cell 3 - weir] through Cell 4**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cell 4 | 0.00 | 67.9715 | ---- | 0.00 | 1.3937 | ---- | Ditch | 4.5209 | ----- | -80169.01 | Cell 3 |
| Cell 4 - CB 50 | 0.41 | 68.08 | 109.29 | 0.6229 | 2.0006 | 0.5716 | 42 in Diam | 11.9761 | 11.3591 | 0.00 | Cell 4 |
| CB 50 - CB 6A | 0.41 | 68.08 | 113.57 | 0.5994 | 1.9536 | 0.5582 | 42 in Diam | 12.3297 | 11.8047 | 0.00 | |
| DM2-DM1 | 0.41 | 68.08 | 86.5813 | 0.7863 | 2.0048 | 0.6683 | 36 in Diam | 13.5628 | 12.2487 | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 57.4624 |
| No approach losses at node CB 50 because inverts and/or crowns are offset. | | | | | | | |
| DM-02 PD | DM-01 PD | 56.6399 | ------ | 1.7643 | ------ | 58.4042 | 67.8500 |
| CB 50 | DM-02 PD | 61.2777 | ------ | 1.0632 | ------ | 62.3409 | 66.0000 |
| Cell 4 - End | CB 50 | 63.3980 | --na-- | --na-- | --na-- | 63.1000 | 63.0000 |
| Cell 3 | Cell 4 - End | 60.6037 | --na-- | --na-- | --na-- | 62.1601 | 63.5000 |
| Cell 2 | Cell 3 | 61.3278 | --na-- | --na-- | --na-- | 62.8709 | 63.5000 |
| Cell 1 | Cell 2 | 64.4481 | --na-- | --na-- | --na-- | 64.9241 | 65.5000 |
| DM-05a | Cell 1 | 70.5559 | ------ | 2.8427 | ------ | 73.3985 | 77.0000 |
| DM-06 | DM-05a | 84.5859 | ------ | 0.0154 | ------ | 84.6013 | 96.2200 |
| DM-08 | DM-06 | 120.1369 | 1.7179 | 0.0113 | ------ | 98.9200 | 98.8200 |
| DM-10 | DM-08 | 110.7321 | 1.5811 | 1.6661 | 0.0566 | 103.3100 | 103.2100 |
| DM-11 | DM-10 | 108.7955 | --na-- | --na-- | --na-- | 108.7955 | 103.0000 |
| No approach losses at node BD-13 because inverts and/or crowns are offset. | | | | | | | |
| OL-01 | DM-11 | 119.5208 | 1.0158 | 1.1689 | 0.5240 | 109.9300 | 109.8300 |
| No approach losses at node DM-19 because inverts and/or crowns are offset. | | | | | | | |
| DM-14 | OL-01 | 111.2788 | 4.1817 | 0.0638 | ------ | 107.1609 | 111.0800 |
| No approach losses at node BE-04 because inverts and/or crowns are offset. | | | | | | | |
| DM-19 | DM-14 | 143.9984 | 3.6707 | 3.9200 | 0.4168 | 125.0500 | 124.9500 |
| No approach losses at node BE-06 because inverts and/or crowns are offset. | | | | | | | |
| BE-04 | DM-19 | 185.4115 | 2.0642 | 0.0198 | ------ | 167.3500 | 167.2500 |
| No approach losses at node BE-13 because inverts and/or crowns are offset. | | | | | | | |
| BE-06 | BE-04 | 188.6221 | 0.8098 | 0.0109 | ------ | 170.8200 | 170.7200 |
| BE-13 | BE-06 | 163.5431 | ------ | ------ | ------ | 163.5431 | 193.8900 |
| DM-21 | DM-19 | 121.7122 | ------ | ------ | ------ | 121.7122 | 139.6700 |
| BD-13 | OL-01 | 130.4745 | ------ | ------ | ------ | 114.6000 | 114.5000 |
| BW-18 | DM-10 | 92.7256 | ------ | ------ | ------ | 92.7256 | 110.7700 |

**Conduit Notes**

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM2-DM1 | 4.9539 | 1.6513 | 68.08 | 2.6324 | 2.6324 | 2.0048 | SuperCrit flow, Inlet end controls |
| CB 50 - CB 6A | 4.1377 | 1.1822 | 68.08 | 3.5754 | 2.5869 | 1.9536 | SuperCrit flow, Inlet end controls |
| Cell 4 - CB 50 | 6.2580 | 1.7880 | 68.08 | 5.2009 | 2.5869 | 2.0006 | Outlet Control |
| Cell 4 | 1.3937 | na | 67.9715 | 5.6379 | 1.1795 | 1.3937 | M1 curve, step from twdepth down to dnDirect Step Backwater Calc |
| Cell 2 to Cell 3 | 1.3278 | na | 73.2726 | 1.3278 | 1.3278 | 0.2432 | Supercritical flow, dc at up node |
| Cell 1 to Cell 2 | 1.4481 | na | 85.8515 | 1.4481 | 1.4481 | 0.2365 | Supercritical flow, dc at up node |
| DM5A-Cell1 | 4.4559 | 1.1140 | 86.12 | 2.8143 | 2.8143 | 2.6985 | SuperCrit flow, Inlet end controls |
| DM6-DM5A | 7.9859 | 2.6620 | 86.12 | 7.1485 | 2.8206 | 1.7443 | SuperCrit flow, Inlet end controls |
| DM8-DM6 | 43.5401 | 14.5134 | 86.12 | 8.0045 | 2.8206 | >D | Outlet Control |
| DM10-DM08 | 25.0739 | 8.3580 | 74.35 | 13.2420 | 2.7120 | >D | Outlet Control |
| DM11-DM10 | 17.0128 | 5.6709 | 71.33 | 11.5182 | 2.6753 | >D | Outlet Control |
| OL01-DM11 | 27.2754 | 9.0918 | 106.89 | 14.8655 | 2.9177 | >D | Outlet Control |
| DM14-OL01 | 18.1168 | 6.0389 | 51.55 | 15.2300 | 2.3358 | >D | Outlet Control |
| DM19-DM14 | 68.3825 | 34.1913 | 51.55 | 2.0000 | >D | >D | Outlet Control |
| BE04-DM19 | 101.9417 | 58.2524 | 36.98 | 1.7500 | >D | >D | Outlet Control |
| BE06-BE04 | 35.4284 | 20.2448 | 27.73 | 5.8900 | 1.7017 | >D | Outlet Control |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BE13-BE06 | 2.1021 | 1.2012 | 12.29 | 1.3068 | 1.3068 | 1.1655 | SuperCrit flow, Inlet end controls |
| DM21-DM19 | 1.5642 | 1.2513 | 5.34 | 0.9368 | 0.9368 | 0.6226 | SuperCrit flow, Inlet end controls |
| BD13-OL01 | 33.2325 | 11.0775 | 57.17 | 3.0000 | 2.4497 | >D | Outlet Control |
| BW18-DM10 | 0.9376 | 0.6251 | 3.08 | 0.6677 | 0.6677 | 0.5129 | SuperCrit flow, Inlet end controls |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [DM-11 overflow] through DM-11 to ground** | | | | | | | | | | | |
| DM-11 to ground | 0.00 | 35.5573 | ---- | 0.00 | 0.2866 | ---- | Ditch | 11.426 | ----- | 0.00 | |

## HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 101.9815 |
| DM-11 Dummy | DM-11 to infiltration | 102.4815 | --na-- | --na-- | --na-- | 102.4815 | 103.0000 |

## Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| DM-11 to ground | 0.6815 | na | 35.5573 | 0.6815 | 0.6815 | 0.2866 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 1 - infiltration] through Cell 1 to ground** | | | | | | | | | | | |
| Cell 1 to ground | 0.00 | 0.0786 | ---- | 0.00 | 0.0293 | ---- | Ditch | 2.4672 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 58.5625 |
| Cell 1-Dummy | Cell 1 to Infiltration | 59.0625 | --na-- | --na-- | --na-- | 59.0625 | 65.5000 |

### Conduit Notes

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 1 to ground | 0.0625 | na | 0.0786 | 0.0625 | 0.0625 | 0.0293 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 2 - infiltration] through Cell 2 to ground** | | | | | | | | | | | |
| Cell 2 to ground | 0.00 | 0.6797 | ---- | 0.00 | 0.1011 | ---- | Ditch | 5.1603 | ----- | 0.00 | |

### HGL Analysis

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.6992 |
| Cell 2 - Dummy | Cell 2 to infiltration | 60.1992 | --na-- | --na-- | --na-- | 60.1992 | 63.5000 |

**Conduit Notes**

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 2 to ground | 0.1992 | na | 0.6797 | 0.1992 | 0.1992 | 0.1011 | Supercritical flow, dc at up node |

| Reach ID | Area (ac) | Flow (cfs) | Full Q (cfs) | Full ratio | nDepth (ft) | Depth ratio | Size | nVel (ft/s) | fVel (ft/s) | Infil Vol (cf) | CBasin / Hyd |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Routing split hyd [Cell 3 - infiltration] through Cell 3 to ground** | | | | | | | | | | | |
| Cell 3 to ground | 0.00 | 0.9458 | ---- | 0.00 | 0.1978 | ---- | Ditch | 3.0019 | ----- | 0.00 | |

**HGL Analysis**

| From Node | To Node | HG El (ft) | App (ft) | Bend (ft) | Junct Loss (ft) | Adjusted HG El (ft) | Max El (ft) |
|---|---|---|---|---|---|---|---|
| | | | | | | | 59.7383 |
| Cell 3 - Dummy | Cell 3 to infiltration | 60.2383 | --na-- | --na-- | --na-- | 60.2383 | 62.0000 |

**Conduit Notes**

| Reach | HW Depth (ft) | HW/D ratio | Q (cfs) | TW Depth (ft) | Dc (ft) | Dn (ft) | Comment |
|---|---|---|---|---|---|---|---|
| Cell 3 to ground | 0.2383 | na | 0.9458 | 0.2383 | 0.2383 | 0.1978 | Supercritical flow, dc at up node |

Flow does exceed capacity in some of the upstream basin pipes. These are known deficiencies that the City of Arlington has previously identified for future repair/upgrade. All the proposed project piping passes the peak storm flows. The bore pipe passes the 100 year flow with a headwater depth of 73.4’ which is 3.7’ below the proposed rim elevation. A backwater effect is present from the piping draining the wetland to the river. The software limitations prevent modeling the backwater situation accurately beyond the outfall piping. See Section 3.1.6 for a full discussion of how backwater from the river outfall occurs.

The actual depths of water stored in the Cells will depend largely on how fast the river rises and falls in relation to the storm event. However, for large storm events, it is more likely than not the backwater will occur from the wetland discharge piping to the river, and that discharge to the WSDOT wetland through the overflow spillway will occur. This is similar to what occurs in the existing condition, when stormwater flows exceed the piping capacity of the Butler outfall or the river is up, and the stormwater flow coming from the downtown basin is largely discharged onto the surface of the subject property from the WSDOT bioswale and CB 6. The stormwater then flows over the surface of the property south to the WSDOT wetland. Allowing the wetland to backwater and flood to the WSDOT wetland when necessary mimics the existing condition to a certain extent. Since the creation of the wetland adds 9 acre feet of additional water storage to the property, it takes more water to create flow to the WSDOT wetland than in the existing condition.

The model gives the following results; however, they do not reflect the backwater from the outfall as discussed above. It is likely that during peak discharge Cells 2, 3, and 4 will all fill to an elevation slightly above 62.5 and that stormwater will be discharged to the WSDOT wetland. It is possible during the 100 year event for stormwater to fill the WSDOT wetland and for stormwater to exit the north side of the wetland and flow west over dike road. The model gives depth of the peak water storage in Cell 1 as 1.92 feet above the weir notch (64.91). This cell is unaffected by the backwater effects. The depth of the peak water storage in Cell 2 is modeled at 1.87 feet above the lower weir notch and 1.37 feet above the upper weir notch (62.87). This peak storage elevation equates to 2.87 feet of water storage in the channel areas and 3.37 feet of water storage in the pool areas. At a water elevation of 62.5, discharge will begin into the WSDOT wetland. The peak depth of the water storage in Cell 3 is 1.81 to 3 feet. The peak flow to the river is modeled as being reduced from 86.12 cfs (coming into the wetland) to 68.08 cfs (out the Butler outfall). Actual peak discharge flows to the river are likely to be lower due to backwater effects. Some of the peak discharge reduction is additional storage in the wetlands and some is discharge to the WSDOT wetland.

**Appended on: Friday, November 20, 2009 2:56:02 PM**

## Layout Report: COA Wetland with Infiltration

| Event | Precip (in) |
|---|---|
| weekly | 0.38 |
| 6 month | 1.26 |
| 2 yr | 1.80 |
| 10 yr | 2.75 |
| 25 yr | 3.20 |
| 100 yr | 3.75 |

### *Reach Records*

Record Id: BD13-OL01

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | OL-01 | **UpNode** | BD-13 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 2594.00 ft | **Slope** | 0.20% |
| **Up Invert** | 102.43 ft | **Dn Invert** | 107.67 ft |

**Conduit Constraints**

| Min Vel | Max Vel | Min Slope | Max Slope | Min Cover |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: BE04-DM19

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-19 | **UpNode** | BE-04 |
| **Material** | unspecified | **Size** | 21 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 1154.00 ft | **Slope** | 3.18% |
| **Up Invert** | 120.167 ft | **Dn Invert** | 156.83 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: BE06-BE04

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | BE-04 | **UpNode** | BE-06 |
| **Material** | unspecified | **Size** | 21 in Diam |
| **Ent Losses** | Groove End Projecting | | |
| **Length** | 586.50 ft | **Slope** | 0.79% |
| **Up Invert** | 157.827 ft | **Dn Invert** | 161.46 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

## Record Id: BE13-BE06

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | BE-06 | **UpNode** | BE-13 |
| **Material** | unspecified | **Size** | 21 in Diam |
| **Ent Losses** | Groove End w/Headwall | | |
| **Length** | 1838.20 ft | **Slope** | 1.48% |
| **Up Invert** | 161.441 ft | **Dn Invert** | 188.61 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

## Record Id: BW18-DM10

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-10 | **UpNode** | BW-18 |
| **Material** | unspecified | **Size** | 18 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 1297.40 ft | **Slope** | 1.15% |
| **Up Invert** | 91.788 ft | **Dn Invert** | 106.76 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: CB 50 - CB 6A

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-02 PD | **UpNode** | CB 50 |
| **Material** | unspecified | **Size** | 42 in Diam |
| **Ent Losses** | Groove End w/Headwall | | |
| **Length** | 214.00 ft | **Slope** | 1.08% |
| **Up Invert** | 57.14 ft | **Dn Invert** | 54.8288 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: Cell 1 to Cell 2

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | | Cell 1- weir |
| **DnNode** | Cell 2 | **UpNode** | Cell 1 |
| **Length** | 1.00 ft | **Slope** | 150.00% |
| **Bottom Width** | 6.00 ft | **Top of Bank** | 3.00 ft |
| **SS1** | 3.00v:1h | **SS2** | 3.00v:1h |
| **Up Invert** | 63.00 ft | **Dn Invert** | 61.50 ft |

### Record Id: Cell 1 to ground

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | | Cell 1 - infiltration |
| **DnNode** | Cell 1 to Infiltration | **UpNode** | Cell 1- Dummy |
| **Length** | 10.00 ft | **Slope** | 5.00% |
| **Bottom Width** | 1.00 ft | **Top of Bank** | 1.00 ft |
| **SS1** | 3.00v:1h | **SS2** | 3.00v:1h |
| **Up Invert** | 59.00 ft | **Dn Invert** | 58.50 ft |

### Record Id: Cell 2 to Cell 3

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | | Cell 2 - weir; Cell 2 -weir - lower |
| **DnNode** | Cell 3 | **UpNode** | Cell 2 |
| **Length** | 1.00 ft | **Slope** | 100.00% |
| **Bottom Width** | 6.00 ft | **Top of Bank** | 3.00 ft |
| **SS1** | 3.00v:1h | **SS2** | 3.00v:1h |
| **Up Invert** | 60.00 ft | **Dn Invert** | 61.00 ft |

### Record Id: Cell 2 to ground

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | | Cell 2 - infiltration |
| **DnNode** | Cell 2 to infiltration | **UpNode** | Cell 2 - Dummy |
| **Length** | 10.00 ft | **Slope** | 5.00% |
| **Bottom Width** | 1.00 ft | **Top of Bank** | 1.00 ft |
| **SS1** | 3.00v:1h | **SS2** | 3.00v:1h |
| **Up Invert** | 60.00 ft | **Dn Invert** | 59.50 ft |

### Record Id: Cell 3 to ground

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.03 |
| **Routing Method:** | Travel Time Shift | | Cell 3 - infiltration |
| **DnNode** | Cell 3 to infiltration | **UpNode** | Cell 3 - Dummy |
| **Length** | 10.00 ft | **Slope** | 5.00% |
| **Bottom Width** | 1.00 ft | **Top of Bank** | 1.00 ft |
| **SS1** | 3.00v:1h | **SS2** | 3.00v:1h |
| **Up Invert** | 60.00 ft | **Dn Invert** | 59.50 ft |

### Record Id: Cell 4

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.03 |
| **Routing Method:** | Travel Time Shift | | Cell 3 - weir |
| **DnNode** | Cell 4 - End | **UpNode** | Cell 3 |
| **Length** | 227.00 ft | **Slope** | 0.77% |
| **Bottom Width** | 8.00 ft | **Top of Bank** | 5.9167 ft |
| **SS1** | 2.00v:1h | **SS2** | 2.00v:1h |
| **Up Invert** | 59.21 ft | **Dn Invert** | 57.4621 ft |

### Record Id: Cell 4 - CB 50

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | CB 50 | **UpNode** | Cell 4 - End |
| **Material** | unspecified | **Size** | 42 in Diam |
| **Ent Losses** | Beveled ring, 33.7 deg bevels | | |
| **Length** | 32.00 ft | **Slope** | 1.00% |
| **Up Invert** | 57.46 ft | **Dn Invert** | 57.14 ft |

| **Conduit Constraints** | | | | |
|---|---|---|---|---|
| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: DM10-DM08

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-08 | **UpNode** | DM-10 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 494.50 ft | **Slope** | 1.24% |
| **Up Invert** | 91.79 ft | **Dn Invert** | 85.678 ft |

| **Conduit Constraints** | | | | |
|---|---|---|---|---|
| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: DM-11 to ground

| | | | |
|---|---|---|---|
| **Section Shape:** | Ditch | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.012 |
| **Routing Method:** | Travel Time Shift | | DM-11 overflow |
| **DnNode** | DM-11 to infiltration | **UpNode** | DM-11 Dummy |
| **Length** | 10.00 ft | **Slope** | 5.00% |
| **Bottom Width** | 10.00 ft | **Top of Bank** | 3.00 ft |
| **SS1** | 3.00v:1h | **SS2** | 3.00v:1h |
| **Up Invert** | 101.80 ft | **Dn Invert** | 101.30 ft |

### Record Id: DM11-DM10

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | | DM-11 outlet |
| **DnNode** | DM-10 | **UpNode** | DM-11 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 181.30 ft | **Slope** | 0.71% |
| **Up Invert** | 93.07 ft | **Dn Invert** | 91.7918 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: DM14-OL01

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | OL-01 | **UpNode** | DM-14 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 183.10 ft | **Slope** | 0.42% |
| **Up Invert** | 93.931 ft | **Dn Invert** | 94.70 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: DM19-DM14

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-14 | **UpNode** | DM-19 |
| **Material** | unspecified | **Size** | 24 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 768.40 ft | **Slope** | 2.90% |
| **Up Invert** | 97.8995 ft | **Dn Invert** | 120.16 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: DM21-DM19

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-19 | **UpNode** | DM-21 |
| **Material** | unspecified | **Size** | 15 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 268.50 ft | **Slope** | 4.17% |
| **Up Invert** | 120.148 ft | **Dn Invert** | 131.35 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: DM2-DM1

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.011 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-01 PD | **UpNode** | DM-02 PD |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Groove End w/Headwall | | |
| **Length** | 262.00 ft | **Slope** | 1.20% |
| **Up Invert** | 51.686 ft | **Dn Invert** | 54.83 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: DM5A-Cell1

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.015 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | Cell 1 | **UpNode** | DM-05a |
| **Material** | unspecified | **Size** | 48 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 172.00 ft | **Slope** | 0.75% |
| **Up Invert** | 64.81 ft | **Dn Invert** | 66.10 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 1.00 ft/s | 15.00 ft/s | 0.25% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

## Record Id: DM6-DM5A

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.024 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-05a | **UpNode** | DM-06 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 75.00 ft | **Slope** | 13.80% |
| **Up Invert** | 76.60 ft | **Dn Invert** | 66.25 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

## Record Id: DM8-DM6

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.024 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-06 | **UpNode** | DM-08 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 567.70 ft | **Slope** | 1.60% |
| **Up Invert** | 85.68 ft | **Dn Invert** | 76.5968 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### Record Id: OL01-DM11

| | | | |
|---|---|---|---|
| **Section Shape:** | Circular | | |
| **Uniform Flow Method:** | Manning's | **Coefficient:** | 0.016 |
| **Routing Method:** | Travel Time Shift | **Contributing Hyd** | |
| **DnNode** | DM-11 | **UpNode** | OL-01 |
| **Material** | unspecified | **Size** | 36 in Diam |
| **Ent Losses** | Headwall | | |
| **Length** | 183.10 ft | **Slope** | 0.47% |
| **Up Invert** | 93.106 ft | **Dn Invert** | 93.93 ft |

**Conduit Constraints**

| **Min Vel** | **Max Vel** | **Min Slope** | **Max Slope** | **Min Cover** |
|---|---|---|---|---|
| 2.00 ft/s | 15.00 ft/s | 0.50% | 2.00% | 3.00 ft |

| | | | |
|---|---|---|---|
| **Drop across MH** | 0.00 ft | **Ex/Infil Rate** | 0.00 in/hr |
| Match inverts. | | | |

### *Node Records*

### Record Id: BD-13

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 107.67 ft | Max El. | 114.50 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

### Record Id: BE-04

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 156.83 ft | Max El. | 167.25 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

### Record Id: BE-06

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 161.46 ft | Max El. | 170.72 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

### Record Id: BE-13

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 188.61 ft | Max El. | 193.89 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

### Record Id: BW-18

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 106.76 ft | Max El. | 110.77 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

### Record Id: CB 50

| | | | |
|---|---|---|---|
| Descrip: | type 2 - 72 | Increment | 0.10 ft |
| Start El. | 57.15 ft | Max El. | 66.00 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 2--72 |
| Ent Ke | | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 28.274 sf |
| MH/CB Type Node | | | |

### Record Id: Cell 1

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 59.00 ft | Max El. | 65.50 ft |
| Void Ratio | 100.00 | | |
| Storage Node | Cell 1 - combo | Discharge Structure | Cell 1 - Storage |
| Detention Pond Type Node | | | |

### Record Id: Cell 1 - Storage

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 59.00 ft | Max El. | 64.50 ft |
| Void Ratio | 100.00 | | |
| **Stage (ft)** | **Area (sf)** | | |
| 0.00 | 2547.00 | | |
| 0.50 | 2619.00 | | |
| 1.00 | 4169.00 | | |
| 2.00 | 5860.00 | | |
| 3.00 | 7614.00 | | |
| 4.00 | 9727.00 | | |
| 5.00 | 11616.00 | | |
| 5.50 | 12683.00 | | |
| Stage-Storage Type Node | | | |

### Record Id: Cell 1- Dummy

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 60.00 ft | Max El. | 65.50 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: Cell 1 to Infiltration

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 59.50 ft | Max El. | 65.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: Cell 2

| | | | |
|---|---|---|---|
| Descrip: | wetland cell | Increment | 0.10 ft |
| Start El. | 60.00 ft | Max El. | 63.50 ft |
| Void Ratio | 100.00 | | |
| Storage Node | Cell 2 - combo | Discharge Structure | Cell 2 - Storage |
| Detention Pond Type Node | | | |

### Record Id: Cell 2 - Storage

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 60.00 ft | Max El. | 63.50 ft |
| Void Ratio | 100.00 | | |

| Stage (ft) | Area (sf) |
|---|---|
| 0.00 | 12782.00 |
| 0.50 | 34486.00 |
| 1.00 | 44088.00 |
| 1.50 | 93666.00 |
| 2.00 | 103242.00 |
| 3.00 | 119563.00 |
| 3.50 | 140434.00 |
| Stage-Storage Type Node | |

### Record Id: Cell 2 - Dummy

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 60.00 ft | Max El. | 63.50 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: Cell 2 to infiltration

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 59.50 ft | Max El. | 63.50 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: Cell 3

| | | | |
|---|---|---|---|
| Descrip: | wetland cell | Increment | 0.10 ft |
| Start El. | 60.00 ft | Max El. | 63.50 ft |
| Void Ratio | 100.00 | | |
| Storage Node | Cell 3 - combo | Discharge Structure | Cell 3 - Storage |
| Detention Pond Type Node | | | |

### Record Id: Cell 3 - Storage

| | | | |
|---|---|---|---|
| Descrip: | cell 3 | Increment | 0.10 ft |
| Start El. | 60.00 ft | Max El. | 63.00 ft |
| Void Ratio | 100.00 | | |

| **Stage (ft)** | **Area (sf)** |
|---|---|
| 0.00 | 44976.00 |
| 0.50 | 52823.00 |
| 1.00 | 60531.00 |
| 1.50 | 68415.00 |
| 2.00 | 78284.00 |
| 3.00 | 99741.00 |
| Stage-Storage Type Node | |

### Record Id: Cell 3 - Dummy

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 60.00 ft | Max El. | 62.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: Cell 3 to infiltration

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 59.50 ft | Max El. | 62.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: Cell 4 - End

| | | | |
|---|---|---|---|
| Descrip: | inlet of pipe system | Increment | 0.10 ft |
| Start El. | 57.46 ft | Max El. | 63.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: DM-01 PD

| | | | |
|---|---|---|---|
| Descrip: | Butler Outfall | Increment | 0.10 ft |
| Start El. | 51.70 ft | Max El. | 57.42 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: DM-02 PD

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 54.83 ft | Max El. | 67.85 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 2--72 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 28.274 sf |
| MH/CB Type Node | | | |

### Record Id: DM-05a

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 66.10 ft | Max El. | 77.00 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 3-72 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 28.2743 sf |
| MH/CB Type Node | | | |

### Record Id: DM-06

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 76.60 ft | Max El. | 96.22 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 2-60 |
| Ent Ke | | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 19.634 sf |
| MH/CB Type Node | | | |

## Record Id: DM-08

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 85.68 ft | Max El. | 98.82 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 2-60 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 19.634 sf |
| MH/CB Type Node | | | |

## Record Id: DM-10

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 91.79 ft | Max El. | 103.21 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 2-60 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 19.634 sf |
| MH/CB Type Node | | | |

## Record Id: DM-11

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 93.07 ft | Max El. | 103.00 ft |
| Void Ratio | 100.00 | | |
| Storage Node | DM-11 Combo | Discharge Structure | DM-11 Storage |
| Detention Pond Type Node | | | |

### Record Id: DM-11 Storage

| | | | |
|---|---|---|---|
| Descrip: | pipe end | Increment | 0.10 ft |
| Start El. | 93.07 ft | Max El. | 103.00 ft |
| Void Ratio | 100.00 | | |

| Stage (ft) | Area (sf) |
|---|---|
| 0.00 | 12.57 |
| 4.93 | 12.57 |
| 8.23 | 12.57 |
| 8.43 | 80.00 |
| 9.73 | 160.00 |
| 9.93 | 180.00 |
| Stage-Storage Type Node | |

### Record Id: DM-11 Dummy

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 101.80 ft | Max El. | 103.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

### Record Id: DM-11 to infiltration

| | | | |
|---|---|---|---|
| Descrip: | Settling Pool | Increment | 0.10 ft |
| Start El. | 101.30 ft | Max El. | 104.00 ft |
| Void Ratio | 100.00 | | |
| Dummy Type Node | | | |

**Record Id: DM-14**

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 94.70 ft | Max El. | 111.08 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

**Record Id: DM-19**

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 120.16 ft | Max El. | 124.95 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

**Record Id: DM-21**

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 131.35 ft | Max El. | 139.67 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

### Record Id: OL-01

| | | | |
|---|---|---|---|
| Descrip: | Manhole structure | Increment | 0.10 ft |
| Start El. | 93.93 ft | Max El. | 109.83 ft |
| Void Ratio | 100.00 | | |
| Condition | Existing | Structure Type | CB-TYPE 1-48 |
| Ent Ke | CMP: Headwall or Headwall & Wingwall sq edge;.ke=0.5 | Channelization | No Special Shape |
| Catch | 0.00 ft | Bottom Area | 12.5664 sf |
| MH/CB Type Node | | | |

### *Discharge Records*

### Record Id: DM-11 Combo

| Combination Discharge Structure | | | |
|---|---|---|---|
| **Descrip:** | combined pipe outlet and curb overflow | **Increment** | 0.10 ft |
| **Start El.** | 93.07 ft | **Max El.** | 103.00 ft |
| **List of Controls** | | DM-11 outlet<br>DM-11 overflow | |

### Record Id: DM-11 outlet

| Vertical Orifice | | | |
|---|---|---|---|
| **Descrip:** | combine infiltration and weir | **Increment** | 0.10 ft |
| **Start El.** | 93.07 ft | **Max El.** | 103.00 ft |
| **Weir Area** | 7.069 sf | **Weir Coeff** | 0.61 |

### Record Id: DM-11 overflow

| Broad Crested Weir | | | |
|---|---|---|---|
| **Descrip:** | combine infiltration and weir | **Increment** | 0.10 ft |
| **Start El.** | 96.25 ft | **Max El.** | 103.00 ft |
| **Length** | 10.00 ft | **cd** | 3.216 |

### Record Id: Cell 1 - combo

| **Combination Discharge Structure** | | | |
|---|---|---|---|
| **Descrip:** | combine infiltration and weir | **Increment** | 0.10 ft |
| **Start El.** | 60.00 ft | **Max El.** | 65.50 ft |
| **List of Controls** | | Cell 1 - infiltration<br>Cell 1- weir | |

### Record Id: Cell 1 - infiltration

| **Infiltration** | | | |
|---|---|---|---|
| **Descrip:** | infiltration out of cell 1 | **Increment** | 0.10 ft |
| **Start El.** | 60.00 ft | **Max El.** | 65.50 ft |
| **Infiltration rate** | 0.25 in/hr | **WP Multiplier** | 0.50 |

### Record Id: Cell 1- weir

| **Broad Crested Weir** | | | |
|---|---|---|---|
| **Descrip:** | Broad Crested Weir | **Increment** | 0.10 ft |
| **Start El.** | 63.00 ft | **Max El.** | 65.50 ft |
| **Length** | 10.00 ft | **cd** | 3.216 |

### Record Id: Cell 2 - combo

| **Combination Discharge Structure** | | | |
|---|---|---|---|
| **Descrip:** | combine infiltration and weir | **Increment** | 0.10 ft |
| **Start El.** | 60.00 ft | **Max El.** | 63.50 ft |
| **List of Controls** | | Cell 2 - infiltration<br>Cell 2 - weir<br>Cell 2 -weir - lower | |

### Record Id: Cell 2 - infiltration

| **Infiltration** | | | |
|---|---|---|---|
| **Descrip:** | infiltration out of cell 2 | **Increment** | 0.10 ft |
| **Start El.** | 60.00 ft | **Max El.** | 63.50 ft |
| **Infiltration rate** | 0.25 in/hr | **WP Multiplier** | 1.00 |

### Record Id: Cell 2 - weir

| Broad Crested Weir | | | |
|---|---|---|---|
| **Descrip:** | Broad Crested Weir | **Increment** | 0.10 ft |
| **Start El.** | 61.50 ft | **Max El.** | 63.50 ft |
| **Length** | 11.00 ft | **cd** | 3.216 |

### Record Id: Cell 2 -weir - lower

| Broad Crested Weir | | | |
|---|---|---|---|
| **Descrip:** | Broad Crested Weir | **Increment** | 0.10 ft |
| **Start El.** | 61.00 ft | **Max El.** | 63.50 ft |
| **Length** | 2.00 ft | **cd** | 3.216 |

### Record Id: Cell 3 - combo

| Combination Discharge Structure | | | |
|---|---|---|---|
| **Descrip:** | combine infiltration and weir | **Increment** | 0.10 ft |
| **Start El.** | 60.00 ft | **Max El.** | 63.50 ft |
| **List of Controls** | | Cell 3 - infiltration<br>Cell 3 - weir | |

### Record Id: Cell 3 - infiltration

| Infiltration | | | |
|---|---|---|---|
| **Descrip:** | infiltration out of cell 3 | **Increment** | 0.10 ft |
| **Start El.** | 60.00 ft | **Max El.** | 63.50 ft |
| **Infiltration rate** | 0.50 in/hr | **WP Multiplier** | 1.00 |

### Record Id: Cell 3 - weir

| Broad Crested Weir | | | |
|---|---|---|---|
| **Descrip:** | Broad Crested Weir | **Increment** | 0.10 ft |
| **Start El.** | 60.25 ft | **Max El.** | 62.00 ft |
| **Length** | 8.00 ft | **cd** | 3.216 |

### *Contributing Drainage Areas*

### Record Id: BD-13

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 57.00 ac | **DCIA** | 65.30 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 40.0494 min | **DC TC** | 25.0767 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 57.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.2% | 0.41 | 1.80 in | 16.1453 min |
| Shallow | gutter flow | 200.00 ft | 2.2% | 0.0118 | | 0.8261 min |
| Sheet | pipe conveyance | 2670.00 ft | 2.2% | 0.012 | 1.80 in | 23.078 min |
| Pervious TC | | | | | | 40.0494 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 65.30 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | Smooth Surfaces. | 50.00 ft | 2.2% | 0.011 | 1.80 in | 0.8932 min |
| Shallow | Paved | 200.00 ft | 2.2% | 0.01 | | 1.1055 min |
| Sheet | pipe system | 2670.00 ft | 2.2% | 0.012 | 1.80 in | 23.078 min |
| Pervious TC | | | | | | 25.0767 min |

## Record Id: BE-04

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 9.90 ac | **DCIA** | 9.40 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 23.9905 min | **DC TC** | 11.0219 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 9.90 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 3.3% | 0.41 | 0.00 in | 13.7281 min |
| Shallow | gutter flow | 200.00 ft | 3.3% | 0.01189 | | 0.6796 min |
| Sheet | pipe conveyance | 1090.00 ft | 3.3% | 0.012 | 1.80 in | 9.5828 min |
| Pervious TC | | | | | | 23.9905 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 9.40 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 3.3% | 0.011 | 0.00 in | 0.7594 min |
| Shallow | gutter flow | 200.00 ft | 3.3% | 0.01189 | | 0.6796 min |
| Sheet | pipe system | 1090.00 ft | 3.3% | 0.012 | 1.80 in | 9.5828 min |
| Pervious TC | | | | | | 11.0219 min |

## Record Id: BE-06

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |

| | | | |
|---|---|---|---|
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 17.00 ac | **DCIA** | 16.30 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 31.3508 min | **DC TC** | 15.1775 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 17.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 1.9% | 0.41 | 0.00 in | 17.1204 min |
| Shallow | gutter flow | 200.00 ft | 1.9% | 0.01189 | | 0.8957 min |
| Sheet | pipe conveyance | 1250.00 ft | 1.9% | 0.012 | 1.80 in | 13.3347 min |
| Pervious TC | | | | | | 31.3508 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 16.30 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 1.9% | 0.011 | 0.00 in | 0.9471 min |
| Shallow | gutter flow | 200.00 ft | 1.9% | 0.01189 | | 0.8957 min |
| Sheet | pipe system | 1250.00 ft | 1.9% | 0.012 | 1.80 in | 13.3347 min |
| Pervious TC | | | | | | 15.1775 min |

### Record Id: BE-13

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |

| | | | |
|---|---|---|---|
| **Pervious Area** | 11.80 ac | **DCIA** | 12.40 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 18.5304 min | **DC TC** | 9.0904 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 11.80 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 7.3% | 0.41 | 0.00 in | 9.9928 min |
| Shallow | gutter flow | 200.00 ft | 7.3% | 0.01189 | | 0.4569 min |
| Sheet | pipe conveyance | 1310.00 ft | 7.3% | 0.012 | 1.80 in | 8.0806 min |
| Pervious TC | | | | | | 18.5304 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 12.40 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 7.3% | 0.011 | 0.00 in | 0.5528 min |
| Shallow | gutter flow | 200.00 ft | 7.3% | 0.01189 | | 0.4569 min |
| Sheet | pipe system | 1310.00 ft | 7.3% | 0.012 | 1.80 in | 8.0806 min |
| Pervious TC | | | | | | 9.0904 min |

## Record Id: BW-18

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 2.00 ac | **DCIA** | 3.70 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |

| | | | |
|---|---|---|---|
| **Pervious TC** | 54.1477 min | **DC TC** | 23.9846 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 2.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 0.4% | 0.41 | 0.00 in | 31.9295 min |
| Shallow | gutter flow | 200.00 ft | 0.4% | 0.01189 | | 2.5927 min |
| Sheet | pipe conveyance | 890.00 ft | 0.4% | 0.012 | 1.80 in | 18.9516 min |
| Pervious TC | | | | | | 53.4738 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 3.70 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 0.4% | 0.011 | 0.00 in | 1.7664 min |
| Shallow | gutter flow | 200.00 ft | 0.4% | 0.01189 | | 2.5927 min |
| Sheet | pipe system | 890.00 ft | 0.4% | 0.012 | 1.80 in | 18.9516 min |
| Pervious TC | | | | | | 23.3107 min |

## Record Id: Cell 1

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 0.19 ac | **DCIA** | 0.33 ac |
| **Pervious CN** | 85.00 | **DC CN** | 98.00 |
| **Pervious TC** | 16.1453 min | **DC TC** | 5.00 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND SLOPES | 0.19 ac | 85.00 |
| Pervious Composited CN (AMC 2) | | 85.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.2% | 0.41 | 0.00 in | 16.1453 min |
| Pervious TC | | | | | | 16.1453 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND POND | 0.33 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Shallow | Nearly bare ground (n=0.025) | 20.00 ft | 2.2% | 0.025 | | 0.175 min |
| Pervious TC | | | | | | 0.175 min |

## Record Id: Cell 2

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 1.10 ac | **DCIA** | 3.04 ac |
| **Pervious CN** | 85.00 | **DC CN** | 98.00 |
| **Pervious TC** | 16.1453 min | **DC TC** | 5.00 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND SLOPES | 1.10 ac | 85.00 |
| Pervious Composited CN (AMC 2) | | 85.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.2% | 0.41 | 0.00 in | 16.1453 min |
| Pervious TC | | | | | | 16.1453 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND POND | 3.04 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Shallow | Nearly bare ground (n=0.025) | 20.00 ft | 2.2% | 0.025 | | 0.175 min |
| Pervious TC | | | | | | 0.175 min |

## Record Id: Cell 3

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 1.10 ac | **DCIA** | 2.30 ac |
| **Pervious CN** | 85.00 | **DC CN** | 98.00 |
| **Pervious TC** | 16.1453 min | **DC TC** | 5.00 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND SLOPES | 1.10 ac | 85.00 |
| Pervious Composited CN (AMC 2) | | 85.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off slopes | 50.00 ft | 2.2% | 0.41 | 1.80 in | 16.1453 min |
| Pervious TC | | | | | | 16.1453 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND POND | 2.30 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Shallow | Nearly bare ground (n=0.025) | 20.00 ft | 2.2% | 0.025 | | 0.175 min |
| Pervious TC | | | | | | 0.175 min |

## Record Id: Cell 4

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 0.18 ac | **DCIA** | 0.23 ac |
| **Pervious CN** | 85.00 | **DC CN** | 98.00 |
| **Pervious TC** | 16.1453 min | **DC TC** | 5.00 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND SLOPES | 0.18 ac | 85.00 |
| Pervious Composited CN (AMC 2) | | 85.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.2% | 0.41 | 0.00 in | 16.1453 min |
| Pervious TC | | | | | | 16.1453 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| WETLAND POND | 0.23 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Shallow | Short grass, pasture and lawns (n=0.030) | 20.00 ft | 2.2% | 0.03 | | 0.21 min |
| Pervious TC | | | | | | 0.21 min |

**Record Id: DM-08**

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 7.00 ac | **DCIA** | 12.90 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 24.7356 min | **DC TC** | 11.0791 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 7.00 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.9% | 0.41 | 0.00 in | 14.4563 min |
| Shallow | gutter flow | 200.00 ft | 2.9% | 0.01189 | | 0.725 min |
| Sheet | pipe conveyance | 1010.00 ft | 2.9% | 0.0121 | 0.00 in | 2.3535 min |
| Pervious TC | | | | | | 17.5348 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 12.90 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 2.9% | 0.011 | 0.00 in | 0.7997 min |
| Shallow | gutter flow | 200.00 ft | 2.9% | 0.01189 | | 0.725 min |
| Sheet | pipe system | 1010.00 ft | 2.9% | 0.0121 | 0.00 in | 2.3535 min |
| Pervious TC | | | | | | 3.8782 min |

## Record Id: DM-21a

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 5.70 ac | **DCIA** | 10.40 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 32.6143 min | **DC TC** | 17.0757 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 5.70 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.1% | 0.41 | 0.00 in | 16.4486 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe conveyance | 1550.00 ft | 2.1% | 0.0121 | 0.00 in | 4.2445 min |
| Pervious TC | | | | | | 21.545 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 10.40 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 2.1% | 0.011 | 0.00 in | 0.9099 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe system | 1550.00 ft | 2.1% | 0.0121 | 0.00 in | 4.2445 min |
| Pervious TC | | | | | | 6.0063 min |

## Record Id: DM-21b

| | | | |
|---|---|---|---|
| **Design Method** | SCS | **Rainfall type** | TYPE1A.RAC |

| | | | |
|---|---|---|---|
| **Hyd Intv** | 15.00 min | **Peaking Factor** | 484.00 |
| **Storm Duration** | 24.00 hrs | **Abstraction Coeff** | 0.20 |
| **Pervious Area** | 3.10 ac | **DCIA** | 5.80 ac |
| **Pervious CN** | 68.00 | **DC CN** | 98.00 |
| **Pervious TC** | 24.658 min | **DC TC** | 9.1194 min |

**Pervious CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| LAWN - SCS A | 3.10 ac | 68.00 |
| Pervious Composited CN (AMC 2) | | 68.00 |

**Pervious TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | off lawn | 50.00 ft | 2.1% | 0.41 | 0.00 in | 16.4486 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe conveyance | 620.00 ft | 2.1% | 0.0121 | 0.00 in | 1.6978 min |
| Pervious TC | | | | | | 18.9983 min |

**DCI - CN Calc**

| **Description** | **SubArea** | **Sub cn** |
|---|---|---|
| Pavement and rooftops | 5.80 ac | 98.00 |
| DC Composited CN (AMC 2) | | 98.00 |

**DCI - TC Calc**

| **Type** | **Description** | **Length** | **Slope** | **Coeff** | **Misc** | **TT** |
|---|---|---|---|---|---|---|
| Sheet | pavement flow | 50.00 ft | 2.1% | 0.011 | 0.00 in | 0.9099 min |
| Shallow | gutter flow | 200.00 ft | 2.1% | 0.01189 | | 0.8519 min |
| Sheet | pipe system | 620.00 ft | 2.1% | 0.0121 | 0.00 in | 1.6978 min |
| Pervious TC | | | | | | 3.4597 min |