Technical Memorandum

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To: City of Beaverton
Development Review

From: Ashley Cantlon, PE

Copies: Levi Patterson, Architect - DLR Group
Project File

Date: December 18, 2015

Subject: Vose Elementary School
Preliminary Drainage Report

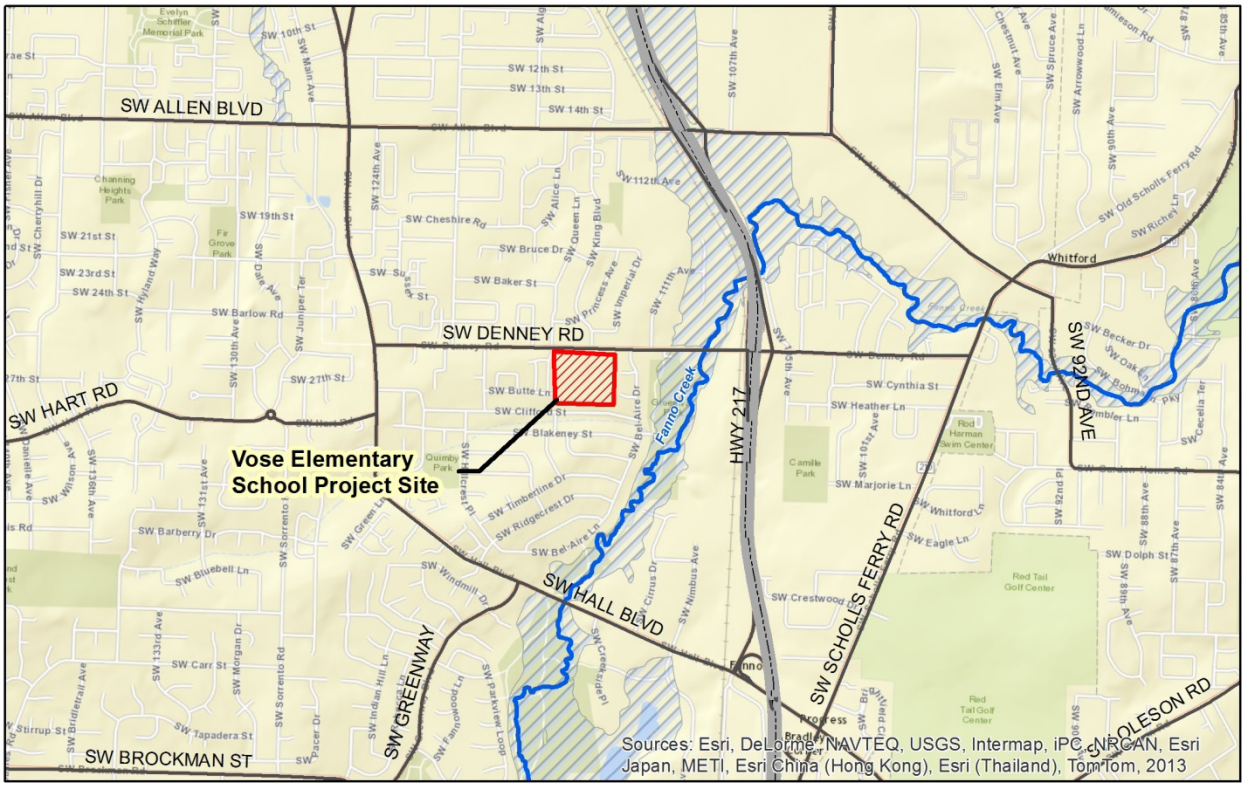
Project No.: 17622 (Otak)

Introduction

This preliminary drainage report documents the preliminary stormwater management design concept for Vose Elementary School, using Clean Water Services (CWS) and City of Beaverton design criteria. Included are the onsite stormwater analysis and a discussion of proposed regional stormwater treatment and detention facilities. The 8.8 acre site will replace 4.0 acres of impervious area with 4.9 acres of impervious area across two basins within the Fanno Creek watershed. Along with onsite development, the frontage of the school along SW Denney Road will also be improved, and will replace 0.15 acres of impervious area with 0.18 acres of impervious area.

Site Description

Vose Elementary School was originally constructed in 1959, and is located in the City of Beaverton on SW Denney Road approximately 0.3 miles west of Highway 217 (see Vicinity Map below). SW Denney Road abuts the property along the northern edge, and local neighborhood housing surrounds the remaining perimeter. Aside from the school building, the property is comprised of paved parking, play areas, and open grassy fields with slopes generally ranging from 2 percent to 6 percent, and terracing ranging from 10 to 18 percent in some areas.



Vicinity Map

Soils

The Natural Resource Conservation Service (NRCS) Soil Survey for Washington County, Oregon online soil survey was referenced to determine hydrologic soil types for the project location. A majority of soils onsite were identified as Woodburn silt loam, categorized by the NRCS as Hydrologic Soil Group Type C, which characteristically have moderate to low infiltration rates. A soil survey map of the proposed site and the soil hydrologic group table are provided in Attachment A.

Receiving Waters

Both onsite drainage basins, along with the school frontage ultimately drain into Fanno Creek. Fanno Creek has listed Total Maximum Daily Loads (TMDL's) for the following parameters: Ammonia, Dissolved Oxygen, E Coli, Phosphorous, and Temperature.

Basins and Hydrology

Existing Conditions

Existing drainage on the Vose Elementary School property is divided into two basins, hereafter referred to as Basin 1 and Basin 2. Basin 1 directs runoff from approximately 1.57 acres of the site (mainly impervious) to the north into the SW Denney Road conveyance system, while Basin 2 collects runoff in a series of pipes and directs flow from approximately 7.24 acres (mainly grass fields and play areas) to an outlet location located at the southeast corner of the site (see Figure 1).

Though not identified in survey data, as-built information shows that some amount of existing runoff draining southeast is detained by an underground 48-inch detention pipe, though the amount of detention provided for the site has been determined to be minimal based on conversations with City of Beaverton staff. Flows are shown to exit this detention pipe into a local roadway drainage system located within SW Clifford Street right- of-way. Stormwater is conveyed to an outfall into the nearby Fanno Creek, which is located approximately 0.2 miles east of the property.

Stormwater runoff draining to SW Denney Road does not currently receive treatment or detention before leaving the site. Runoff exiting the Vose Elementary School property at the southeast corner is not shown to receive treatment prior to discharging into public stormwater systems in SW Clifford Street.

Proposed Conditions

Onsite

Proposed redevelopment will consist of replacing the two existing school buildings and surrounding walk and driveways with one larger building having a footprint area of approximately 50,000 square feet, walkways and driveways with bus loading areas, a parking lot, and open recreational space.

For this analysis the proposed development was divided to maintain two drainage basins to mimic existing conditions. Basin 1 drains to the north and Basin 2 to the south (see Figure 2). These basins were further subdivided into contributing pervious and impervious areas within each basin. Onsite areas representing runoff from rooftops, sidewalks, driveway and parking areas are considered to be impervious areas, while remaining areas, including landscaped and soft play areas are considered to be pervious surfaces. A list summarizing the impervious and pervious areas in each basin is included in Attachment B.

A drainage analysis was performed using a preliminary grading plan and future drainage basin divide between Basin 1 and Basin 2. The north portion of the site within Basin 1 is shown to drain an impervious area less than the impervious area that is currently draining to the SW Denney Road system, while the impervious area within Basin 2 is shown to increase under proposed conditions.

Stormwater treatment within Basin 1 will be accomplished through mechanical treatment devices; however, detention will be unnecessary due to the calculated decreased runoff in proposed conditions. Runoff from Basin 2 will be treated and detained by a regional extended dry basin located at the southeast corner of this site to account for the increased impervious area in proposed conditions.

Public Right-of -Way

Along with onsite redevelopment, this project will include improvements to the school frontage along SW Denney Road within the public right-of-way. Improvements within the public right-of-way on SW Denney Road, including approximately 0.18 ac. of impervious area, will utilize Low Impact Development Approach (LIDA) facilities to treat offsite drainage.

Table 1 compares impervious and pervious areas within each drainage basin under existing and proposed conditions based on a preliminary design.

Table 1 –Basin Area Comparison

Basin	Existing Conditions		Proposed Conditions	
	Impervious Area (ac)	Pervious Area (ac)	Impervious Area (ac)	Pervious Area (ac)
1	1.41	0.16	1.16	0.51
2	2.61	4.62	3.72	3.41
Public ROW	0.15	0.11	0.18	0.09
Total	4.2	4.9	5.1	4.0

Downstream Conditions

Stormwater runoff from both Basin 1 and Basin 2 will ultimately discharge into existing offsite conveyance systems. Under existing and proposed conditions, Basin 1 discharges into the SW Denney Road conveyance system, which currently conveys runoff generated by the Vose Elementary School property. The existing conveyance system collects runoff from the property and SW Denney Road, as well as portions of the local neighborhood, and directs flows east to an outfall in a ditch between SW Denney Road and the Tualatin Hills Parks and Recreation District property adjacent to Fanno Creek. Flows travel through a series of ditches and culverts before discharging ultimately into Fanno Creek. No deficiencies have been brought to Otak's attention for the piped system, so it is assumed that the flows are able to be accommodated under proposed conditions based on the future drainage basin divide.

Under both existing and proposed conditions, Basin 2 discharges at the southeast corner of the site into an existing piped conveyance system, where runoff from the site discharges through pipes located within an easement between private properties into the conveyance system in SW Clifford Street. Based on as-built information, the main conveyance line in SW Clifford Street directs stormwater south into a pipe aligned along the back of residential properties between SW Clifford Street and SW Blakeney Street. This run of pipe crosses beneath SW Bel-Aire Drive and along SW Fanno Street before discharging through an existing outfall into Fanno Creek. Some localized flooding concerns within this offsite conveyance alignment have been brought to Otak's attention, so it is assumed that existing flows, based on conditions prior to development, are appropriate as the baseline comparison for detention sizing within Basin 2. Detention is necessary in Basin 2 due to a calculated increase in runoff generated by the newly developed area, and a runoff rate greater than the allowable threshold per City of Beaverton standards.

Design Criteria

The proposed stormwater system will meet the following design criteria:

- *City of Beaverton Engineering Design Manual and Standard Drawings* (COB, 2007)
- *Design and Construction Standards for Sanitary Sewer and Surface Water Management* (CWS, 2007)

The City of Beaverton has adopted the Clean Water Services (CWS) *Design and Construction Standards for Sanitary Sewer and Surface Water Management* as the water quality standard. All City standards in the *Engineering Design Manual* meet or exceed the CWS stormwater requirements for conveyance and detention. The City has adopted CWS standards for calculating water quality runoff and requirements for treatment.

Hydrology

The stormwater system for the Vose Elementary School property was modeled using the Santa Barbara Urban Hydrograph (SBUH) method in HydroCAD v10.0.

Rainfall Depth

Rainfall depths for the storm events of interest, obtained from the COB *Engineering Design Manual* and listed in Table 2, were applied to the Natural Resource Conservation Service (NRCS) Type 1A rainfall distribution in HydroCAD. These precipitation depths are slightly higher, and therefore more conservative, values than those required by Clean Water Services.

Table 2: COB Precipitation Depths for 24-Hour Duration Storm Events	
Recurrence Interval	Precipitation Depth (in)
2-year	2.50
10-year	3.50
25-year	4.00
100-year	4.50

Curve Number

Runoff Curve Numbers (CN) for impervious and pervious areas during existing and proposed conditions were selected using Table 2-2a – Runoff Curve Numbers for Urban Areas from *Technical Release 55: Urban Hydrology for Small Watersheds* (SCS, 1986) (see Appendix A). A summary of the runoff curve numbers under existing and proposed conditions is provided in Table 3.

Table 3: Runoff Curve Numbers			
Category	Cover Type	Hydrologic Soil Group	Curve Number
Impervious Area	Pavement, roofs, sidewalks	C	98
Existing Pervious Area	Grass Cover, Fair Condition	C	79
Proposed Pervious Area	Grass Cover, Fair Condition	C	79

Time of Concentration

The time of concentration represents the maximum time needed for all areas of a given basin to be contributing to the outflow hydrograph. Time of concentration values for each contributing drainage basin during existing and proposed conditions were calculated using the method provided by the SCS Technical Release 55 (SCS, 1986). The minimum allowable time of concentration for any drainage basin is five minutes. Table 4 lists the time of concentration values input into the hydrologic calculations in HydroCAD.

Table 4: Time of Concentration			
Basin		Impervious Area Tc (minutes)	Pervious Area Tc (minutes)
1	Existing Conditions	5.0	12.6
	Proposed Conditions	5.0	12.6
2	Existing Conditions	N/A	31.8
	Proposed Conditions	5.0	31.8
ROW	Existing Conditions	5.0	5.0
	Proposed Conditions	5.0	5.0

Water Quality Treatment

Onsite

The proposed design assumes that runoff from the Vose Elementary School property generated during the water quality storm event will be treated onsite with mechanical treatment devices (e.g. StormFilter ® cartridges) within Basin 1 and a vegetated extended dry basin within Basin 2. The extended dry basin was incorporated into the design to treat runoff from approximately 3.72 contributing impervious acres, as well as provide detention for high flow runoff within Basin 2.

Basin 2 will be required to provide mitigation for water quantity due to the increase in flows calculated for the proposed condition. Design of an extended dry basin facility will incorporate water quality treatment of on-site impervious area within Basin 2, as well as detention for runoff to account for these mitigation efforts.

Public Right-of-Way

Low Impact Development Approach (LIDA) facilities are proposed to treat runoff from the roadway and sidewalks within the City's right-of-way and associated offsite contributing impervious area. The City of Beaverton has adopted CWS water quality standards for designing stormwater facilities, therefore a simplified approach was used to calculate approximate LIDA facility areas needed to provide water quality treatment for drainage sub-basins within the public right-of-way and the offsite contributing impervious area. This simplified method assumes that a treatment facility will require a footprint area equal to six percent of the contributing impervious area. In this application, the contributing impervious area is assumed to include impervious areas draining to each facility, as shown in Figure 3. Roadway and sidewalk runoff will enter the LIDA facilities via curb cuts and direct sheet flow, respectively.

LIDA facilities are proposed to be located within the landscaping strip that borders SW Denney Road along the school's frontage. Overflow structures within each LIDA facility will direct flows

from storm events larger than the water quality event into the main conveyance system. Using the simplified approach method for facility sizing, the proposed onsite impervious areas will require approximately 1,392 square feet of total LIDA area to treat contributing right of way runoff, meeting CWS water quality treatment requirements. Table 5 shows example images of the vegetated facilities and related structures associated with the proposed plan.

Table 5: Examples of Proposed Vegetated Water Quality Treatment

Flow-Through Planter	Extended Dry Basin	Emergency Overflow Riser

Conveyance

A schematic layout was developed and preliminary pipe sizes were calculated for the Vose Elementary School site to represent the future drainage system. Inlets, manholes, and pipes were located based on assumed contributing impervious areas, treatment and detention facilities, and connections to offsite systems. At this stage of design, vertical components of pipes (i.e., slopes, rim elevations, and invert elevations) are not defined, and diameters are preliminary based on conveyance of the 25-year storm event with a minimum of 1-foot of freeboard below the ground surface. To account for the flooding concerns on the adjacent downstream property, an overflow path was considered. If the system in Basin 2 gets surcharged, and flows overtop the manholes, runoff will flow over the fields and either directly into the extended dry basin, or into a series of area drains located along the south edge of the site, which have been included in the proposed design to intercept overland runoff (see Figure 2). In Basin 1, all flows are directed to the east, and any overflow would be directed to SW Denney Road.

Detention

Stormwater detention is required for increased runoff flows generated by adding impervious area to a site. Basin 1 will contain approximately 10,908 square feet less impervious area compared to existing conditions, and the public right-of-way will add 1,008 square feet of impervious area compared to existing conditions, resulting in a net decrease of 9,900 square feet of impervious area

draining to the SW Denney Road conveyance system. Due to decreased runoff rates (see Attachment C3) in Basin 1, stormwater quantity mitigation will be unnecessary. Runoff generated by Basin 2 will be detained onsite in an extended dry basin, which is proposed to be located in the southeast corner of the site. The City of Beaverton requires post-developed peak runoff rates to match pre-developed peak runoff rates for the 2-year, 10-year, and 25-year, 24-hour storm events, and also requires that the proposed conditions runoff rate be less than or equal to "one half (0.5) cubic feet per second per acre in the 25-year event." The stormwater management system must also safely convey the 100-year, 24-hour storm event. A HydroCAD analysis was performed using the SBUH runoff method and a Type IA 24-hr storm rainfall distribution. Based on matching pre-developed to proposed condition runoff rates, the HydroCAD model was used to calculate the necessary size of the extended dry basin. The results of this model can be found in Attachment C.

Because the existing drainage within Basin 2 is currently only partially detained underground in a 48-inch detention pipe, and accounts of flooding have been documented by adjacent downstream property owners, it is assumed that the existing condition for this basin includes a pre-developed, grass-covered drainage basin without impervious area rather than a developed basin as under current conditions. Flow rate targets for Basin 2 were calculated for pre-developed conditions, and were used for matching flow rates based on City of Beaverton detention standards.

Table 6 lists the peak runoff rates for the site under existing and proposed conditions without mitigation efforts in Basin 1 and using an extended dry basin to provide detention in Basin 2. Runoff rates for each storm event during existing and proposed conditions are included in the output tables from HydroCAD (see Appendix C).

Table 6: Peak Runoff Rates				
	Peak Runoff Rate (cfs)			
	2-year	10-year	25-year	100-year
Basin 1				
Existing Conditions	0.93	1.35	1.57	1.78
Proposed Conditions	0.85	1.27	1.49	1.71
Basin 2				
Existing Conditions	0.72	1.65	2.18	2.74
Proposed Conditions	2.42	3.73	4.41	5.10
Mitigated Conditions	0.71	1.53	2.18	3.28

The proposed extended dry basin will release mitigated flows from the proposed 7.13 acre basin through a pipe that is proposed to connect into the existing system in SW Clifford Street, as it does under current conditions. An emergency overflow riser will be incorporated into the drainage of the detention facility, which will have capacity to convey the 100-yr storm event into the downstream

conveyance system in the event that the primary flow control outlet structure becomes clogged or damaged. Table 7 defines the elevation parameters of the extended dry basin, as well as, the elevation of the pond at different flow events.

Table 7: Extended Dry Basin Design Elevations	
	Pond Elevation (ft)
Bottom of pond	207
2-year	209.14
10- year	209.78
25- year	209.95
100-year	210.09
Emergency overflow riser	210.2
Top of pond	211

Conclusion

The stormwater management system for the Vose Elementary School property will include standard inlets, mechanical and vegetated treatment facilities, conveyance pipes, and manholes to convey, treat, and detain runoff through the site. Basin 1 runoff will be conveyed through a mechanical treatment facility located in the northeast corner of the site to receive treatment before discharging into the existing conveyance system in SW Denney Road. Runoff from Basin 2 will be conveyed to an extended dry basin in the southeast corner of the site, which will provide water quality treatment for 3.72 acres of impervious area within Basin 2, as well as detention for the entire 7.13 acre basin. Runoff exiting the extended dry basin facility will discharge into the piped system in SW Clifford Street.

Flow rates generated in Basin 1 are calculated to decrease under proposed conditions as compared to existing conditions, and therefore will not require mitigation for water quantity. Requirements will be met in Basin 2 by constructing an onsite extended dry basin located in the southeast corner of the site. Post-development peak release rates will match pre-development peak runoff rates for the 2-year and 10-year storm events, and the post developed peak 25-year, 24-hour flow rate will not exceed 0.5 cfs per acre. The pond was sized using land use assumptions provided in the proposed site plan.

Treatment for right of way runoff associated with frontage improvements along SW Denney Road will be accomplished using vegetated LIDA facilities. Sizing and placement of LIDA water quality facilities within the public right-of-way were determined using the simplified approach method, allowing for a LIDA footprint equal to six percent of the contributing impervious area. Applicable project plan sheets are provided in Attachment D.

References

COB, 2007. *City of Beaverton Engineering Design Manual and Standard Drawings*, City of Beaverton, January 2007.

CWS, 2007. *Design and Construction Standards for Sanitary Sewer and Surface Water Management*, Clean Water Services, June 2007.

SCS, 1986. *Technical Release 55: Urban Hydrology for Small Watersheds*, United States Department of Agriculture Soil Conservation Service, June 1986.

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Figures

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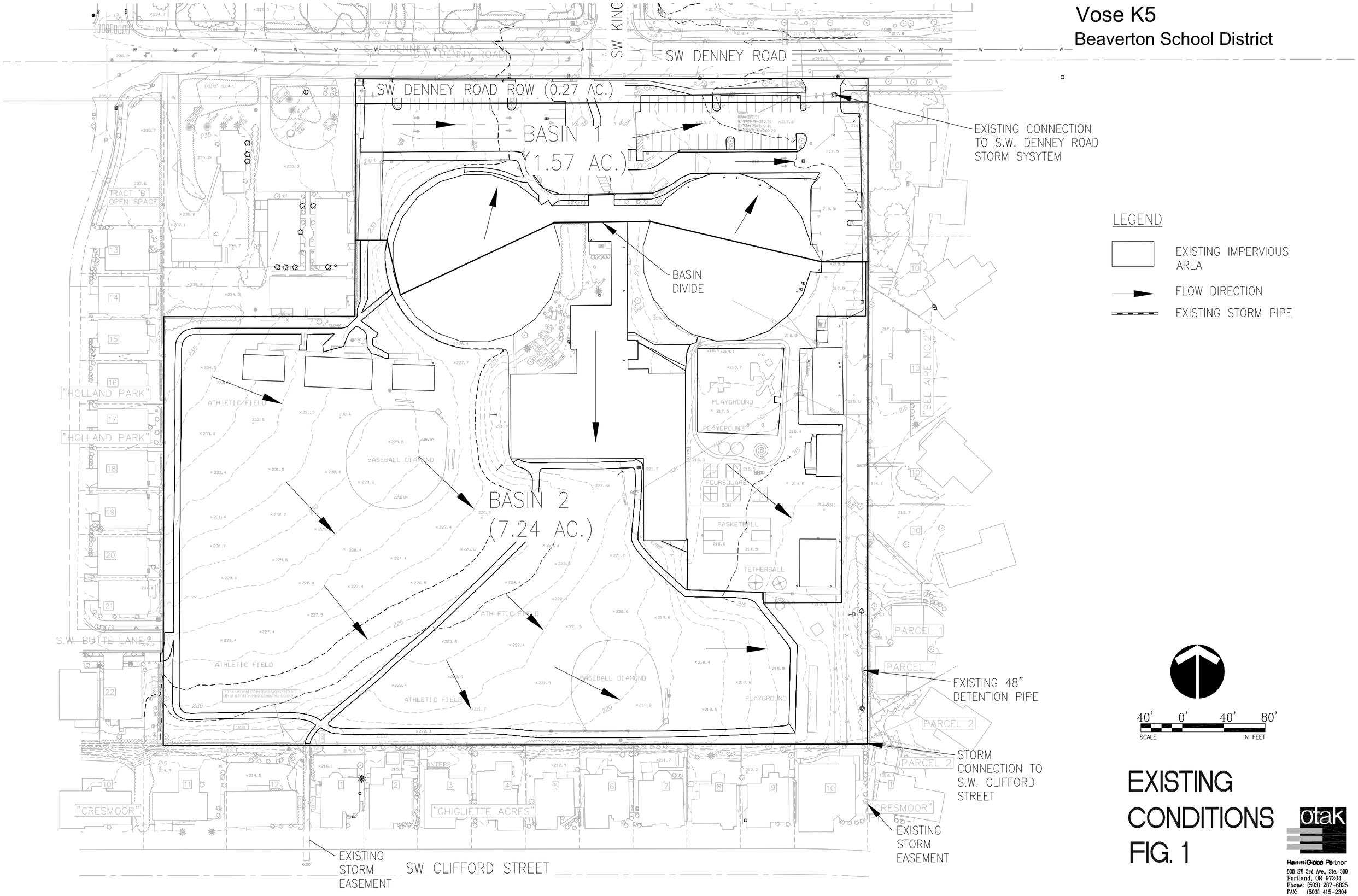
Vose K5

Beaverton School District



EXISTING CONDITIONS FIG. 1

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Vose K5
Beaverton School District

Design Developmer

OFFSITE CONTRIBUTING IMPERVIOUS AREA = 0.36

SW DENNEY ROAD

SW KING

PROPOSED LIDA PLANTER

PUBLIC ROW = 0.27

STORM LINE EXTENSION IN SW DENNEY ROAD

PROPOSED CONNECTION TO SW DENNEY ROAD STORM SYSYTEM

PROPOSED MECHANICAL TREATMENT CATCH BASIN

PROPOSED MECHANICAL TREATMENT MANHOLE (SHALLOW)

BASIN 1 (1.67 AC.)

BASIN 2 (7.13 AC.)

TRACT "B" OPEN SPACE

"HOLLAND PARK"

"HOLLAND PARK"

S.W. BUTTE LANE

"CRESMOOR"

"GHIGLIETTE ACRES"

"BEL AIRE NO.2"

PARCEL 1

PARCEL 2

"CRESMOOR"

SW CLIFFORD STREET

PROPOSED EXTENDED DRY BASIN

OUTFLOW CONTROL STRUCTURE

EMERGENCY OVERFLOW RISER

STORM CONNECTION TO S.W. CLIFFORD STREET

AREA DRAINS

LEGEND

- PROPOSED FLOW DIRECTION
- PROPOSED DRAINAGE BASINS
- PSD — STORM LINE
- STORM MANHOLE
- STORM CURB INLET/CATCH BASIN
- PSD — PRIVATE STORM LINE
- PROPOSED EXTENDED DRY BASIN
- PERF — PERFORATED DRAIN LINE
- CONTRIBUTING OFFSITE DRAINAGE BASINS
- PROPOSED LIDA PLANTER

40' 0' 40' 80'
SCALE IN FEET

PROPOSED STORMWATER MANAGEMENT PLAN
FIG. 2

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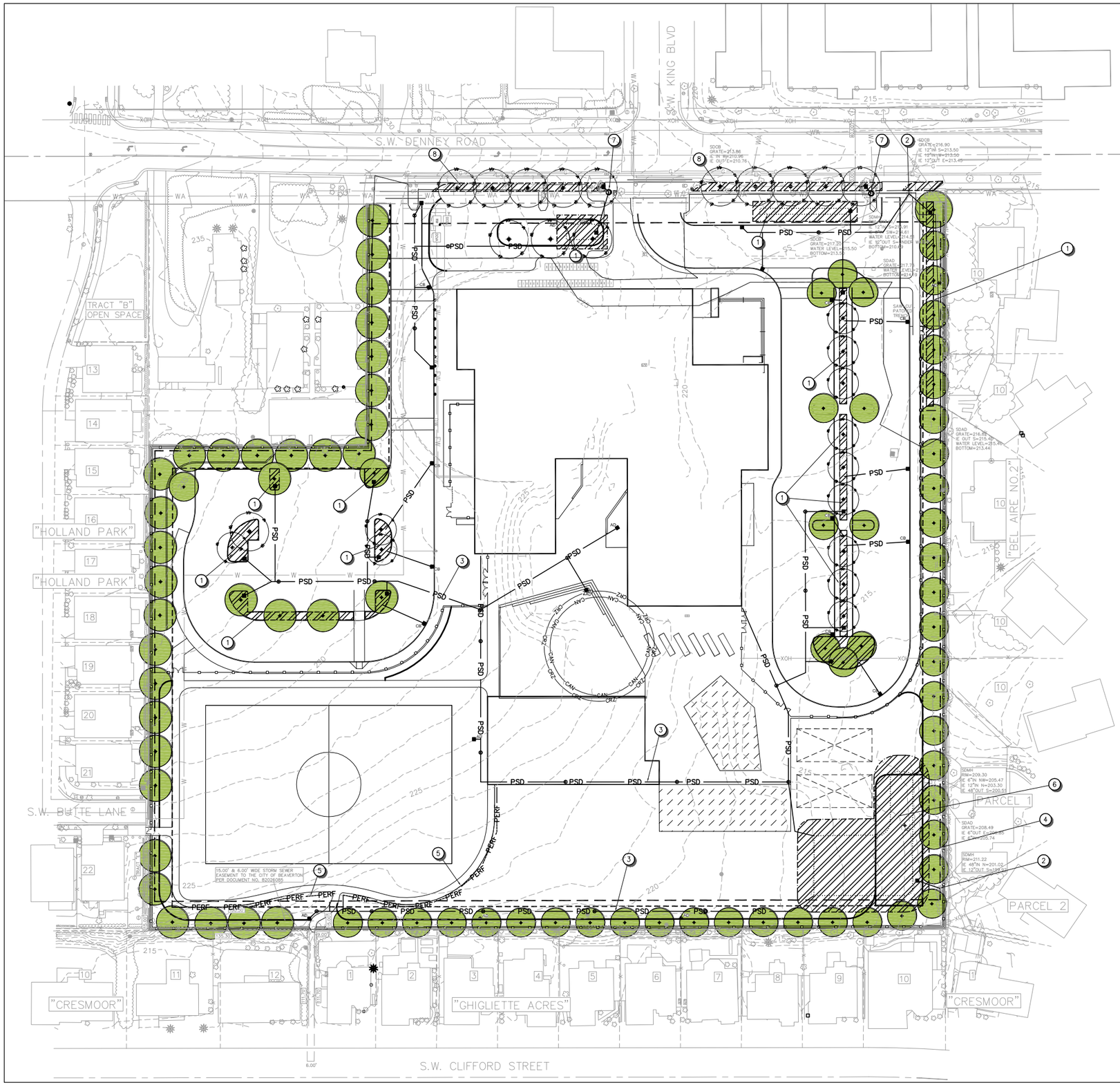

40' 0' 40' 80'
SCALE IN FEET

KEYNOTES:

1. CONSTRUCT PRIVATE VEGETATED STORM FACILITY.
2. CONNECT TO EXISTING STORM SEWER.
3. INSTALL PRIVATE STORM PIPE.
4. FIELD VERIFY AND COLLECT SURVEY DATA FOR EXISTING DETENTION PIPE.
5. INSTALL GRAVEL TRENCH AND PERFORATED PIPE ALONG PATH.
6. CONSTRUCT COMBINED VEGETATED WATER QUALITY AND DETENTION FACILITY.
7. PROPOSED MANHOLE OVER EXISTING STORM LINE. STORM LINE LOCATION SHOWN IS APPROXIMATE AND IS TO BE VERIFIED IN FIELD.
8. CONSTRUCT PUBLIC VEGETATED STORM FACILITY

LEGEND

	EXISTING	PROPOSED
STORM LINE	ST	PSD
STORM MANHOLE		
STORM CURB INLET/CATCH BASIN		
PRIVATE STORM LINE	ST	PSD
PRIVATE STORM CATCH BASIN		
STORM CLEANOUT		
SANITARY LINE		SS
SANITARY MANHOLE		
WATER LINE	WA	W
WATER METER		WM
DOUBLE CHECK VALVE ASSEMBLY		DCVA
DOUBLE CHECK DETECTOR (FIRE)		DCDA
FIRE HYDRANT		
FDC		
DOMESTIC WATER LINE (PVT)		DW
FIRE WATER LINE (PVT)		FW
OVERHEAD POWER	XOH	
UNDERGROUND POWER	E	
POWER POLE		
LIGHT POLE		
GAS LINE	GAS	
1' CONTOUR		
5' CONTOUR	230	
STORMWATER FACILITY		
PERFORATED DRAIN LINE		PERF PERF

FIG 2

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DLR Group
Architecture Planning Interiors

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Schematic Design

OREGON PROFESSIONAL ENGINEER 72629 PRELIMINARY JUNE 11, 2015 KEITH BUSTAMANTE
EXPIRES: 12/31/2015

STORM CONCEPT DESIGN

UTILITY PLAN
Vose K5
Beaverton School District

C2.0
74-15111-10
10/19/2015
REVISIONS

Attachment A — Hydrologic Soil Group Map

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Sw Denney Rd
Denney
Sw Denney Rd
Sw Bel Air
45B
Sw Marylyn
1
200 ft

Hydrologic Soil Group and Surface Runoff

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

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 four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

Report—Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

Hydrologic Soil Group and Surface Runoff–Washington County, Oregon			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
1—Aloha silt loam			
Aloha	90	—	C/D

Hydrologic Soil Group and Surface Runoff–Washington County, Oregon			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
45B—Woodburn silt loam, 3 to 7 percent slopes			
Woodburn	85	—	C

Data Source Information

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 12, Sep 19, 2014

Attachment B – Project Area Summary

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Existing Conditions

17622 Vose Elementary School

	Sidewalk (sf)	Roadway (sf)	Roof (sf)	Total Impervious (sf)	Total Impervious (ac)	Total Pervious (sf)	Total Pervious (ac)	Total Drainage Area (sf)	Total Drainage Area (ac)
Basin 1	7073	34037	20246	61,355	1.41	6,843	0.16	68198	1.57
Basin 2	30848	28,710	54252	113,811	2.61	201,354	4.62	315,164	7.24
				TOTAL ACRE	4.0		4.8		8.8
Public ROW	2163	4494.14	0	6,657	0.15	4,900	0.11	11557.5	0.27

Proposed Conditions

17622 Vose Elementary School

	Sidewalk (sf)	Roadway (sf)	Roof (sf)	Total Impervious (sf)	Total Impervious (ac)	Total Pervious (sf)	Total Pervious (ac)	Total Drainage Area (sf)	Total Drainage Area (ac)
Basin 1	14469	22555	13423	50,447	1.16	22,329	0.51	72,776	1.67
Basin 2	60914	61459.1	39788	162,161	3.72	148481	3.41	310642.09	7.13
				TOTAL ACRE	4.9		3.9		8.8
Public ROW	2669	4995.96	0	7,665	0.18	3,892	0.09	11557.54	0.27

Attachment C – Water Quantity and Quality Facilities, Preliminary Design

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Water Quality Calculations and Orifice Calculations

Vose School

Water Quality Event	0.36	inches in 4 hours with a 96 hour return period
C	0.62	
H	2.10	ft

Basin	Imperivous Area (sf)	Imperivous Area (ac)	Water Quality Volume (cf)	Water Quality Flow (cfs)	Orifice Flow (cfs)	Orifice Diameter (in)	Orifice Area (sf)
Basin 2 Pond	162,161	3.72	4864.83	0.338	0.028	0.846	0.004
Building	36,204	0.83	1086.12	0.075			
Portable	1,792	0.04	53.76	0.004			
Portable	1,792	0.04	53.76	0.004			
Plaza	48267	1.11	1448.01	0.101			
Walkway	9,052	0.21	271.56	0.019			
Fence	3,595	0.08	107.85	0.007			
Parking	61,459	1.41	1843.77	0.128			

StormFilter Calculations

Vose Basin 1 (Majority)

WQ Storm =	**0.36**	inches		
WQ Storm Duration =	**4**	hours		
New Impervious Area =	47,007	sf	**1.079125**	ac
Treated Impervious Area =	1	acres		

Water Quality Volume (WQV): volume of water produced by the water quality storm. 0.36 inches over 100-percent of the new impervious area

WQ Volume = 1410 ft^3

Water Quality Flow (WQF): The average design flow anticipated from the water quality storm

WQ Flow = 44 gpm = 0.10 cfs

STORMFILTER

No. of Cartridges = 5

Use 72" manhole with shallow cartridges

Vose Basin 1 NE

WQ Storm =	**0.36**	inches		
WQ Storm Duration =	**4**	hours		
New Impervious Area =	6,978	sf	**0.1602**	ac
Treated Impervious Area =	0	acres		

Water Quality Volume (WQV): volume of water produced by the water quality storm. 0.36 inches over 100-percent of the new impervious area

WQ Volume = 209 ft^3

Water Quality Flow (WQF): The average design flow anticipated from the water quality storm

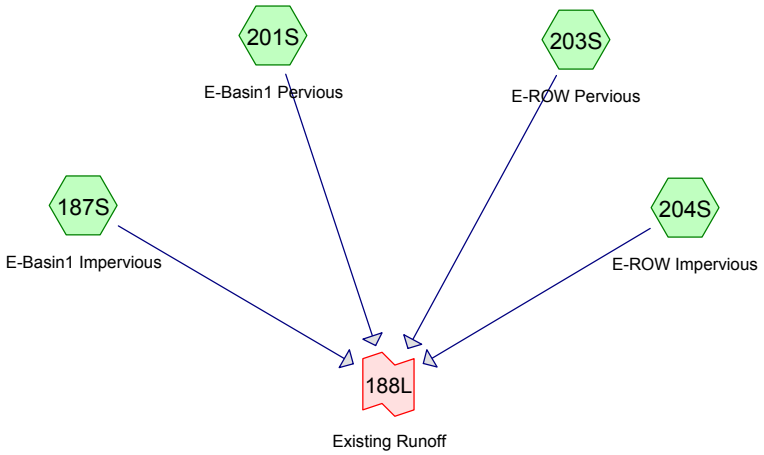
WQ Flow = 7 gpm = 0.01 cfs

STORMFILTER

No. of Cartridges = 1

Use catch basin SF with shallow cartridge

Basin 1 to SW Denney Road

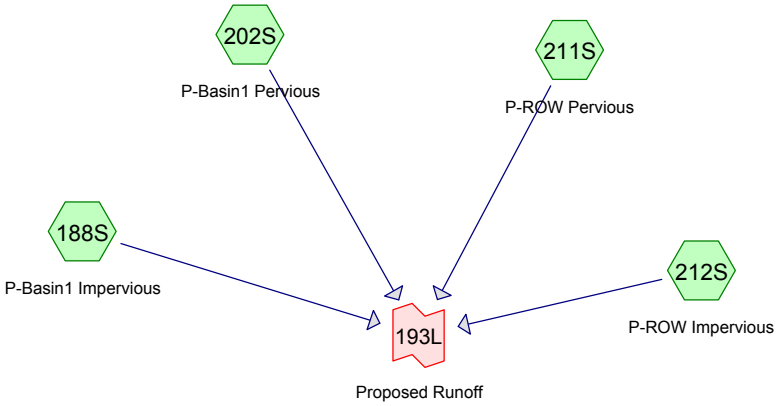


Existing Targets

2-yr = 0.93 cfs

10-yr = 1.36 cfs

25-yr = 1.58 cfs

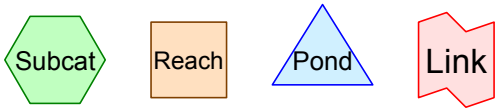


Proposed Flows

2-yr = 0.85

10-yr = 1.28

25-yr = 1.5



Routing Diagram for 17622_Detention_WQ_updated2015_1211
Prepared by Otak, Inc., Printed 12/18/2015
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.867	79	50-75% Grass cover, Fair, HSG C (201S, 202S, 203S, 211S)
2.900	98	Paved parking, HSG C (187S, 188S, 204S, 212S)
3.767	**94**	**TOTAL AREA**

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment187S: E-Basin1 Impervious Runoff Area=1.410 ac 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=0.81 cfs 0.267 af

Subcatchment188S: P-Basin1 Impervious Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=0.67 cfs 0.220 af

Subcatchment201S: E-Basin1 Pervious Runoff Area=0.157 ac 0.00% Impervious Runoff Depth=0.84"
Flow Length=557' Tc=12.6 min CN=79/0 Runoff=0.02 cfs 0.011 af

Subcatchment202S: P-Basin1 Pervious Runoff Area=0.510 ac 0.00% Impervious Runoff Depth=0.84"
Flow Length=557' Tc=12.6 min CN=79/0 Runoff=0.07 cfs 0.036 af

Subcatchment203S: E-ROW Pervious Runoff Area=0.110 ac 0.00% Impervious Runoff Depth=0.84"
Tc=5.0 min CN=79/0 Runoff=0.02 cfs 0.008 af

Subcatchment204S: E-ROW Impervious Runoff Area=0.150 ac 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=0.09 cfs 0.028 af

Subcatchment211S: P-ROW Pervious Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=0.84"
Tc=5.0 min CN=79/0 Runoff=0.01 cfs 0.006 af

Subcatchment212S: P-ROW Impervious Runoff Area=0.180 ac 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=0.10 cfs 0.034 af

Link 188L: Existing Runoff Inflow=0.93 cfs 0.314 af
Primary=0.93 cfs 0.314 af

Link 193L: Proposed Runoff Inflow=0.85 cfs 0.295 af
Primary=0.85 cfs 0.295 af

Total Runoff Area = 3.767 ac Runoff Volume = 0.609 af Average Runoff Depth = 1.94"
23.02% Pervious = 0.867 ac 76.98% Impervious = 2.900 ac

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment187S: E-Basin1 Impervious Runoff Area=1.410 ac 100.00% Impervious Runoff Depth=3.27"
Tc=5.0 min CN=0/98 Runoff=1.16 cfs 0.384 af

Subcatchment188S: P-Basin1 Impervious Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=3.27"
Tc=5.0 min CN=0/98 Runoff=0.95 cfs 0.316 af

Subcatchment201S: E-Basin1 Pervious Runoff Area=0.157 ac 0.00% Impervious Runoff Depth=1.57"
Flow Length=557' Tc=12.6 min CN=79/0 Runoff=0.05 cfs 0.020 af

Subcatchment202S: P-Basin1 Pervious Runoff Area=0.510 ac 0.00% Impervious Runoff Depth=1.57"
Flow Length=557' Tc=12.6 min CN=79/0 Runoff=0.16 cfs 0.067 af

Subcatchment203S: E-ROW Pervious Runoff Area=0.110 ac 0.00% Impervious Runoff Depth=1.57"
Tc=5.0 min CN=79/0 Runoff=0.04 cfs 0.014 af

Subcatchment204S: E-ROW Impervious Runoff Area=0.150 ac 100.00% Impervious Runoff Depth=3.27"
Tc=5.0 min CN=0/98 Runoff=0.12 cfs 0.041 af

Subcatchment211S: P-ROW Pervious Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=1.57"
Tc=5.0 min CN=79/0 Runoff=0.03 cfs 0.012 af

Subcatchment212S: P-ROW Impervious Runoff Area=0.180 ac 100.00% Impervious Runoff Depth=3.27"
Tc=5.0 min CN=0/98 Runoff=0.15 cfs 0.049 af

Link 188L: Existing Runoff Inflow=1.36 cfs 0.459 af
Primary=1.36 cfs 0.459 af

Link 193L: Proposed Runoff Inflow=1.28 cfs 0.443 af
Primary=1.28 cfs 0.443 af

Total Runoff Area = 3.767 ac Runoff Volume = 0.903 af Average Runoff Depth = 2.88"
23.02% Pervious = 0.867 ac 76.98% Impervious = 2.900 ac

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment187S: E-Basin1 Impervious Runoff Area=1.410 ac 100.00% Impervious Runoff Depth=3.77"
Tc=5.0 min CN=0/98 Runoff=1.33 cfs 0.442 af

Subcatchment188S: P-Basin1 Impervious Runoff Area=1.160 ac 100.00% Impervious Runoff Depth=3.77"
Tc=5.0 min CN=0/98 Runoff=1.09 cfs 0.364 af

Subcatchment201S: E-Basin1 Pervious Runoff Area=0.157 ac 0.00% Impervious Runoff Depth=1.96"
Flow Length=557' Tc=12.6 min CN=79/0 Runoff=0.06 cfs 0.026 af

Subcatchment202S: P-Basin1 Pervious Runoff Area=0.510 ac 0.00% Impervious Runoff Depth=1.96"
Flow Length=557' Tc=12.6 min CN=79/0 Runoff=0.21 cfs 0.083 af

Subcatchment203S: E-ROW Pervious Runoff Area=0.110 ac 0.00% Impervious Runoff Depth=1.96"
Tc=5.0 min CN=79/0 Runoff=0.05 cfs 0.018 af

Subcatchment204S: E-ROW Impervious Runoff Area=0.150 ac 100.00% Impervious Runoff Depth=3.77"
Tc=5.0 min CN=0/98 Runoff=0.14 cfs 0.047 af

Subcatchment211S: P-ROW Pervious Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=1.96"
Tc=5.0 min CN=79/0 Runoff=0.04 cfs 0.015 af

Subcatchment212S: P-ROW Impervious Runoff Area=0.180 ac 100.00% Impervious Runoff Depth=3.77"
Tc=5.0 min CN=0/98 Runoff=0.17 cfs 0.056 af

Link 188L: Existing Runoff Inflow=1.58 cfs 0.533 af
Primary=1.58 cfs 0.533 af

Link 193L: Proposed Runoff Inflow=1.50 cfs 0.519 af
Primary=1.50 cfs 0.519 af

Total Runoff Area = 3.767 ac Runoff Volume = 1.052 af Average Runoff Depth = 3.35"
23.02% Pervious = 0.867 ac 76.98% Impervious = 2.900 ac

Basin 2 to SW Clifford Street

Existing Targets

E-Basin2 Pervious

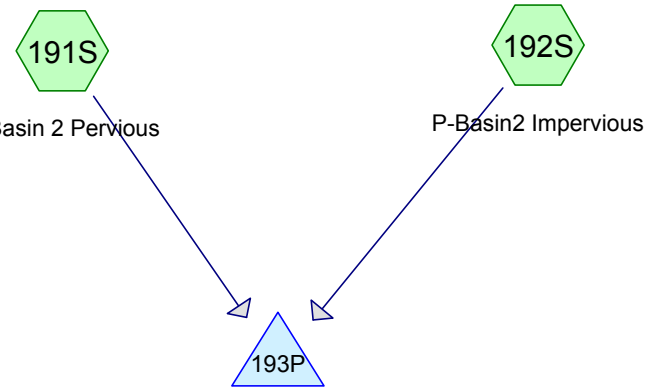
2-year: 0.72 cfs

10-year: 1.65 cfs

25 year: 2.18 cfs

Pre-Developed Conditions

Proposed Flows



P-Basin 2 Pervious

P-Basin2 Impervious

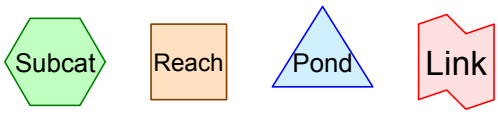
Extended Dry Basin

2-year: 0.71 cfs

10-year: 1.53 cfs

25 year: 2.18 cfs

Proposed Conditions



Routing Diagram for 17622_Detention_WQ_updated2015_1211
Prepared by Otak, Inc., Printed 12/16/2015
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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
10.600	79	50-75% Grass cover, Fair, HSG C (157S, 191S)
3.720	98	Paved parking, HSG C (192S)
14.320	**84**	**TOTAL AREA**

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment157S: E-Basin2 Pervious Runoff Area=7.230 ac 0.00% Impervious Runoff Depth=0.84"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=0.72 cfs 0.505 af

Subcatchment191S: P-Basin 2 Pervious Runoff Area=3.370 ac 0.00% Impervious Runoff Depth=0.84"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=0.34 cfs 0.235 af

Subcatchment192S: P-Basin2 Impervious Runoff Area=3.720 ac 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=2.14 cfs 0.704 af

Pond 193P: Extended Dry Basin Peak Elev=209.14' Storage=0.271 af Inflow=2.42 cfs 0.939 af
Outflow=0.71 cfs 0.885 af

Total Runoff Area = 14.320 ac Runoff Volume = 1.444 af Average Runoff Depth = 1.21"
74.02% Pervious = 10.600 ac 25.98% Impervious = 3.720 ac

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment157S: E-Basin2 Pervious Runoff Area=7.230 ac 0.00% Impervious Runoff Depth=1.57"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=1.65 cfs 0.944 af

Subcatchment191S: P-Basin 2 Pervious Runoff Area=3.370 ac 0.00% Impervious Runoff Depth=1.57"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=0.77 cfs 0.440 af

Subcatchment192S: P-Basin2 Impervious Runoff Area=3.720 ac 100.00% Impervious Runoff Depth=3.27"
Tc=5.0 min CN=0/98 Runoff=3.05 cfs 1.013 af

Pond 193P: Extended Dry Basin Peak Elev=209.78' Storage=0.374 af Inflow=3.73 cfs 1.452 af
Outflow=1.53 cfs 1.394 af

Total Runoff Area = 14.320 ac Runoff Volume = 2.396 af Average Runoff Depth = 2.01"
74.02% Pervious = 10.600 ac 25.98% Impervious = 3.720 ac

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment157S: E-Basin2 Pervious Runoff Area=7.230 ac 0.00% Impervious Runoff Depth=1.96"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=2.18 cfs 1.183 af

Subcatchment191S: P-Basin 2 Pervious Runoff Area=3.370 ac 0.00% Impervious Runoff Depth=1.96"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=1.02 cfs 0.551 af

Subcatchment192S: P-Basin2 Impervious Runoff Area=3.720 ac 100.00% Impervious Runoff Depth=3.77"
Tc=5.0 min CN=0/98 Runoff=3.50 cfs 1.167 af

Pond 193P: Extended Dry Basin Peak Elev=209.95' Storage=0.402 af Inflow=4.41 cfs 1.719 af
Outflow=2.18 cfs 1.659 af

Total Runoff Area = 14.320 ac Runoff Volume = 2.902 af Average Runoff Depth = 2.43"
74.02% Pervious = 10.600 ac 25.98% Impervious = 3.720 ac

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment157S: E-Basin2 Pervious Runoff Area=7.230 ac 0.00% Impervious Runoff Depth=2.38"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=2.74 cfs 1.432 af

Subcatchment191S: P-Basin 2 Pervious Runoff Area=3.370 ac 0.00% Impervious Runoff Depth=2.38"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=1.28 cfs 0.667 af

Subcatchment192S: P-Basin2 Impervious Runoff Area=3.720 ac 100.00% Impervious Runoff Depth=4.26"
Tc=5.0 min CN=0/98 Runoff=3.95 cfs 1.322 af

Pond 193P: Extended Dry Basin Peak Elev=210.09' Storage=0.427 af Inflow=5.10 cfs 1.989 af
Outflow=3.28 cfs 1.928 af

Total Runoff Area = 14.320 ac Runoff Volume = 3.421 af Average Runoff Depth = 2.87"
74.02% Pervious = 10.600 ac 25.98% Impervious = 3.720 ac

Time span=0.00-50.00 hrs, dt=0.01 hrs, 5001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment157S: E-Basin2 Pervious Runoff Area=7.230 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=0.00 cfs 0.000 af

Subcatchment191S: P-Basin 2 Pervious Runoff Area=3.370 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=807' Tc=31.8 min CN=79/0 Runoff=0.00 cfs 0.000 af

Subcatchment192S: P-Basin2 Impervious Runoff Area=3.720 ac 100.00% Impervious Runoff Depth=0.36"
Tc=5.0 min CN=0/98 Runoff=0.34 cfs 0.113 af

Pond 193P: Extended Dry Basin Peak Elev=207.61' Storage=0.066 af Inflow=0.34 cfs 0.113 af
Outflow=0.03 cfs 0.108 af

Total Runoff Area = 14.320 ac Runoff Volume = 0.113 af Average Runoff Depth = 0.09"
74.02% Pervious = 10.600 ac 25.98% Impervious = 3.720 ac

Summary for Pond 193P: Extended Dry Basin

Inflow Area = 7.090 ac, 52.47% Impervious, Inflow Depth = 1.59" for 2-year Storm event
Inflow = 2.42 cfs @ 7.93 hrs, Volume= 0.939 af
Outflow = 0.71 cfs @ 9.85 hrs, Volume= 0.885 af, Atten= 70%, Lag= 115.5 min
Primary = 0.71 cfs @ 9.85 hrs, Volume= 0.885 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.01 hrs
Peak Elev= 209.14' @ 9.85 hrs Surf.Area= 0.152 ac Storage= 0.271 af

Plug-Flow detention time= 314.2 min calculated for 0.885 af (94% of inflow)
Center-of-Mass det. time= 273.7 min (999.7 - 725.9)

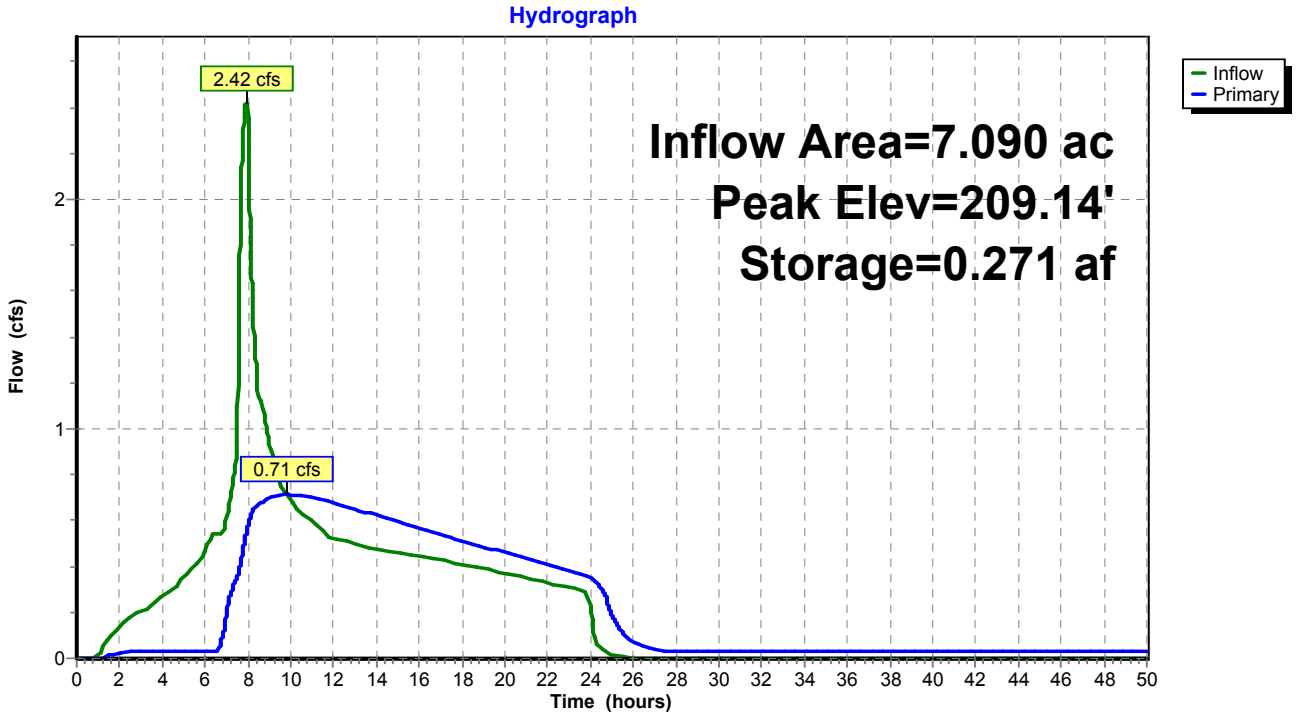
Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	0.597 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
207.00	0.103	0.000	0.000
208.00	0.125	0.114	0.114
209.00	0.148	0.137	0.251
210.00	0.173	0.160	0.411
211.00	0.200	0.187	0.597

Device	Routing	Invert	Outlet Devices
#1	Primary	205.50'	**12.0" Round Outlet Pipe** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 205.50' / 202.20' S= 0.0330 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	210.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	209.40'	**14.0" Vert. 10-yr Orifice** C= 0.600
#4	Device 1	208.00'	**4.9" Horiz. 2-yr Orifice** C= 0.600 Limited to weir flow at low heads
#5	Device 1	203.50'	**0.9" Horiz. WQ Orifice** C= 0.600 Limited to weir flow at low heads
#6	Device 5	207.00'	**2.1' long Ditch Inlet** 2 End Contraction(s)

Primary OutFlow Max=0.71 cfs @ 9.85 hrs HW=209.14' (Free Discharge)
└─**1=Outlet Pipe** (Passes 0.71 cfs of 6.70 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├─**3=10-yr Orifice** (Controls 0.00 cfs)
  ├─**4=2-yr Orifice** (Orifice Controls 0.67 cfs @ 5.14 fps)
  └─**5=WQ Orifice** (Orifice Controls 0.04 cfs @ 9.19 fps)
    └─**6=Ditch Inlet** (Passes 0.04 cfs of 17.12 cfs potential flow)

Pond 193P: Extended Dry Basin



Summary for Pond 193P: Extended Dry Basin

Inflow Area = 7.090 ac, 52.47% Impervious, Inflow Depth = 2.46" for 10-year Storm event
Inflow = 3.73 cfs @ 7.94 hrs, Volume= 1.452 af
Outflow = 1.53 cfs @ 8.96 hrs, Volume= 1.394 af, Atten= 59%, Lag= 61.2 min
Primary = 1.53 cfs @ 8.96 hrs, Volume= 1.394 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.01 hrs
Peak Elev= 209.78' @ 8.96 hrs Surf.Area= 0.168 ac Storage= 0.374 af

Plug-Flow detention time= 276.0 min calculated for 1.394 af (96% of inflow)
Center-of-Mass det. time= 247.3 min (965.2 - 717.8)

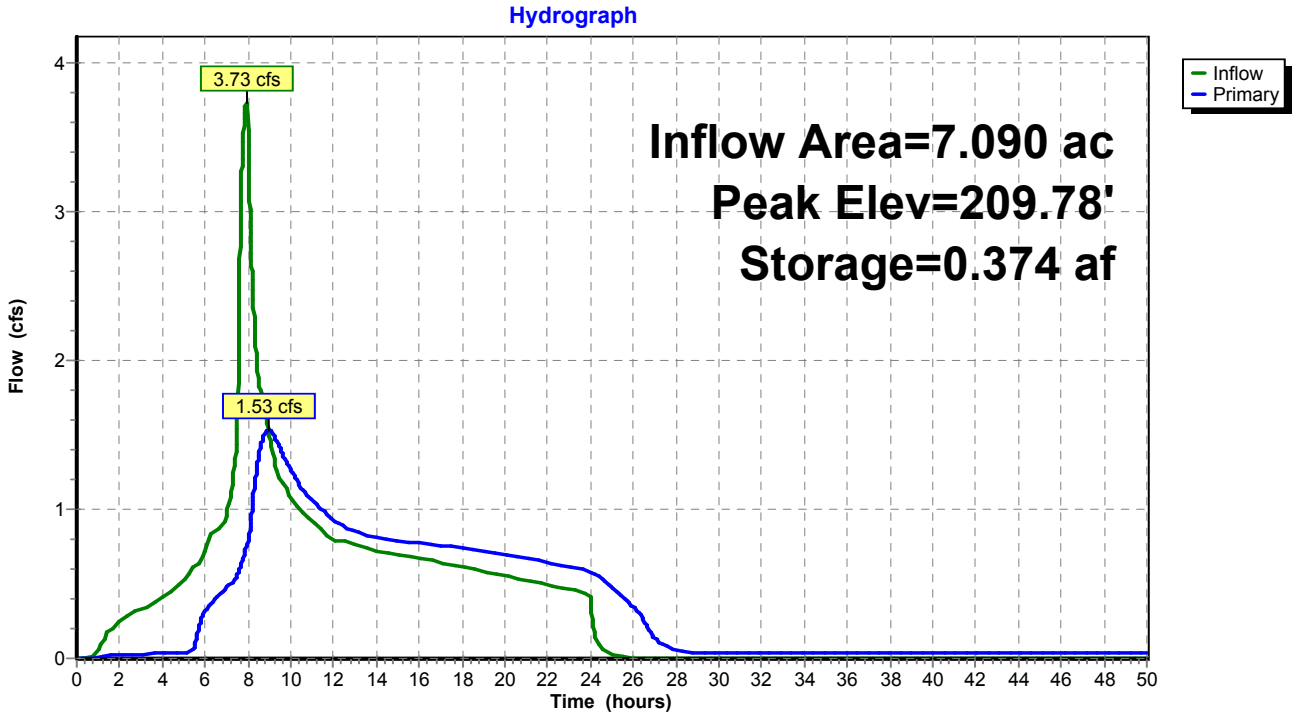
Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	0.597 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
207.00	0.103	0.000	0.000
208.00	0.125	0.114	0.114
209.00	0.148	0.137	0.251
210.00	0.173	0.160	0.411
211.00	0.200	0.187	0.597

Device	Routing	Invert	Outlet Devices
#1	Primary	205.50'	**12.0" Round Outlet Pipe** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 205.50' / 202.20' S= 0.0330 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	210.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	209.40'	**14.0" Vert. 10-yr Orifice** C= 0.600
#4	Device 1	208.00'	**4.9" Horiz. 2-yr Orifice** C= 0.600 Limited to weir flow at low heads
#5	Device 1	203.50'	**0.9" Horiz. WQ Orifice** C= 0.600 Limited to weir flow at low heads
#6	Device 5	207.00'	**2.1' long Ditch Inlet** 2 End Contraction(s)

Primary OutFlow Max=1.53 cfs @ 8.96 hrs HW=209.78' (Free Discharge)
└─**1=Outlet Pipe** (Passes 1.53 cfs of 7.36 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├─**3=10-yr Orifice** (Orifice Controls 0.64 cfs @ 2.11 fps)
  ├─**4=2-yr Orifice** (Orifice Controls 0.84 cfs @ 6.43 fps)
  └─**5=WQ Orifice** (Orifice Controls 0.04 cfs @ 9.97 fps)
    └─**6=Ditch Inlet** (Passes 0.04 cfs of 23.43 cfs potential flow)

Pond 193P: Extended Dry Basin



Summary for Pond 193P: Extended Dry Basin

Inflow Area = 7.090 ac, 52.47% Impervious, Inflow Depth = 2.91" for 25-year Storm event
Inflow = 4.41 cfs @ 7.94 hrs, Volume= 1.719 af
Outflow = 2.18 cfs @ 8.58 hrs, Volume= 1.659 af, Atten= 51%, Lag= 38.5 min
Primary = 2.18 cfs @ 8.58 hrs, Volume= 1.659 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.01 hrs
Peak Elev= 209.95' @ 8.58 hrs Surf.Area= 0.172 ac Storage= 0.402 af

Plug-Flow detention time= 253.9 min calculated for 1.658 af (96% of inflow)
Center-of-Mass det. time= 228.7 min (943.1 - 714.3)

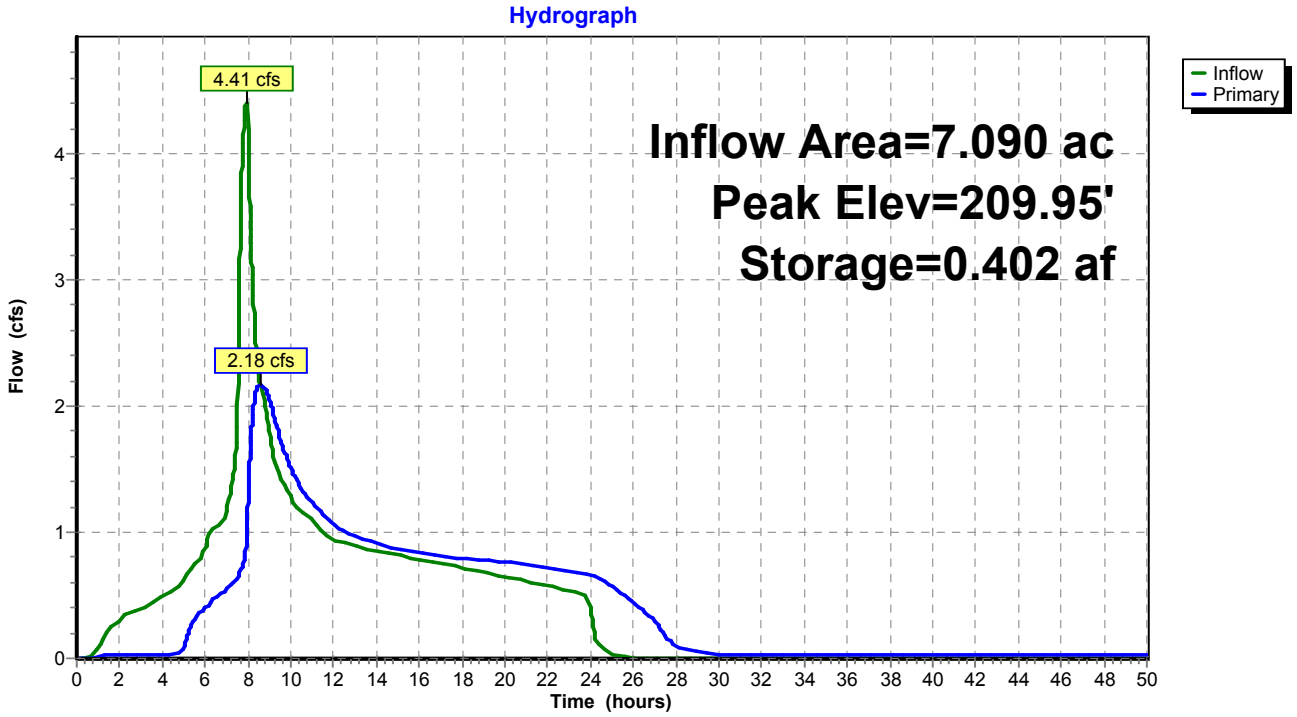
Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	0.597 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
207.00	0.103	0.000	0.000
208.00	0.125	0.114	0.114
209.00	0.148	0.137	0.251
210.00	0.173	0.160	0.411
211.00	0.200	0.187	0.597

Device	Routing	Invert	Outlet Devices
#1	Primary	205.50'	**12.0" Round Outlet Pipe** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 205.50' / 202.20' S= 0.0330 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	210.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	209.40'	**14.0" Vert. 10-yr Orifice** C= 0.600
#4	Device 1	208.00'	**4.9" Horiz. 2-yr Orifice** C= 0.600 Limited to weir flow at low heads
#5	Device 1	203.50'	**0.9" Horiz. WQ Orifice** C= 0.600 Limited to weir flow at low heads
#6	Device 5	207.00'	**2.1' long Ditch Inlet** 2 End Contraction(s)

Primary OutFlow Max=2.17 cfs @ 8.58 hrs HW=209.95' (Free Discharge)
└─**1=Outlet Pipe** (Passes 2.17 cfs of 7.52 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├─**3=10-yr Orifice** (Orifice Controls 1.25 cfs @ 2.52 fps)
  ├─**4=2-yr Orifice** (Orifice Controls 0.88 cfs @ 6.72 fps)
  └─**5=WQ Orifice** (Orifice Controls 0.04 cfs @ 10.16 fps)
    └─**6=Ditch Inlet** (Passes 0.04 cfs of 25.01 cfs potential flow)

Pond 193P: Extended Dry Basin



Summary for Pond 193P: Extended Dry Basin

Inflow Area = 7.090 ac, 52.47% Impervious, Inflow Depth = 3.37" for 100-year Storm event
Inflow = 5.10 cfs @ 7.95 hrs, Volume= 1.989 af
Outflow = 3.28 cfs @ 8.26 hrs, Volume= 1.928 af, Atten= 36%, Lag= 18.7 min
Primary = 3.28 cfs @ 8.26 hrs, Volume= 1.928 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.01 hrs
Peak Elev= 210.09' @ 8.26 hrs Surf.Area= 0.175 ac Storage= 0.427 af

Plug-Flow detention time= 233.4 min calculated for 1.928 af (97% of inflow)
Center-of-Mass det. time= 210.7 min (921.9 - 711.2)

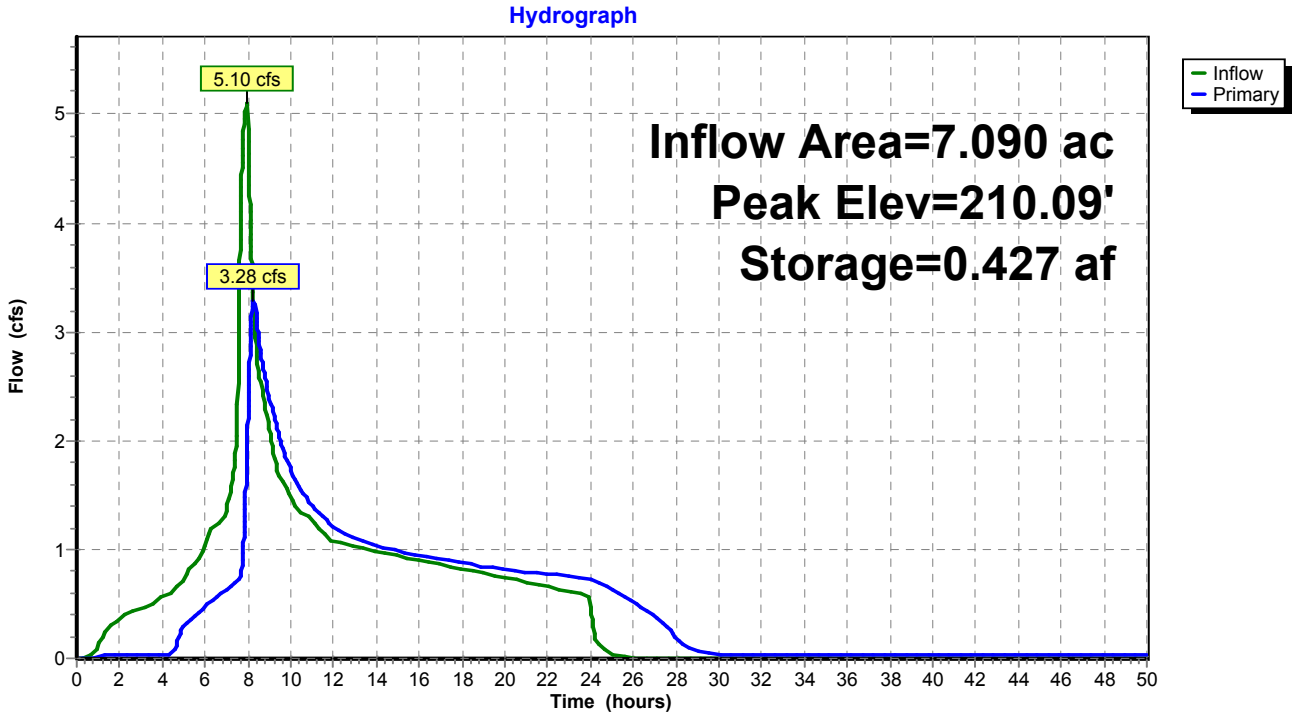
Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	0.597 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
207.00	0.103	0.000	0.000
208.00	0.125	0.114	0.114
209.00	0.148	0.137	0.251
210.00	0.173	0.160	0.411
211.00	0.200	0.187	0.597

Device	Routing	Invert	Outlet Devices
#1	Primary	205.50'	**12.0" Round Outlet Pipe** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 205.50' / 202.20' S= 0.0330 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	210.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	209.40'	**14.0" Vert. 10-yr Orifice** C= 0.600
#4	Device 1	208.00'	**4.9" Horiz. 2-yr Orifice** C= 0.600 Limited to weir flow at low heads
#5	Device 1	203.50'	**0.9" Horiz. WQ Orifice** C= 0.600 Limited to weir flow at low heads
#6	Device 5	207.00'	**2.1' long Ditch Inlet** 2 End Contraction(s)

Primary OutFlow Max=3.27 cfs @ 8.26 hrs HW=210.09' (Free Discharge)
└─**1=Outlet Pipe** (Passes 3.27 cfs of 7.65 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.45 cfs @ 0.99 fps)
  ├─**3=10-yr Orifice** (Orifice Controls 1.87 cfs @ 2.83 fps)
  ├─**4=2-yr Orifice** (Orifice Controls 0.91 cfs @ 6.96 fps)
  └─**5=WQ Orifice** (Orifice Controls 0.05 cfs @ 10.32 fps)
    └─**6=Ditch Inlet** (Passes 0.05 cfs of 26.33 cfs potential flow)

Pond 193P: Extended Dry Basin



Summary for Pond 193P: Extended Dry Basin

Inflow Area = 7.090 ac, 52.47% Impervious, Inflow Depth = 0.19" for WQ Storm event
Inflow = 0.34 cfs @ 7.93 hrs, Volume= 0.113 af
Outflow = 0.03 cfs @ 24.02 hrs, Volume= 0.108 af, Atten= 91%, Lag= 965.4 min
Primary = 0.03 cfs @ 24.02 hrs, Volume= 0.108 af

Routing by Stor-Ind method, Time Span= 0.00-50.00 hrs, dt= 0.01 hrs
Peak Elev= 207.61' @ 24.02 hrs Surf.Area= 0.116 ac Storage= 0.066 af

Plug-Flow detention time= 916.7 min calculated for 0.108 af (96% of inflow)
Center-of-Mass det. time= 886.8 min (1,639.1 - 752.3)

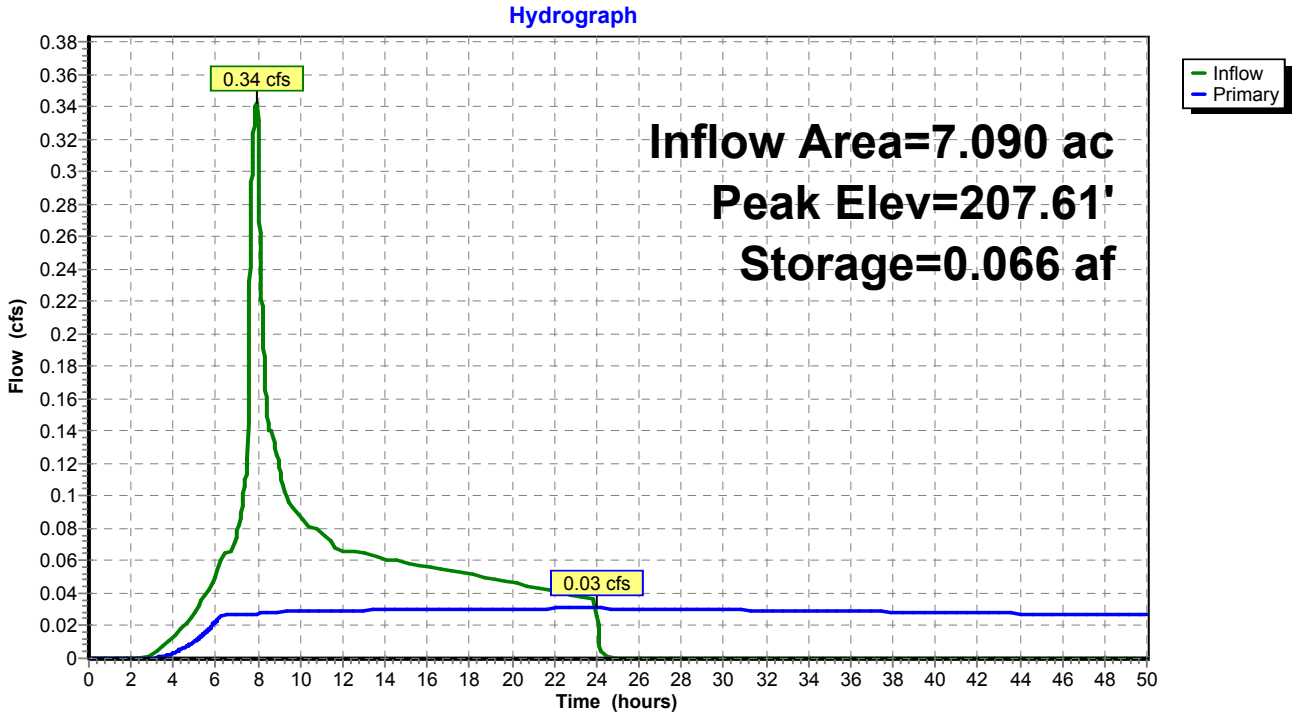
Volume	Invert	Avail.Storage	Storage Description
#1	207.00'	0.597 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
207.00	0.103	0.000	0.000
208.00	0.125	0.114	0.114
209.00	0.148	0.137	0.251
210.00	0.173	0.160	0.411
211.00	0.200	0.187	0.597

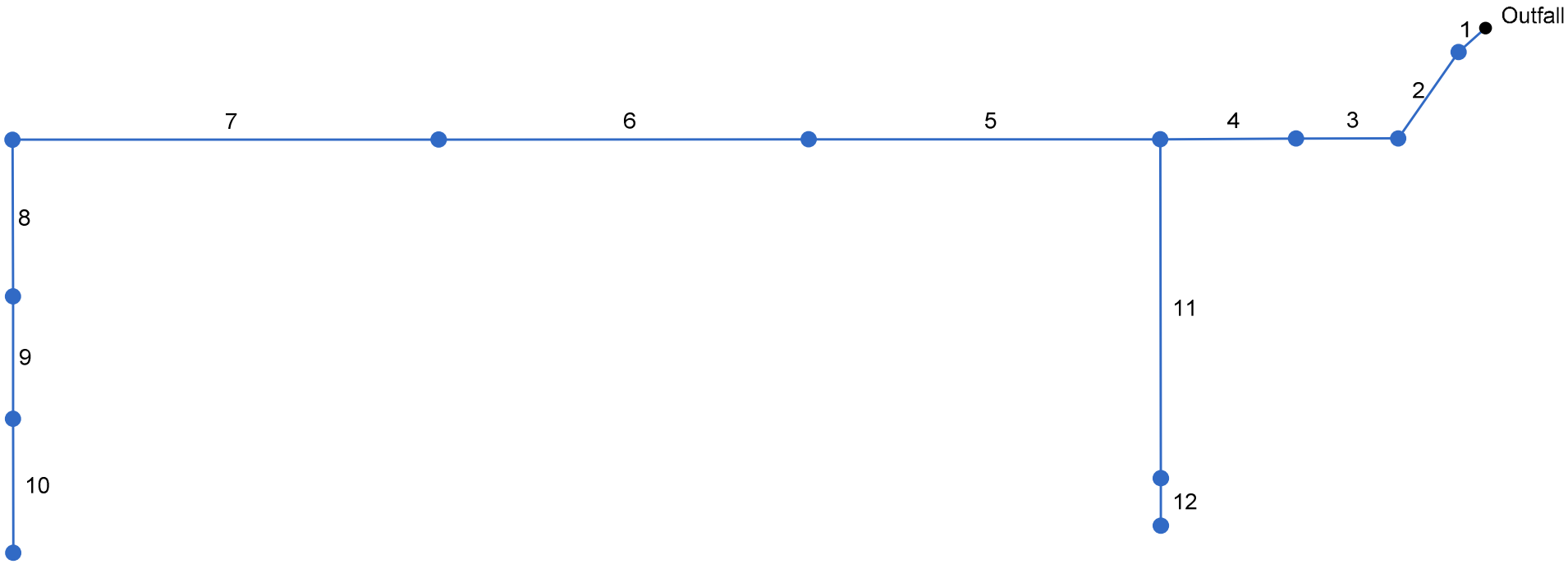
Device	Routing	Invert	Outlet Devices
#1	Primary	205.50'	**12.0" Round Outlet Pipe** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 205.50' / 202.20' S= 0.0330 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	210.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	209.40'	**14.0" Vert. 10-yr Orifice** C= 0.600
#4	Device 1	208.00'	**4.9" Horiz. 2-yr Orifice** C= 0.600 Limited to weir flow at low heads
#5	Device 1	203.50'	**0.9" Horiz. WQ Orifice** C= 0.600 Limited to weir flow at low heads
#6	Device 5	207.00'	**2.1' long Ditch Inlet** 2 End Contraction(s)

Primary OutFlow Max=0.03 cfs @ 24.02 hrs HW=207.61' (Free Discharge)
└─**1=Outlet Pipe** (Passes 0.03 cfs of 4.79 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├─**3=10-yr Orifice** (Controls 0.00 cfs)
  ├─**4=2-yr Orifice** (Controls 0.00 cfs)
  └─**5=WQ Orifice** (Orifice Controls 0.03 cfs @ 6.99 fps)
    └─**6=Ditch Inlet** (Passes 0.03 cfs of 3.05 cfs potential flow)

Pond 193P: Extended Dry Basin



Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Vose_Basin1Convey.stm	Number of lines: 12	Date: 12/17/2015

Storm Sewers v10.30

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	10.537	137.120	MH	0.00	0.16	0.81	5.0	215.00	0.57	215.06	12	Cir	0.012	0.27	218.00	Pipe - (35)
2	1	30.995	-13.248	MH	0.00	0.00	0.00	0.0	215.07	0.52	215.23	12	Cir	0.012	0.86	219.50	Pipe - (34)
3	2	29.247	56.035	MH	0.00	0.12	0.86	5.0	215.33	0.51	215.48	12	Cir	0.012	0.15	220.50	Pipe - (33)
4	3	38.881	-0.241	MH	0.00	0.00	0.00	0.0	217.38	0.57	217.60	12	Cir	0.012	1.00	221.50	Pipe - (32)
5	4	100.653	0.334	MH	0.00	0.31	0.85	5.0	217.70	0.50	218.20	10	Cir	0.012	0.15	222.50	Pipe - (31)
6	5	105.890	-0.035	MH	0.00	0.39	0.56	5.0	218.30	0.66	219.00	10	Cir	0.012	0.15	224.50	Pipe - (30)
7	6	122.010	0.001	MH	0.00	0.11	0.90	5.0	219.10	0.57	219.80	8	Cir	0.012	1.00	227.50	Pipe - (29)
8	7	46.715	-90.164	MH	0.00	0.00	0.00	0.0	219.90	0.64	220.20	8	Cir	0.012	0.15	225.50	Pipe - (28)
9	8	36.517	0.198	MH	0.00	0.09	0.90	5.0	220.30	0.82	220.60	8	Cir	0.012	0.15	224.83	Pipe - (27)
10	9	40.000	-0.111	MH	0.00	0.18	0.67	5.0	220.70	0.75	221.00	8	Cir	0.012	1.00	225.98	Pipe - (26)
11	4	101.109	-89.772	MH	0.00	0.17	0.86	5.0	217.70	0.54	218.25	10	Cir	0.012	0.15	222.00	Pipe - (37)
12	11	14.138	0.106	MH	0.00	0.15	0.78	5.0	218.35	0.57	218.43	8	Cir	0.012	1.00	222.00	Pipe - (36)

Project File: Vose_Basin1Convey.stm | Number of lines: 12 | Date: 12/17/2015

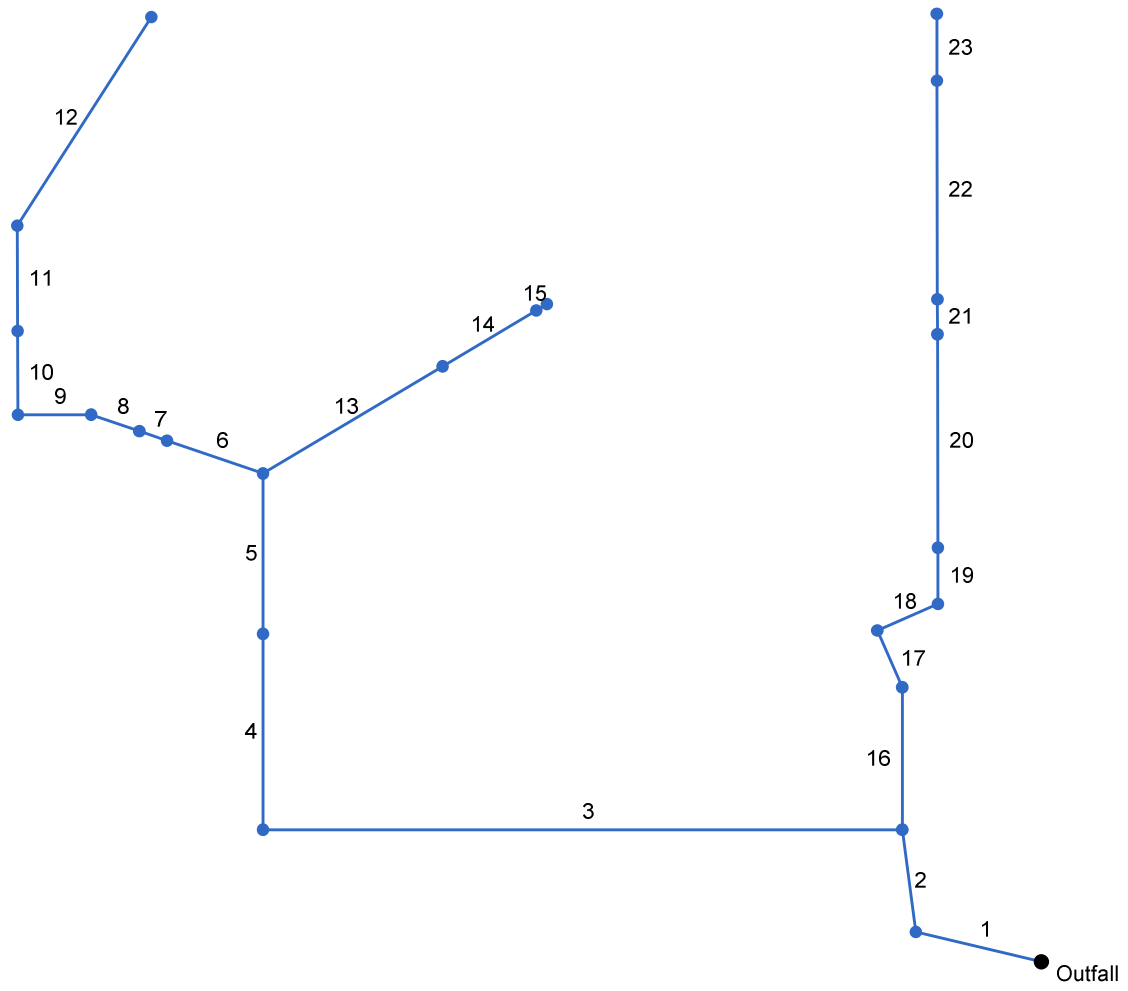
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	10.537	0.16	1.68	0.81	0.13	1.28	5.0	9.7	2.0	2.56	2.91	3.73	12	0.57	215.00	215.06	215.83	215.86	217.05	218.00	Pipe - (35)
2	1	30.995	0.00	1.52	0.00	0.00	1.15	0.0	9.5	2.0	2.31	2.77	3.39	12	0.52	215.07	215.23	215.92	216.01	218.00	219.50	Pipe - (34)
3	2	29.247	0.12	1.52	0.86	0.10	1.15	5.0	9.3	2.0	2.33	2.76	3.43	12	0.51	215.33	215.48	216.17	216.26	219.50	220.50	Pipe - (33)
4	3	38.881	0.00	1.40	0.00	0.00	1.05	0.0	9.1	2.0	2.14	2.90	4.04	12	0.57	217.38	217.60	218.02	218.24	220.50	221.50	Pipe - (32)
5	4	100.653	0.31	1.08	0.85	0.26	0.78	5.0	8.6	2.1	1.63	1.67	3.20	10	0.50	217.70	218.20	218.49	218.90	221.50	222.50	Pipe - (31)
6	5	105.890	0.39	0.77	0.56	0.22	0.52	5.0	7.8	2.2	1.12	1.93	3.04	10	0.66	218.30	219.00	218.93	219.47	222.50	224.50	Pipe - (30)
7	6	122.010	0.11	0.38	0.90	0.10	0.30	5.0	6.8	2.3	0.68	0.99	3.06	8	0.57	219.10	219.80	219.50	220.20	224.50	227.50	Pipe - (29)
8	7	46.715	0.00	0.27	0.00	0.00	0.20	0.0	6.2	2.3	0.47	1.05	2.34	8	0.64	219.90	220.20	220.35	220.52	227.50	225.50	Pipe - (28)
9	8	36.517	0.09	0.27	0.90	0.08	0.20	5.0	5.8	2.4	0.48	1.19	3.03	8	0.82	220.30	220.60	220.59	220.92	225.50	224.83	Pipe - (27)
10	9	40.000	0.18	0.18	0.67	0.12	0.12	5.0	5.0	2.4	0.30	1.13	2.59	8	0.75	220.70	221.00	220.93	221.25	224.83	225.98	Pipe - (26)
11	4	101.109	0.17	0.32	0.86	0.15	0.26	5.0	5.3	2.4	0.64	1.75	2.06	10	0.54	217.70	218.25	218.49	218.60	221.50	222.00	Pipe - (37)
12	11	14.138	0.15	0.15	0.78	0.12	0.12	5.0	5.0	2.4	0.29	0.98	2.41	8	0.57	218.35	218.43	218.60	218.68	222.00	222.00	Pipe - (36)

Project File: Vose_Basin1Convey.stm | Number of lines: 12 | Run Date: 12/17/2015

NOTES:Intensity = 36.90 / (Inlet time + 14.00) ^ 0.92 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Vose_Basin2aConvey.stm	Number of lines: 23	Date: 12/17/2015

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	53.000	-166.572	MH	0.00	0.00	0.00	0.0	209.00	8.49	213.50	24	Cir	0.012	0.95	217.68	Pipe - (46)
2	1	42.519	69.038	MH	0.00	0.00	0.00	0.0	213.60	3.29	215.00	24	Cir	0.012	0.99	219.90	Pipe - (45)
3	2	262.457	-82.466	MH	0.00	0.00	0.00	0.0	215.10	0.53	216.50	24	Cir	0.012	1.00	223.50	Pipe - (66)
4	3	80.727	90.000	MH	0.00	0.19	0.31	5.0	216.60	0.50	217.00	24	Cir	0.012	0.15	224.50	Pipe - (65)
5	4	66.103	0.000	MH	0.00	0.29	0.90	5.0	217.10	0.61	217.50	24	Cir	0.012	0.96	224.70	Pipe - (64)
6	5	41.676	-71.018	MH	0.00	0.00	0.00	0.0	218.00	1.20	218.50	18	Cir	0.012	0.15	224.20	Pipe - (63)
7	6	11.974	0.000	MH	0.00	0.55	0.79	5.0	218.60	0.84	218.70	18	Cir	0.012	0.15	224.20	Pipe - (62)
8	7	20.957	0.000	MH	0.00	0.12	0.81	5.0	218.80	0.95	219.00	18	Cir	0.012	0.38	224.80	Pipe - (61)
9	8	30.053	-19.112	MH	0.00	0.11	0.47	5.0	219.10	0.67	219.30	12	Cir	0.012	1.00	227.50	Pipe - (60)
10	9	34.529	89.935	MH	0.00	0.26	0.79	5.0	219.40	0.58	219.60	12	Cir	0.012	0.15	225.60	Pipe - (59)
11	10	43.420	0.000	MH	0.00	0.15	0.67	5.0	219.70	0.69	220.00	12	Cir	0.012	0.60	225.50	Pipe - (58)
12	11	102.133	32.808	MH	0.00	0.09	0.73	5.0	220.10	0.59	220.70	12	Cir	0.012	1.00	224.71	Pipe - (76)
13	5	85.974	59.080	MH	0.00	0.13	0.64	5.0	217.60	0.58	218.10	18	Cir	0.012	0.15	225.20	Pipe - (69)
14	13	44.802	0.000	MH	0.00	0.11	0.70	5.0	218.20	0.67	218.50	12	Cir	0.012	0.15	224.84	Pipe - (68)
15	14	5.119	0.000	MH	0.00	0.33	0.88	5.0	218.60	0.59	218.63	12	Cir	0.012	1.00	224.66	Pipe - (67)
16	2	58.712	7.534	MH	0.00	0.00	0.00	0.0	215.10	0.68	215.50	18	Cir	0.012	0.46	221.40	Pipe - (44)
17	16	25.567	-23.620	MH	0.00	0.22	0.90	5.0	215.60	0.78	215.80	18	Cir	0.012	1.00	221.30	Pipe - (43)
18	17	27.193	90.000	MH	0.00	0.26	0.81	5.0	215.90	0.74	216.10	18	Cir	0.012	0.93	220.80	Pipe - (42)
19	18	23.214	-66.491	MH	0.00	0.11	0.84	5.0	216.20	0.86	216.40	18	Cir	0.012	0.15	220.90	Pipe - (75)
20	19	87.978	0.000	MH	0.00	0.20	0.82	5.0	216.50	0.57	217.00	12	Cir	0.012	0.15	221.80	Pipe - (41)
21	20	14.395	0.000	MH	0.00	0.14	0.87	5.0	217.10	0.69	217.20	12	Cir	0.012	0.15	221.80	Pipe - (40)
22	21	90.133	0.000	MH	0.00	0.10	0.87	5.0	217.30	0.50	217.75	12	Cir	0.012	0.15	221.80	Pipe - (39)
23	22	27.588	0.000	MH	0.00	0.13	0.82	5.0	217.85	0.54	218.00	10	Cir	0.012	1.00	221.90	Pipe - (38)

Project File: Vose_Basin2aConvey.stm | Number of lines: 23 | Date: 12/17/2015

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	53.000	0.00	3.49	0.00	0.00	2.71	0.0	10.3	6.9	18.64	71.40	12.07	24	8.49	209.00	213.50	209.76	215.05	215.46	217.68	Pipe - (46)
2	1	42.519	0.00	3.49	0.00	0.00	2.71	0.0	10.2	6.9	18.70	44.46	7.39	24	3.29	213.60	215.00	215.05	216.56	217.68	219.90	Pipe - (45)
3	2	262.457	0.00	2.33	0.00	0.00	1.73	0.0	9.1	7.1	12.33	17.90	5.47	24	0.53	215.10	216.50	216.56	217.76	219.90	223.50	Pipe - (66)
4	3	80.727	0.19	2.33	0.31	0.06	1.73	5.0	8.8	7.2	12.45	17.25	5.96	24	0.50	216.60	217.00	217.86	218.27	223.50	224.50	Pipe - (65)
5	4	66.103	0.29	2.14	0.90	0.26	1.67	5.0	8.5	7.3	12.13	19.06	6.12	24	0.61	217.10	217.50	218.27	218.75	224.50	224.70	Pipe - (64)
6	5	41.676	0.00	1.28	0.00	0.00	0.96	0.0	8.4	7.3	6.99	12.46	6.35	18	1.20	218.00	218.50	218.80	219.52	224.70	224.20	Pipe - (63)
7	6	11.974	0.55	1.28	0.79	0.43	0.96	5.0	8.3	7.3	7.00	10.40	5.80	18	0.84	218.60	218.70	219.52	219.72	224.20	224.20	Pipe - (62)
8	7	20.957	0.12	0.73	0.81	0.10	0.52	5.0	8.2	7.4	3.84	11.11	3.86	18	0.95	218.80	219.00	219.72	219.75	224.20	224.80	Pipe - (61)
9	8	30.053	0.11	0.61	0.47	0.05	0.42	5.0	8.0	7.4	3.13	3.15	4.57	12	0.67	219.10	219.30	219.92	220.11	224.80	227.50	Pipe - (60)
10	9	34.529	0.26	0.50	0.79	0.21	0.37	5.0	7.9	7.4	2.76	2.94	3.52	12	0.58	219.40	219.60	220.44	220.60	227.50	225.60	Pipe - (59)
11	10	43.420	0.15	0.24	0.67	0.10	0.17	5.0	7.5	7.5	1.25	3.21	2.54	12	0.69	219.70	220.00	220.63	220.47	225.60	225.50	Pipe - (58)
12	11	102.133	0.09	0.09	0.73	0.07	0.07	5.0	5.0	8.2	0.54	2.96	2.35	12	0.59	220.10	220.70	220.47	221.01	225.50	224.71	Pipe - (76)
13	5	85.974	0.13	0.57	0.64	0.08	0.45	5.0	5.2	8.2	3.69	8.68	3.42	18	0.58	217.60	218.10	218.75	218.83	224.70	225.20	Pipe - (69)
14	13	44.802	0.11	0.44	0.70	0.08	0.37	5.0	5.0	8.2	3.03	3.16	4.58	12	0.67	218.20	218.50	218.98	219.29	225.20	224.84	Pipe - (68)
15	14	5.119	0.33	0.33	0.88	0.29	0.29	5.0	5.0	8.2	2.40	2.95	3.92	12	0.59	218.60	218.63	219.33	219.35	224.84	224.66	Pipe - (67)
16	2	58.712	0.00	1.16	0.00	0.00	0.98	0.0	6.8	7.7	7.57	9.39	4.98	18	0.68	215.10	215.50	216.56	216.57	219.90	221.40	Pipe - (44)
17	16	25.567	0.22	1.16	0.90	0.20	0.98	5.0	6.7	7.8	7.60	10.06	5.95	18	0.78	215.60	215.80	216.57	216.87	221.40	221.30	Pipe - (43)
18	17	27.193	0.26	0.94	0.81	0.21	0.78	5.0	6.6	7.8	6.09	9.76	5.10	18	0.74	215.90	216.10	216.87	217.05	221.30	220.80	Pipe - (42)
19	18	23.214	0.11	0.68	0.84	0.09	0.57	5.0	6.4	7.8	4.48	10.56	4.45	18	0.86	216.20	216.40	217.05	217.21	220.80	220.90	Pipe - (75)
20	19	87.978	0.20	0.57	0.82	0.16	0.48	5.0	6.1	7.9	3.79	2.91	4.83	12	0.57	216.50	217.00	217.50	218.35	220.90	221.80	Pipe - (41)
21	20	14.395	0.14	0.37	0.87	0.12	0.32	5.0	6.0	7.9	2.50	3.22	3.19	12	0.69	217.10	217.20	218.41	218.47	221.80	221.80	Pipe - (40)
22	21	90.133	0.10	0.23	0.87	0.09	0.19	5.0	5.3	8.2	1.58	2.73	2.09	12	0.50	217.30	217.75	218.49	218.62	221.80	221.80	Pipe - (39)

Project File: Vose_Basin2aConvey.stm | Number of lines: 23 | Run Date: 12/17/2015

NOTES:Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
23	22	27.588	0.13	0.13	0.82	0.11	0.11	5.0	5.0	8.2	0.88	1.75	1.78	10	0.54	217.85	218.00	218.64	218.66	221.80	221.90	Pipe - (38)

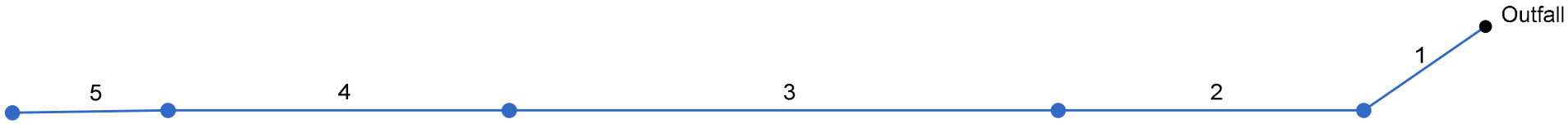
Project File: Vose_Basin2aConvey.stm

Number of lines: 23

Run Date: 12/17/2015

NOTES:Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Vose_Basin2bConvey.stm	Number of lines: 5	Date: 12/17/2015

Storm Sewers v10.30

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	45.509	145.326	MH	0.00	0.00	0.00	0.0	208.00	6.37	210.90	12	Cir	0.012	0.62	217.80	Pipe - (74)
2	1	93.953	34.674	MH	0.00	0.40	0.43	5.0	211.00	0.96	211.90	12	Cir	0.012	0.15	219.06	Pipe - (73)
3	2	168.802	0.000	MH	0.00	0.12	0.20	5.0	212.00	0.53	212.90	12	Cir	0.012	0.15	220.56	Pipe - (72)
4	3	104.928	0.000	MH	0.00	0.00	0.00	0.0	213.00	0.57	213.60	12	Cir	0.012	0.15	220.43	Pipe - (71)
5	4	47.851	-0.888	MH	0.00	1.39	0.28	10.0	213.70	0.63	214.00	12	Cir	0.012	1.00	220.76	Pipe - (70)

Project File: Vose_Basin2bConvey.stm | Number of lines: 5 | Date: 12/17/2015

Storm Sewer Tabulation

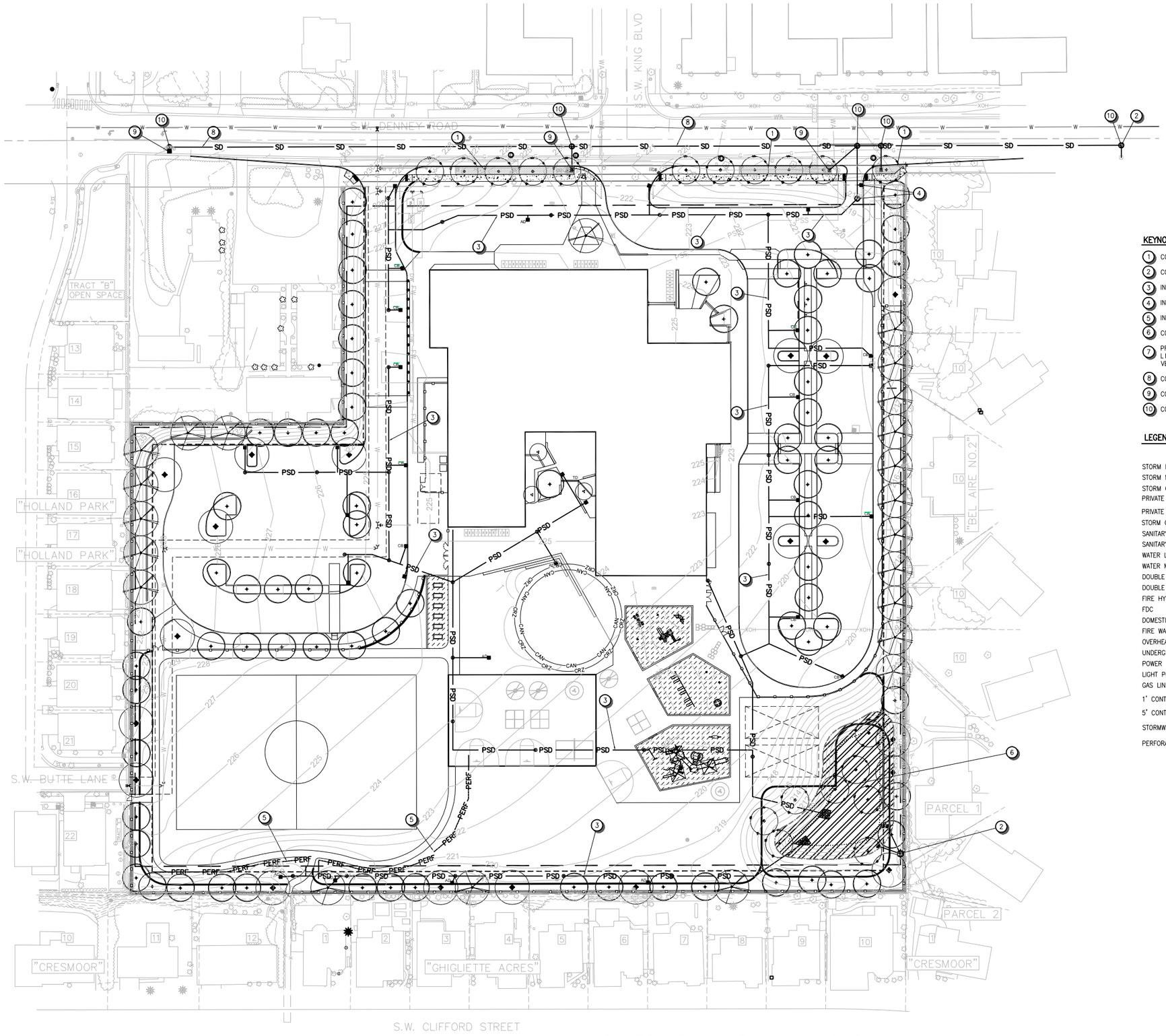
Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	45.509	0.00	1.91	0.00	0.00	0.59	0.0	11.9	6.6	3.84	9.74	7.77	12	6.37	208.00	210.90	208.49	211.73	216.26	217.80	Pipe - (74)
2	1	93.953	0.40	1.91	0.43	0.17	0.59	5.0	11.5	6.6	3.88	3.78	4.96	12	0.96	211.00	211.90	212.02	212.87	217.80	219.06	Pipe - (73)
3	2	168.802	0.12	1.51	0.20	0.02	0.41	5.0	10.7	6.8	2.81	2.82	3.88	12	0.53	212.00	212.90	212.93	213.72	219.06	220.56	Pipe - (72)
4	3	104.928	0.00	1.39	0.00	0.00	0.39	0.0	10.2	6.9	2.68	2.92	4.21	12	0.57	213.00	213.60	213.76	214.36	220.56	220.43	Pipe - (71)
5	4	47.851	1.39	1.39	0.28	0.39	0.39	10.0	10.0	6.9	2.70	3.05	4.39	12	0.63	213.70	214.00	214.43	214.73	220.43	220.76	Pipe - (70)

Project File: Vose_Basin2bConvey.stm | Number of lines: 5 | Run Date: 12/17/2015

NOTES:Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Attachment D – Applicable Project Plan Sheets

HanmiGlobal Partner



KEYNOTES:

1. CONSTRUCT PUBLIC LIDA PLANTER.
2. CONNECT TO EXISTING STORM SEWER.
3. INSTALL PRIVATE STORM PIPE.
4. INSTALL MECHANICAL STORMWATER TREATMENT STRUCTURE.
5. INSTALL GRAVEL TRENCH AND PERFORATED PIPE ALONG PATH.
6. CONSTRUCT EXTENDED DRY BASIN FACILITY.
7. PROPOSED MANHOLE OVER EXISTING STORM LINE. STORM LINE LOCATION SHOWN IS APPROXIMATE AND IS TO BE VERIFIED IN FIELD.
8. CONSTRUCT PUBLIC STORM PIPE.
9. CONSTRUCT PUBLIC INLET.
10. CONSTRUCT PUBLIC MANHOLE.

LEGEND

	EXISTING	PROPOSED
STORM LINE	ST	PSD
STORM MANHOLE		
STORM CURB INLET/CATCH BASIN		
PRIVATE STORM LINE	ST	PSD
PRIVATE STORM CATCH BASIN		
STORM CLEANOUT		
SANITARY LINE		SS
SANITARY MANHOLE		
WATER LINE	WA	W
WATER METER		WM
DOUBLE CHECK VALVE ASSEMBLY		DCVA
DOUBLE CHECK DETECTOR (FIRE)		DCDA
FIRE HYDRANT		
FDC		
DOMESTIC WATER LINE (PVT)		DW
FIRE WATER LINE (PVT)		FW
OVERHEAD POWER	XOH	
UNDERGROUND POWER	E	
POWER POLE		
LIGHT POLE		
GAS LINE	GAS	
1' CONTOUR		
5' CONTOUR	230	
STORMWATER FACILITY		
PERFORATED DRAIN LINE		PERF PERF

Design Development

REGISTERED PROFESSIONAL ENGINEER
OREGON
JAN. 8, 2013
ASHLEY C. SIMONS
PRELIMINARY
EXPIRES: 12/31/2012

STORM OVERALL SITE PLAN

UTILITY PLAN
Vose K5
Beaverton School District

C2.0

74-15111-10
10/19/2015
REVISIONS

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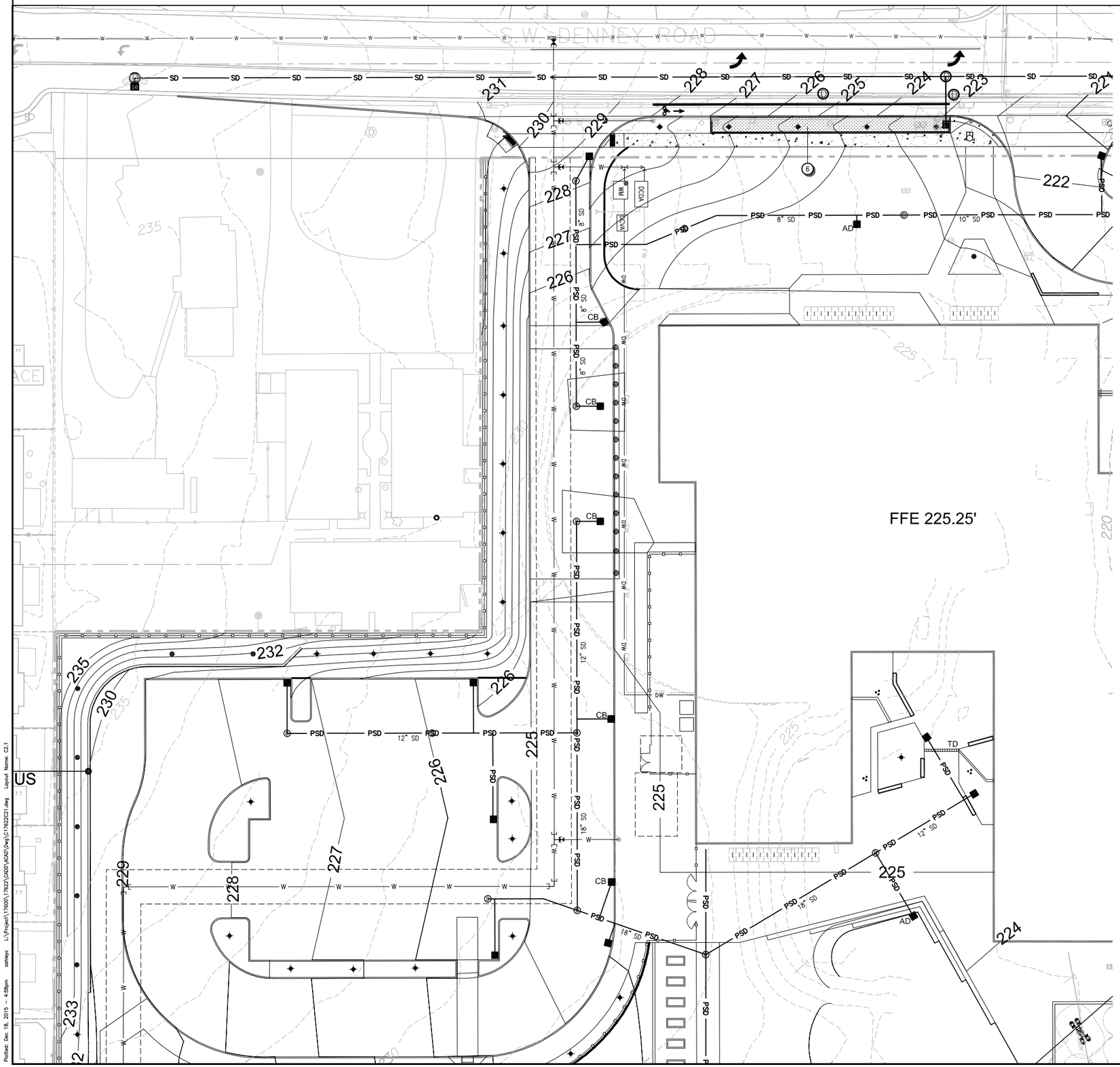
Plotted: Dec 18, 2015 - 4:56pm ashleyc L:\Project\17600\17622\CADD\ACAD\Dwg\C17622C20.dwg Layout Name: C2.0



20' 0' 20' 80'
SCALE IN FEET

KEYNOTES:

1. CONSTRUCT MECHANICAL TREATMENT FACILITY. SEE SHEET C2.5 FOR DETAILS
2. CONNECT TO PUBLIC STORM SEWER.
3. CONNECT TO EXISTING STORM SEWER.
4. INSTALL GRAVEL TRENCH AND PERFORATED PIPE ALONG PATH.
5. CONSTRUCT EXTENDED DRY BASIN. SEE SHEET C2.5 FOR DETAILS.
6. CONSTRUCT PUBLIC VEGETATED LIDA FACILITY. SHEET R4.1 FOR DETAILS.

LEGEND

	EXISTING	PROPOSED
STORM LINE	ST	PSD
STORM MANHOLE		
STORM CURB INLET/CATCH BASIN		
PRIVATE STORM LINE	ST	PSD
PRIVATE STORM CATCH BASIN		
STORM CLEANOUT		
LIDA FACILITY		
1' CONTOUR	230	224
5' CONTOUR		225
STORMWATER FACILITY		
PERFORATED DRAIN LINE		PERF PERF

KEYMAP

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JAN. 8, 2014
ASHLEY C. SIMONS
PRELIMINARY
EXPIRES: 12/31/2012

STORM PLAN A

UTILITY PLAN
Vose K5
Beaverton School District

C2.1

74-15111-10
10/19/2015
revisions

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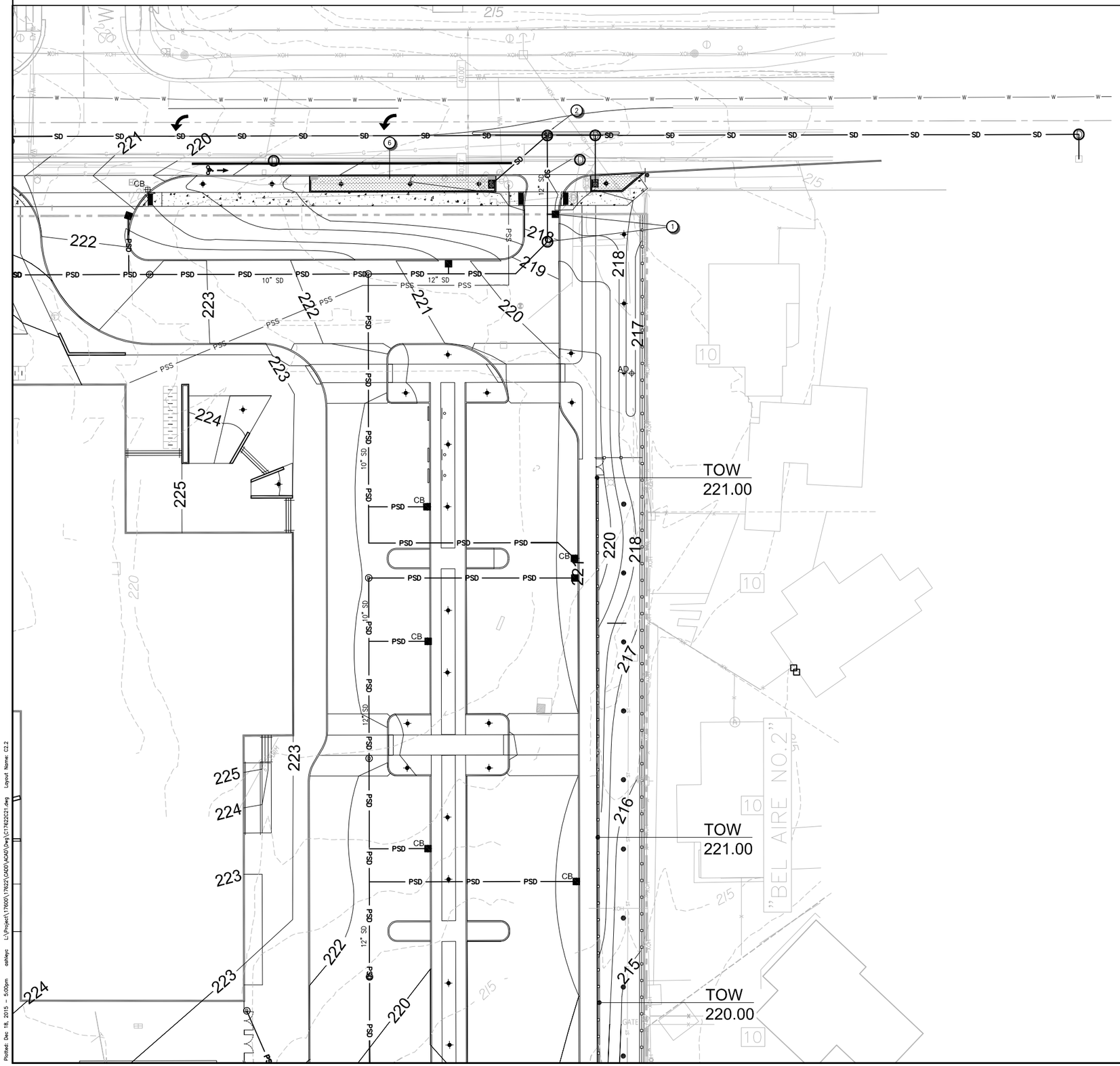
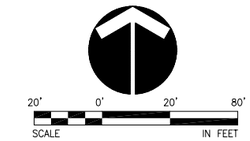




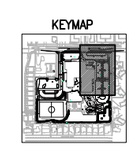
KEYNOTES:

1. CONSTRUCT MECHANICAL TREATMENT FACILITY. SEE SHEET C2.5 FOR DETAILS
2. CONNECT TO PUBLIC STORM SEWER.
3. CONNECT TO EXISTING STORM SEWER.
4. INSTALL GRAVEL TRENCH AND PERFORATED PIPE ALONG PATH.
5. CONSTRUCT EXTENDED DRY BASIN. SEE SHEET C2.5 FOR DETAILS.
6. CONSTRUCT PUBLIC VEGETATED LIDA FACILITY. SHEET R4.1 FOR DETAILS.

LEGEND

	EXISTING	PROPOSED
STORM LINE	ST	PSD
STORM MANHOLE		
STORM CURB INLET/CATCH BASIN		
PRIVATE STORM LINE	ST	PSD
PRIVATE STORM CATCH BASIN		
STORM CLEANOUT		
LIDA FACILITY		
1' CONTOUR		224
5' CONTOUR	230	225
STORMWATER FACILITY		
PERFORATED DRAIN LINE		PERF PERF

KEYMAP



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Design Development

REGISTERED PROFESSIONAL ENGINEER
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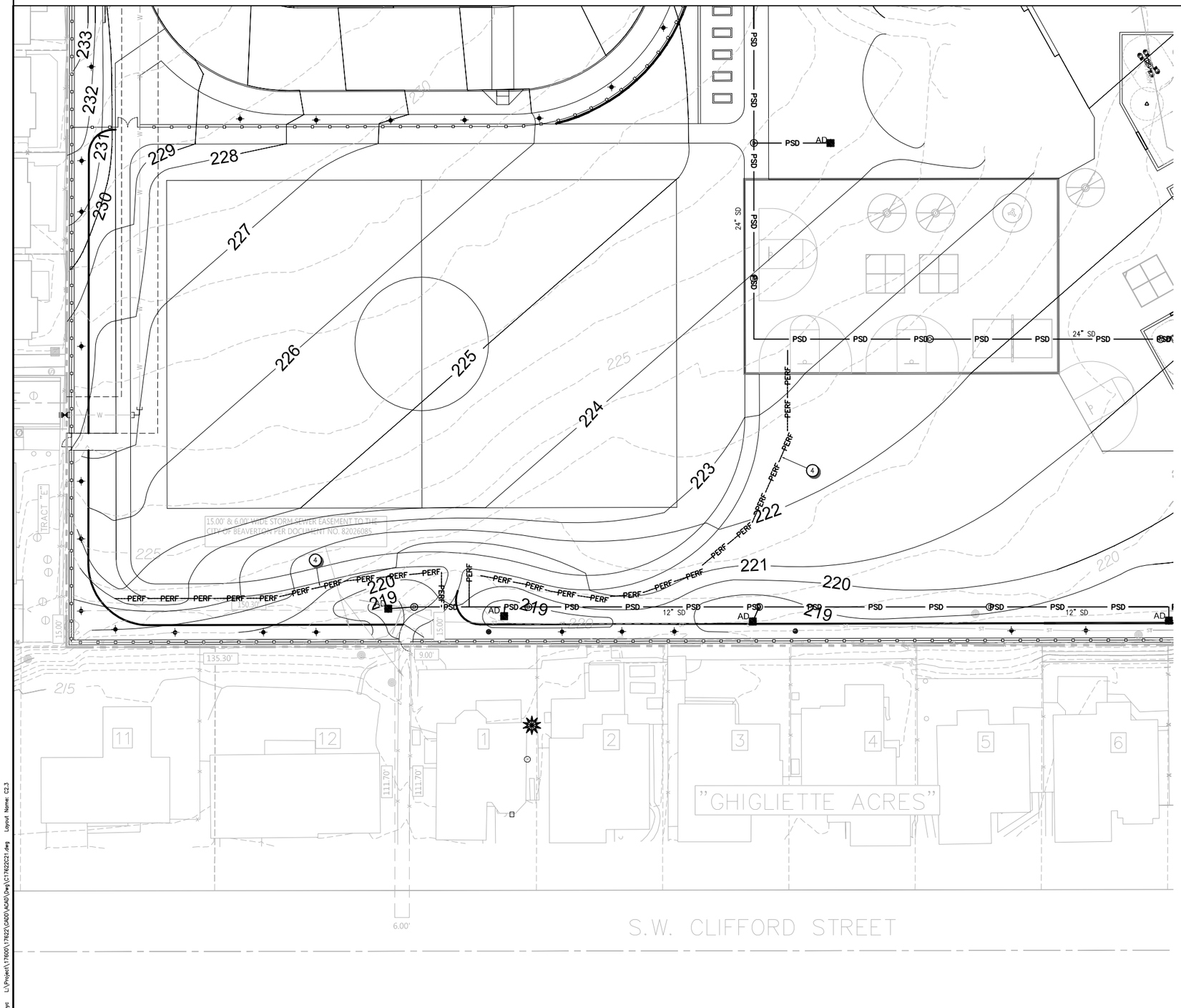
JAN 8, 2013
ASHLEY C. STANDAFER
PRELIMINARY
EXPIRES: 12/31/2012

STORM PLAN B

UTILITY PLAN
Vose K5
Beaverton School District

C2.2
74-15111-10
10/19/2015
REVISIONS

Plotted: Dec 18, 2015 - 5:00pm ashleyc L:\Project\17600\17622\CADD\ACAD\Dwg\C17622C221.dwg Layout Name: C2.2



20' 0' 20' 80'
SCALE IN FEET

KEYNOTES:

1. CONSTRUCT MECHANICAL TREATMENT FACILITY. SEE SHEET C2.5 FOR DETAILS
2. CONNECT TO PUBLIC STORM SEWER.
3. CONNECT TO EXISTING STORM SEWER.
4. INSTALL GRAVEL TRENCH AND PERFORATED PIPE ALONG PATH.
5. CONSTRUCT EXTENDED DRY BASIN. SEE SHEET C2.5 FOR DETAILS.
6. CONSTRUCT PUBLIC VEGETATED LIDA FACILITY. SHEET R4.1 FOR DETAILS.

LEGEND

	EXISTING	PROPOSED
STORM LINE	ST	PSD
STORM MANHOLE		
STORM CURB INLET/CATCH BASIN		
PRIVATE STORM LINE	ST	PSD
PRIVATE STORM CATCH BASIN		
STORM CLEANOUT		
LIDA FACILITY		
1' CONTOUR	230	224
5' CONTOUR		225
STORMWATER FACILITY		
PERFORATED DRAIN LINE		PERF

KEYMAP

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OREGON
JAN 8, 2015
ASHLEY C. STUMPF
EXPIRES: 12/31/2012

STORM PLAN C

UTILITY PLAN
Vose K5
Beaverton School District

C2.3
74-15111-10
10/19/2015
REVISIONS

Plotted: Dec 18, 2015 – 5:02pm cashleys L:\Project\17600\17622\CADD\ACAD\Dwg\C17622C21.dwg Layout Name: C2.3

20' 0' 20' 80'
SCALE IN FEET

KEYNOTES:

1. CONSTRUCT MECHANICAL TREATMENT FACILITY. SEE SHEET C2.5 FOR DETAILS
2. CONNECT TO PUBLIC STORM SEWER.
3. CONNECT TO EXISTING STORM SEWER.
4. INSTALL GRAVEL TRENCH AND PERFORATED PIPE ALONG PATH.
5. CONSTRUCT EXTENDED DRY BASIN. SEE SHEET C2.5 FOR DETAILS.
6. CONSTRUCT PUBLIC VEGETATED LIDA FACILITY. SHEET R4.1 FOR DETAILS.

LEGEND

	EXISTING	PROPOSED
STORM LINE	ST	PSD
STORM MANHOLE		
STORM CURB INLET/CATCH BASIN		
PRIVATE STORM LINE	ST	PSD
PRIVATE STORM CATCH BASIN		
STORM CLEANOUT		
LIDA FACILITY		
1' CONTOUR		224
5' CONTOUR	230	225
STORMWATER FACILITY		
PERFORATED DRAIN LINE		PERF PERF

KEYMAP

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JAN 8, 2016
ASHLEY C. STANDAHL
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EXPIRES: 12/31/2012

STORM PLAN D

UTILITY PLAN
Vose K5
Beaverton School District

C2.4
74-15111-10
10/19/2015
REVISIONS

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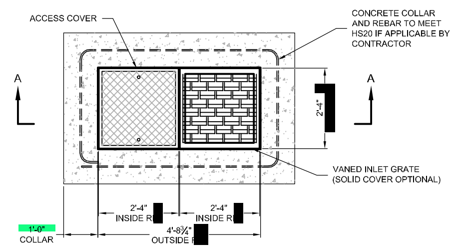
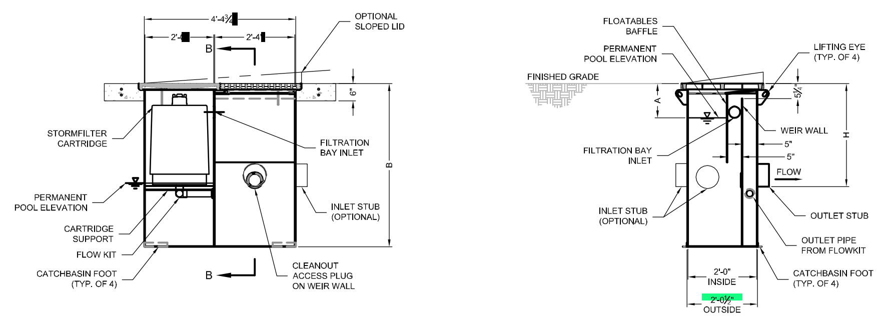


PLAN VIEW



SECTION A-A

SECTION B-B

STORMFILTER CATCHBASIN DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. 1 CARTRIDGE CATCHBASIN HAS A MAXIMUM OF ONE CARTRIDGE. SYSTEM IS SHOWN WITH A 27" CARTRIDGE, AND IS ALSO AVAILABLE WITH AN 18" CARTRIDGE. STORMFILTER CATCHBASIN CONFIGURATIONS ARE AVAILABLE WITH A DRY INLET BAY FOR VECTOR CONTROL.
PEAK HYDRAULIC CAPACITY PER TABLE BELOW. IF THE SITE CONDITIONS EXCEED PEAK HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		18"		18" DEEP	
MINIMUM HYDRAULIC DROP (H)	3.05'		2.3'		3.3'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	15	7.5
PEAK HYDRAULIC CAPACITY	1.0		1.0		1.8	
INLET PERMANENT POOL LEVEL (A)	1'-0"		1'-0"		2'-0"	
OVERALL STRUCTURE HEIGHT (B)	4'-9"		3'-9"		4'-9"	

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STORMFILTER CATCHBASIN STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. STORMFILTER CATCHBASIN WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
4. INLET SHOULD NOT BE LOWER THAN OUTLET. INLET (IF APPLICABLE) AND OUTLET PIPING TO BE SPECIFIED BY ENGINEER AND PROVIDED BY CONTRACTOR.
5. STORMFILTER CATCHBASIN EQUIPPED WITH 4 INCH (APPROXIMATE) LONG STUBS FOR INLET (IF APPLICABLE) AND OUTLET PIPING. STANDARD OUTLET STUB IS 8 INCHES IN DIAMETER. MAXIMUM OUTLET STUB IS 15 INCHES IN DIAMETER. CONNECTION TO COLLECTION PIPING CAN BE MADE USING FLEXIBLE COUPLING BY CONTRACTOR.
6. STEEL STRUCTURE TO BE MANUFACTURED OF 1/4 INCH STEEL PLATE. CASTINGS SHALL MEET AASHTO M306 LOAD RATING. TO MEET HS20 LOAD RATING ON STRUCTURE, A CONCRETE COLLAR IS REQUIRED. WHEN REQUIRED, CONCRETE COLLAR WITH QUANTITY (2) #4 REINFORCING BARS TO BE PROVIDED BY CONTRACTOR.
7. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 37 SECONDS.
8. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CATCHBASIN (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

1-CARTRIDGE CATCHBASIN STORMFILTER DATA

STRUCTURE ID		XXX
WATER QUALITY FLOW RATE (cfs)		X.XX
PEAK FLOW RATE (<1 cfs)		X.XX
RETURN PERIOD OF PEAK FLOW (yrs)		XXX
CARTRIDGE FLOW RATE (gpm)		XX
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)		XXXXX
RIM ELEVATION		XXX.XX'
PIPE DATA:	I.E.	DIAMETER
INLET STUB	XXX.XX'	XX"
OUTLET STUB	XXX.XX'	XX"
CONFIGURATION (OUTLET / INLET / INLET — OUTLET / INLET / INLET)		
SLOPED LID		YES\NO
SOLID COVER		YES\NO
NOTES/SPECIAL REQUIREMENTS:		

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

1 CARTRIDGE CATCHBASIN STORMFILTER STANDARD DETAIL

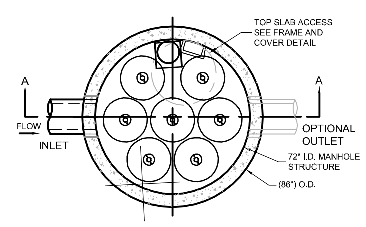
INFILTRATOR STORMFILTER DESIGN NOTES

INFILTRATOR STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (7).

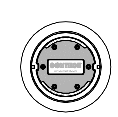
Ø72" MANHOLE STORMFILTER PEAK HYDRAULIC CAPACITY IS 1.5 CFS. IF THE SITE CONDITIONS EXCEED 1.5 CFS AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"		18"		LOW DROP	
RECOMMENDED HYDRAULIC DROP (H)	3.05'		2.3'		1.8'	
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²	2 gpm/ft²	1 gpm/ft²
CARTRIDGE FLOW RATE (gpm)	22.5	11.25	15	7.5	10	5



PLAN VIEW
TOP SLAB NOT SHOWN

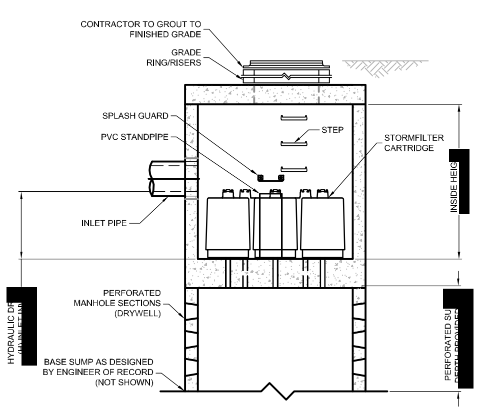


FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			*
WATER QUALITY FLOW RATE (cfs)			*
PEAK FLOW RATE (cfs)			*
RETURN PERIOD OF PEAK FLOW (yrs)			*
# OF CARTRIDGES REQUIRED			*
CARTRIDGE FLOW RATE			*
MEDIA TYPE (CSF, PERLITE, ZPG, GAC, PHS)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	*	*
INLET PIPE #2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

* PER ENGINEER OF RECORD



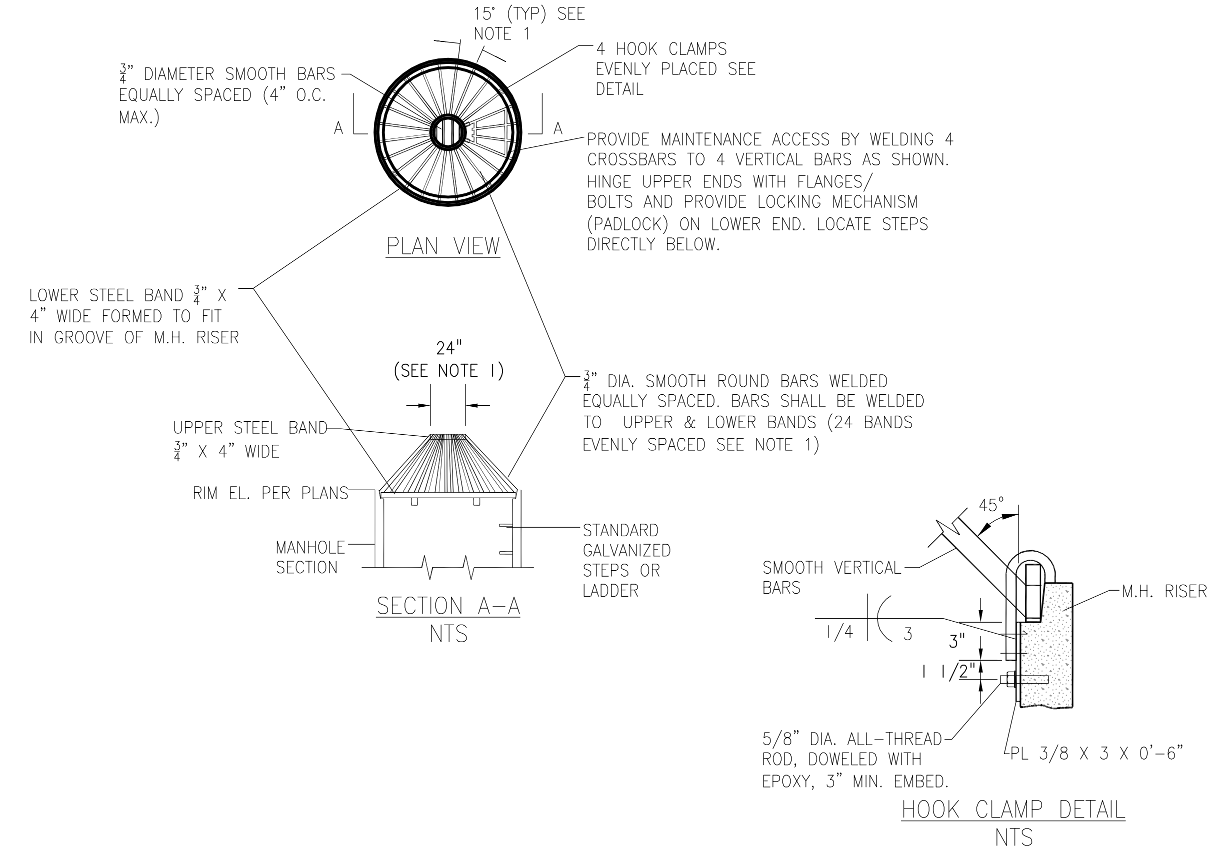
SECTION A-A

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR SITE SPECIFIC DRAWINGS WITH DETAILED VAULT DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
4. INFILTRATOR STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
6. FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 39 SECONDS.
7. SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).

INSTALLATION NOTES
1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET PIPE(S).
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

SFIN-MH72
INFILTRATOR STORMFILTER
STANDARD DETAIL



NOTES:
1. DIMENSIONS ARE FOR ILLUSTRATION ON 54" DIAMETER MH. FOR DIFFERENT DIAMETER MH'S ADJUST TO MAINTAIN 45° ANGLE ON "VERTICAL" BARS AND 4" O.C. MAXIMUM SPACING OF BARS AROUND LOWER STEEL BAND.
2. METAL PARTS MUST BE CORROSION RESISTANT; STEEL BARS MUST BE GALVANIZED.
3. THIS DEBRIS BARRIER IS ALSO RECOMMENDED FOR USE ON THE INLET TO ROADWAY CROSS-CULVERTS WITH HIGH POTENTIAL FOR DEBRIS COLLECTION (EXCEPT ON TYPE 2 STREAMS).

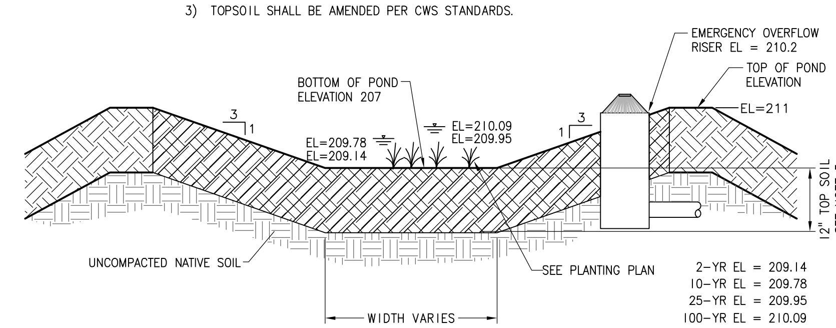
BIRDCAGE GRATE
NTS

NOTES:

1) JUTE MATTING TO BE GEOJUTE PLUS FOR ENTIRE POND AREA UP TO 25 YEAR DETENTION AND ECONOJUTE FROM FREEBOARD AND ABOVE. INSTALL PER MANUFACTURER'S INSTALLATION REQUIREMENTS.

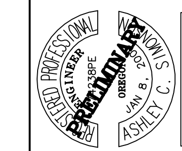
2) SEE LANDSCAPE DRAWINGS FOR FENCE AND PLANTING DETAILS.

3) TOPSOIL SHALL BE AMENDED PER CWS STANDARDS.



EXTENDED DRY BASIN TYPICAL SECTION
NTS

Design Development



STORM POND DETAILS

UTILITY DETAILS
Vose K5
Beaverton School District

C2.5
74-15111-10
10/19/2015

otak
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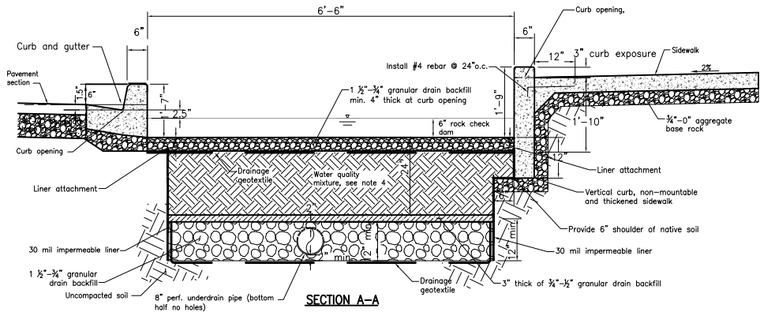
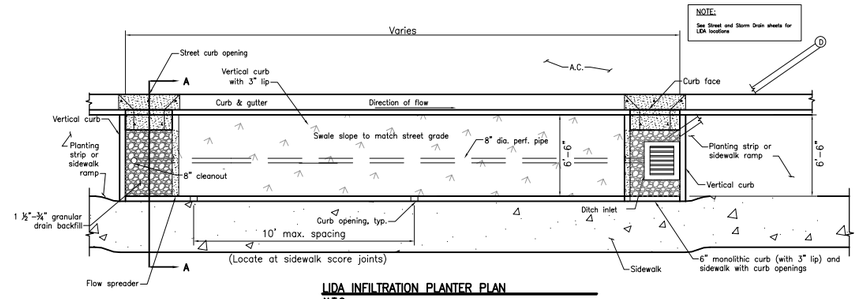


SECTION A-A

LIDA INFILTRATION PLANTER
N.T.S.



LIDA INFILTRATION PLANTER PLAN
N.T.S.

Design Development

LICENSED PROFESSIONAL ENGINEER
12,629
PRELIMINARY
OREGON
JUNE 11, 1970
KEITH BUSINESS

EXPIRES: 12/31/2015

PUBLIC IMPROVEMENTS -
WATER QUALITY FACILITY DETAILS
Vose K5
Beaverton School District

R4.1
74-15111-10
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