Tualatin Business Park
Storm Drainage Calculations

SW 112th and Myslony Street
Tualatin, Oregon

January 2015
Project Number: 14305

TMR

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Introduction

This project is located north of Tualatin-Sherwood Road at SW 112th in Tualatin, Oregon. The site area is approximately 7 acres. Site development will consist of three commercial buildings on two lots with SW 112th Avenue extending north between the two lots. Storm runoff from each site will be treated and detained onsite prior to discharge to the public storm system created with the adjacent street construction, completed in 2011.

With construction of SW 112th Avenue and construction of a ¾ section of SW Myslony St., a public stormwater facility was constructed within a public storm drainage tract at the southwest corner of Myslony Street and 112th Avenue.

These storm drainage calculations address the private storm system; and reference the public storm system design prepared by this office and provided with the public street design documentation.

Water Quality Treatment

Water quality treatment conforms to current City of Tualatin and Clean Water Services (CWS) standards. The standards specify a water quality event of 0.36 inches of rainfall over four hours. Water quality treatment is provided by Contech Stormwater Solutions water quality cartridge systems that treat 10 gallons per minute (0.0223 cubic feet per second) per cartridge.

The site west of 112th Avenue consists of 95,011 square feet of impervious area with a water quality flow rate of 0.20 cfs requiring 9 cartridges to provide treatment.

WQ Volume = (0.36 in x 95,011 sf) / 12 in/ft = 2,850 cubic feet.
WQ Flow = 2,850 cf /14,400 sec = 0.20 cfs.

The eastern site consists of 163,580 sq ft of impervious area with a water quality flow rate of 0.34 cfs requiring 16 cartridges to provide treatment.

WQ Volume = (0.36 in x 163,580 sf) / 12 in/ft = 4,907 cubic feet.
WQ Flow = 4,823 cf / 14,400 sec = 0.34cfs.

Water quality calculations are attached.

Detention

When this project was initially submitted to the City of Tualatin for review both the public street and the development sites were analyzed and calculations were reviewed and approved for both facets of work. Due to unfavorable economic conditions, only the public street and associated public storm systems were constructed. No changes to the site area nor buildings have been made since the initial review and approval and consequently this analysis uses the same design parameters as originally approved.

Runoff for detention analysis is modeled using HydroCAD™ software employing Santa Barbara Unit Hydrograph (SBUH) methodology. Rainfall is based on 2 (2.5"), 10 (3.45"), and 25 (3.9") year Type 1A storm events, per CWS Resolution and Order 07-20.

The existing conditions are modeled as pasture/grassland with a runoff curve number, CN of 79. Time of concentration for the predevelopment conditions was calculated for each site based on slope and length of travel and is a combination of sheet flow and shallow concentrated flow. See the attached HydroCAD output for specific information.

Detention at each lot is provided by an ADS StormTech SC 740 storm detention chamber system, consisting of semicircular chambers set on a bed of drain rock with drain rock backfill. The analysis utilizes both the chamber volume and additional volume in the surrounding rock backfill for capacity. See the tables below for specific detention information for each site and plans for detention chamber configuration.

West Site

Control Structure Discharge	2 Year	10 Year	25 Year
Predevelopment Runoff, cfs	0.32	0.71	0.92
Post Development Runoff, cfs	1.32	1.89	2.17
Controlled Outflow, cfs	0.32	0.71	0.84
Orifice Elevation, ft.	135.05	138.83	138.83
Orifice Diameter, in.	3.10	4.30	*
Water Surface Elevation, ft.	138.83	139.34	139.66
Detained Volume, cf.	4,968	6,555	7,512

*Orifice for 10 year event controls for 25 year event as well.

East Site

Control Structure Discharge	2 Year	10 Year	25 Year
Predevelopment Runoff, cfs	0.59	1.29	1.67
Post Development Runoff, cfs	2.26	3.25	3.72
Controlled Outflow, cfs	0.59	1.29	1.52
Orifice Elevation, ft.	135.00	139.07	139.07
Orifice Diameter, in.	4.1	5.1	*
Water Surface Elevation, ft.	139.06	139.79	140.28
Detained Volume, cf.	8,610	11,252	12,788

*Orifice for 10 year event controls for 25 year event as well.

Runoff for sizing private on-site storm piping is calculated based on the rational method, Q=CIA, where C is 0.90 and I is 3.0 inches per hour at five minutes initial time of concentration (ten year storm), per CWS R & O 07-20, Section 5.04.02, Drawing 1275. Pipe sizing is based on Manning's Equation with a roughness coefficient, n, of 0.013. See attached pipe sizing spreadsheets and basin maps.

Public Storm System

The public storm system constructed in 112th Avenue and Myslony Street was designed to maintain the general runoff characteristics of the existing drainage basin, in conformance with City of Tualatin and CWS standards current at the time of construction and also current at this time. The basin tributary to the public street improvements was identified utilizing topographic information from the project survey combined with other large scale topographic maps. This area was confirmed by City staff based on information from the City of Tualatin on the City's storm drainage master plan. The resulting drainage basin is approximately 22 acres, including Myslony and 112th streets, the two development sites, the public storm drainage tract, and the undeveloped tributary area east of the development.

Portions of the drainage basin east and north of Myslony Street have not been developed. This area is zoned to allow commercial development and runoff will be treated for water quality and will be detained on site when development occurs, resulting in runoff flow rates to the public storm system in Myslony Street consistent with existing conditions. Conveyance piping within both 112th and Myslony was based on existing conditions/post detention flow rates, except the public streets which are assumed to be undetained but developed.

Storm runoff from the drainage basin is collected in the public storm system and directed to an existing public water quality treatment extended dry basin located in a public tract as described above. The facility discharges though a public pipe system at the western portion of the Myslony Street right of way directed to Hedges Creek to the west.

Water Quality Treatment:
Total impervious area for the street rights of way is 84,038 square feet and the water quality event is 0.36 inches resulting in a required treatment extended dry basin volume of:

WQ Volume = (0.36 in x 84,038 sf)/12 in/ft=2,521 cubic feet

The private development described above as well future development tributary to the roadways comprises an additional 730,962 square feet of impervious surface area that will be directed to the extended dry basin. As noted above, the private development will provide on-site water quality treatment but since the extended dry basin will still receive the runoff from the development sites, the basin is sized to also treat this area, effectively for a second time.

The extended dry basin has a capacity of 24,651 cubic feet, based on a design water surface elevation of 138.60 feet, corresponding to a maximum depth of four feet. Additionally, a permanent pool is provided which is 0.40 ft. deep. The entire tributary basin's anticipated impervious area is 815,000 square feet, based on the undeveloped areas ultimately having 15 percent landscape, as required by Tualatin codes. This total area results in a required pond volume of:

WQ Volume = (0.36 in x 815,000 sf)/12 in/ft=24,450 cubic feet

This design conformed to CWS R&O 07-20, subsection 4.06.03. Due to available area for the basin, one cell with a forebay at the inlet to the basin was provided. Discharge is limited by installation of an orifice at the outlet. Sizing calculations provided with the original design and approved previously by City and CWS staff are attached.

Detention:
As indicated above, the new public streets have a total impervious area of 84,038 square feet while the basin area tributary to the new public streets, including the streets, is 22 acres.

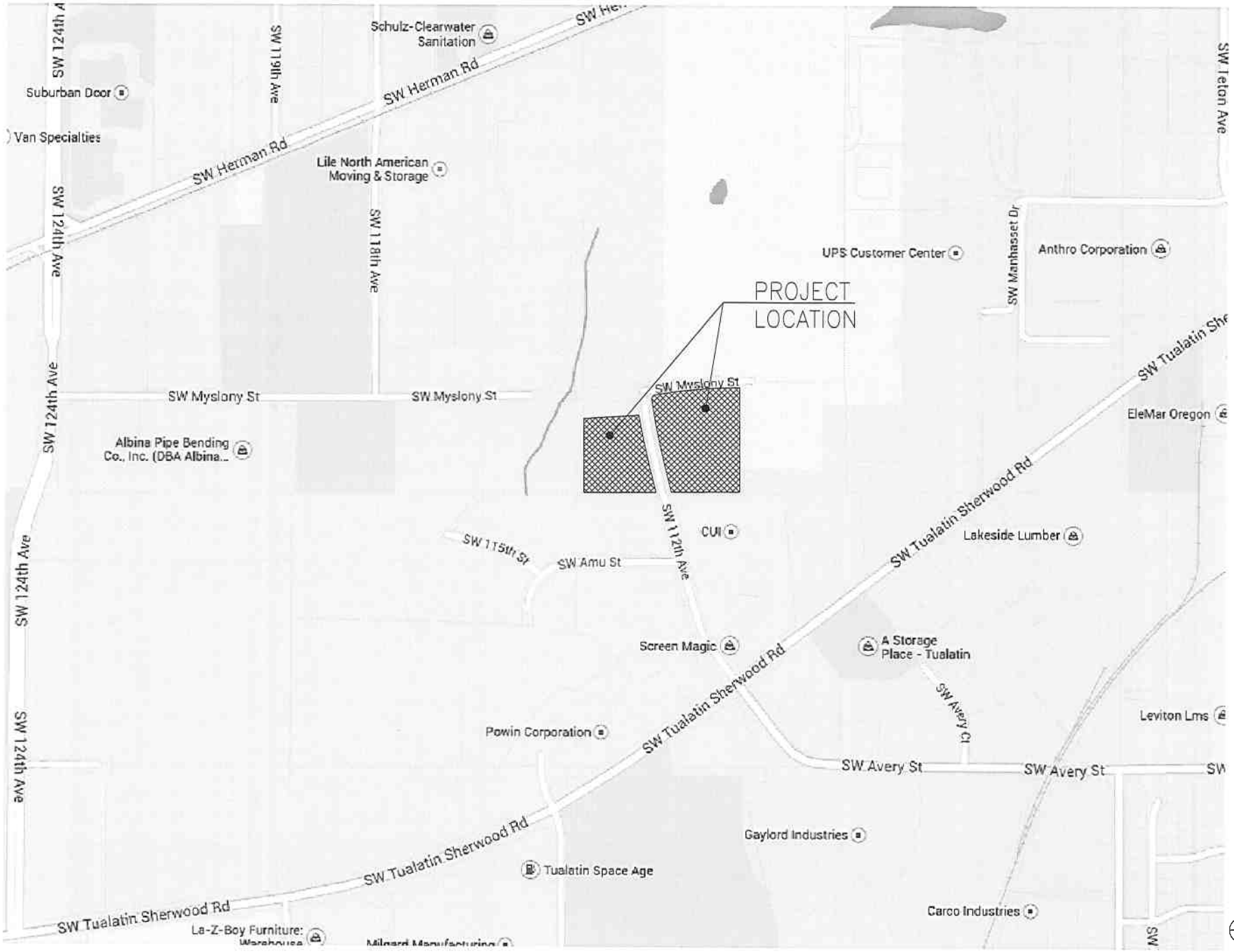
Undeveloped runoff from the street area is 0.41 cfs, the developed runoff from the street area is 1.57 cfs, and undeveloped runoff from the entire basin (development sites, roadways, and presently undeveloped properties east of Myslony) tributary to the roadways is 5.64 cfs, all based on a 25 year rainfall event.

Since installing a control structure at the public storm facility outlet to detain flow from the roadways to the undeveloped outflow rate would have resulted in an outflow rate significantly less than the undeveloped outflow from the entire basin (0.41 cfs versus 5.64 cfs) and since the developed flow from the roadways is less than the allowable outflow from the undeveloped basin (1.57 cfs for the roadways versus 5.64 cfs for the basin) no detention for the developed roadways occurs in the storm facility. This was also approved by City and CWS staff previously.

As no changes to the originally approved design outflows from the current development sites are proposed, no modification to the public system is required.

Maintenance and Operation Manual

See the appendix for specific information on maintenance and operation.



Architectural Review Submittal - January 2015

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Tualatin, OR

Sheet Title
VICINITY MAP

Revisions

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Architectural Review Submittal - January 2015

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MAP

Revisions

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Appendix 1

Site Location

Appendix 2

Storm Drainage Calculations

Water Quality Treatment Calculations
HydroCAD Output for Site Runoff
HydroCAD Output for Public System
Site Conveyance Calculations

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December 9, 2014

Tualatin Business Center
Buildings 1 to 3

Project Number: 14305

Storm Water Quality Treatment Sizing

West Site

Impervious Area 95,011 ft^2

Water Quality Volume

$$WQV(cf) = \frac{0.36 \text{ in.} \times 95011.3 \text{ ft}^2}{12 \text{ (in/ft)}}$$

$$= \mathbf{2850.3378} \ \mathbf{cf}$$

Water Quality Flow

$$WQF(cfs) = \frac{2850.3378 \text{ cf}}{14{,}400 \text{ sec}}$$

$$= \mathbf{0.1979} \ \mathbf{cfs}$$

Cartridge Flow Rate 0.02228 cfs (10 gpm)

Cartridges Required 8.8842067
Use 9 cartridges

Tualatin Business Center
Buildings 1 to 3
Project Number: 14305
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Page 2

East Site

Impervious Area 163,580 ft^2

Water Quality
Volume

$$WQV(cf) = \frac{0.36 \text{ in.}}{12 \text{ (in/ft)}} \times 163580 \text{ ft}^2$$

$$= \mathbf{4907.4} \ \mathbf{cf}$$

Water Quality Flow

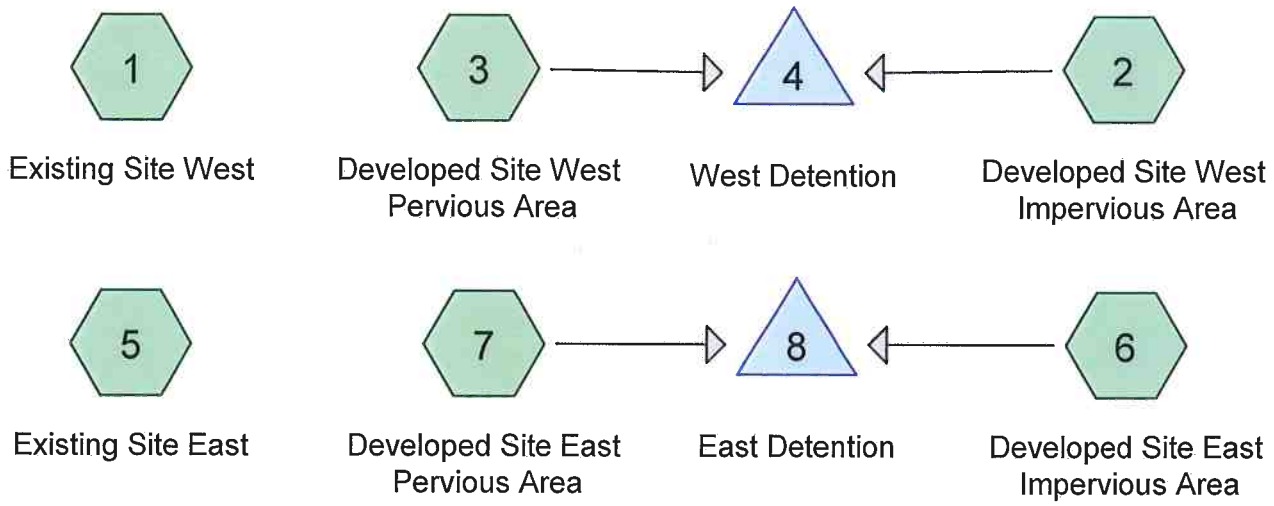
$$WQF(cfs) = \frac{4907.4 \text{ cf}}{14{,}400 \text{ sec}}$$

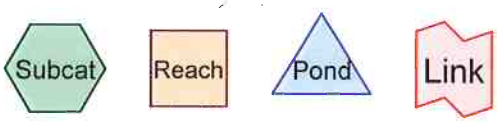
$$= \mathbf{0.3408} \ \mathbf{cfs}$$

Cartridge Flow Rate 0.02228 cfs (10 gpm)

Cartridges Required 15.295856
Use 16 cartridges

DEVELOPMENT SITES
(2015)





Routing Diagram for 2015-1-5 Development Sites
Prepared by Microsoft, Printed 1/5/2015
HydroCAD® 10.00-13 s/n 02239 © 2014 HydroCAD Software Solutions LLC

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	4	137.25	137.20	3.0	0.0167	0.013	15.0	0.0	0.0
2	8	137.25	137.20	8.0	0.0063	0.013	18.0	0.0	0.0

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Existing Site West Runoff Area=112,631 sf 0.00% Impervious Runoff Depth=0.84"
Flow Length=410' Tc=18.3 min CN=79 Runoff=0.32 cfs 7,860 cf

Subcatchment 2: Developed Site West Runoff Area=95,011 sf 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=98 Runoff=1.26 cfs 17,979 cf

Subcatchment 3: Developed Site West Runoff Area=17,620 sf 0.00% Impervious Runoff Depth=0.84"
Tc=5.0 min CN=79 Runoff=0.07 cfs 1,230 cf

Subcatchment 5: Existing Site East Runoff Area=192,373 sf 0.00% Impervious Runoff Depth=0.84"
Flow Length=350' Tc=14.9 min CN=79 Runoff=0.59 cfs 13,425 cf

Subcatchment 6: Developed Site East Runoff Area=163,580 sf 100.00% Impervious Runoff Depth=2.27"
Flow Length=550' Tc=5.0 min CN=98 Runoff=2.16 cfs 30,954 cf

Subcatchment 7: Developed Site East Runoff Area=28,793 sf 0.00% Impervious Runoff Depth=0.84"
Tc=5.0 min CN=79 Runoff=0.11 cfs 2,009 cf

Pond 4: West Detention Peak Elev=138.83' Storage=4,968 cf Inflow=1.32 cfs 19,208 cf
Outflow=0.32 cfs 18,843 cf

Pond 8: East Detention Peak Elev=139.06' Storage=8,610 cf Inflow=2.26 cfs 32,963 cf
Outflow=0.59 cfs 32,037 cf

Total Runoff Area = 610,008 sf Runoff Volume = 73,457 cf Average Runoff Depth = 1.45"
57.61% Pervious = 351,417 sf 42.39% Impervious = 258,591 sf

Summary for Subcatchment 1: Existing Site West

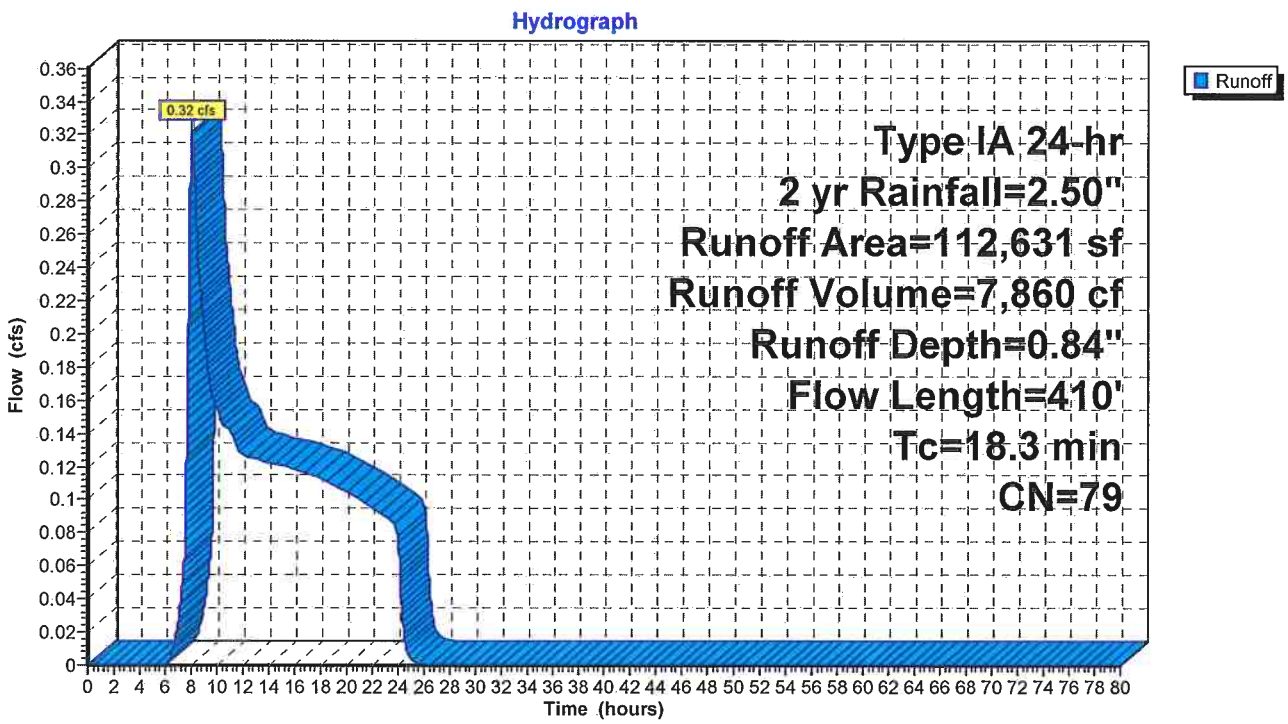
Runoff = 0.32 cfs @ 8.01 hrs, Volume= 7,860 cf, Depth= 0.84"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

Area (sf)	CN	Description
112,631	79	Pasture/grassland/range, Fair, HSG C
112,631		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	100	0.0125	0.14		**Sheet Flow,** Range n= 0.130 P2= 2.50"
6.4	310	0.0133	0.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
18.3	410	Total			

Subcatchment 1: Existing Site West



Summary for Subcatchment 2: Developed Site West Impervious Area

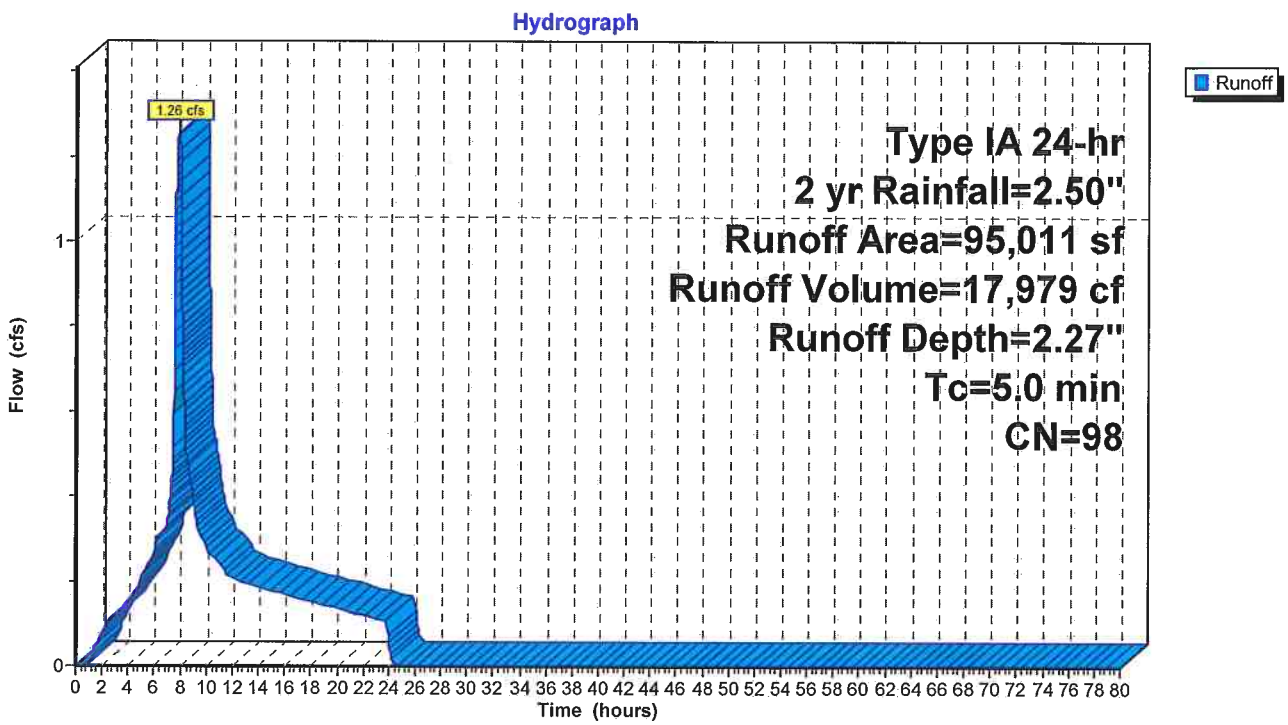
Runoff = 1.26 cfs @ 7.88 hrs, Volume= 17,979 cf, Depth= 2.27"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

Area (sf)	CN	Description
95,011	98	Paved parking & roofs
95,011		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Developed Site West Impervious Area



Summary for Subcatchment 3: Developed Site West Pervious Area

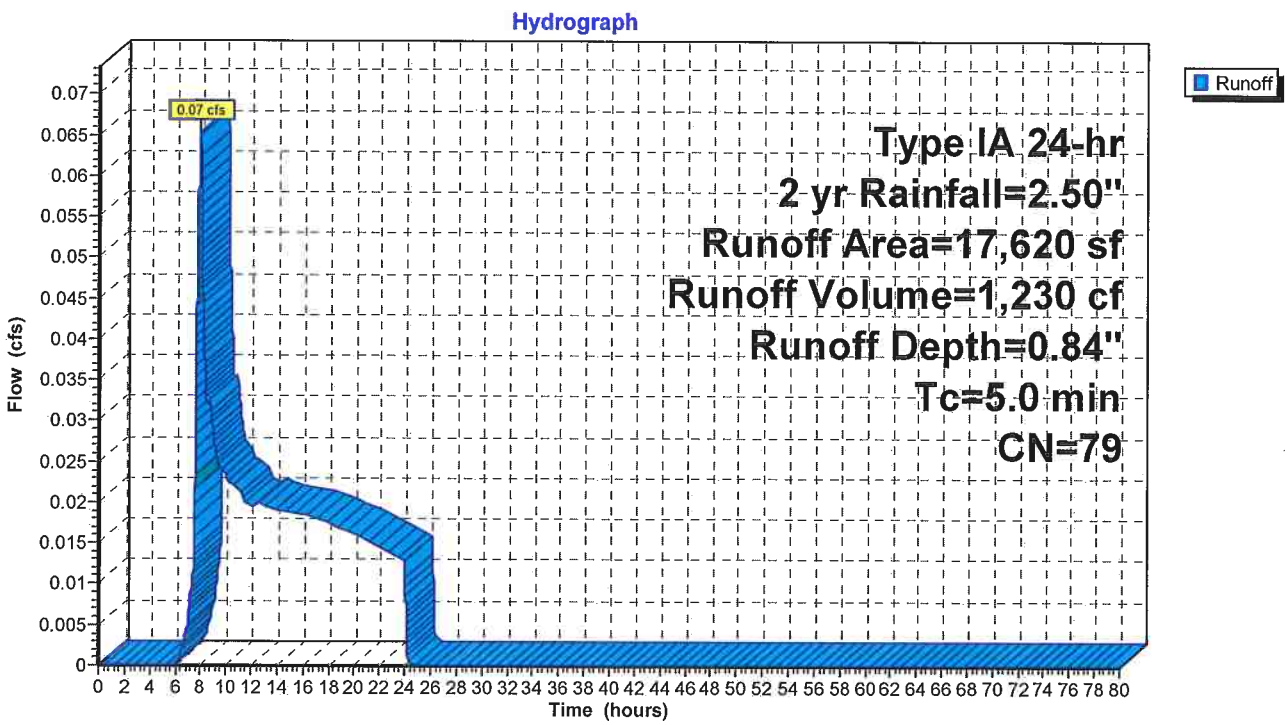
Runoff = 0.07 cfs @ 8.00 hrs, Volume= 1,230 cf, Depth= 0.84"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

Area (sf)	CN	Description
17,620	79	50-75% Grass cover, Fair, HSG C
17,620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Developed Site West Pervious Area



Summary for Subcatchment 5: Existing Site East

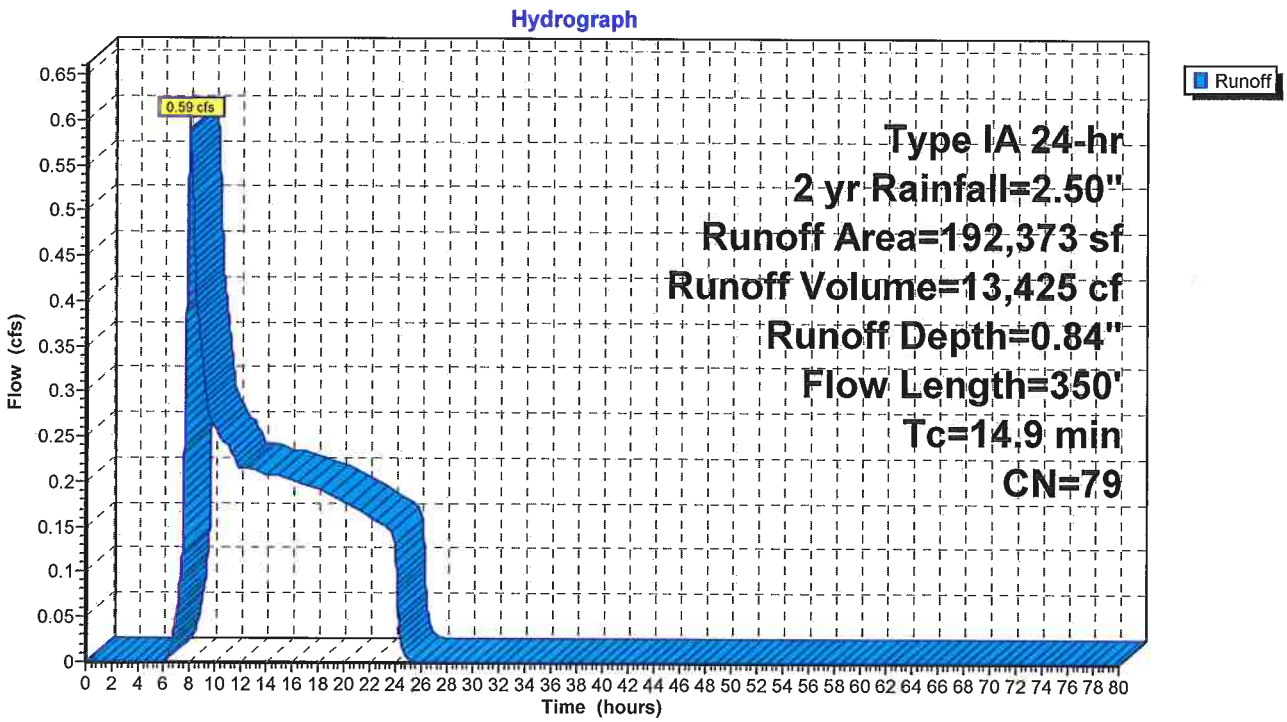
Runoff = 0.59 cfs @ 8.01 hrs, Volume= 13,425 cf, Depth= 0.84"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

Area (sf)	CN	Description
192,373	79	Pasture/grassland/range, Fair, HSG C
192,373		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	150	0.0400	0.24		**Sheet Flow,** Range n= 0.130 P2= 2.50"
4.5	200	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.9	350	Total			

Subcatchment 5: Existing Site East



Summary for Subcatchment 6: Developed Site East Impervious Area

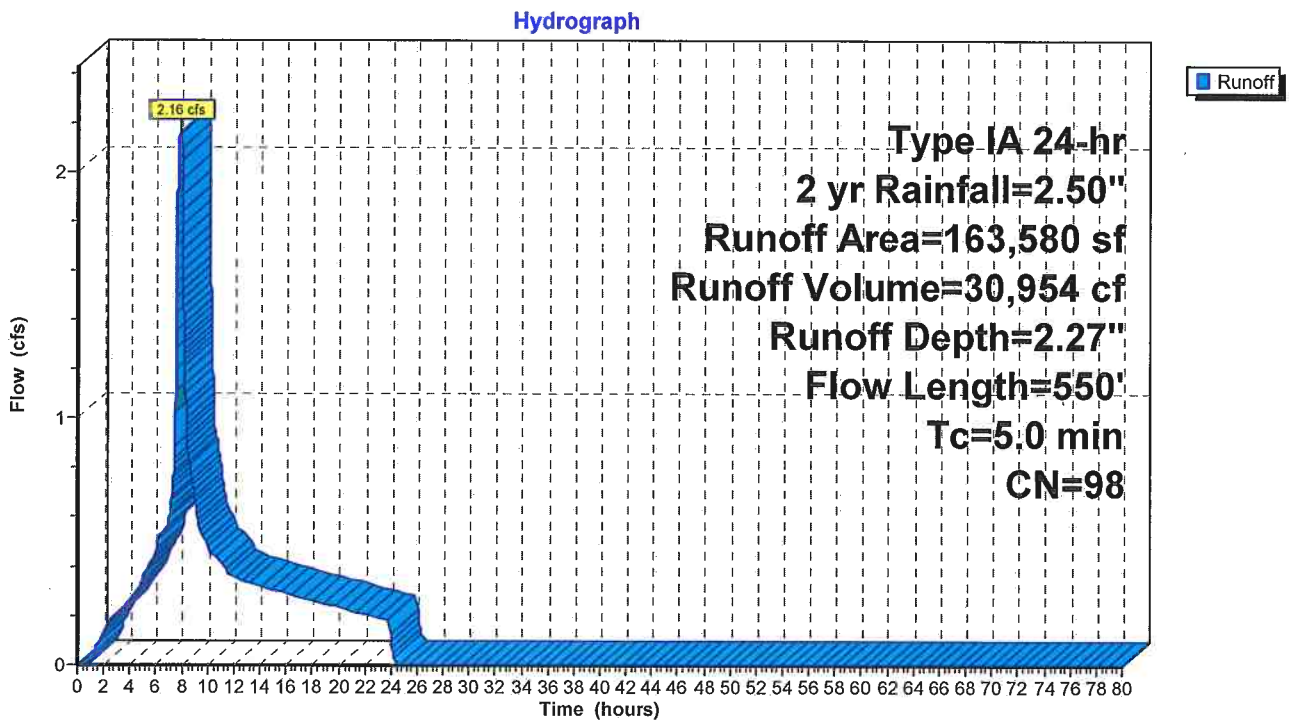
Runoff = 2.16 cfs @ 7.88 hrs, Volume= 30,954 cf, Depth= 2.27"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

Area (sf)	CN	Description
163,580	98	Paved parking & roofs
163,580		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	550		1.83		**Direct Entry,**

Subcatchment 6: Developed Site East Impervious Area



Summary for Subcatchment 7: Developed Site East Pervious Area

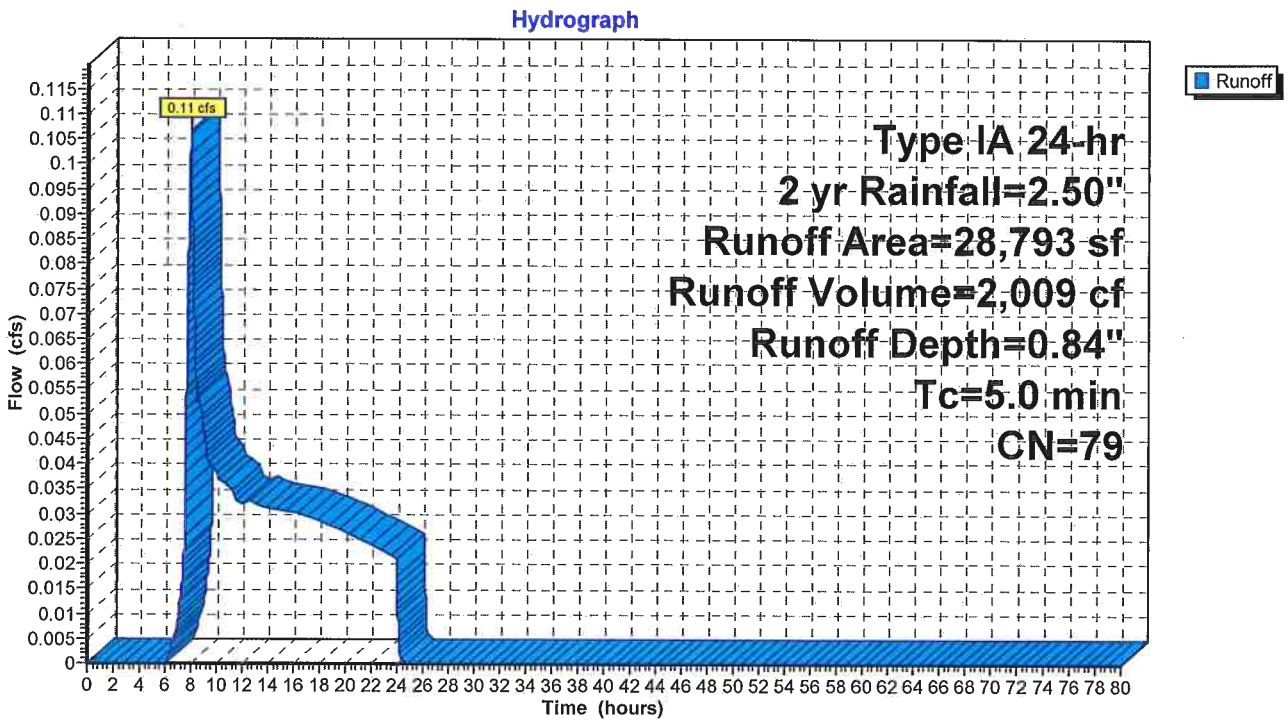
Runoff = 0.11 cfs @ 8.00 hrs, Volume= 2,009 cf, Depth= 0.84"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

Area (sf)	CN	Description
28,793	79	50-75% Grass cover, Fair, HSG C
28,793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: Developed Site East Pervious Area



Summary for Pond 4: West Detention

Inflow Area =	112,631 sf,	84.36% Impervious,	Inflow Depth =	2.05"	for 2 yr event
Inflow =	1.32 cfs @	7.89 hrs, Volume=	19,208 cf		
Outflow =	0.32 cfs @	9.82 hrs, Volume=	18,843 cf,	Atten= 76%,	Lag= 115.7 min
Primary =	0.32 cfs @	9.82 hrs, Volume=	18,843 cf		

Routing by Stor-Ind method; Time Span= 0.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 138.83' @ 9.82 hrs Surf.Area= 5,023 sf Storage= 4,968 cf

Plug-Flow detention time= 199.0 min calculated for 18,841 cf (98% of inflow)
Center-of-Mass det. time= 184.9 min (869.4 - 684.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.00'	6,534 cf	**20.50'W x 173.32'L x 4.00'H Field A Z=2.0** 20,756 cf Overall - 4,422 cf Embedded = 16,334 cf x 40.0% Voids
#2A	137.50'	4,422 cf	**ADS_StormTech SC-740** x 96 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 4 rows
		10,955 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	137.25'	**15.0" Round Culvert** L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 137.25' / 137.20' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	135.05'	**3.1" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	138.83'	**4.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.32 cfs @ 9.82 hrs HW=138.83' (Free Discharge)
└─**1=Culvert** (Passes 0.32 cfs of 5.15 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 6.05 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 4: West Detention - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 (ADS StormTech® SC-740)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.45 sf x 4 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

24 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 171.32' Row Length +12.0" End Stone x 2 = 173.32' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
6.0" Base + 30.0" Chamber Height + 12.0" Cover = 4.00' Field Height

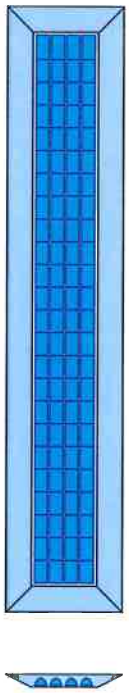
2.0 '/' Side-Z x Height = 96.0" Flare/Side
Base Length + Flare x 2 = 189.32' Top Length
Base Width + Flare x 2 = 36.50' Top Width

96 Chambers x 45.9 cf +0.44' Row Adjustment x 6.45 sf x 4 Rows = 4,421.6 cf Chamber Storage

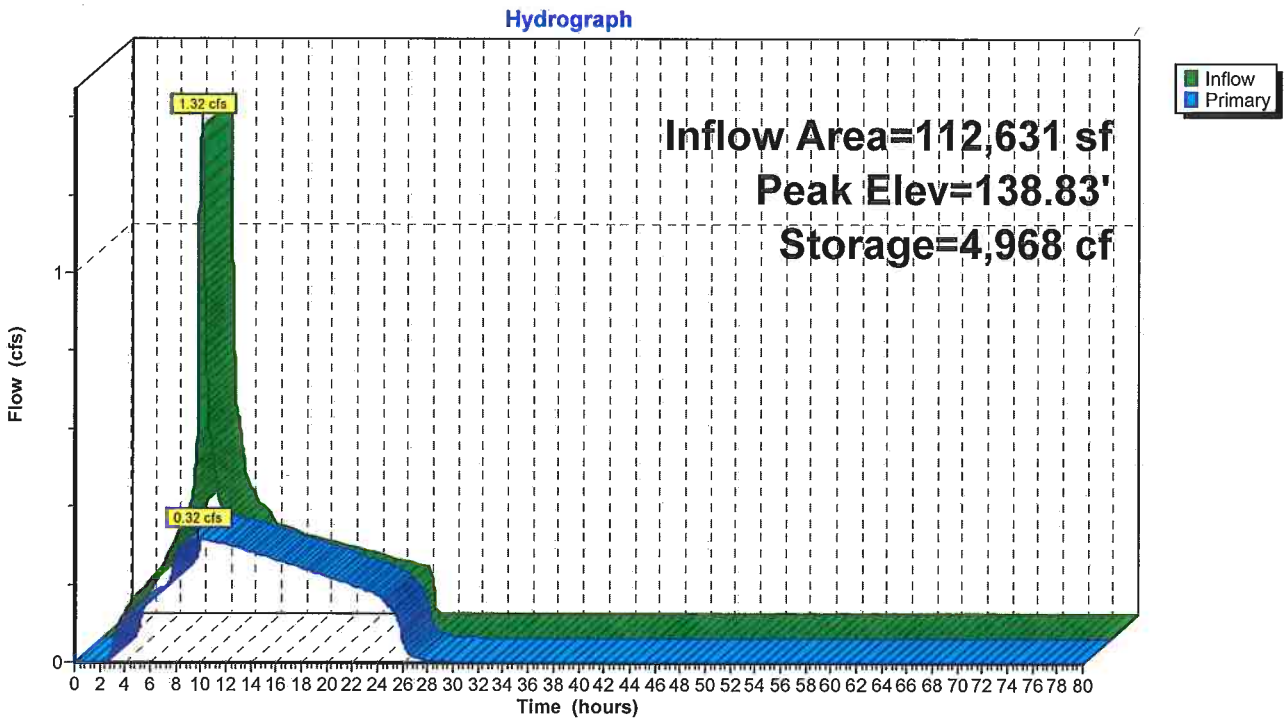
20,755.8 cf Field - 4,421.6 cf Chambers = 16,334.2 cf Stone x 40.0% Voids = 6,533.7 cf Stone Storage

Chamber Storage + Stone Storage = 10,955.3 cf = 0.251 af
Overall Storage Efficiency = 52.8%

96 Chambers
768.7 cy Field
605.0 cy Stone



Pond 4: West Detention



Summary for Pond 8: East Detention

Inflow Area =	192,373 sf,	85.03% Impervious,	Inflow Depth =	2.06"	for 2 yr event
Inflow =	2.26 cfs @	7.89 hrs, Volume=	32,963 cf		
Outflow =	0.59 cfs @	9.34 hrs, Volume=	32,037 cf,	Atten= 74%,	Lag= 87.0 min
Primary =	0.59 cfs @	9.34 hrs, Volume=	32,037 cf		

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 139.06' @ 9.34 hrs Surf.Area= 6,990 sf Storage= 8,610 cf

Plug-Flow detention time= 197.0 min calculated for 32,033 cf (97% of inflow)
Center-of-Mass det. time= 176.3 min (860.3 - 684.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	136.80'	6,642 cf	**25.25'W x 194.68'L x 3.50'H Field A Z=2.0** 22,822 cf Overall - 6,216 cf Embedded = 16,606 cf x 40.0% Voids
#2A	137.30'	6,216 cf	**ADS_StormTech SC-740** x 135 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 5 rows
		12,858 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	137.25'	**18.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 137.25' / 137.20' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	135.00'	**4.1" Vert. Orifice/Grate** C= 0.600
#3	Device 1	139.07'	**5.1" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.59 cfs @ 9.34 hrs HW=139.06' (Free Discharge)
└─**1=Culvert** (Passes 0.59 cfs of 7.55 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.59 cfs @ 6.49 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Pond 8: East Detention - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 (ADS StormTech® SC-740)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.45 sf x 5 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

27 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 192.68' Row Length +12.0" End Stone x 2 = 194.68' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

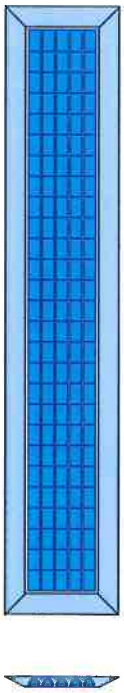
2.0 '/' Side-Z x Height = 84.0" Flare/Side
Base Length + Flare x 2 = 208.68' Top Length
Base Width + Flare x 2 = 39.25' Top Width

135 Chambers x 45.9 cf +0.44' Row Adjustment x 6.45 sf x 5 Rows = 6,216.1 cf Chamber Storage

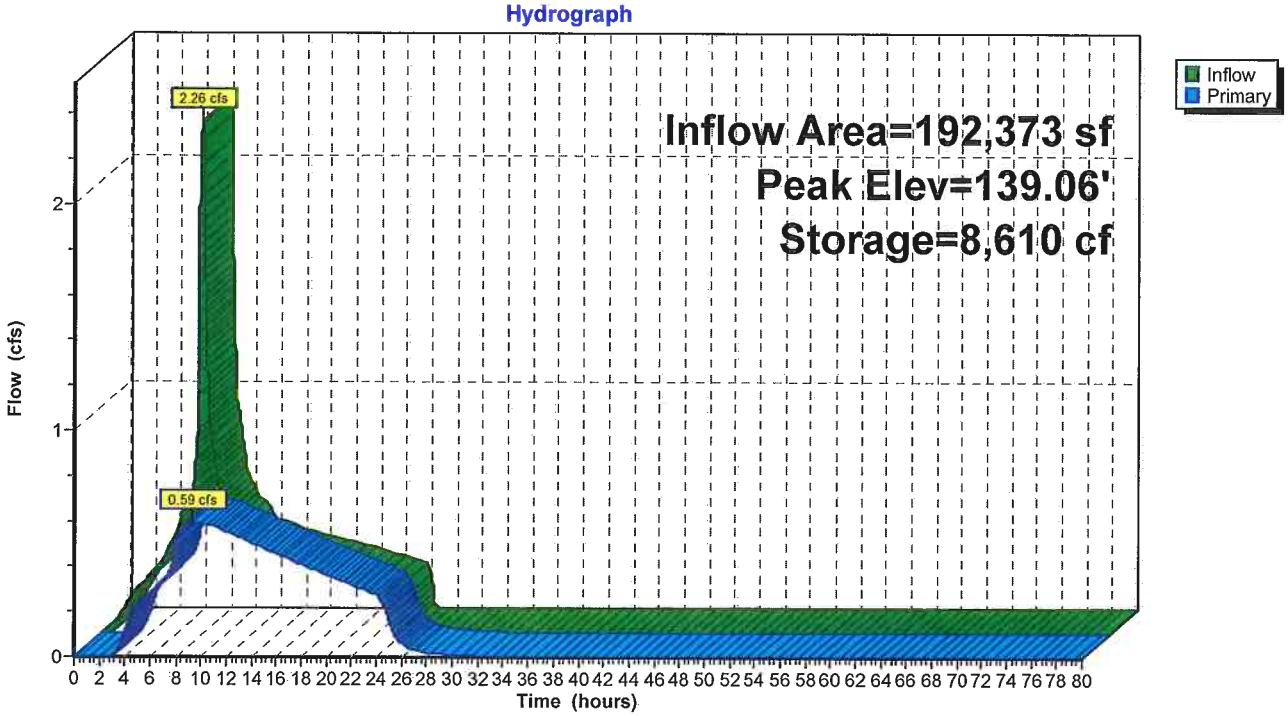
22,821.8 cf Field - 6,216.1 cf Chambers = 16,605.7 cf Stone x 40.0% Voids = 6,642.3 cf Stone Storage

Chamber Storage + Stone Storage = 12,858.4 cf = 0.295 af
Overall Storage Efficiency = 56.3%

135 Chambers
845.3 cy Field
615.0 cy Stone



Pond 8: East Detention



Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Existing Site West Runoff Area=112,631 sf 0.00% Impervious Runoff Depth=1.53"
Flow Length=410' Tc=18.3 min CN=79 Runoff=0.71 cfs 14,335 cf

Subcatchment 2: Developed Site West Runoff Area=95,011 sf 100.00% Impervious Runoff Depth=3.22"
Tc=5.0 min CN=98 Runoff=1.76 cfs 25,468 cf

Subcatchment 3: Developed Site West Runoff Area=17,620 sf 0.00% Impervious Runoff Depth=1.53"
Tc=5.0 min CN=79 Runoff=0.14 cfs 2,243 cf

Subcatchment 5: Existing Site East Runoff Area=192,373 sf 0.00% Impervious Runoff Depth=1.53"
Flow Length=350' Tc=14.9 min CN=79 Runoff=1.29 cfs 24,483 cf

Subcatchment 6: Developed Site East Runoff Area=163,580 sf 100.00% Impervious Runoff Depth=3.22"
Flow Length=550' Tc=5.0 min CN=98 Runoff=3.03 cfs 43,848 cf

Subcatchment 7: Developed Site East Runoff Area=28,793 sf 0.00% Impervious Runoff Depth=1.53"
Tc=5.0 min CN=79 Runoff=0.22 cfs 3,664 cf

Pond 4: West Detention Peak Elev=139.34' Storage=6,555 cf Inflow=1.89 cfs 27,710 cf
Outflow=0.71 cfs 27,345 cf

Pond 8: East Detention Peak Elev=139.79' Storage=11,252 cf Inflow=3.25 cfs 47,513 cf
Outflow=1.29 cfs 46,586 cf

Total Runoff Area = 610,008 sf Runoff Volume = 114,041 cf Average Runoff Depth = 2.24"
57.61% Pervious = 351,417 sf 42.39% Impervious = 258,591 sf

Summary for Subcatchment 1: Existing Site West

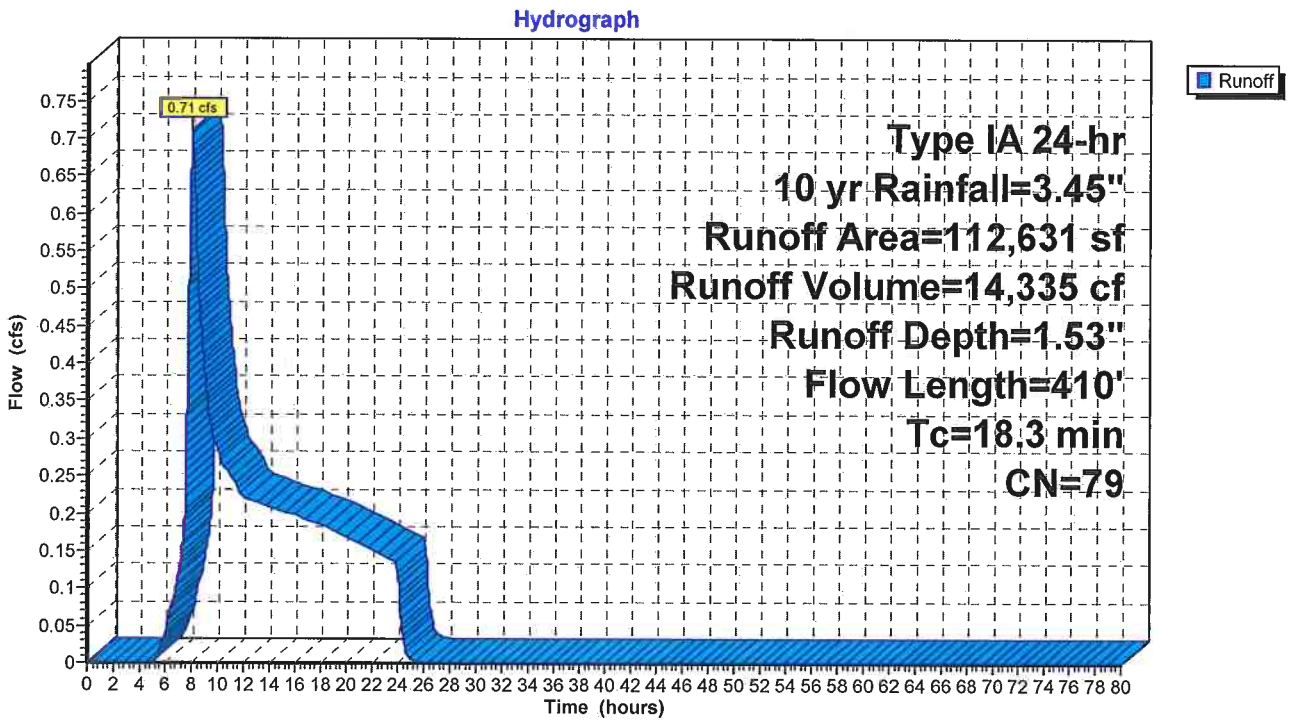
Runoff = 0.71 cfs @ 8.01 hrs, Volume= 14,335 cf, Depth= 1.53"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.45"

Area (sf)	CN	Description
112,631	79	Pasture/grassland/range, Fair, HSG C
112,631		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	100	0.0125	0.14		**Sheet Flow,** Range n= 0.130 P2= 2.50"
6.4	310	0.0133	0.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
18.3	410	Total			

Subcatchment 1: Existing Site West



Summary for Subcatchment 2: Developed Site West Impervious Area

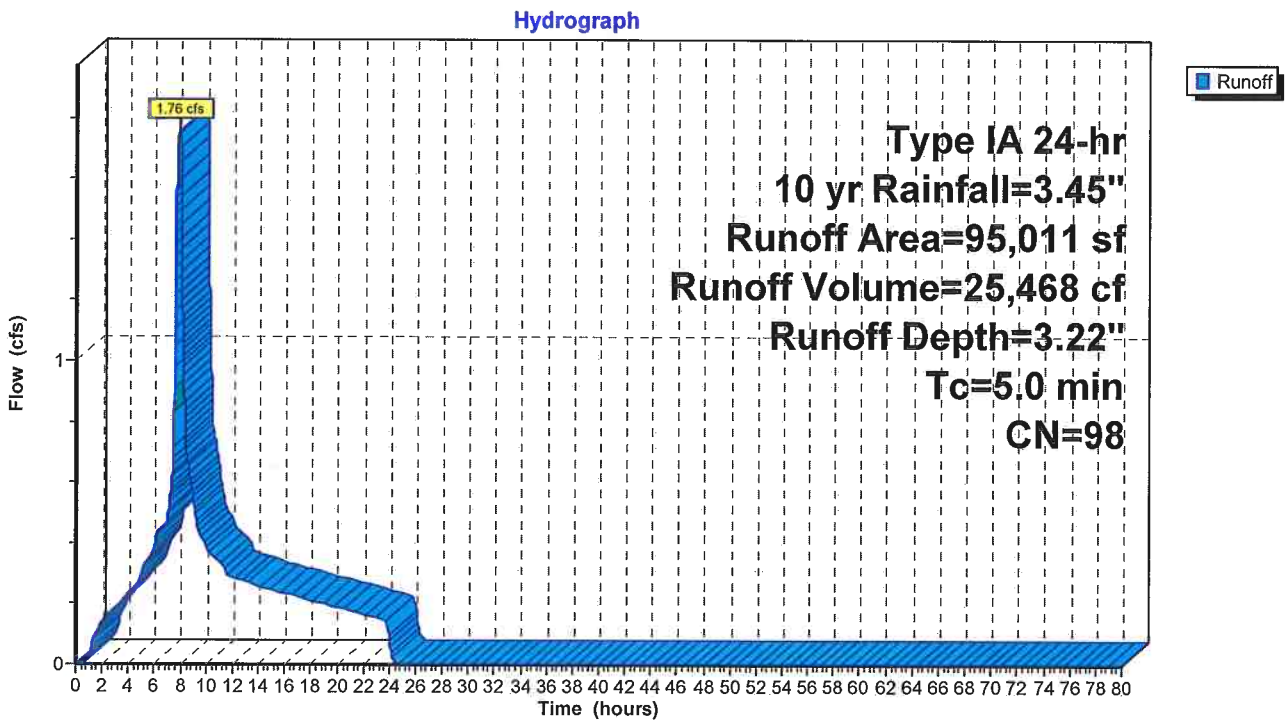
Runoff = 1.76 cfs @ 7.88 hrs, Volume= 25,468 cf, Depth= 3.22"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.45"

Area (sf)	CN	Description
95,011	98	Paved parking & roofs
95,011		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Developed Site West Impervious Area



Summary for Subcatchment 3: Developed Site West Pervious Area

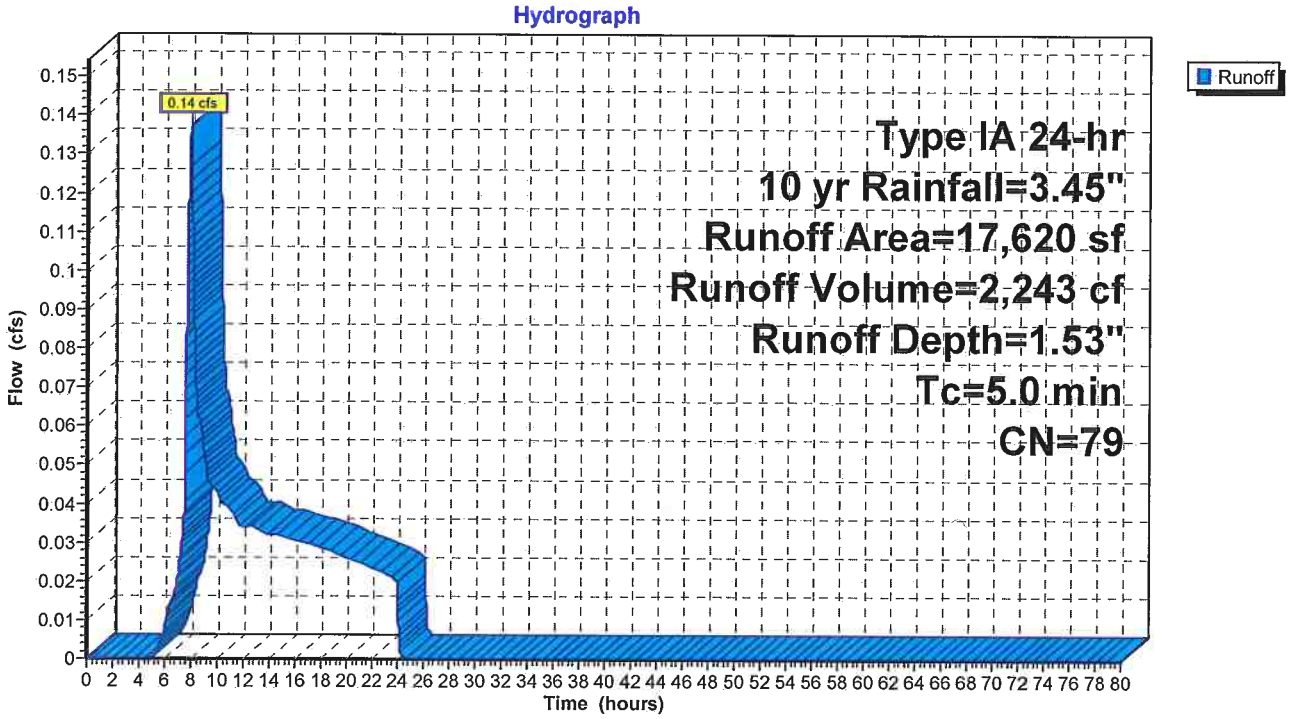
Runoff = 0.14 cfs @ 7.99 hrs, Volume= 2,243 cf, Depth= 1.53"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.45"

Area (sf)	CN	Description
17,620	79	50-75% Grass cover, Fair, HSG C
17,620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Developed Site West Pervious Area



Summary for Subcatchment 5: Existing Site East

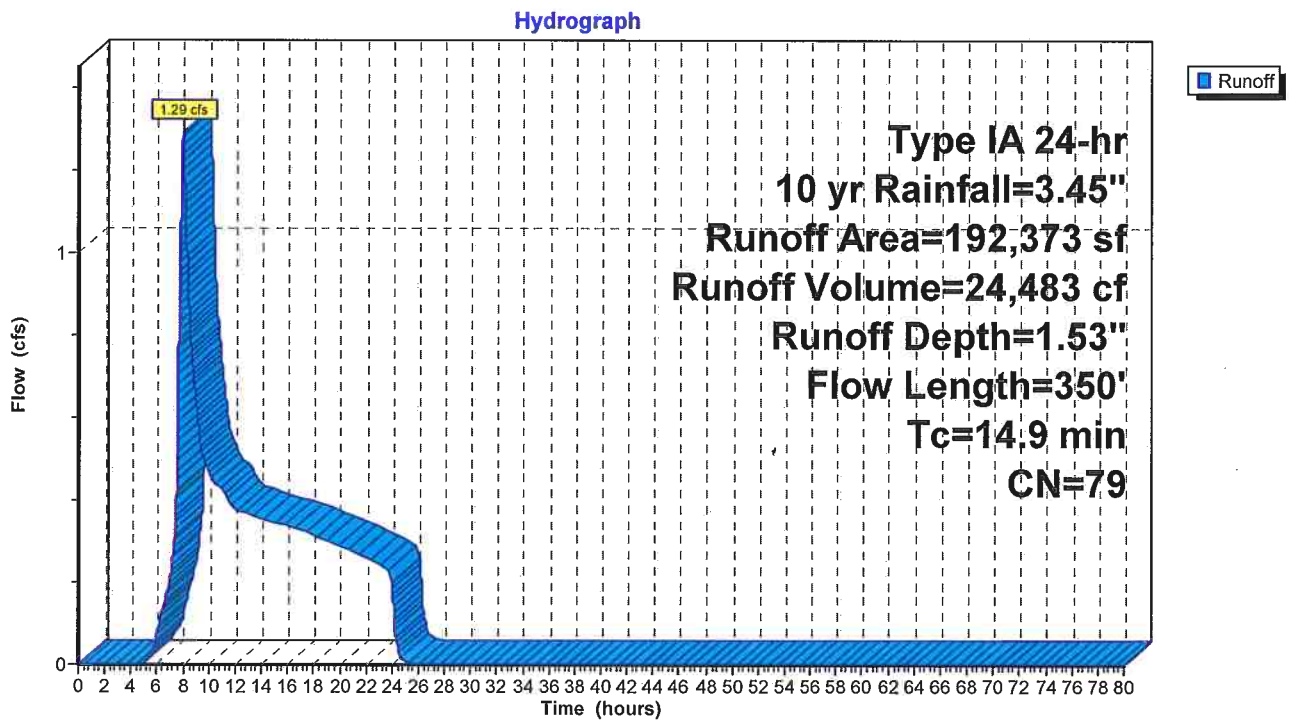
Runoff = 1.29 cfs @ 8.00 hrs, Volume= 24,483 cf, Depth= 1.53"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.45"

Area (sf)	CN	Description
192,373	79	Pasture/grassland/range, Fair, HSG C
192,373		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	150	0.0400	0.24		**Sheet Flow,** Range n= 0.130 P2= 2.50"
4.5	200	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.9	350	Total			

Subcatchment 5: Existing Site East



Summary for Subcatchment 6: Developed Site East Impervious Area

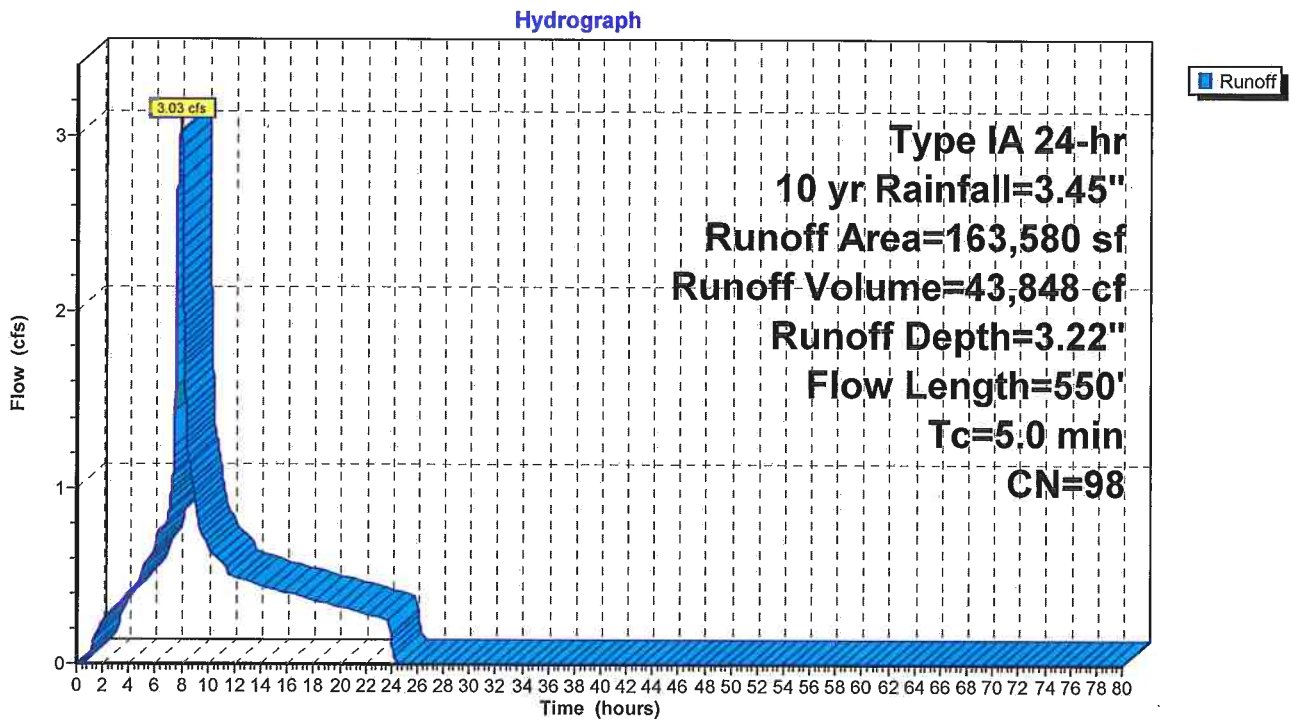
Runoff = 3.03 cfs @ 7.88 hrs, Volume= 43,848 cf, Depth= 3.22"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.45"

Area (sf)	CN	Description
163,580	98	Paved parking & roofs
163,580		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	550		1.83		**Direct Entry,**

Subcatchment 6: Developed Site East Impervious Area



Summary for Subcatchment 7: Developed Site East Pervious Area

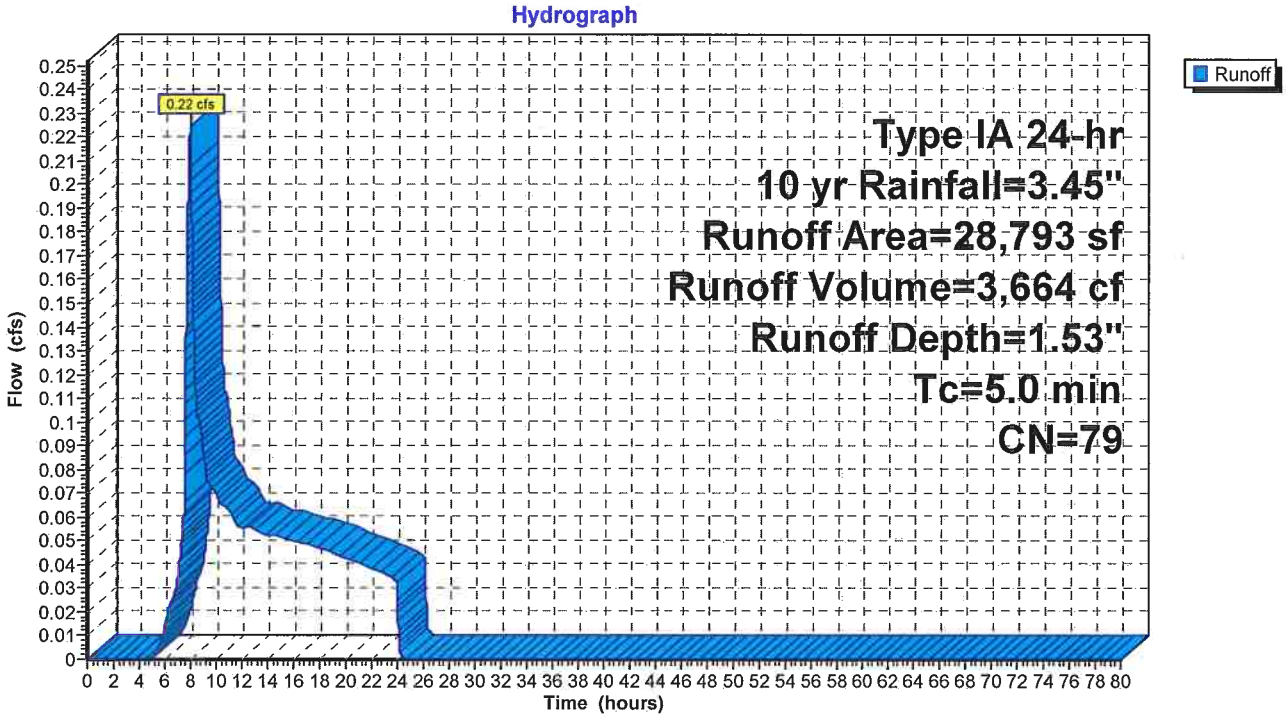
Runoff = 0.22 cfs @ 7.99 hrs, Volume= 3,664 cf, Depth= 1.53"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.45"

Area (sf)	CN	Description
28,793	79	50-75% Grass cover, Fair, HSG C
28,793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: Developed Site East Pervious Area



Summary for Pond 4: West Detention

Inflow Area =	112,631 sf,	84.36% Impervious,	Inflow Depth =	2.95"	for 10 yr event
Inflow =	1.89 cfs @	7.89 hrs, Volume=	27,710 cf		
Outflow =	0.71 cfs @	8.69 hrs, Volume=	27,345 cf,	Atten= 63%,	Lag= 48.2 min
Primary =	0.71 cfs @	8.69 hrs, Volume=	27,345 cf		

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 139.34' @ 8.69 hrs Surf.Area= 5,452 sf Storage= 6,555 cf

Plug-Flow detention time= 196.4 min calculated for 27,345 cf (99% of inflow)
Center-of-Mass det. time= 186.2 min (862.0 - 675.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.00'	6,534 cf	**20.50'W x 173.32'L x 4.00'H Field A Z=2.0** 20,756 cf Overall - 4,422 cf Embedded = 16,334 cf x 40.0% Voids
#2A	137.50'	4,422 cf	**ADS_StormTech SC-740** x 96 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 4 rows
		10,955 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	137.25'	**15.0" Round Culvert** L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 137.25' / 137.20' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	135.05'	**3.1" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	138.83'	**4.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.71 cfs @ 8.69 hrs HW=139.34' (Free Discharge)
└─**1=Culvert** (Passes 0.71 cfs of 7.14 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 6.96 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.35 cfs @ 3.43 fps)

Pond 4: West Detention - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 (ADS StormTech® SC-740)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.45 sf x 4 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

24 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 171.32' Row Length +12.0" End Stone x 2 = 173.32' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
6.0" Base + 30.0" Chamber Height + 12.0" Cover = 4.00' Field Height

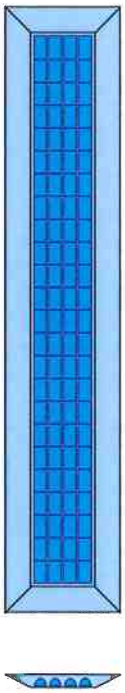
2.0 '/' Side-Z x Height = 96.0" Flare/Side
Base Length + Flare x 2 = 189.32' Top Length
Base Width + Flare x 2 = 36.50' Top Width

96 Chambers x 45.9 cf +0.44' Row Adjustment x 6.45 sf x 4 Rows = 4,421.6 cf Chamber Storage

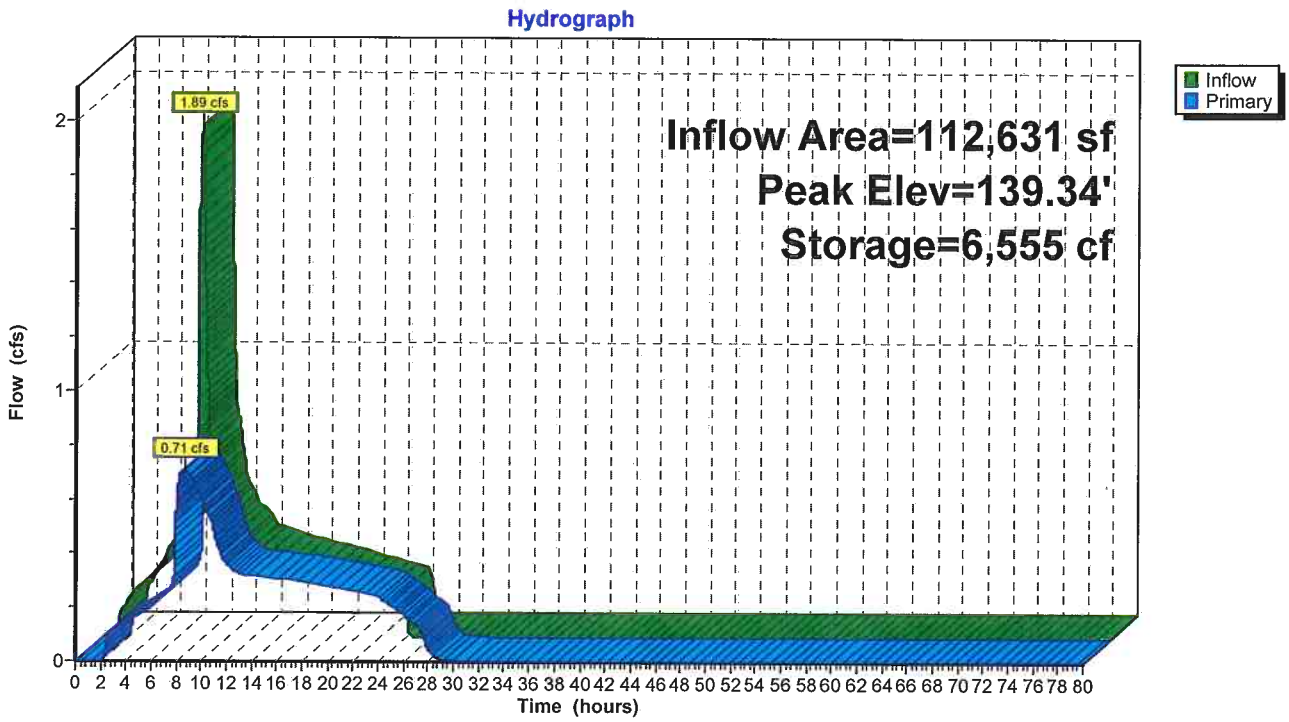
20,755.8 cf Field - 4,421.6 cf Chambers = 16,334.2 cf Stone x 40.0% Voids = 6,533.7 cf Stone Storage

Chamber Storage + Stone Storage = 10,955.3 cf = 0.251 af
Overall Storage Efficiency = 52.8%

96 Chambers
768.7 cy Field
605.0 cy Stone



Pond 4: West Detention



Summary for Pond 8: East Detention

Inflow Area =	192,373 sf,	85.03% Impervious,	Inflow Depth =	2.96"	for 10 yr event
Inflow =	3.25 cfs @	7.89 hrs, Volume=	47,513 cf		
Outflow =	1.29 cfs @	8.46 hrs, Volume=	46,586 cf,	Atten= 60%,	Lag= 34.7 min
Primary =	1.29 cfs @	8.46 hrs, Volume=	46,586 cf		

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 139.79' @ 8.46 hrs Surf.Area= 7,693 sf Storage= 11,252 cf

Plug-Flow detention time= 189.8 min calculated for 46,581 cf (98% of inflow)
Center-of-Mass det. time= 175.3 min (850.5 - 675.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	136.80'	6,642 cf	**25.25'W x 194.68'L x 3.50'H Field A Z=2.0** 22,822 cf Overall - 6,216 cf Embedded = 16,606 cf x 40.0% Voids
#2A	137.30'	6,216 cf	**ADS_StormTech SC-740** x 135 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 5 rows
		12,858 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	137.25'	**18.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 137.25' / 137.20' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	135.00'	**4.1" Vert. Orifice/Grate** C= 0.600
#3	Device 1	139.07'	**5.1" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.29 cfs @ 8.46 hrs HW=139.79' (Free Discharge)
└─**1=Culvert** (Passes 1.29 cfs of 11.40 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.70 cfs @ 7.68 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.58 cfs @ 4.10 fps)

Pond 8: East Detention - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 (ADS StormTech® SC-740)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.45 sf x 5 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

27 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 192.68' Row Length +12.0" End Stone x 2 = 194.68' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

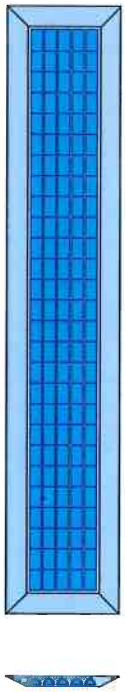
2.0 '/' Side-Z x Height = 84.0" Flare/Side
Base Length + Flare x 2 = 208.68' Top Length
Base Width + Flare x 2 = 39.25' Top Width

135 Chambers x 45.9 cf +0.44' Row Adjustment x 6.45 sf x 5 Rows = 6,216.1 cf Chamber Storage

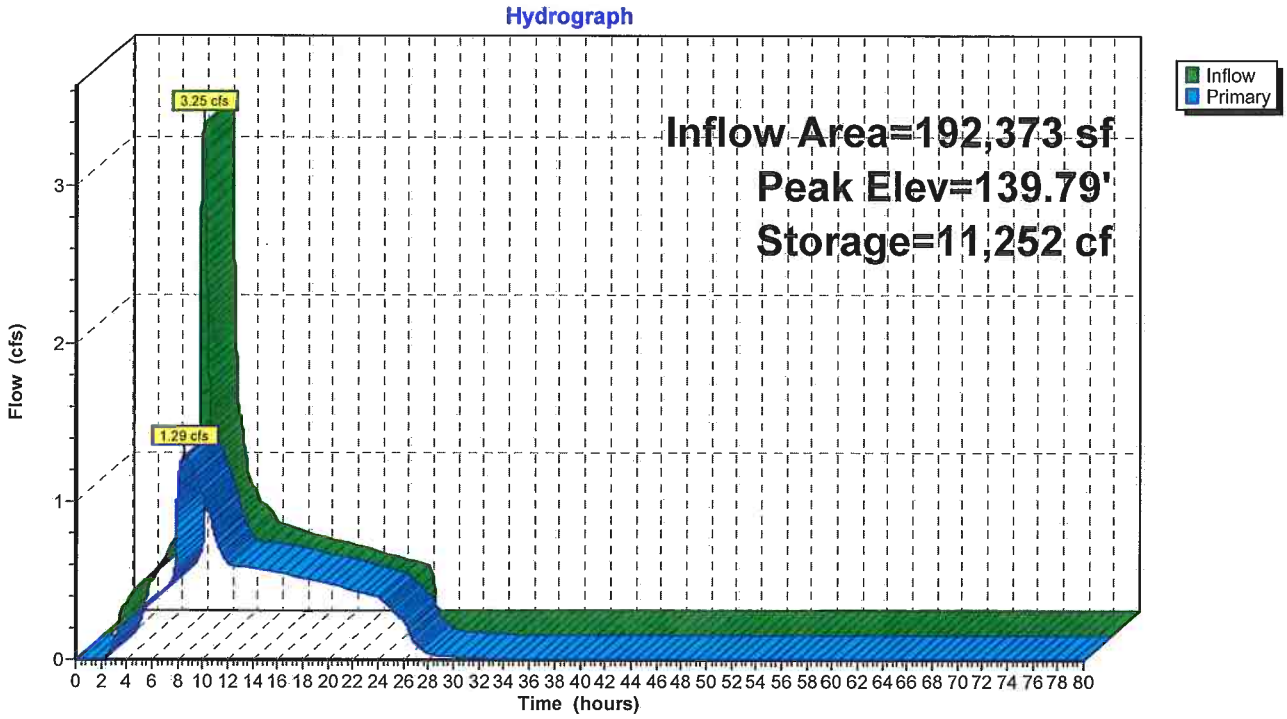
22,821.8 cf Field - 6,216.1 cf Chambers = 16,605.7 cf Stone x 40.0% Voids = 6,642.3 cf Stone Storage

Chamber Storage + Stone Storage = 12,858.4 cf = 0.295 af
Overall Storage Efficiency = 56.3%

135 Chambers
845.3 cy Field
615.0 cy Stone



Pond 8: East Detention



Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Existing Site West Runoff Area=112,631 sf 0.00% Impervious Runoff Depth=1.88"
Flow Length=410' Tc=18.3 min CN=79 Runoff=0.92 cfs 17,670 cf

Subcatchment 2: Developed Site West Runoff Area=95,011 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=2.00 cfs 29,021 cf

Subcatchment 3: Developed Site West Runoff Area=17,620 sf 0.00% Impervious Runoff Depth=1.88"
Tc=5.0 min CN=79 Runoff=0.18 cfs 2,764 cf

Subcatchment 5: Existing Site East Runoff Area=192,373 sf 0.00% Impervious Runoff Depth=1.88"
Flow Length=350' Tc=14.9 min CN=79 Runoff=1.67 cfs 30,181 cf

Subcatchment 6: Developed Site East Runoff Area=163,580 sf 100.00% Impervious Runoff Depth=3.67"
Flow Length=550' Tc=5.0 min CN=98 Runoff=3.44 cfs 49,965 cf

Subcatchment 7: Developed Site East Runoff Area=28,793 sf 0.00% Impervious Runoff Depth=1.88"
Tc=5.0 min CN=79 Runoff=0.29 cfs 4,517 cf

Pond 4: West Detention Peak Elev=139.66' Storage=7,512 cf Inflow=2.17 cfs 31,785 cf
Outflow=0.84 cfs 31,420 cf

Pond 8: East Detention Peak Elev=140.28' Storage=12,788 cf Inflow=3.72 cfs 54,482 cf
Outflow=1.52 cfs 53,556 cf

Total Runoff Area = 610,008 sf Runoff Volume = 134,118 cf Average Runoff Depth = 2.64"
57.61% Pervious = 351,417 sf 42.39% Impervious = 258,591 sf

Summary for Subcatchment 1: Existing Site West

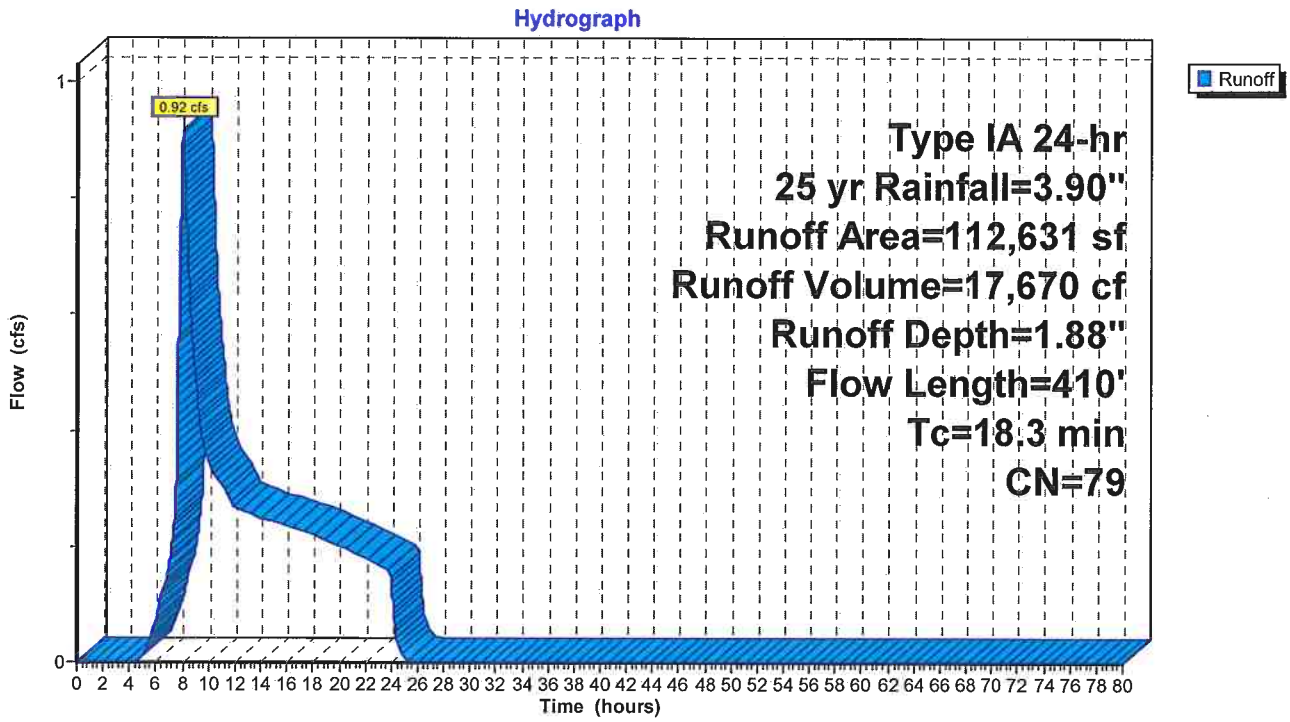
Runoff = 0.92 cfs @ 8.01 hrs, Volume= 17,670 cf, Depth= 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
112,631	79	Pasture/grassland/range, Fair, HSG C
112,631		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	100	0.0125	0.14		**Sheet Flow,** Range n= 0.130 P2= 2.50"
6.4	310	0.0133	0.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
18.3	410	Total			

Subcatchment 1: Existing Site West



Summary for Subcatchment 2: Developed Site West Impervious Area

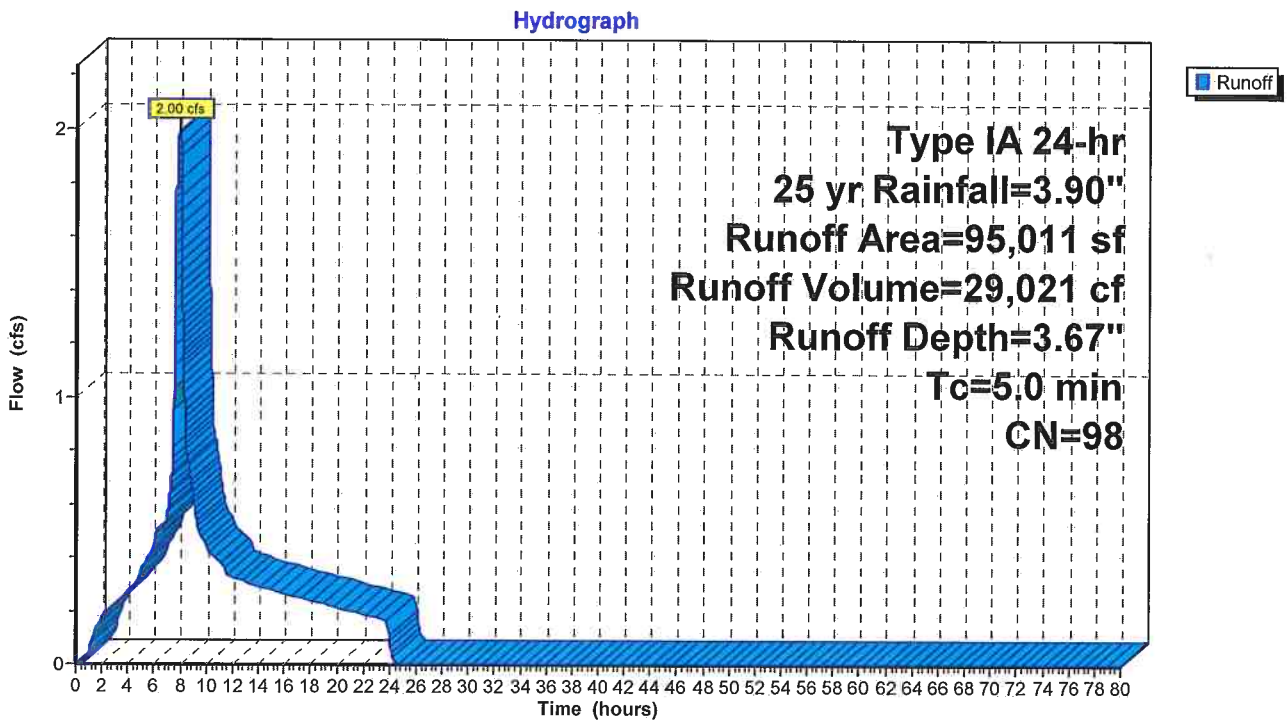
Runoff = 2.00 cfs @ 7.88 hrs, Volume= 29,021 cf, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
95,011	98	Paved parking & roofs
95,011		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Developed Site West Impervious Area



Summary for Subcatchment 3: Developed Site West Pervious Area

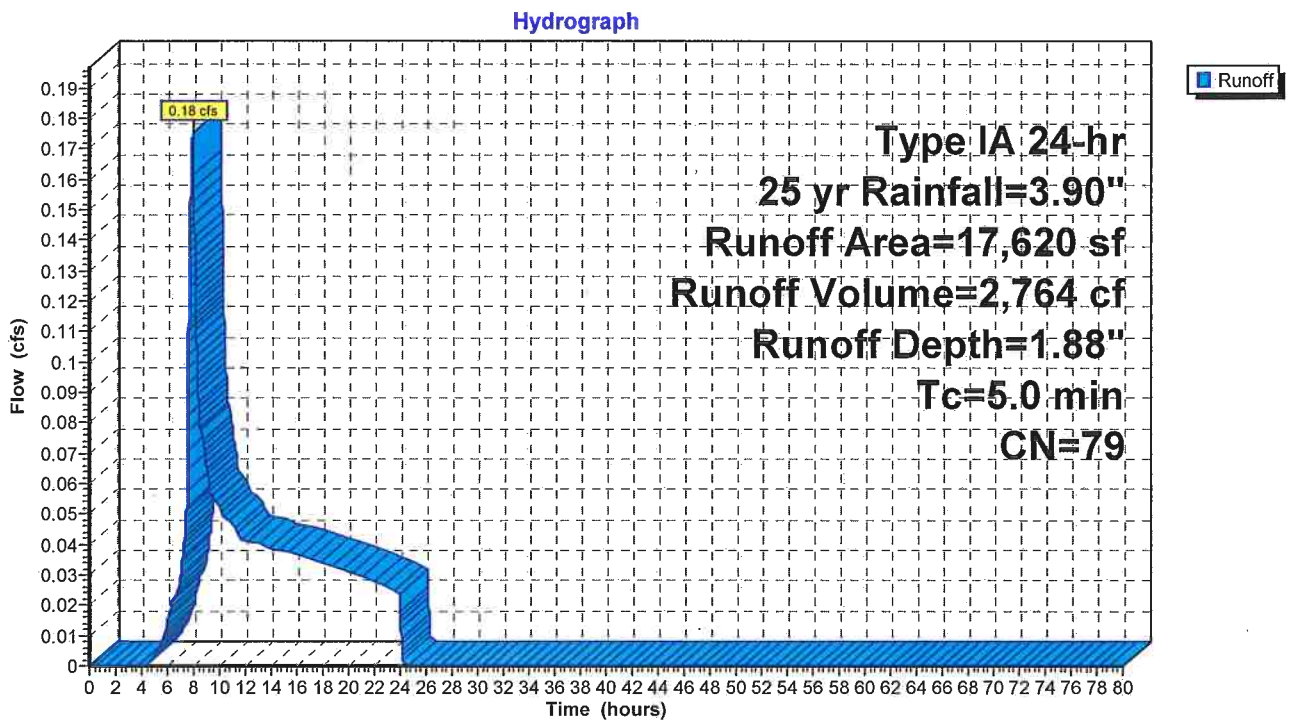
Runoff = 0.18 cfs @ 7.98 hrs, Volume= 2,764 cf, Depth= 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
17,620	79	50-75% Grass cover, Fair, HSG C
17,620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Developed Site West Pervious Area



Summary for Subcatchment 5: Existing Site East

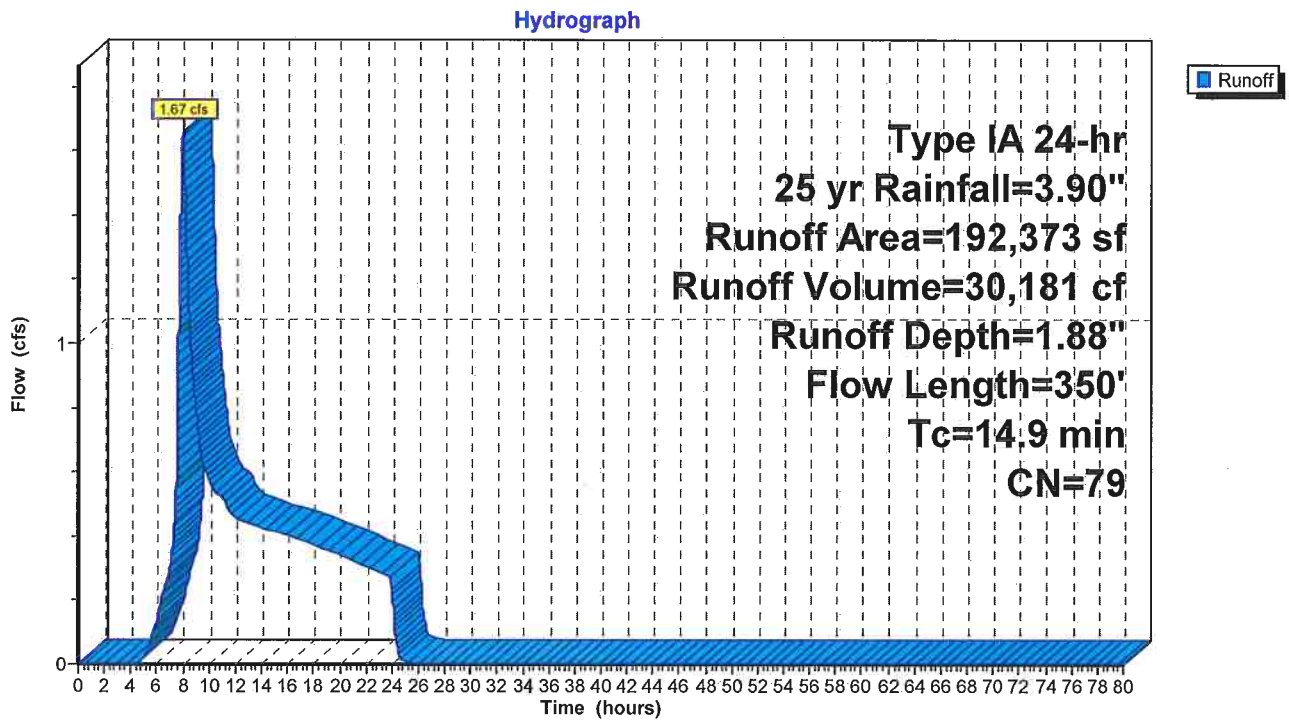
Runoff = 1.67 cfs @ 8.00 hrs, Volume= 30,181 cf, Depth= 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
192,373	79	Pasture/grassland/range, Fair, HSG C
192,373		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	150	0.0400	0.24		**Sheet Flow,** Range n= 0.130 P2= 2.50"
4.5	200	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.9	350	Total			

Subcatchment 5: Existing Site East



Summary for Subcatchment 6: Developed Site East Impervious Area

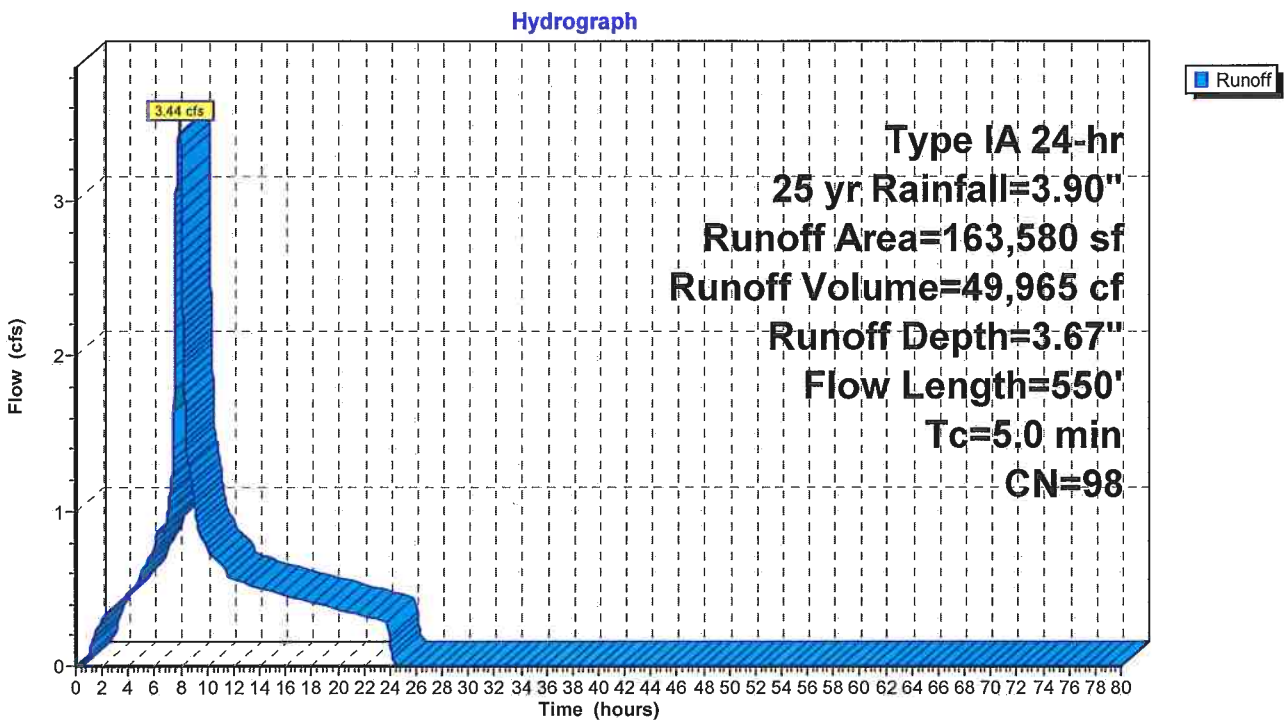
Runoff = 3.44 cfs @ 7.88 hrs, Volume= 49,965 cf, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
163,580	98	Paved parking & roofs
163,580		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	550		1.83		**Direct Entry,**

Subcatchment 6: Developed Site East Impervious Area



Summary for Subcatchment 7: Developed Site East Pervious Area

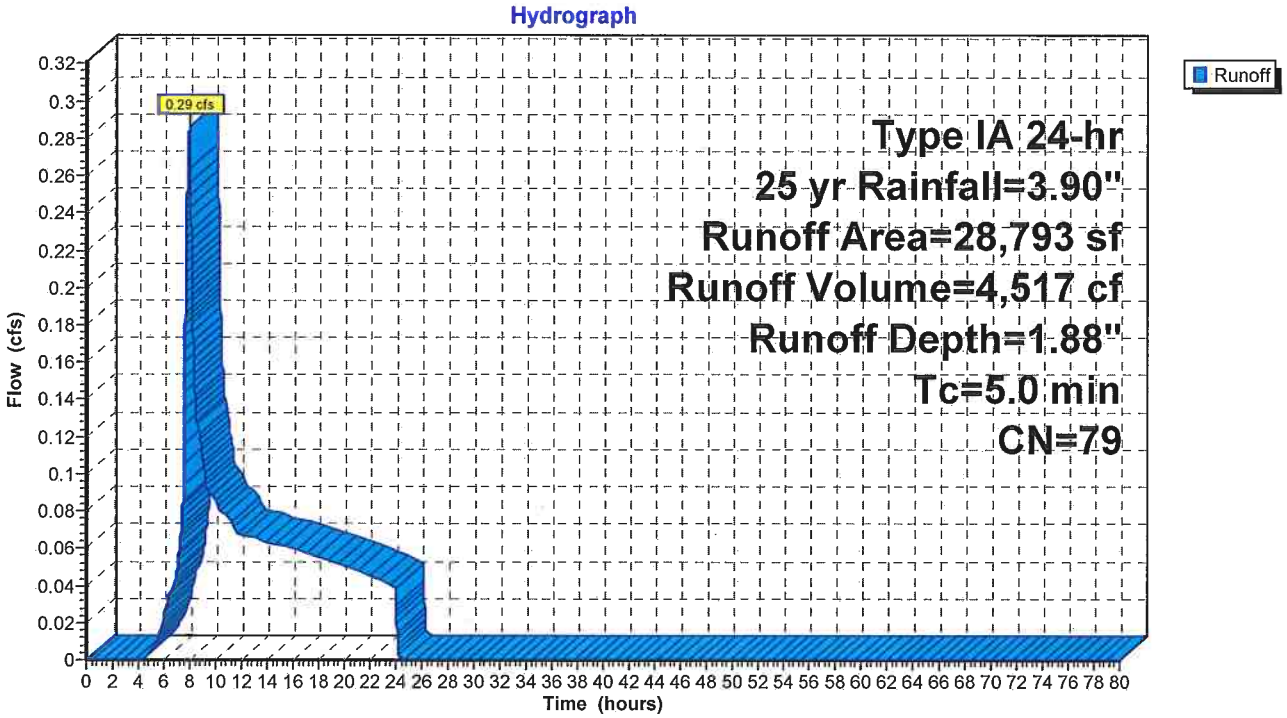
Runoff = 0.29 cfs @ 7.98 hrs, Volume= 4,517 cf, Depth= 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
28,793	79	50-75% Grass cover, Fair, HSG C
28,793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: Developed Site East Pervious Area



Summary for Pond 4: West Detention

Inflow Area =	112,631 sf,	84.36% Impervious,	Inflow Depth =	3.39"	for 25 yr event
Inflow =	2.17 cfs @	7.89 hrs, Volume=	31,785 cf		
Outflow =	0.84 cfs @	8.49 hrs, Volume=	31,420 cf,	Atten= 61%,	Lag= 36.2 min
Primary =	0.84 cfs @	8.49 hrs, Volume=	31,420 cf		

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 139.66' @ 8.49 hrs Surf.Area= 5,732 sf Storage= 7,512 cf

Plug-Flow detention time= 193.4 min calculated for 31,420 cf (99% of inflow)
Center-of-Mass det. time= 184.5 min (857.3 - 672.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.00'	6,534 cf	**20.50'W x 173.32'L x 4.00'H Field A Z=2.0** 20,756 cf Overall - 4,422 cf Embedded = 16,334 cf x 40.0% Voids
#2A	137.50'	4,422 cf	**ADS_StormTech SC-740** x 96 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 4 rows
		10,955 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	137.25'	**15.0" Round Culvert** L= 3.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 137.25' / 137.20' S= 0.0167 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	135.05'	**3.1" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	138.83'	**4.3" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.84 cfs @ 8.49 hrs HW=139.66' (Free Discharge)
└─**1=Culvert** (Passes 0.84 cfs of 7.90 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.39 cfs @ 7.48 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.44 cfs @ 4.40 fps)

Pond 4: West Detention - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 (ADS StormTech® SC-740)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.45 sf x 4 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

24 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 171.32' Row Length +12.0" End Stone x 2 = 173.32' Base Length
4 Rows x 51.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.50' Base Width
6.0" Base + 30.0" Chamber Height + 12.0" Cover = 4.00' Field Height

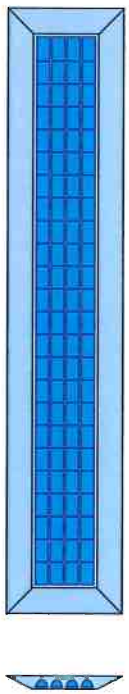
2.0 '/' Side-Z x Height = 96.0" Flare/Side
Base Length + Flare x 2 = 189.32' Top Length
Base Width + Flare x 2 = 36.50' Top Width

96 Chambers x 45.9 cf +0.44' Row Adjustment x 6.45 sf x 4 Rows = 4,421.6 cf Chamber Storage

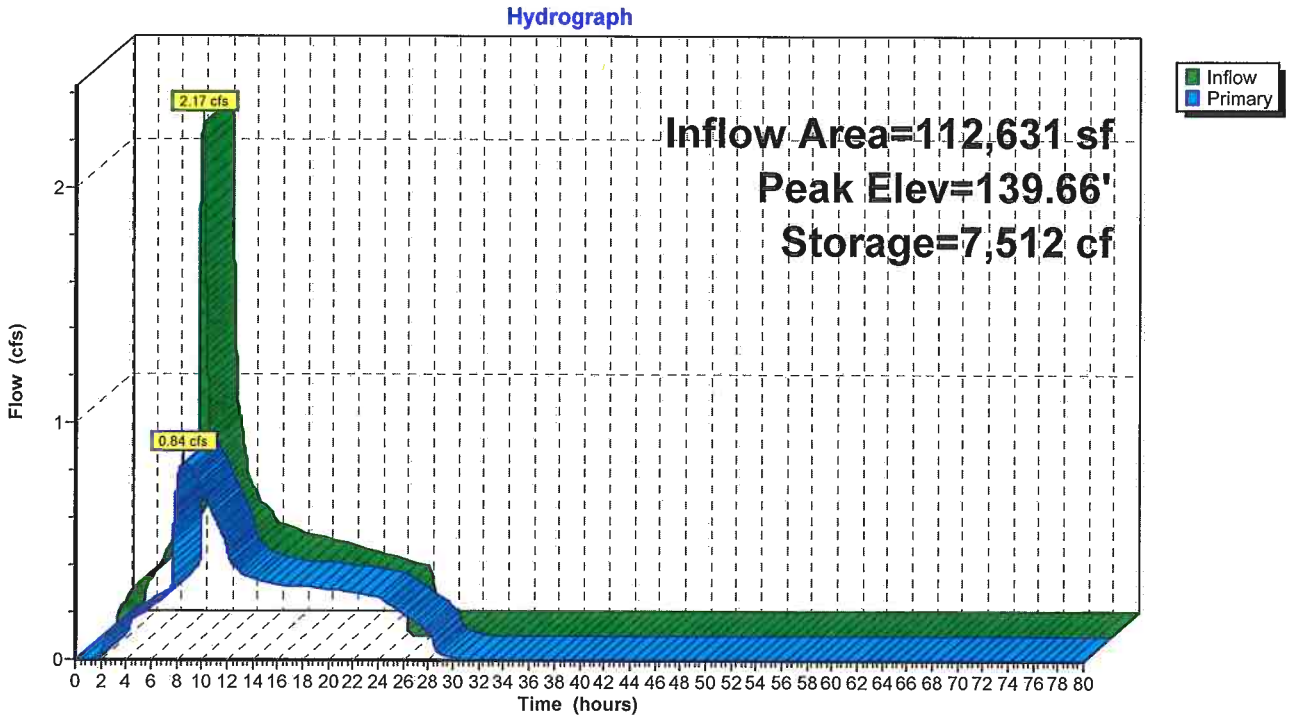
20,755.8 cf Field - 4,421.6 cf Chambers = 16,334.2 cf Stone x 40.0% Voids = 6,533.7 cf Stone Storage

Chamber Storage + Stone Storage = 10,955.3 cf = 0.251 af
Overall Storage Efficiency = 52.8%

96 Chambers
768.7 cy Field
605.0 cy Stone



Pond 4: West Detention



Summary for Pond 8: East Detention

Inflow Area =	192,373 sf,	85.03% Impervious,	Inflow Depth =	3.40"	for 25 yr event
Inflow =	3.72 cfs @	7.88 hrs, Volume=	54,482 cf		
Outflow =	1.52 cfs @	8.44 hrs, Volume=	53,556 cf,	Atten= 59%,	Lag= 33.1 min
Primary =	1.52 cfs @	8.44 hrs, Volume=	53,556 cf		

Routing by Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 140.28' @ 8.44 hrs Surf.Area= 8,169 sf Storage= 12,788 cf

Plug-Flow detention time= 186.8 min calculated for 53,549 cf (98% of inflow)
Center-of-Mass det. time= 174.1 min (846.3 - 672.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	136.80'	6,642 cf	**25.25'W x 194.68'L x 3.50'H Field A Z=2.0** 22,822 cf Overall - 6,216 cf Embedded = 16,606 cf x 40.0% Voids
#2A	137.30'	6,216 cf	**ADS_StormTech SC-740** x 135 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 5 rows
		12,858 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	137.25'	**18.0" Round Culvert** L= 8.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 137.25' / 137.20' S= 0.0063 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	135.00'	**4.1" Vert. Orifice/Grate** C= 0.600
#3	Device 1	139.07'	**5.1" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.52 cfs @ 8.44 hrs HW=140.28' (Free Discharge)
└─**1=Culvert** (Passes 1.52 cfs of 12.84 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.77 cfs @ 8.38 fps)
  └─**3=Orifice/Grate** (Orifice Controls 0.75 cfs @ 5.29 fps)

Pond 8: East Detention - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 (ADS StormTech® SC-740)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
Row Length Adjustment= +0.44' x 6.45 sf x 5 rows

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

27 Chambers/Row x 7.12' Long +0.44' Row Adjustment = 192.68' Row Length +12.0" End Stone x 2 = 194.68' Base Length
5 Rows x 51.0" Wide + 6.0" Spacing x 4 + 12.0" Side Stone x 2 = 25.25' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

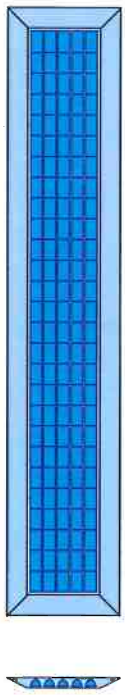
2.0 '/' Side-Z x Height = 84.0" Flare/Side
Base Length + Flare x 2 = 208.68' Top Length
Base Width + Flare x 2 = 39.25' Top Width

135 Chambers x 45.9 cf +0.44' Row Adjustment x 6.45 sf x 5 Rows = 6,216.1 cf Chamber Storage

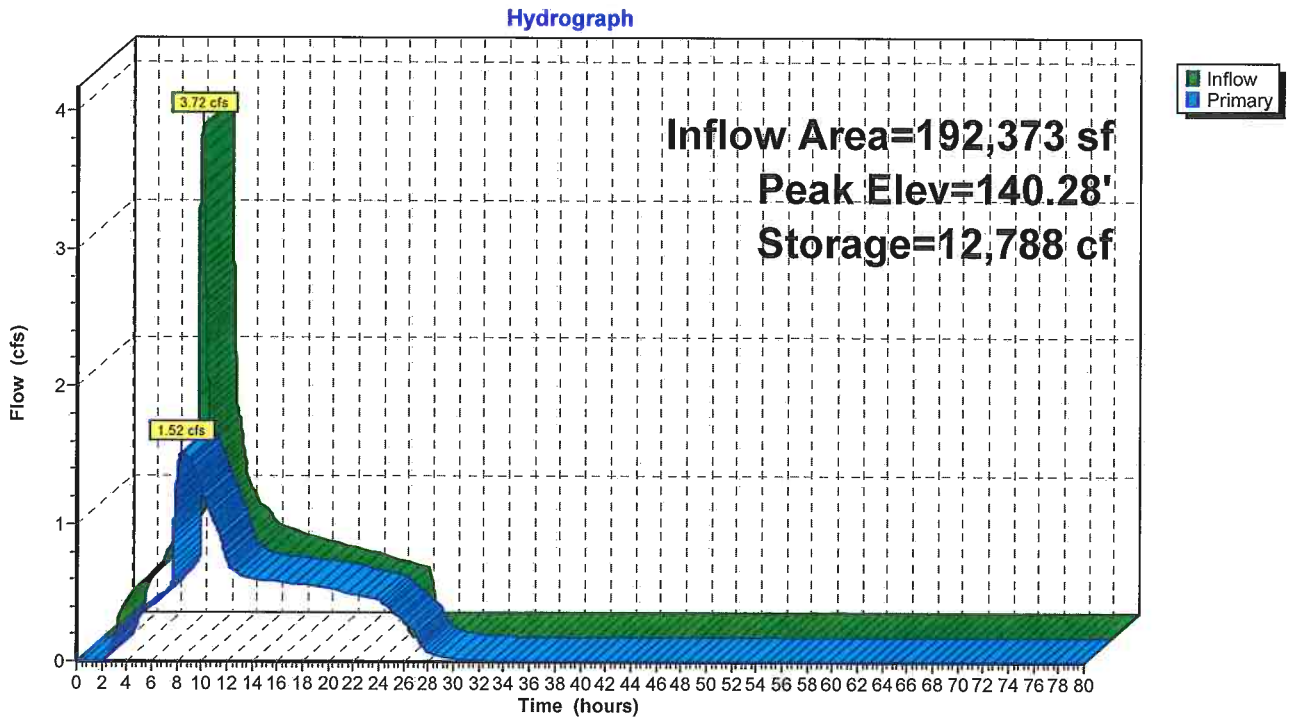
22,821.8 cf Field - 6,216.1 cf Chambers = 16,605.7 cf Stone x 40.0% Voids = 6,642.3 cf Stone Storage

Chamber Storage + Stone Storage = 12,858.4 cf = 0.295 af
Overall Storage Efficiency = 56.3%

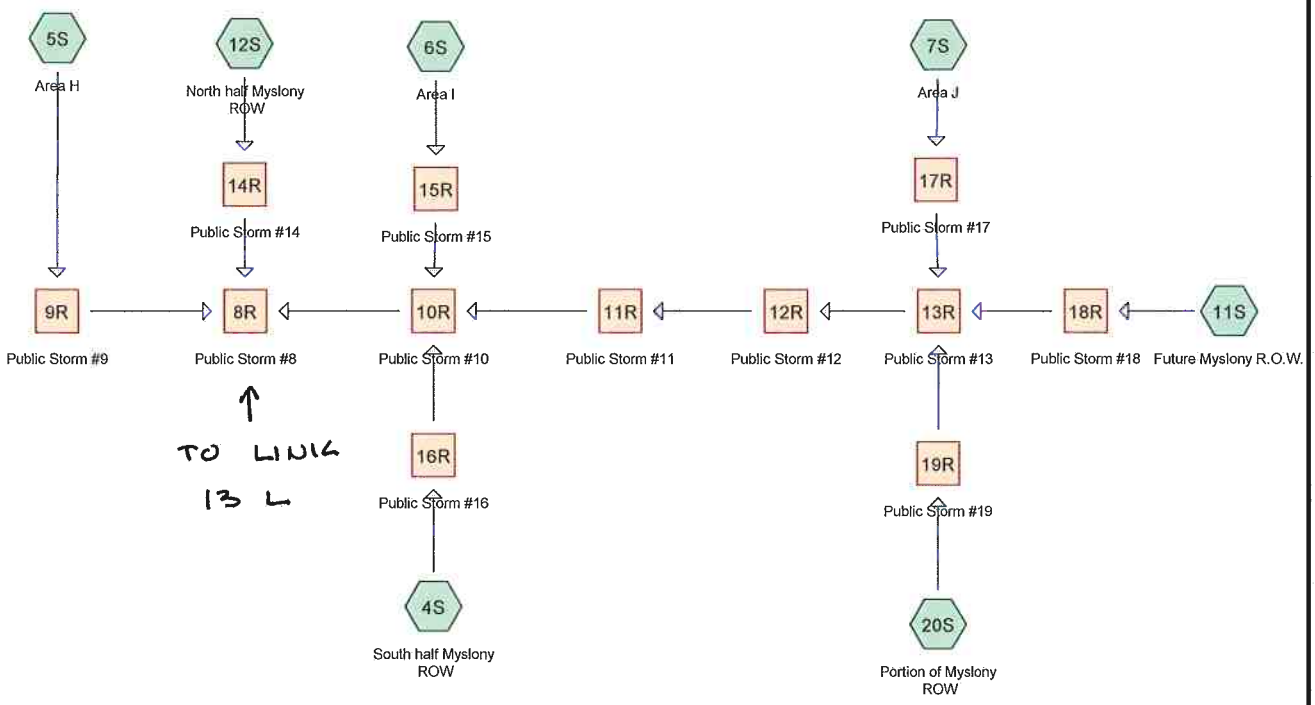
135 Chambers
845.3 cy Field
615.0 cy Stone

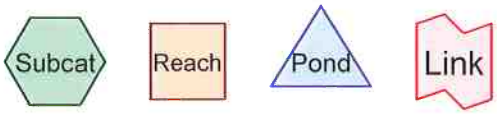


Pond 8: East Detention



MYSLONY ANALYSIS (2008)





Routing Diagram for 5381-2008-12-09 Myslony Public-1
Prepared by Microsoft, Printed 12/11/2014
HydroCAD® 10.00-13 s/n 02239 © 2014 HydroCAD Software Solutions LLC

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	8R	135.25	134.95	75.0	0.0040	0.013	24.0	0.0	0.0
2	9R	135.50	135.35	55.0	0.0027	0.013	12.0	0.0	0.0
3	10R	135.50	135.35	50.0	0.0030	0.013	24.0	0.0	0.0
4	11R	135.90	135.60	100.0	0.0030	0.013	18.0	0.0	0.0
5	12R	136.45	136.00	150.0	0.0030	0.013	18.0	0.0	0.0
6	13R	137.05	136.55	162.0	0.0031	0.013	18.0	0.0	0.0
7	14R	140.80	138.70	11.0	0.1909	0.013	12.0	0.0	0.0
8	15R	138.65	138.60	10.0	0.0050	0.013	12.0	0.0	0.0
9	16R	139.50	139.10	20.0	0.0200	0.013	12.0	0.0	0.0
10	17R	137.20	137.10	11.0	0.0091	0.013	12.0	0.0	0.0
11	18R	137.17	137.15	5.0	0.0040	0.013	15.0	0.0	0.0
12	19R	142.95	142.70	20.0	0.0125	0.013	12.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4S: South half Myslony Runoff Area=11,977 sf 100.00% Impervious Runoff Depth>3.66"
Tc=5.0 min CN=98 Runoff=0.25 cfs 3,652 cf

Subcatchment 5S: Area H Runoff Area=142,626 sf 0.00% Impervious Runoff Depth>1.88"
Tc=5.0 min CN=79 Runoff=1.42 cfs 22,317 cf

Subcatchment 6S: Area I Runoff Area=128,769 sf 0.00% Impervious Runoff Depth>1.88"
Tc=5.0 min CN=79 Runoff=1.28 cfs 20,149 cf

Subcatchment 7S: Area J Runoff Area=249,784 sf 0.00% Impervious Runoff Depth>1.88"
Tc=5.0 min CN=79 Runoff=2.49 cfs 39,084 cf

Subcatchment 11S: Future Myslony Runoff Area=33,614 sf 100.00% Impervious Runoff Depth>3.66"
Tc=5.0 min CN=98 Runoff=0.71 cfs 10,250 cf

Subcatchment 12S: North half Myslony Runoff Area=11,977 sf 0.00% Impervious Runoff Depth>1.88"
Tc=5.0 min CN=79 Runoff=0.12 cfs 1,874 cf

Subcatchment 20S: Portion of Myslony Runoff Area=4,020 sf 100.00% Impervious Runoff Depth>3.66"
Tc=5.0 min CN=98 Runoff=0.08 cfs 1,226 cf

Reach 8R: Public Storm #8 Avg. Flow Depth=0.95' Max Vel=4.46 fps Inflow=6.56 cfs 119,074 cf
24.0" Round Pipe n=0.013 L=75.0' S=0.0040 '/' Capacity=14.31 cfs Outflow=6.56 cfs 119,026 cf

Reach 9R: Public Storm #9 Avg. Flow Depth=0.65' Max Vel=2.61 fps Inflow=1.42 cfs 22,317 cf
12.0" Round Pipe n=0.013 L=55.0' S=0.0027 '/' Capacity=1.86 cfs Outflow=1.42 cfs 22,306 cf

Reach 10R: Public Storm #10 Avg. Flow Depth=0.89' Max Vel=3.74 fps Inflow=5.03 cfs 94,924 cf
24.0" Round Pipe n=0.013 L=50.0' S=0.0030 '/' Capacity=12.39 cfs Outflow=5.02 cfs 94,894 cf

Reach 11R: Public Storm #11 Avg. Flow Depth=0.84' Max Vel=3.41 fps Inflow=3.50 cfs 71,174 cf
18.0" Round Pipe n=0.013 L=100.0' S=0.0030 '/' Capacity=5.75 cfs Outflow=3.50 cfs 71,125 cf

Reach 12R: Public Storm #12 Avg. Flow Depth=0.85' Max Vel=3.41 fps Inflow=3.50 cfs 71,257 cf
18.0" Round Pipe n=0.013 L=150.0' S=0.0030 '/' Capacity=5.75 cfs Outflow=3.50 cfs 71,174 cf

Reach 13R: Public Storm #13 Avg. Flow Depth=0.80' Max Vel=3.39 fps Inflow=3.27 cfs 50,558 cf
18.0" Round Pipe n=0.013 L=162.0' S=0.0031 '/' Capacity=5.84 cfs Outflow=3.26 cfs 50,503 cf

Reach 14R: Public Storm #14 Avg. Flow Depth=0.06' Max Vel=5.88 fps Inflow=0.12 cfs 1,874 cf
12.0" Round Pipe n=0.013 L=11.0' S=0.1909 '/' Capacity=15.57 cfs Outflow=0.12 cfs 1,874 cf

Reach 15R: Public Storm #15 Avg. Flow Depth=0.51' Max Vel=3.22 fps Inflow=1.28 cfs 20,149 cf
12.0" Round Pipe n=0.013 L=10.0' S=0.0050 '/' Capacity=2.52 cfs Outflow=1.28 cfs 20,147 cf

Reach 16R: Public Storm #16 Avg. Flow Depth=0.15' Max Vel=3.34 fps Inflow=0.25 cfs 3,652 cf
12.0" Round Pipe n=0.013 L=20.0' S=0.0200 '/' Capacity=5.04 cfs Outflow=0.25 cfs 3,652 cf

Reach 17R: Public Storm #17 Avg. Flow Depth=0.64' Max Vel=4.72 fps Inflow=2.49 cfs 39,084 cf
12.0" Round Pipe n=0.013 L=11.0' S=0.0091 '/' Capacity=3.40 cfs Outflow=2.49 cfs 39,082 cf

Reach 18R: Public Storm #18 Avg. Flow Depth=0.35' Max Vel=2.49 fps Inflow=0.71 cfs 10,250 cf
15.0" Round Pipe n=0.013 L=5.0' S=0.0040 '/' Capacity=4.09 cfs Outflow=0.71 cfs 10,250 cf

Reach 19R: Public Storm #19 Avg. Flow Depth=0.10' Max Vel=2.05 fps Inflow=0.08 cfs 1,226 cf
12.0" Round Pipe n=0.013 L=20.0' S=0.0125 '/' Capacity=3.98 cfs Outflow=0.08 cfs 1,226 cf

Total Runoff Area = 582,767 sf Runoff Volume = 98,553 cf Average Runoff Depth = 2.03"
91.49% Pervious = 533,156 sf 8.51% Impervious = 49,611 sf

Summary for Subcatchment 4S: South half Myslony ROW

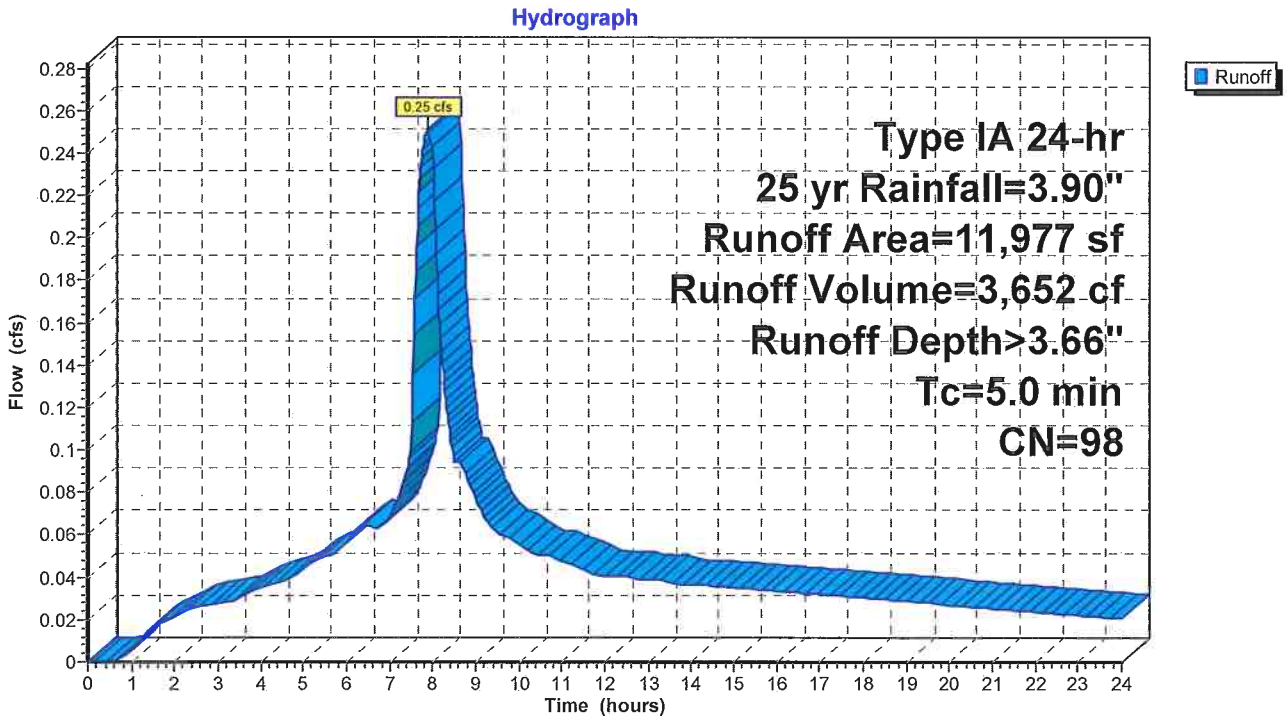
Runoff = 0.25 cfs @ 7.88 hrs, Volume= 3,652 cf, Depth> 3.66"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
11,977	98	Paved parking & roofs
11,977		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: South half Myslony ROW



Summary for Subcatchment 5S: Area H

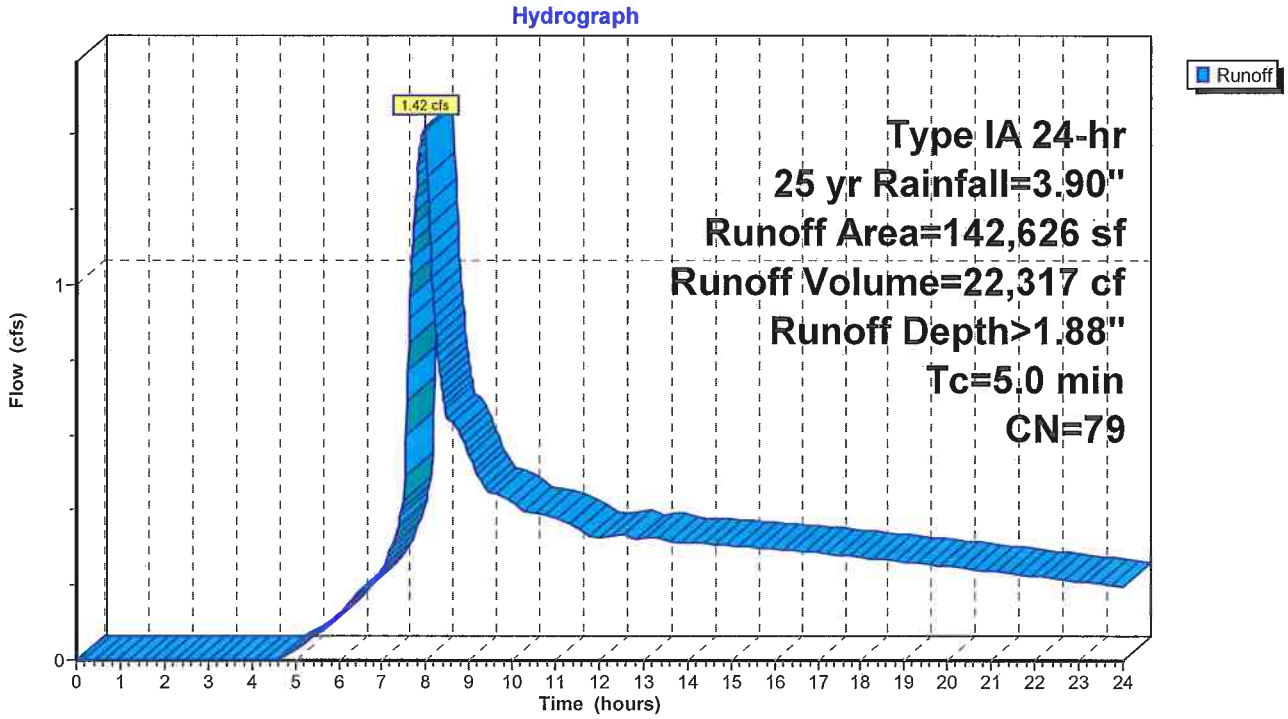
Runoff = 1.42 cfs @ 7.98 hrs, Volume= 22,317 cf, Depth> 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
142,626	79	Pasture/grassland/range, Fair, HSG C
142,626		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: Area H



Summary for Subcatchment 6S: Area I

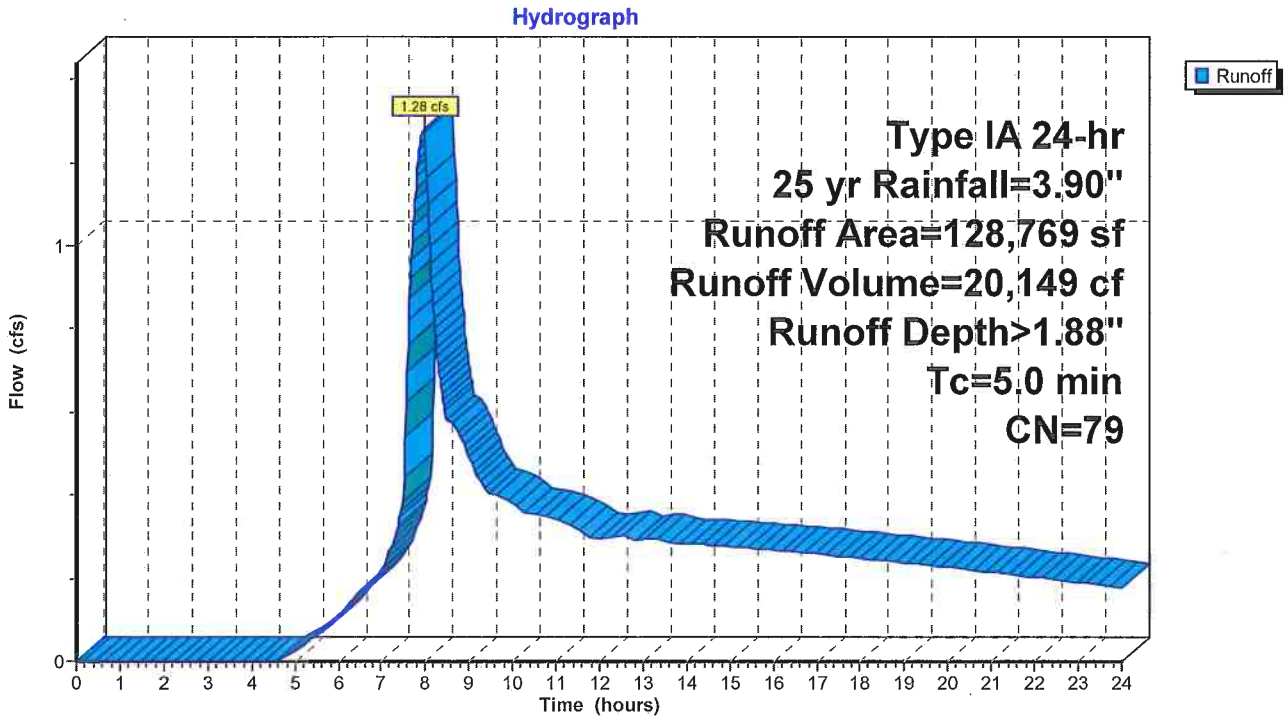
Runoff = 1.28 cfs @ 7.98 hrs, Volume= 20,149 cf, Depth> 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
128,769	79	Pasture/grassland/range, Fair, HSG C
128,769		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: Area I



Summary for Subcatchment 7S: Area J

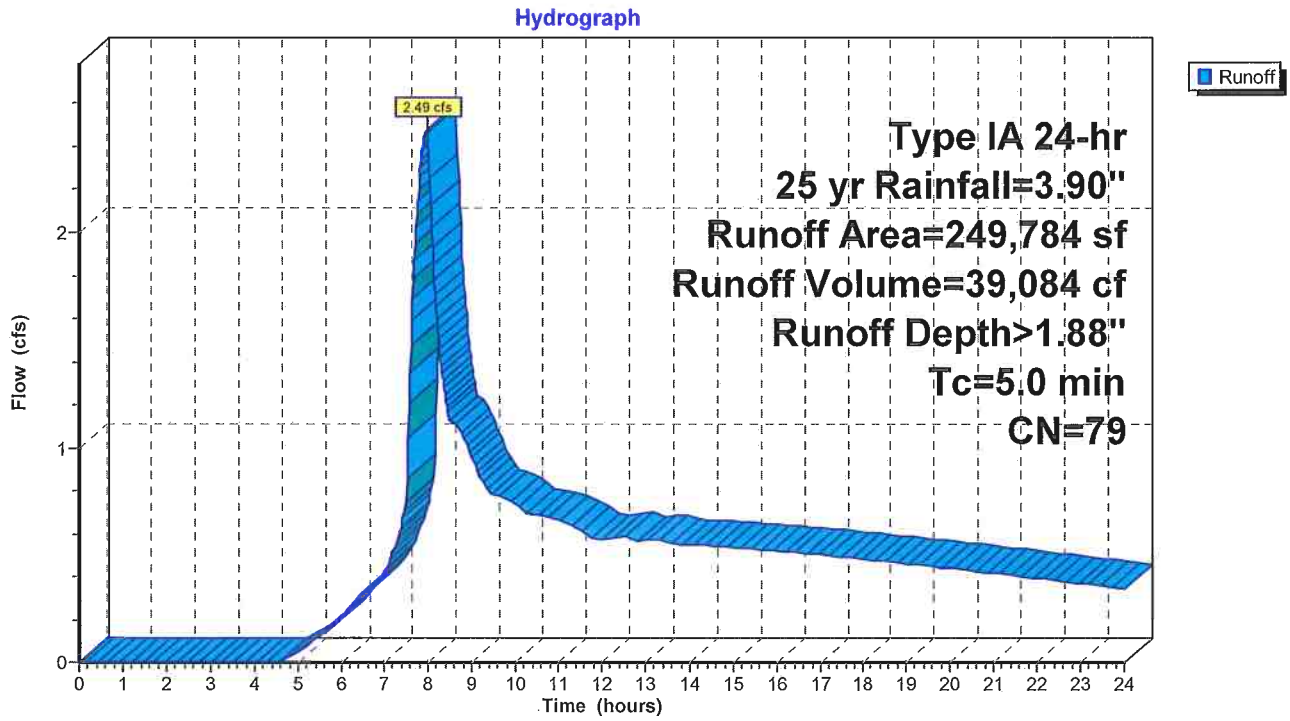
Runoff = 2.49 cfs @ 7.98 hrs, Volume= 39,084 cf, Depth> 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
249,784	79	Pasture/grassland/range, Fair, HSG C
249,784		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: Area J



Summary for Subcatchment 11S: Future Myslony R.O.W.

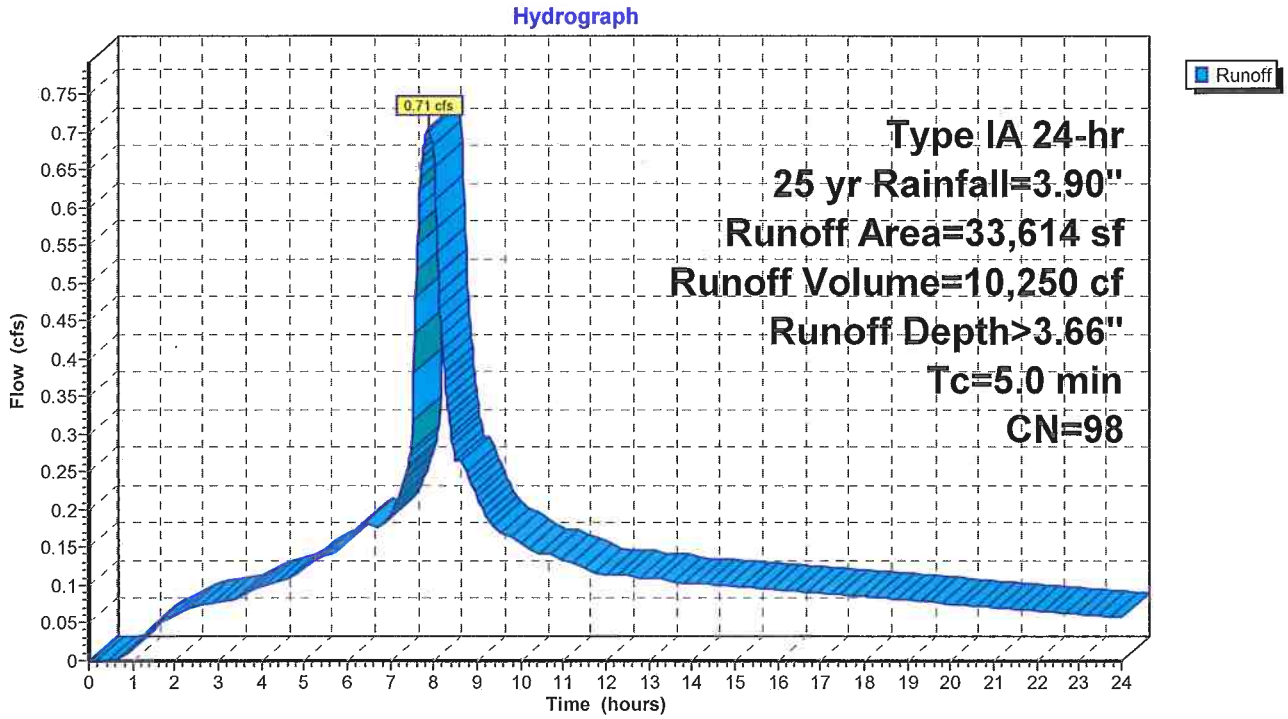
Runoff = 0.71 cfs @ 7.88 hrs, Volume= 10,250 cf, Depth> 3.66"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
33,614	98	Paved roads w/curbs & sewers
33,614		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: Future Myslony R.O.W.



Summary for Subcatchment 12S: North half Myslony ROW

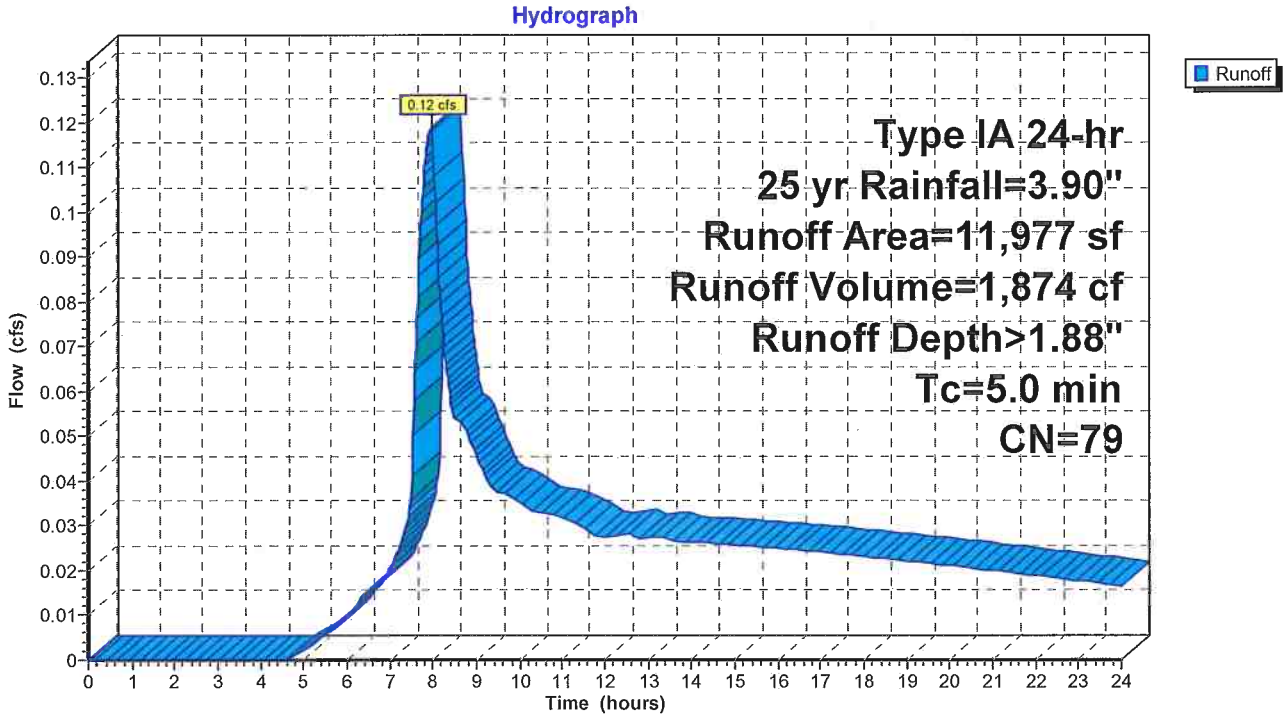
Runoff = 0.12 cfs @ 7.98 hrs, Volume= 1,874 cf, Depth> 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
11,977	79	50-75% Grass cover, Fair, HSG C
11,977		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: North half Myslony ROW



Summary for Subcatchment 20S: Portion of Myslony ROW

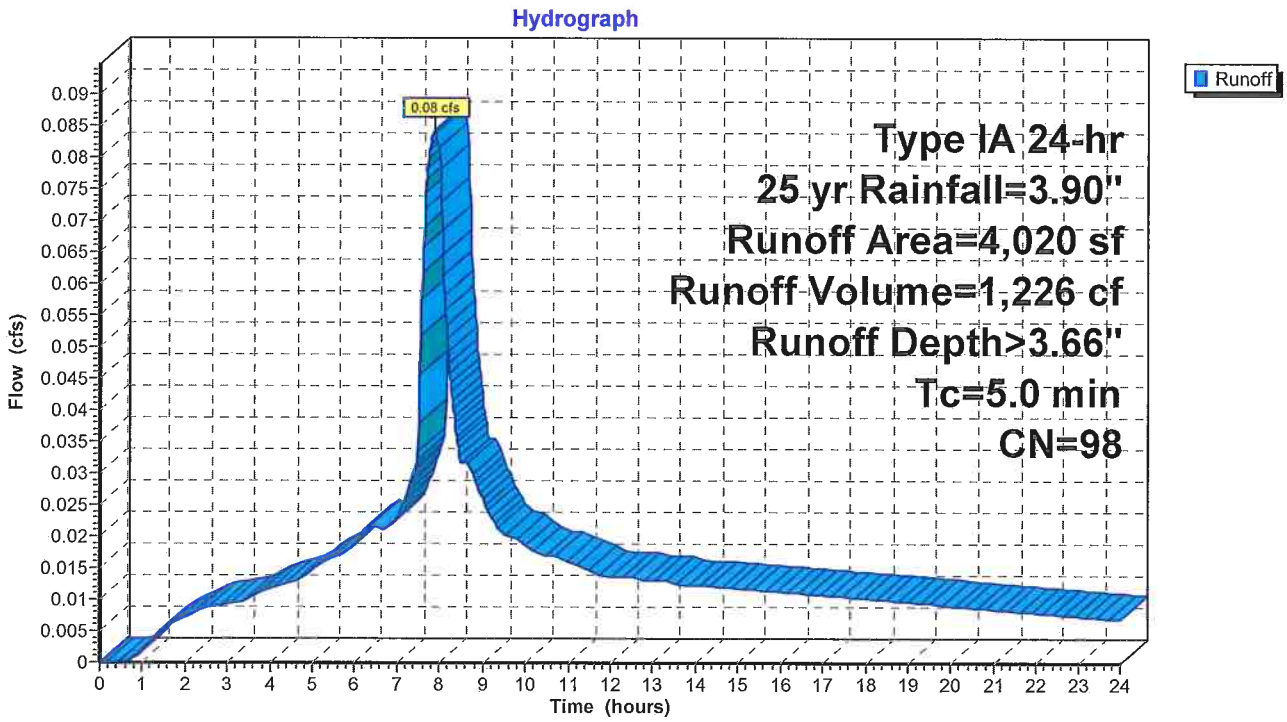
Runoff = 0.08 cfs @ 7.88 hrs, Volume= 1,226 cf, Depth> 3.66"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
4,020	98	Paved parking & roofs
4,020		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 20S: Portion of Myslony ROW



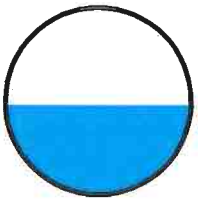
Summary for Reach 8R: Public Storm #8

Inflow Area = 582,767 sf, 8.51% Impervious, Inflow Depth > 2.45" for 25 yr event
Inflow = 6.56 cfs @ 7.99 hrs, Volume= 119,074 cf
Outflow = 6.56 cfs @ 8.00 hrs, Volume= 119,026 cf, Atten= 0%, Lag= 0.3 min

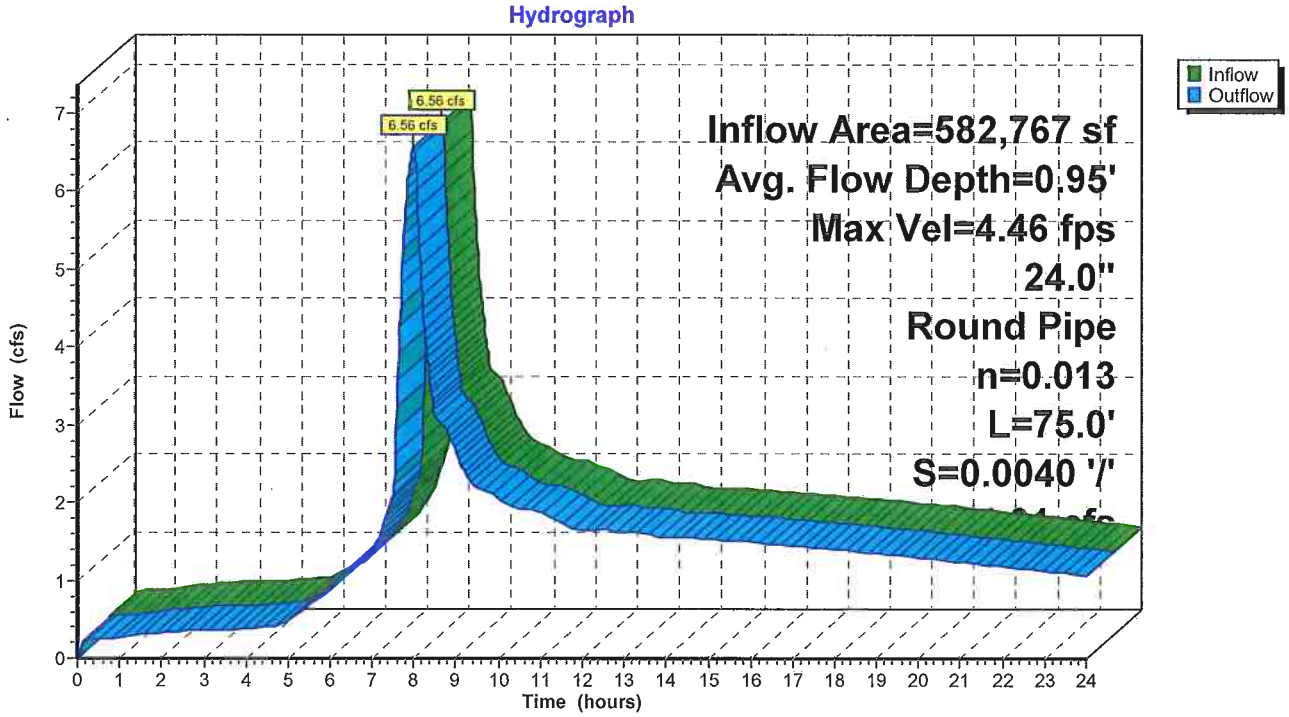
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 4.46 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.75 fps, Avg. Travel Time= 0.5 min

Peak Storage= 110 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.95'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 14.31 cfs

24.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 75.0' Slope= 0.0040 '/'
Inlet Invert= 135.25', Outlet Invert= 134.95'



Reach 8R: Public Storm #8



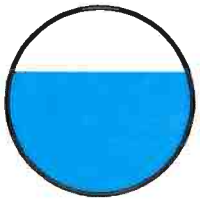
Summary for Reach 9R: Public Storm #9

Inflow Area = 142,626 sf, 0.00% Impervious, Inflow Depth > 1.88" for 25 yr event
Inflow = 1.42 cfs @ 7.98 hrs, Volume= 22,317 cf
Outflow = 1.42 cfs @ 8.00 hrs, Volume= 22,306 cf, Atten= 0%, Lag= 1.1 min

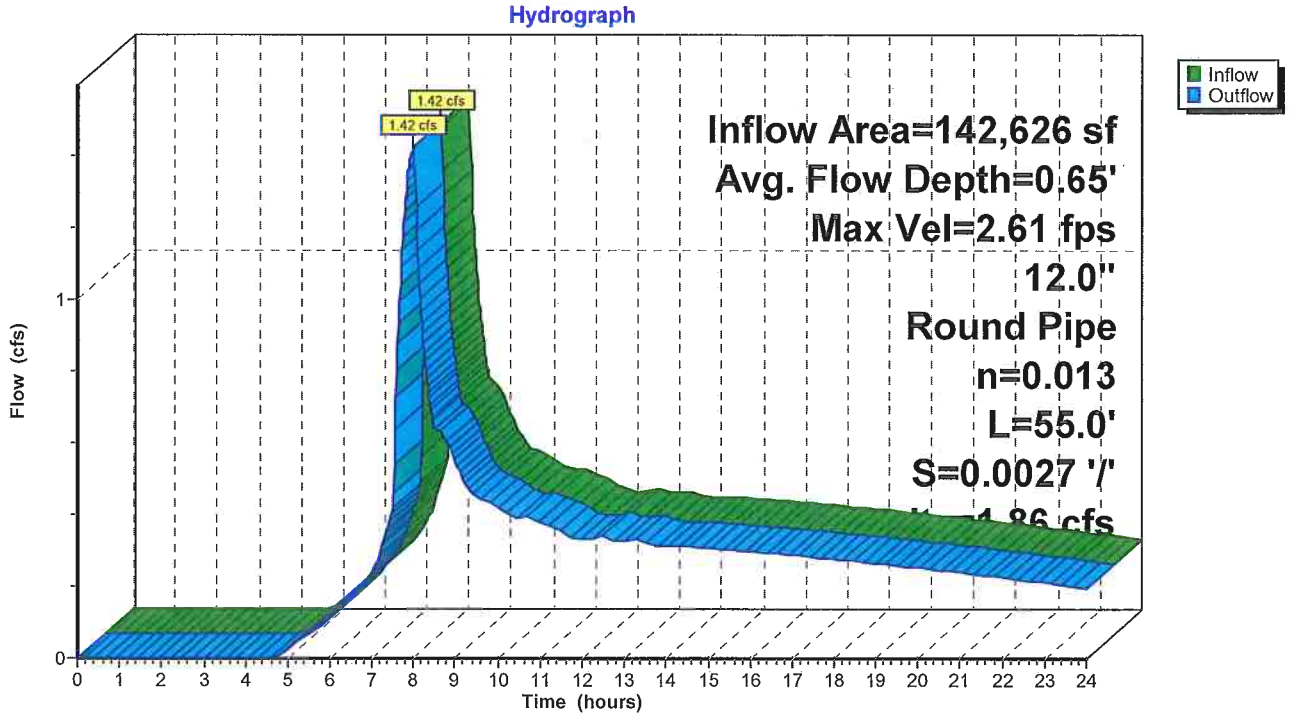
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.61 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 0.5 min

Peak Storage= 30 cf @ 7.99 hrs
Average Depth at Peak Storage= 0.65'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 1.86 cfs

12.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 55.0' Slope= 0.0027 '/'
Inlet Invert= 135.50', Outlet Invert= 135.35'



Reach 9R: Public Storm #9



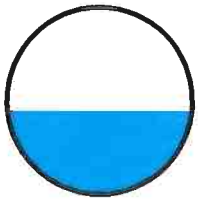
Summary for Reach 10R: Public Storm #10

Inflow Area = 428,164 sf, 11.59% Impervious, Inflow Depth > 2.66" for 25 yr event
Inflow = 5.03 cfs @ 7.99 hrs, Volume= 94,924 cf
Outflow = 5.02 cfs @ 8.00 hrs, Volume= 94,894 cf, Atten= 0%, Lag= 0.2 min

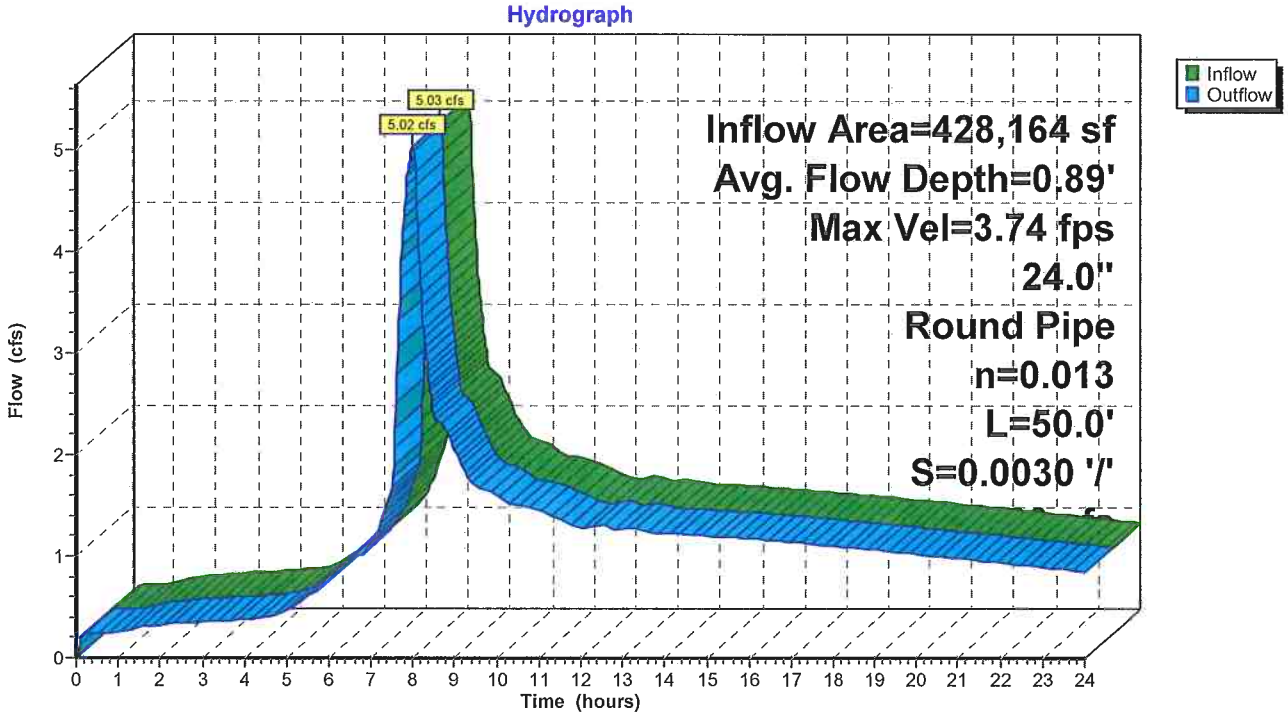
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.74 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.34 fps, Avg. Travel Time= 0.4 min

Peak Storage= 67 cf @ 7.99 hrs
Average Depth at Peak Storage= 0.89'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 12.39 cfs

24.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 50.0' Slope= 0.0030 '/'
Inlet Invert= 135.50', Outlet Invert= 135.35'



Reach 10R: Public Storm #10



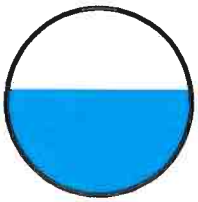
Summary for Reach 11R: Public Storm #11

Inflow Area = 287,418 sf, 13.09% Impervious, Inflow Depth > 2.97" for 25 yr event
Inflow = 3.50 cfs @ 8.00 hrs, Volume= 71,174 cf
Outflow = 3.50 cfs @ 8.01 hrs, Volume= 71,125 cf, Atten= 0%, Lag= 0.7 min

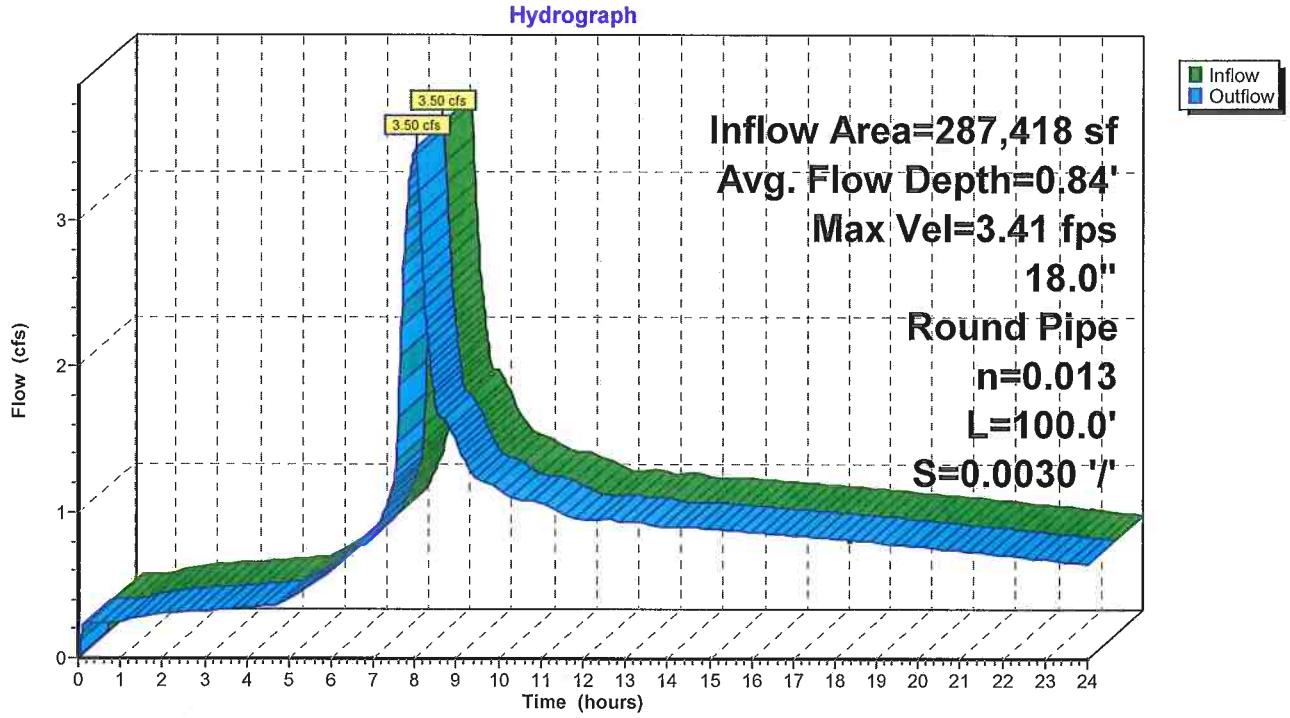
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.41 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 0.7 min

Peak Storage= 103 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.84'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.75 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 135.90', Outlet Invert= 135.60'



Reach 11R: Public Storm #11



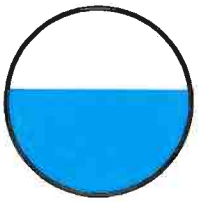
Summary for Reach 12R: Public Storm #12

Inflow Area = 287,418 sf, 13.09% Impervious, Inflow Depth > 2.98" for 25 yr event
Inflow = 3.50 cfs @ 7.98 hrs, Volume= 71,257 cf, Incl. 0.24 cfs Base Flow
Outflow = 3.50 cfs @ 8.00 hrs, Volume= 71,174 cf, Atten= 0%, Lag= 1.0 min

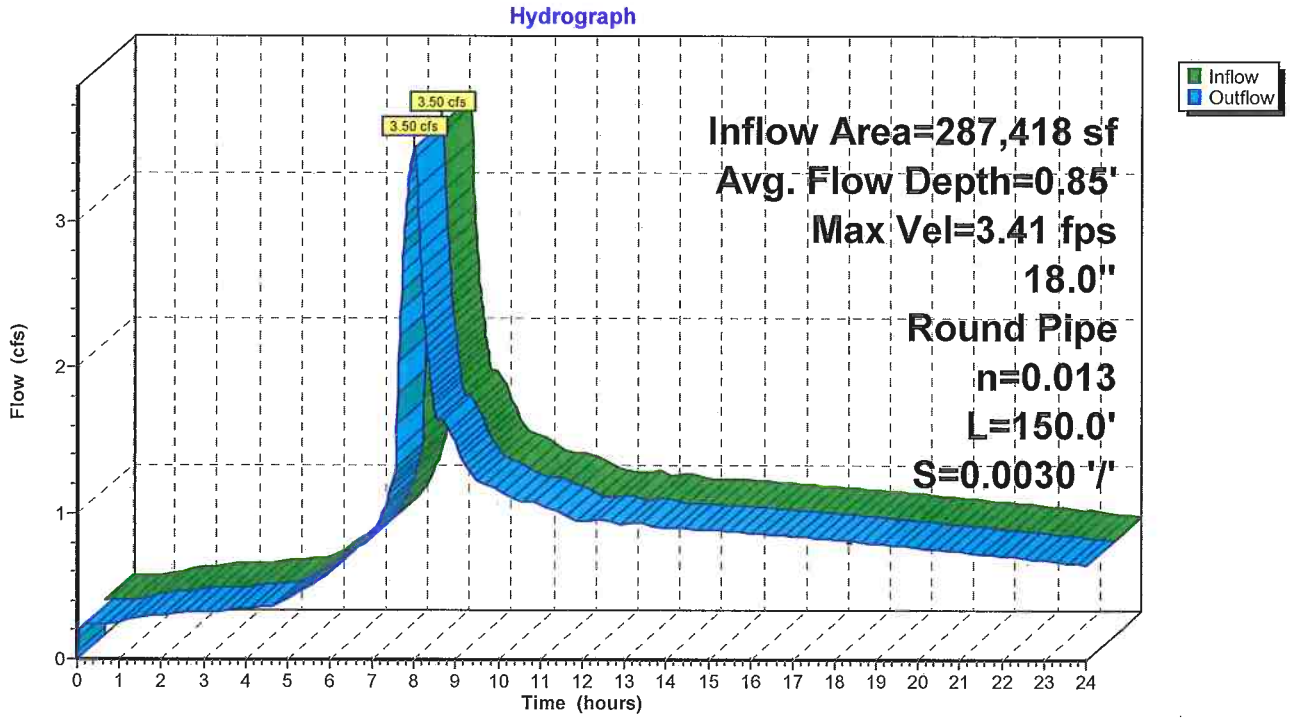
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.41 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 1.1 min

Peak Storage= 154 cf @ 7.99 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.75 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 150.0' Slope= 0.0030 '/'
Inlet Invert= 136.45', Outlet Invert= 136.00'



Reach 12R: Public Storm #12



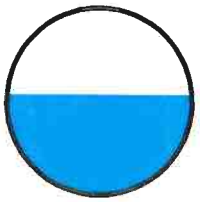
Summary for Reach 13R: Public Storm #13

Inflow Area = 287,418 sf, 13.09% Impervious, Inflow Depth > 2.11" for 25 yr event
Inflow = 3.27 cfs @ 7.96 hrs, Volume= 50,558 cf
Outflow = 3.26 cfs @ 7.98 hrs, Volume= 50,503 cf, Atten= 0%, Lag= 1.4 min

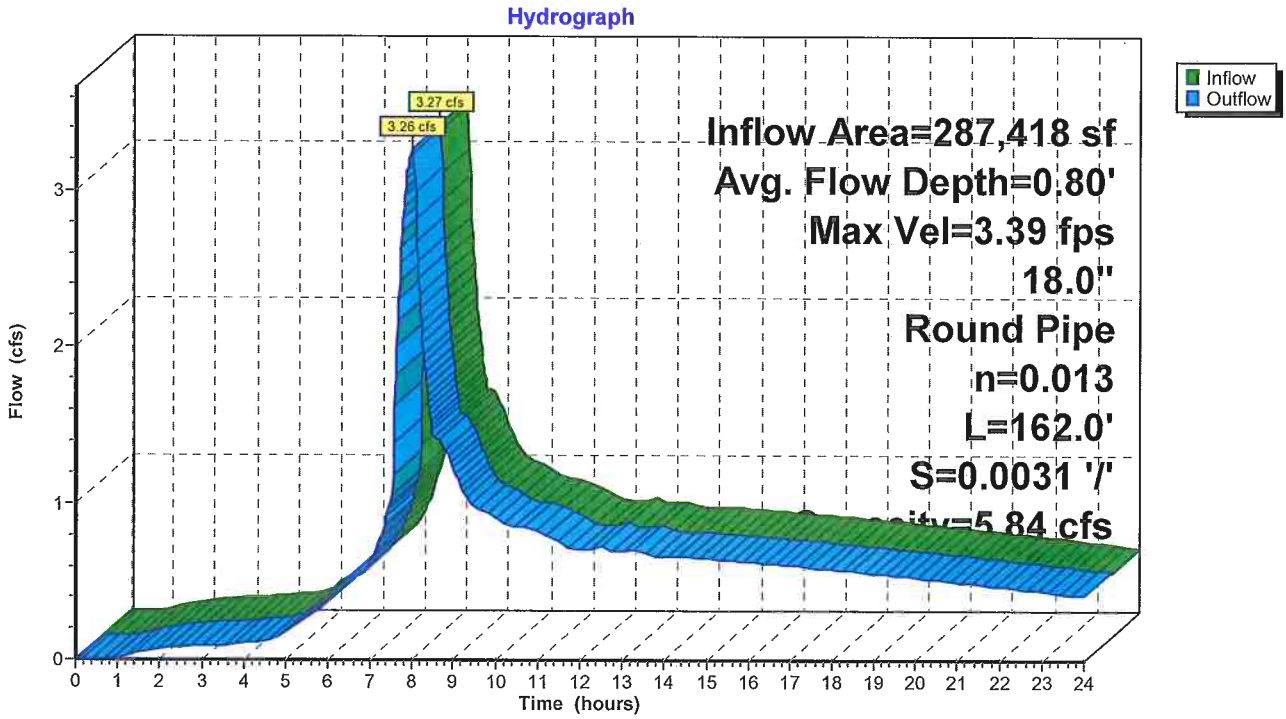
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.39 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.98 fps, Avg. Travel Time= 1.4 min

Peak Storage= 156 cf @ 7.97 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 5.84 cfs

18.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 162.0' Slope= 0.0031 '/'
Inlet Invert= 137.05', Outlet Invert= 136.55'



Reach 13R: Public Storm #13



Summary for Reach 14R: Public Storm #14

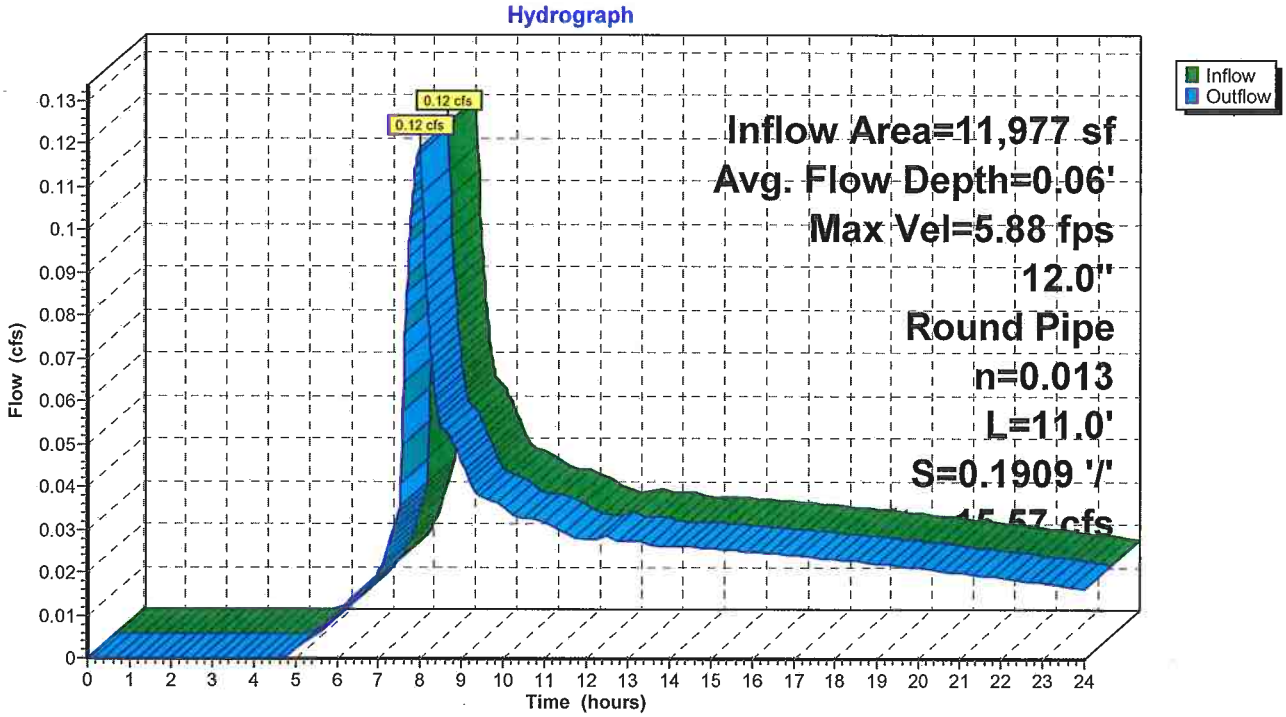
Inflow Area = 11,977 sf, 0.00% Impervious, Inflow Depth > 1.88" for 25 yr event
Inflow = 0.12 cfs @ 7.98 hrs, Volume= 1,874 cf
Outflow = 0.12 cfs @ 7.98 hrs, Volume= 1,874 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 5.88 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.64 fps, Avg. Travel Time= 0.1 min

Peak Storage= 0 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.06'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 15.57 cfs

12.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 11.0' Slope= 0.1909 '/'
Inlet Invert= 140.80', Outlet Invert= 138.70'

Reach 14R: Public Storm #14



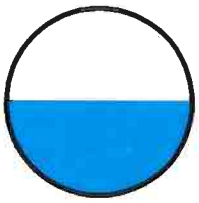
Summary for Reach 15R: Public Storm #15

Inflow Area = 128,769 sf, 0.00% Impervious, Inflow Depth > 1.88" for 25 yr event
Inflow = 1.28 cfs @ 7.98 hrs, Volume= 20,149 cf
Outflow = 1.28 cfs @ 7.98 hrs, Volume= 20,147 cf, Atten= 0%, Lag= 0.1 min

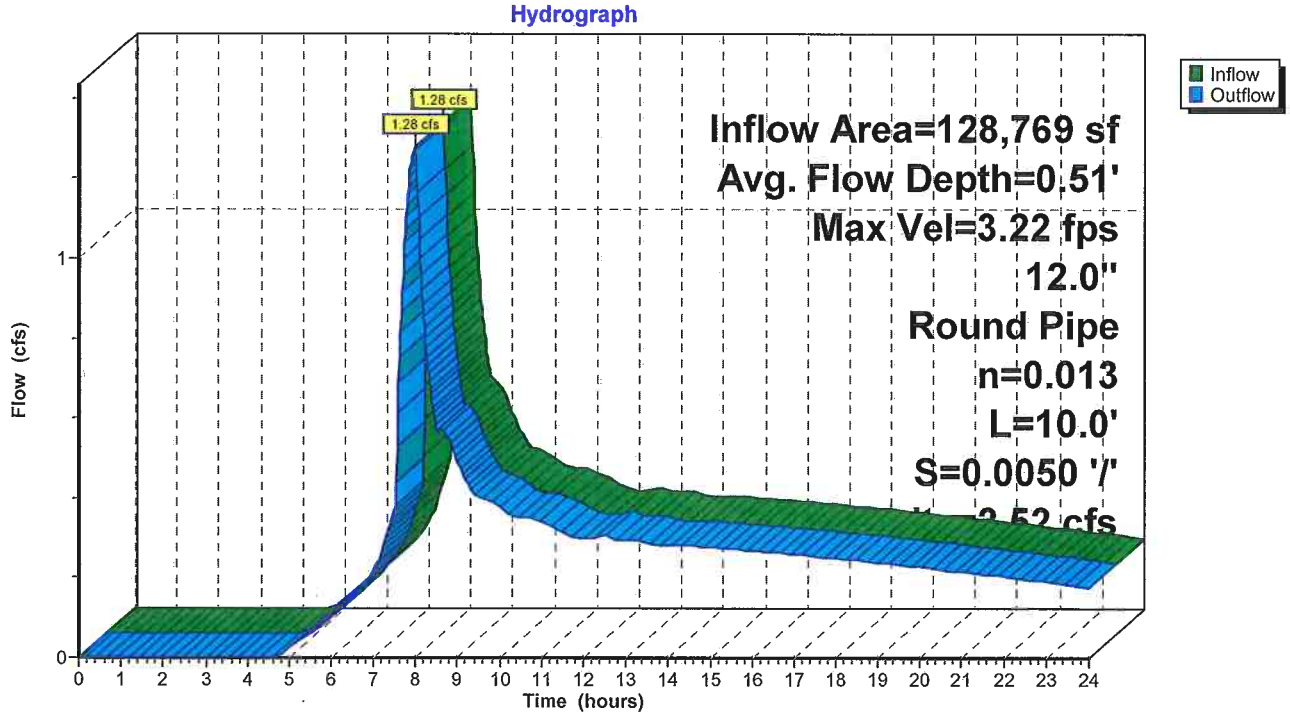
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.22 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 0.1 min

Peak Storage= 4 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.51'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 2.52 cfs

12.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 10.0' Slope= 0.0050 '/'
Inlet Invert= 138.65', Outlet Invert= 138.60'



Reach 15R: Public Storm #15



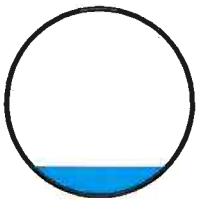
Summary for Reach 16R: Public Storm #16

Inflow Area = 11,977 sf,100.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 0.25 cfs @ 7.88 hrs, Volume= 3,652 cf
Outflow = 0.25 cfs @ 7.88 hrs, Volume= 3,652 cf, Atten= 0%, Lag= 0.2 min

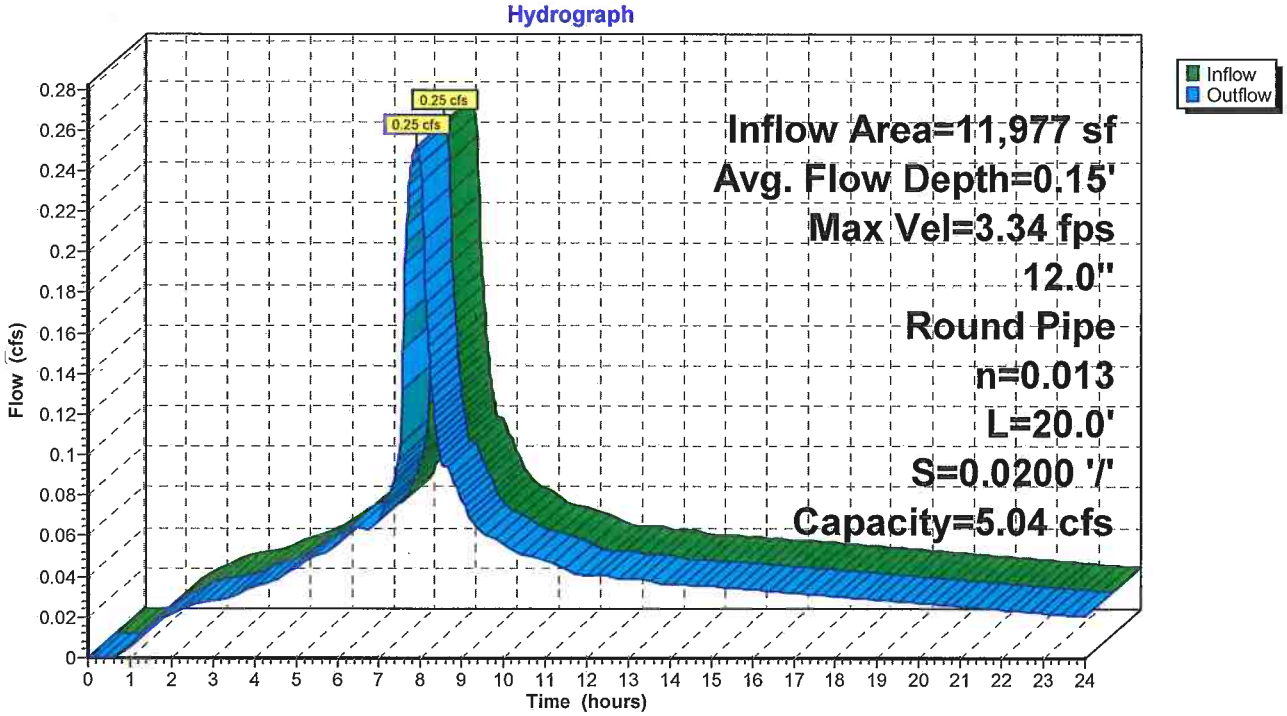
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.34 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 0.2 min

Peak Storage= 2 cf @ 7.88 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 5.04 cfs

12.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 20.0' Slope= 0.0200 '/'
Inlet Invert= 139.50', Outlet Invert= 139.10'



Reach 16R: Public Storm #16



Summary for Reach 17R: Public Storm #17

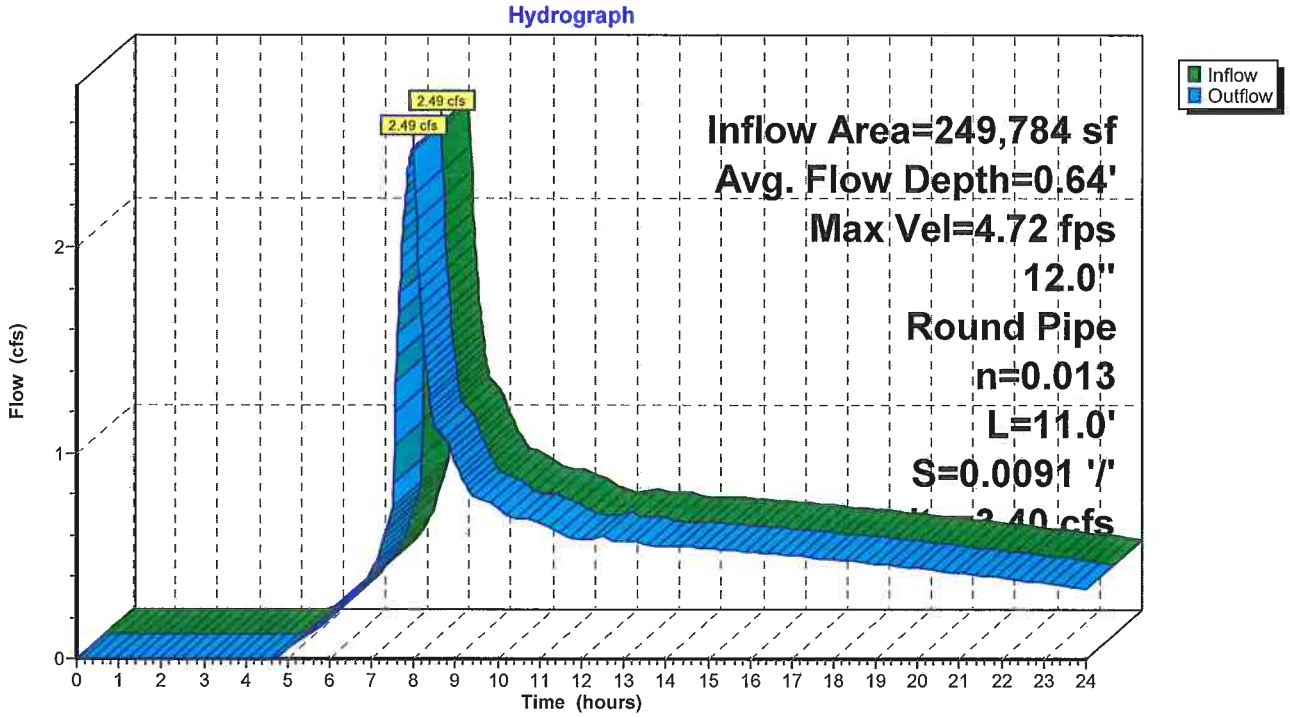
Inflow Area = 249,784 sf, 0.00% Impervious, Inflow Depth > 1.88" for 25 yr event
Inflow = 2.49 cfs @ 7.98 hrs, Volume= 39,084 cf
Outflow = 2.49 cfs @ 7.98 hrs, Volume= 39,082 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 4.72 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.07 fps, Avg. Travel Time= 0.1 min

Peak Storage= 6 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.40 cfs

12.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 11.0' Slope= 0.0091 '/'
Inlet Invert= 137.20', Outlet Invert= 137.10'

Reach 17R: Public Storm #17



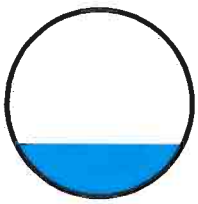
Summary for Reach 18R: Public Storm #18

Inflow Area = 33,614 sf,100.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 0.71 cfs @ 7.88 hrs, Volume= 10,250 cf
Outflow = 0.71 cfs @ 7.88 hrs, Volume= 10,250 cf, Atten= 0%, Lag= 0.1 min

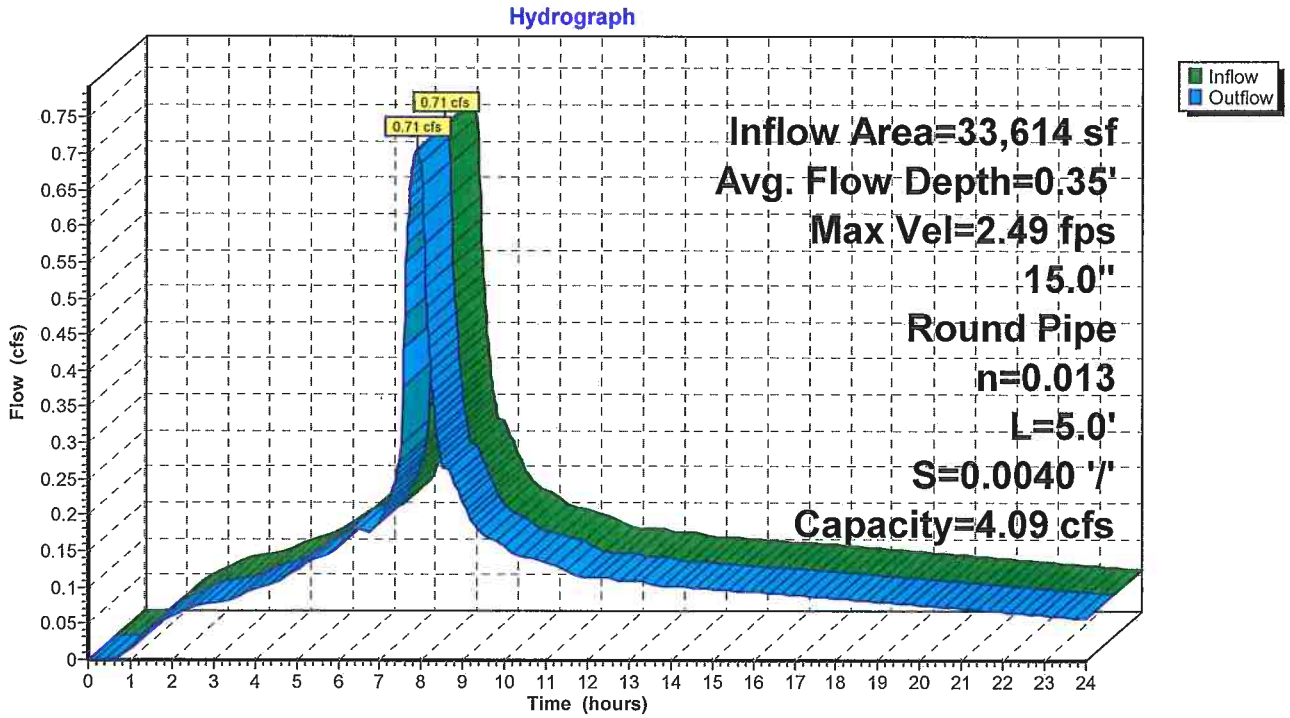
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.49 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 0.1 min

Peak Storage= 1 cf @ 7.88 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.09 cfs

15.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 5.0' Slope= 0.0040 '/'
Inlet Invert= 137.17', Outlet Invert= 137.15'



Reach 18R: Public Storm #18



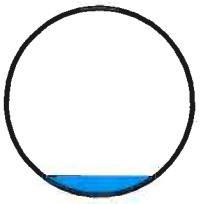
Summary for Reach 19R: Public Storm #19

Inflow Area = 4,020 sf,100.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 0.08 cfs @ 7.88 hrs, Volume= 1,226 cf
Outflow = 0.08 cfs @ 7.89 hrs, Volume= 1,226 cf, Atten= 0%, Lag= 0.3 min

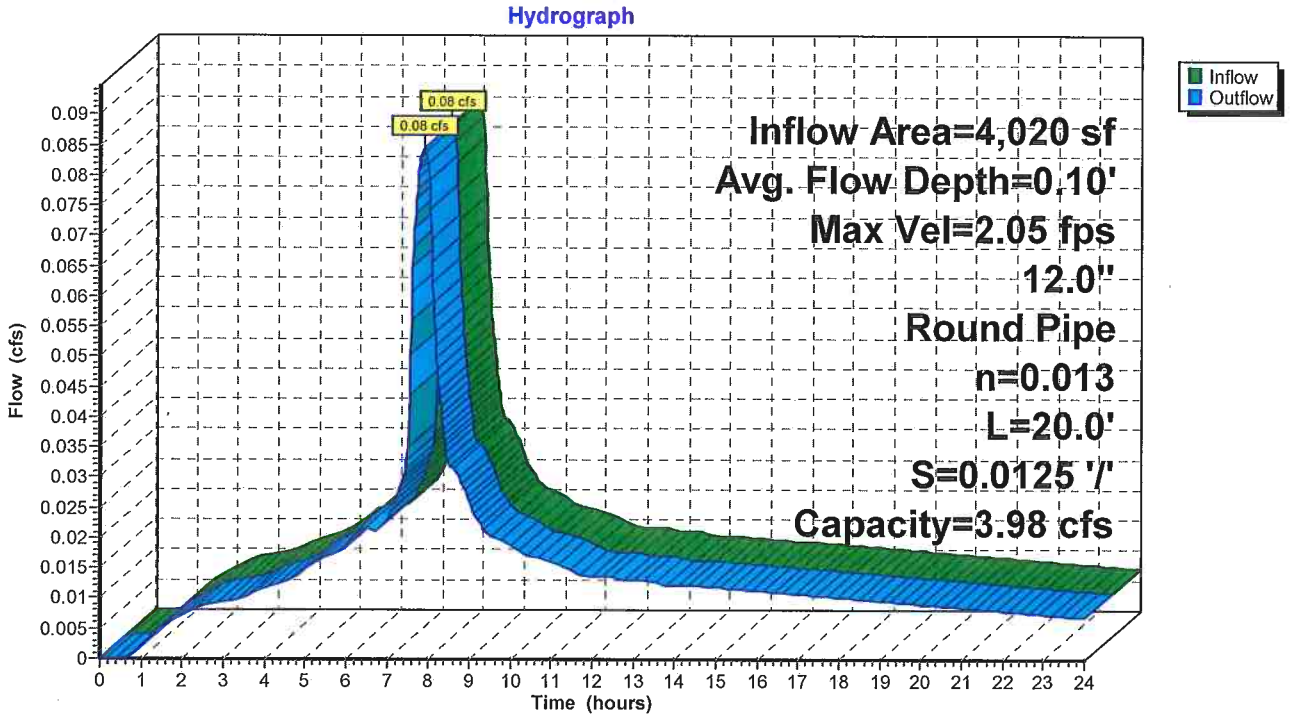
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.05 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.15 fps, Avg. Travel Time= 0.3 min

Peak Storage= 1 cf @ 7.88 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.98 cfs

12.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 20.0' Slope= 0.0125 '/'
Inlet Invert= 142.95', Outlet Invert= 142.70'



Reach 19R: Public Storm #19



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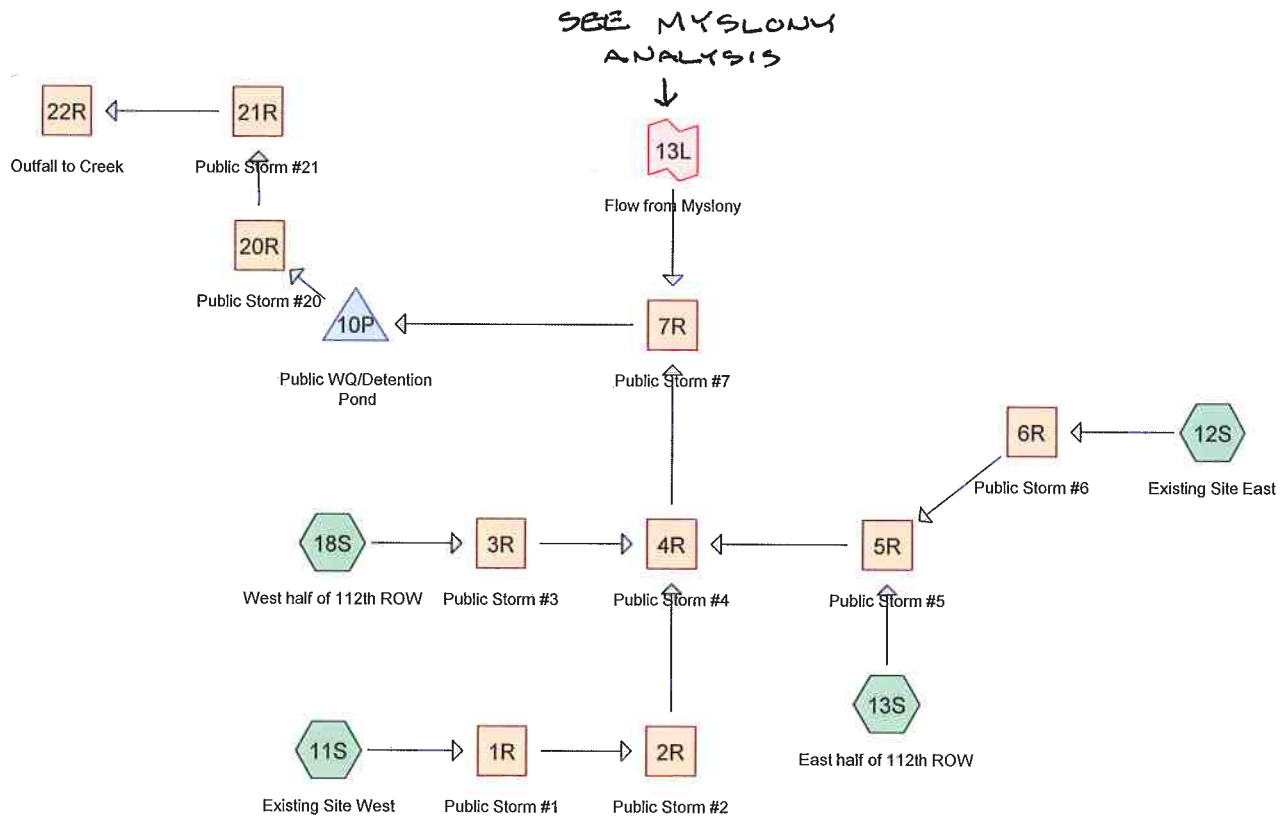
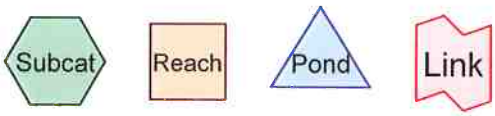
(2008)





Routing Diagram for 5381-2008-12-09 Myslony Public-2
Prepared by Microsoft, Printed 12/11/2014
HydroCAD® 10.00-13 s/n 02239 © 2014 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: Existing Site West Runoff Area=113,228 sf 0.00% Impervious Runoff Depth>1.88"
Tc=5.0 min CN=79 Runoff=1.13 cfs 17,717 cf

Subcatchment 12S: Existing Site East Runoff Area=192,441 sf 0.00% Impervious Runoff Depth>1.88"
Tc=5.0 min CN=79 Runoff=1.92 cfs 30,112 cf

Subcatchment 13S: East half of 112th Runoff Area=56,802 sf 100.00% Impervious Runoff Depth>3.66"
Tc=5.0 min CN=98 Runoff=1.19 cfs 17,321 cf

Subcatchment 18S: West half of 112th Runoff Area=56,802 sf 100.00% Impervious Runoff Depth>3.66"
Tc=5.0 min CN=98 Runoff=1.19 cfs 17,321 cf

Reach 1R: Public Storm #1 Avg. Flow Depth=0.43' Max Vel=2.42 fps Inflow=1.13 cfs 17,717 cf
21.0" Round Pipe n=0.013 L=36.0' S=0.0028 '/' Capacity=8.35 cfs Outflow=1.13 cfs 17,711 cf

Reach 2R: Public Storm #2 Avg. Flow Depth=0.42' Max Vel=2.36 fps Inflow=1.13 cfs 17,711 cf
24.0" Round Pipe n=0.013 L=56.0' S=0.0027 '/' Capacity=11.71 cfs Outflow=1.13 cfs 17,700 cf

Reach 3R: Public Storm #3 Avg. Flow Depth=0.20' Max Vel=10.98 fps Inflow=1.19 cfs 17,321 cf
12.0" Round Pipe n=0.013 L=24.0' S=0.1583 '/' Capacity=14.18 cfs Outflow=1.19 cfs 17,320 cf

Reach 4R: Public Storm #4 Avg. Flow Depth=0.88' Max Vel=4.06 fps Inflow=5.39 cfs 82,443 cf
24.0" Round Pipe n=0.013 L=14.0' S=0.0036 '/' Capacity=13.52 cfs Outflow=5.39 cfs 82,437 cf

Reach 5R: Public Storm #5 Avg. Flow Depth=0.62' Max Vel=3.69 fps Inflow=3.09 cfs 47,429 cf
24.0" Round Pipe n=0.013 L=24.0' S=0.0042 '/' Capacity=14.60 cfs Outflow=3.09 cfs 47,422 cf

Reach 6R: Public Storm #6 Avg. Flow Depth=0.52' Max Vel=2.97 fps Inflow=1.92 cfs 30,112 cf
24.0" Round Pipe n=0.013 L=15.0' S=0.0033 '/' Capacity=13.06 cfs Outflow=1.92 cfs 30,108 cf

Reach 7R: Public Storm #7 Avg. Flow Depth=1.05' Max Vel=4.56 fps Inflow=11.92 cfs 201,463 cf
48.0" Round Pipe n=0.013 L=65.0' S=0.0031 '/' Capacity=79.68 cfs Outflow=11.93 cfs 201,396 cf

Reach 20R: Public Storm #20 Avg. Flow Depth=1.20' Max Vel=3.35 fps Inflow=10.59 cfs 198,302 cf
48.0" Round Pipe n=0.013 L=35.0' S=0.0014 '/' Capacity=54.29 cfs Outflow=10.59 cfs 198,253 cf

Reach 21R: Public Storm #21 Avg. Flow Depth=0.99' Max Vel=4.38 fps Inflow=10.59 cfs 198,253 cf
48.0" Round Pipe n=0.013 L=66.0' S=0.0030 '/' Capacity=79.07 cfs Outflow=10.59 cfs 198,183 cf

Reach 22R: Outfall to Creek Avg. Flow Depth=1.10' Max Vel=3.79 fps Inflow=10.59 cfs 198,183 cf
48.0" Round Pipe n=0.013 L=124.0' S=0.0020 '/' Capacity=64.50 cfs Outflow=10.58 cfs 198,032 cf

Pond 10P: Public WQ/Detention Pond Peak Elev=135.91' Storage=9,596 cf Inflow=11.93 cfs 201,396 cf
Outflow=10.59 cfs 198,302 cf

Link 25 yr Outflow Imported from 5381-2008-12-09 Myslony Public-1~Reach 8R.hce Inflow=6.56 cfs 119,026 cf
Area= 582,767 sf 8.51% Imperv. Primary=6.56 cfs 119,026 cf

Total Runoff Area = 419,273 sf Runoff Volume = 82,471 cf Average Runoff Depth = 2.36"
72.90% Pervious = 305,669 sf 27.10% Impervious = 113,604 sf

Summary for Subcatchment 11S: Existing Site West

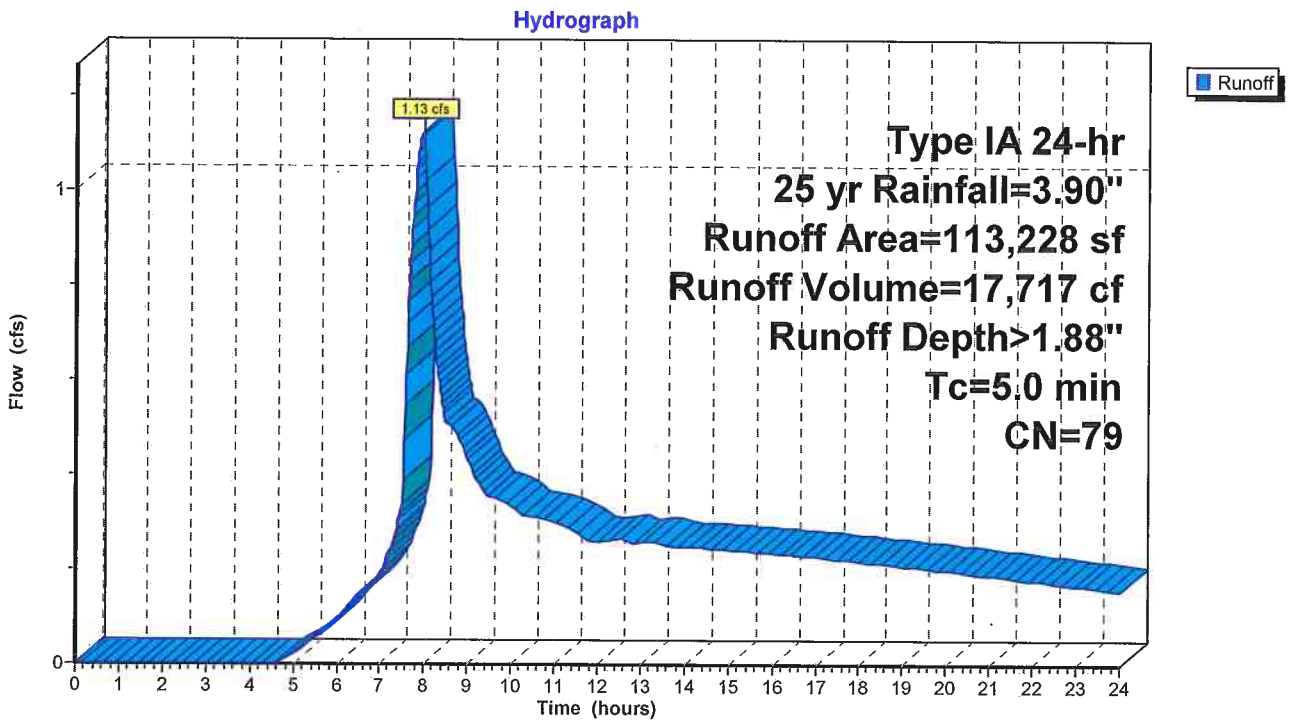
Runoff = 1.13 cfs @ 7.98 hrs, Volume= 17,717 cf, Depth> 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
113,228	79	Pasture/grassland/range, Fair, HSG C
113,228		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: Existing Site West



Summary for Subcatchment 12S: Existing Site East

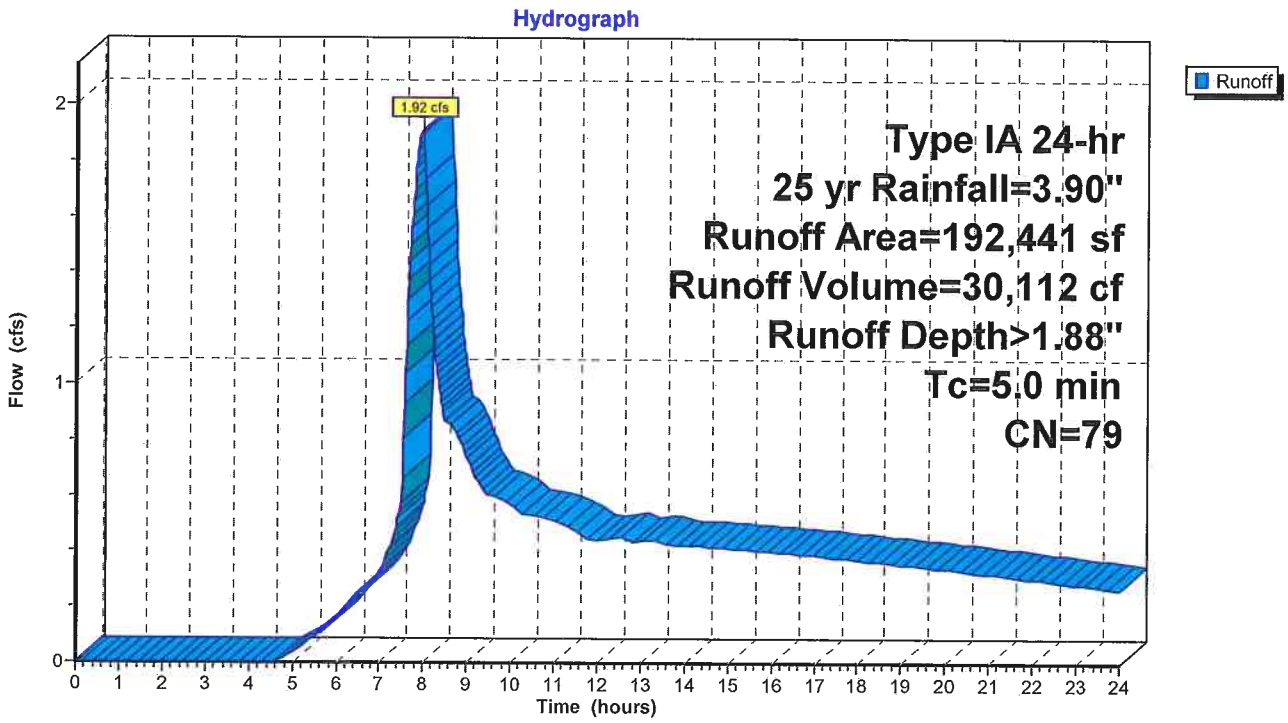
Runoff = 1.92 cfs @ 7.98 hrs, Volume= 30,112 cf, Depth> 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
192,441	79	Pasture/grassland/range, Fair, HSG C
192,441		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: Existing Site East



Summary for Subcatchment 13S: East half of 112th ROW

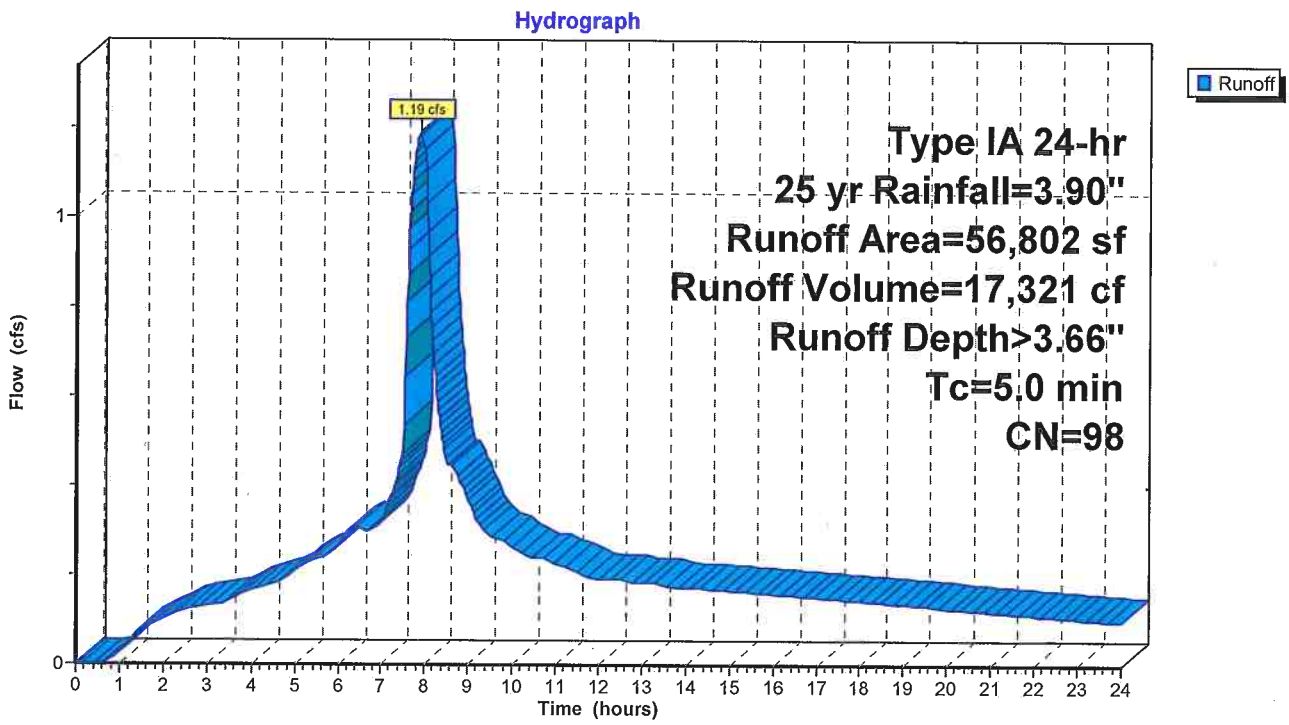
Runoff = 1.19 cfs @ 7.88 hrs, Volume= 17,321 cf, Depth> 3.66"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
56,802	98	Paved parking & roofs
56,802		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 13S: East half of 112th ROW



Summary for Subcatchment 18S: West half of 112th ROW

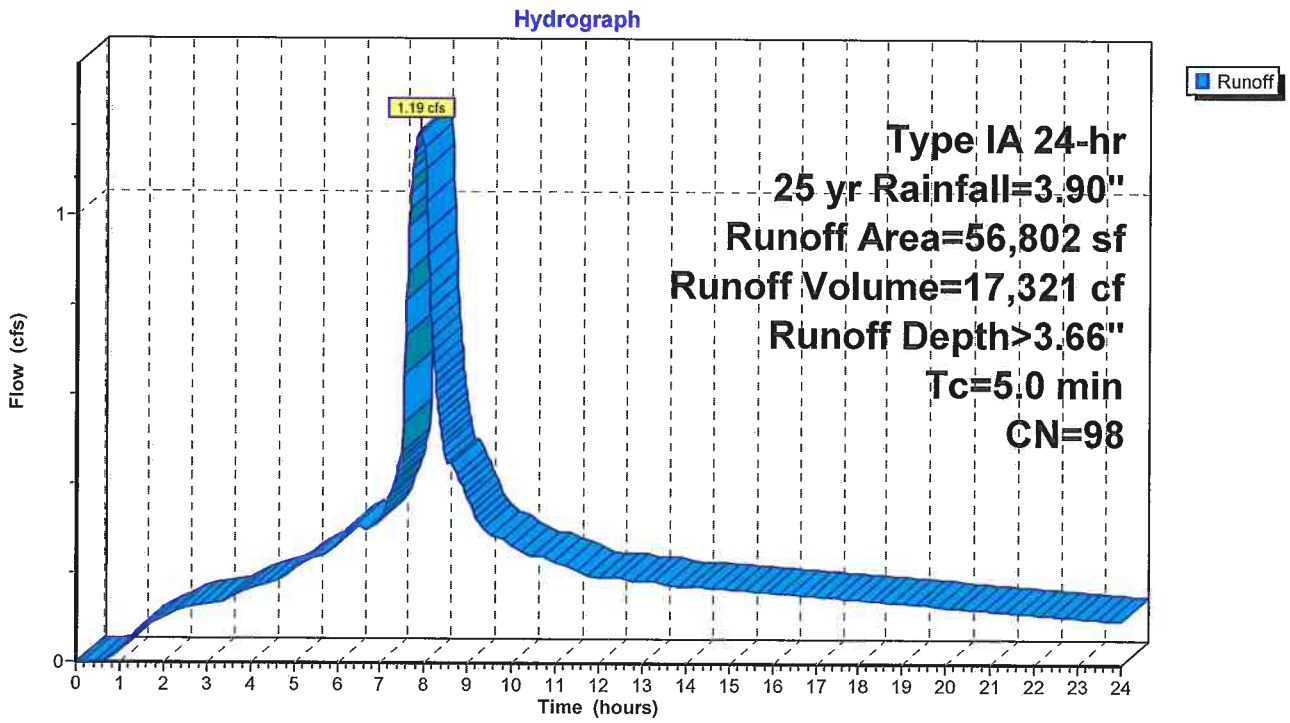
Runoff = 1.19 cfs @ 7.88 hrs, Volume= 17,321 cf, Depth> 3.66"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type IA 24-hr 25 yr Rainfall=3.90"

Area (sf)	CN	Description
56,802	98	Paved parking & roofs
56,802		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 18S: West half of 112th ROW



Summary for Reach 1R: Public Storm #1

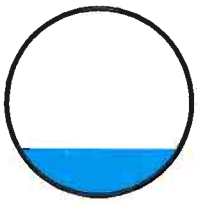
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area =	113,228 sf,	0.00% Impervious,	Inflow Depth >	1.88"	for 25 yr event
Inflow =	1.13 cfs @	7.98 hrs, Volume=	17,717 cf		
Outflow =	1.13 cfs @	7.99 hrs, Volume=	17,711 cf, Atten= 0%, Lag= 0.4 min		

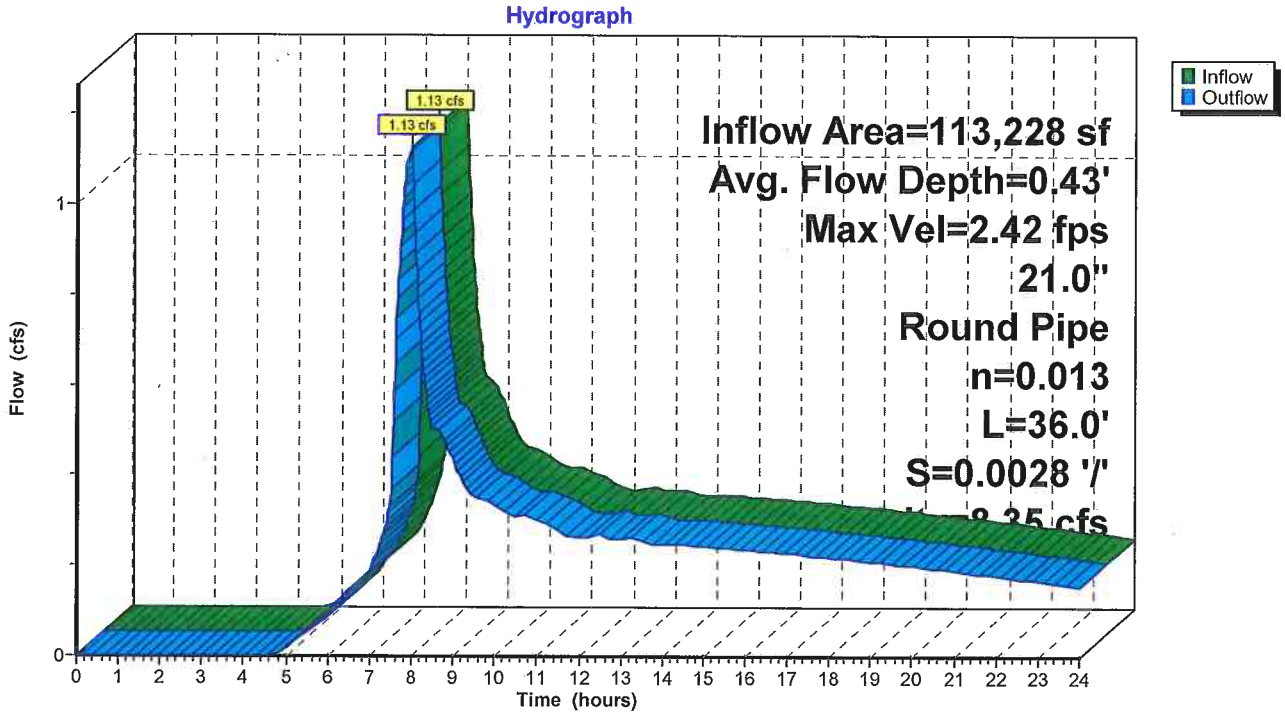
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.42 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 0.4 min

Peak Storage= 17 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.75' Flow Area= 2.4 sf, Capacity= 8.35 cfs

21.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 36.0' Slope= 0.0028 '/'
Inlet Invert= 135.35', Outlet Invert= 135.25'



Reach 1R: Public Storm #1



Summary for Reach 2R: Public Storm #2

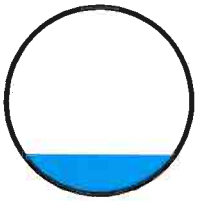
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach 1R outlet invert by 0.37' @ 8.00 hrs

Inflow Area =	113,228 sf,	0.00% Impervious,	Inflow Depth >	1.88"	for 25 yr event
Inflow =	1.13 cfs @	7.99 hrs, Volume=	17,711 cf		
Outflow =	1.13 cfs @	7.99 hrs, Volume=	17,700 cf, Atten= 0%, Lag= 0.2 min		

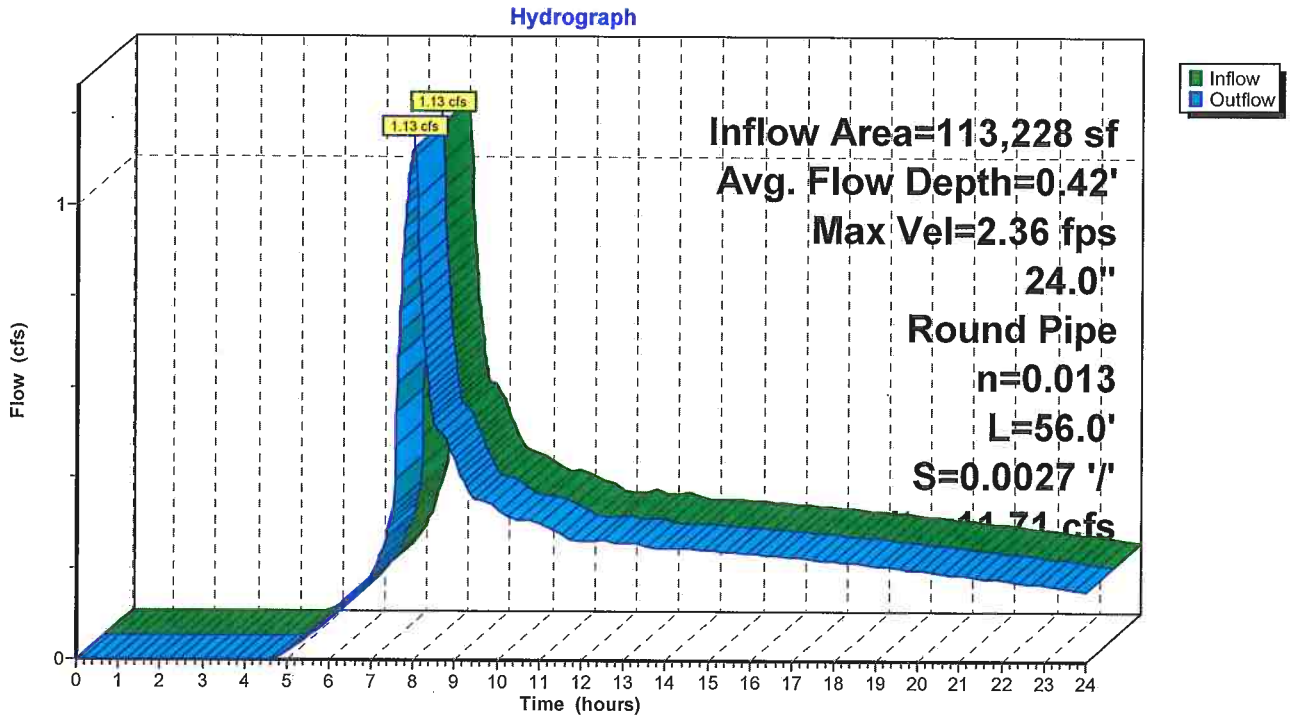
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.36 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.46 fps, Avg. Travel Time= 0.6 min

Peak Storage= 27 cf @ 7.99 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 11.71 cfs

24.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 56.0' Slope= 0.0027 '/'
Inlet Invert= 135.20', Outlet Invert= 135.05'



Reach 2R: Public Storm #2



Summary for Reach 3R: Public Storm #3

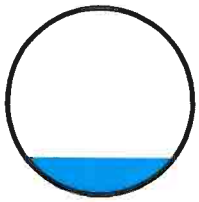
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 56,802 sf,100.00% Impervious, Inflow Depth > 3.66" for 25 yr event
Inflow = 1.19 cfs @ 7.88 hrs, Volume= 17,321 cf
Outflow = 1.19 cfs @ 7.88 hrs, Volume= 17,320 cf, Atten= 0%, Lag= 0.1 min

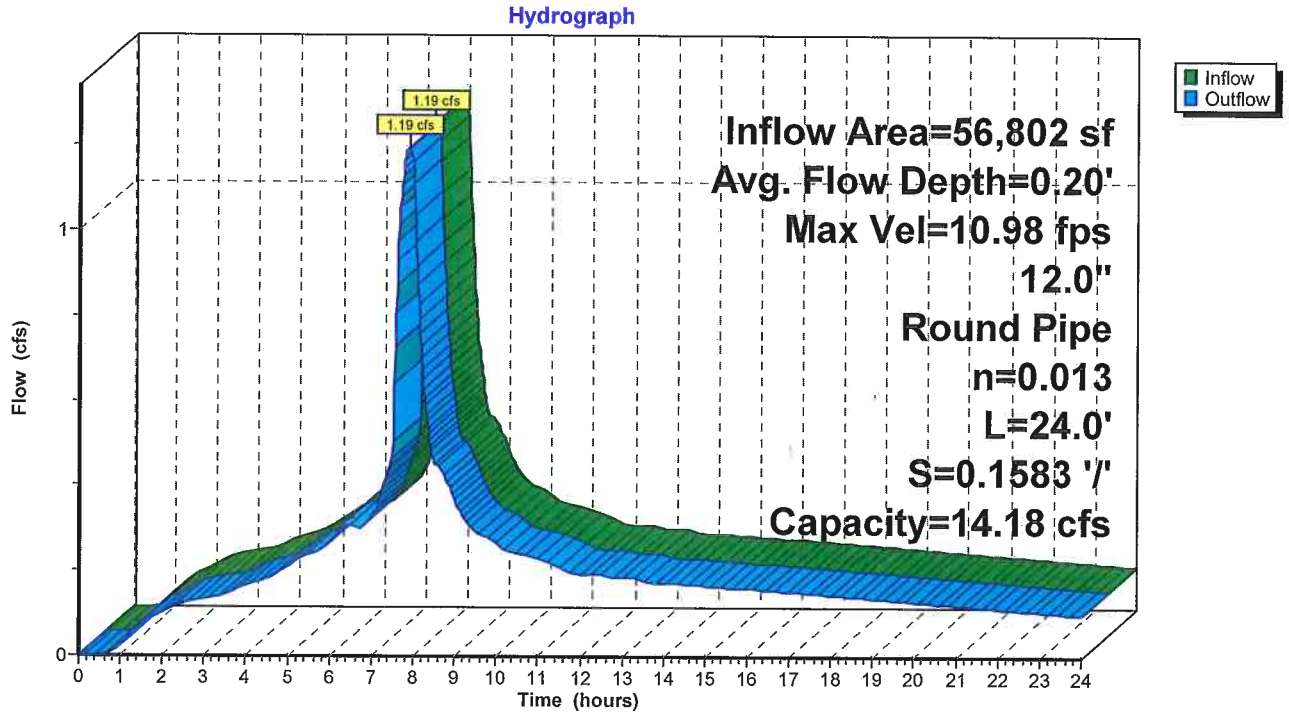
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 10.98 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 6.21 fps, Avg. Travel Time= 0.1 min

Peak Storage= 3 cf @ 7.88 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 14.18 cfs

12.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 24.0' Slope= 0.1583 '/'
Inlet Invert= 138.85', Outlet Invert= 135.05'



Reach 3R: Public Storm #3



Summary for Reach 4R: Public Storm #4

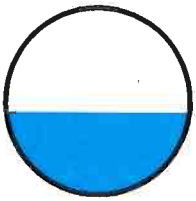
[52] Hint: Inlet/Outlet conditions not evaluated
[63] Warning: Exceeded Reach 2R INLET depth by 0.26' @ 7.92 hrs
[62] Hint: Exceeded Reach 3R OUTLET depth by 0.63' @ 7.96 hrs
[63] Warning: Exceeded Reach 5R INLET depth by 0.10' @ 7.94 hrs

Inflow Area =	419,273 sf,	27.10% Impervious,	Inflow Depth >	2.36"	for	25 yr event
Inflow =	5.39 cfs @	7.95 hrs,	Volume=	82,443 cf		
Outflow =	5.39 cfs @	7.95 hrs,	Volume=	82,437 cf,	Atten= 0%,	Lag= 0.1 min

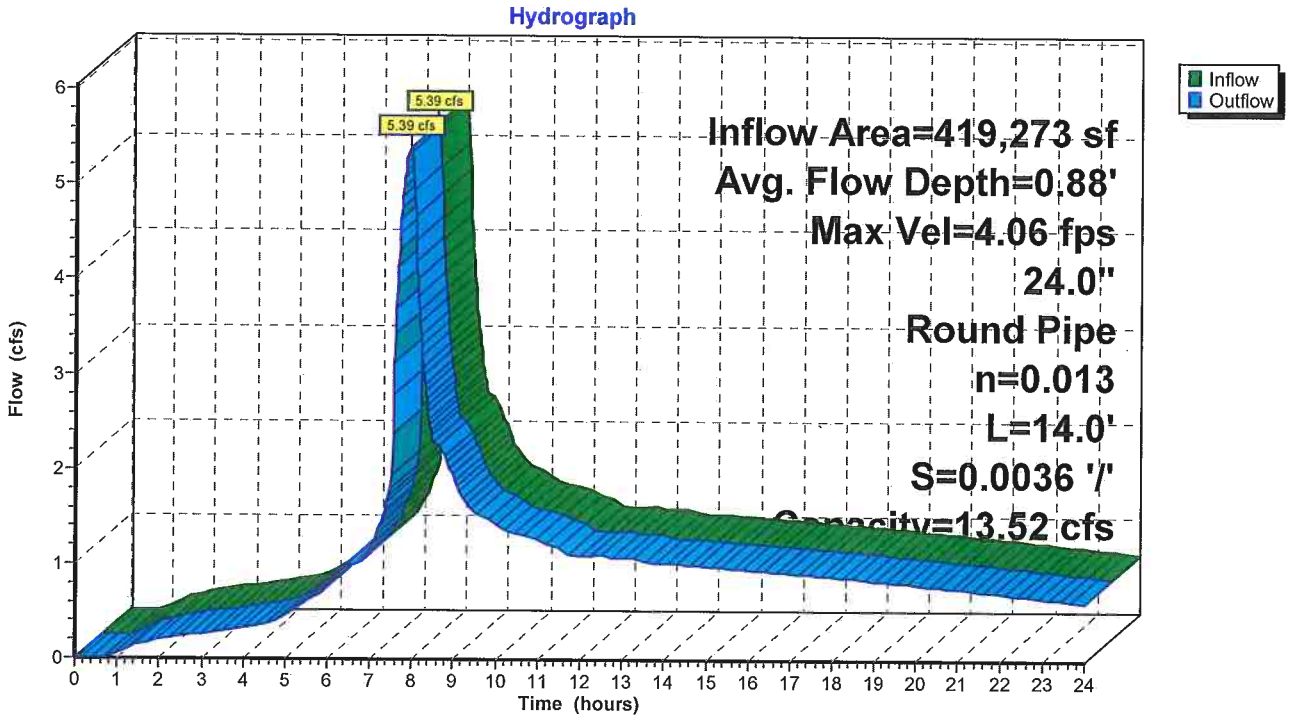
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 4.06 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.37 fps, Avg. Travel Time= 0.1 min

Peak Storage= 19 cf @ 7.95 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 13.52 cfs

24.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 14.0' Slope= 0.0036 '/'
Inlet Invert= 135.00', Outlet Invert= 134.95'



Reach 4R: Public Storm #4



Summary for Reach 5R: Public Storm #5

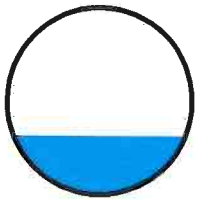
[52] Hint: Inlet/Outlet conditions not evaluated
[63] Warning: Exceeded Reach 6R INLET depth by 0.11' @ 4.54 hrs

Inflow Area =	249,243 sf,	22.79% Impervious,	Inflow Depth >	2.28"	for 25 yr event
Inflow =	3.09 cfs @	7.95 hrs,	Volume=	47,429 cf	
Outflow =	3.09 cfs @	7.95 hrs,	Volume=	47,422 cf,	Atten= 0%, Lag= 0.2 min

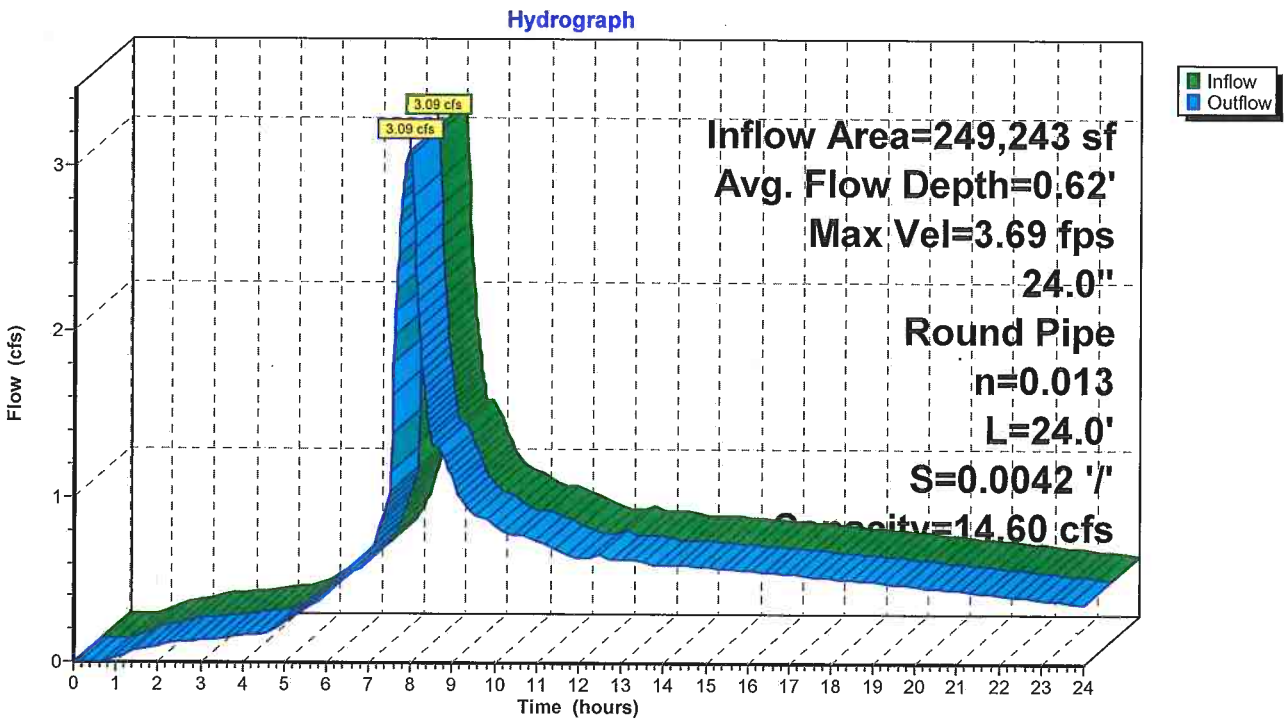
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.69 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.12 fps, Avg. Travel Time= 0.2 min

Peak Storage= 20 cf @ 7.95 hrs
Average Depth at Peak Storage= 0.62'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 14.60 cfs

24.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 24.0' Slope= 0.0042 '/'
Inlet Invert= 135.15', Outlet Invert= 135.05'



Reach 5R: Public Storm #5



Summary for Reach 6R: Public Storm #6

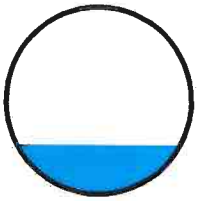
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 192,441 sf, 0.00% Impervious, Inflow Depth > 1.88" for 25 yr event
Inflow = 1.92 cfs @ 7.98 hrs, Volume= 30,112 cf
Outflow = 1.92 cfs @ 7.98 hrs, Volume= 30,108 cf, Atten= 0%, Lag= 0.1 min

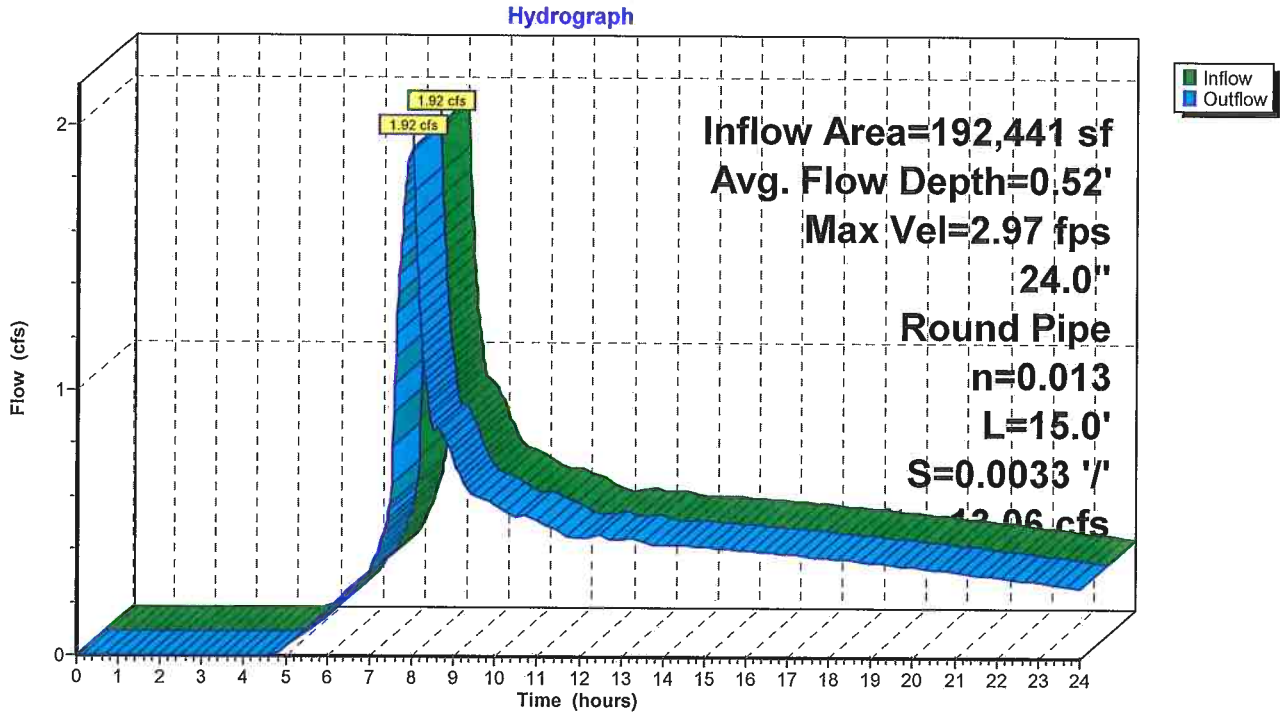
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.97 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.84 fps, Avg. Travel Time= 0.1 min

Peak Storage= 10 cf @ 7.98 hrs
Average Depth at Peak Storage= 0.52'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 13.06 cfs

24.0" Round Pipe
n= 0.013 Concrete pipe, straight & clean
Length= 15.0' Slope= 0.0033 '/'
Inlet Invert= 135.20', Outlet Invert= 135.15'



Reach 6R: Public Storm #6



Summary for Reach 7R: Public Storm #7

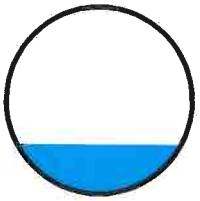
[52] Hint: Inlet/Outlet conditions not evaluated
[88] Warning: Qout>Qin may require smaller dt or Finer Routing
[63] Warning: Exceeded Reach 4R INLET depth by 0.05' @ 8.08 hrs

Inflow Area =	1,002,040 sf,	16.29% Impervious,	Inflow Depth >	2.41"	for 25 yr event
Inflow =	11.92 cfs @	7.99 hrs,	Volume=	201,463 cf	
Outflow =	11.93 cfs @	7.99 hrs,	Volume=	201,396 cf,	Atten= 0%, Lag= 0.3 min

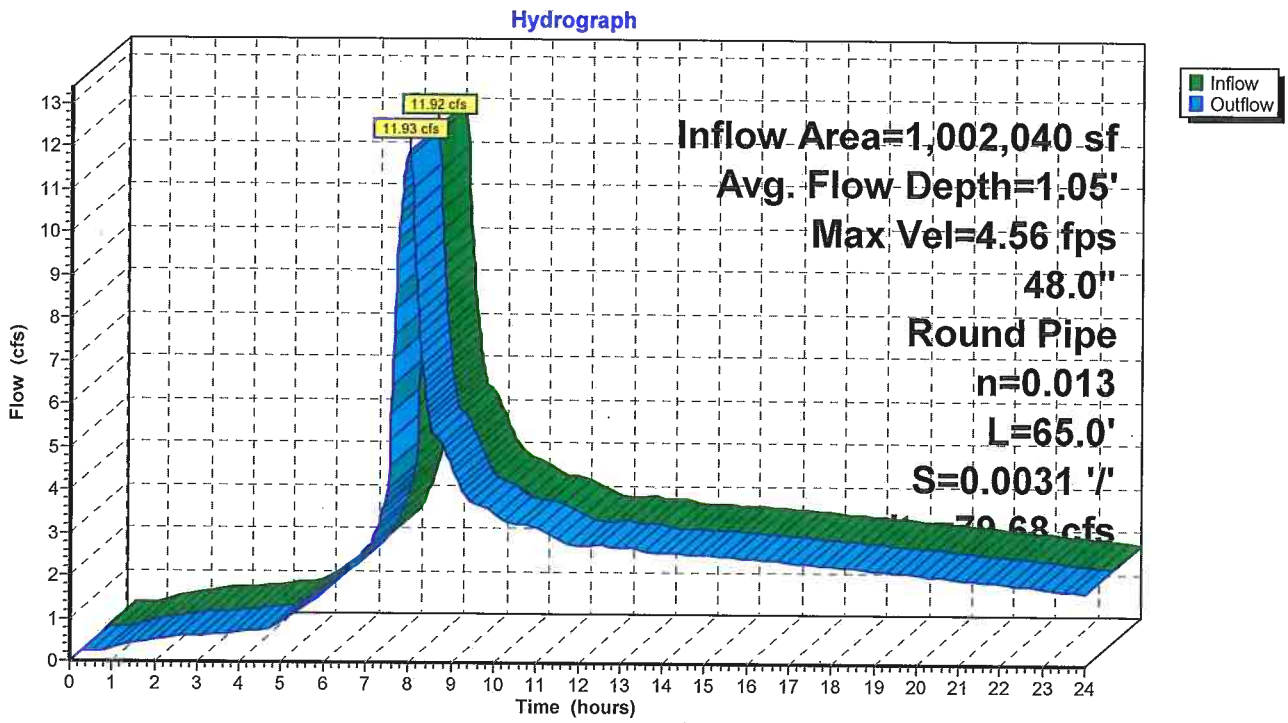
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 4.56 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.68 fps, Avg. Travel Time= 0.4 min

Peak Storage= 170 cf @ 7.99 hrs
Average Depth at Peak Storage= 1.05'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 79.68 cfs

48.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 65.0' Slope= 0.0031 '/'
Inlet Invert= 134.85', Outlet Invert= 134.65'



Reach 7R: Public Storm #7



Summary for Reach 20R: Public Storm #20

[52] Hint: Inlet/Outlet conditions not evaluated
[81] Warning: Exceeded Pond 10P by 0.05' @ 0.34 hrs

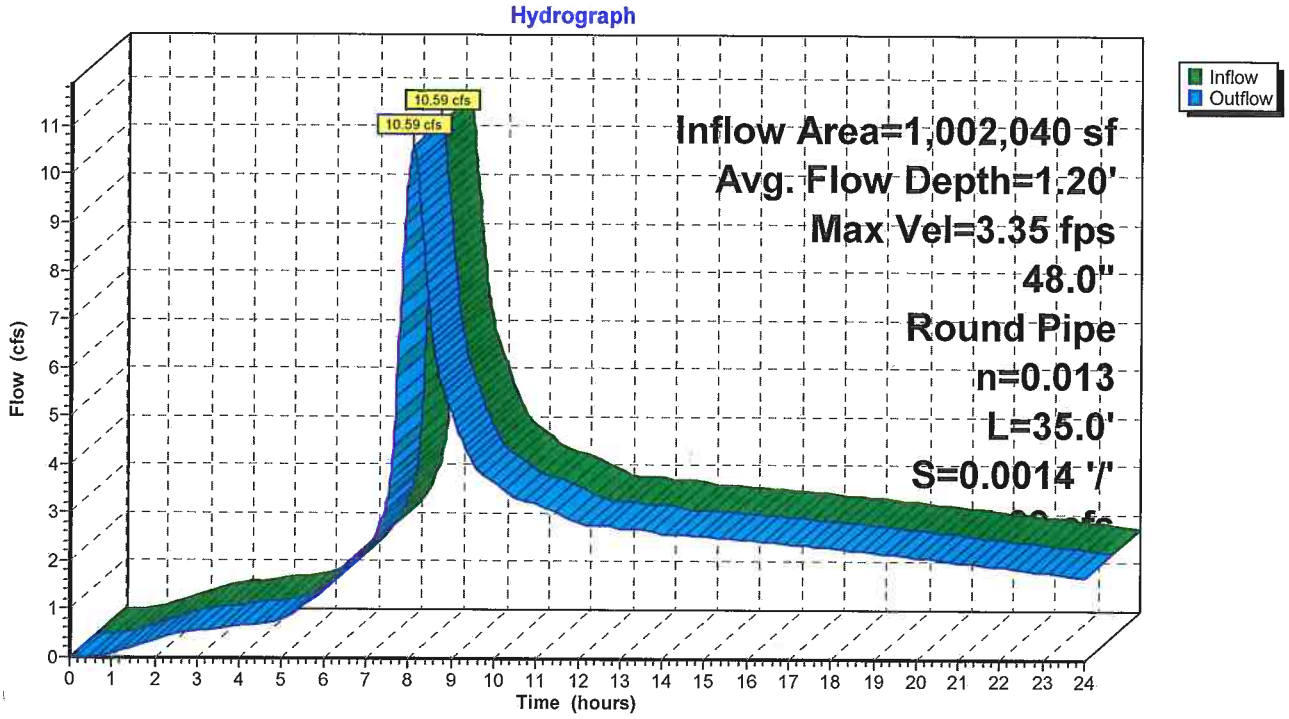
Inflow Area =	1,002,040 sf,	16.29% Impervious,	Inflow Depth >	2.37"	for 25 yr event
Inflow =	10.59 cfs @	8.08 hrs,	Volume=	198,302 cf	
Outflow =	10.59 cfs @	8.09 hrs,	Volume=	198,253 cf,	Atten= 0%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.35 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.01 fps, Avg. Travel Time= 0.3 min

Peak Storage= 111 cf @ 8.08 hrs
Average Depth at Peak Storage= 1.20'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 54.29 cfs

48.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 35.0' Slope= 0.0014 '/'
Inlet Invert= 134.45', Outlet Invert= 134.40'

Reach 20R: Public Storm #20



Summary for Reach 21R: Public Storm #21

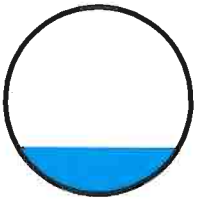
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach 20R outlet invert by 0.99' @ 8.08 hrs

Inflow Area = 1,002,040 sf, 16.29% Impervious, Inflow Depth > 2.37" for 25 yr event
Inflow = 10.59 cfs @ 8.09 hrs, Volume= 198,253 cf
Outflow = 10.59 cfs @ 8.09 hrs, Volume= 198,183 cf, Atten= 0%, Lag= 0.4 min

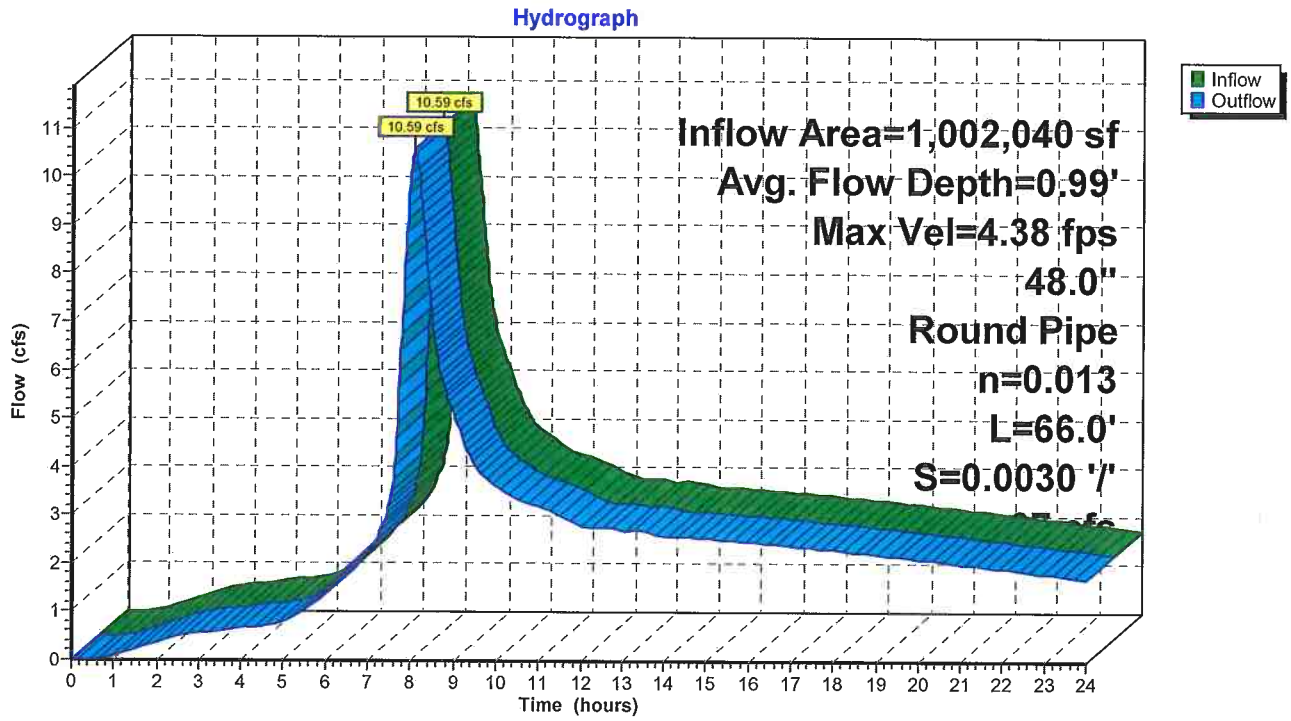
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 4.38 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.62 fps, Avg. Travel Time= 0.4 min

Peak Storage= 160 cf @ 8.09 hrs
Average Depth at Peak Storage= 0.99'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 79.07 cfs

48.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 66.0' Slope= 0.0030 '/'
Inlet Invert= 134.40', Outlet Invert= 134.20'



Reach 21R: Public Storm #21



Summary for Reach 22R: Outfall to Creek

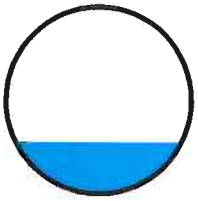
[52] Hint: Inlet/Outlet conditions not evaluated
[62] Hint: Exceeded Reach 21R OUTLET depth by 0.11' @ 8.16 hrs

Inflow Area =	1,002,040 sf,	16.29% Impervious,	Inflow Depth >	2.37"	for 25 yr event
Inflow =	10.59 cfs @	8.09 hrs, Volume=	198,183 cf		
Outflow =	10.58 cfs @	8.11 hrs, Volume=	198,032 cf,	Atten= 0%,	Lag= 1.0 min

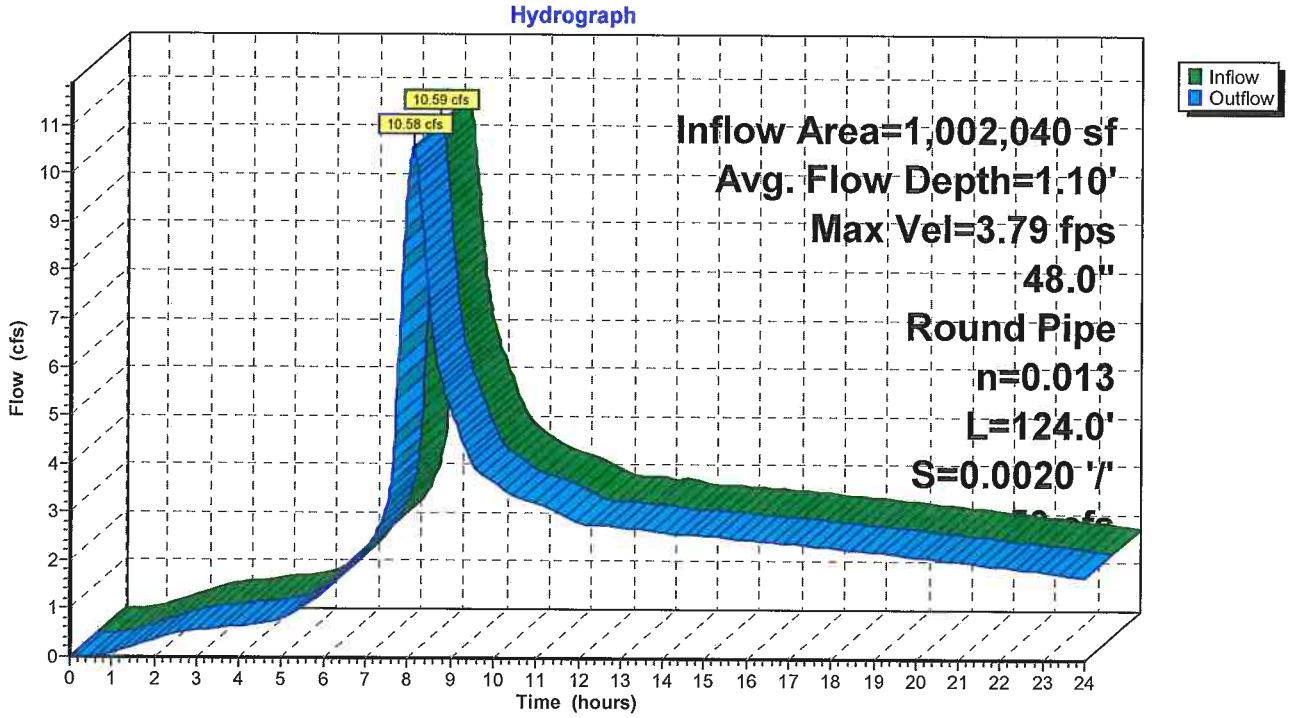
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.79 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 2.27 fps, Avg. Travel Time= 0.9 min

Peak Storage= 346 cf @ 8.10 hrs
Average Depth at Peak Storage= 1.10'
Bank-Full Depth= 4.00' Flow Area= 12.6 sf, Capacity= 64.50 cfs

48.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 124.0' Slope= 0.0020 '/'
Inlet Invert= 134.20', Outlet Invert= 133.95'



Reach 22R: Outfall to Creek



Summary for Pond 10P: Public WQ/Detention Pond

[63] Warning: Exceeded Reach 7R INLET depth by 0.13' @ 8.18 hrs

Inflow Area =	1,002,040 sf,	16.29% Impervious,	Inflow Depth >	2.41"	for 25 yr event
Inflow =	11.93 cfs @	7.99 hrs,	Volume=	201,396 cf	
Outflow =	10.59 cfs @	8.08 hrs,	Volume=	198,302 cf,	Atten= 11%, Lag= 5.4 min
Primary =	10.59 cfs @	8.08 hrs,	Volume=	198,302 cf	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Peak Elev= 135.91' @ 8.08 hrs Surf.Area= 7,378 sf Storage= 9,596 cf

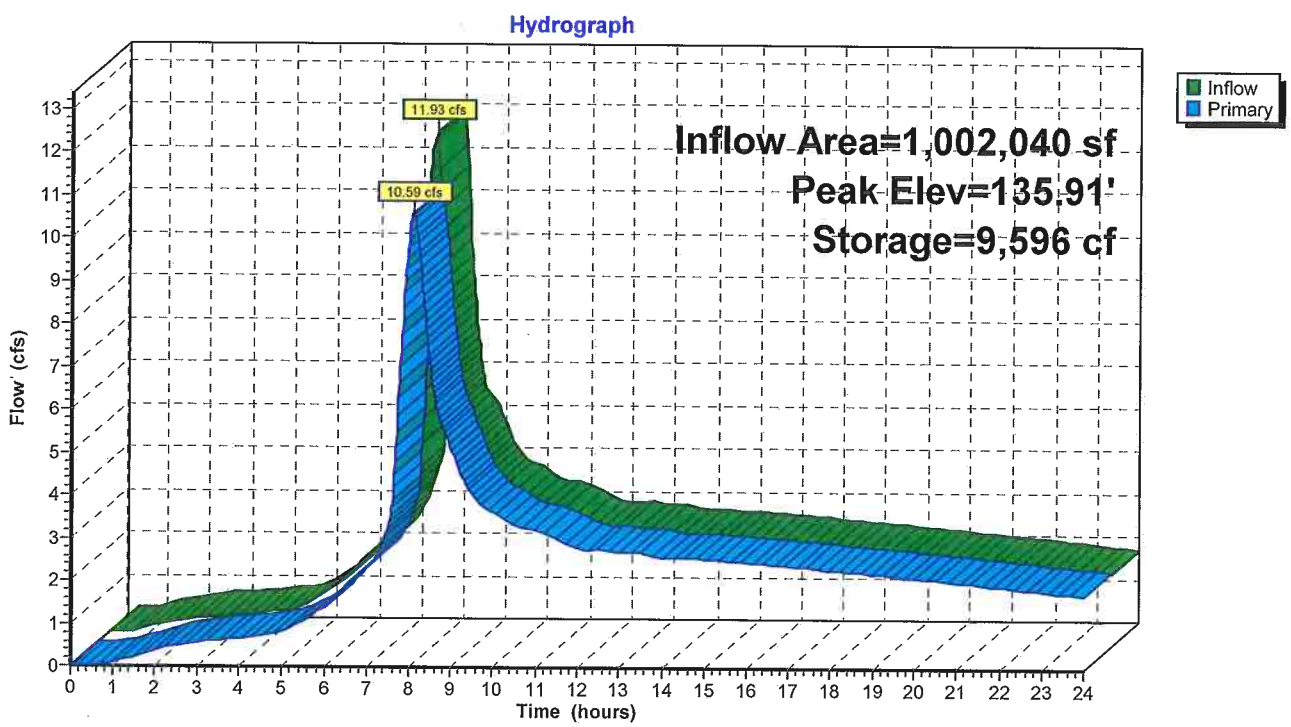
Plug-Flow detention time= 24.8 min calculated for 198,136 cf (98% of inflow)
Center-of-Mass det. time= 14.5 min (776.7 - 762.2)

Volume	Invert	Avail.Storage	Storage Description
#1	134.40'	32,448 cf	**30.00'W x 180.00'L x 4.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	134.40'	**24.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=10.59 cfs @ 8.08 hrs HW=135.91' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 10.59 cfs @ 4.18 fps)

Pond 10P: Public WQ/Detention Pond



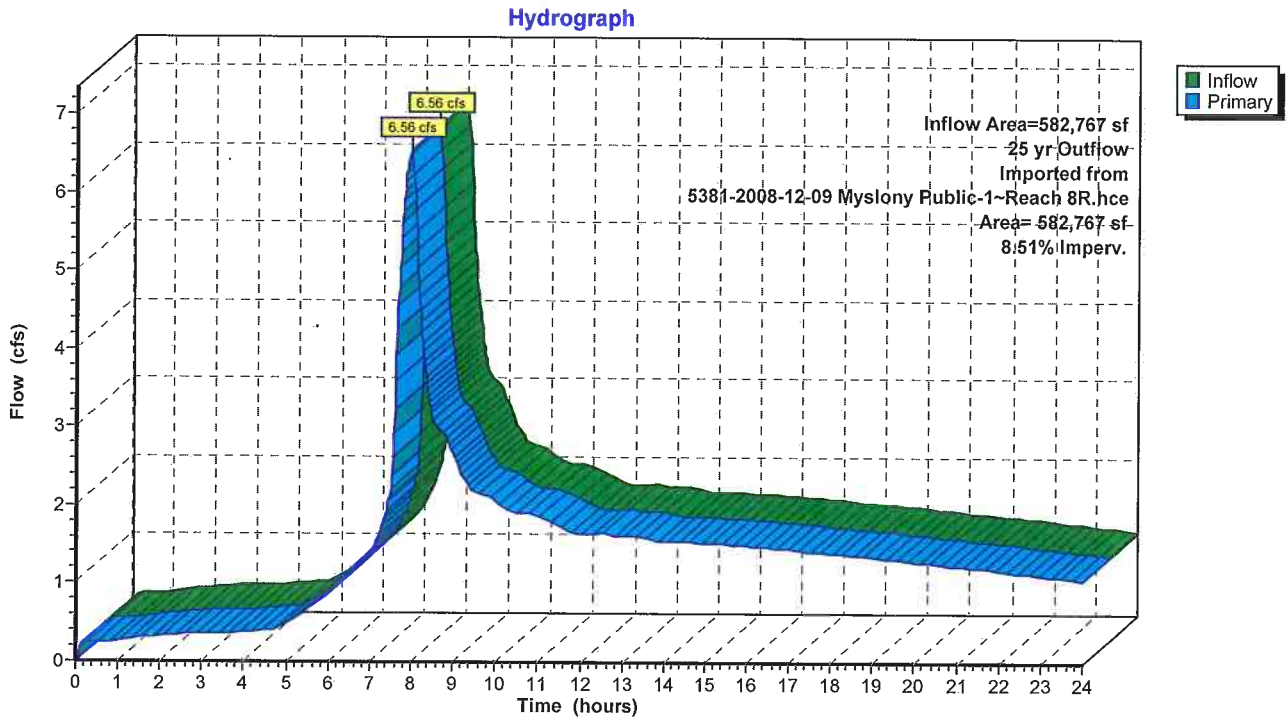
Summary for Link 13L: Flow from Myslony

Inflow Area = 582,767 sf, 8.51% Impervious, Inflow Depth > 2.45" for 25 yr event
Inflow = 6.56 cfs @ 8.00 hrs, Volume= 119,026 cf
Primary = 6.56 cfs @ 8.00 hrs, Volume= 119,026 cf, Atten= 0%, Lag= 0.0 min

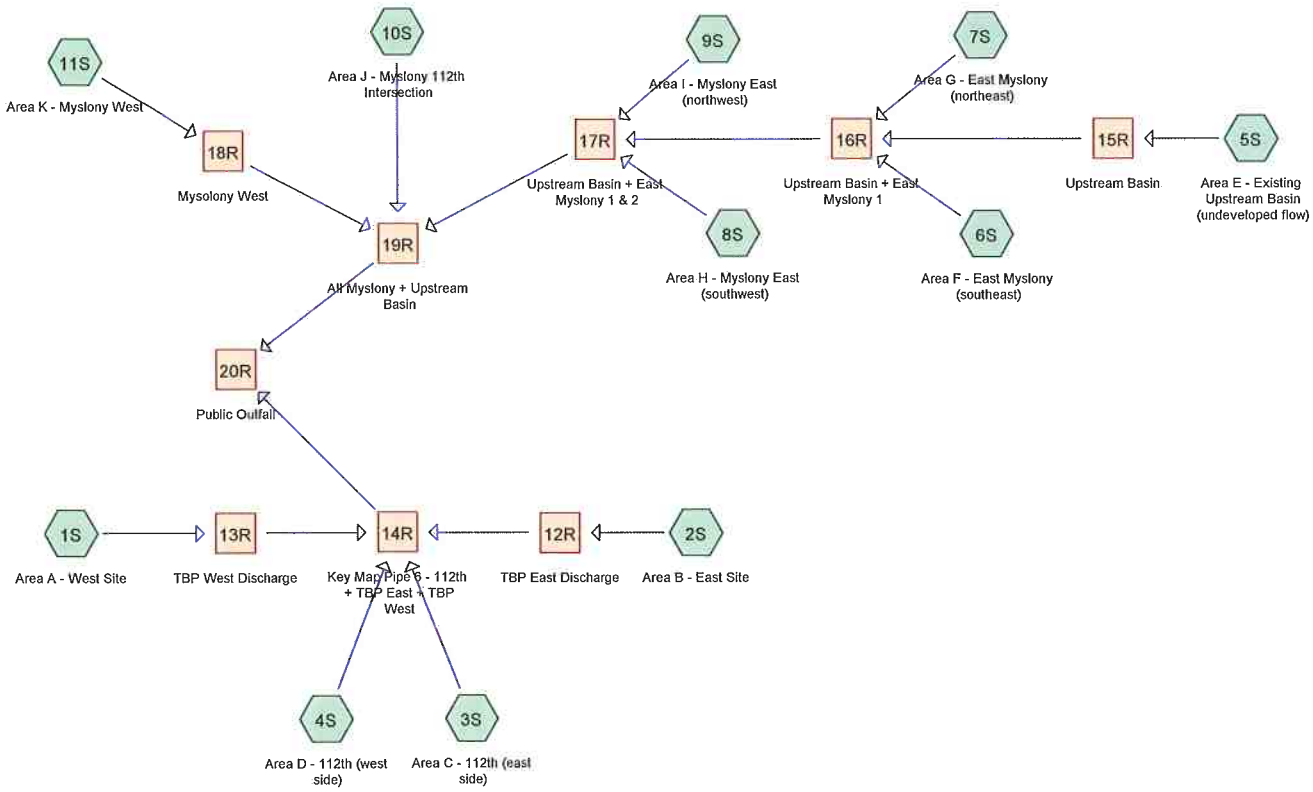
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs

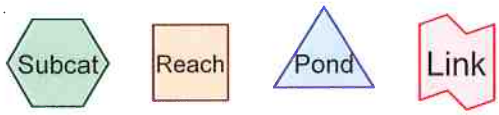
25 yr Outflow Imported from 5381-2008-12-09 Myslony Public-1~Reach 8R.hce

Link 13L: Flow from Myslony



OVERALL ROUTING
ANALYSIS (2008)





Routing Diagram for TMR5381-Public Conveyance COMPLETE
Prepared by Microsoft, Printed 12/11/2014
HydroCAD® 10.00-13 s/n 02239 © 2014 HydroCAD Software Solutions LLC

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SBUH method, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area A - West Site Runoff Area=112,631 sf 85.00% Impervious Runoff Depth=3.23"
Tc=5.0 min CN=94 Runoff=2.16 cfs 0.695 af

Subcatchment 2S: Area B - East Site Runoff Area=192,373 sf 85.00% Impervious Runoff Depth=3.23"
Tc=5.0 min CN=94 Runoff=3.69 cfs 1.187 af

Subcatchment 3S: Area C - 112th (east Runoff Area=15,095 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.32 cfs 0.106 af

Subcatchment 4S: Area D - 112th (west Runoff Area=14,756 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.31 cfs 0.103 af

Subcatchment 5S: Area E - Existing Runoff Area=12.800 ac 0.00% Impervious Runoff Depth=1.88"
Flow Length=1,200' Slope=0.0125 '/' Tc=37.0 min CN=79 Runoff=3.44 cfs 2.008 af

Subcatchment 6S: Area F - East Myslony Runoff Area=3,914 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.08 cfs 0.027 af

Subcatchment 7S: Area G - East Myslony Runoff Area=3,490 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.07 cfs 0.024 af

Subcatchment 8S: Area H - Myslony East Runoff Area=8,330 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.18 cfs 0.058 af

Subcatchment 9S: Area I - Myslony East Runoff Area=8,359 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.18 cfs 0.059 af

Subcatchment 10S: Area J - Myslony Runoff Area=10,081 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.21 cfs 0.071 af

Subcatchment 11S: Area K - Myslony Runoff Area=19,563 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.137 af

Reach 12R: TBP East Discharge Avg. Flow Depth=0.79' Max Vel=3.92 fps Inflow=3.69 cfs 1.187 af
18.0" Round Pipe n=0.013 L=24.0' S=0.0042 '/' Capacity=6.78 cfs Outflow=3.69 cfs 1.187 af

Reach 13R: TBP West Discharge Avg. Flow Depth=0.72' Max Vel=2.94 fps Inflow=2.16 cfs 0.695 af
15.0" Round Pipe n=0.013 L=36.0' S=0.0028 '/' Capacity=3.40 cfs Outflow=2.16 cfs 0.695 af

Reach 14R: Key Map Pipe 6 - 112th + Avg. Flow Depth=1.35' Max Vel=3.91 fps Inflow=6.47 cfs 2.092 af
18.0" Round Pipe n=0.013 L=15.0' S=0.0033 '/' Capacity=6.06 cfs Outflow=6.47 cfs 2.092 af

Reach 15R: Upstream Basin Avg. Flow Depth=0.77' Max Vel=3.79 fps Inflow=3.44 cfs 2.008 af
18.0" Round Pipe n=0.013 L=10.0' S=0.0040 '/' Capacity=6.64 cfs Outflow=3.44 cfs 2.008 af

Reach 16R: Upstream Basin + East Avg. Flow Depth=0.79' Max Vel=3.76 fps Inflow=3.56 cfs 2.060 af
18.0" Round Pipe n=0.013 L=162.0' S=0.0038 '/' Capacity=6.50 cfs Outflow=3.56 cfs 2.060 af

Reach 17R: Upstream Basin + East Avg. Flow Depth=0.85' Max Vel=3.70 fps Inflow=3.85 cfs 2.177 af
18.0" Round Pipe n=0.013 L=63.0' S=0.0035 '/' Capacity=6.21 cfs Outflow=3.85 cfs 2.177 af

Reach 18R: Mysolony West Avg. Flow Depth=0.26' Max Vel=2.59 fps Inflow=0.41 cfs 0.137 af
12.0" Round Pipe n=0.013 L=70.0' S=0.0064 '/' Capacity=2.86 cfs Outflow=0.41 cfs 0.137 af

Reach 19R: All Myslony + Upstream Avg. Flow Depth=0.76' Max Vel=4.04 fps Inflow=4.40 cfs 2.385 af
24.0" Round Pipe n=0.013 L=81.0' S=0.0041 '/' Capacity=14.44 cfs Outflow=4.40 cfs 2.385 af

Reach 20R: Public Outfall Avg. Flow Depth=1.43' Max Vel=4.43 fps Inflow=10.63 cfs 4.477 af
24.0" Round Pipe n=0.013 L=60.0' S=0.0030 '/' Capacity=12.39 cfs Outflow=10.63 cfs 4.477 af

Total Runoff Area = 21.721 ac Runoff Volume = 4.477 af Average Runoff Depth = 2.47"
63.76% Pervious = 13.850 ac 36.24% Impervious = 7.871 ac

Summary for Subcatchment 1S: Area A - West Site

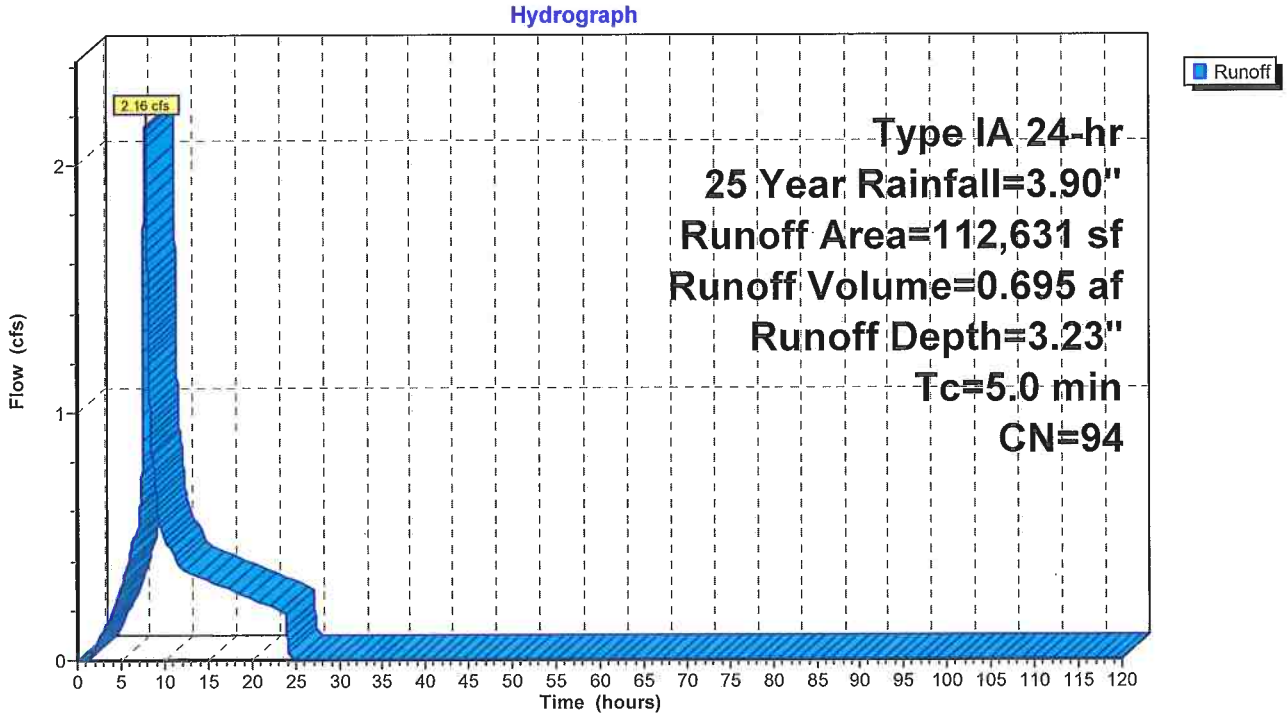
Runoff = 2.16 cfs @ 7.89 hrs, Volume= 0.695 af, Depth= 3.23"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
112,631	94	Urban commercial, 85% imp, HSG C
16,895		15.00% Pervious Area
95,736		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Area A - West Site



Summary for Subcatchment 2S: Area B - East Site

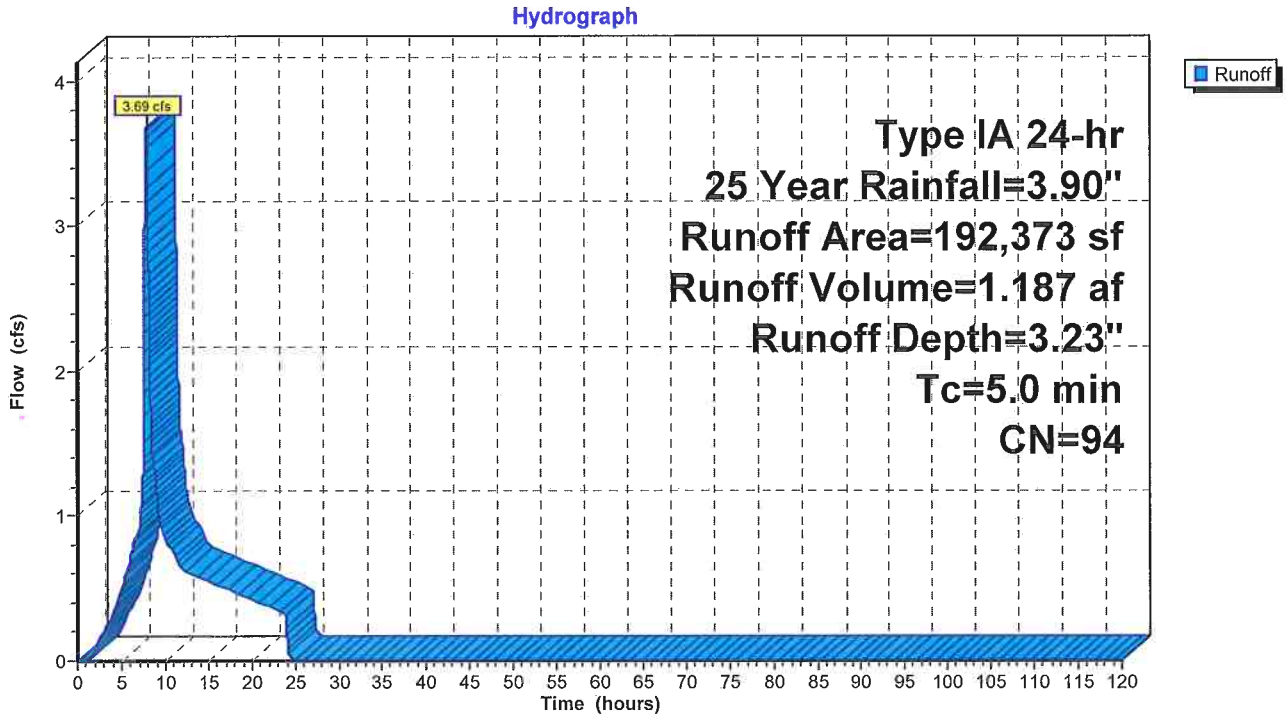
Runoff = 3.69 cfs @ 7.89 hrs, Volume= 1.187 af, Depth= 3.23"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
192,373	94	Urban commercial, 85% imp, HSG C
28,856		15.00% Pervious Area
163,517		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: Area B - East Site



Summary for Subcatchment 3S: Area C - 112th (east side)

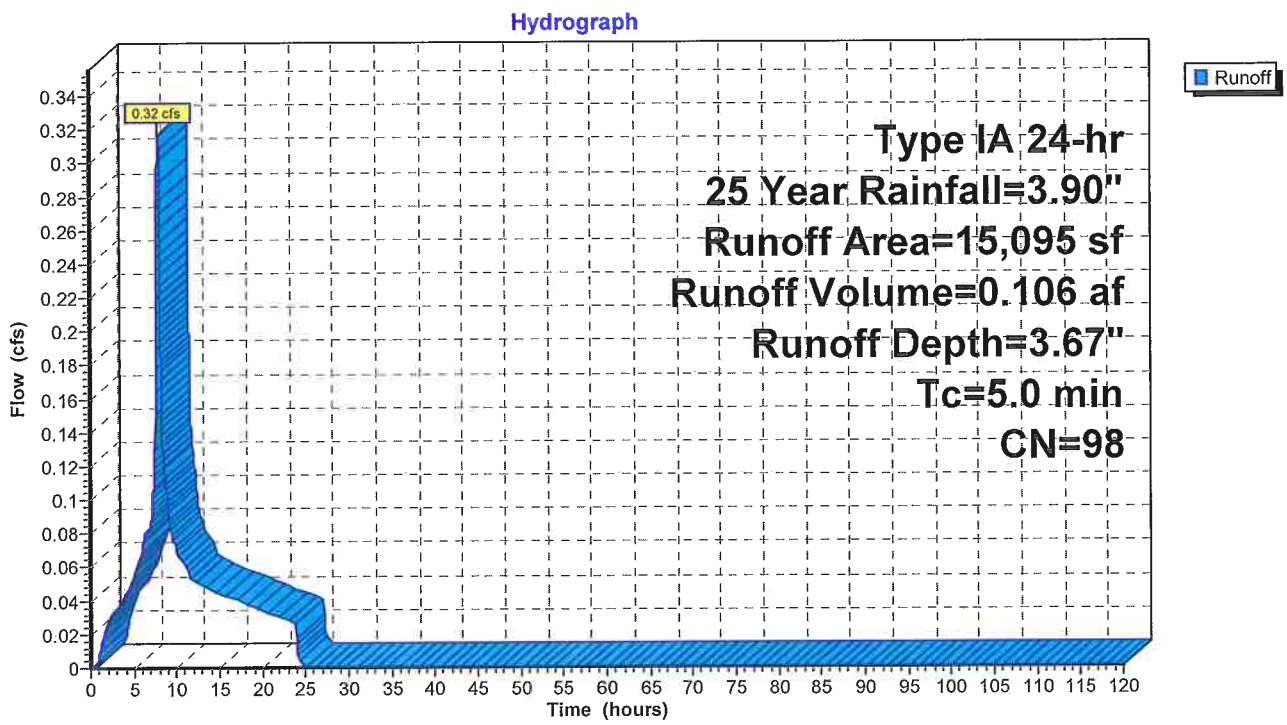
Runoff = 0.32 cfs @ 7.88 hrs, Volume= 0.106 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
15,095	98	Paved roads w/curbs & sewers
15,095		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: Area C - 112th (east side)



Summary for Subcatchment 4S: Area D - 112th (west side)

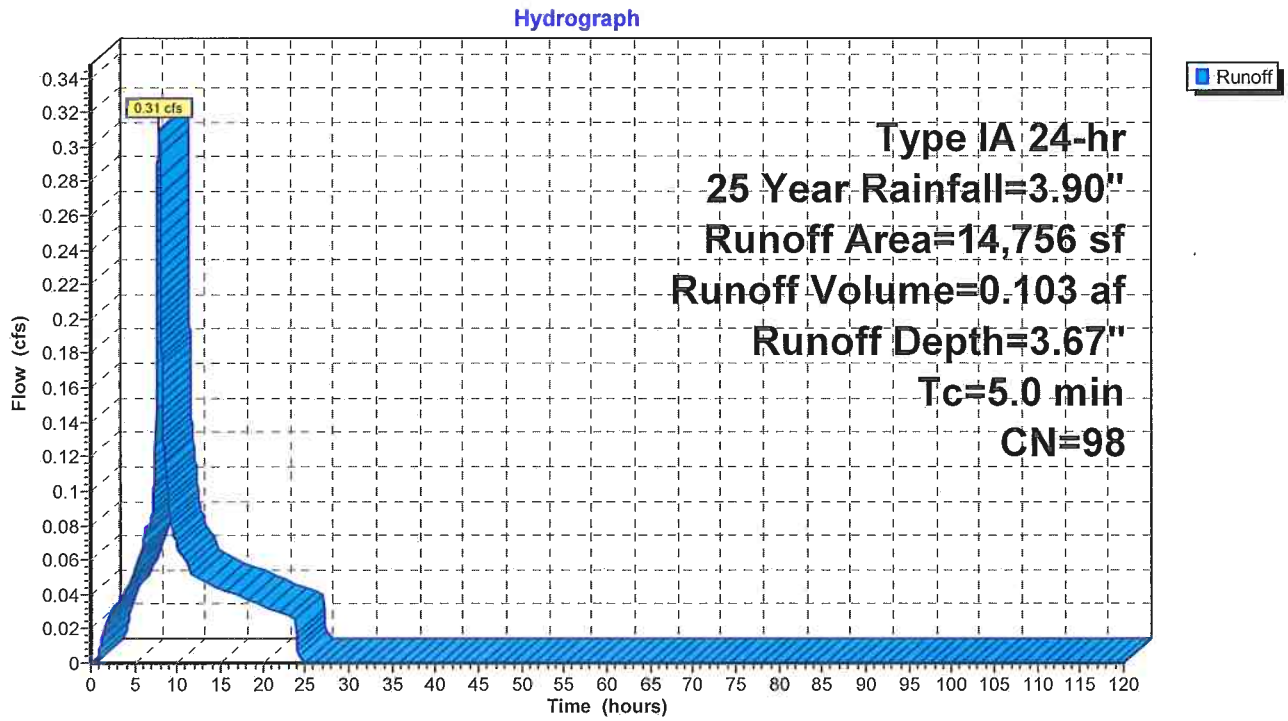
Runoff = 0.31 cfs @ 7.88 hrs, Volume= 0.103 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
14,756	98	Paved roads w/curbs & sewers
14,756		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: Area D - 112th (west side)



Summary for Subcatchment 5S: Area E - Existing Upstream Basin (undeveloped flow)

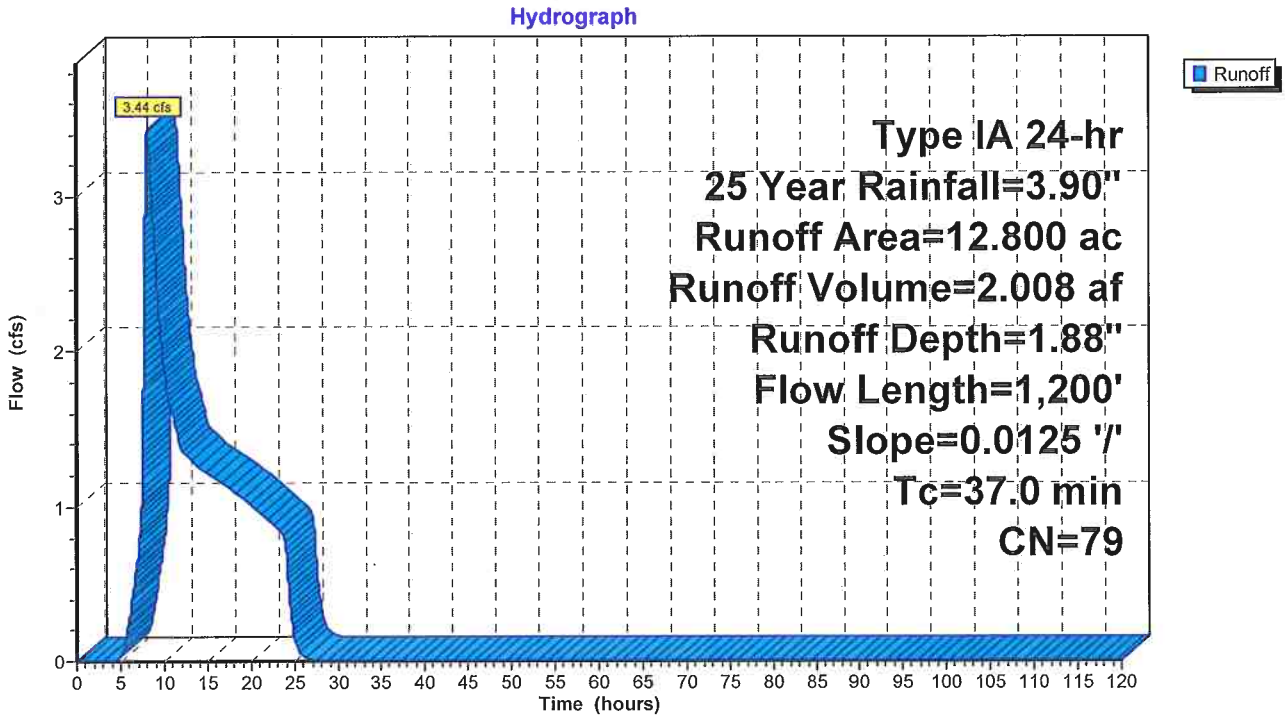
Runoff = 3.44 cfs @ 8.11 hrs, Volume= 2.008 af, Depth= 1.88"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (ac)	CN	Description
12.800	79	Pasture/grassland/range, Fair, HSG C
12.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.7	300	0.0125	0.17		**Sheet Flow,** Range n= 0.130 P2= 2.50"
8.3	900	0.0125	1.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
37.0	1,200	Total			

Subcatchment 5S: Area E - Existing Upstream Basin (undeveloped flow)



Summary for Subcatchment 6S: Area F - East Myslony (southeast)

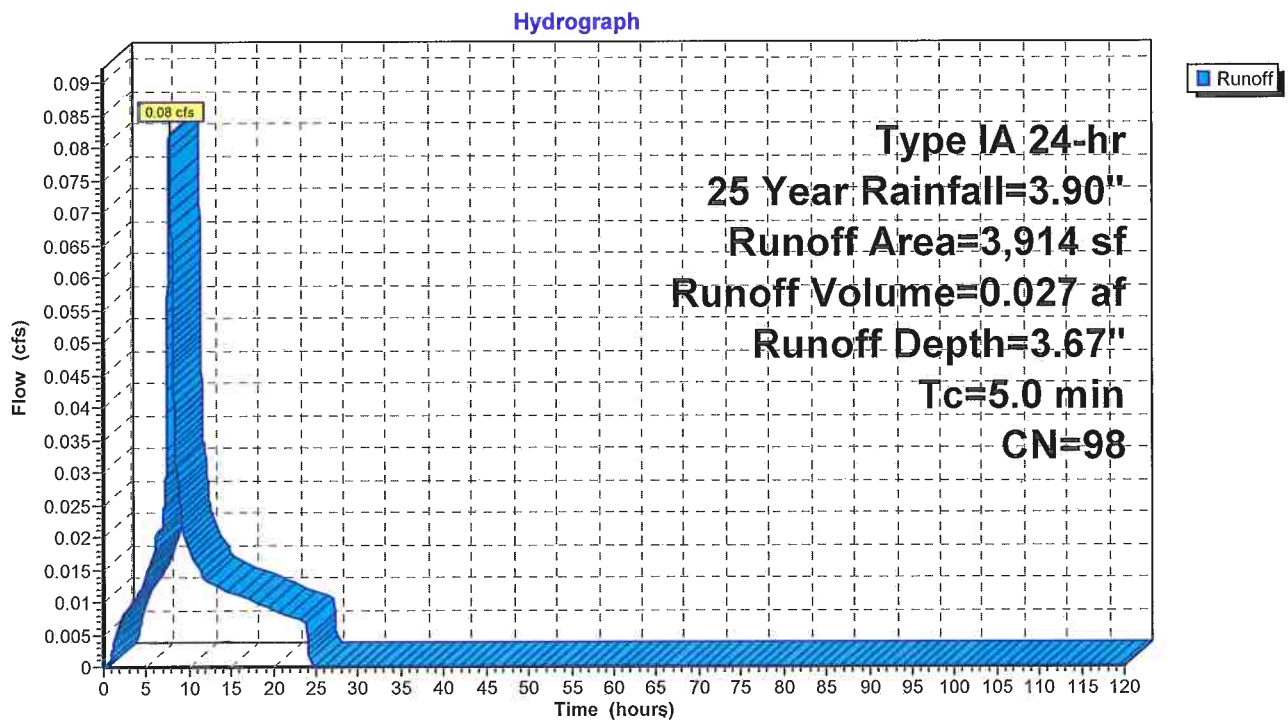
Runoff = 0.08 cfs @ 7.88 hrs, Volume= 0.027 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
3,914	98	Paved roads w/curbs & sewers
3,914		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: Area F - East Myslony (southeast)



Summary for Subcatchment 7S: Area G - East Myslony (northeast)

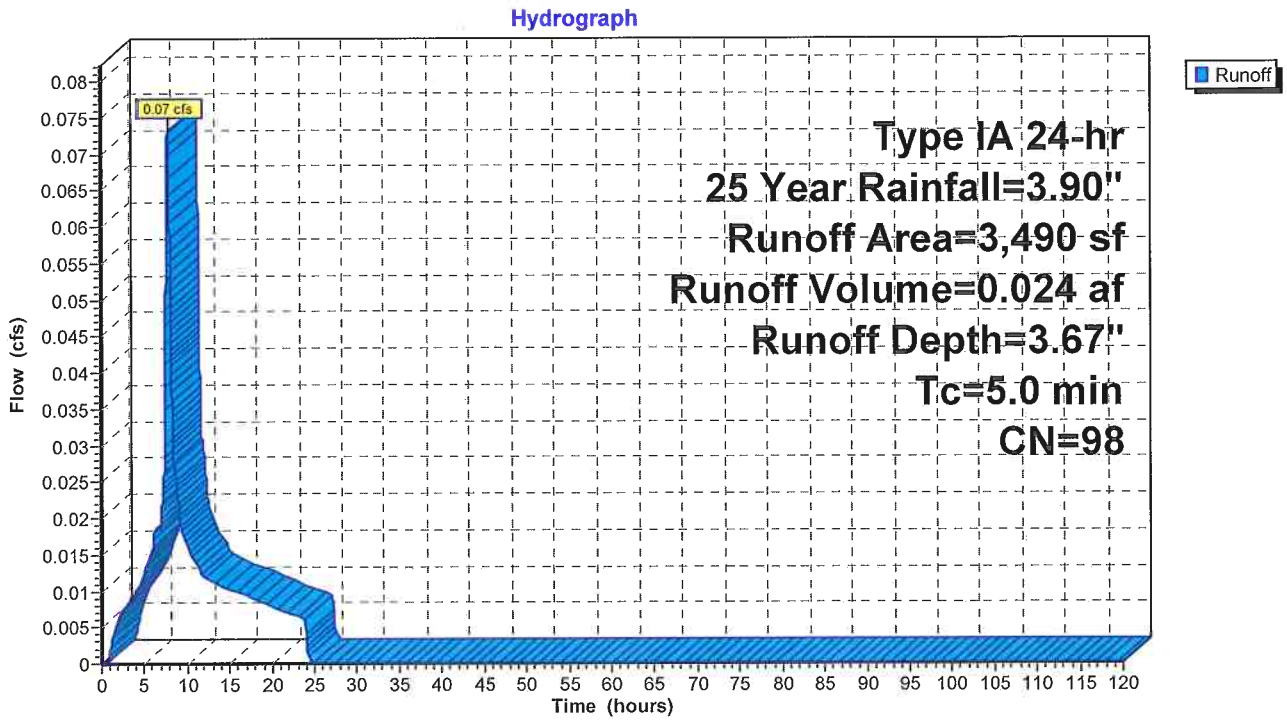
Runoff = 0.07 cfs @ 7.88 hrs, Volume= 0.024 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
3,490	98	Paved roads w/curbs & sewers
3,490		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: Area G - East Myslony (northeast)



Summary for Subcatchment 8S: Area H - Myslony East (southwest)

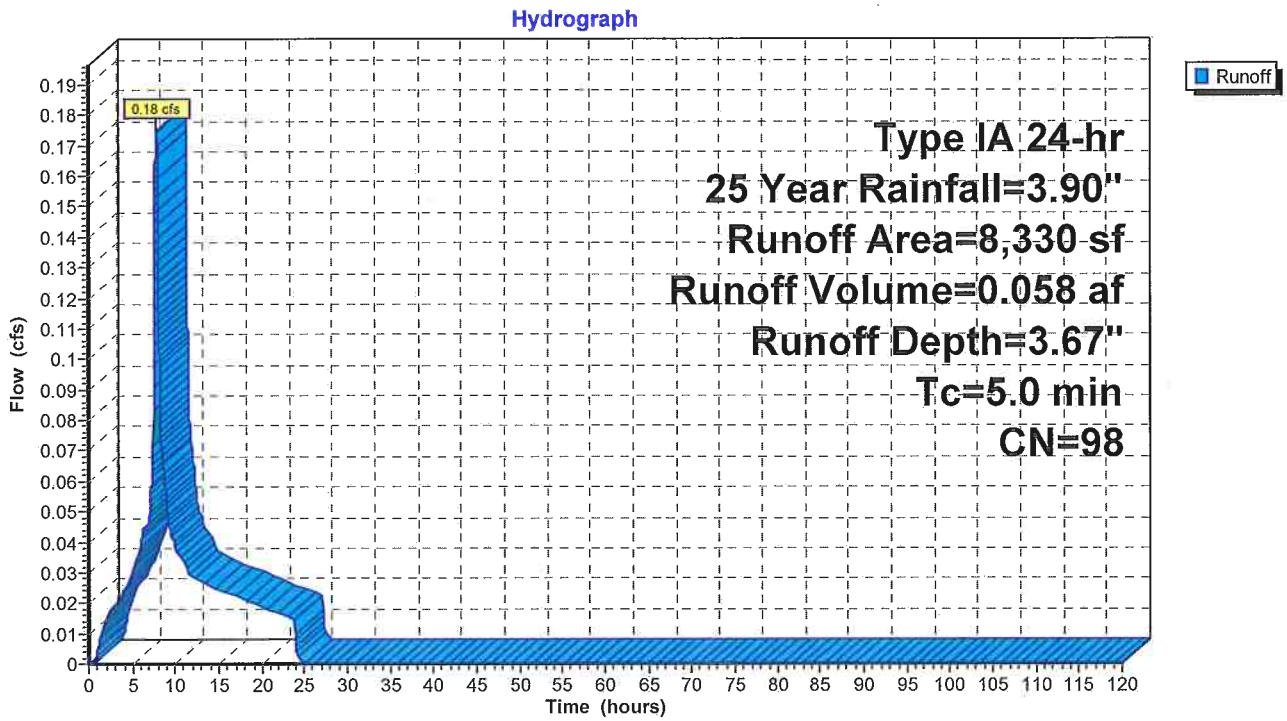
Runoff = 0.18 cfs @ 7.88 hrs, Volume= 0.058 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
8,330	98	Paved roads w/curbs & sewers
8,330		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 8S: Area H - Myslony East (southwest)



Summary for Subcatchment 9S: Area I - Myslony East (northwest)

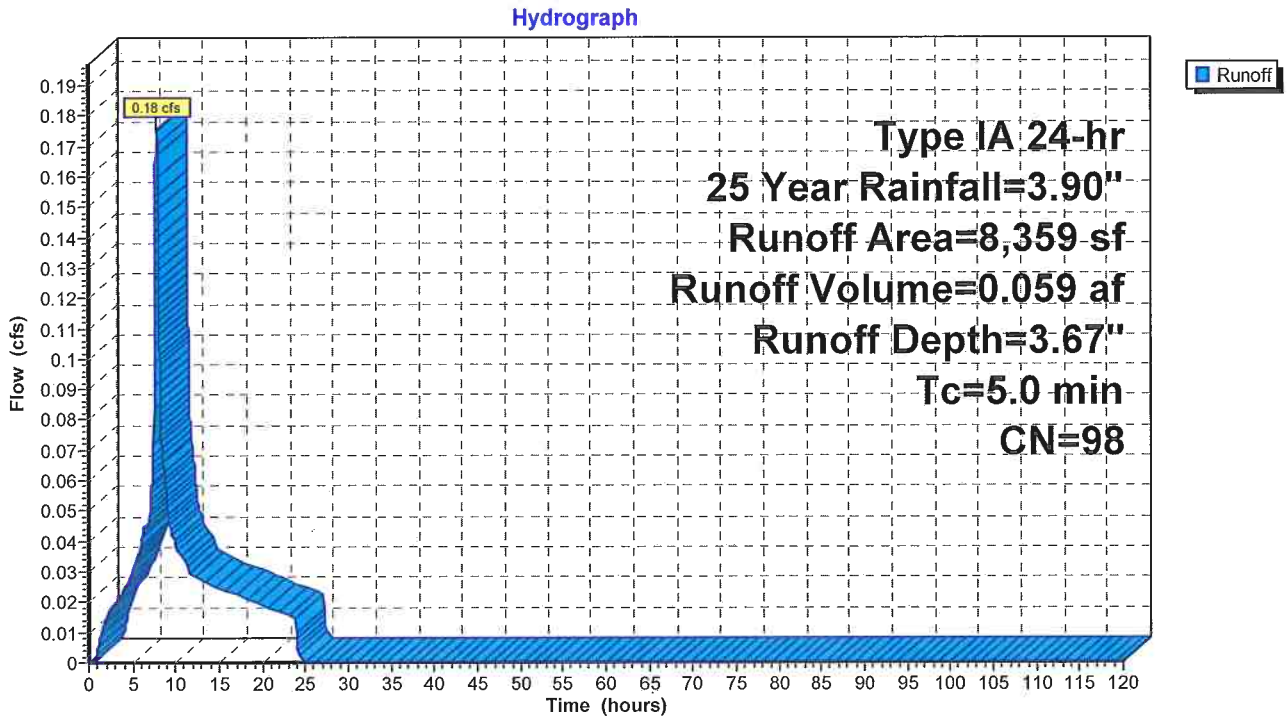
Runoff = 0.18 cfs @ 7.88 hrs, Volume= 0.059 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
8,359	98	Paved roads w/curbs & sewers
8,359		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: Area I - Myslony East (northwest)



Summary for Subcatchment 10S: Area J - Myslony 112th Intersection

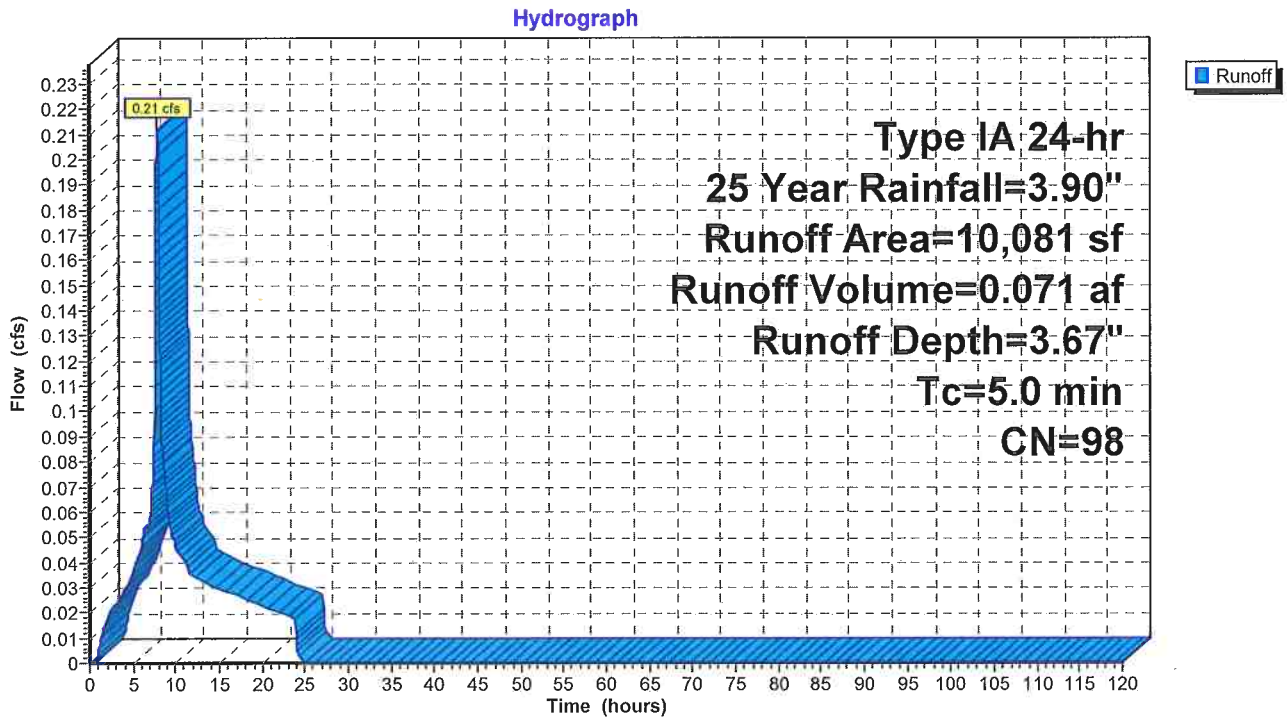
Runoff = 0.21 cfs @ 7.88 hrs, Volume= 0.071 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
10,081	98	Paved roads w/curbs & sewers
10,081		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: Area J - Myslony 112th Intersection



Summary for Subcatchment 11S: Area K - Myslony West

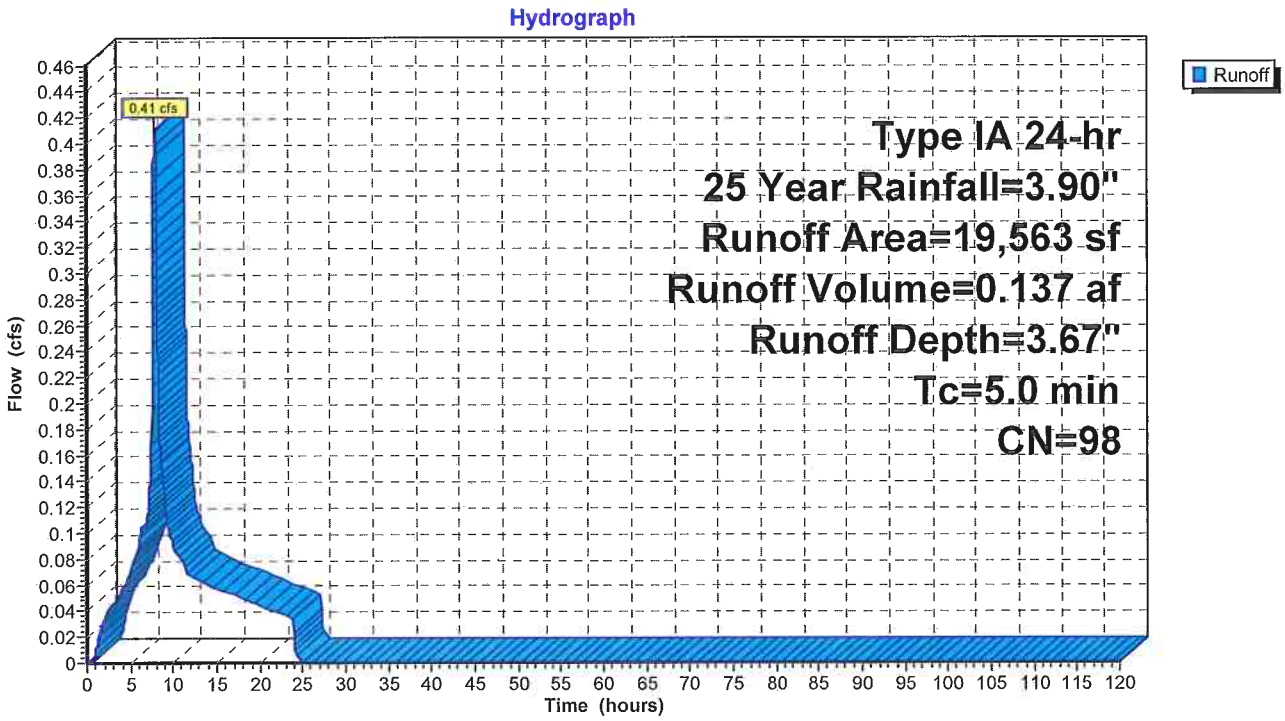
Runoff = 0.41 cfs @ 7.88 hrs, Volume= 0.137 af, Depth= 3.67"

Runoff by SBUH method, Weighted-CN, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25 Year Rainfall=3.90"

Area (sf)	CN	Description
19,563	98	Paved roads w/curbs & sewers
19,563		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: Area K - Myslony West



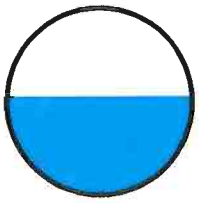
Summary for Reach 12R: TBP East Discharge

Inflow Area = 4.416 ac, 85.00% Impervious, Inflow Depth = 3.23" for 25 Year event
Inflow = 3.69 cfs @ 7.89 hrs, Volume= 1.187 af
Outflow = 3.69 cfs @ 7.90 hrs, Volume= 1.187 af, Atten= 0%, Lag= 0.2 min

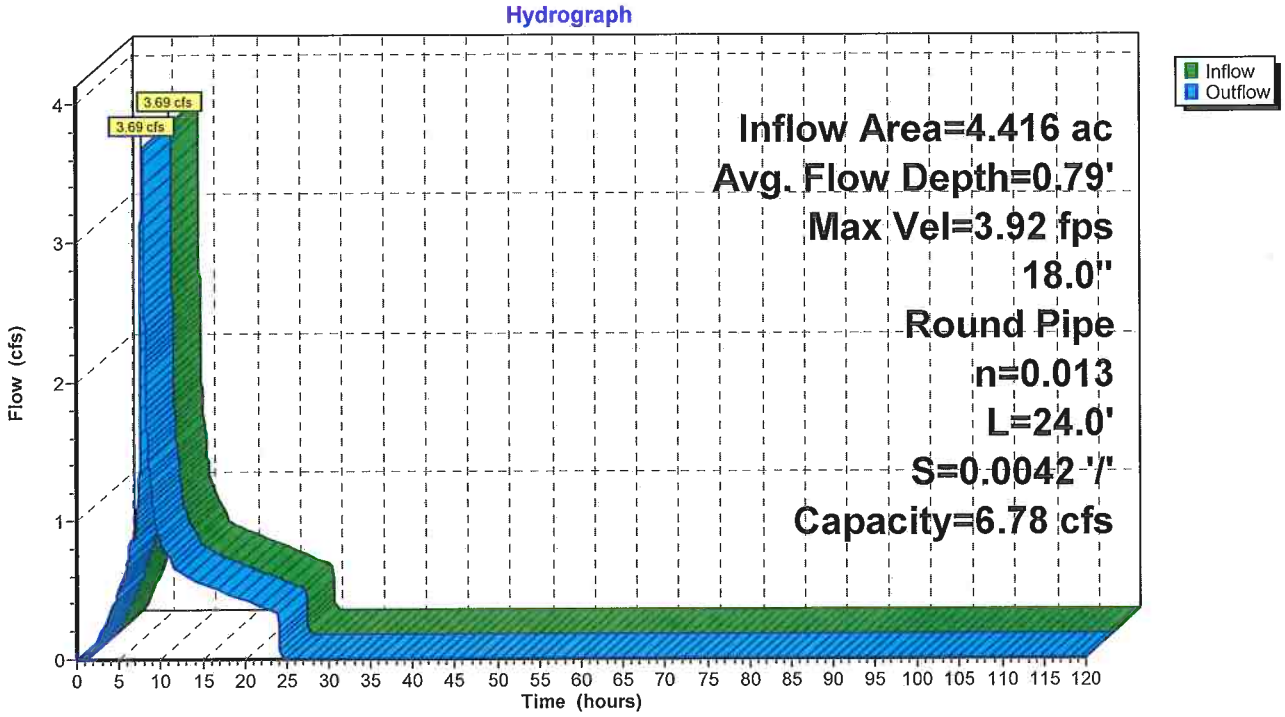
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.92 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.24 fps, Avg. Travel Time= 0.2 min

Peak Storage= 23 cf @ 7.89 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 6.78 cfs

18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 24.0' Slope= 0.0042 '/'
Inlet Invert= 135.15', Outlet Invert= 135.05'



Reach 12R: TBP East Discharge



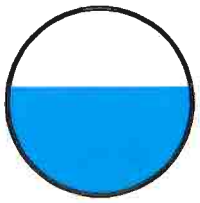
Summary for Reach 13R: TBP West Discharge

Inflow Area = 2.586 ac, 85.00% Impervious, Inflow Depth = 3.23" for 25 Year event
Inflow = 2.16 cfs @ 7.89 hrs, Volume= 0.695 af
Outflow = 2.16 cfs @ 7.90 hrs, Volume= 0.695 af, Atten= 0%, Lag= 0.4 min

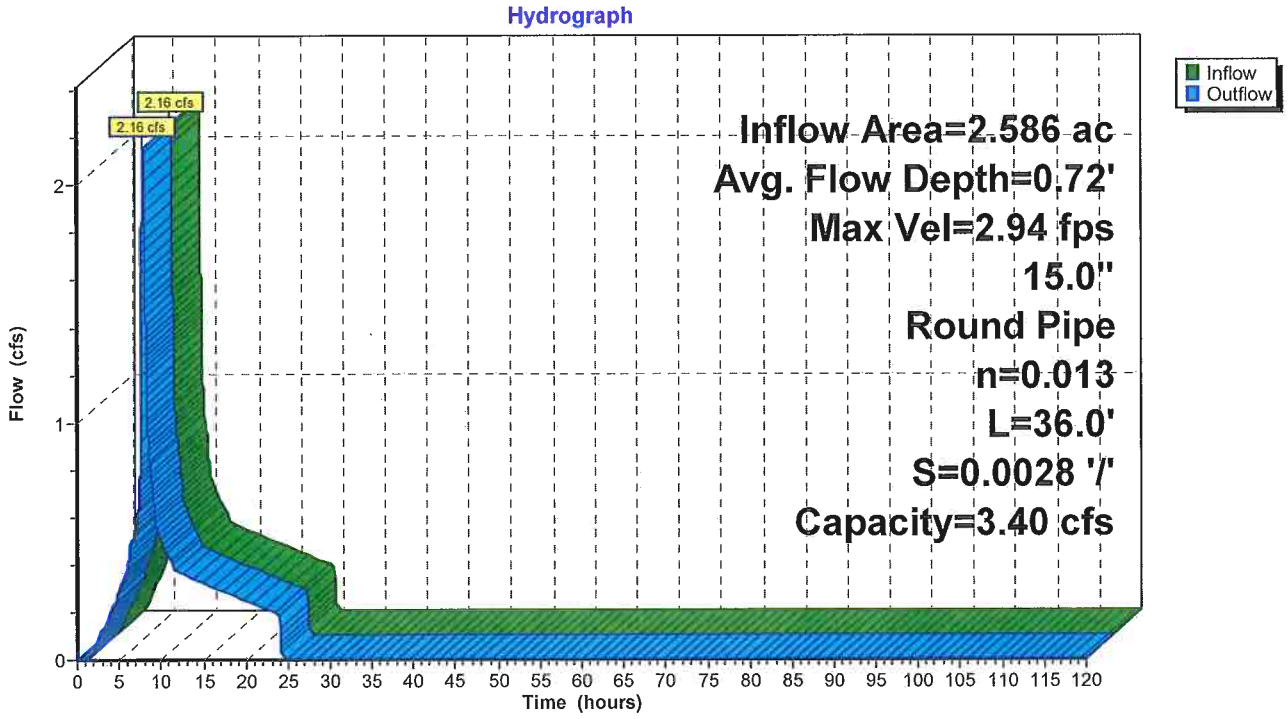
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.94 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.69 fps, Avg. Travel Time= 0.4 min

Peak Storage= 26 cf @ 7.90 hrs
Average Depth at Peak Storage= 0.72'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 3.40 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 36.0' Slope= 0.0028 '/'
Inlet Invert= 135.35', Outlet Invert= 135.25'



Reach 13R: TBP West Discharge



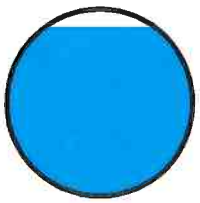
Summary for Reach 14R: Key Map Pipe 6 - 112th + TBP East + TBP West

Inflow Area = 7.687 ac, 86.34% Impervious, Inflow Depth = 3.27" for 25 Year event
Inflow = 6.47 cfs @ 7.90 hrs, Volume= 2.092 af
Outflow = 6.47 cfs @ 7.90 hrs, Volume= 2.092 af, Atten= 0%, Lag= 0.2 min

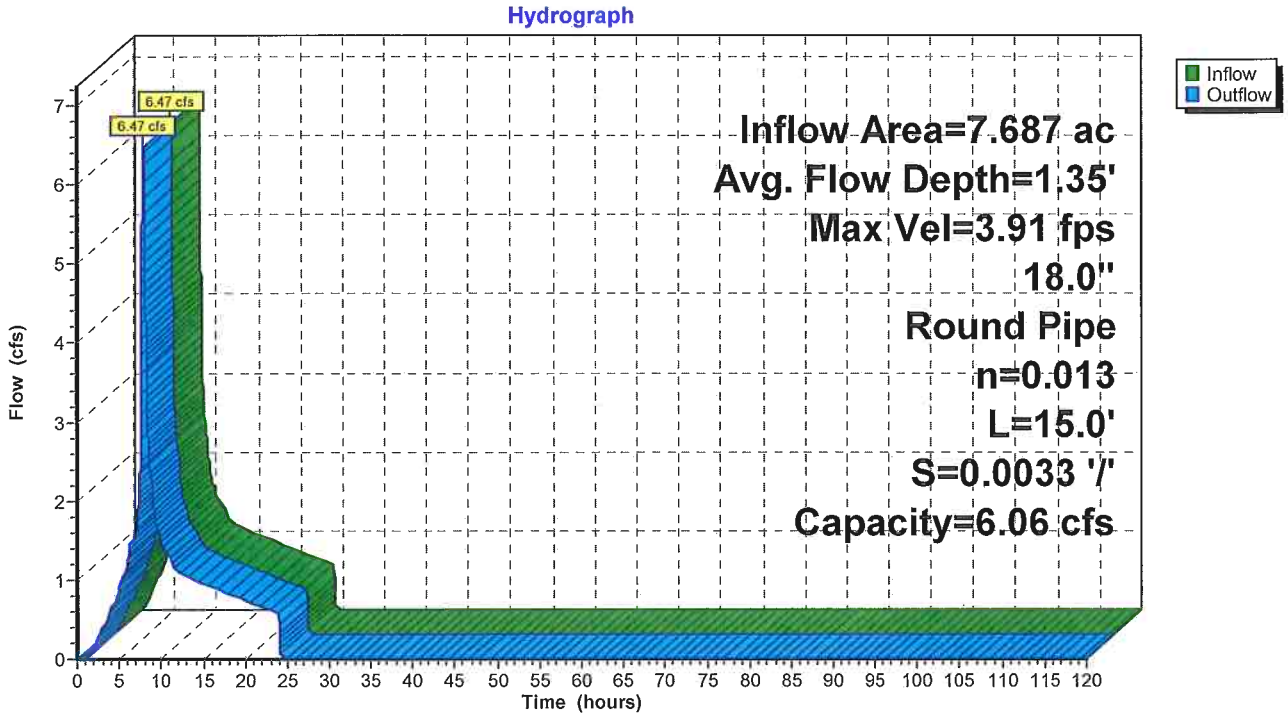
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.91 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.37 fps, Avg. Travel Time= 0.1 min

Peak Storage= 25 cf @ 7.90 hrs
Average Depth at Peak Storage= 1.35'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 6.06 cfs

18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 15.0' Slope= 0.0033 '/'
Inlet Invert= 135.00', Outlet Invert= 134.95'



Reach 14R: Key Map Pipe 6 - 112th + TBP East + TBP West



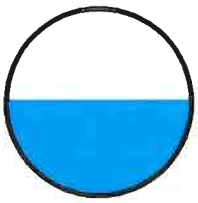
Summary for Reach 15R: Upstream Basin

Inflow Area = 12.800 ac, 0.00% Impervious, Inflow Depth = 1.88" for 25 Year event
Inflow = 3.44 cfs @ 8.11 hrs, Volume= 2.008 af
Outflow = 3.44 cfs @ 8.12 hrs, Volume= 2.008 af, Atten= 0%, Lag= 0.1 min

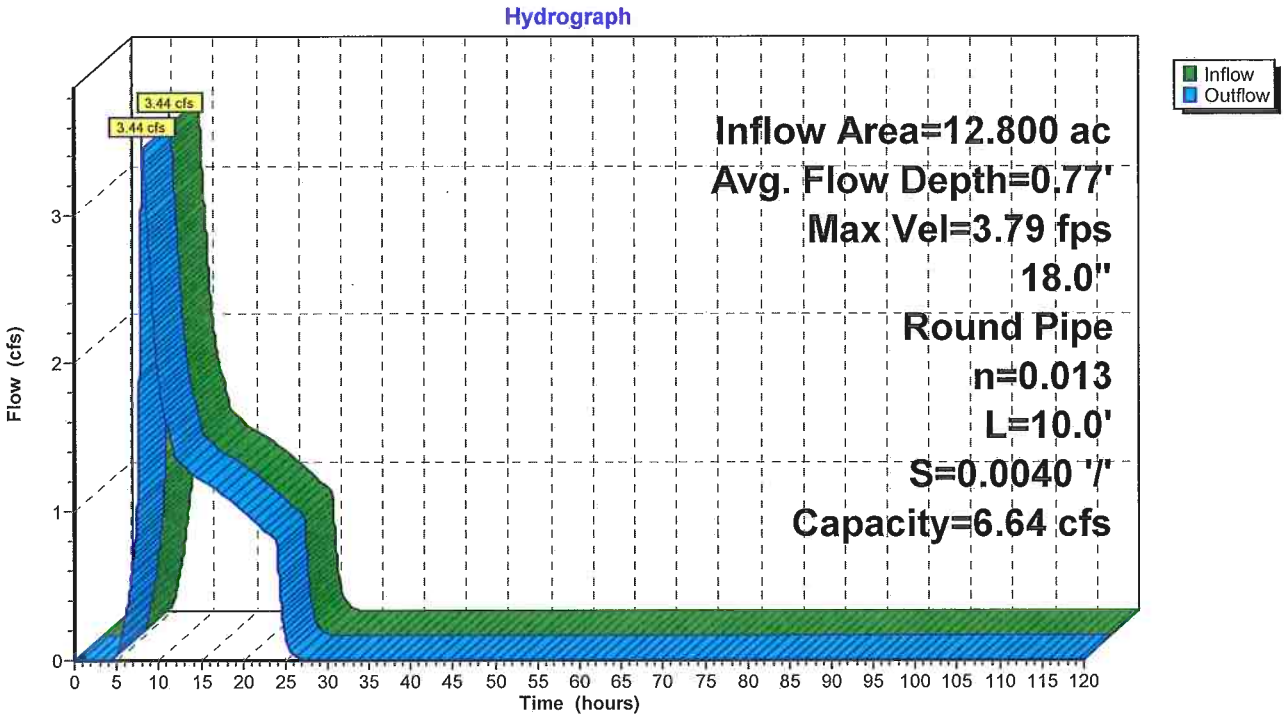
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.79 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.29 fps, Avg. Travel Time= 0.1 min

Peak Storage= 9 cf @ 8.11 hrs
Average Depth at Peak Storage= 0.77'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 6.64 cfs

18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 10.0' Slope= 0.0040 '/'
Inlet Invert= 137.20', Outlet Invert= 137.16'



Reach 15R: Upstream Basin



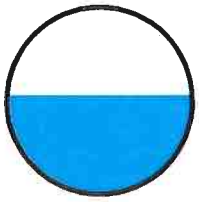
Summary for Reach 16R: Upstream Basin + East Myslony 1

Inflow Area = 12.970 ac, 1.31% Impervious, Inflow Depth = 1.91" for 25 Year event
Inflow = 3.56 cfs @ 8.07 hrs, Volume= 2.060 af
Outflow = 3.56 cfs @ 8.09 hrs, Volume= 2.060 af, Atten= 0%, Lag= 1.3 min

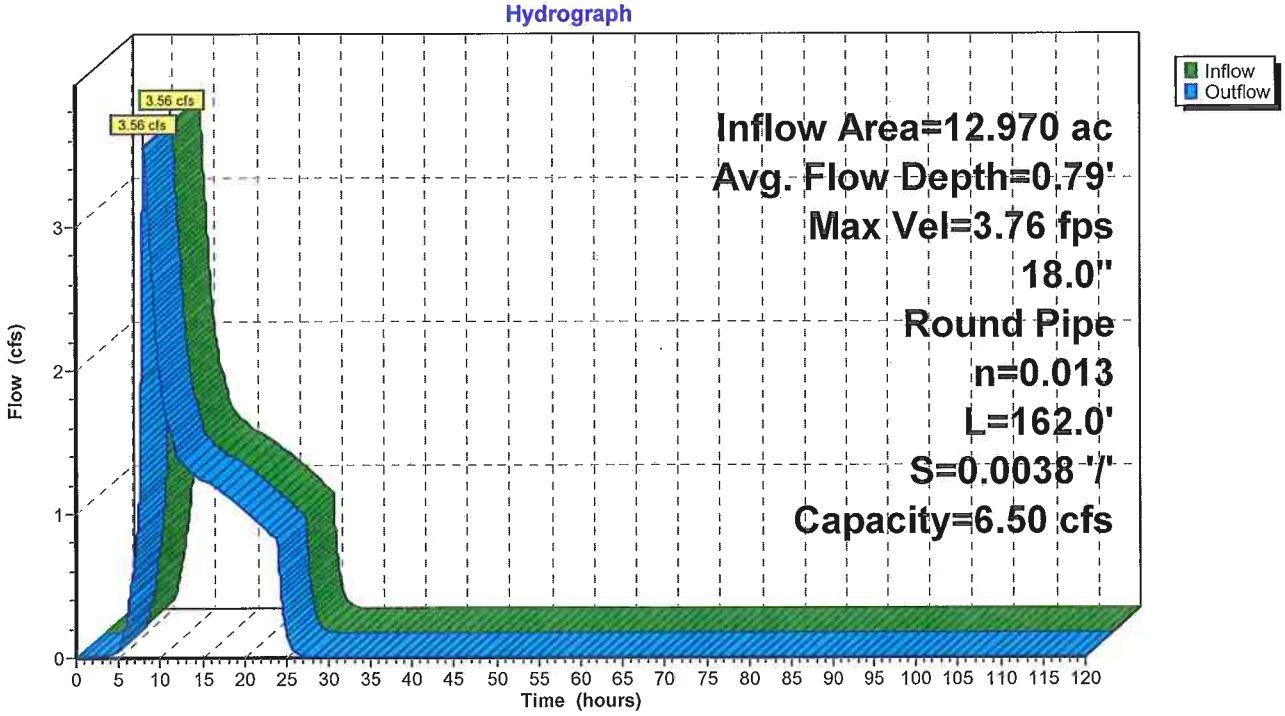
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.76 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 2.06 fps, Avg. Travel Time= 1.3 min

Peak Storage= 153 cf @ 8.08 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 6.50 cfs

18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 162.0' Slope= 0.0038 '/'
Inlet Invert= 136.30', Outlet Invert= 135.68'



Reach 16R: Upstream Basin + East Myslony 1



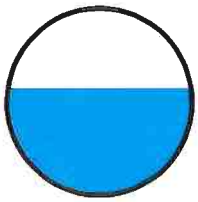
Summary for Reach 17R: Upstream Basin + East Myslony 1 & 2

Inflow Area = 13.353 ac, 4.14% Impervious, Inflow Depth = 1.96" for 25 Year event
Inflow = 3.85 cfs @ 8.03 hrs, Volume= 2.177 af
Outflow = 3.85 cfs @ 8.04 hrs, Volume= 2.177 af, Atten= 0%, Lag= 0.6 min

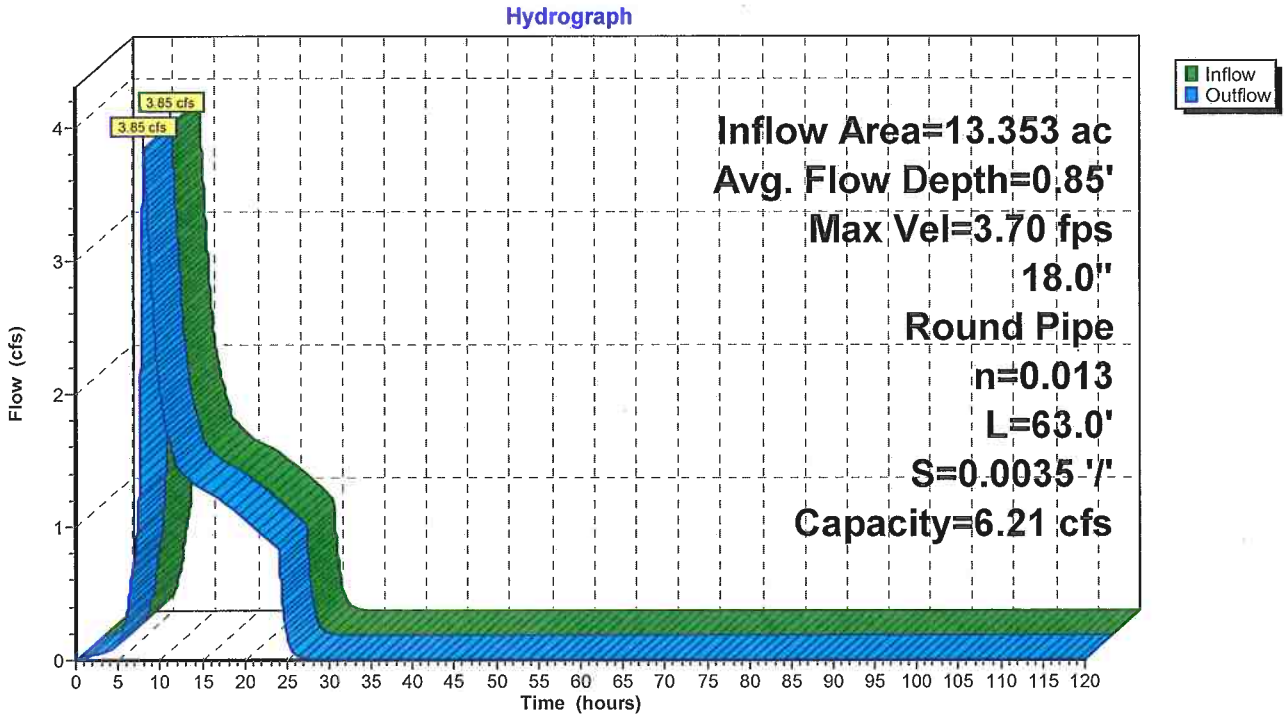
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.70 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.06 fps, Avg. Travel Time= 0.5 min

Peak Storage= 66 cf @ 8.04 hrs
Average Depth at Peak Storage= 0.85'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 6.21 cfs

18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 63.0' Slope= 0.0035 '/'
Inlet Invert= 135.39', Outlet Invert= 135.17'



Reach 17R: Upstream Basin + East Myslony 1 & 2



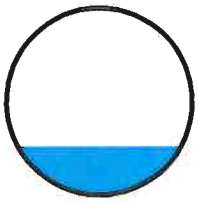
Summary for Reach 18R: Mysolony West

Inflow Area = 0.449 ac,100.00% Impervious, Inflow Depth = 3.67" for 25 Year event
Inflow = 0.41 cfs @ 7.88 hrs, Volume= 0.137 af
Outflow = 0.41 cfs @ 7.89 hrs, Volume= 0.137 af, Atten= 0%, Lag= 0.8 min

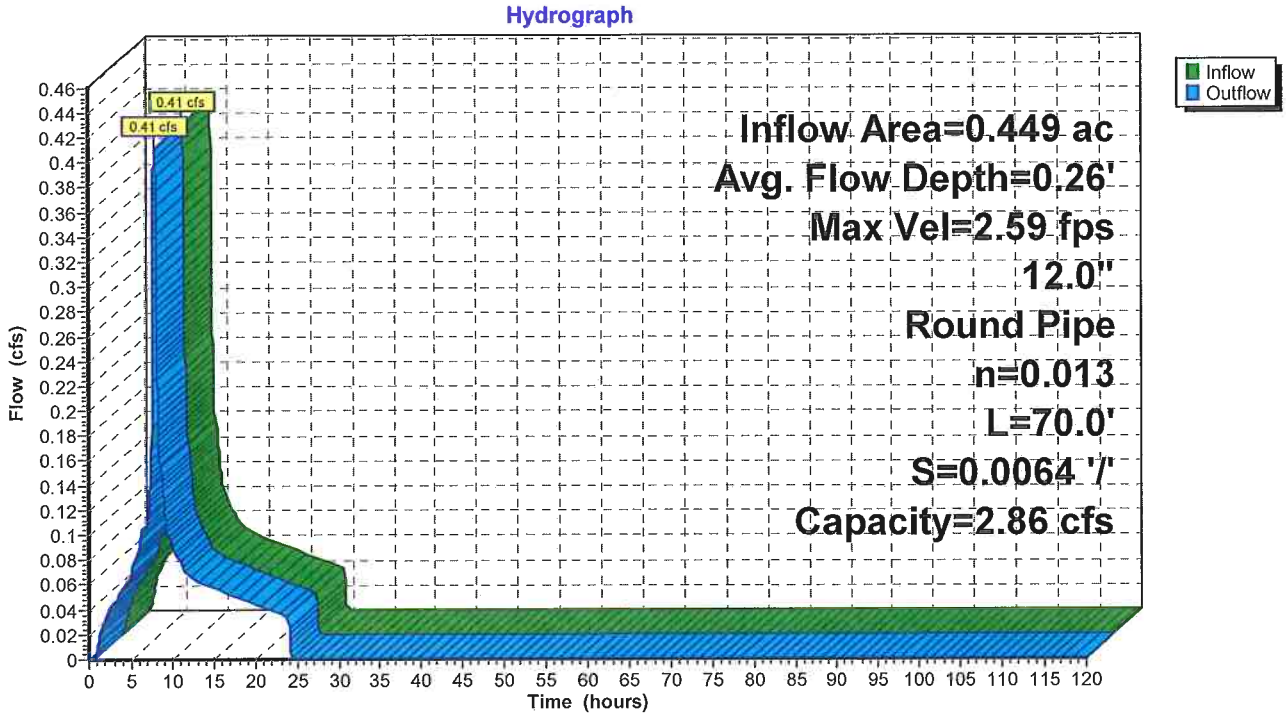
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.59 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.44 fps, Avg. Travel Time= 0.8 min

Peak Storage= 11 cf @ 7.88 hrs
Average Depth at Peak Storage= 0.26'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 2.86 cfs

12.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 70.0' Slope= 0.0064 '/'
Inlet Invert= 135.60', Outlet Invert= 135.15'



Reach 18R: Mysolony West



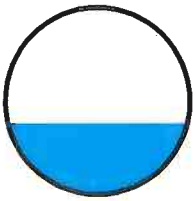
Summary for Reach 19R: All Myslony + Upstream Basin

Inflow Area = 14.034 ac, 8.79% Impervious, Inflow Depth = 2.04" for 25 Year event
Inflow = 4.40 cfs @ 8.02 hrs, Volume= 2.385 af
Outflow = 4.40 cfs @ 8.03 hrs, Volume= 2.385 af, Atten= 0%, Lag= 0.6 min

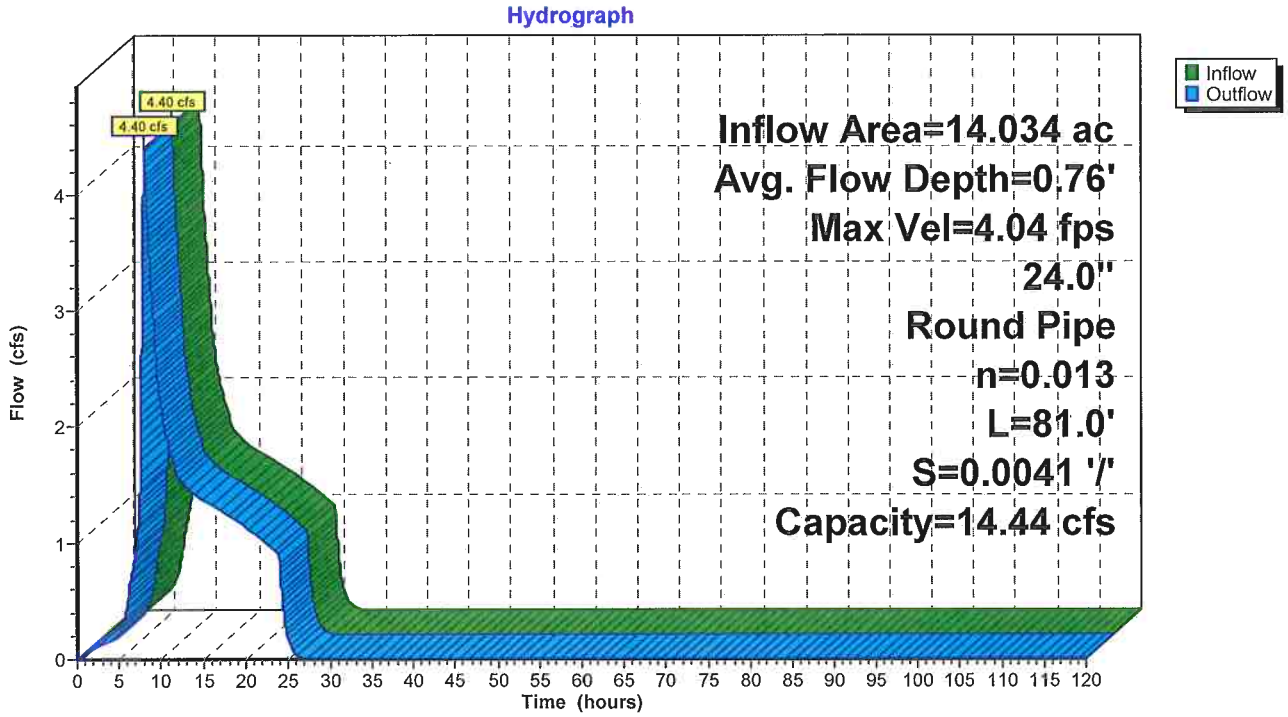
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.04 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.21 fps, Avg. Travel Time= 0.6 min

Peak Storage= 88 cf @ 8.03 hrs
Average Depth at Peak Storage= 0.76'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 14.44 cfs

24.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 81.0' Slope= 0.0041 '/'
Inlet Invert= 135.15', Outlet Invert= 134.82'



Reach 19R: All Myslony + Upstream Basin



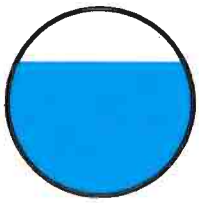
Summary for Reach 20R: Public Outfall

Inflow Area = 21.721 ac, 36.24% Impervious, Inflow Depth = 2.47" for 25 Year event
Inflow = 10.63 cfs @ 8.00 hrs, Volume= 4.477 af
Outflow = 10.63 cfs @ 8.00 hrs, Volume= 4.477 af, Atten= 0%, Lag= 0.0 min

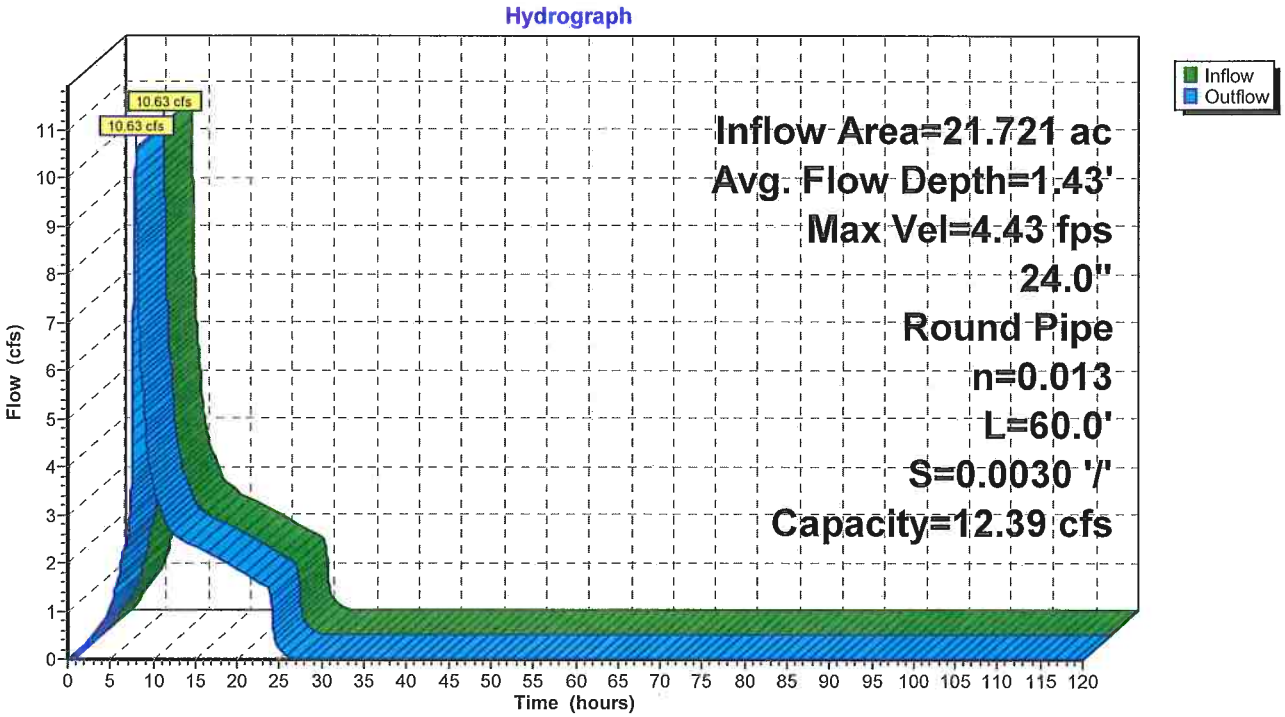
Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.43 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.38 fps, Avg. Travel Time= 0.4 min

Peak Storage= 144 cf @ 8.00 hrs
Average Depth at Peak Storage= 1.43'
Bank-Full Depth= 2.00' Flow Area= 3.1 sf, Capacity= 12.39 cfs

24.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 60.0' Slope= 0.0030 '/'
Inlet Invert= 134.85', Outlet Invert= 134.67'



Reach 20R: Public Outfall



TM Rippey
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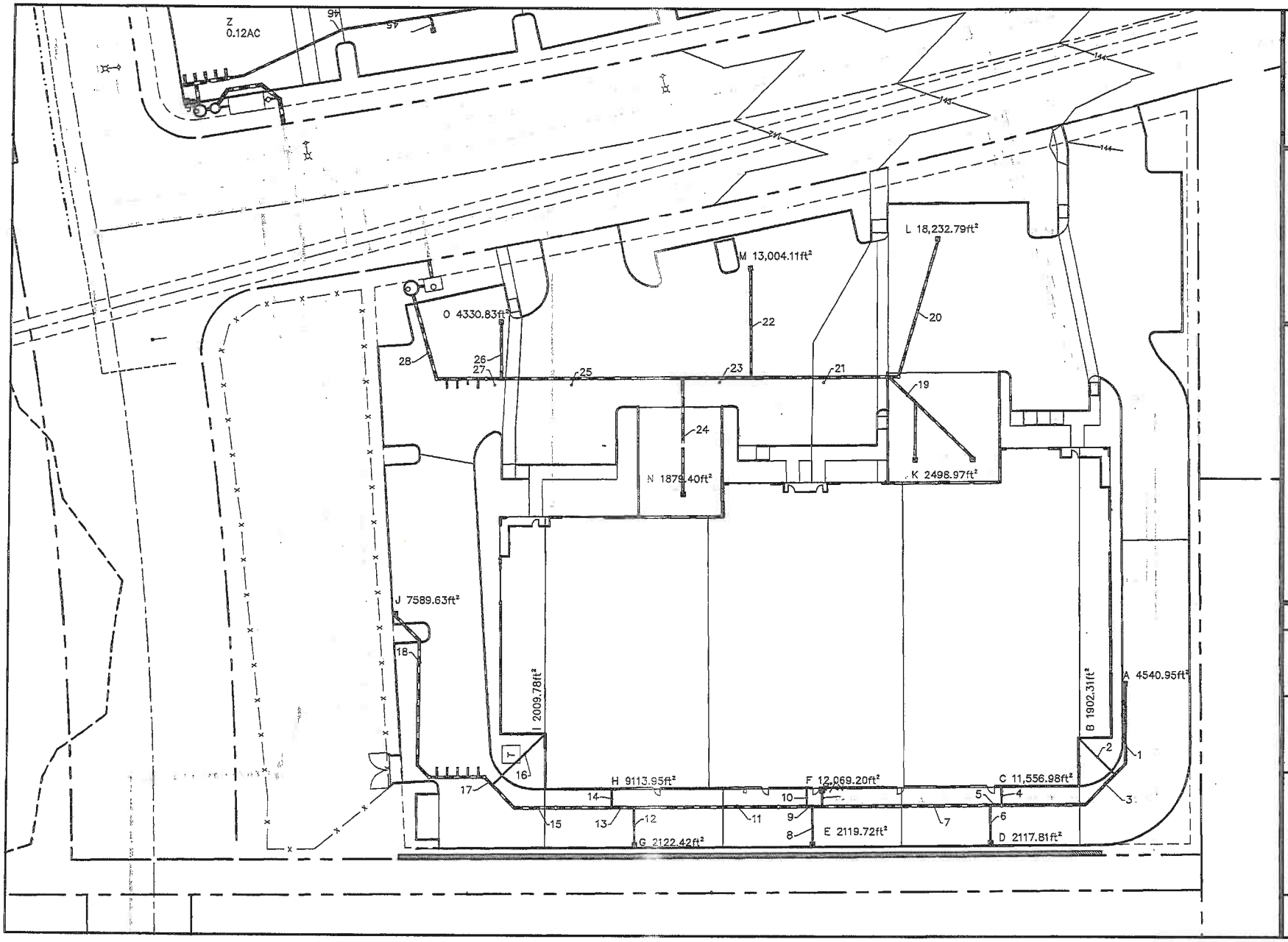
STORM SEWER DESIGN FORM:		Unit Conversion (acre/ft^2)	2.30E-05		
PROJECT NUMBER:	5381	Runoff Coefficient	0.9	DESIGNED BY:	JEC
PROJECT NAME:	TBP West	Rainfall Intensity (in/hr):	3	CHECKED BY:	KJK
DATE:	6/24/2009	Manning's Coefficient (n)=	0.013		

DESIGN AREA	DRAINAGE BASIN PIPE #	AREA ft^2	AREA acres	Equiv. Area for 100% Runoff (C)(A)	CUMULATIVE DRAINAGE AREA acres	UPPER INVERT	LOWER INVERT	PIPE LENGTH L	PIPE SIZE in	INVERT SLOPE ft/ft	DESIGN DISCHARGE cfs	FULL FLOW CAPACITY cfs	VELOC. @ Q/Qf V
A	1	4541	0.1042	0.094	0.0938	141.20	140.95	42	6	0.006	0.25	0.4	1.72
B	2	1902	0.0437	0.039	0.0393	142.00	140.95	23	6	0.046	0.11	1.2	11.50
	3		0.0000	0.000	0.1331	140.95	140.65	57	8	0.005	0.36	0.9	2.47
C	4	11567	0.2655	0.239	0.2390	142.00	140.65	7	6	0.199	0.65	2.5	3.91
	5	0	0.0000	0.000	0.3721	140.65	140.6	4	8	0.012	1.00	1.3	1.32
D	6	2118	0.0486	0.044	0.0438	141.20	140.6	16	6	0.037	0.12	1.1	9.28
	7	0	0.0000	0.000	0.4159	140.60	140.15	80	10	0.006	1.12	1.7	1.48
E	8	2120	0.0487	0.044	0.0438	141.20	140.15	16	6	0.066	0.12	1.5	12.26
	9				0.4597	140.15	140.1	3	10	0.020	1.24	3.1	2.52
F	10	12069	0.2771	0.249	0.2494	142.00	140.1	8	6	0.253	0.67	2.8	4.23
	11		0.0000	0.000	0.7090	140.10	139.70	78	12	0.005	1.91	2.6	1.35
G	12	2122	0.0487	0.044	0.0439	141.20	139.70	16	6	0.094	0.12	1.7	14.64
	13	0	0.0000	0.000	0.7529	139.70	139.65	10	12	0.005	2.03	2.5	1.25
H	14	9114	0.2092	0.188	0.1883	142.00	139.65	8	6	0.313	0.51	3.2	6.23
	15	0	0.0000	0.000	0.9412	139.65	139.35	58	15	0.005	2.54	4.7	1.85
I	16	2010	0.0461	0.042	0.0415	142.00	139.35	32	6	0.082	0.11	1.6	14.50
	17				0.9827	139.35	139.3	4	15	0.012	2.65	7.3	2.75
J	18	7590	0.1742	0.157	0.1568	139.70	139.3	81	6	0.005	0.42	0.4	0.94
K	19	2499	0.0574	0.052	0.0516	138.20	138.05	52	6	0.003	0.14	0.3	2.18
L	20	18233	0.4186	0.377	0.3767	139.05	138.05	70	8	0.014	1.02	1.5	1.43
	21		0.0000	0.000	0.4283	138.05	137.85	70	10	0.003	1.16	1.2	1.02
M	22	13004	0.2985	0.269	0.2687	138.55	137.85	52	8	0.014	0.73	1.4	1.96
	23	0	0.0000	0.000	0.6970	137.85	137.75	33	12	0.003	1.88	2.0	1.05
N	24	1879	0.0431	0.039	0.0388	138.20	137.75	56	6	0.008	0.10	0.5	4.84
	25	0	0.0000	0.000	0.7359	137.75	137.5	88	15	0.003	1.99	3.5	1.75
O	26	4331	0.0994	0.089	0.0895	138.35	137.55	28	6	0.029	0.24	1.0	3.97
	27				0.8253	137.55	137.5	7	15	0.007	2.23	5.5	2.47



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REGISTERED PROFESSIONAL ENGINEER 15504
OREGON JULY 25, 1991 KARL KOROCH
EXPIRES: 6/30/~~11~~ 15

TUALATIN BUSINESS PARK WEST KEY MAP

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DATE: Month Day, Year
FILE NAME: C2.0.dwg
DRAWN BY: DRN BY
CHK'D BY: CK'D BY
SHEET
#
OF #
PROJECT No.:
####

PROJECT: TBC BLDG 2 & 3 DESIGN FREQUENCY: 10YR / n=0.013 DESIGNED BY: KJK DATE: 5.12.09

AREA	Drainage Basin PIPE No.	Drainage Basin Area acres	Runoff Coeff.	Equiv. Area for 100% Runoff (3) x (4)	Total Drainage Area acres	Time of Concent. or Flow Time minutes	Total Time of Concent. minutes	Average Rainfall Intensity inch/hr.	Design Discharge, cfs	Invert Slope %	Pipe Size inches	Capacity Flowing Full cfs	Velocity Flowing Full fps	Length feet	FLOW TIME MIN.	REMARKS
		3	4													
A	1	0.12	0.9	0.112	0.112	5	5	3	0.33	0.5	6	0.40	1.81	125	1	
B	2	0.17	0.9	0.150	0.150	5	5	3	0.45	2	6	0.79	4.04	20	—	
	3				0.26		6	2.84	0.74	0.5	8	0.85	2.45	5	—	
C	4	0.41	0.9	0.372	0.37	5	5	3	1.12	1	8	1.21	3.46	25	0.12	
D	5	0.14	0.9	0.124	0.124	5	5	3	0.37	2	6	0.79	4.04	20	—	
	6				0.50			3	1.49	0.6	10	1.70	3.11	60	0.3	
	7				0.76		6	2.84	2.15	0.5	12	2.52	3.21	50	0.26	
E	8	0.11	0.9	0.102	0.102	5	5	3	0.31	4.6	6	1.19	6.1	45	—	
F	9	0.09	0.9	0.088	0.08	5	5	3	0.26	2	6	0.79	4.04	10	—	
	10				0.19			3	0.57	2	6	0.79	4.04	30	—	
	11				0.95		6	2.84	2.69	0.7	12	2.98	3.80	10	—	
G	12	0.02	0.9	0.03	0.03	5	5	3	0.09	—	—	—	—	—	—	PUMP DISCHARGE
	13				0.98		6	2.84	2.78	0.7	12	2.98	3.80	15	0.10	
H	14	0.30	0.9	0.269	0.27	5	5	3	0.81	2.5	6	0.87	4.43	10	—	
	15				1.25		6	2.84	3.55	0.7	15	5.40	4.40	45	0.17	
I	16	0.28	0.9	0.248	0.25	5	5	3	0.74	2	6	0.79	4.04	70	—	

PROJECT: TBC BLDG 2 & 3 DESIGN FREQUENCY: 10 YR / n=0.013 DESIGNED BY: KJK DATE: 5.12.09

2/4

AREA	Drainage Basin PIPE No.	Area acres	Runoff Coeff.	Equiv. Area for 100% Runoff (3) x (4)	Total Drainage Area acres	Time of Concent. or Flow Time minutes	Total Time of Concent. minutes	Average Rainfall Intensity inch/hr.	Design Discharge, cfs	Invert Slope %	Pipe Size inches	Capacity Flowing Full cfs	Velocity Flowing Full fps	Length feet	FLOW TIME MIN.	REMARKS
		3	4													
	17				1.50		7	2.68	4.02	0.7	15	5.40	4.40	25	0.10	
J	18	0.03	0.9	0.029	0.03	5	5	3	0.09	—	—	—	—	—	—	PUMP DISCHARGE
	19				1.53		7	2.68	4.10	0.7	15	5.40	4.40	20	0.08	
K	20	0.26	0.9	0.238	0.24	5	5	3	0.71	2	6	0.79	4.04	5	—	
	21				1.77		7	2.68	4.74	0.7	15	5.40	4.40	15	0.05	
L	22	0.03	0.9	0.029	0.03	5	5	3	0.09	—	—	—	—	—	—	PUMP DISCHARGE
M	23	0.12	0.9	0.11	0.11	5	5	3	0.32	3.6	6	1.05	5.35	50	—	
N	24	0.12	0.9	0.11	0.11	5	5	3	0.32	2	6	0.79	4.04	5	—	
	25				0.21			3	0.64	3	6	0.97	4.95	60	—	
	26				1.98		7	2.68	5.30	0.7	15	5.40	4.40	85	0.32	
O	27	0.41	0.9	0.38	0.38	5	5	3	1.13	5	6	1.22	6.10	10	—	
	28				2.36		7	2.68	6.32	0.7	18	8.79	4.97	20	0.08	
P	29	0.03	0.9	0.03	0.03	5	5	3	0.09	—	—	—	—	—	—	PUMP DISCHARGE
	30				2.39		7	2.68	6.41	0.7	18	8.79	4.97	25	0.08	CONN. TO MH AT DETENTION

PROJECT: TBC BLDG. 2 & 3 DESIGN FREQUENCY: 10 YR / n=0.013 DESIGNED BY: KJK DATE: 5.12.09

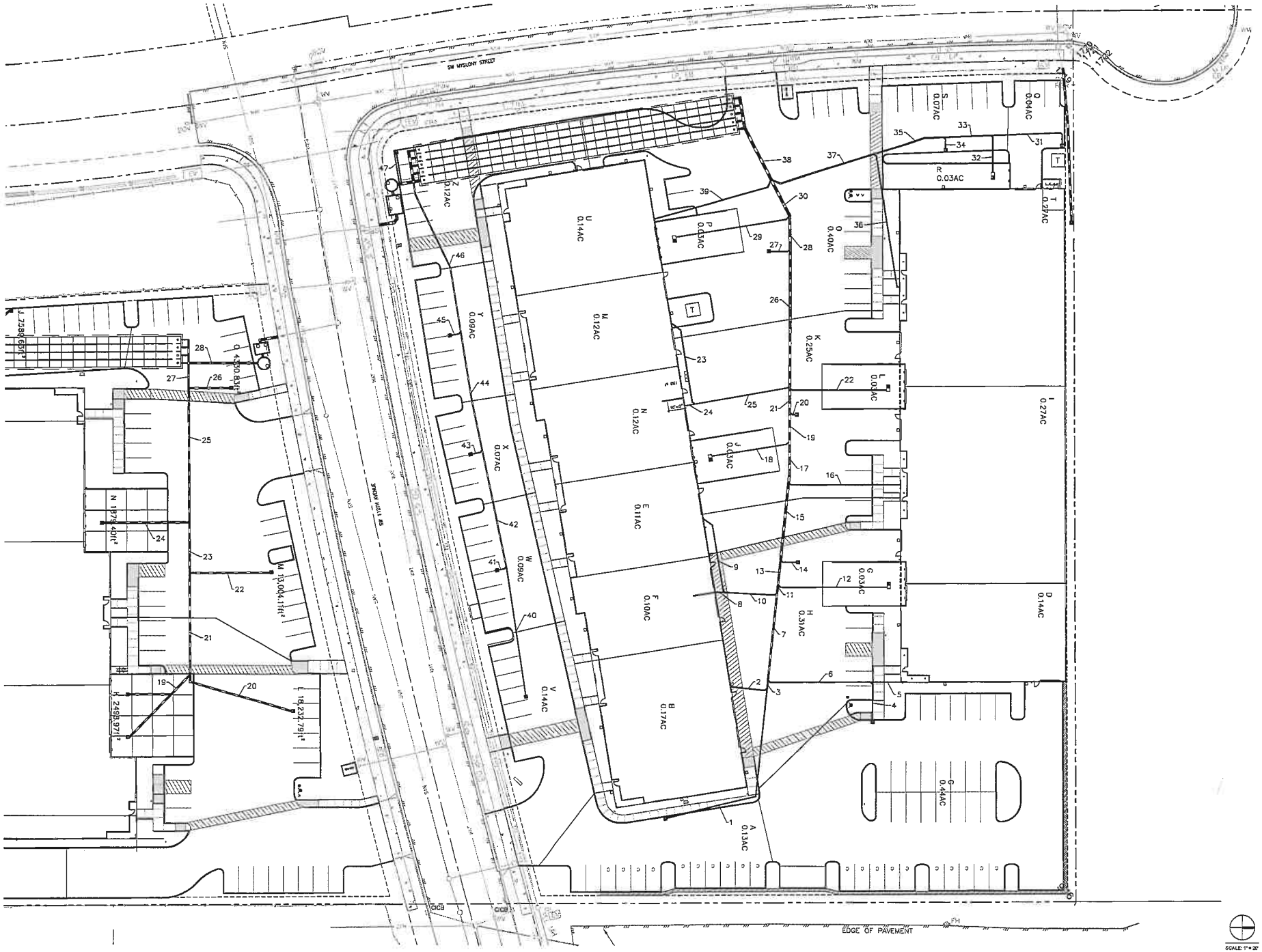
3/4

AREA	Drainage Basin PIPE No.	Area acres	Runoff Coeff.	Equiv. Area for 100% Runoff (3) x (4)	Total Drainage Area acres	Time of Concent. or Flow Time minutes	Total Time of Concent. minutes	Average Rainfall Intensity inch/hr.	Design Discharge, cfs	Invert Slope %	Pipe Size inches	Capacity Flowing Full cfs	Velocity Flowing Full fps	Length feet	FLOW TIME MIN.	REMARKS
		3	4													
Q	31	0.05	0.9	0.05	0.05	5	5	3	0.19	6	6	2	—	50	—	
R	32	0.03	0.9	0.02	0.02	5	5	3	0.07	0.5	6	0.4	2.02	25	0.21	
	33	[illegible]	[illegible]		0.07		5	3	0.21	0.5	6	0.45	2.02	45	0.37	
S	34	0.08	0.9	0.07	0.07	5	5	3	0.22	2	6	0.79	4.04	10	—	
	35				0.15			3	0.44	0.5	8	0.85	2.45	40	0.27	
T	36	0.28	0.9	0.25	0.25	5	5	3	0.75	4.8	6	1.25	—	85	—	
	37				0.40			3	1.18	0.5	8	1.24	3.46	55	0.30	CONN TO MH AT DETENTION
	38				2.79		7	2.68	7.47	~~0.7~~ 0.4	~~18~~ 24	~~8.79~~ 10.4	4.97	5	—	CONN TO DETENTION
U	39	0.15	0.9	0.13	0.13	5	5	3	0.39	2.8	6	0.79	4.04	20	—	CONN. TO DETENTION
V	40	0.18	0.9	0.15	0.15	5	5	3	0.45	0.9	6	0.53	2.71	80	0.49	
W	41	0.09	0.9	0.08	0.08	5	5	3	0.25	2	6	0.79	4.04	5	—	
	42				0.23			3	0.70	0.9	8	1.15	3.28	75	0.38	
X	43	0.07	0.9	0.07	0.07	5	5	3	0.20	2	6	0.79	4.04	10	—	
	44				0.30			3	0.90	0.9	8	1.15	3.28	75	0.38	
Y	45	0.09	0.9	0.08	0.08	5	5	3	0.25	2	6	0.79	4.04	10	—	

PROJECT: TBC BLDG 2 & 3 DESIGN FREQUENCY: 10YR / n=0.013 DESIGNED BY: KJK DATE: 5.12.09

4/4

AREA	Drainage Basin PIPE No.	Area acres	Runoff Coeff.	Equiv. Area for 100% Runoff (3) x (4)	Total Drainage Area acres	Time of Concent. or Flow Time minutes	Total Time of Concent. minutes	Average Rainfall Intensity inch/hr.	Design Discharge, cfs	Invert Slope %	Pipe Size inches	Capacity Flowing Full cfs	Velocity Flowing Full fps	Length feet	FLOW TIME MIN.	REMARKS
		3	4													
	46				0.38		6	2.84	1.09	0.9	8	1.15	3.28	95	–	CONNECT TO DETENTION
E	47	0.13	0.9	0.12	0.12	5	5	3	0.35	2	6	0.79	4.04	5	–	CONNECT TO DETENT.
					3.29		7	2.68	8.82	0.8	18	9.40	5.32	10		TO CONTROL MH /
										0.3	24	12.40				W.Q. & PUBLIC SYST.
							23	1.68								
		13.8	0.3	4.14	4.14		23	1.68	6.96	1	18	10.5				OFFSITE – UNDEVEL.
																13.82 AC
																1000 FT – 1.5% AVG



Architectural Review Submittal - January 2015

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REGISTERED PROFESSIONAL ENGINEER 16504 KARL W. KOROON
EXPIRES: 6/30/15

Owner:
Pacific NW Properties

6600 SW 105th, Ste 175
Beaverton, OR 97005

Project:
Tualatin Business Park

SW 112th Avenue
Tualatin, OR

Sheet Title:
BASIN MAP

Revisions:

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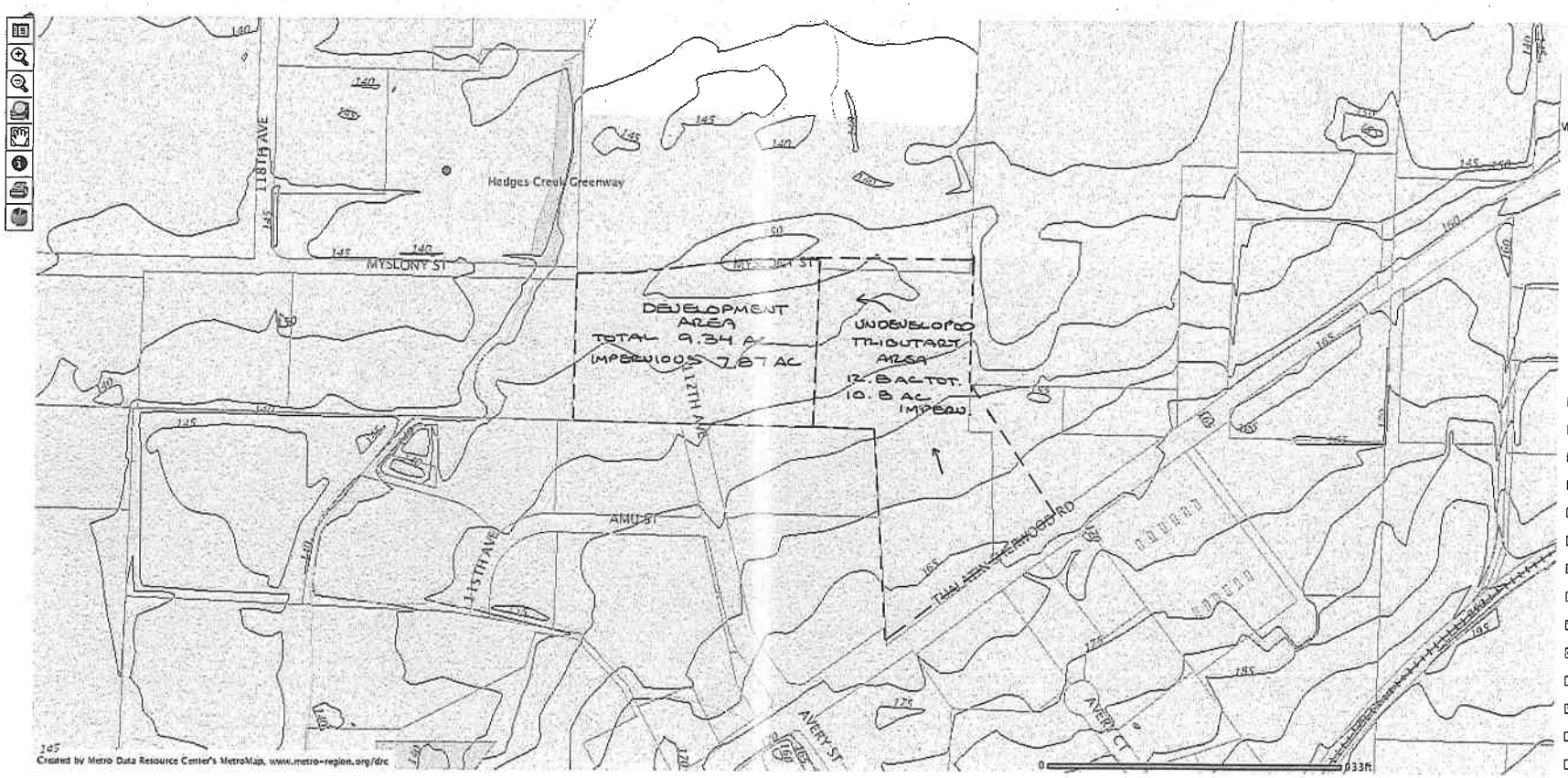
Date	7 January 2015
Drawn by: AS	Checked by: KJK
TMR Job Number	14305
Sheet	BASIN



NORTH

OVERALL DRAINAGE BASIN MAP

Map Layers

When adding layers, refresh map.

Refresh Map

Visible Active

- ☑ Places
- ☐ Bus stops
- ☐ Bus lines
- ☐ Bike routes
- ☑ Freeways
- ☑ Streets
- ☑ Taxlots
- ☑ Park and ride
- ☐ Transit centers
- ☑ Streams
- ☑ Contours
- ☑ Watersheds
- ☐ Metro boundary
- ☑ Urban Growth Boundary
- ☑ Stream shading
- ☐ 100 year flood plain
- ☐ Undeveloped land
- ☐ Portland environmental zones
- ☑ Parks
- ☐ Slope (25%)
- ☐ Wetlands
- ☐ 2007 aerial photo
- ☐ 2006 rural photo
- ☐ Land use plan
- ☐ Zoning

Refresh Map

Zoom in to see more layers

Available Layers

TUALATIN BUSINESS PARK
5381

RATIONAL METHOD RAINFALL INTENSITIES

Rainfall intensity is for East Washington County and is shown as inches per hour

TIME OF CONCENTRATION (MINUTES)	STORM EVENT: YEAR AND PROBABILITY					
	2 50%	5 20%	10 10%	25 4%	50 2%	100 1%
0	1.90	2.50	3.00	3.40	4.00	4.50
5	1.90	2.50	3.00	3.40	4.00	4.50
10	1.30	1.70	2.20	2.50	3.00	3.50
15	1.10	1.40	1.80	2.10	2.50	2.90
20	0.90	1.20	1.50	1.80	2.10	2.40
30	0.75	0.95	1.20	1.40	1.65	1.90
40	0.60	0.75	1.00	1.15	1.30	1.60
50	0.55	0.70	0.85	1.00	1.15	1.35
70	0.45	0.55	0.70	0.82	0.95	1.10
100	0.40	0.45	0.55	0.67	0.75	0.90
180 >	0.35	0.40	0.50	0.60	0.70	0.85

RATIONAL METHOD RAINFALL INTENSITIES

DRAWING NO. 1275

REVISED 05-07

Clean Water Services
Our commitment is clear.

24-HOUR RAINFALL DEPTHS

RECURRENCE INTERVAL (YEARS)	TOTAL PRECIPITATION DEPTH (INCHES)
2	2.50
5	3.10
10	3.45
25	3.90
50	4.20
100	4.50

24-HOUR RAINFALL DEPTHS

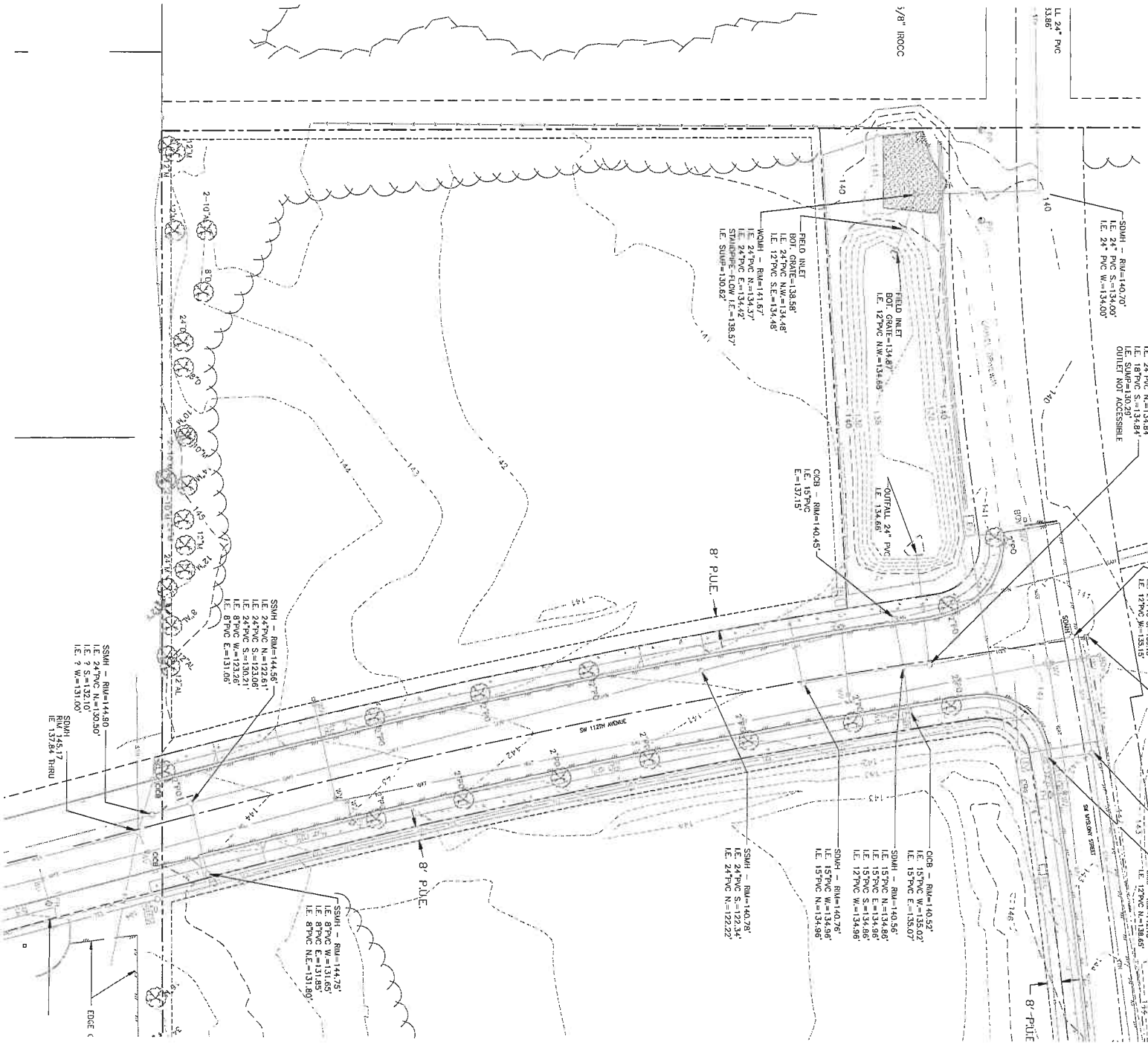
DRAWING NO. 1280

REVISED 12–06

Clean Water Services
Our commitment is clear.

Appendix 3

Construction Plans



WEDDLE SURVEYING INC.
Excellence is our business.
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PH: (503) 941-9595 FAX: (503) 941-0640
www.weddlesurveying.net

BENCHMARK

WASHINGTON COUNTY BENCH MARK NO. 89. ELEVATION = 279.48'. TRANSFERRED TO TBM IN PREVIOUS SURVEY. TBM IS SHOWN HEREON. ORIGINAL BENCH MARK HAS BEEN DESTROYED.

BASIS OF BEARINGS

THE BASIS OF BEARINGS FOR THIS SURVEY IS NORTH 00°27'50" WEST BETWEEN MONUMENTS FOUND ON THE WEST LINE OF THIS SURVEY PER SURVEY NUMBER 30,837.

SITE SURVEYED: JULY 8, 2011
REV. AUG 10, 2011: ADDED STORM WATER QUALITY MANHOLE INVERT ELEVATIONS
REV. DEC 30, 2014: VERIFIED SITE GRADES, ADDED CUL-DE-SAC

LEGEND

	EXISTING
PROJECT BOUNDARY	
PROPERTY LINE	
FENCE	
EDGE OF PAVEMENT	
1' CONTOUR	145
5' CONTOUR	150
STORM SEWER LINE	
WATER LINE	
SANITARY SEWER LINE	
GAS LINE	
OVERHEAD UTILITY WIRE	
EXISTING FEATURE OR CONDITION	(E)

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Project:
Tualatin Business Park

SW 112th Avenue
Tualatin, OR

Sheet Title:
Existing Conditions Plan Bldg. 1

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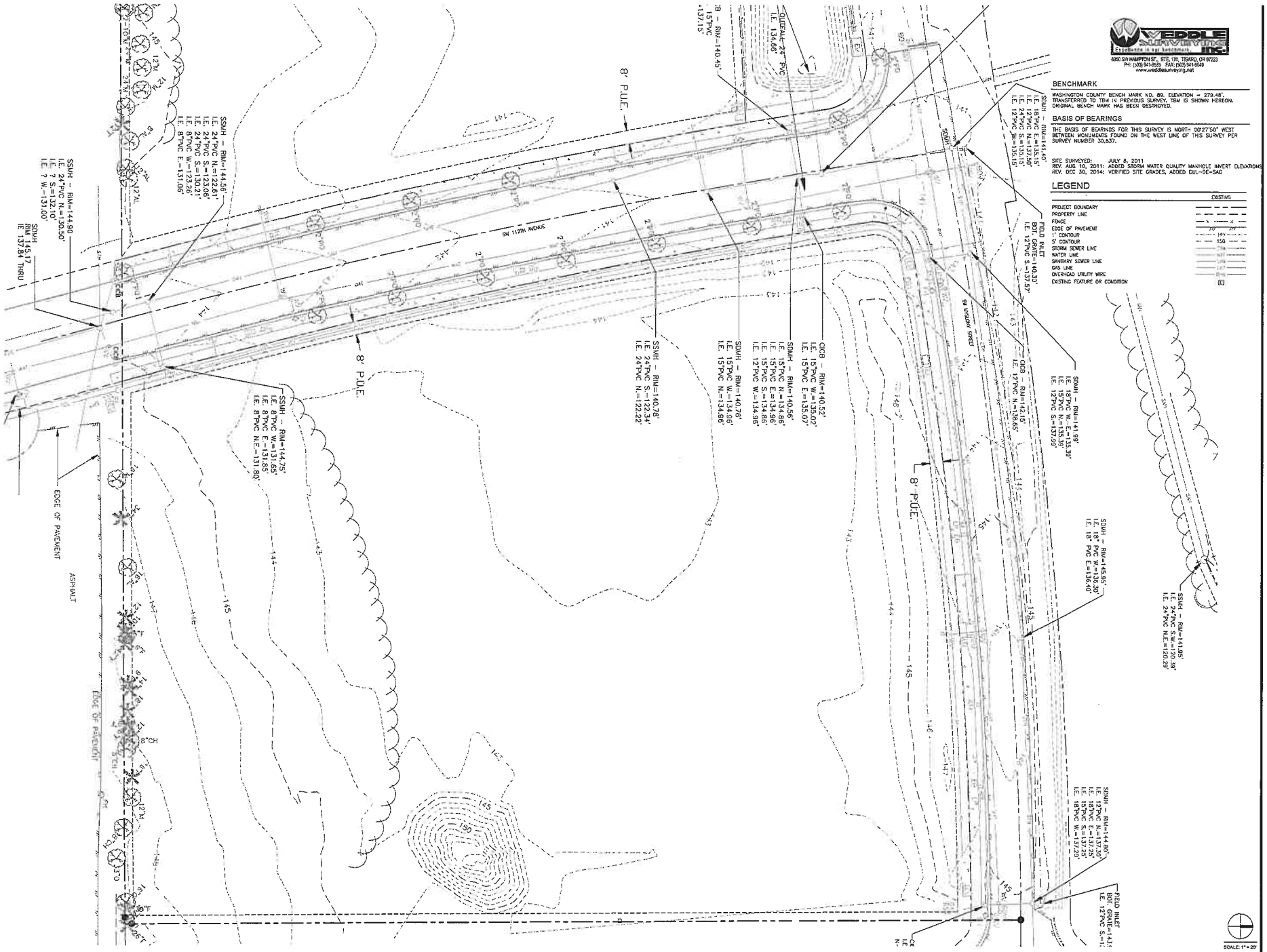

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REV. DEC 30, 2014: VERIFIED SITE GRADES, ADDED CUL-DE-SAC

LEGEND

	EXISTING
PROJECT BOUNDARY	
PROPERTY LINE	
FENCE	
EDGE OF PAVEMENT	
1' CONTOUR	141
5' CONTOUR	150
STORM SEWER LINE	
WATER LINE	
SANITARY SEWER LINE	
GAS LINE	
OVERHEAD UTILITY WIRE	
EXISTING FEATURE OR CONDITION	

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Tualatin, OR

Sheet Title:
Existing Conditions Plan Bldg. 2 & 3

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Sheet
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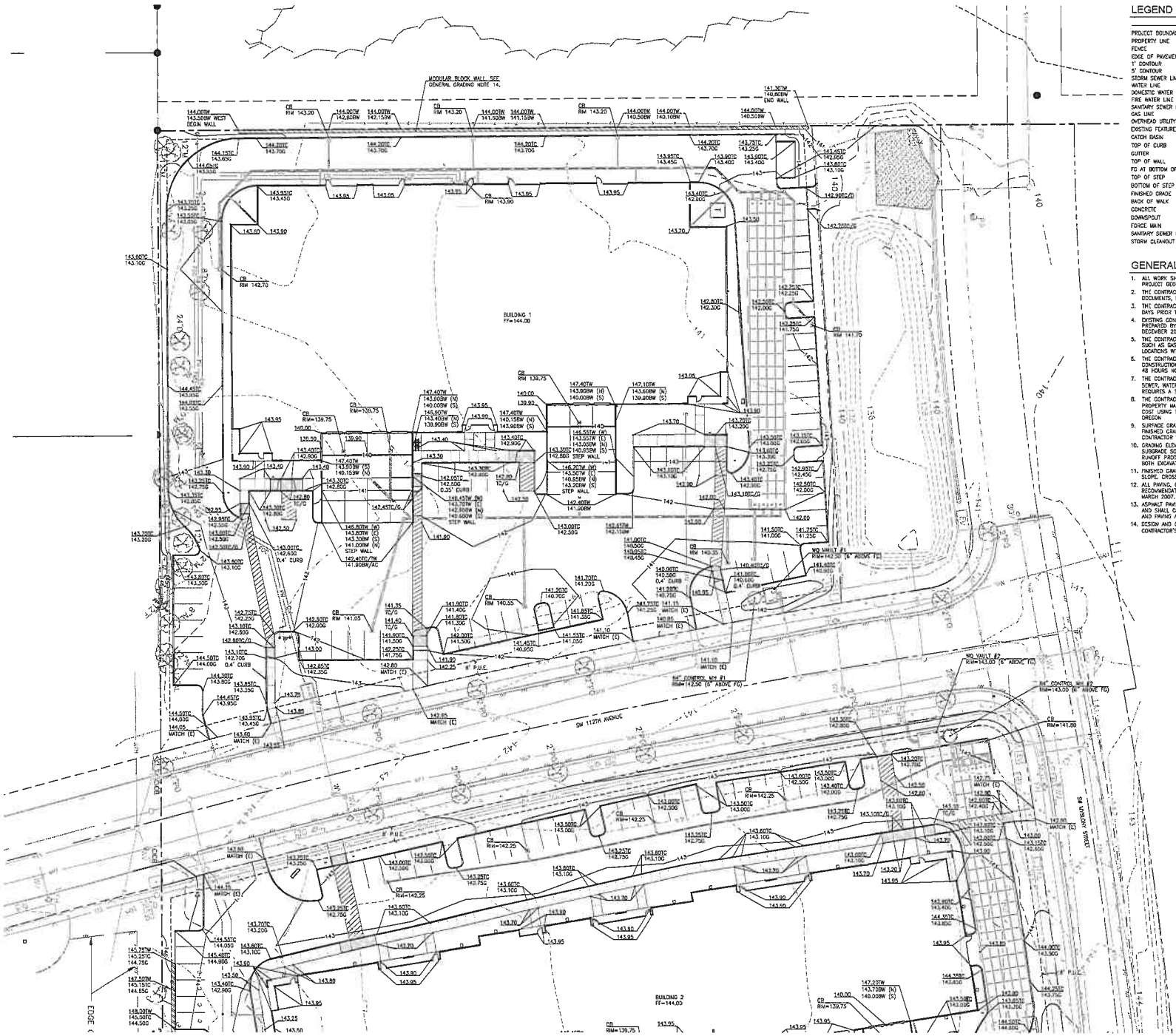

LEGEND

	PROPOSED	DISTING
PROJECT BOUNDARY		
PROPERTY LINE		
FENCE		
EDGE OF PAVEMENT		
1' CONTOUR	149	149
5' CONTOUR	150	150
STORM SEWER LINE		STM
WATER LINE	W	WAT
DOMESTIC WATER LINE	DW	
FIRE WATER LINE	FW	
SANITARY SEWER LINE	SAN	SAN
GAS LINE		GAS
OVERHEAD UTILITY WIRE		W
EXISTING FEATURE OR CONDITION		(T)
CATCH BASIN	CB	
TOP OF CURB	TC	
GUTTER	G	
TOP OF WALL	TW	
FG AT BOTTOM OF WALL	BW	
TOP OF STEP	TS	
BOTTOM OF STEP	BS	
FINISHED GRADE	FG	
BACK OF WALK	BWALK	
CONCRETE	CONC	
DOWNSPOUT	DS	
FORCE MAIN	FM	
SANITARY SEWER CLEANOUT	SS CO	
STORM CLEANOUT	STM CO	

GENERAL GRADING NOTES

1. ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF THE JURISDICTION AND THE PROJECT GEOTECHNICAL INVESTIGATION.
2. THE CONTRACTOR SHALL HAVE A FULL SET OF THE CURRENT APPROVED CONSTRUCTION DOCUMENTS, INCLUDING ADDENDA ON THE PROJECT SITE AT ALL TIMES.
3. THE CONTRACTOR SHALL NOTIFY THE OREGON UTILITY NOTIFICATION CENTER 3 BUSINESS DAYS PRIOR TO ANY EXCAVATION BY CALLING 800 332 2344.
4. EXISTING CONDITIONS BASED ON TOPOGRAPHIC, BOUNDARY, AND UTILITY SURVEY PREPARED BY WEDDLE SURVEYING, INC., DATED DECEMBER 2005 AND UPDATED DECEMBER 2014.
5. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF PRIVATE FRANCHISE UTILITIES SUCH AS GAS, TELEPHONE, POWER, DATA, CABLE TELEVISION, ETC. CONFIRM VAULT LOCATIONS WITH THE ARCHITECT.
6. THE CONTRACTOR SHALL KEEP THE ARCHITECT AND JURISDICTION INFORMED OF CONSTRUCTION PROGRESS TO FACILITATE SITE OBSERVATIONS AT REQUIRED INTERVALS. 48 HOURS NOTICE IS REQUIRED.
7. THE CONTRACTOR SHALL OBTAIN ALL REQUIRED PERMITS (PUBLIC WORKS, GRADING, SEWER, WATER, ETC) BEFORE COMMENCING WORK. WORK IN THE RIGHT OF WAY REQUIRES A SEPARATE PERMIT FROM CITY OF TUALATIN.
8. THE CONTRACTOR SHALL BE RESPONSIBLE TO PROTECT LAND CORNERS. DISTURBED PROPERTY MARKERS, BENCHMARKS, ETC. SHALL BE REPLACED AT THE CONTRACTOR'S COST USING THE SERVICES OF A REGISTERED SURVEYOR LICENSED IN THE STATE OF OREGON
9. SURFACE GRADES ARE TO BE ROUGHT TO WITHIN 0.08 FEET IN 10 FEET OF THE FINISHED GRADE AT SUBGRADE AND WITHIN 0.03 FEET IN 10 FEET AT FINISH GRADE. CONTRACTOR TO ALLOW FOR PLACEMENT OF REQUIRED TOPSOIL IN ROUGH GRADING.
10. GRADING ELEVATIONS SHOWN ON GRADING PLAN ARE FINISHED GRADE, WHICH INCLUDES SUBGRADE SOIL, PAVING, BASE ROCK, TOPSOIL, SOIL AMENDMENTS, ROCKERY, AND RUNOFF PROTECTION. CONTRACTOR IS RESPONSIBLE TO COORDINATE GRADING WITH BOTH EXCAVATOR AND LANDSCAPE CONTRACTOR.
11. FINISHED GRADES WITHIN ADA PARKING AND LOADING AREAS SHALL NOT EXCEED 2% SLOPE. CROSS SLOPES AT WALKS AND CROSSWALKS SHALL NOT EXCEED 2%.
12. ALL PAVING, GRADING, EXCAVATION, AND FILL PLACEMENT TO CONFORM TO RECOMMENDATIONS IN PROJECT GEOTECHNICAL ANALYSIS BY GEODESIGN, INC., DATED MARCH 2007.
13. ASPHALT PAVING AND BASE ROCK TO BE AS DESCRIBED ON PROJECT PAVING PLAN AND SHALL CONFORM TO THE REQUIREMENTS PROVIDED IN THE GEOTECHNICAL ANALYSIS AND PAVING AND EARTHWORK SPECIFICATION SECTIONS.
14. DESIGN AND CONSTRUCTION OF MODULAR BLOCK RETAINING WALLS TO BE BY GENERAL CONTRACTOR'S DESIGN-BUILD SUBCONTRACTOR.

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REGISTERED PROFESSIONAL ENGINEER 16684 OREGON JULY 29, 1986 KARL KORSCH
EXPIRES: 6/30/15

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Project:
Tualatin Business Park

SW 112th Avenue
Tualatin, OR

Sheet Title:
Grading Plan
Bldg. 1

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TMR Job Number: 14305
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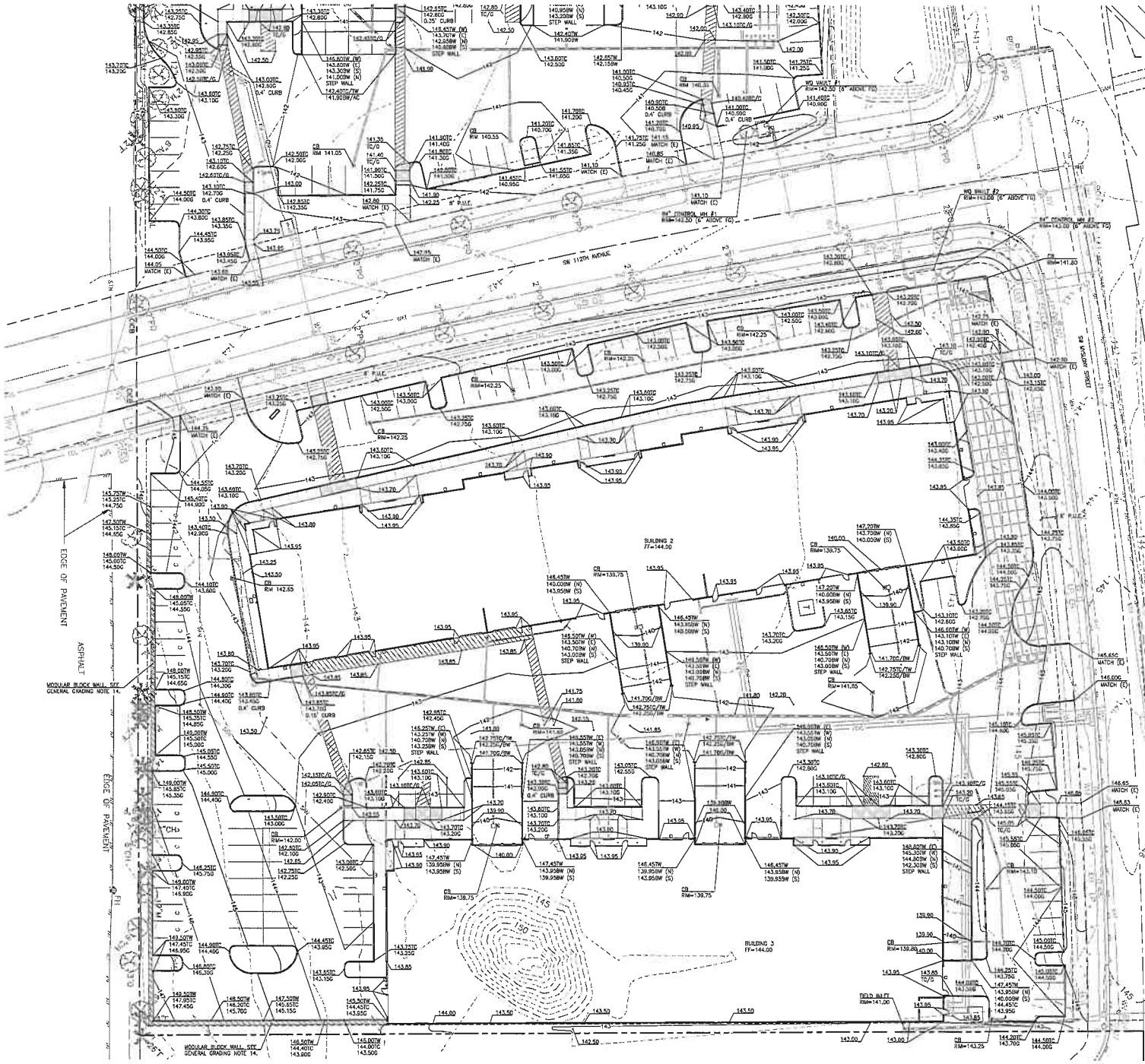

LEGEND

	PROPOSED	EXISTING
PROJECT BOUNDARY		
PROPERTY LINE		
FENCE		
EDGE OF PAVEMENT		
1' CONTOUR	149	148
5' CONTOUR	150	150
STORM SEWER LINE	STM	STM
WATER LINE	W	W
DOMESTIC WATER LINE	DW	
FIRE WATER LINE	FW	
SANITARY SEWER LINE	SAN	SAN
GAS LINE		GAS
OVERHEAD UTILITY WIRE		OHW
EXISTING FEATURE OR CONDITION		(E)
CATCH BASIN	CB	
TOP OF CURB	TC	
GUTTER	G	
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FG AT BOTTOM OF WALL	BW	
TOP OF STEP	TS	
BOTTOM OF STEP	BS	
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DOWNSPOUT	DS	
FORCE MAIN	FM	
SANITARY SEWER CLEANOUT	SS CO	
STORM CLEANOUT	STM CO	

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REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 25, 1989
KARL KOROCH
EXPIRES: 6/30/15

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6600 SW 105th, Ste 175
Beaverton, OR 97005

Project:
Tualatin Business Park

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Sheet Title:
Grading Plan
Bldg. 2 & 3

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Date: 7 January 2015

Drawn by: A.S
Checked by: K.K

TMR Job Number: 14305

Sheet: C2.1

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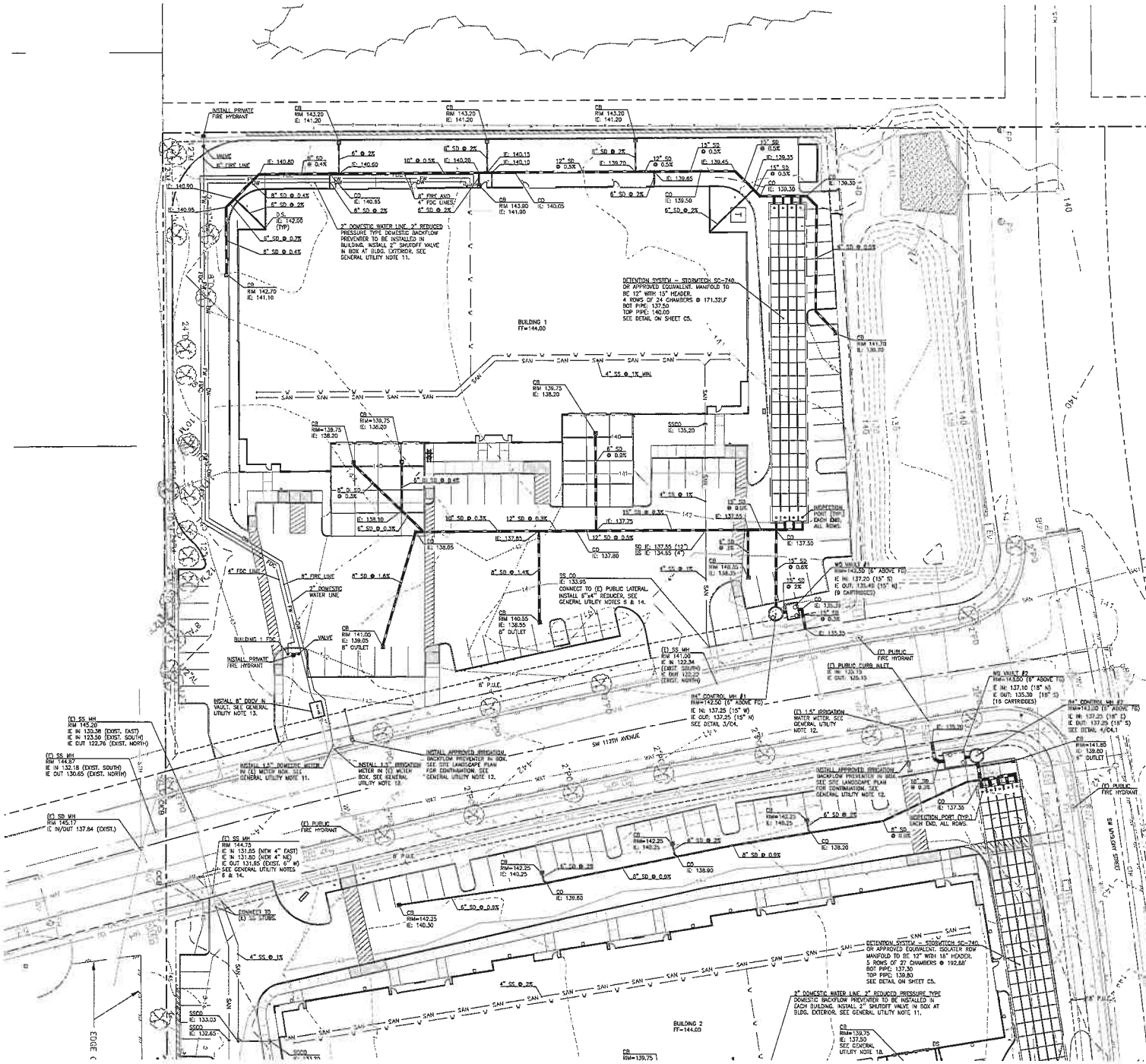

LEGEND

	PROPOSED	EXISTING
PROJECT BOUNDARY		
PROPERTY LINE		
FENCE		
EDGE OF PAVEMENT		
1' CONTOUR	100	100
5' CONTOUR	150	150
STORM SEWER LINE		
WATER LINE	W	
DOMESTIC WATER LINE	DW	
FIRE WATER LINE	FW	
SANITARY SEWER LINE	SAN	SAN
GAS LINE		GAS
OVERHEAD UTILITY WIRE		OHW
EXISTING FEATURE OR CONDITION		(E)
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GUTTER	G	
TOP OF WALL	TW	
FG AT BOTTOM OF WALL	BW	
TOP OF STEP	TS	
BOTTOM OF STEP	BS	
FINISHED GRADE	FG	
BACK OF WALK	BWALK	
CONCRETE	CONC	
DOWNSPOUT	DS	
FORCE MAIN	FM	
SANITARY SEWER CLEANOUT	SS CO	
STORM CLEANOUT	STM CO	
PERFORATED PERIMETER DRAIN CLEANOUT	PERF CO	

GENERAL UTILITY NOTES

1. ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF THE CURRENT EDITION OF THE PLUMBING CODE, BUILDING CODE, AND THE FIRE CODE. THE CONTRACTOR SHALL HAVE A FULL SET OF THE CURRENT APPROVED CONSTRUCTION DOCUMENTS INCLUDING ADDENDA ON THE PROJECT SITE AT ALL TIMES.
2. THE CONTRACTOR SHALL NOTIFY THE OREGON UTILITY NOTIFICATION CENTER, THREE BUSINESS DAYS PRIOR TO ANY EXCAVATION BY CALLING 800 332 2344.
3. EXISTING CONDITIONS BASED ON TOPOGRAPHIC, BOUNDARY, AND UTILITY SURVEY PREPARED BY WEDDLE LAND SURVEYING, INC., DATED DECEMBER 2006 AND UPDATED DECEMBER 2014.
4. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATION AND ADJUSTMENT OF PRIVATE UTILITIES SUCH AS GAS, TELEPHONE, POWER, CABLE TELEVISION, ETC.
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7. THIS PLAN IS GENERALLY DIAGRAMMATIC. IT DOES NOT SHOW EVERY JOINT, BEND, FITTING, OR ACCESSORY REQUIRED FOR CONSTRUCTION.
8. UTILITIES WITHIN FIVE FEET OF A BUILDING SHALL BE CONSTRUCTED OF MATERIALS APPROVED FOR INTERIOR USE AS DESCRIBED IN THE CURRENT EDITION OF THE PLUMBING CODE.
9. INSTALL CLEANOUTS AT 100' MAX AND AT EACH 135 DEGREES OF AGGREGATE BEND. INSTALL CLEANOUTS AT EACH BUILDING RAIN DRAIN.
10. CHANGES IN DIRECTION OF STORM AND SANITARY PIPING SHALL BE MADE BY THE APPROPRIATE USE OF APPROVED FITTINGS AND SHALL BE OF THE ANGLES PRESENTED BY ONE-SIXTEENTH BEND, ONE-EIGHTH BEND, ONE-SIXTH BEND OR OTHER APPROVED FITTINGS OF EQUIVALENT SWEEP.
11. CITY OF TUALATIN TO INSTALL NEW 1.5-INCH DOMESTIC METER IN EXISTING METER BOX. CONTRACTOR TO COORDINATE WITH CITY WATER DEPARTMENT TO OBTAIN METER AND FOR INSTALLATION. CONTRACTOR TO EXTEND 2-INCH DOMESTIC SERVICE PIPE TO BUILDING AND INSTALL 2-INCH BALL VALVE SHUT OFF IN APPROVED BOX THREE FEET FROM BUILDING EXTERIOR. APPROVED 2-INCH REDUCED PRESSURE TYPE BACKFLOW PREVENTER TO BE INSTALLED WITHIN BUILDING. SEE BUILDING PLUMBING DRAWINGS FOR SPECIFIC INFORMATION ON BACKFLOW PREVENTER AND CONTINUATION OF PIPING WITHIN BUILDING. DOMESTIC SERVICE LINE SIZE, METER SIZE, AND BACKFLOW PREVENTER SIZE IS ASSUMED. BUILDING PLUMBING DESIGNER TO CONFIRM METER SIZE, SERVICE LINE SIZE, AND BACKFLOW PREVENTER TYPE AND SIZING PRIOR TO CONSTRUCTION OR ORDERING MATERIAL. SEE GENERAL UTILITY NOTES 6, 12, AND 13.
12. CITY OF TUALATIN TO INSTALL NEW 1.5-INCH IRRIGATION METER IN EXISTING METER BOX. CONTRACTOR TO COORDINATE WITH CITY WATER DEPARTMENT TO OBTAIN METER AND FOR INSTALLATION. APPROVED IRRIGATION BACKFLOW PREVENTER TO BE INSTALLED ADJACENT TO RIGHT OF WAY OR AS DIRECTED BY CITY INSPECTOR. SEE IRRIGATION PLAN FOR SPECIFIC INFORMATION ON BACKFLOW PREVENTER AND CONTINUATION OF IRRIGATION PIPING. IRRIGATION SERVICE LINE SIZE, METER SIZE, AND BACKFLOW PREVENTER SIZE IS ASSUMED. IRRIGATION SYSTEM DESIGNER TO CONFIRM METER SIZE, SERVICE LINE SIZE, AND BACKFLOW PREVENTER TYPE AND SIZING PRIOR TO CONSTRUCTION OR ORDERING MATERIAL. SEE GENERAL UTILITY NOTES 6, 11, AND 13.
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14. LOCATION OF EXISTING SITE SEWER LATERAL FOR BUILDING 1 BASED ON PUBLIC STREET RECORD DRAWINGS. LOCATION AND DEPTH ARE TO BE CONFIRMED BY POTHOLING PRIOR TO CONSTRUCTION. SEE GENERAL UTILITY NOTE 6. CONNECTION TO EXISTING LATERAL REQUIRES SEPARATE PUBLIC WORKS PERMIT.
15. SITE RUNOFF FOR STORM PIPE SIZING HAS BEEN QUANTIFIED USING RATIONAL METHOD ANALYSIS BASED ON A 10-YEAR RECURRENCE AND PEAK RAINFALL INTENSITY OF THREE INCHES PER HOUR PER CLEAN WATER SERVICES RESOLUTION AND ORDER 07-20, DRAWING 1275. PIPE SIZING IS BASED ON MANNING'S EQUATION WITH A ROUGHNESS COEFFICIENT, N OF 0.013.
16. STORM FITTINGS TO BE ECCENTRIC.
17. INLETS AND OUTLETS OF ON-SITE MANHOLES AND TREATMENT DEVICES SHALL HAVE FLEXIBLE FITTINGS NO CLOSER THAN 12 INCHES AND NO FARTHER THAN 36 INCHES FROM STRUCTURE.
18. WORK SHOWN WITHIN PUBLIC RIGHTS OF WAY TO CONFORM TO THE REQUIREMENTS OF THE CITY OF TUALATIN PUBLIC WORKS AND WATER DEPARTMENTS. SEPARATE PERMITS ARE REQUIRED FOR WORK WITHIN THE RIGHTS OF WAY. OTHER THAN WORK ON THE WATER SYSTEM NO OTHER WORK WITHIN THE RIGHTS OF WAY IS INCLUDED AS PART OF THESE PLANS.
19. THE CONTRACTOR SHALL CLEAN ALL CATCH BASINS AND STORM LINES IMPACTED BY SITE DEVELOPMENT FOLLOWING COMPLETION OF CONSTRUCTION OR AS DIRECTED BY THE CITY OF TUALATIN. NO SEDIMENT SHALL BE ALLOWED TO ENTER THE STORM SYSTEM.

SCALE: 1" = 20'

Architectural Review Submittal - January 2015

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Project:
Tualatin Business Park

SW 112th Avenue
Tualatin, OR

Sheet Title
Utility Plan
Bldg. 1

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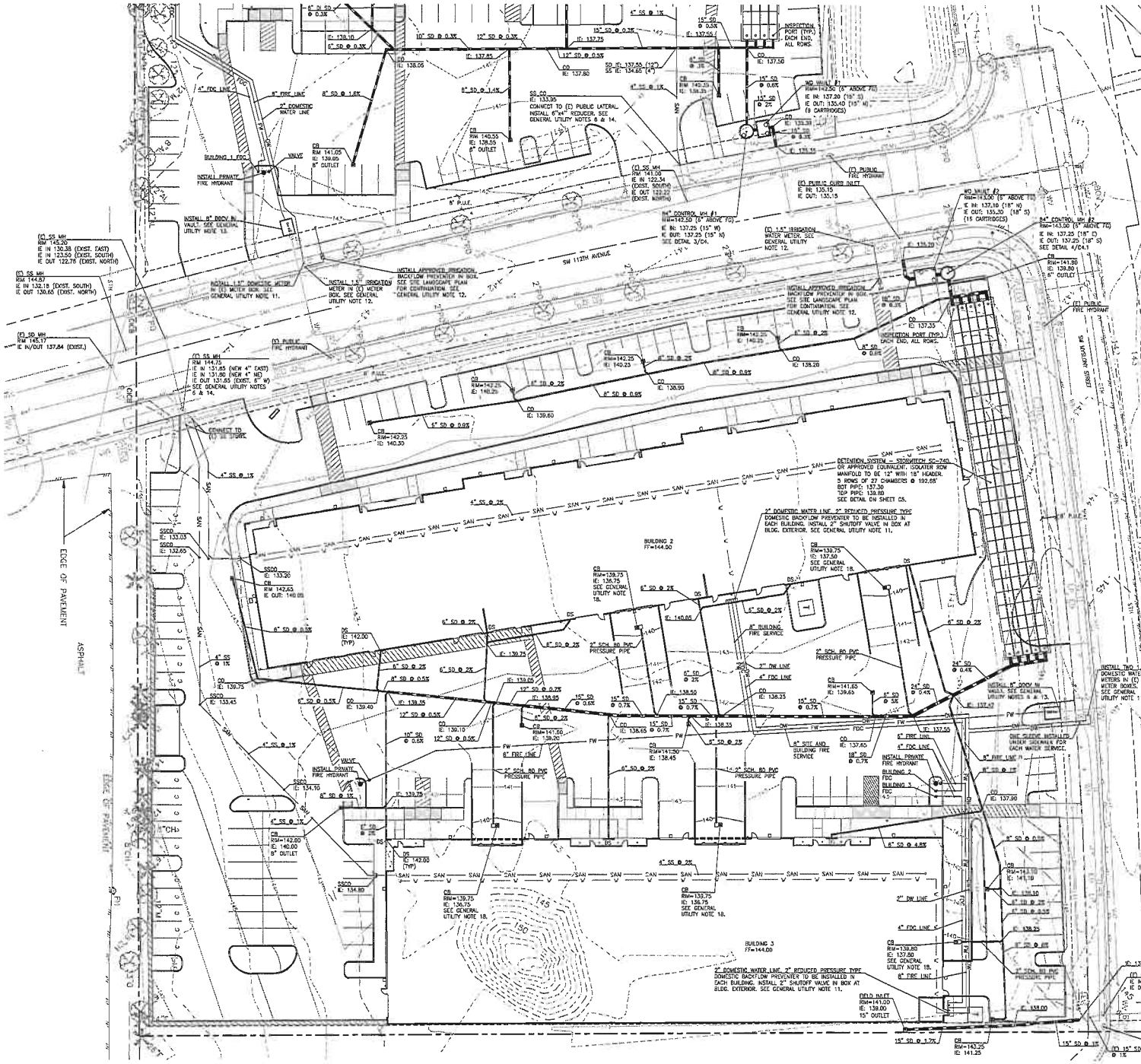
Date: 7 January 2015	
Drawn by: AS	Checked by: KJK
TMR Job Number: 14305	
Sheet C3	



LEGEND

	PROPOSED	EXISTING
PROJECT BOUNDARY		
PROPERTY LINE		
FENCE		
EDGE OF PAVEMENT		
1' CONTOUR	145	145
5' CONTOUR	150	150
STORM SEWER LINE		STM
WATER LINE		WAT
DOMESTIC WATER LINE	DW	
FIRE WATER LINE	FW	
SANITARY SEWER LINE	SAN	SN
GAS LINE		GAS
OVERHEAD UTILITY WIRE		OHW
EXISTING FEATURE OR CONDITION		(E)
CATCH BASIN	CB	
TOP OF CURB	TC	
GUTTER	G	
TOP OF WALL	TW	
FG AT BOTTOM OF WALL	BW	
TOP OF STEP	TS	
BOTTOM OF STEP	BS	
FINISHED GRADE	FG	
BACK OF WALK	BWALK	
CONCRETE	CONC	
DOWNSPOUT	DS	
FORCE MAIN	FM	
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14. CONNECTION TO EXISTING PUBLIC SANITARY MANHOLE TO SERVE BUILDINGS 2 AND 3 TO BE MADE BY CORING MANHOLE IN CONFORMANCE WITH CITY OF TUALATIN PUBLIC WORKS STANDARDS. CONSTRUCT SMOOTH WATERWAY WITHIN MANHOLE. IF DIRECTED BY CITY INSPECTOR, RELOCATE MANHOLE STEPS TO CLEAR NEW PENETRATIONS AND ROTATE MANHOLE CONE AND LID AS REQUIRED TO ALIGN WITH NEW STEP LOCATION. CIRCUIT MANHOLE JOINTS AND TEST MANHOLE AS REQUIRED BY INSPECTOR. CONNECTION TO EXISTING MANHOLE REQUIRES SEPARATE PUBLIC WORKS PERMIT.
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18. LOADING DOCK CATCH BASINS TO BE TWO COMPARTMENT TYPE WITH BOLT DOWN LID AND WELDED OUTLET FOR DISCHARGE. PROVIDE PUMP SYSTEM IN EACH DOCK CATCH BASIN. EACH PUMP TO HAVE 100 GPM AND 15FT. TDH DISCHARGE CAPACITY. CONTRACTOR TO PROVIDE COMPLETE PUMP SYSTEM, INCLUDING PUMPS, CATCH BASIN/SUMP/PUMP CHAMBER, CONTROLS, FLOATS, CONDUIT, CONDUCTORS, AND DEDICATED ELECTRICAL CIRCUIT. PROVIDE VENT TO ABOVE ADJACENT BUILDING WALL. PRESSURE LINES AND FITTINGS FROM PUMP TO MAIN STORM LINE TO BE SCHEDULE 80 PVC. THE SYSTEM SHALL BE DESIGNED TO MEET CITY OF TUALATIN STANDARDS.
19. WORK SHOWN WITHIN PUBLIC RIGHTS OF WAY TO CONFORM TO THE REQUIREMENTS OF THE CITY OF TUALATIN PUBLIC WORKS AND WATER DEPARTMENTS. SEPARATE PERMITS ARE REQUIRED FOR WORK WITHIN THE RIGHTS OF WAY. OTHER THAN WORK ON THE WATER SYSTEM AND CONNECTION TO EXISTING SANITARY MANHOLE, NO OTHER WORK WITHIN THE RIGHTS OF WAY IS INCLUDED AS PART OF THESE PLANS.
20. THE CONTRACTOR SHALL CLEAN ALL CATCH BASINS AND STORM LINES IMPACTED BY SITE DEVELOPMENT FOLLOWING COMPLETION OF CONSTRUCTION OR AS DIRECTED BY THE CITY OF TUALATIN. NO SEDIMENT SHALL BE ALLOWED TO ENTER THE STORM SYSTEM.

SCALE: 1" = 20'

Architectural Review Submittal - January 2015

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REGISTERED PROFESSIONAL ENGINEER
KARL KOBOCH
EXPIRES: 6/30/15

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Project:
Tualatin Business Park

SW 112th Avenue
Tualatin, OR

Sheet Title:
Utility Plan
Bldg. 2 & 3

Revisions:

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Date: 7 January 2015
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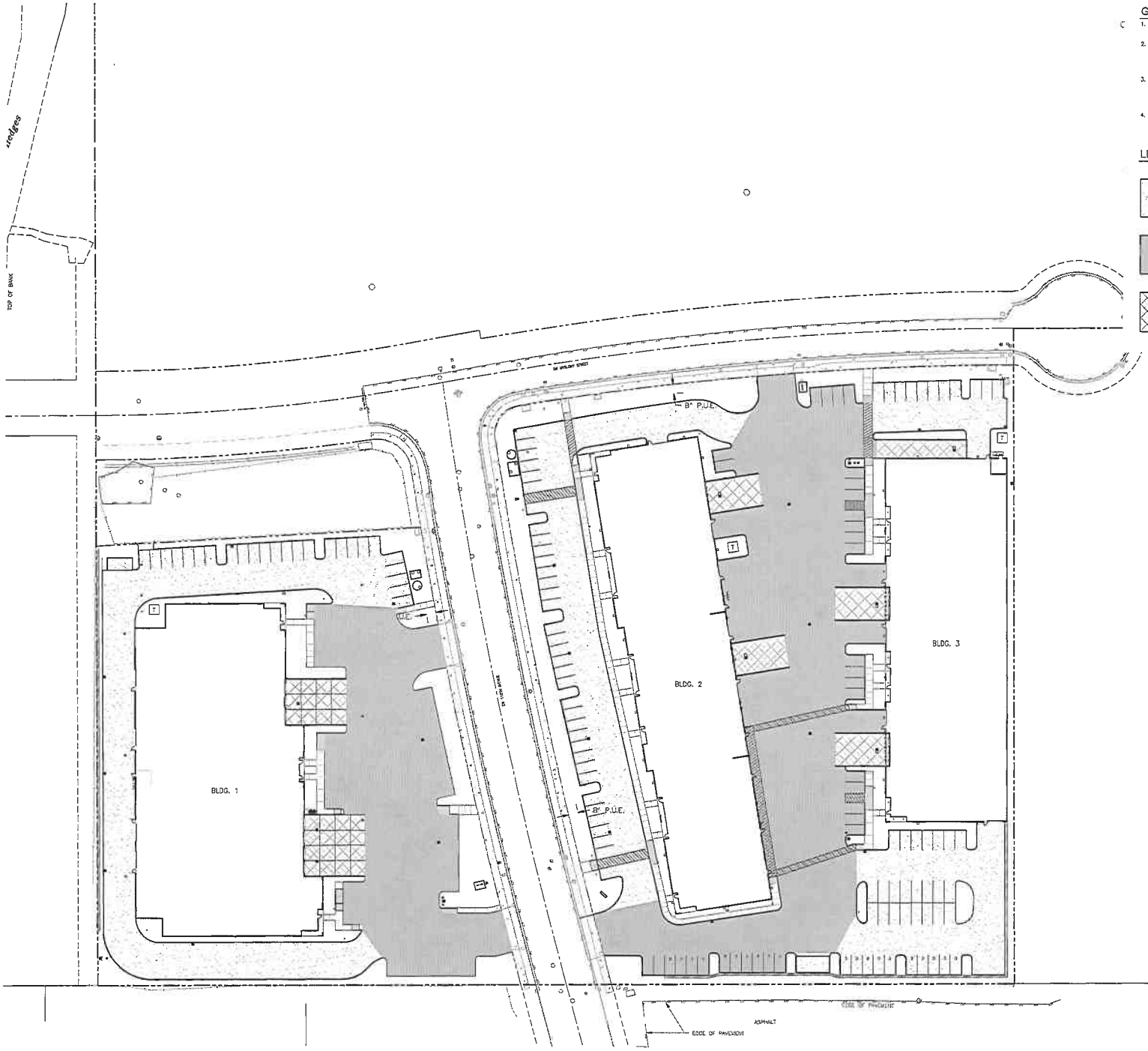
Checked by: KJK
TMR Job Number: 14305
Sheet
C3.1



GENERAL PAVING NOTES

1. PAVING AND BASE ROCK PLACEMENT SHALL CONFORM TO THE CITY OF TUALATIN REQUIREMENTS AND TO THE REQUIREMENTS OF THE PROJECT GEOTECHNICAL INVESTIGATION.
2. PAVING:
   - CAR PARKING PAVING TO BE 2.5 INCHES OF ASPHALT CONCRETE ON 12 INCHES OF COMPACTED AGGREGATE ON COMPACTED SUBGRADE.
   - LIGHT TRUCK ROUTE PAVING TO BE 3 INCHES OF ASPHALT CONCRETE ON 13 INCHES OF COMPACTED AGGREGATE ON COMPACTED SUBGRADE.
3. ADDITIVE ALTERNATE PAVING:
   - CAR PARKING PAVING TO BE 2.5 INCHES OF ASPHALT CONCRETE ON 4 INCHES OF COMPACTED AGGREGATE ON 12 INCHES OF CEMENT AMENDED SUBGRADE.
   - LIGHT TRUCK ROUTE PAVING TO BE 3 INCHES OF ASPHALT CONCRETE ON 4 INCHES OF COMPACTED AGGREGATE ON 12 INCHES OF CEMENT AMENDED SUBGRADE.
4. NO PAVING TO OCCUR PRIOR TO THE INSTALLATION AND APPROVAL BY THE CITY OF THE STORM TREATMENT AND DETENTION SYSTEMS.

LEGEND

CAR PARKING AREA

LIGHT TRUCKING ROUTES

CONCRETE TRUCK DOCK: SEE ARCHITECTURAL PLANS FOR TRUCK DOCK SECTION.

SCALE: 1" = 30'

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Project:
Tualatin Business Park

SW 112th Avenue
Tualatin, OR

Sheet Title:
Paving Plan

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Date:	7 January 2015
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TMR Job Number:	14305
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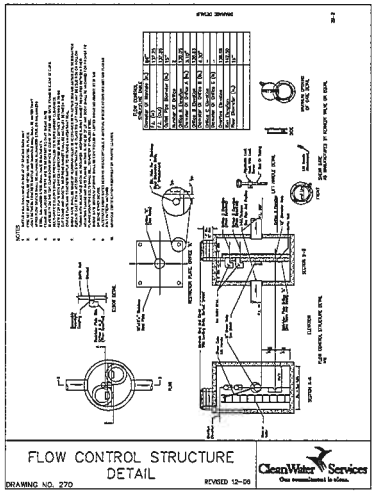
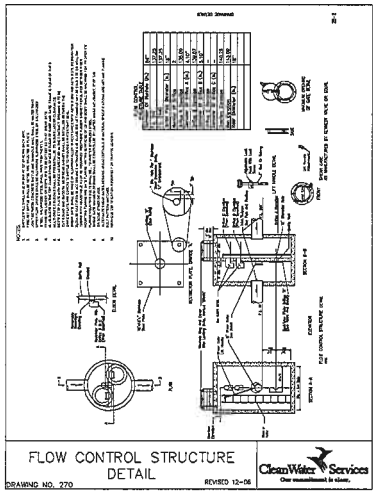
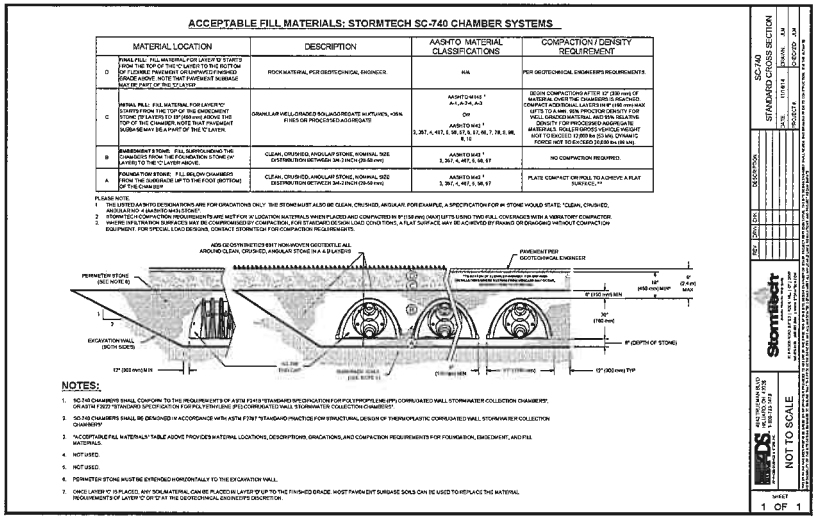


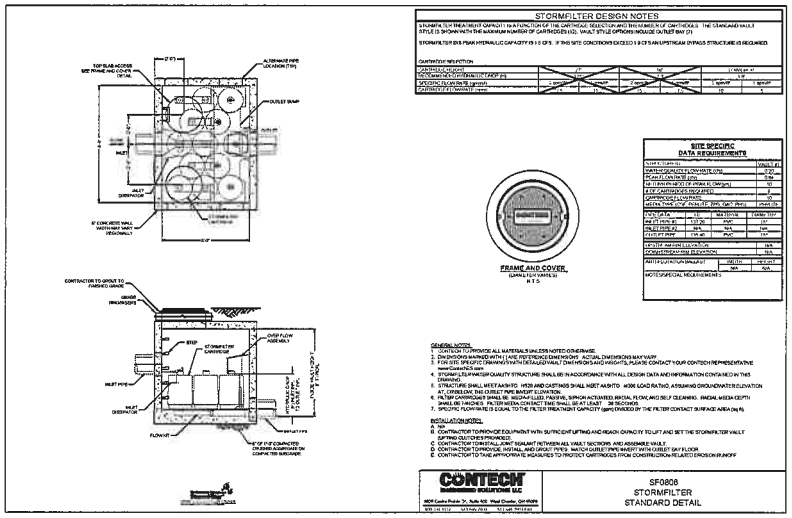
1 CONTROL MANHOLE #1 DETAIL
NOT TO SCALE



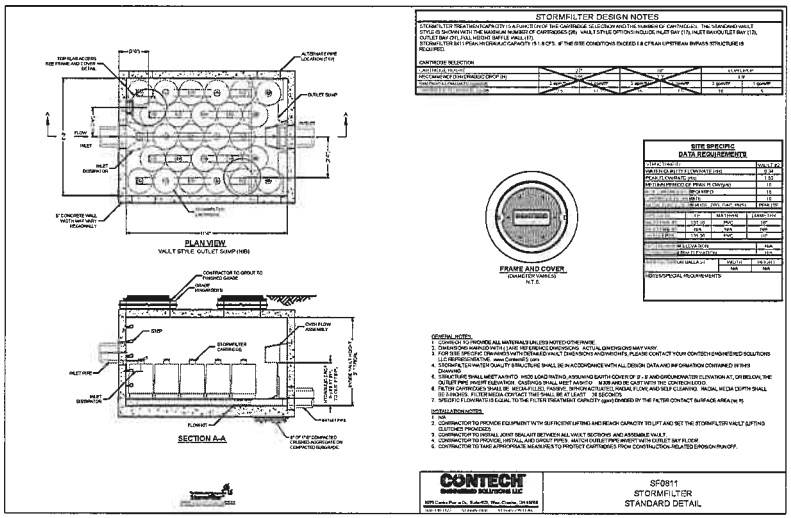
2 CONTROL MANHOLE #2 DETAIL
NOT TO SCALE



3 STORMTECH SC-740 DETENTION SYSTEM DETAIL
NOT TO SCALE



4 WATER QUALITY VAULT #1 DETAIL
NOT TO SCALE



5 WATER QUALITY VAULT #2 DETAIL
NOT TO SCALE

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REGISTERED PROFESSIONAL ENGINEER
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Details

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Date: 7 January 2015
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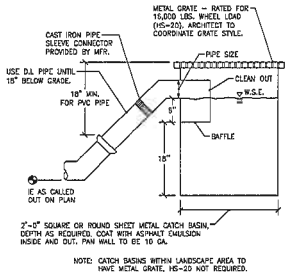
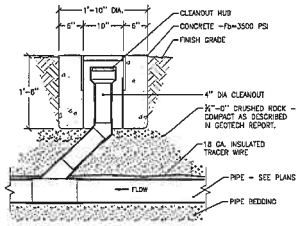
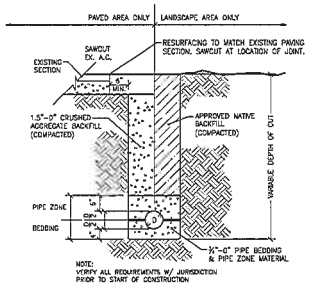


1 CATCH BASIN / FIELD INLET DETAIL
NOT TO SCALE



2 TYPICAL CLEANOUT SECTION
NOT TO SCALE



3 TRENCH BACKFILL DETAIL
NOT TO SCALE

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Appendix 4

Geotechnical Analysis

GEODESIGN INC

REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Myslony Site

SW Myslony Street and SW 112th Avenue

Tualatin, Oregon

For

Pacific Northwest Properties

March 28, 2007

GeoDesign Project: PNWP-40-01

Engineers | Geologists | Environmental Consultants

GEODESIGN INC

March 28, 2007

Pacific Northwest Properties
P.O. Box 2206
Beaverton, OR 97075

Attention: Mr. Paul Gram

Report of Geotechnical Engineering Services
Myslony Site
SW Myslony Street and SW 112th Avenue
Tualatin, Oregon
GeoDesign Project: PNWP-40-01

GeoDesign, Inc. is pleased to submit this report of geotechnical engineering services for the two proposed industrial buildings located on SW 112th Avenue just south of SW Myslony Street in Tualatin, Oregon. Our services for this project were conducted in accordance with our proposal dated December 15, 2006.

We appreciate the opportunity to be of continued service to you. Please call if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.

George Saunders, P.E., G.E.
Principal Engineer

NNP:RWH:GPS:sms
Attachments
Two copies submitted
Document ID: PNWP-40-01-032807-geor.doc
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1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this report of geotechnical engineering services for the two proposed industrial buildings located north of Franklin Business Park in Tualatin, Oregon. The approximately 6-acre site is located on SW 112th Avenue just south of the extension of SW Myslony Street. Hedges Creek lies approximately 200 to 300 feet west of the site. Figure 1 shows the site relative to existing topographic and physical features.

We understand that site development will include construction of two buildings with plan areas of approximately 34,000 and 46,000 square feet. We have assumed that buildings will be lightly loaded concrete tilt-up or steel-frame structures with concrete slabs-on-grade. We expect maximum wall and column loads will be on the order of 4 kips per foot and 120 kips, respectively. We expect that maximum floor loads will be on the order of 200 psf. Based on site topography, we assume that site cuts and fills will likely be less than 5 feet each.

Because structural loads were assumed, we recommend that GeoDesign be contacted to review final loads to verify that our recommendations and conclusions are appropriate for the actual proposed construction.

For your reference, definitions of all acronyms used are attached at the end of this document.

2.0 PURPOSE AND SCOPE

The purpose of our geotechnical engineering site evaluation was to evaluate subsurface soil and groundwater conditions at the site and develop geotechnical engineering recommendations for use in design and construction of the proposed development. Specifically, we have completed the following tasks:

- Coordinated and managed the field investigation (including utility locates, site access authorizations, access preparation, and scheduling of subcontractors and GeoDesign staff).
- Reviewed the readily available geotechnical and geologic information in the site area from our in-house files.
- Explored subsurface conditions by completing the following explorations at the site:
  - Two borings to a depth of 81.5 feet BGS
  - Two borings to a depth of 26.5 feet BGS
  - Four borings to a depth of 6.5 feet BGS
- Obtained representative soil samples for laboratory testing and maintained a detailed log of subsurface conditions encountered in each exploration.
- Performed a laboratory testing program, including the following tests:
  - Forty-one moisture content determinations on selected soil samples in general accordance with ASTM D 2216
  - Nine particle-size analyses (percent passing a U.S. Standard No. 200 Sieve) in general accordance with ASTM C 117
  - Three Atterberg limits tests in general accordance with ASTM D 4318
  - Two consolidation tests in general accordance with ASTM D 2435

- Provided recommendations for site preparation, grading and drainage, compaction criteria for both on site and imported materials, fill type for imported materials, procedures for use of on-site soils, and wet weather earthwork procedures.
- Evaluated groundwater conditions at the site.
- Provided recommendations for the use of on site native and fill materials for support of floor slabs and pavements.
- Provided recommendations for preferred foundation type.
- Provided recommendations for use in the design of conventional retaining walls (including backfill and drainage requirements and lateral earth pressures).
- Provided recommendations for asphalt concrete pavement design sections and pavement subgrade preparation.
- Provided recommendations for seismic design factors in accordance with the procedures outlined in the 2006 IBC and the SOSSCA.
- Prepared this report of our explorations, findings, conclusions, and recommendations.

3.0 SITE CONDITIONS

3.1 GEOLOGIC SETTING

The site is located in the southeast portion of the Tualatin Basin physiographic province. The Coast Range and Chehalem Mountains bound the basin to the west, and the Tualatin Mountains and Portland Hills bound the basin to the east. The geologic profile in the vicinity of the site consists of catastrophic flood deposits underlain by fluvial and lacustrine deposits that extend to a depth of approximately 150 feet. The Columbia River Basalt is considered as the basement material at this site and is present below depths of 150 feet (Burns, et al., 1997; Madin, 1990; Schlicker and Deacon, 1967).

The near-surface geologic unit is mapped as Pleistocene Age (15,500 to 13,000 years before present) catastrophic flood deposits (Qff), specifically the fine-grained deposits. The unit consists of poorly consolidated, fine- to coarse-grained sand, silt, and clay. The catastrophic flood deposits originated from multiple outburst floods from glacial Lake Missoula during the last episode of glaciations (Orr, et al, 1992). The thickness of this unit is reported to range from 30 to 60 feet in the site vicinity (Gannett and Caldwell, 1998; Madin, 1990).

The Pleistocene to Miocene Age (5.3 to 1.6 million years before present) fluvial and lacustrine deposits (Tfs) underlie the catastrophic flood deposits and extend to a depth of approximately 150 feet in the site vicinity (Gannett and Caldwell, 1998; Burns, et al., 1997; Madin, 1990; Schlicker and Deacon, 1967). The unit consists of moderately to poorly cemented micaceous siltstone, claystone, and fine sandstone. The unit is considered to be equivalent to the Sandy River Mudstone.

Underlying the fluvial and lacustrine deposits is the Miocene Age (20 to 10 million years before present) Columbia River Basalt Group that is a series of basalt flows that originated from southeastern Washington and northeastern Oregon. The Columbia River Basalt Group is considered the geologic basement unit for this report (Gannett and Caldwell, 1998; Madin, 1990; Schlicker and Deacon, 1967).

3.2 *SURFACE CONDITIONS*

The site has relief of about 10 feet, with topographic highs in the northeast and southeast corners of the property. Site drainage is from east to west towards the topographic low in the northwest corner, adjacent to Hedges Creek. Several pink flags delineating the low-lands area were observed in the vicinity of boring B-4.

Vegetation consists of relatively immature cut grasses over most of the site. Although the root systems are not as well-developed as for mature grassland, the site is currently used for agricultural purposes. Trees are present on the southern and western site boundaries. Several debris piles were present in the southeastern portion of the site. The piles contained organics (tree branches, grasses, etc.) as well as stripped material.

3.3 SUBSURFACE CONDITIONS

3.3.1 General

Subsurface exploration consisted of eight borings (B-1 through B-8) to depths up to 81.5 feet BGS. The approximate locations of the explorations are shown on Figure 2. A detailed description of the subsurface exploration is found in the appendix.

Relatively consistent soil conditions were observed in our explorations. In general, the subsurface conditions consist of 10 to 15 feet of silt and sand underlain by gravel. Beneath the gravel, we observed layers of sand and silt with variable thicknesses. Clay was observed below the silt and sand at the completed depth of the borings. We encountered near-surface organic material in boring B-4, which is within the site topographic low point. A more detailed description of the generally distinct soil layers follows.

3.3.2 Near Surface Sand and Silt

Shallow root zones were observed in all borings except boring B-8. The root zones extend up to 3 inches BGS.

The sand that was encountered within 15 feet of the surface is loose to medium dense with trace to some silt. The sand is poorly graded, moist to wet, and was observed at the surface in five of the eight borings. The moisture content of selected soil samples varied between 26 and 37 percent at the time of our exploration.

The silt observed within 15 feet of the surface is very soft to medium stiff, brown, and sandy. Except for the organic material that was encountered in boring B-4, the silt is moist with low to medium plasticity. The moisture content of selected soil samples varied between 30 and 36 percent at the time of our exploration.

3.3.3 Organic Material

We encountered soft and wet, plastic organic silt in boring B-4, adjacent to the topographic low point on the site. This location is adjacent to Hedges Creek in which significant organic deposits have been encountered on other sites to the southwest. The thickness of this organic silt at boring B-4 was up to 5 feet starting at approximately 2.5 feet BGS. The moisture content of the organic silt at the sample location is 94 percent. Organic silt was not encountered in the other seven borings across the site.

3.3.4 Gravel

Medium dense to dense, brown to dark gray gravel was observed in three deep borings. The gravel is fine to course with trace to some silt and sand. The gravel is wet, poorly graded, and subrounded to subangular. A cobble layer was observed in boring B-3 between 15.5 and 16.3 feet BGS.

3.3.5 Deep Sand and Silt

The sand layers observed below the gravel layer are medium dense to dense and brown or gray with varying amounts of silt. The sand is poorly graded and wet. In general, the sand becomes denser with increasing depth.

The silt layers encountered below the gravel layer are medium stiff to very stiff and gray with trace to some fine sand. Trace to some sand is present in the silt below a depth of approximately 60 feet BGS. The silt has rapid dilatancy and low plasticity near the gravel layer that gradually increases to high plasticity at a depth of 60 feet BGS.

3.3.6 Clay

Stiff to hard, red-brown or gray clay with some silt was encountered at a depth of 80 feet BGS in boring B-1 and 74 feet BGS in boring B-2. The clay is moist with medium to high plasticity.

3.3.7 Groundwater

Groundwater was encountered within 7 feet of the surface during our explorations in January 2007. While the explorations were conducted during the wet season, it is possible that the water may rise to within a few feet of the surface during extended periods of rain.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL

Based on our research, explorations, testing, analyses, and other available information, it is our opinion that the development can be constructed as proposed. Although we have not reviewed a preliminary grading plan, we assume that the site grade will be raised less than 3 feet by excavation at the topographic highs in the northwest and southeast corners, and filling in the central and western portions of the site. With the exception of organic silt encountered in the vicinity of boring B-4, geotechnical conditions are favorable. We anticipate that the following factors will have an impact on design and construction of the proposed structure:

1. Soft organic silt was encountered at boring B-4 during explorations. This organic silt is not suitable to support building or pavement loads. We recommend removing all high organic material within the proposed building and pavement areas. Additional explorations (test pits) should be completed to identify the limits of the organic material.
2. Debris piles were observed in the southeast corner of the site during explorations. The material in these piles should not be used for structural fill and should be used in non-structural areas or transported off site.

3. The surficial site soils are generally fine-grained and become moist with depth. The presence of these materials will require special attention during earthwork construction, including:
   - Moist, fine-grained soils are difficult to compact unless they are conditioned to the proper moisture content for compaction. Depending upon the time of year, the weather, and scheduling considerations, it may not be feasible to use conventional aeration methods to conduct earthwork at the site.
   - Surfical silts on site are easily disturbed when moist, and careful attention will need to be paid to protect subgrades during construction.
4. The project has been expanded to include additional development along the northeast corner of the site. Explorations should be completed in this area and can be combined with the recommended test pits identified under Item No. 1 of this section.

Our specific recommendations for site development are presented in the following sections and should be incorporated into the design and implemented during construction of the proposed development.

4.2 SITE PREPARATION

4.2.1 Stripping and Grubbing

The existing grasses and brush should be stripped and removed from all proposed structural fill, pavement, and building areas and for a 5-foot margin around such areas. Based on our explorations and observed immature root development, the stripping depth will be approximately 3 inches. Greater stripping depths will be required to remove the thicker vegetation and debris stockpiles observed in the southeast corner of the site. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

Existing trees or shrubs, such as in the southeast corner should be removed from all pavement and building areas. We assume that the trees and shrubs adjacent to Hedges Creek along the western property boundary will remain. Root balls should be grubbed out to the depth of the roots, which could exceed 3 feet BGS. Depending on the methods used to remove the root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend that soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with structural fill.

4.2.2 Agricultural Topsoil/Till Zone

The site has a history of agricultural cultivation resulting is an approximate 12-inch-deep topsoil/till zone. Reliable strength properties are extremely difficult to predict for the topsoil/till zone material due to the disturbed nature of these materials through years of agricultural cultivation.

Within all proposed structural fill, pavement, and improvement areas (including a 5-foot margin beyond such areas) and where less than 1 foot of cut is required, we recommend that the stripped subgrade be either:

- Removed and replaced (to a depth of 12 inches) with structural fill

- Scarified and compacted (to a depth of 12 inches) as recommended for structural fill
- Cement amended (to a depth of 12 inches) as recommended for structural fill

As discussed in the "Structural Fill" section of this report, the native silts can be sensitive to small changes in moisture content and will be difficult, if not impossible, to compact adequately during wet weather. While scarification and compaction of the subgrade is the best option for subgrade improvement, it will likely only be possible during extended dry periods and following moisture conditioning of the soil. As discussed further on in this report, cement amendment is an option for conditioning the soils for use as structural fill during periods of wet weather or when drying the soil is not an option.

4.2.3 Organic Silt

Soft, wet, organic-rich silt is present with in the northwest portion of the site near boring B-4. As discussed in the "Conclusions and Recommendations" section of this report, this silt is not suitable for supporting building or pavement loads. We recommend removing the organic silt within building and pavement areas and replacing it with compacted structural fill as described in the "Structural Fill" section of this report. We also recommend that additional explorations be completed to determine the extent of the organic silt.

4.2.4 Subgrade Evaluation

A member of our geotechnical staff should observe all exposed subgrades after stripping and site cutting have been completed to determine if there are areas of unsuitable surface or unstable soil. Our representative should observe a proofroll with a fully loaded dump truck or similar heavy rubber-tire construction equipment to identify soft, loose, or unsuitable areas. Areas that appear to be too wet and soft to support proofrolling equipment should be evaluated by probing and prepared in accordance with the recommendations for wet weather construction presented in the "Wet Weather/Wet Soil Grading" section of this report.

4.2.5 Wet Weather/Wet Soil Grading

The surficial silty soils at the site are easily disturbed during the wet season, especially at the lower elevations in the northwest corner of the site, and when they are moist. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant subgrade repair costs can result. If construction is planned when the surficial soils are wet or may become wet, the construction methods and schedule should be carefully considered with respect to protecting the subgrade to reduce the need to over-excavate disturbed or softened soil. The project budget should reflect the recommendations below if construction is planned during wet weather or when the surficial soils are wet.

If construction occurs when silty, wet soils are present, site preparation activities may need to be accomplished using track-mounted excavating equipment that loads removed material into trucks supported on granular haul roads. The thickness of the granular material for haul roads and staging areas will depend on the amount and type of construction traffic. Generally, a 12- to 18-inch-thick mat of imported granular material is sufficient for light staging areas and the basic building pad, but is not expected to be adequate to support heavy equipment or truck traffic. The granular mat for haul roads and areas with repeated heavy construction traffic typically needs to be increased to between 18 to 24 inches. The actual thickness of haul roads and

staging areas should be based on the contractor's approach to site development and the amount and type of construction traffic. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum, non-vibratory roller. Additionally, a geotextile fabric should be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The imported granular material and the geotextile fabric should meet the specifications in the "Structural Fill" section of this report.

As an alternative to placing thick rock sections to support construction traffic, the subgrade can be stabilized using a cement amendment. If this approach is used, the cement amended soil should meet the guidelines provided in the "Structural Fill" section of this report.

4.3 EXCAVATION

4.3.1 General

Based upon the materials exposed in our explorations, excavations into the site soils should be readily accomplished with conventional earthwork equipment. However, sloughing and caving of the sidewalls should be expected at all depths due to the loose consistency and high moisture contents of the granular subsurface materials.

4.3.2 Trench Cuts and Trench Shoring

Trench cuts may stand near vertical to a depth of at least 4 feet. Open excavation techniques may be used to excavate trenches with depths between 4 and 7 feet, provided the walls of the excavation are cut at a slope of 1H:1V, groundwater seepage is not present, and with the understanding that some minor sloughing may occur. The trenches should be flattened to 1½H:1V if excessive sloughing occurs.

Use of approved temporary shoring is recommended where sloping is not possible. If a conventional shield is used, the contractor should limit the length of open trench. If shoring is used, we recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation. All excavations should be made in accordance with applicable OSHA and state regulations.

4.3.2 Dewatering

Excavations that extend below approximately 5 feet will likely encounter groundwater seepage and the earthwork contractor should be prepared to use dewatering techniques. Groundwater should be removed by pumping from a sump. Water should be routed to a suitable discharge point.

If groundwater seepage or softer, sensitive subgrade conditions are present in the base of the utility excavation, we recommend over excavating the trench by 12 to 18 inches and placing stabilization material in the base. Stabilization material should consist of well-graded, crushed rock or crushed gravel meeting the in the "Structural Fill" section of this report. The stabilization material should be placed in one lift and compacted until well keyed and a firm condition.

4.4 STRUCTURAL FILL

4.4.1 General

A variety of material may be used as structural fill at the site. Fills should only be placed over subgrade that has been prepared in conformance with the "Site Preparation" section of this report. Structural fill should meet the specifications provided in the OSSC 00330 – Earthwork, OSSC 00400 – Drainage and Sewers, and OSSC 02600 – Aggregates, depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided below.

4.4.2 On-Site Soil

The surfical (non-organic) silt and sand on site could be suitable for use as structural fill, if they are dried extensively. Our laboratory testing indicates the in-situ moisture content of the silt is between 26 and 37 percent. Based on our experience, we estimate the optimum moisture content for compaction is between 16 and 20 percent; therefore, moisture conditioning (drying and mixing) will likely be required to use on-site soil for structural fill. Accordingly, extended dry weather may be required to adequately condition the soils for use as structural fill.

If the on-site soils are moisture conditioned, then they should only be used if they are free of debris, organic material, or other unsuitable materials; have no particles larger than 4 inches in diameter; and meet the specifications provided in OSSC 00330.12 – Borrow Material. When used as structural fill, native soils should be placed in lifts with a maximum uncompacted thickness of 6 to 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D 1557.

4.4.3 Imported Granular Material

Imported granular material used for structural fill should be pit or quarry run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.14 – Selected Granular Backfill or OSSC 00330.15 – Selected Stone Backfill. Imported granular material should be fairly well graded between coarse and fine material and have less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 8 to 12 inches and be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557. During the wet season or when wet subgrade conditions exist, the initial lift should be approximately 18 inches in uncompacted thickness and should be compacted by rolling with a smooth-drum roller without using vibratory action.

4.4.4 Aggregate Base Rock

Imported granular material used as base rock for building floor slabs and pavements should consist of ¾- or 1½-inch-minus material meeting the specifications provided in OSSC 00641 – Aggregate Subbase, Base, and Shoulders Base Aggregate, with the exception that the aggregate has less than 5 percent by dry weight passing a U.S. Standard No. 200 Sieve. Aggregate base rock should be placed in lifts with a maximum uncompacted thickness of 8 to 12 inches and be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557.

4.4.5 Trench Backfill

Trench backfill for the utility pipe base and pipe zone should consist of well-graded, granular material with a maximum particle size of 1 inch and less than 5 percent by dry weight passing the U.S. Standard No. 200 Sieve and should meet the specifications provided in OSSC 00405.14 – Class B Backfill. The material should be free of roots, organic matter, and other unsuitable materials. The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department.

When under a roadway or building pad, trench backfill should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557, or as required by the pipe manufacturer or local building department. The upper 2 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D 1557.

4.4.6 Stabilization Material

Stabilization material required for excavations where soft soils or water is present should consist of crushed rock, or crushed gravel and sand and meet the specifications provided in OSSC 00330.15 – Selected Stone Backfill, though with a minimum particle size of 4 inches and less than 5 percent by dry weight passing the U.S. Standard No. 4 Sieve. The material should have at least two fractured faces; rounded aggregate is not acceptable. The material should be free of organic matter and other deleterious material. Stabilization material should be placed in one lift and compacted to a firm condition.

4.4.7 Granular Retaining Wall Backfill

Imported granular backfill for retaining should extend a horizontal distance of ½H from the back of the wall, where H is the height of the retaining wall, and should consist of select granular material meeting the specifications provided in OSSC 00510.12 – Granular Wall Backfill or OSSC 00510.13 – Granular Structure Backfill. We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric which meets the specifications provided in OSSC 02320.20 – Geotextile Property Values for drainage geotextiles. The geotextile should be installed in conformance with the specifications provided in OSSC 00350 – Geosynthetic Installation. Compaction requirements for retaining wall backfill are discussed in the "Retaining Structures" section of this report.

4.4.8 Drainage Rock

Drain rock used for back-of-wall drains or footing drains should meet specifications provided in OSSC 00430.11 – Granular Drain Backfill. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in OSSC 02320.20 – Geotextile Property Values for drainage geotextiles. The geotextile should be installed in conformance with the specifications provided in OSSC 00350 – Geosynthetic Installation.

4.4.9 Soil Amendment with Cement

As an alternative to the use of imported granular material for wet-weather structural fill, an experienced contractor may be able to amend the on-site soils with portland cement or with limekiln dust and portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and

amendment quantities. Specific recommendations, based upon exposed site conditions, for soil amending can be provided if necessary. However, for preliminary planning purposes, it may be assumed a minimum of 5 percent cement (by dry weight, assuming a unit weight of 100 pcf) will be sufficient for subgrade and general fill amendment. Treatment depths of 12 to 16 inches for roadway subgrades are typical (assuming a 7-day unconfined compressive strength of at least 80 psi), though may be adjusted in the field depending upon site conditions. Soil amending should be conducted in accordance with the specifications provided in OSSC 00344 – Treated Subgrade.

Portland cement-amended soils are hard and have low permeability; therefore, these soils do not drain well, nor are they suitable for planting. Future landscape areas should not be cement amended, if practical, or accommodations should be planned for drainage and planting. A contingency for cobbles and boulders should be included for this project.

4.5 PERMANENT SLOPES

Permanent fill slopes are not anticipated based on the site topography and relief of about 10 feet. Landscaped slopes on adjacent property are less than 4 feet high. The north slope of the property to the southwest is steep and showing signs of slumping. Should they be required, permanent cut and fill slopes up to 10 feet tall may be built to a gradient as steep as 2H:1V. However, cut slopes over 10 feet tall should be limited to a gradient of 2½H:1V or should be partially retained by a retaining wall. Slopes that will be maintained by mowing should not be constructed steeper than 3H:1V. Newly constructed fill slopes should be over-built by at least 12 inches and then trimmed back to the required slope to maintain a firm face.

Access roads and pavements should be located at least 5 feet from the top of cut and fill slopes. The setback should be increased to 10 feet for buildings, unless special foundation considerations are implemented. Slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

4.6 EROSION CONTROL

The silty soil at this site is eroded easily by wind and water; therefore, erosion control measures should be carefully planned and in place before construction begins. Erosion control plans are typically required by local ordinances on new construction projects. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads.

4.7 FOUNDATION SUPPORT

4.7.1 General

Based on the assumed foundation loads previously stated and provided the site is prepared as recommended in the preceding sections, it is our opinion that the proposed structures can be supported on conventional shallow footings bearing on firm native soil, or on structural fill bearing on firm native soil. Foundation elements (footings and floor slabs) should not be supported on the soft organic soils encountered at the northwest corner of the site (vicinity of

boring B-4). As discussed in the "Site Preparation" section of this report, the soft organic soils should be removed from all building and pavement areas and the resulting excavations backfilled with structural fill.

We recommend that a member of our geotechnical staff observe the prepared footing subgrade to verify that unsuitable fill materials have been removed and adequate bearing surfaces have been achieved. Removed fill should be replaced with structural fill, as described in the "Structural Fill" section of this report.

4.7.2 Dimensions and Capacities

Continuous wall and isolated spread footings should be at least 16 and 20 inches wide, respectively. The bottom of exterior footings should be at least 18 inches below the lowest adjacent exterior grade. The bottom of interior footings should be established at least 12 inches below the base of the slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,000 psf. This is a net bearing pressure; the weight of the footing and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and can be increased by one-third for short-term loads such as those resulting from wind or seismic forces.

Based on our analysis and experience with similar soils, total post-construction settlement should be less than 1 inch, with differential settlement of less than ½ inch over a 50-foot span.

4.7.3 Resistance to Sliding

Lateral loads on footings can be resisted by passive earth pressure on the sides of the structures and by friction on the base of the footings. Our analysis indicates that the available passive earth pressure for footings confined by on-site soils and structural fills above groundwater levels is 250 pcf, modeled as an equivalent fluid pressure. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance. To rely upon passive resistance, a minimum of 10 feet of horizontal clearance must exist between the face of the footings and adjacent down slopes. The passive equivalent fluid pressure should be reduced to 115 pcf below groundwater depths (assume 5 feet for design).

For footings in contact with the on-site native material, a coefficient of friction equal to 0.30 may be used when calculating resistance to sliding. This value should be increased to 0.40 for a layer of crushed rock or imported granular fill that is at least 6 inches deep.

4.7.4 Construction Considerations

All footing and floor subgrades should be evaluated by the project geotechnical engineer or their representative to confirm suitable bearing conditions. Observations should also confirm that all loose or soft material, organics, unsuitable fill, prior topsoil zones, and softened subgrades (if present) have been removed. Localized deepening of footing excavations may be required to penetrate deleterious materials.

If footing excavations are conducted during wet weather conditions, we recommend that a minimum of 4 inches of granular material be placed and compacted until well keyed at the base of the excavations. The granular material reduces subgrade disturbance during placement of forms and reinforcement and provides clean conditions for the reinforcing steel.

4.8 FLOOR SLABS

Satisfactory subgrade support for building floor slabs supporting up to 200-psf areal loading can be obtained on the existing subgrade prepared as previously described. As discussed in the "Site Preparation" section of this report, the soft organic soils encountered at the northwest corner of the site (vicinity of boring B-4) should be removed from all building areas.

A minimum 6-inch-thick layer of compacted, imported granular material should be placed over the prepared subgrade to assist as a capillary break. Imported granular material should meet the requirements for aggregate base rock in the "Structural Fill" section of this report. The imported granular material should be placed in one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557. A subgrade modulus value of 150 pci may be used to design the floor slabs, provided the site is prepared as recommended and the floor slab is underlain by 6 inches of imported granular material.

Vapor barriers beneath floor slabs are typically required by flooring manufactures to maintain the warranty on their products. In our experience, adequate performance of floor adhesives can be achieved by using a clean base rock (less than 5 percent fines) beneath the floor slab with no vapor barrier. In fact, vapor barriers can frequently cause moisture problems by trapping water beneath the floor slab that is introduced during construction. If a vapor barrier is used, water should not be applied to the base rock prior to pouring the slab and the work should be completed during extended dry weather so that rainfall is not trapped on top of the vapor barrier. Selection and design of an appropriate vapor barrier, if needed, should be based on discussions among members of the design team. We can provide additional information to assist you with your decision.

Slabs should be reinforced according to their proposed use and per the structural engineer's recommendations. Load-bearing concrete slabs may be designed assuming a modulus of subgrade reaction, k, of 150 pounds per square inch per inch.

4.9 DRAINAGE

4.9.1 Temporary

During grading at the site, the contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface. During rough and finished grading of the building site, the contractor should keep all footing excavations and building pads free of water.

4.9.2 Surface

The finished ground surface around buildings should be sloped away from their foundations at a minimum 2 percent gradient for a distance of at least 5 feet. Downspouts or roof scuppers should discharge into a storm drain system that that carries the collected water to an appropriate stormwater system. Trapped planter areas should not be created adjacent to the building without providing means for positive drainage (i.e., swales or catch basins).

4.9.3 Subsurface

Based on our explorations and depth to the water, it is our opinion that perimeter footing drains should be installed around the proposed building. The footing drains should consist of a filter fabric-wrapped, drain rock-filled trench that extends at least 18 inches below the finished floor slab grade. A perforated pipe should be placed at the base to collect water that gathers in the drain rock. The drain rock and filter fabric should meet the specifications outlined in the "Structural Fill" section of this report. The discharge for the footing drain should not be tied directly into the stormwater drainage system, unless mechanisms are installed to prevent backflow.

4.10 RETAINING STRUCTURES

4.10.1 Assumptions

Our retaining wall design recommendations are based on the following assumptions: (1) the walls consist of conventional, cantilevered retaining walls; (2) the walls are less than 8 feet in height; (3) the backfill is drained and consists of imported granular materials; and (4) the backfill has a slope flatter than 4H:1V. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

4.10.2 Wall Design Parameters

For unrestrained retaining walls, an active pressure of 35 pcf equivalent fluid pressure should be used for design. For embedded building walls, a superimposed seismic lateral force should be calculated based on a dynamic force of $6H^2$ pounds per lineal foot of wall, where H is the height of the wall in feet, and applied a distance of 0.6H from the base of the wall. Where retaining walls are restrained from rotation prior to being backfilled, a pressure of 55 pcf equivalent fluid pressure should be used for design.

If surcharges (i.e., retained slopes, building foundations, vehicles, steep slopes, terraced walls, etc.) are located within a horizontal distance from the back of a wall equal to twice the height of the wall, then additional pressures will need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based on the actual magnitude and configuration of the applied loads.

The wall footings should be designed in accordance with the guidelines provided in the appropriate portion of the "Foundation Support" section of this report.

4.10.3 Wall Drainage and Backfill

The above design parameters have been provided assuming that back-of-wall drains will be installed to prevent buildup of hydrostatic pressures behind all walls. If a drainage system is not installed, then our office should be contacted for revised design forces.

Backfill material placed behind retaining walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of granular retaining wall backfill as described in the "Structural Fill" section of this report. We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided in OSSC 350 and 2320 for drainage geotextiles.

Alternatively, the on-site soils can be used as backfill material, provided a minimum 2-foot-wide column of angular drain rock wrapped in a geotextile is placed against the wall and the on-site soils can be adequately moisture conditioned for compaction. The rock column should extend from the perforated drainpipe or foundation drains to within approximately 1 foot of the ground surface. The angular drain rock should meet the requirements provided in the "Structural Fill" section of this report.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by the most recent ASTM D 1557 standard. However, backfill located within a horizontal distance of 3 feet from a retaining wall should only be compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D 1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (such as jumping jack or vibratory plate compactors). If flat work (sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D 1557.

Perforated collector pipes should be placed at the base of the walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock. The drain rock should meet specifications provided in the "Structural Fill" section of this report. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in OSSC 350 and 2320 for drainage geotextiles. The collector pipes should discharge at an appropriate location away from the base of the wall. Unless measures are taken to prevent backflow into the wall's drainage system, the discharge pipe should not be tied directly into stormwater drain systems.

Settlements of up to 1 percent of the wall height commonly occur immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flat work adjacent to retaining walls be postponed at least 4 weeks after backfilling of the wall, unless survey data indicates that settlement is complete prior to that time.

4.11 PAVEMENT DESIGN

Pavements should be installed on native subgrade or new engineered fills prepared in conformance with the "Site Preparation" and "Structural Fill" sections of this report. This includes removal of organic soils and the recommended treatment of the topsoil/till zone materials. Our pavement recommendations are based on the following assumptions:

- The top 12 inches of soil subgrade below the roadway alignment is compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557.

- A resilient modulus of 3,000 psi was assumed for the subgrade.
- A resilient modulus of 20,000 psi was estimated for the base rock.
- Initial and terminal serviceability index of 4.2 and 2.5, respectively.
- Reliability and standard deviation of 85 percent and 0.45, respectively.
- Structural coefficient of 0.42 and 0.10 for the asphalt and base rock, respectively.

If any of these assumptions are incorrect, our office should be contacted with the appropriate information so the pavement designs can be revised. We do not have specific information on the frequency and type of vehicles expected at the site. We have made assumptions based on three loading types as described below:

- **Automobile Areas:** For areas exposed to passenger car traffic only
- **Moderate Truck Areas:** Assuming a maximum of 5 trucks per day (40 percent 2-axle, 30 percent 3-axle, 20 percent 4-axle, and 10 percent 5-axle)
- **Heavy Truck Areas:** Assuming a maximum of 20 trucks per day (at the same breakdown as above)

Our pavement design recommendations for the assumptions and loadings provided above are summarized in Table 1.

Table 1. Recommended Standard Pavement Sections

Traffic Levels	Trucks per Day	ESALs	AC (inches)	Base Rock (inches)
Car Parking Areas	0	10,000	2.5	12.0
Light Trucking Routes	5	23,500	3.0	13.0
Frequent Trucking Routes	20	94,000	4.0	15.0

If the subgrade material is amended with cement, (providing the amended soil achieves a 7-day unconfined compressive strength of at least 80 psi to the thicknesses indicated below) then the pavements can be constructed as recommended in Table 2.

Table 2. Recommended Pavement Sections with Cement Amendment

Traffic Levels	Trucks per Day	ESALs	AC (inches)	Base Rock (inches)	Cement Amendment[1] (inches)
Car Parking Areas	0	10,000	2.5	4.0	12.0
Light Trucking Routes	5	23,500	3.0	4.0	12.0
Frequent Trucking Routes	20	94,000	4.0	6.0	12.0

Note 1. Assume a minimum 7-day unconfined compressive strength of 80 psi.

The amended surface should be protected from abrasion by placing a minimum of 4 inches of base rock. The crushed rock may typically become contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas so that the minimum thickness of free draining base at the surface is 4 inches.

The AC should be Level 2, ½-inch, dense HMAC in accordance with the specifications provided in OSSC 00745 and be compacted to 91 percent of Rice Density of the mix in accordance with ASTM D 2041. The minimum lift thickness for ½-inch, dense HMAC is 1.5 inches. Asphalt binder should be performance graded and conform to PG 64-22. The base rock should meet the specifications for aggregate base rock provided in the "Structural Fill" section of this report.

The pavement subgrade should be prepared in accordance with the "Site Preparation" and "Structural Fill" sections of this report. The top 12 inches of subgrade below the pavement should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D 1557, or until proofrolling with a fully loaded dump or water truck indicates an unyielding, non-pumping subgrade is present.

Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed road sections, an allowance for this additional traffic will need to be made in the design pavement section.

4.12 SEISMIC CONSIDERATIONS

4.12.1 Seismic Coefficients

Based on our investigation, the following design parameters can be applied if the building is designed using the applicable provisions of the 2006 IBC or 2007 SOSSCA as required by the local jurisdiction. The parameters in Table 3 should be used to compute seismic base shear forces.

Table 3. IBC Seismic Design Parameters

Seismic Design Parameter	Short Period	1-Second Period
Maximum Credible Earthquake Spectral Acceleration	$S_s = 1.05$ g	$S_1 = 0.37$ g
Site Class	D	
Site Coefficient	$F_a = 1.08$	$F_v = 1.66$
Adjusted Spectral Acceleration	$S_{MS} = 1.13$ g	$S_{M1} = 0.61$ g
Design Spectral Response Acceleration Parameters	0.76 g	0.41 g
Design Spectral PGA	0.30 g	

4.12.2 Seismic Hazards

Based on our research, subsurface investigation, and prior work in the vicinity, it is our opinion that there is a low potential for seismic hazards such as liquefaction, lateral spreading, or fault rupture to affect the site.

5.0 OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient monitoring of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect if subsurface conditions change significantly from those anticipated.

We recommend that GeoDesign be retained to observe earthwork activities, including stripping, proofrolling of the subgrade and repair of soft areas, footing subgrade preparation, performing laboratory compaction and field moisture-density tests, observing final proofrolling of the pavement subgrade and base rock, and asphalt placement and compaction.

6.0 LIMITATIONS

We have prepared this report for use by Pacific Northwest Properties and the design and construction team for the proposed project. The data and report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were preliminary at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction for the buildings, the conclusions and recommendations presented may not be applicable. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty, express or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

Richard W. Hanford. P.E.
Associate Engineer

George Saunders, P.E., G.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
13028
OREGON
July 26, 1985
RICHARD W. HANFORD JR.
EXPIRES: 6/30/07

REFERENCES

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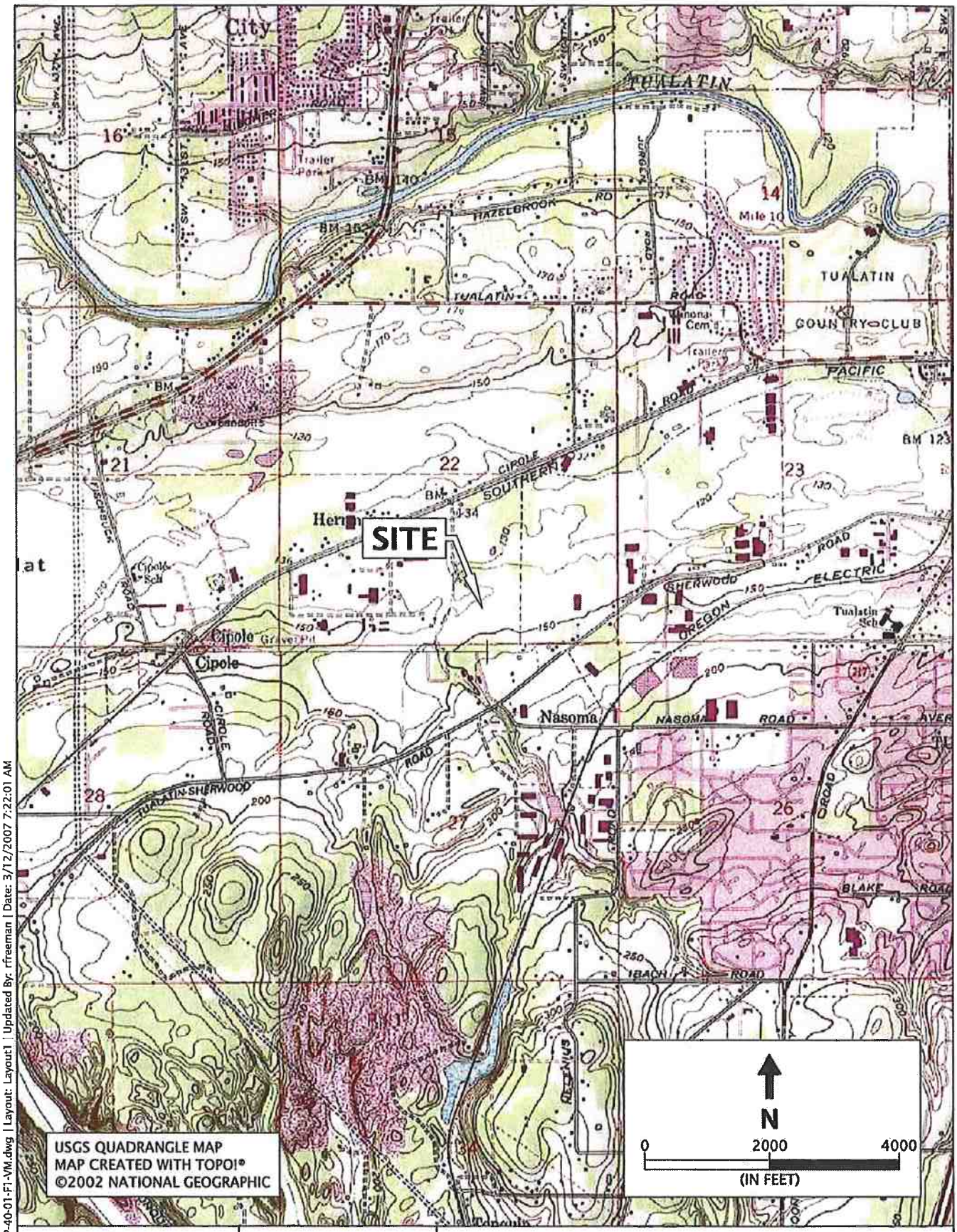
FIGURES



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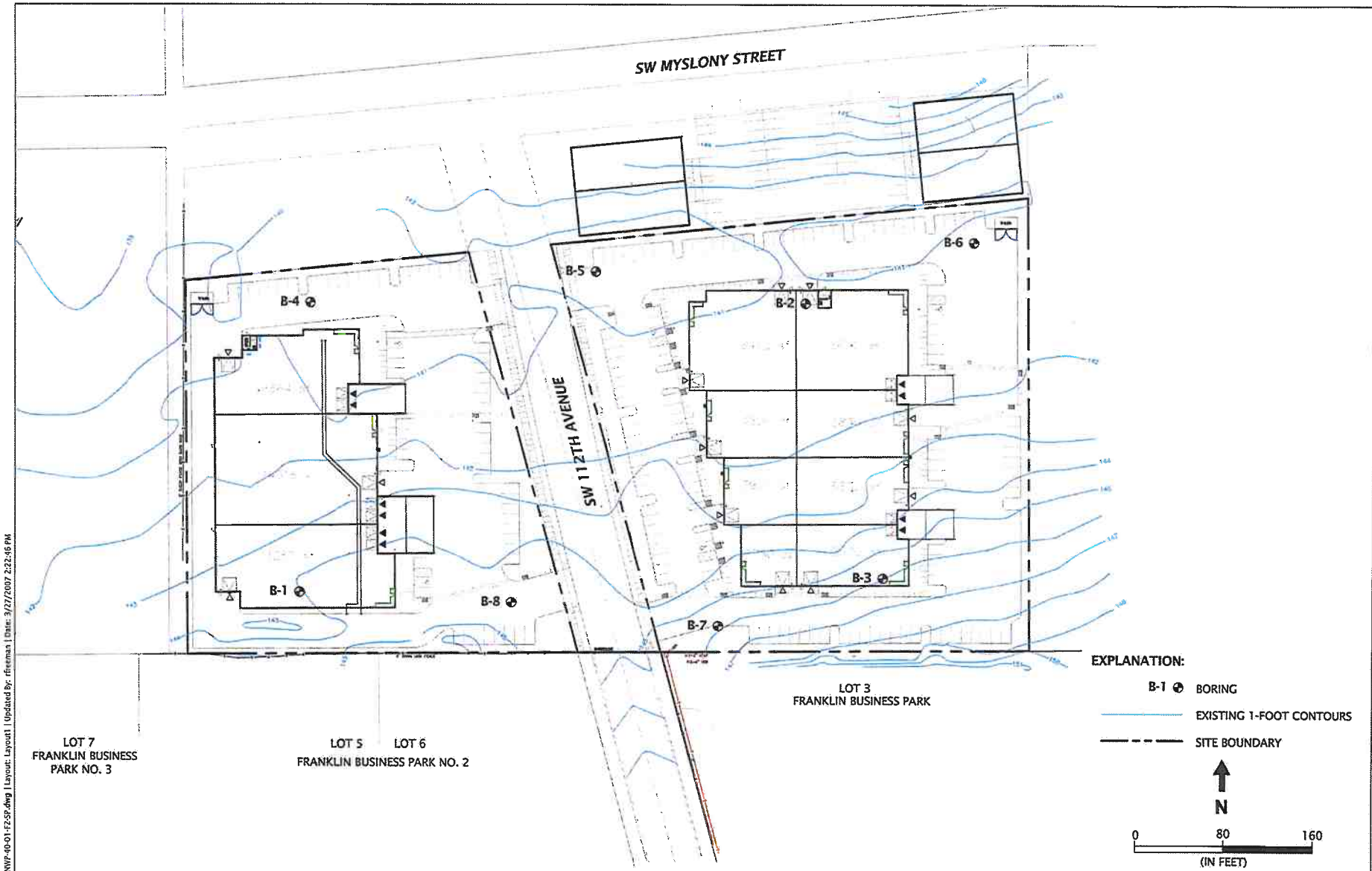
PNWP-40-01	VICINITY MAP	
MARCH 2007	MYSLONY SITE TUALATIN, OR	FIGURE 1



SITE PLAN BASED ON DRAWING PROVIDED BY MILDREN DESIGN GROUP, L.L.C. MARCH 27, 2007

SITE PLAN

MYSLONY SITE
TUALATIN, OR

FIGURE 2

PNWP-40-01

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APPENDIX

APPENDIX

FIELD EXPLORATIONS

GENERAL

Subsurface conditions at the site were explored by completing eight borings (B-1 through B-8) to depths up to 81.5 feet BGS on January 23 and 24, 2007. The borings were completed with a truck mounted drill rig using mud-rotary drilling techniques. The borings were completed by Western States Soil Conservation of Aurora, Oregon. Logs of the explorations are included in this appendix. The locations of the explorations were determined in the field by pacing from site features. This information should be considered accurate to the degree implied by the methods used.

SOIL SAMPLING

Samples were obtained from the test pits, sealed in plastic bags, and transported to GeoDesign's soil laboratory for subsequent testing. Samples were obtained from the sidewalls of the test pits or from the trackhoe bucket. Soil classifications and sampling intervals are presented on the exploration logs included in this appendix.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Key to Test Pit and Boring Logs Symbols" (Table A-1) and "Soil Classification System and Guidelines" (Table A-2), which are included in this appendix. The exploration logs indicate the depths at which the soils or their characteristics change, although the change could be gradual. A horizontal line between soil types indicates an observed (visual or drill action) change. If the change occurred between sample locations and was not observed, the depth was interpreted and the change is indicated using a dashed line. Classifications and sampling intervals are presented on the exploration logs included in this appendix.

LABORATORY TESTING

CLASSIFICATION

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are presented on the exploration logs if those classifications differed from the field classifications.

MOISTURE CONTENT DETERMINATION

We tested the natural moisture content of 41 soil samples in general accordance with ASTM D 2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The moisture contents range from 23 to 94 percent. The test results are presented on the exploration logs included in this appendix.

DRY DENSITY

We tested the in-situ dry density of four soil samples in general accordance with ASTM D 2937. The dry density is the ratio between the mass of the soil (not including water) and the volume of the intact sample. The density is expressed in units of pcf. The measured dry densities range from 88 to 95 pcf, with an average value of approximately 91 pcf. The test values are shown on the appropriate boring logs presented in this appendix.

PERCENT FINES DETERMINATIONS

Grain-size testing, consisting of the percent passing the U.S. Standard No. 200 Sieve, in general accordance with the guidelines presented in ASTM C 117 and D 1140 was completed on nine soil samples. The test results are presented on the exploration logs included in this appendix.

ATTERBERG LIMITS

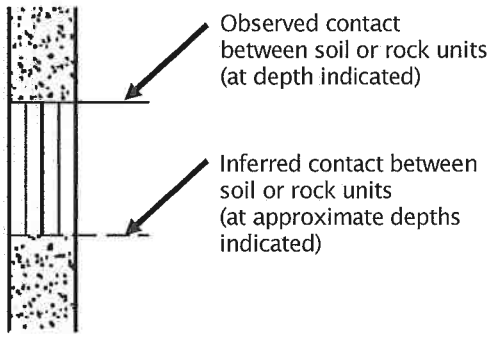
Atterberg limits tests were performed on three samples obtained from the test pit excavations in general accordance with ASTM D 4318. Atterberg limits include the liquid limit, plastic limit, and the plasticity index of soils. These index properties are used to classify soils and for correlation with other engineering properties of soils. The test results are included in this appendix.

CONSOLIDATION TESTING

Two one-dimensional consolidation tests were completed on a relatively undisturbed soil sample obtained from the borings. The test was conducted in general accordance with ASTM D 2435. The test measures the volume change (consolidation) of a soil sample under predetermined loads. The results of the consolidation testing are included in this appendix.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
	Location of sample obtained using thin-wall shelby tube or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample obtained using Dames & Moore sampler and 140-pound hammer or pushed with recovery
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown

Graphic Log of Soil and Rock Types



GEOTECHNICAL TESTING EXPLANATIONS

PP	Pocket Penetrometer	DD	Dry Density
TOR	Torvane	ATT	Atterberg Limits
CON	Consolidation	CBR	California Bearing Ratio
DS	Direct Shear	OC	Organic Content
P200	Percent Passing U.S. Standard No. 200 Sieve	P	Pushed Sample
HYD	Hydrometer Gradation	RES	Resilient Modulus
UC	Unconfined Compressive Strength	VS	Vane Shear
SIEV	Sieve Gradation	kPa	kiloPascal

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
PID	Photoionization Detector Headspace Analysis	NS	No Visible Sheen
ppm	Parts per Million	SS	Slight Sheen
P	Pushed Sample	MS	Moderate Sheen
		HS	Heavy Sheen

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KEY TO TEST PIT AND BORING LOG SYMBOLS

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOILS

Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very Loose	0 – 4	0 - 11	0 - 4
Loose	4 – 10	11 - 26	4 - 10
Medium Dense	10 – 30	26 - 74	10 - 30
Dense	30 – 50	74 - 120	30 - 47
Very Dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOILS

Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 – 6	2 - 5	0.25 - 0.50
Medium Stiff	4 - 8	6 – 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 – 25	9 - 19	1.0 - 2.0
Very Stiff	15 - 30	25 – 65	19 – 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

SOIL CLASSIFICATION NAME

Name and Modifier Terms		Constituent Percentage
Coarse Grained	GRAVEL, SAND	>50%
	sandy, gravelly	30 - 50%
	silty, clayey	15 - 50%
	some (gravel, sand)	15 - 30%
	some (silt, clay)	5 - 15%
	trace (gravel, sand)	
	trace (silt, clay)	<5%
Fine Grained	CLAY, SILT	>50%
	silty, clayey	30 - 50%
	sandy, gravelly	
	some (sand, gravel)	15 - 30%
	some (silt, clay)	
	trace (sand, gravel)	5 - 15%
	trace (silt, clay)	
Organic	PEAT	50 - 100%
	organic (soil name)	15 - 50%
	(soil name) with some organics	5 - 15%

MOISTURE CLASSIFICATION

Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

GRAIN-SIZE CLASSIFICATION

Description		Sieve*	Observed Size
boulders		-	>12"
cobbles		-	3" - 12"
gravel	coarse	0.75" - 3"	0.75" - 3"
	fine	#4 - 0.75"	0.19" - 0.75"
sand	coarse	#10 - #4	0.079" - 0.19"
	medium	#40 - #10	0.017" - 0.079"
	fine	#200 - #40	00029" - 0.017"
fines		<#200	<0.0029"

* Use of #200 field sieve encouraged

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SOIL CLASSIFICATION SYSTEM AND GUIDELINES

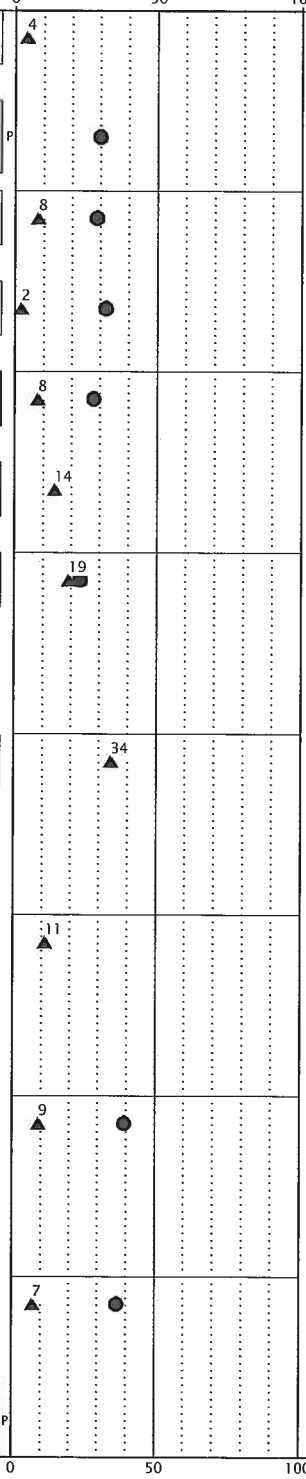
TABLE A-2

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	INSTALLATION AND COMMENTS
0	Soft, brown SILT with trace to some clay; moist, low to medium plasticity (3-inch-thick root zone).	144.0		
	Medium dense, light brown, fine to coarse SAND with some silt; moist, poorly graded.	140.5 / 3.5	DD ATT	DD = 89 pcf LL = 35% PL = 23%
5	becomes loose, brown, and silty; moist to wet and sparse fine gravel at 5.0 feet		P200	P200 = 28%
	Very soft to soft, brown, sandy SILT interbedded with very loose, light brown, fine to coarse, silty sand to fine to coarse sand with trace to some silt; moist to wet, poorly graded; contacts are gradational.	136.5 / 7.5	P200	P200 = 51%
10	Loose, light brown, fine SAND with trace to some silt; wet, poorly graded, rapid dilatancy.	134.0 / 10.0		
	becomes fine to medium at 11.5 feet	131.8 / 12.2		
15	Medium dense, brown, fine GRAVEL with trace silt and some sand to fine; wet, poorly graded, subrounded to subangular, weak cementation.			
20	becomes dark gray at 20.0 feet			
25	Medium dense, brown-gray, fine SAND with trace to some silt; wet, poorly graded; interbeds (5 inches thick) of gray, fine to coarse sand; sparse rootlets, rapid dilation.	119.0 / 25.0		Driller comment: softer drilling at 24.0 feet
30	becomes loose and gray with some silt at 30.0 feet			
35	Medium stiff, gray-brown SILT with trace fine sand; moist	109.0 / 35.0	P200	P200 = 89%
40				No sample recovery at 38.0 feet.

GRAPHIC LOG

SAMPLE

▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%



~7.0 feet, during exploration

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: BBP

COMPLETED: 01/23/07

BORING METHOD: mud rotary (see report text)

BORING BIT DIAMETER: 4 7/8-inch

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PNWP-40-01

MARCH 2007

BORING B-1

MYSLONY SITE
TUALATIN, OR

FIGURE A-1

BORING LOG PNWP-40-01-B1-8.GPJ GEODESIGN.GDT PRINT DATE: 3/28/07:RSD:RLF

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
40		Medium dense, light gray SAND with trace silt; moist. becomes gray; moist to wet at 41.2 feet	104.0 / 40.0	DD	P	▲ 15 ●	DD = 88 pcf
45						▲ 13 ●	
50		becomes fine to medium at 51.0 feet				▲ 25	
55		becomes loose and fine at 55.0 feet				▲ 9 ●	
60		Medium stiff, gray SILT with some sand; wet, rapid dilatancy.	84.0 / 60.0			▲ 7	
65		becomes very stiff and clayey with medium to high plasticity at 65.0 feet				▲ 19 ●	
70		Medium dense, dark gray, fine SAND; wet, poorly graded, rapid dilatancy.	74.0 / 70.0			▲ 16	
75		Very stiff, blue-gray, clayey SILT with light brown mottles to SILT with some clay; dry to moist, medium plasticity.	70.0 / 74.0			▲ 27 ●	Driller comment: gravel at 74.0 feet
80							

DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: BBP COMPLETED: 01/23/07

BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-1
(continued)

MYSLONY SITE
TUALATIN, OR

FIGURE A-1

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
80		Hard, light gray CLAY with light gray mottles with some silt; moist, high plasticity; possible weathered tuff.	64.0 / 80.0			▲ 42	
		Exploration completed at 81.5 feet.	62.5 / 81.5				
85							
90							
95							
100							
105							
110							
115							
120							

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BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-1
(continued)

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MYSLONY SITE
TUALATIN, OR

FIGURE A-1

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0		Soft to medium stiff, brown, sandy SILT with trace to some clay and organics (sparse rootlets to 1.0 foot); moist, medium plasticity; sand is fine to coarse increasing with depth (3-inch-thick root zone).	141.0				
		Loose, brown, fine to coarse, silty SAND; moist, poorly graded, subrounded to subangular. with trace gravel at approximately 4.5 feet	138.5 / 2.5	P200		▲ 4, ▲ 4, ●	P200 = 59%
5				P200		▲ 7, ●	P200 = 33%
		Medium stiff, light brown SILT with trace to some fine sand; moist, low plasticity.	133.5 / 7.5			▲ 5, ●	LL = NP PL = NP
10		Medium dense, brown, fine GRAVEL with trace to some silt and sand; wet, poorly graded, subrounded to subangular.	131.0 / 10.0			▲ 19	Driller comment: gravel at 10.0 feet
						▲ 13, ●	
15						▲ 25	
20						▲ 9	
		Medium dense, gray, fine to medium SAND; wet, poorly graded, rapid dilatancy.	118.0 / 23.0				
25						▲ 12, ●	
30		becomes fine at 30.0 feet				▲ 13, ●	Shut down drill at 1730 on 01/23/07. Resume drilling at 0905 on 01/24/07. Delay in drilling due to freezing weather.
35		becomes loose to medium dense with trace to some silt at 35.0 feet				▲ 11	
40		becomes loose at 38.0 feet		DD	P	●	DD = 95 pcf

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BORING B-2

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MYSLONY SITE
TUALATIN, OR

FIGURE A-2

BORING LOG PNWP-40-01-B1-8.GPJ GEODESIGN.GDT PRINT DATE: 3/28/07:RSD:RLF

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
40		(continued from previous page)					
		Medium stiff, gray SILT with trace to some fine sand; moist.	100.0 / 41.0			8	
45		Medium dense, gray, fine SAND interbedded with stiff, gray silt with some sand; wet, poorly graded, low plasticity, rapid dilatancy.	96.0 / 45.0			23	
50		Stiff, gray SILT with trace to some sand interbedded with silt and trace clay; moist, low to medium plasticity.	91.0 / 50.0			22	
55		Loose, gray, fine, silty SAND; wet, poorly graded, rapid dilatancy.	86.0 / 55.0			12	
		Stiff, gray SILT with trace to some clay; moist to wet, medium plasticity.	85.5 / 55.5				
60		with trace clay at 60.0 feet				18	
65		Medium dense, dark gray, fine to medium SAND with trace silt; moist, poorly graded.	76.0 / 65.0			29	
70		Very stiff, gray, clayey SILT to silty CLAY; moist, high plasticity.	70.0 / 71.0			21	
		Medium dense, dark gray, fine to medium SAND with trace silt; moist, poorly graded.	69.6 / 71.4				
75		Stiff, red-brown CLAY with some silt; moist, medium to high plasticity.	67.0 / 74.0			13	
80							

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BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-2
(continued)

MARCH 2007

MYSLONY SITE
TUALATIN, OR

FIGURE A-2

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
80		(continued from previous page)				13	
		Exploration completed at 81.5 feet.	59.5 / 81.5				
85							
90							
95							
100							
105							
110							
115							
120							

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BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-2
(continued)

MARCH 2007

MYSLONY SITE
TUALATIN, OR

FIGURE A-2

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0		Very loose, light brown, fine to coarse SAND with trace to some silt, clay, and fine gravel; moist to wet, poorly graded, subrounded to subangular (1-inch-thick root zone).	146.0				
		Medium stiff, brown, sandy SILT; moist, low plasticity.	143.5 / 2.5	P200		1; 6	P200 = 54%
5				DD CON	P		DD = 90 pcf
						22	
10						18	
						16	
15		Very dense, brown, fine to coarse GRAVEL with trace silt and sand; wet, poorly graded, subrounded. with cobble layer from 15.5 to 16.3 feet	131.0 / 15.0			8-50/4"	
20		Medium dense, gray, fine SAND; wet, poorly graded.	126.0 / 20.0				
		Stiff, dark gray SILT with trace clay and organics; moist, low plasticity.	125.2 / 20.8	P200		11	P200 = 67%
25		becomes gray with trace to some clay and trace sand; moist to wet and medium plasticity at 25.0 feet	120.5 / 25.5			26	
		Medium dense, dark gray, fine to medium SAND; wet, poorly graded.	119.5 / 26.5				
		Exploration completed at 26.5 feet.					
30							
35							
40							

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BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-3

MYSLONY SITE
TUALATIN, OR

FIGURE A-3

BORING LOG PNWP-40-01-B1-8.GPJ GEODESIGN.GDT PRINT DATE: 3/28/07:RSD:RLF

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	INSTALLATION AND COMMENTS
0	Loose, fine SAND with trace silt and clay; moist, low to medium plasticity; common rootlets to 1.0 foot (1-inch-thick root zone).	140.5		
	Soft, dark brown, organic SILT; wet, low to medium plasticity.	138.0 / 2.5	DD CON ATT	DD = 47 pcf LL = 125% PL = 76%
5	with some organics and trace sand at approximately 5.5 feet			
	Loose, dark gray, fine to coarse, silty SAND with trace fine gravel; moist, poorly graded, subrounded.	133.0 / 7.5	P200	P200 = 37%
10	Medium dense, dark gray, fine to coarse GRAVEL with some sand; wet, poorly graded, subrounded to subangular.	130.5 / 10.0		
	Medium dense, brown, fine to coarse SAND with some silt and trace fine gravel; wet, poorly graded, subrounded to subangular.	128.0 / 12.5		
15				
20	Medium dense, dark gray, fine to coarse GRAVEL with some silt and sand; wet, poorly graded, subrounded to subangular.	120.5 / 20.0	P200	P200 = 45%
	Medium stiff to stiff, light brown SILT; moist, low plasticity.	120.1 / 20.4		
	Loose, light brown, fine to medium SAND; wet, poorly graded.	119.7 / 20.8		
25	becomes medium dense, light gray and fine with trace silt and rapid dilatancy at 25.0 feet	114.0 / 26.5		
	Exploration completed at 26.5 feet.			
30				
35				
40				

SAMPLE: P

▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%

Blow count: 2, 2, 9, 15, 13, 15, 8, 13

Moisture content: 0 – 50 – 100

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BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-4

MYSLONY SITE
TUALATIN, OR

FIGURE A-4

BORING LOG PNWP-40-01-B1-8.GPJ GEODESIGN.GDT PRINT DATE: 3/28/07:RSD:RLF

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % RQD% CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0		Medium stiff, brown SILT with trace clay and organics and some sand; moist, low to medium plasticity (2-inch-thick root zone).	141.0				
		Loose, light brown, silty SAND with trace clay; moist, low plasticity.	138.5 / 2.5				
5		with trace to some silt and without clay at 5.0 feet					
		becomes light gray at approximately 5.8 feet	134.5 / 6.5				
		Exploration completed at 6.5 feet.					
10							
15							
20							
25							
30							
35							
40							

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BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-5

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MYSLONY SITE
TUALATIN, OR

FIGURE A-5

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0		Very loose, brown, fine to coarse SAND with some silt and trace clay and organics; moist, poorly graded, subrounded to subangular (2-inch-thick root zone).	141.0			2	
		Very soft, light brown SILT; moist, low plasticity.	138.5 / 2.5			5	
		Loose, light brown, fine SAND; moist to wet, poorly graded.	138.0 / 3.0			6	Bottom of sampler is wet at 4.0 feet.
		Exploration completed at 6.5 feet.	134.5 / 6.5				
5							
10							
15							
20							
25							
30							
35							
40							

DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: BBP COMPLETED: 01/24/07

BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-6

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MYSLONY SITE
TUALATIN, OR

FIGURE A-6

BORING LOG PNWP-40-01-B1-8.GPJ GEODESIGN.GDT PRINT DATE: 3/28/07:RSD:RLF

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0		Very loose, brown, fine to coarse, silty SAND with trace clay; moist, poorly graded (1-inch-thick root zone).	146.0			▲ 2	
		Medium stiff, brown, sandy SILT to silty SAND; moist, medium plasticity, poorly graded.	143.5 / 2.5			▲ 7	
5		Loose to medium dense, light brown, fine to medium SAND with trace to some silt and trace clay; moist, poorly graded.	141.0 / 5.0			▲ 10 ●	
		Exploration completed at 6.5 feet.	139.5 / 6.5				
10							
15							
20							
25							
30							
35							
40							

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BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-7

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MYSLONY SITE
TUALATIN, OR

FIGURE A-7

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0		Very loose, brown, fine to coarse SAND with trace to some silt and trace clay; moist, poorly graded.	145.0			▲ 3	
				DD	P	●	DD = 93 pcf
		becomes loose, fine to medium, and without clay at 3.5 feet	140.5 / 4.5				Drilling equipment failure at 4.5 feet.
		Exploration completed at 4.5 feet.					
5							
10							
15							
20							
25							
30							
35							
40							

DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: BBP COMPLETED: 01/24/07

BORING METHOD: mud rotary (see report text) BORING BIT DIAMETER: 4 7/8-inch

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BORING B-8

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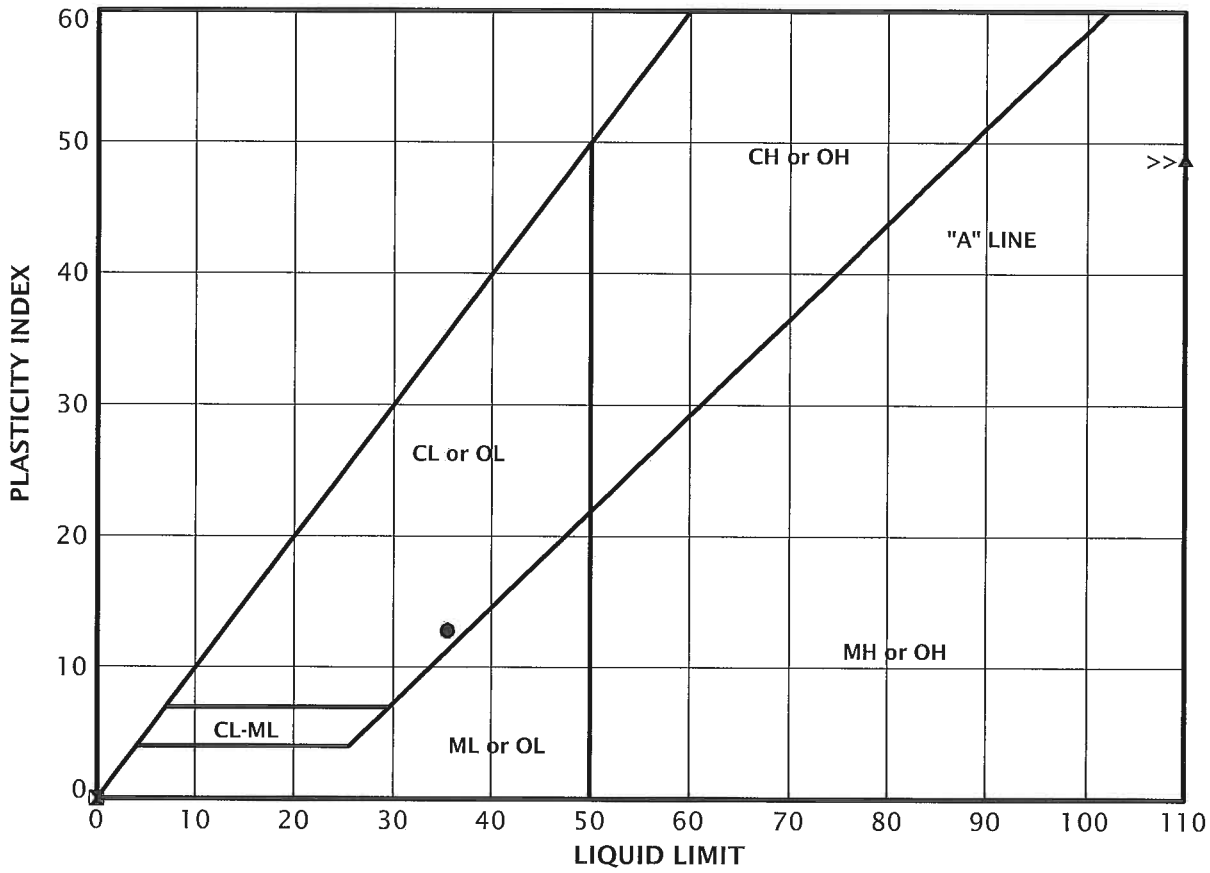
MYSLONY SITE
TUALATIN, OR

FIGURE A-8



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-1	2.5	29	35	23	12
⊠	B-2	7.5	37	NP	NP	NP
▲	B-4	2.5	94	125	76	49

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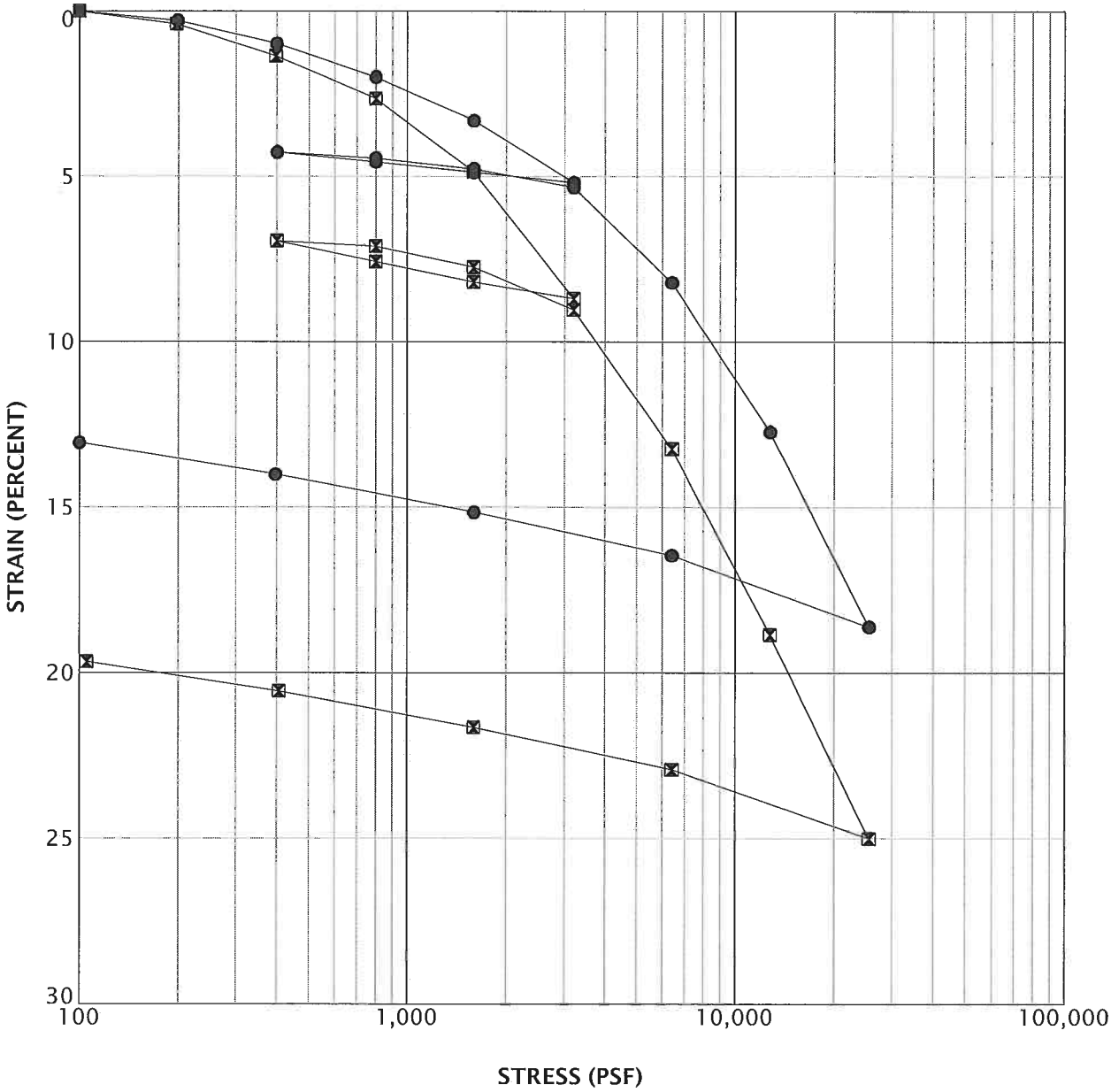
ATTERBERG LIMITS TEST RESULTS

MYSLONY SITE
TUALATIN, OR

FIGURE A-9

ATTERBERG_LIMITS 7 PNWP-40-01-B1-8.GPJ GEODESIGN.GDT PRINT DATE: 3/28/07:RSD:RLF



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)
●	B-3	5.5	29	90
⊠	B-4	2.5	94	47

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CONSOLIDATION TEST RESULTS

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FIGURE A-10

CONSOL_STRAIN_100K PNWP-40-01-B1-8.GPJ GEODESIGN.GDT PRINT DATE: 3/28/07:RSD:RLF

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT (PERCENT)	PLASTIC LIMIT (PERCENT)	PLASTICITY INDEX (PERCENT)
B-1	2.5	141.5	30	89				35	23	12
B-1	5.0	139.0	29				28			
B-1	7.5	136.5	32				51			
B-1	10.0	134.0	28							
B-1	15.0	129.0	23							
B-1	30.0	114.0	39							
B-1	35.0	109.0	37				89			
B-1	40.0	104.0	36	88						
B-1	45.0	99.0	37							
B-1	55.0	89.0	36							
B-1	65.0	79.0	29							
B-1	75.0	69.0	36							
B-2	2.5	138.5	36				59			
B-2	5.0	136.0	32				33			
B-2	7.5	133.5	37					NP	NP	NP
B-2	12.5	128.5	25							
B-2	25.0	116.0	34							
B-2	30.0	111.0	36							
B-2	38.0	103.0	29	95						
B-2	50.0	91.0	30							
B-2	60.0	81.0	32							
B-2	75.0	66.0	44							
B-3	2.5	143.5	32				54			
B-3	5.0	141.0	29							
B-3	5.5	140.5	29	90						
B-3	10.0	136.0	23							
B-3	12.5	133.5	24							

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SUMMARY OF LABORATORY DATA

MYSLONY SITE
TUALATIN, OR

FIGURE A-11

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT (PERCENT)	PLASTIC LIMIT (PERCENT)	PLASTICITY INDEX (PERCENT)
B-3	20.0	126.0	32				67			
B-4	2.5	138.0	94	47				125	76	49
B-4	4.5	136.0	68							
B-4	7.5	133.0	37				37			
B-4	12.5	128.0	30							
B-4	15.0	125.5	25							
B-4	20.0	120.5	34				45			
B-4	25.0	115.5	36							
B-5	2.5	138.5	37							
B-5	5.0	136.0	37							
B-6	2.5	138.5	36							
B-6	5.0	136.0	32							
B-7	5.0	141.0	30							
B-8	2.5	142.5	26	93						

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SUMMARY OF LABORATORY DATA
(continued)

MYSLONY SITE
TUALATIN, OR

FIGURE A-11

ACRONYMS

ACRONYMS

AC	asphalt concrete
ASTM	American Society for Testing and Materials
BGS	below the ground surface
ESAL	equivalent single-axle load
g	gravitational acceleration (32.2 feet/second^2)
H:V	horizontal to vertical
HMAC	hot mix asphalt concrete
IBC	International Building Code
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Standard Specifications for Construction (2002)
pcf	pounds per cubic foot
pci	pounds per cubic inch
PG	performance grade
PGA	peak ground acceleration
psf	pounds per square foot
psi	pounds per square inch
SOSSCA	State of Oregon 2007 Structural Specialty Code Amendments

Appendix 5

Operation and Maintenance

Stormwater Facility Maintenance and Operation Plan

Tualatin Business Park

December 2014

Project Owner:	Pacific NW Properties, Inc.
Facility Address:	112th and Myslony Street Tualatin, Oregon
Jurisdiction:	City of Tualatin
Case Files:	
Civil Engineer:	TM Rippey Consulting Engineers Karl Koroch, PE 7650 SW Beveland Street Suite 100 Tigard, Oregon 97223

Responsibility:
The storm drainage facilities will be maintained by the owner's maintenance staff.

Description:
This sites are approximately 7 acres of building and paving. Storm runoff at each site is directed to underground chambers to provide detention for runoff flow control. Outflow is limited by a control manhole at the 112th frontage at each site. Runoff treatment is provided by treatment vaults containing a series of cartridges. The site facilities discharge to a public conveyance system located in SW 112th.

Inspection and Maintenance Schedule:
The system shall be inspected and maintained monthly and within 48 hours after each major storm event. For this O & M plan, a major storm event is defined as greater than 0.5 inches of rainfall in 24 hours. All components of storm system must be maintained frequently or they will cease to function effectively. The owner shall keep a log, recording inspection dates, observations, and maintenance activities. Receipts shall be saved when maintenance is performed and there is a record of expense.

Inspection and Maintenance Schedule:
The following items shall be inspected and maintained as stated:

Detention System:

- Check condition of detention piping biannually. Contact ADS StormTech Stormwater Management, Inc. for inspection and maintenance of detention chambers.
- Sediment shall be removed from detention pipes biannually.
- Quarterly inspection for clogging shall be performed.

Flow Control Structure and Piping:

- Check condition of control structure and internal components annually.
- Sediment shall be removed from around overflow riser and from pipes biannually.
- Quarterly inspection for clogging shall be performed.

Contech Treatment System:

- Check condition of structure, internal components, and piping biannually. Contact Contech, Inc. for inspection and maintenance of treatment cartridges.
- Sediment shall be removed from inlet sump biannually.
- Quarterly inspection for clogging shall be performed.

Source Control:
Source control measures prevent pollutants form mixing with stormwater. Typical non-structural control measures include raking and removing leaves and limited and controlled application of pesticides, herbicides, and fertilizers.

Spill Prevention:
Spill prevention measures shall be exercised when handling substances that can contaminate stormwater. Virtually all sites present dangers from spills. If hazardous substances are spilled within the vicinity of the stormwater facilities, identify the spill and provide appropriate cleanup and notify appropriate authorities.

Insects and Rodents:

- Insects and rodents shall not be harbored in any part of the storm system.
- Pest control measures shall be taken when insects or rodents are found to be present. Standing water and food sources shall be prevented.
- If sprays are considered, a mosquito larvicide such as Bacillus thurendensis or Altoside formulations can be applied only if absolutely necessary and shall not be used where it will enter the groundwater or come into contact with any standing water. Sprays shall be applied only by licensed individuals or contractors.
- Holes in the ground located in and around the storm system shall be filled.

- Outfalls draining into vegetated swales shall be inspected and cleaned regularly to

ensure no rodent activity, which can clog or decrease the efficiency of the storm system.

Access:
Access shall be maintained for all facilities so operation and maintenance can be performed as regularly scheduled.

CONTECH
CONSTRUCTION PRODUCTS INC.

StormFilter Inspection and Maintenance Procedures

The Stormwater Management
StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are likely many effective maintenance options, we believe the following procedure is efficient and can be implemented using common equipment and existing maintenance protocols. A two step procedure is recommended as follows:

1. Inspection

Inspection of the vault interior to determine the need for maintenance.

2. Maintenance

Cartridge replacement

Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, in late summer to early fall when flows into the system are not likely to be present.

Maintenance Frequency

The primary factor controlling timing of maintenance of the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs.

Prior to the development of the maintenance database, the following maintenance frequencies should be followed:

Inspection

One time per year

After major storms

Maintenance

As needed, based on results of inspection (The average maintenance lifecycle is approximately 1-3 years)

Per Regulatory requirement

In the event of a chemical spill

Frequencies should be updated as required. The recommended initial frequency for inspection is one time per year. StormFilter units should be inspected after major storms.

Sediment removal and cartridge replacement on an as needed basis is recommended unless site conditions warrant.

Once an understanding of site characteristics has been established, maintenance may not be needed for one to three years, but inspection is warranted and recommended annually.

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

To conduct an inspection:

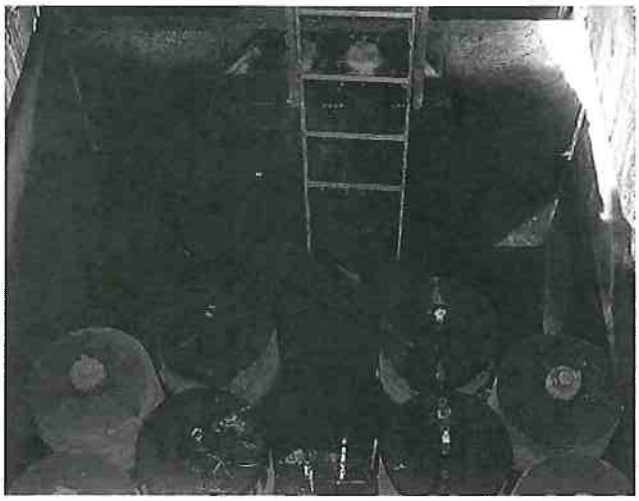
Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.

3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to weather or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered)



1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water in the cartridge bay for more that 24 hours after end of rain event, maintenance is required.
4. Plugged media.
   a. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.
8. Calendar Lifecycle.
   a. If system has not been maintained for 3 years maintenance is required.

Assumptions

- No rainfall for 24 hours or more
- No upstream detention (at least not draining into StormFilter)
- Structure is online
- Outlet pipe is clear of obstruction
- Construction bypass is plugged

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from CONTECH Construction Products.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and CONTECH Construction Products immediately.

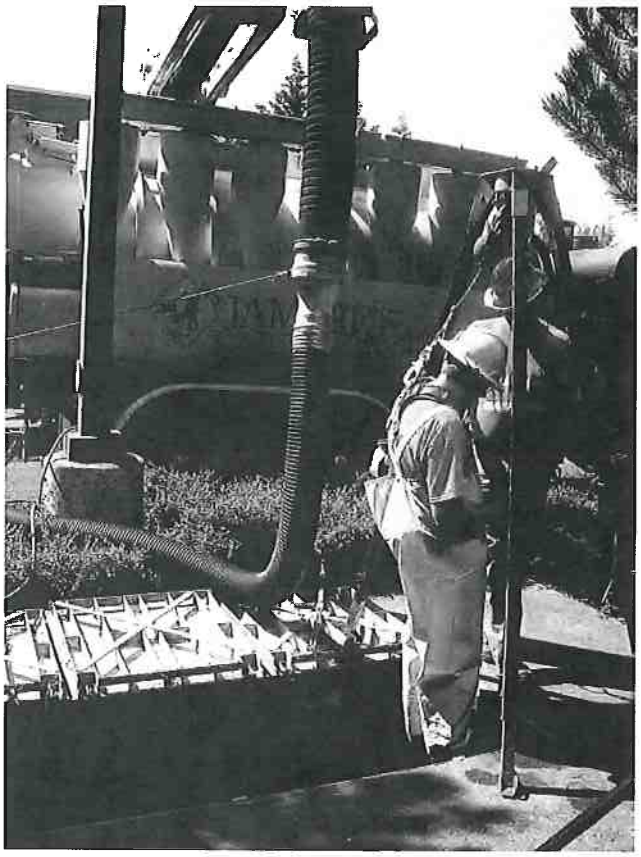
To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Unscrew (counterclockwise rotations) each filter cartridge from the underdrain connector. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact CONTECH Construction Products for suggested attachment devices.



Important: Note that cartridges containing leaf media (CSF) do not require unscrewing from their connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and could be capped during the maintenance activity to prevent sediments from entering the underdrain manifold.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless CONTECH Construction Products performs the maintenance activities and damage is not related to discharges to the system.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. Enter the vault using appropriate confined space protocols.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood screws (3) hood and float.

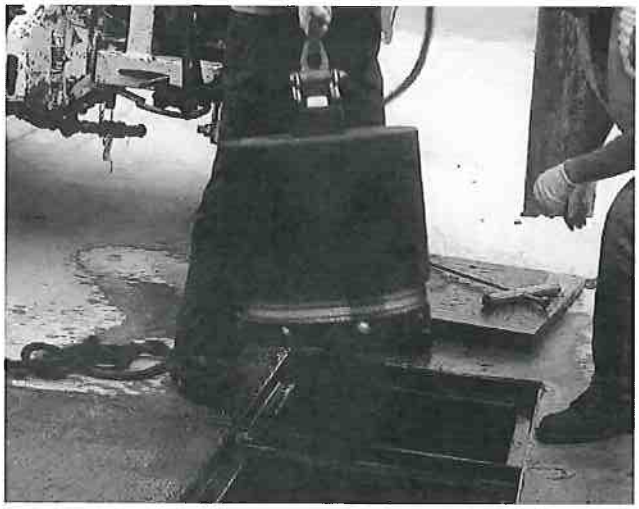
D. At location under structure access, tip the cartridge on its side.

Important: Note that cartridges containing media other than the leaf media require unscrewing from their threaded connectors. Take care not to damage the manifold connectors. This connector should remain installed in the manifold and capped if necessary.

D. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

E. Set the empty, used cartridge aside or load onto the hauling truck.

F. Continue steps a through e until all cartridges have been removed.



8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors. The connectors are short sections of 2-inch schedule 40 PVC, or threaded schedule 80 PVC that should protrude about 1" above the floor of the vault. Lightly wash down the vault interior.
   a. Replace any damaged connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used empty cartridges to CONTECH Construction Products.

Related Maintenance Activities -

Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

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CONTECH CONSTRUCTION PRODUCTS INC.
800.338.1122
www.contech-cpi.com

Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our engineers.

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CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; related foreign patents or other patents pending.

Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other ☐

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service:

Oil in Forebay: Yes ☐ No ☐

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____