MACKENZIE.

PRELIMINARY STORMWATER DRAINAGE REPORT

To
City of Tualatin

For
Lam Campus AR Submittal

Dated
July 16, 2025

Project Number
2250180.00

MACKENZIE
Since 1960
© 2025 Mackenzie Inc.

RiverEast Center | 1515 SE Water Avenue, Suite 100, Portland, OR 97214
PO Box 14310, Portland, OR 97293 | T 503.224.9560 | www.mackenzie.inc

TABLE OF CONTENTS

I. Project Introduction 1
II. Stormwater Quality Treatment 3
Hydromodification Areas Only (Cyan) 3
Detention Areas Only (Pink) 3
Water Quality and Detention Areas (Yellow) 3
III. Stormwater Quantity Management 4
Downstream Analysis 4
Hydromodification Areas Only (Cyan) 5
Building H, Lab/CUB, and Access Road 5
Detention Areas Only (Pink) 5
Detention Areas (Yellow) 6
Parking Areas 6
IV. Conclusion 8

APPENDICES

A. Stormwater Quality Calculations
B. Stormwater Detention Calculations
C. 2024 LAM Storm Drainage Report

I. PROJECT INTRODUCTION

Lam Research is proposing to construct a new office, Lab (laboratory), and CUB (central utility building) Building, along with additional parking at their existing campus on SW Leveton Drive in Tualatin, Oregon. The new buildings will be located north of Building G, west of Building D, and south of Building F. To support the new buildings, new parking fields will be dispersed throughout the campus. Since the time of the last campus plan, Lam has purchased another approximately 17.9-acre parcel from their neighbor, JAE, to the west of the main campus. This report will focus on the updated areas of the campus only. The approved stormwater report completed with Building G and attached to this report will be used as the existing conditions and to denote a starting point from where changes are occurring. The vicinity map and site plan below show the location and layout of the site relative to nearby geographic features.

Figure 1: Vicinity Map

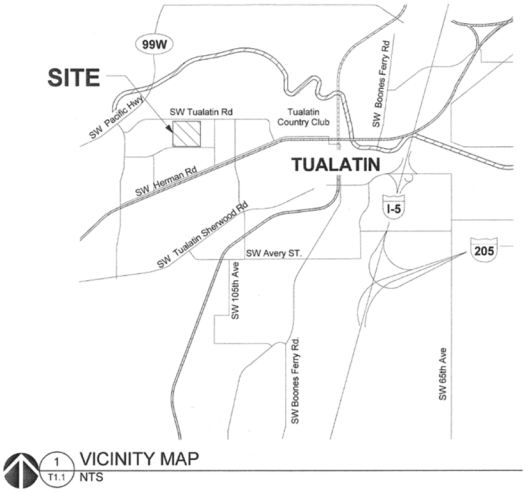
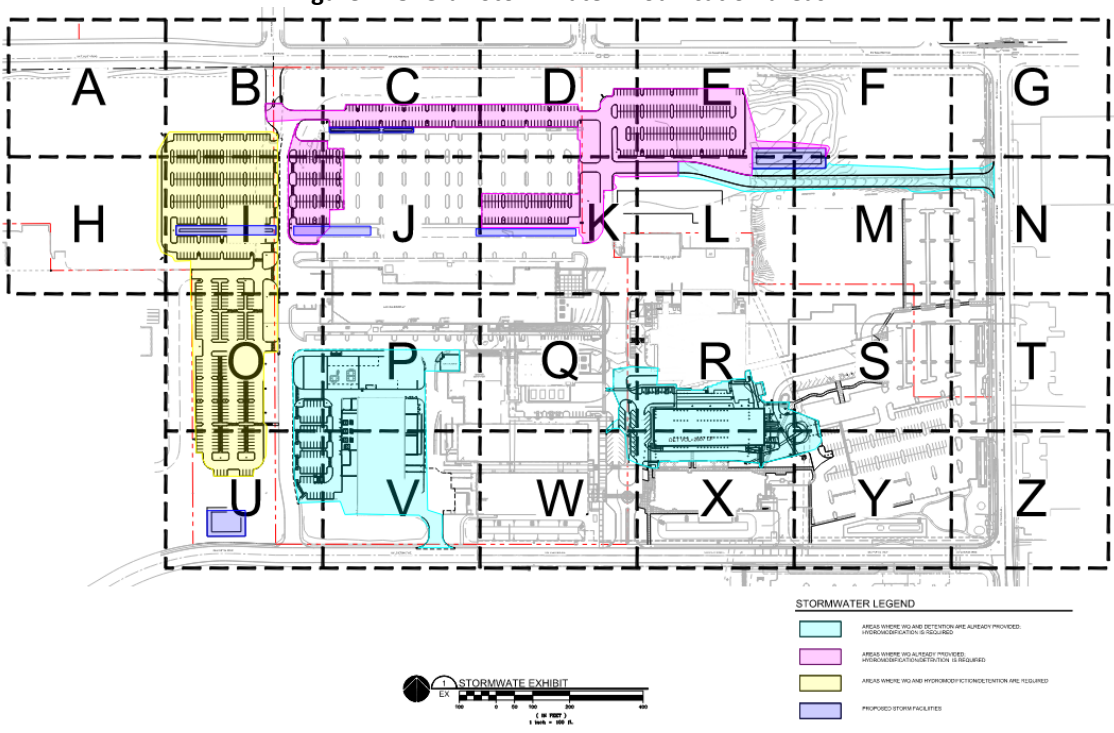


Figure 2: Overall Stormwater Modification areas



Stormwater drainage and treatment will be provided in accordance with current Clean Water Services and City of Tualatin standards through a series of facilities across campus:

Cyan areas (Hydromodification only areas):

- Water Quality accounted for with previous development.
- Areas currently meeting CWS and previously matching 2-, 10-, and 25-year existing runoff rates requirements.
- Hydromodification volume required for these areas to bring them up to code.

Pink(Detention only) areas:

- Water Quality accounted for in existing ponds near Leveton.
- Detention volume not available is existing downstream ponds due to previous development.
- Hydromodification/Detention required.

Yellow (Water Quality and Detention areas) areas:

- Water quality required.
- Hydromodification/Detention required.

Blue proposed new storm:

- Detention and Water Quality Facilities.

The following summarizes the design for the proposed stormwater management approach.

II. STORMWATER QUALITY TREATMENT

Water quality treatment at the new development on the Lam Campus will be provided through a collection of existing, modified, and new facilities. The following summarizes the facilities within each basin type:

Hydromodification Areas Only (Cyan)

Proposed improvements within the cyan areas include new parking, redeveloped parking, new Lab, CUB, and Building H, along with a realigned roadway out to 108th. Runoff from the new/redeveloped impervious surfaces will be routed to existing storm treatment facilities along Leveton. The roadway going out to 108th will be treated in the existing pond in the southeast corner of the site. Therefore, water quality is currently accommodated for these areas.

Detention Areas Only (Pink)

Proposed improvements within the pink areas include new parking and redeveloped parking. Runoff from the new/redeveloped impervious surfaces will be routed to existing storm treatment facilities along Leveton. Therefore, as per the cyan areas, no new proposed water quality treatment is proposed.

Water Quality and Detention Areas (Yellow)

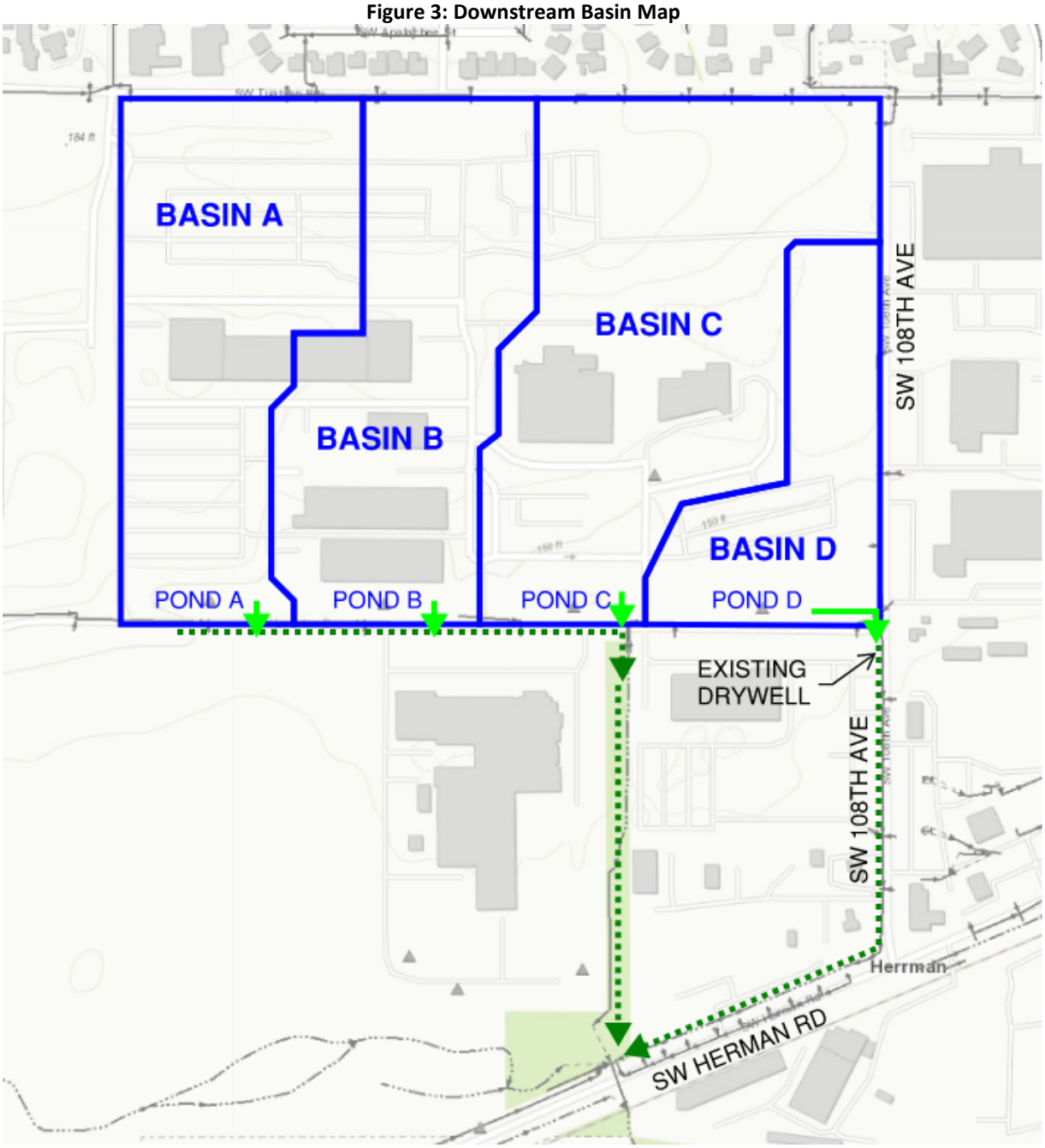
Proposed improvements within the yellow areas include new parking. These areas are in the recently purchased property from JAE and therefore have no existing water quality associated with them. Therefore, water quality treatment for the runoff from these areas will be required. The treatment will be accomplished through newly developed extended dry ponds and swales.

III. STORMWATER QUANTITY MANAGEMENT

Downstream Analysis

The existing Lam Research campus storm drainage system connects to the public storm system along Leveton Drive as depicted below. An additional connection will be required from the new pond on the recently annexed JAE portion of the campus. The full downstream analysis was completed in a prior report attached herein (Appendix C). Since all proposed improvements are designed to release at less than existing runoff rates, due to hydromodification implementation, no increases to existing runoff rates are proposed, and therefore no adverse impacts to downstream infrastructure are anticipated.

Figure 3: Downstream Basin Map



Hydromodification Areas Only (Cyan)

Proposed improvements within the cyan areas include a new Lab, CUB, and Building H, along with modified parking and a realigned access drive aisle out to 108th. Runoff from the new/redeveloped impervious surfaces will be routed to existing storm water facilities located along Leveton. These areas currently have detention meeting the old CWS standards applied to them. Therefore, these areas will be required to meet the new hydromodification requirements for the new or redeveloped impervious surfaces. These areas have been divided into three areas: the areas surrounding proposed Building H; the area surrounding the proposed Lab and CUB Buildings; and the realigned access drive out to 108th. The hydromodification requirements have been previously determined; see previously approved stormwater report attached (Appendix C). The main difference is the release of the developed 2-year storm event is now calculated to be ½ of the existing 2-year runoff rate.

Building H, Lab/CUB, and Access Road

The disturbed redeveloped areas around H, Lab/CUB, and Access Road consists of:

Table 1 – Hydromodification Only			
	Building H	Lab/CUB	Access Road
Basin area	2.75 ac	3.94 ac	1.10 ac
Proposed Impervious	2.06 ac	3.59 ac	0.73 ac
Proposed Pervious	0.69 ac	0.36 ac	0.37 ac
2-year Detention Volume	4,242 cf	6,443 cf	1,576 cf
Hydrograph½ 2-year Detention Volume	6,849 cf	12,439 cf	2,505 cf
Additional Required Volume	2,607 cf	5,996 cf	923 cf

The areas were routed through the software package Hydraflow meeting existing predeveloped runoff rates for the 2-year event and then rerouted releasing at half the existing predeveloped 2-year runoff rate. The difference in the two volumes is attributed to hydromodification requirements. The additional volume of 2,607 cf for Building H is being proposed to be accomplished by installing 207 lf of 48" detention pipe on the east side of Building H. The additional volume of 5,996 cf for the Lab and CUB redeveloped area is proposed to be accomplished by ensuring the new pond at the Southern portion of the new JAE annexed area has an additional 6,125 cf of detention volume. The access road will be routed to the pond at the southeast corner of the site. An additional 923 cf of detention volume will be added to the system.

Detention Areas Only (Pink)

Proposed improvements within the pink areas include new parking. Runoff from the new impervious surfaces will be routed to new storm water facilities adjacent to the parking fields. These areas currently have no detention allotted them, since the previously approved Building G Expansion utilized the extra volume capacity to meet hydromodification. Therefore, these areas will be required to meet the full hydromodification/detention requirements for the new or redeveloped impervious surfaces. The pink areas have been divided into four areas. Each parking field will be developed with a dry detention basin. The detention/hydromodification numbers have been identified below. These newly developed areas will

be connected to the existing storm system on site and routed through the existing ponds adjacent to Leveton prior to being released to the public storm system in Leveton.

The disturbed redeveloped areas around Parking Areas.

Table 2 – Detention Only Areas				
	Parking Northwest	Parking Northeast	Parking Southwest	Parking Southeast
Basin area	1.80 ac	2.29 ac	0.84 ac	1.30 ac
Proposed Impervious	1.13 ac	1.58 ac	0.69 ac	0.92 ac
Proposed Pervious	0.67 ac	0.71 ac	0.15 ac	0.38 ac
Detention Volume	9,310 cf	11,671 cf	4,827 cf	6,526 cf
WQ Volume	n/a	n/a	n/a	n/a
Total Volume	9,310 cf	11,671 cf	4,827 cf	6,526 cf

The following table summarizes the flow from each pond.

Table 3 – Detention Only Areas Release Rates				
	Parking northwest	Parking northeast	Parking southwest	Parking southeast
Existing 2-year Existing 5-year Existing 10-year	0.26 cfs 0.44 cfs 0.56 cfs	0.34 cfs 0.56 cfs 0.71 cfs	0.12 cfs 0.21 cfs 0.26 cfs	0.19 cfs 0.32 cfs 0.40 cfs
Developed 2-year Developed 5-year Developed 10-year	2-year: 0.73 cfs 5-year: 0.99 cfs 10-year: 1.15 cfs	2-year: 0.98 cfs 5-year: 1.33 cfs 10-year: 1.53 cfs	2-year: 0.43 cfs 5-year: 0.55 cfs 10-year: 0.63 cfs	2-year: 0.59 cfs 5-year: 0.79 cfs 10-year: 0.90 cfs
Release 2-year Release 5-year Release 10-year	½ 2-year: 0.13 cfs 5-year: 0.17 cfs 10-year: 0.19 cfs	½ 2-year: 0.17 cfs 5-year: 0.22 cfs 10-year: 0.24 cfs	½ 2-year: 0.06 cfs 5-year: 0.07 cfs 10-year: 0.07 cfs	½ 2-year: 0.08 cfs 5-year: 0.09 cfs 10-year: 0.09 cfs

Detention Areas (Yellow)

Proposed improvements within the yellow areas include new parking. Runoff from the new impervious surfaces will be routed to new storm water facilities adjacent to the parking fields and adjacent to Leveton. These areas currently have no WQ or detention. Therefore, these areas will be required to meet the full hydromodification/detention requirements for the new or redeveloped impervious surfaces. These areas have been divided into two areas. Each parking field will be developed with a dry detention basin. The detention/hydromodification numbers have been identified below.

Parking Areas

The disturbed redeveloped areas around Parking Areas.

Table 4 – Annexed JAE New Areas		
	Parking North	Parking South
Basin area	2.78 ac	3.68 ac
Proposed Impervious	2.17 ac	2.19 ac
Proposed Pervious	0.61 ac	1.49 ac
Detention Volume	6,904 cf	13,055 cf
WQ Volume	2,835 cf	2,862 cf
Total Volume	9,739 cf	15,917 cf

The following table summarizes the flow from each pond.

Table 5 – Annexed JAE Facility Release Rates		
	Parking North	Parking South
Existing 2-year Existing 5-year Existing 10-year	0.41 cfs 0.69 cfs 0.86 cfs	0.54 cfs 0.91 cfs 1.14 cfs
Developed 2-year Developed 5-year Developed 10-year	2-year: 1.34 cfs 5-year: 1.76 cfs 10-year: 2.01 cfs	2-year: 1.49 cfs 5-year: 2.04 cfs 10-year: 2.36 cfs
Release ½ 2-year Release 5-year Release 10-year	½ 2-year: 0.2 cfs 5-year: 0.27 cfs 10-year: 0.31 cfs	½ 2-year: 0.27 cfs 5-year: 0.36 cfs 10-year: 0.41 cfs

IV. CONCLUSION

The proposed building and parking expansion at the Lam Research campus will increase the impervious area coverage on campus by approximately 2.8 ac. The Stormwater facilities for the developed/redeveloped areas on the original Lam campus have capacity for water quality to be provided for in the existing facilities. In addition, approximately 4.4 ac of impervious area will be added to the newly acquired JAE property. Stormwater runoff treatment from the newly annexed areas will be done through dry detention basins which will discharge to Leveton.

Detention will be provided to new Clean Water Services standards to meet hydromodification requirements for new/redeveloped impervious area. Some areas will only need to provide the upgrade for additional detention to meet hydromodification requirement. Other areas will need to provide the current standard for full hydromodification/detention standards. The proposed modifications to the existing and proposed stormwater facilities will ensure that the campus improvements are in compliance with current CWS standards and requirements.

Appendix A

Water Quality Caclulations- LAM

Project Number: 2250180.00

Date: July 16, 2025

Table 4 Annexed JAE New Areas		
	Parking North	Parking South
Basin area	2.78 ac	3.68 ac
Proposed Impervious	2.17 ac	2.19 ac
Proposed Pervious	0.61 ac	1.49 ac
Detention Volume	6,904	13,055 cf
WQ Volume	2,835 cf	2,862 cf
Total Volume	X cf	X cf

Q=CIA C=1.0

I=0.36"

Parking North= 2836 cf

Parking South= 2862 cf

Appendix B

Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Reports & Calc Templates\Calc Templates\Stormwater\Hydraflow Stormwater Precipitation Data\CWS precipitation.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.50	0.00	3.10	3.45	3.90	4.20	4.50
SCS 6-Hr	0.00	1.05	0.00	1.25	1.55	1.70	1.80	1.90
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

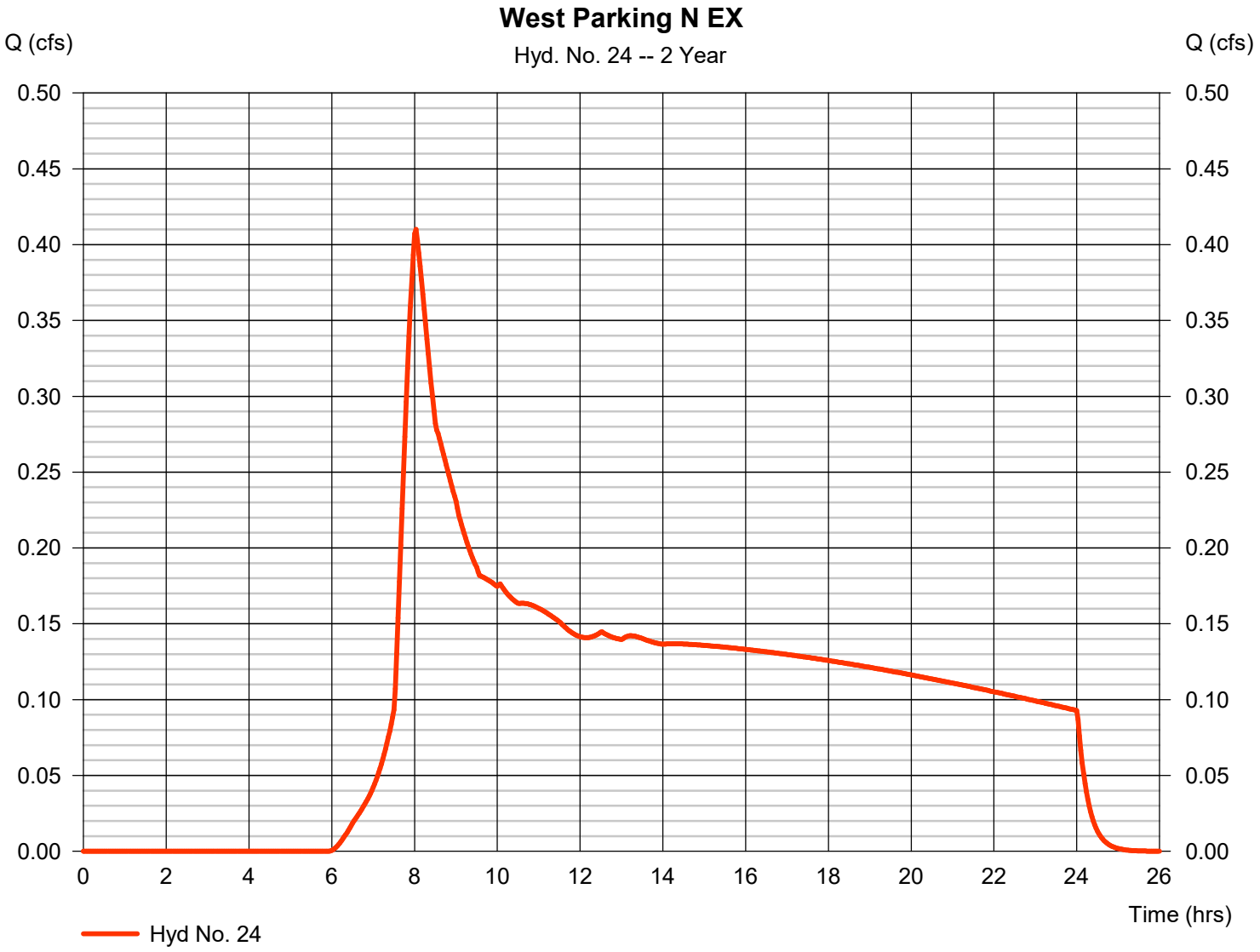
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 24

West Parking N EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.410 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 8,970 cuft
Drainage area	= 2.780 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

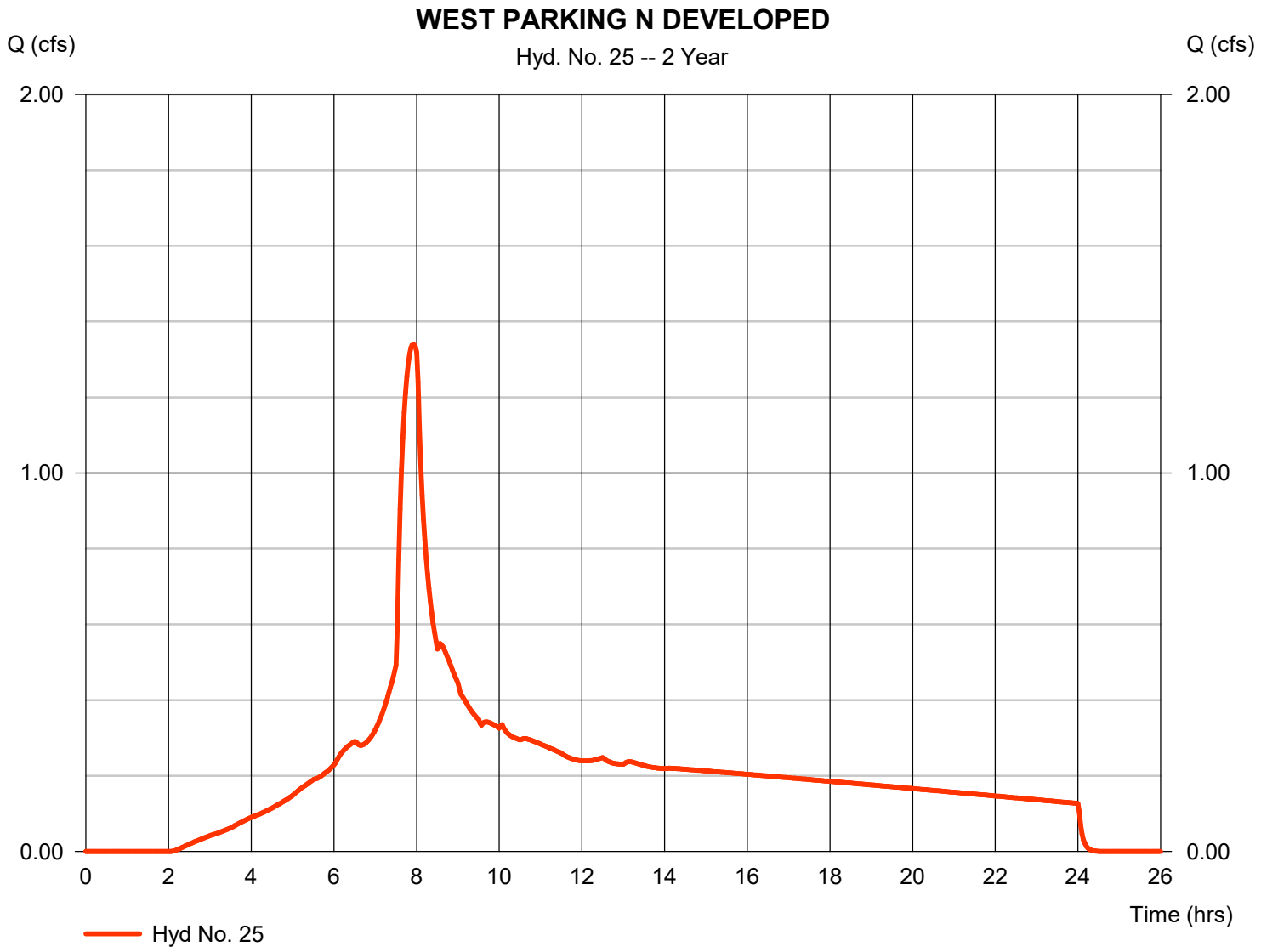
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 25

WEST PARKING N DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.341 cfs
Storm frequency	= 2 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 18,865 cuft
Drainage area	= 2.780 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.170 x 98) + (0.610 x 80)] / 2.780



Hydrograph Report

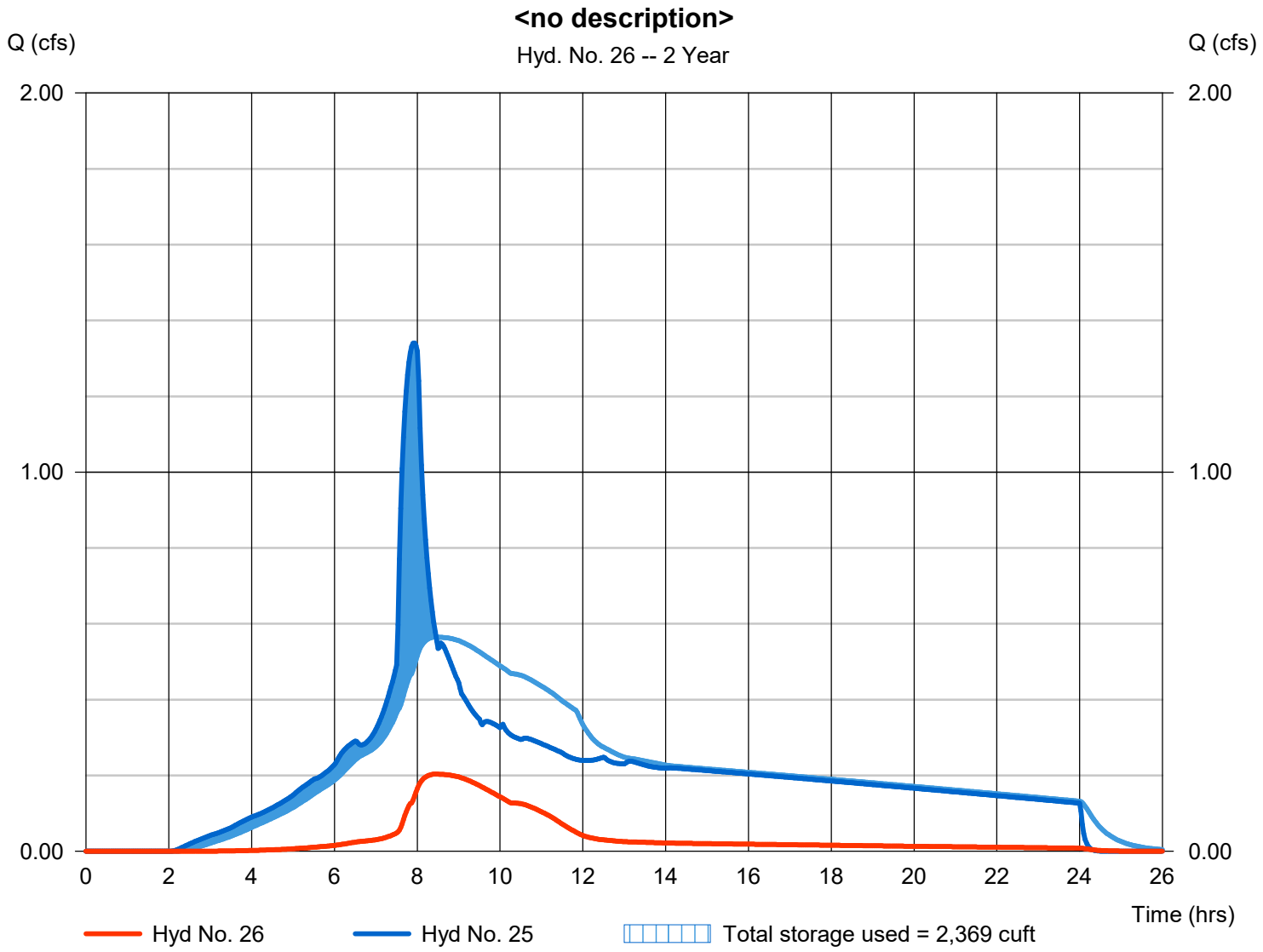
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 26

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.203 cfs
Storm frequency	=	2 yrs	Time to peak	=	8.47 hrs
Time interval	=	2 min	Hyd. volume	=	3,168 cuft
Inflow hyd. No.	=	25 - WEST PARKING N DEVELOPED	Max. Elevation	=	100.49 ft
Reservoir name	=	WEST NORTH DETENTION	Max. Storage	=	2,369 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 — Wednesday, 07 / 16 / 2025

Pond No. 13 - WEST NORTH DETENTION

Pond Data

Trapezoid -Bottom L x W = 16.6 x 263.6 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 1.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	4,367	0	0
0.15	100.15	4,620	674	674
0.30	100.30	4,875	712	1,386
0.45	100.45	5,131	750	2,137
0.60	100.60	5,389	789	2,926
0.75	100.75	5,648	828	3,753
0.90	100.90	5,909	867	4,620
1.05	101.05	6,172	906	5,526
1.20	101.20	6,436	946	6,472
1.35	101.35	6,702	985	7,457
1.50	101.50	6,970	1,025	8,482

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 3.90	0.00	0.00	0.00
Span (in)	= 3.90	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 100.00	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

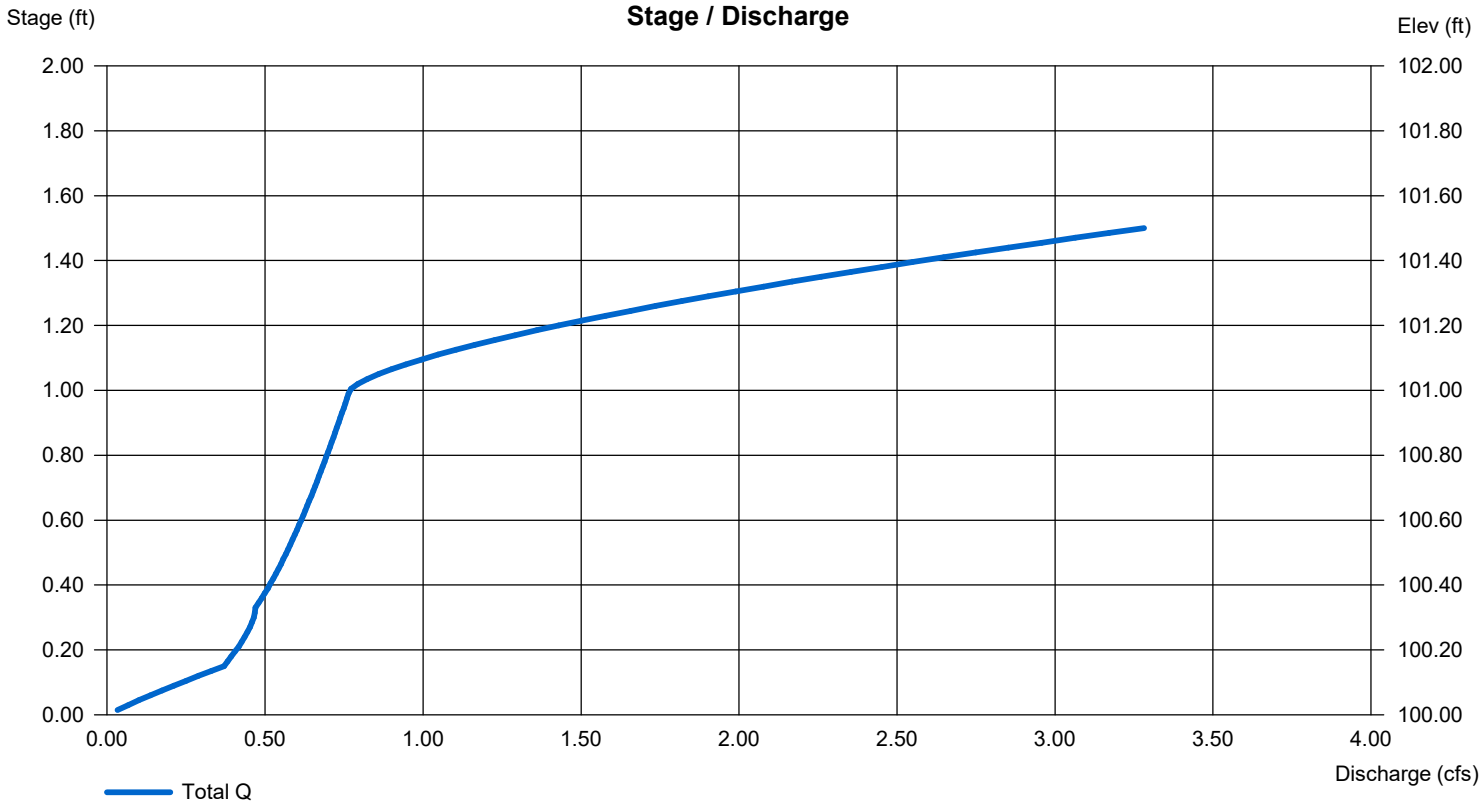
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 2.00	0.00	0.00	0.00
Crest El. (ft)	= 101.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 3.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



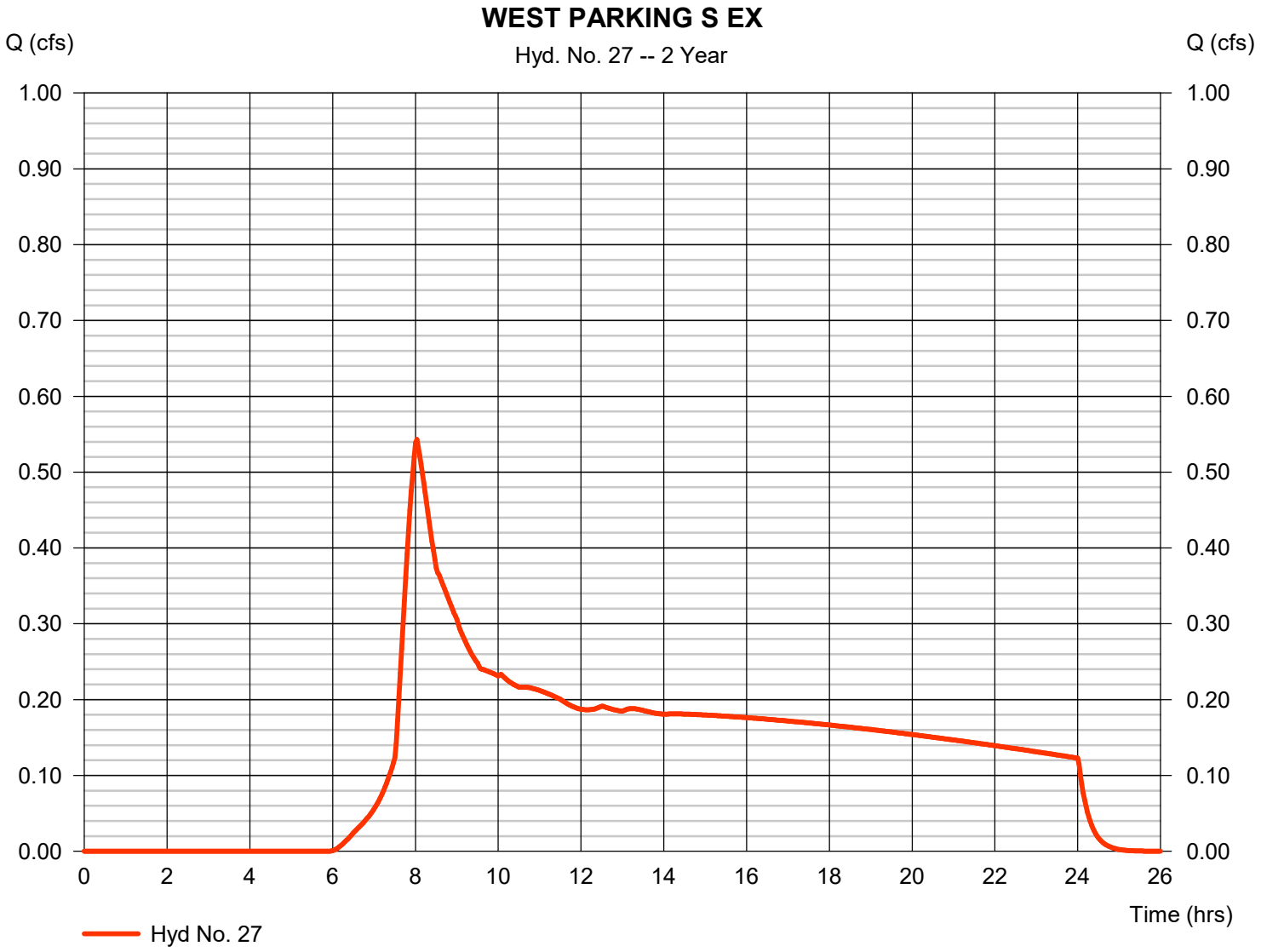
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 27

WEST PARKING S EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.543 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 11,874 cuft
Drainage area	= 3.680 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

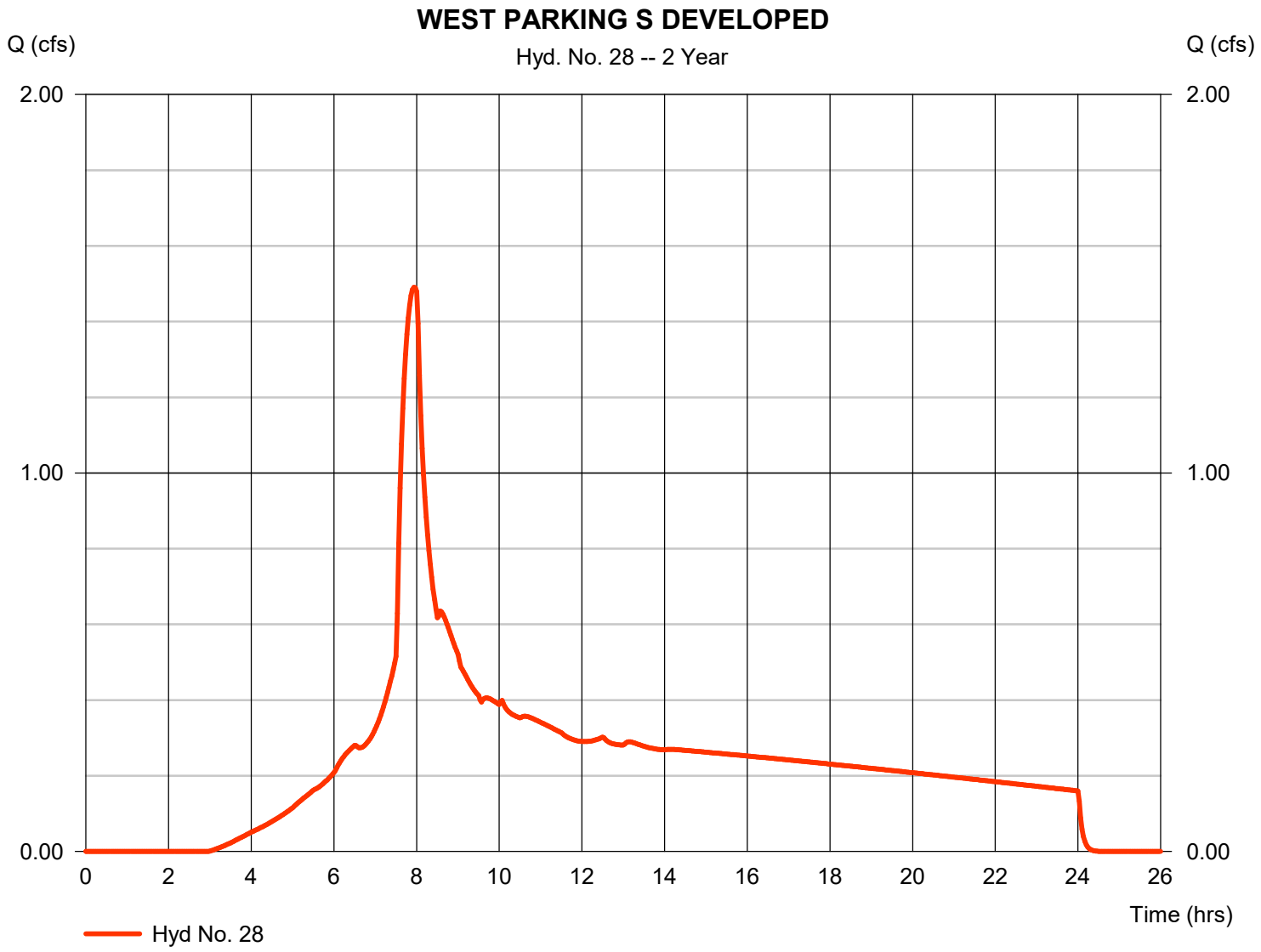
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 28

WEST PARKING S DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.491 cfs
Storm frequency	= 2 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 21,512 cuft
Drainage area	= 3.680 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.190 x 98) + (1.490 x 80)] / 3.680



Hydrograph Report

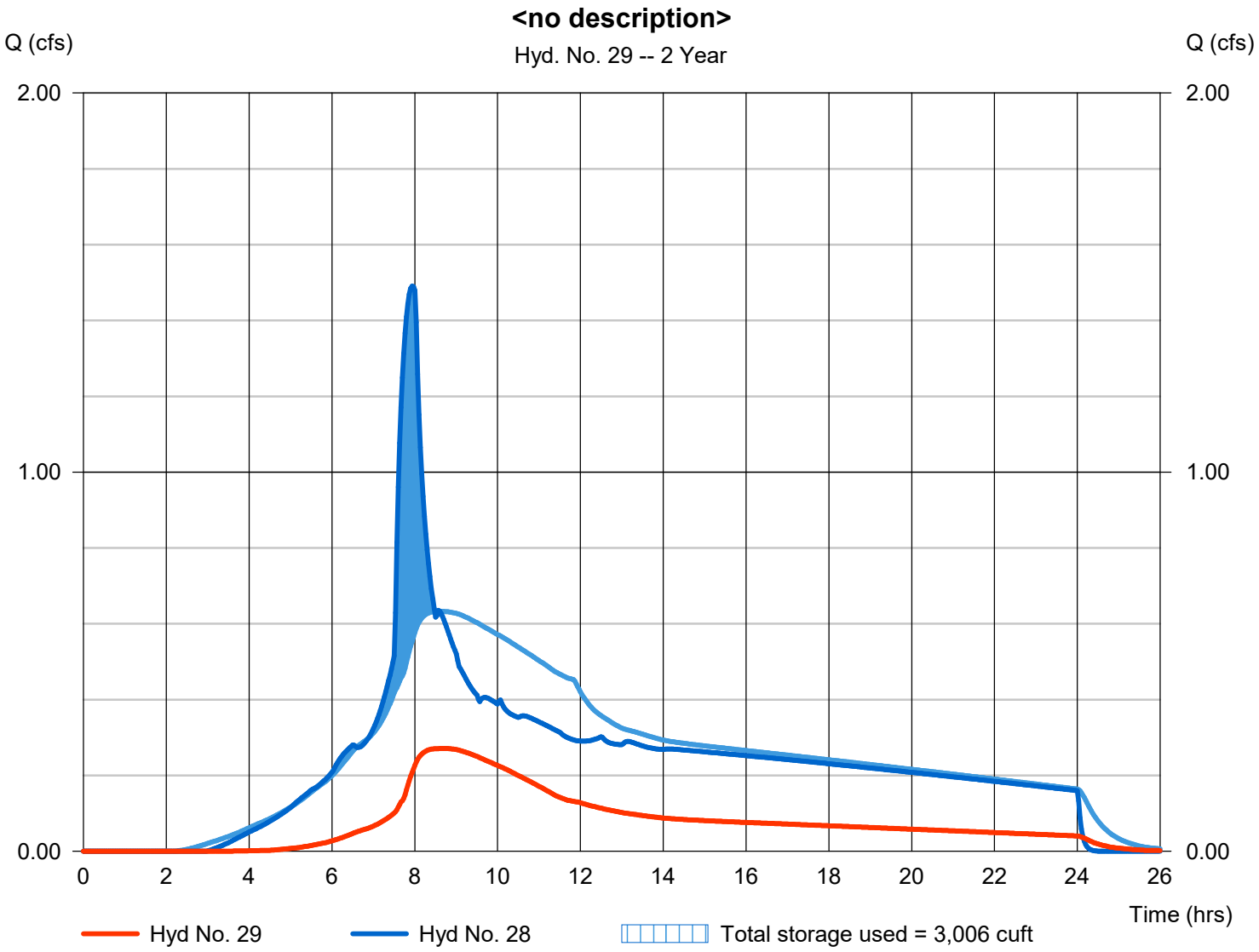
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 29

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.271 cfs
Storm frequency	=	2 yrs	Time to peak	=	8.70 hrs
Time interval	=	2 min	Hyd. volume	=	6,868 cuft
Inflow hyd. No.	=	28 - WEST PARKING S DEVELOPED	Max. Elevation	=	100.66 ft
Reservoir name	=	WEST SOUTH DETENTION	Max. Storage	=	3,006 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 — Wednesday, 07 / 16 / 2025

Pond No. 12 - WEST SOUTH DETENTION

Pond Data

Trapezoid -Bottom L x W = 84.7 x 50.7 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 3.26 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	4,290	0	0
0.33	100.33	4,559	1,442	1,442
0.65	100.65	4,835	1,531	2,973
0.98	100.98	5,119	1,622	4,595
1.30	101.30	5,410	1,716	6,311
1.63	101.63	5,710	1,812	8,124
1.96	101.96	6,016	1,911	10,035
2.28	102.28	6,331	2,012	12,047
2.61	102.61	6,653	2,116	14,163
2.93	102.93	6,983	2,222	16,386
3.26	103.26	7,320	2,331	18,717

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 4.00	0.00	0.00	0.00
Span (in)	= 4.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 100.00	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

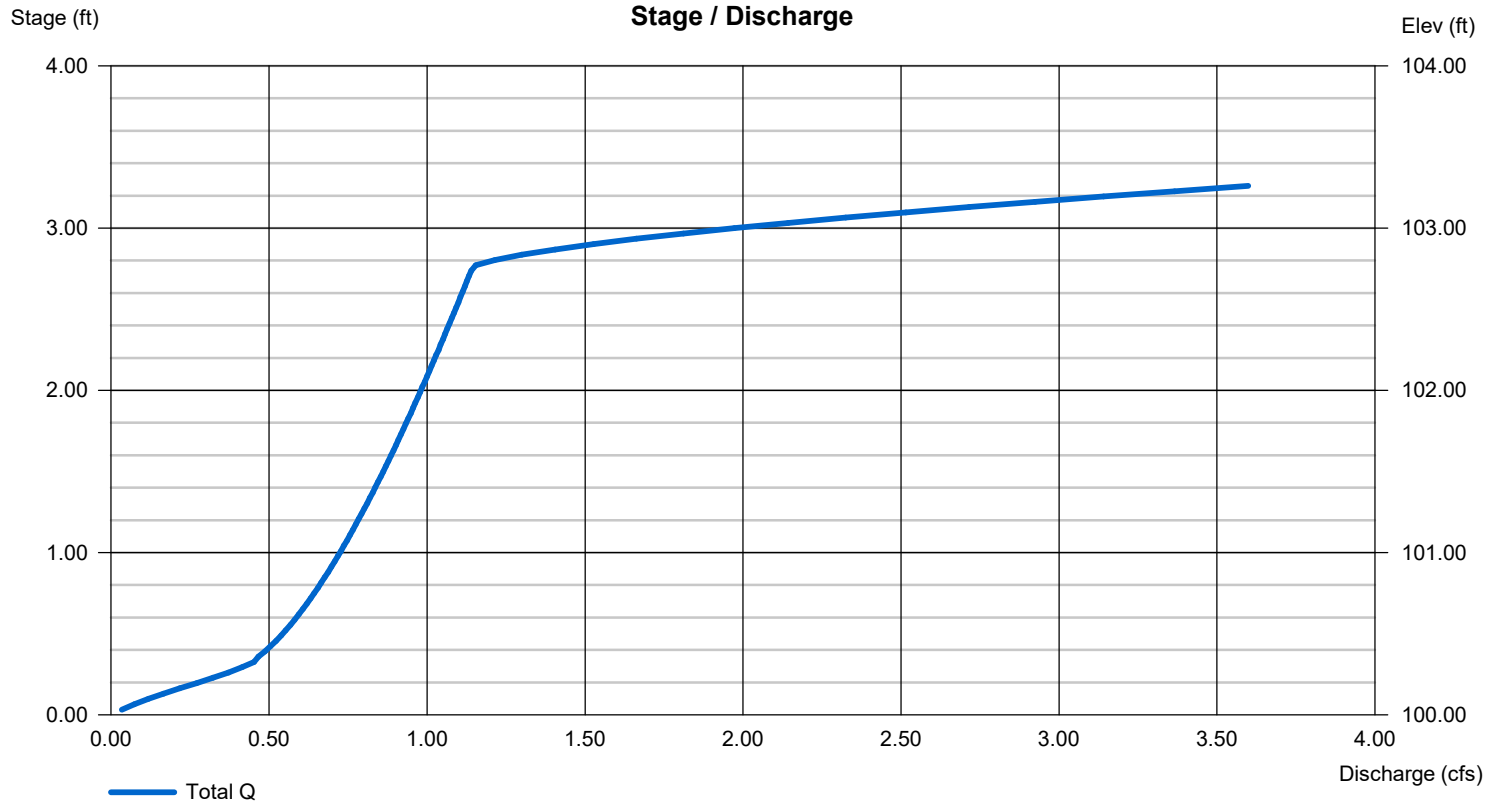
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 2.00	0.00	0.00	0.00
Crest El. (ft)	= 102.76	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 3.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



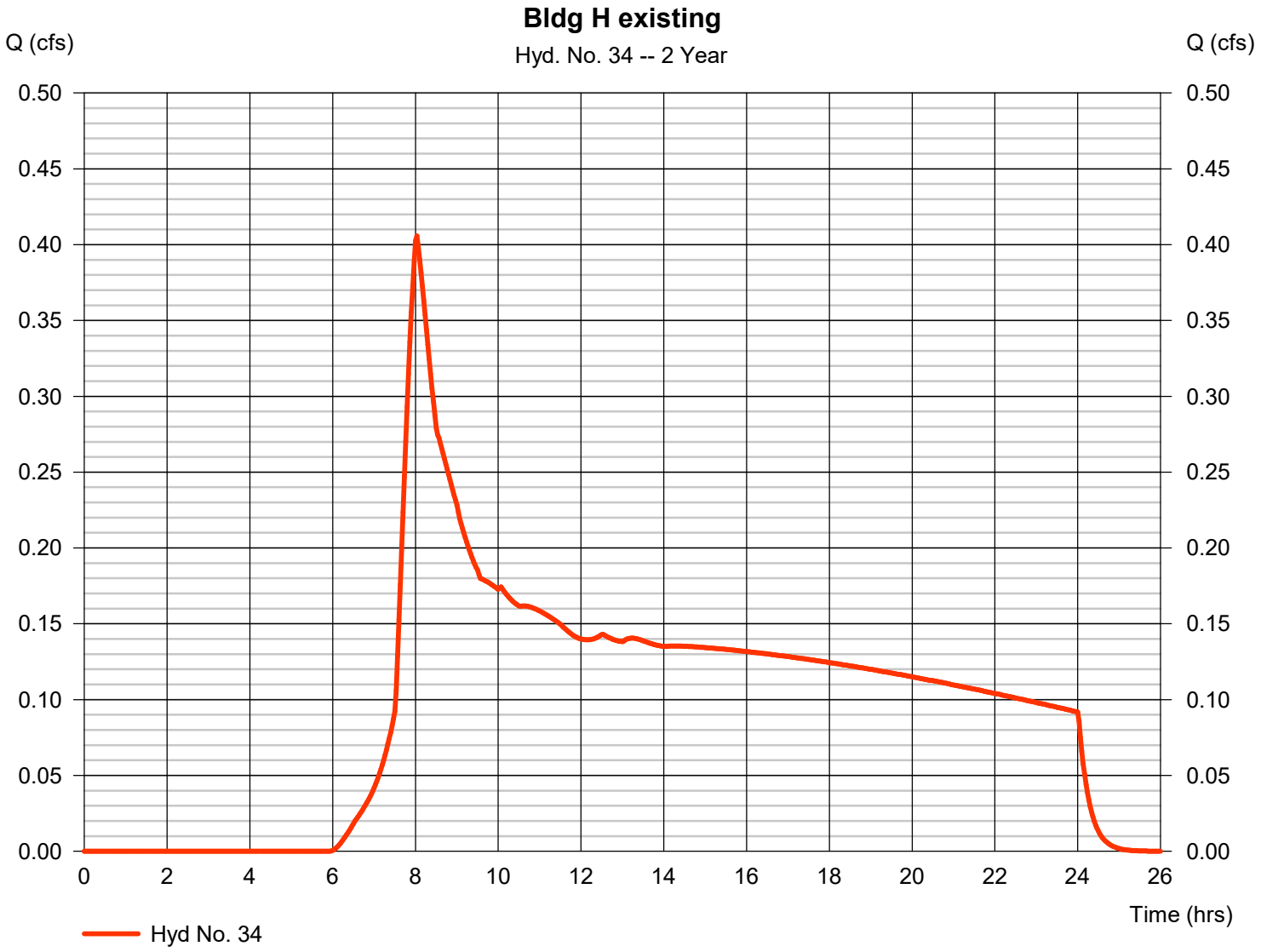
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 34

Bldg H existing

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.406 cfs
Storm frequency	=	2 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	8,873 cuft
Drainage area	=	2.750 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

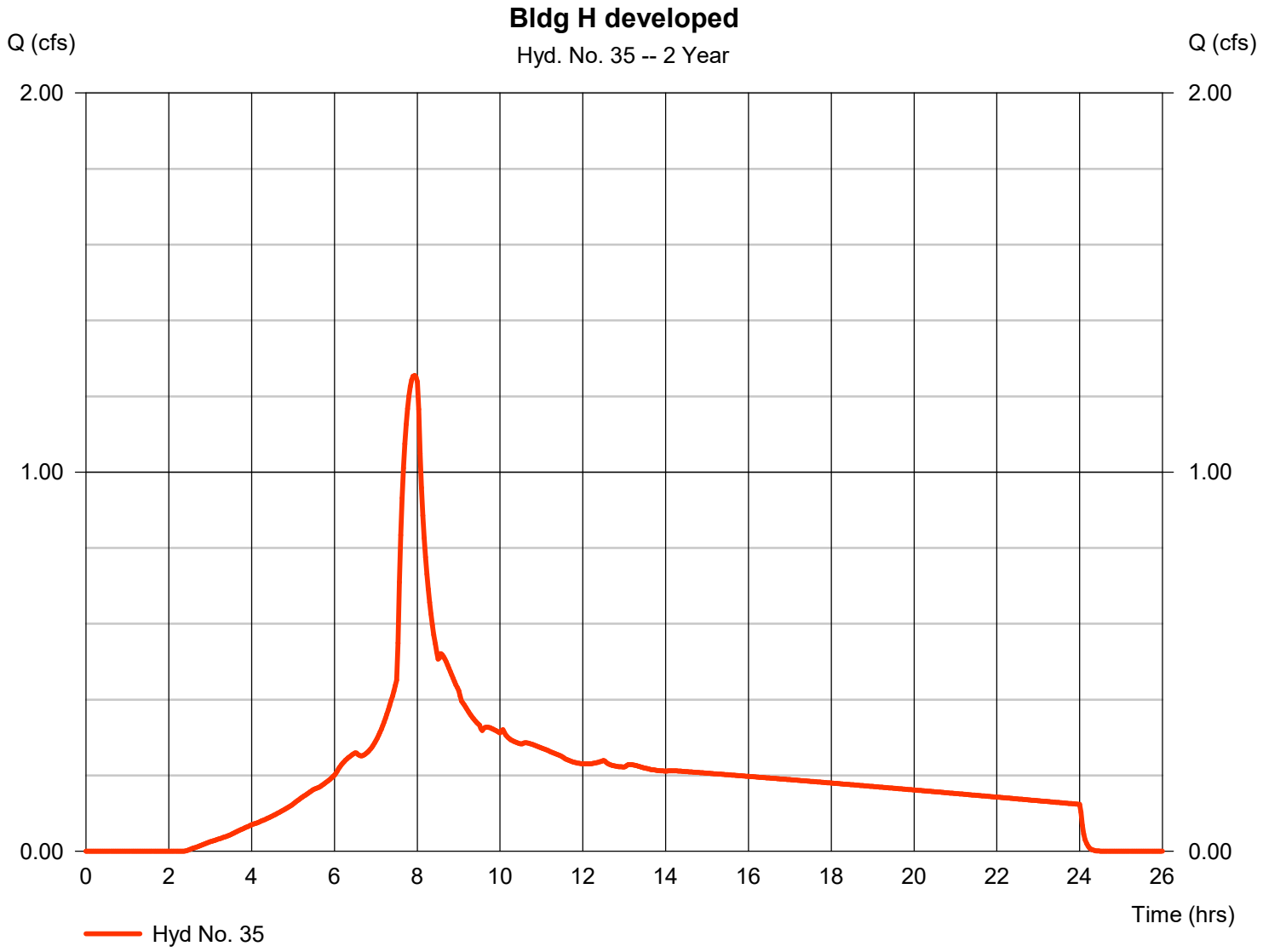
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 35

Bldg H developed

Hydrograph type	=	SBUH Runoff	Peak discharge	=	1.255 cfs
Storm frequency	=	2 yrs	Time to peak	=	7.93 hrs
Time interval	=	2 min	Hyd. volume	=	17,763 cuft
Drainage area	=	2.750 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(2.060 x 98) + (0.690 x 80)] / 2.750



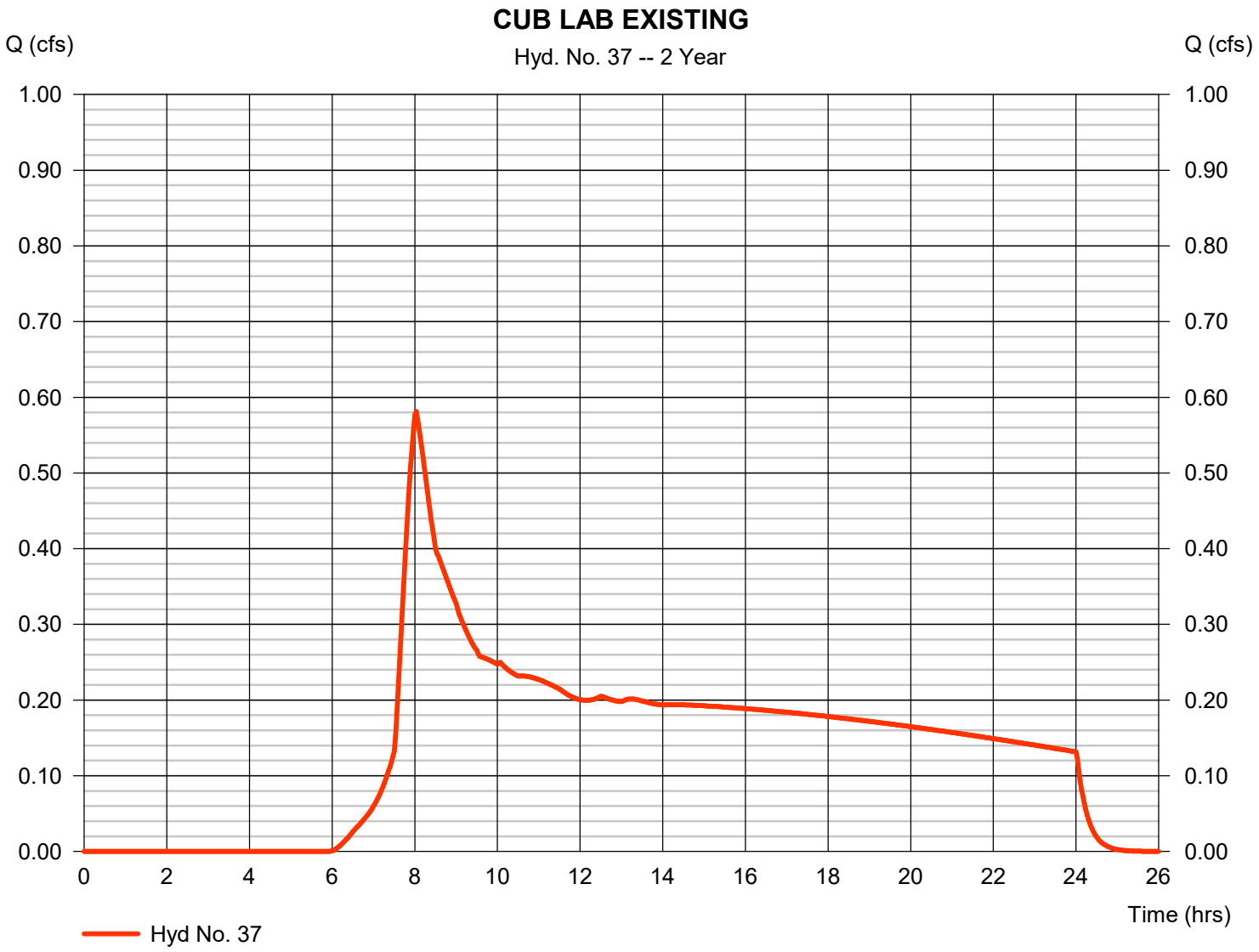
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 37

CUB LAB EXISTING

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.581 cfs
Storm frequency	=	2 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	12,713 cuft
Drainage area	=	3.940 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

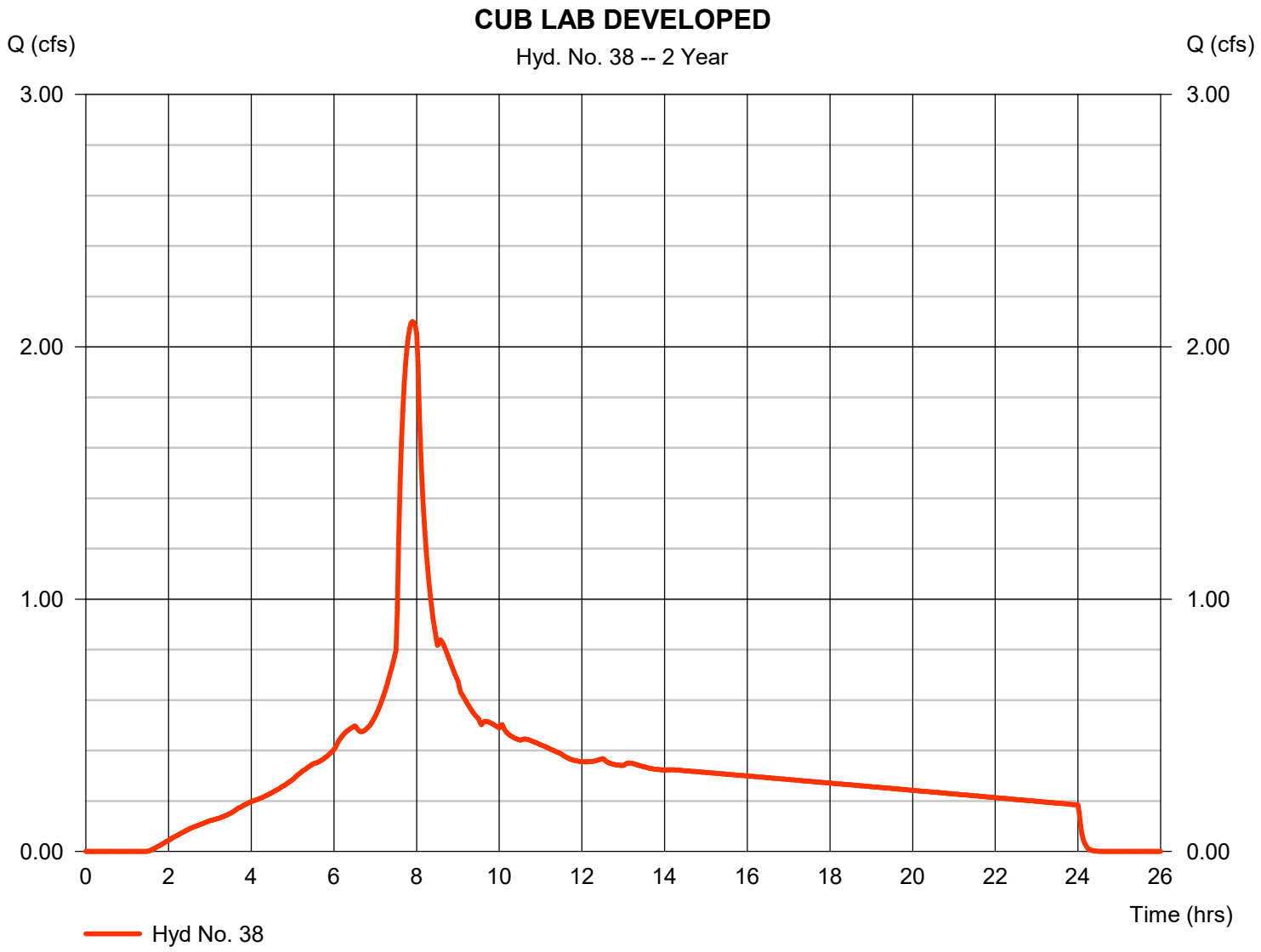
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 38

CUB LAB DEVELOPED

Hydrograph type	=	SBUH Runoff	Peak discharge	=	2.101 cfs
Storm frequency	=	2 yrs	Time to peak	=	7.90 hrs
Time interval	=	2 min	Hyd. volume	=	29,481 cuft
Drainage area	=	3.940 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(3.590 x 98) + (0.350 x 80)] / 3.940



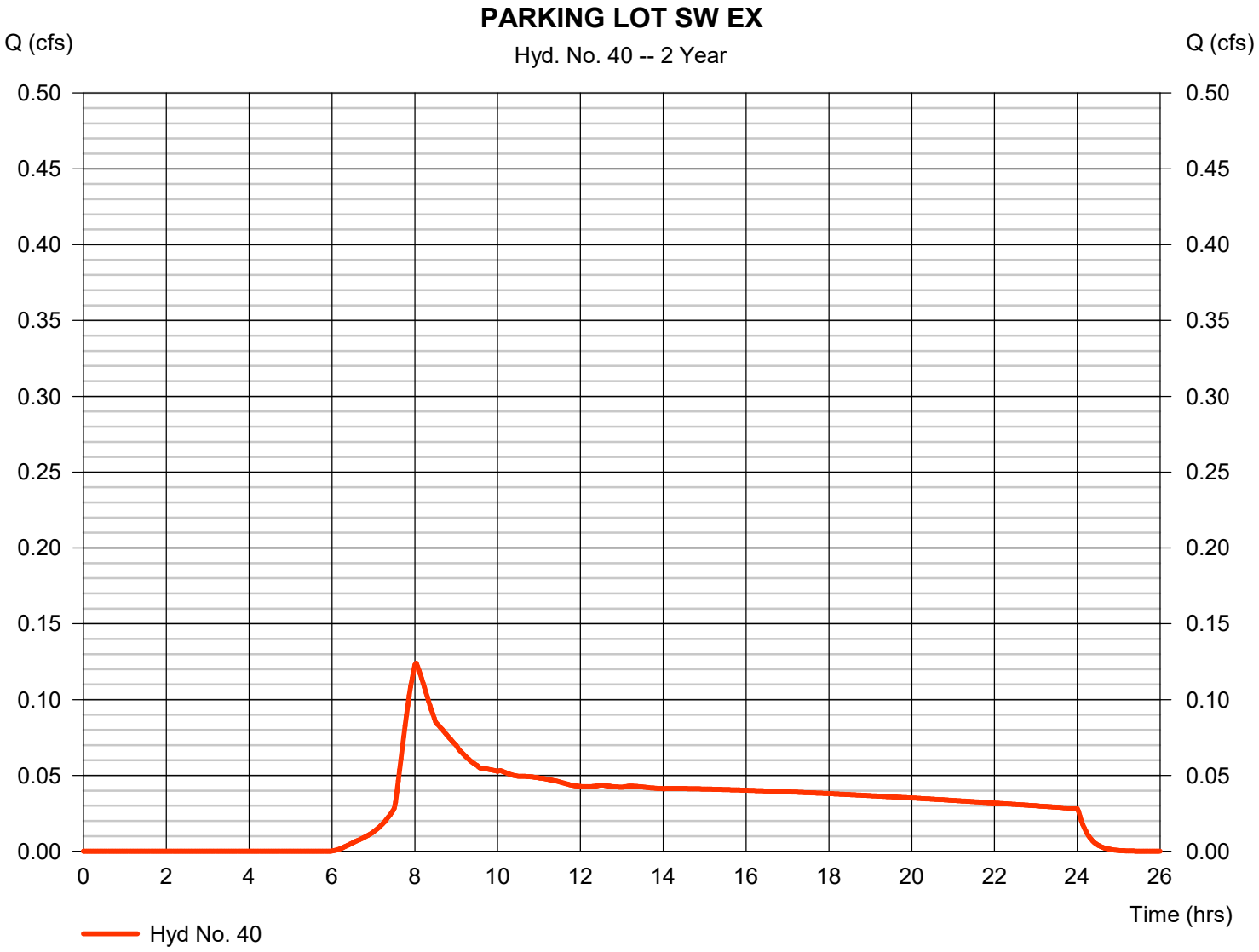
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 40

PARKING LOT SW EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.124 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 2,710 cuft
Drainage area	= 0.840 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 41

PARKING LOT SW DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.427 cfs
Storm frequency	= 2 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 5,986 cuft
Drainage area	= 0.840 ac	Curve number	= 95*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.690 x 98) + (0.150 x 80)] / 0.840

Hydrograph Report

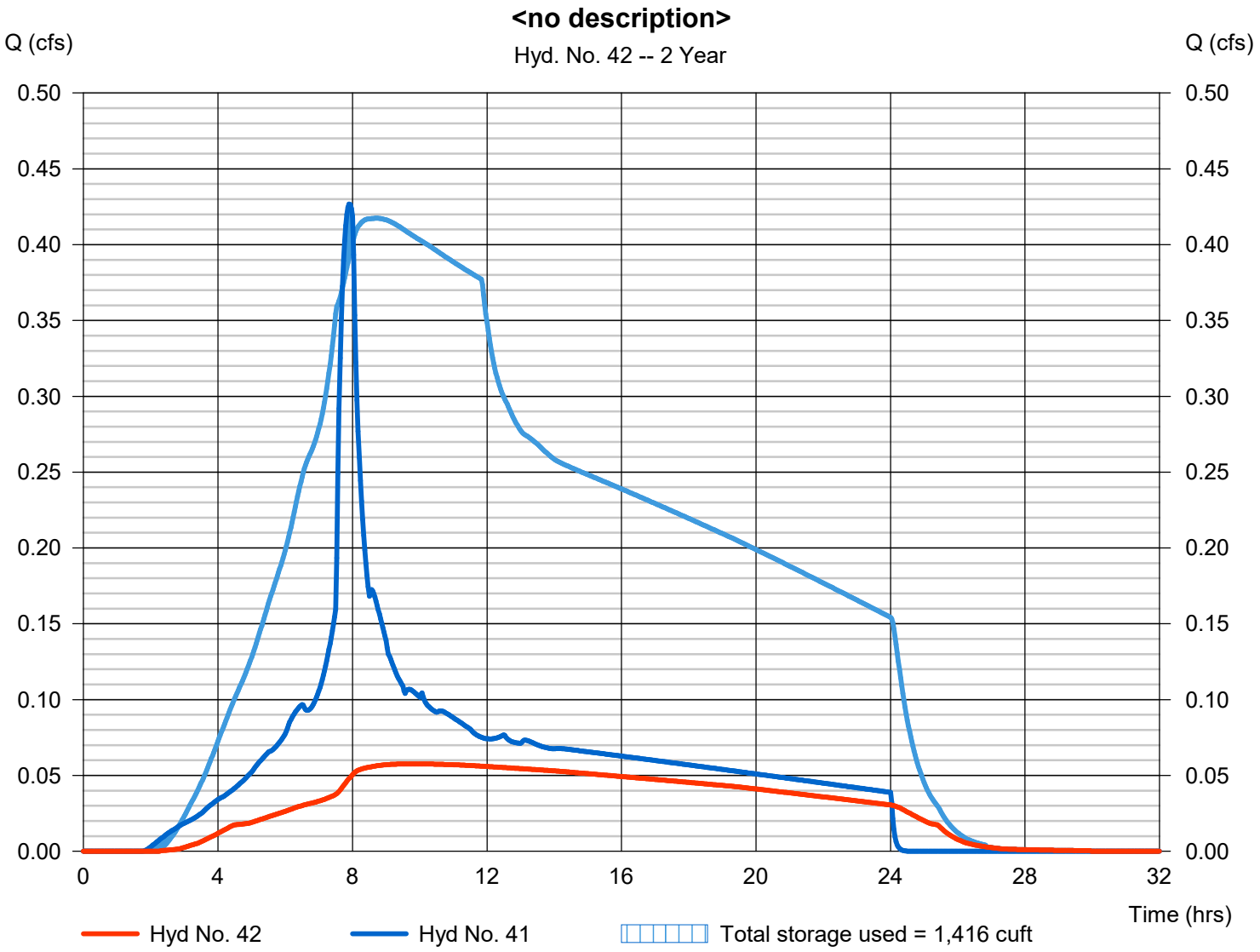
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 42

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.058 cfs
Storm frequency	= 2 yrs	Time to peak	= 9.90 hrs
Time interval	= 2 min	Hyd. volume	= 3,334 cuft
Inflow hyd. No.	= 41 - PARKING LOT SW DEVELOPED	Max. Elevation	= 101.06 ft
Reservoir name	= SW Parking Lot Detention	Max. Storage	= 1,416 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 — Wednesday, 07 / 16 / 2025

Pond No. 21 - SW Parking Lot Detention

Pond Data

Trapezoid -Bottom L x W = 4.0 x 180.0 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 3.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	720	0	0
0.30	100.30	1,054	266	266
0.60	100.60	1,395	367	633
0.90	100.90	1,743	471	1,104
1.20	101.20	2,097	576	1,680
1.50	101.50	2,457	683	2,362
1.80	101.80	2,824	792	3,154
2.10	102.10	3,197	903	4,057
2.40	102.40	3,577	1,016	5,073
2.70	102.70	3,963	1,131	6,204
3.00	103.00	4,356	1,248	7,452

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 1.75	0.00	0.00	0.00
Span (in)	= 1.75	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 100.00	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

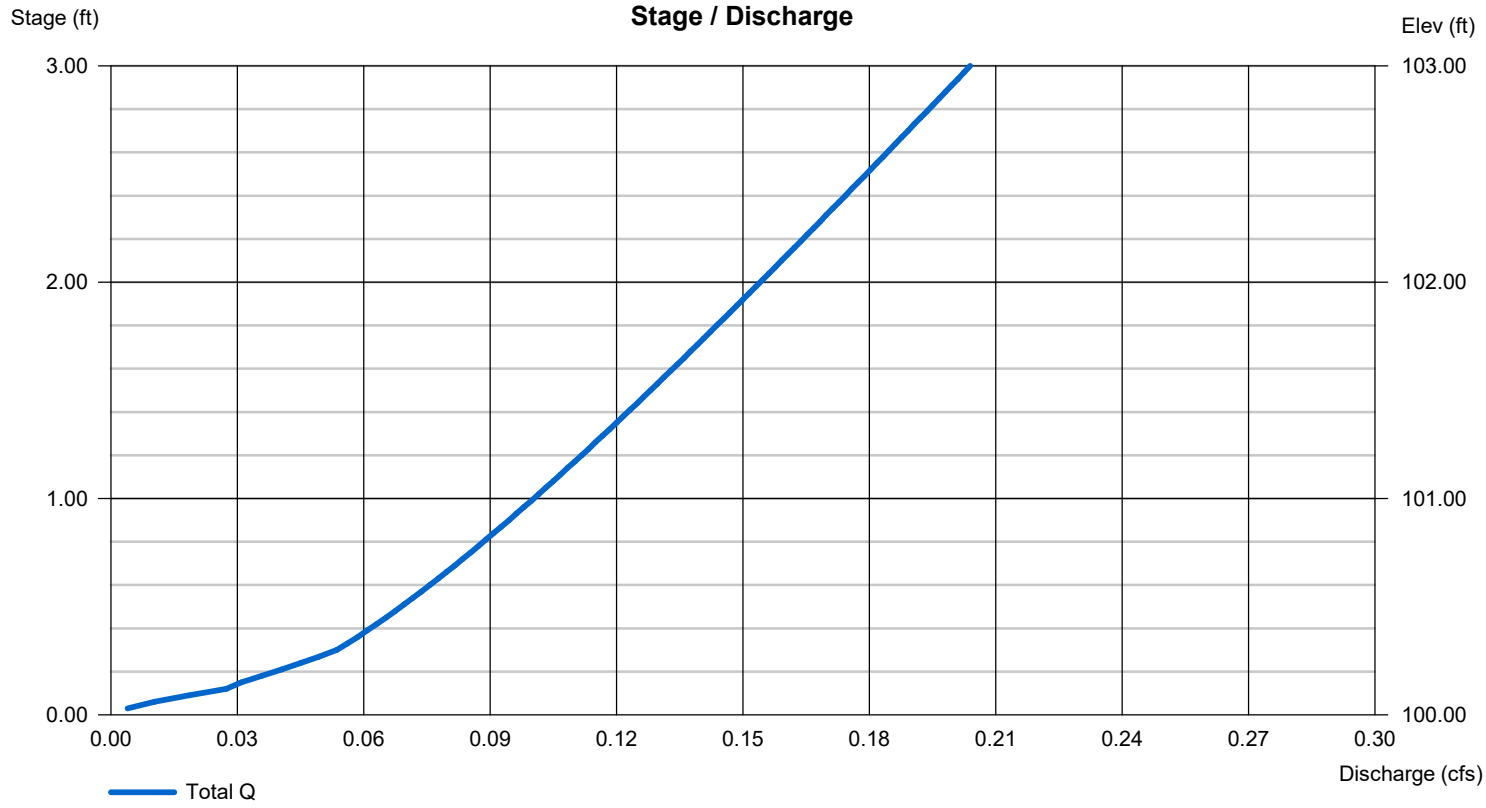
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 1.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



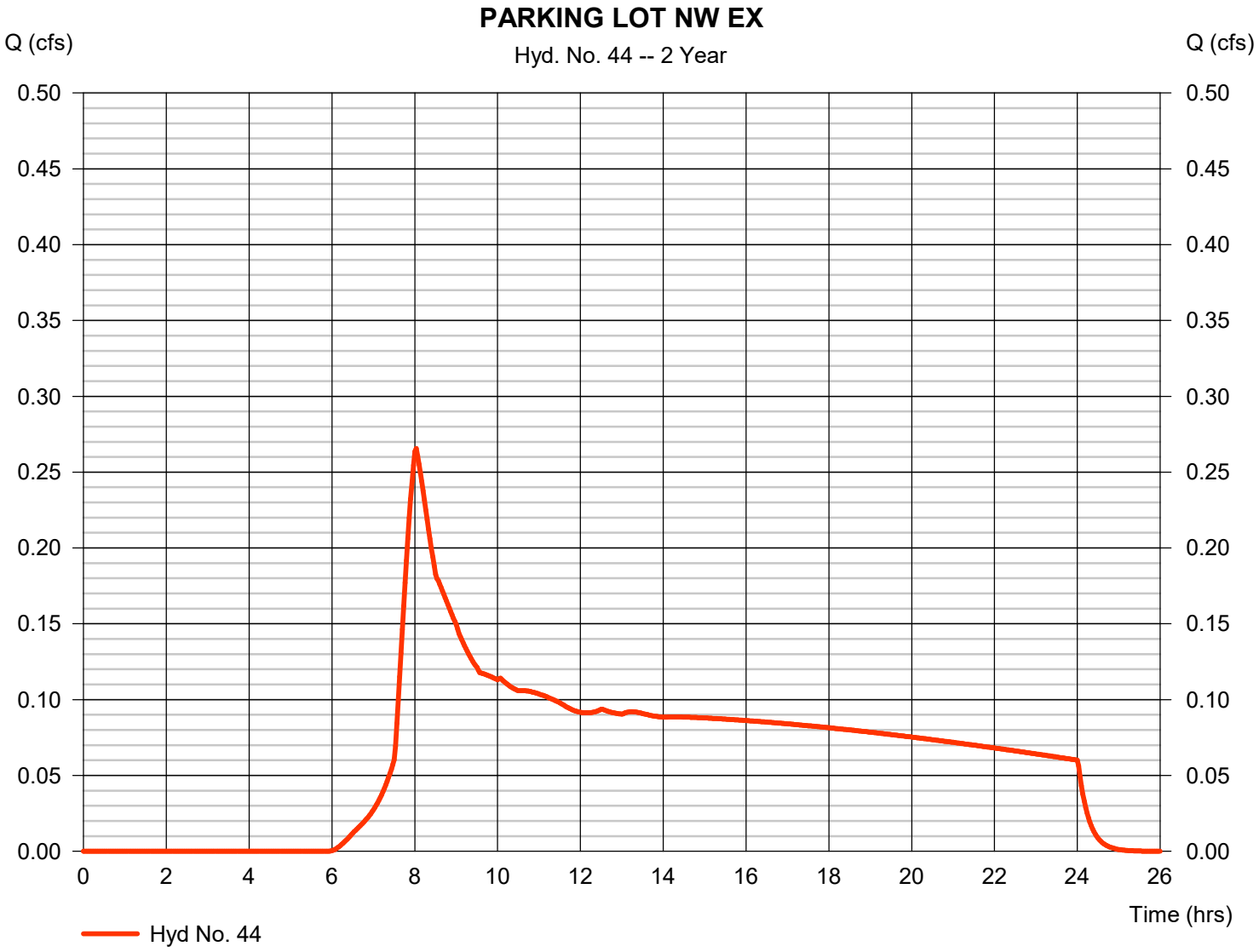
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 44

PARKING LOT NW EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.266 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 5,808 cuft
Drainage area	= 1.800 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 45

PARKING LOT NW DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.729 cfs
Storm frequency	= 2 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 10,522 cuft
Drainage area	= 1.800 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.130 x 98) + (0.670 x 80)] / 1.800

Hydrograph Report

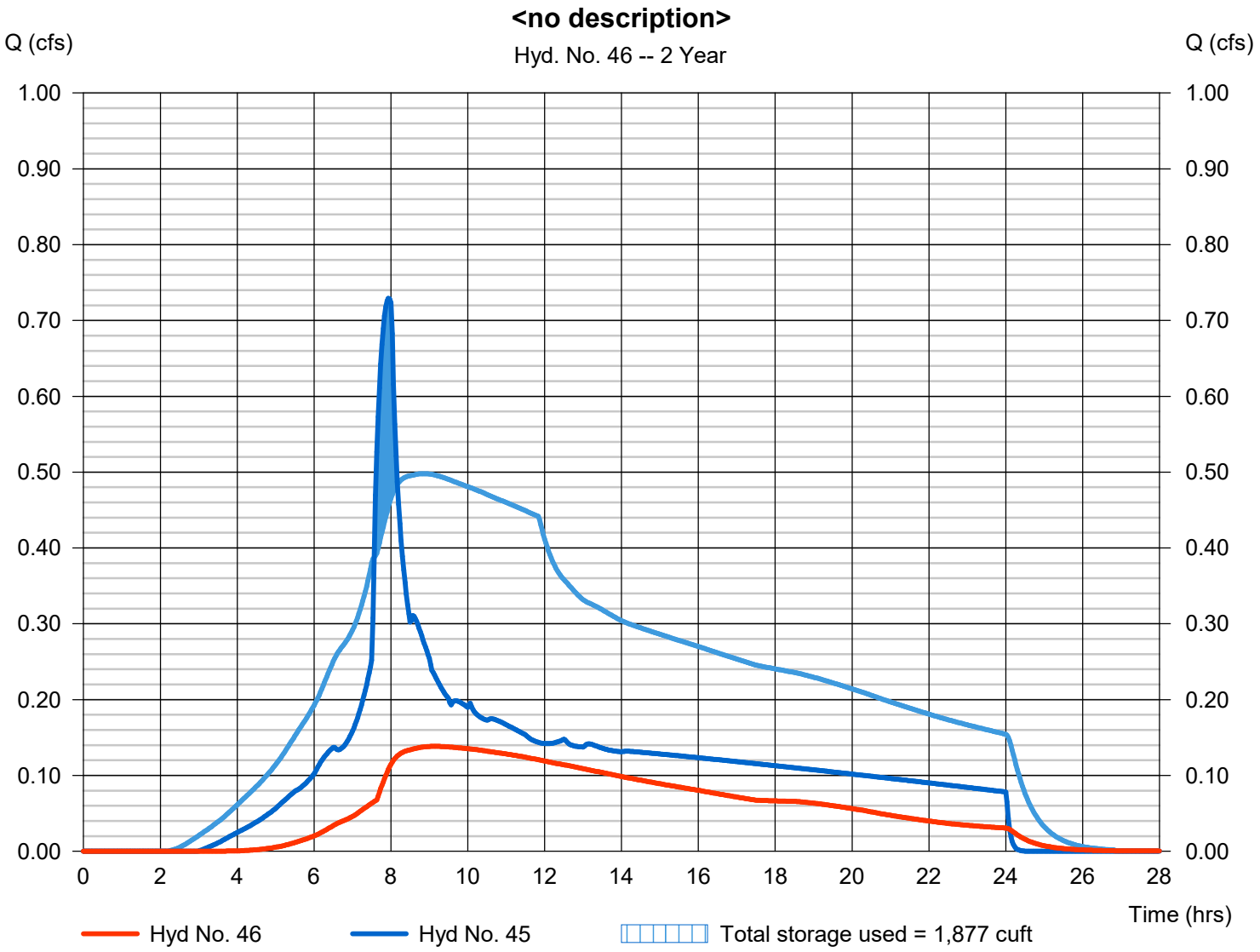
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 46

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.138 cfs
Storm frequency	= 2 yrs	Time to peak	= 9.13 hrs
Time interval	= 2 min	Hyd. volume	= 5,385 cuft
Inflow hyd. No.	= 45 - PARKING LOT NW DEVELOPED	Max. Elevation	= 100.61 ft
Reservoir name	= NW Parking Lot Detention	Max. Storage	= 1,877 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Pond No. 23 - NW Parking Lot Detention

Pond Data

Trapezoid -Bottom L x W = 450.0 x 5.0 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 1.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	2,250	0	0
0.15	100.15	2,660	368	368
0.30	100.30	3,072	430	798
0.45	100.45	3,486	492	1,290
0.60	100.60	3,901	554	1,844
0.75	100.75	4,318	616	2,460
0.90	100.90	4,736	679	3,139
1.05	101.05	5,156	742	3,881
1.20	101.20	5,578	805	4,686
1.35	101.35	6,001	868	5,555
1.50	101.50	6,426	932	6,487

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 2.95	0.00	0.00	0.00
Span (in)	= 2.95	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 100.00	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

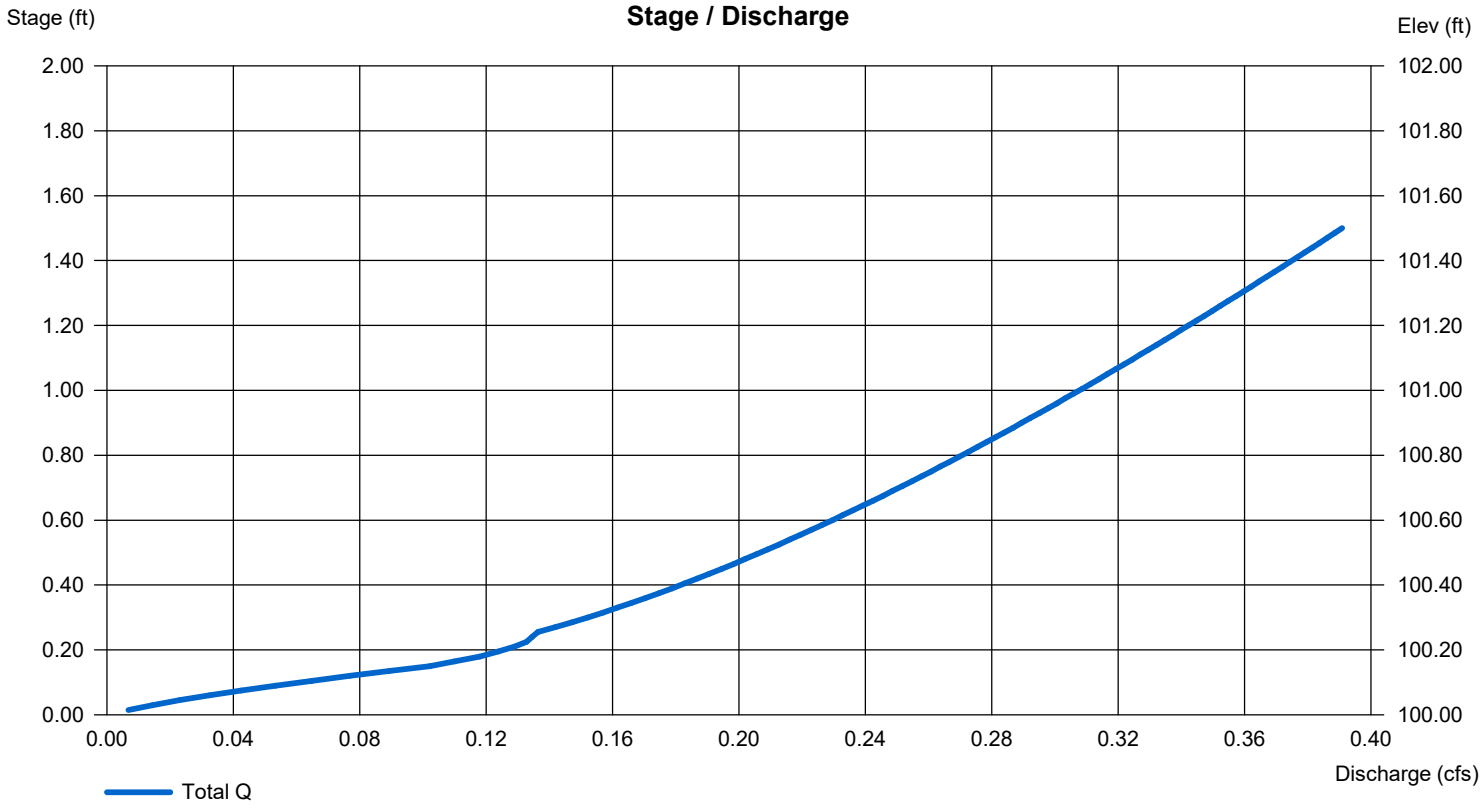
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 1.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



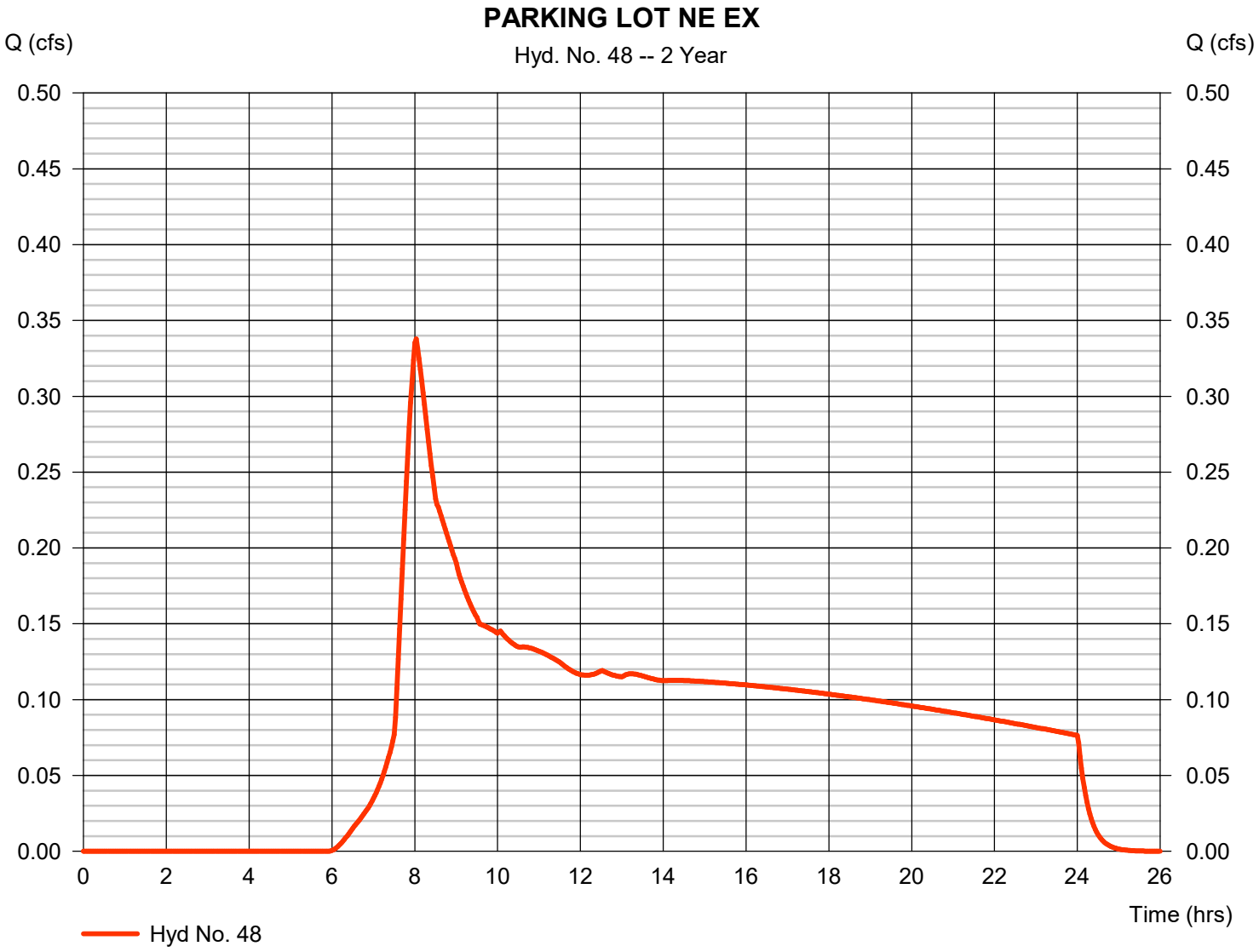
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 48

PARKING LOT NE EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.338 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 7,389 cuft
Drainage area	= 2.290 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

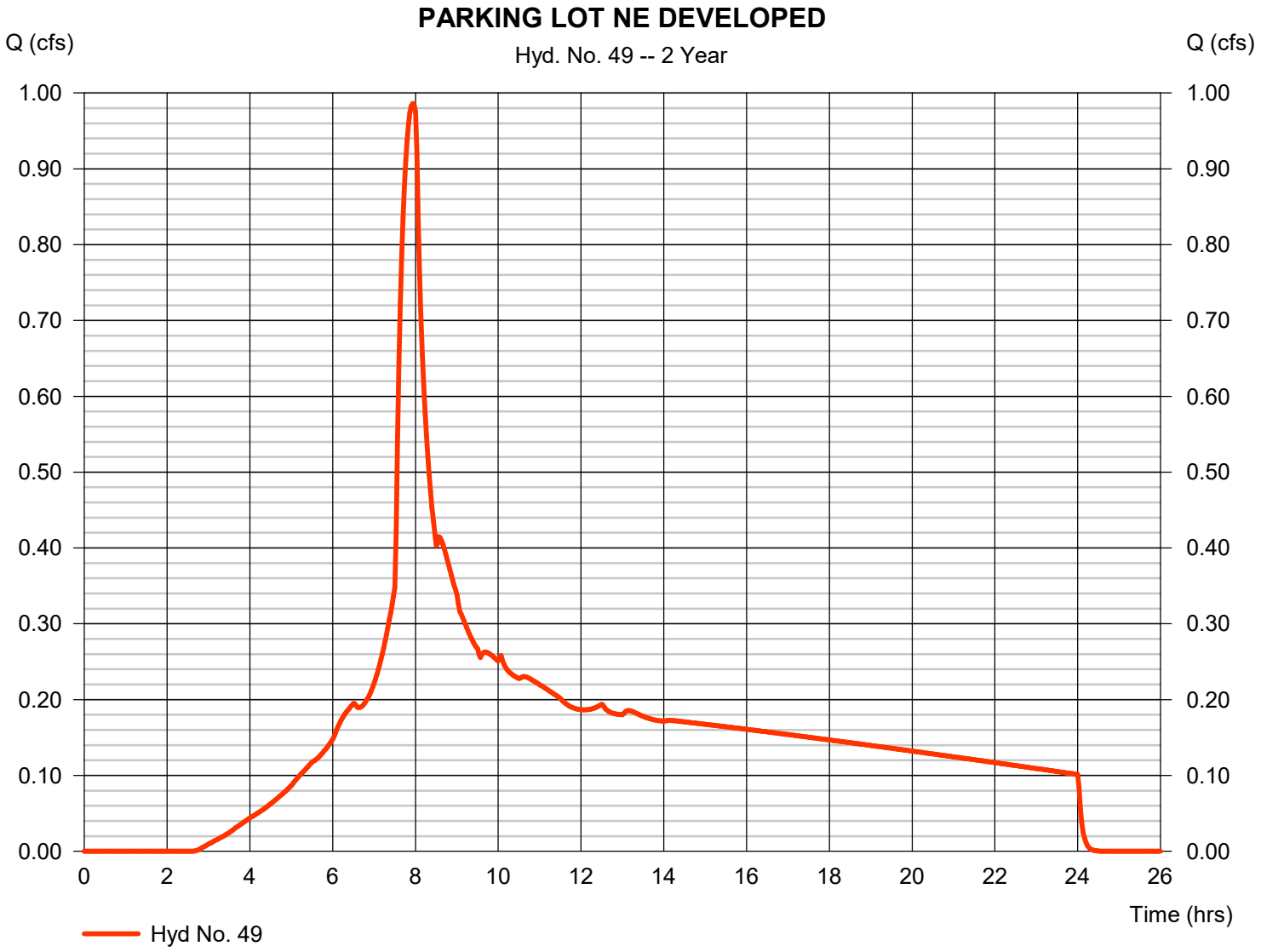
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 49

PARKING LOT NE DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.986 cfs
Storm frequency	= 2 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 14,075 cuft
Drainage area	= 2.290 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.580 x 98) + (0.710 x 80)] / 2.290



Hydrograph Report

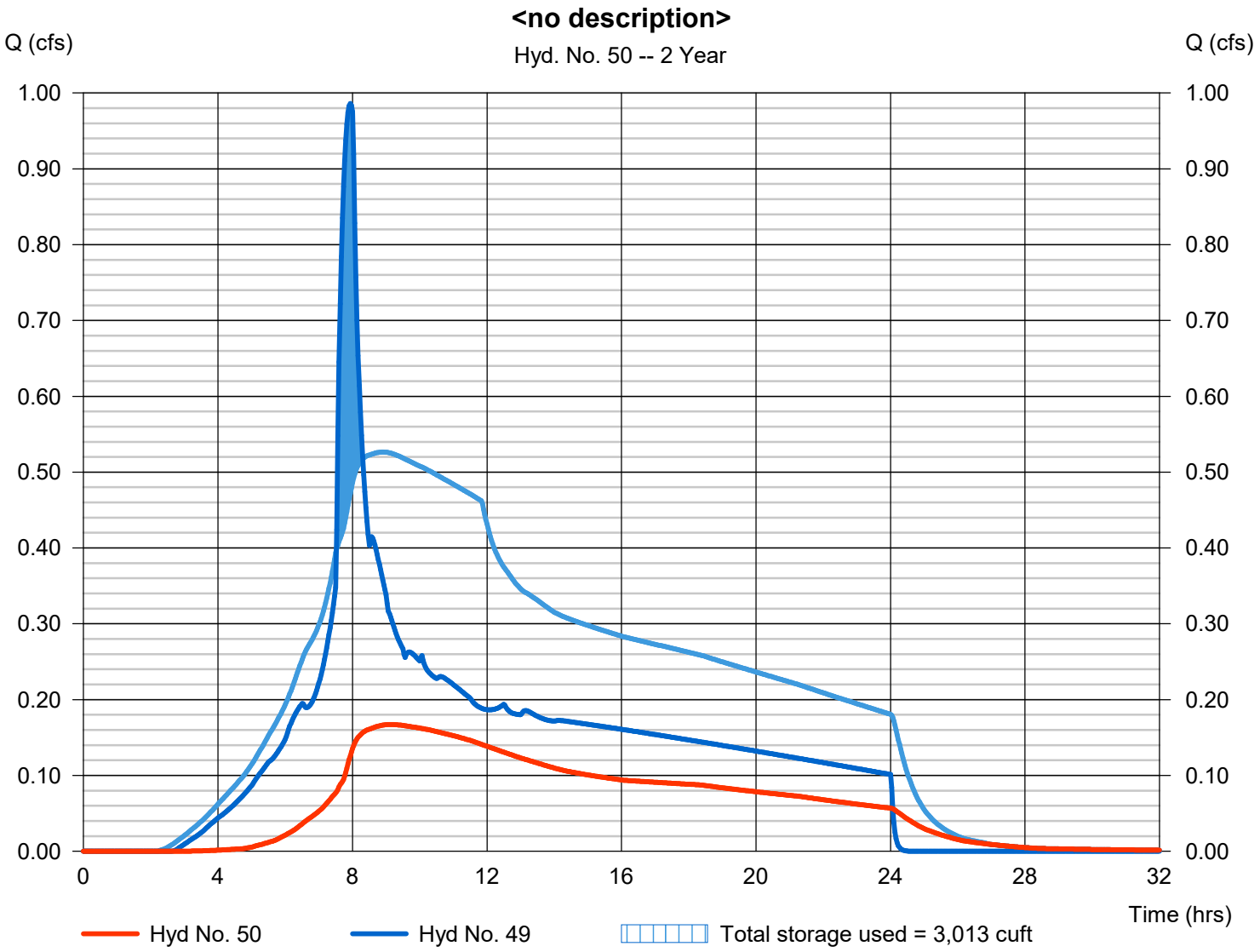
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 50

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.167 cfs
Storm frequency	=	2 yrs	Time to peak	=	9.13 hrs
Time interval	=	2 min	Hyd. volume	=	6,952 cuft
Inflow hyd. No.	=	49 - PARKING LOT NE DEVELOPED	Max. Elevation	=	100.52 ft
Reservoir name	=	NE Parking Lot Detention	Max. Storage	=	3,013 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 — Wednesday, 07 / 16 / 2025

Pond No. 17 - NE Parking Lot Detention

Pond Data

Trapezoid -Bottom L x W = 175.0 x 31.0 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 4.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	5,425	0	0
0.40	100.40	5,925	2,270	2,270
0.80	100.80	6,437	2,472	4,742
1.20	101.20	6,960	2,679	7,421
1.60	101.60	7,495	2,891	10,311
2.00	102.00	8,041	3,107	13,418
2.40	102.40	8,599	3,328	16,746
2.80	102.80	9,168	3,553	20,299
3.20	103.20	9,749	3,783	24,082
3.60	103.60	10,341	4,018	28,099
4.00	104.00	10,945	4,257	32,356

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 3.42	0.00	0.00	0.00
Span (in)	= 3.42	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 100.00	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

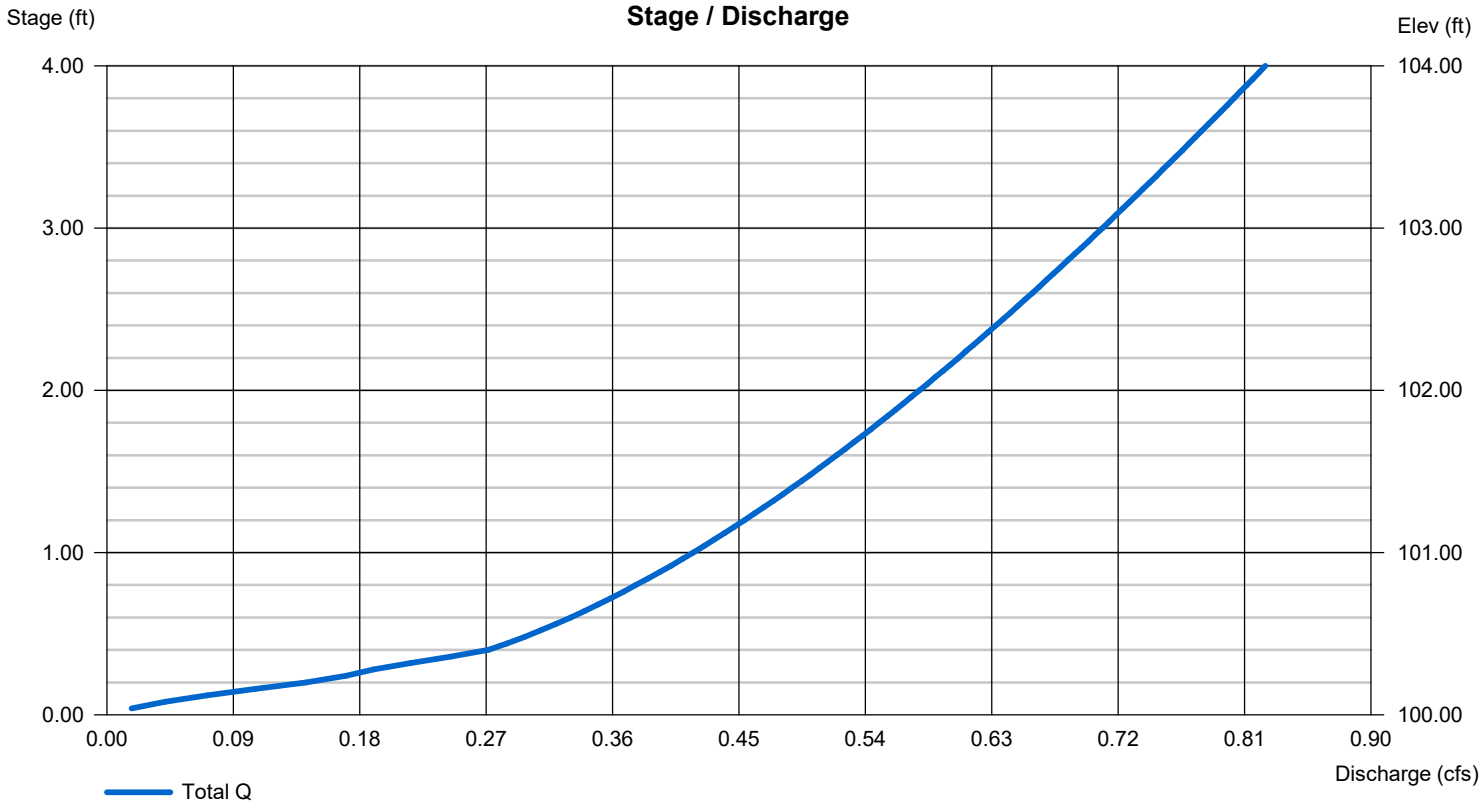
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 1.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



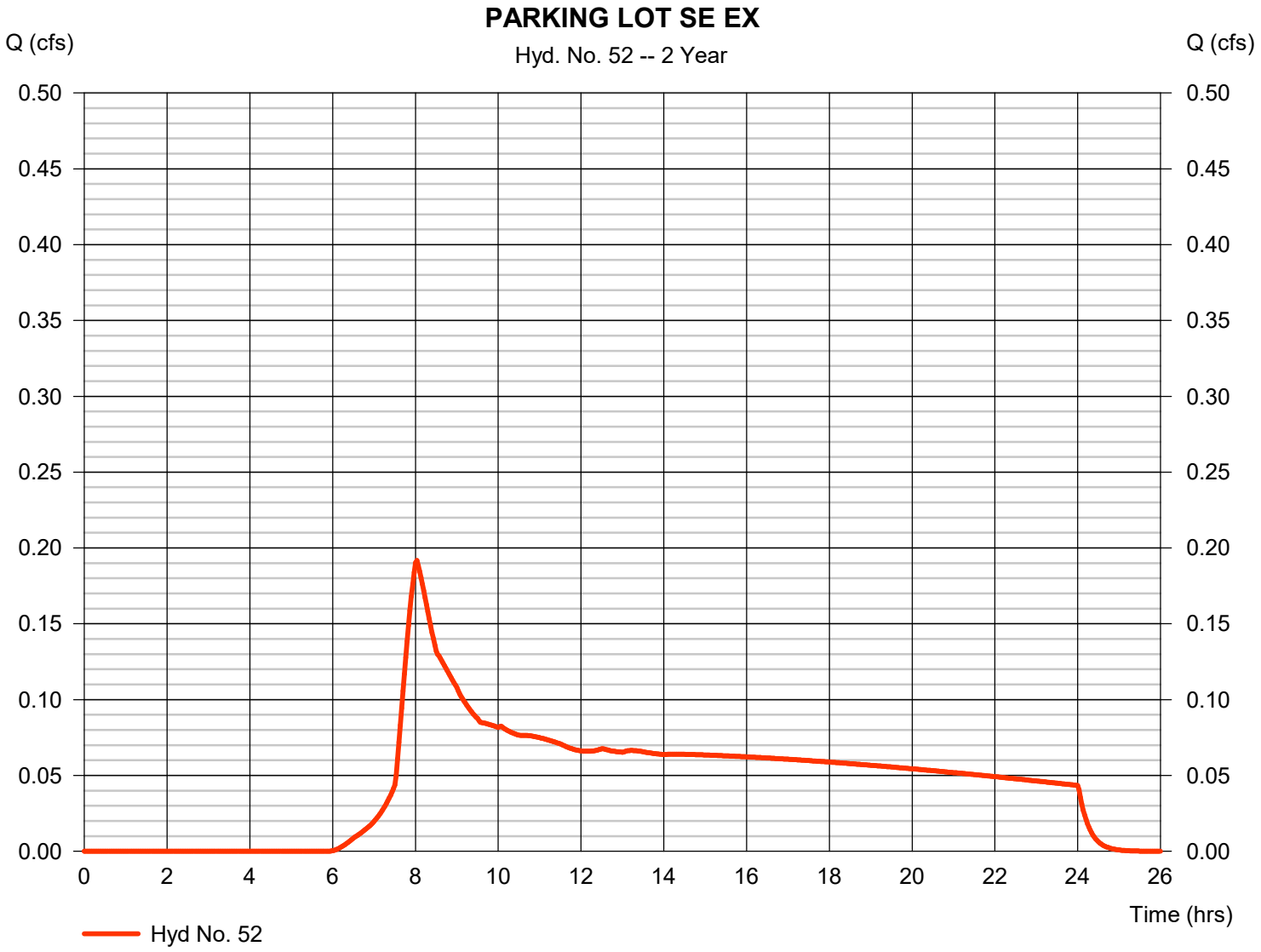
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 52

PARKING LOT SE EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.192 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 4,195 cuft
Drainage area	= 1.300 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 53

PARKING LOT SE DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.593 cfs
Storm frequency	= 2 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 8,397 cuft
Drainage area	= 1.300 ac	Curve number	= 93*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.920 x 98) + (0.380 x 80)] / 1.300

Hydrograph Report

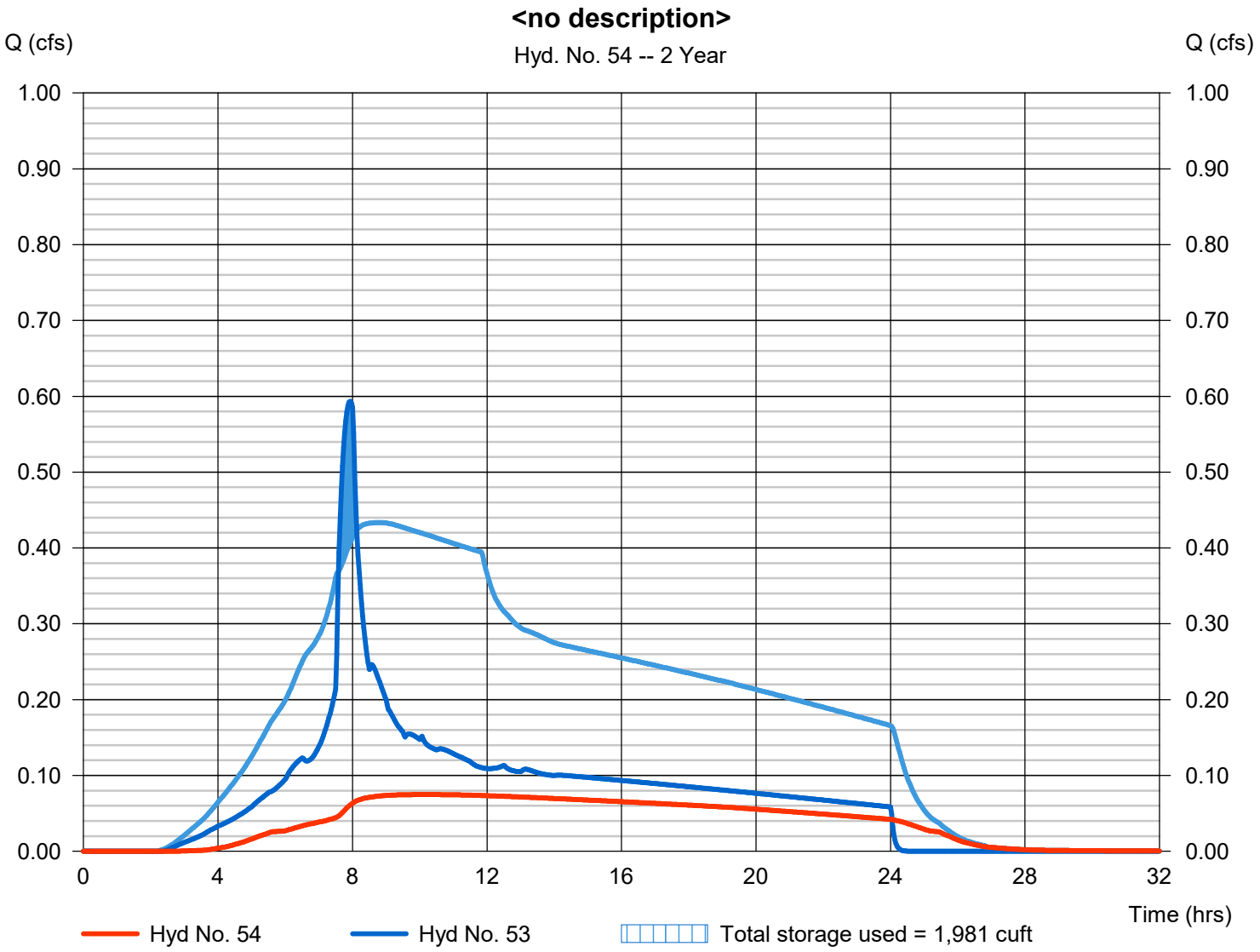
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 54

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.075 cfs
Storm frequency	=	2 yrs	Time to peak	=	10.17 hrs
Time interval	=	2 min	Hyd. volume	=	4,319 cuft
Inflow hyd. No.	=	53 - PARKING LOT SE DEVELOPED	Max. Elevation	=	100.95 ft
Reservoir name	=	SE Parking Lot Detention	Max. Storage	=	1,981 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 — Wednesday, 07 / 16 / 2025

Pond No. 19 - SE Parking Lot Detention

Pond Data

Trapezoid -Bottom L x W = 5.0 x 260.0 ft, Side slope = 3.00:1, Bottom elev. = 100.00 ft, Depth = 3.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	1,300	0	0
0.30	100.30	1,780	462	462
0.60	100.60	2,267	607	1,069
0.90	100.90	2,760	754	1,823
1.20	101.20	3,260	903	2,726
1.50	101.50	3,766	1,054	3,779
1.80	101.80	4,279	1,207	4,986
2.10	102.10	4,798	1,361	6,347
2.40	102.40	5,323	1,518	7,865
2.70	102.70	5,855	1,677	9,542
3.00	103.00	6,394	1,837	11,379

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 2.00	0.00	0.00	0.00
Span (in)	= 2.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 100.00	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

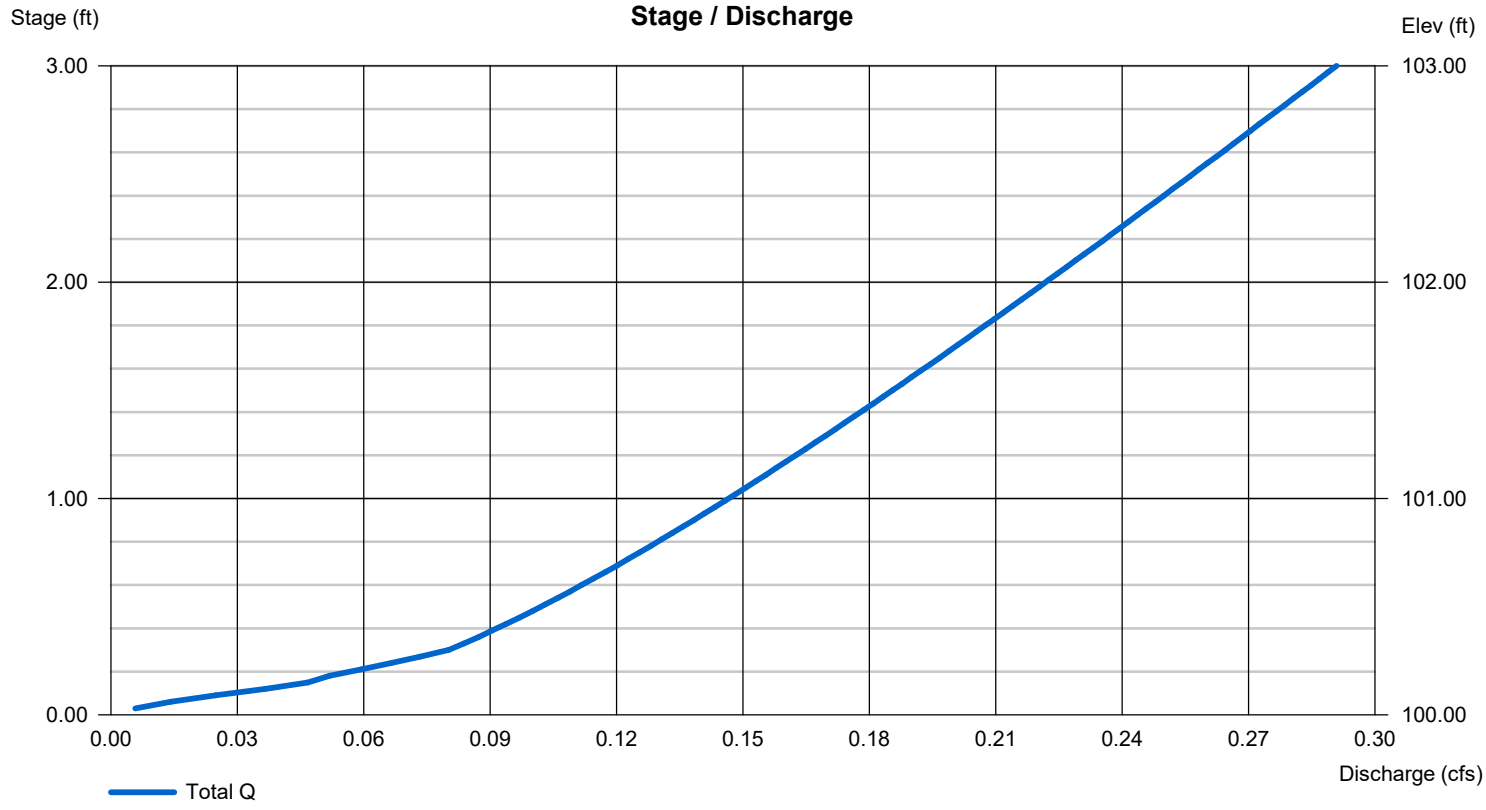
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 1.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



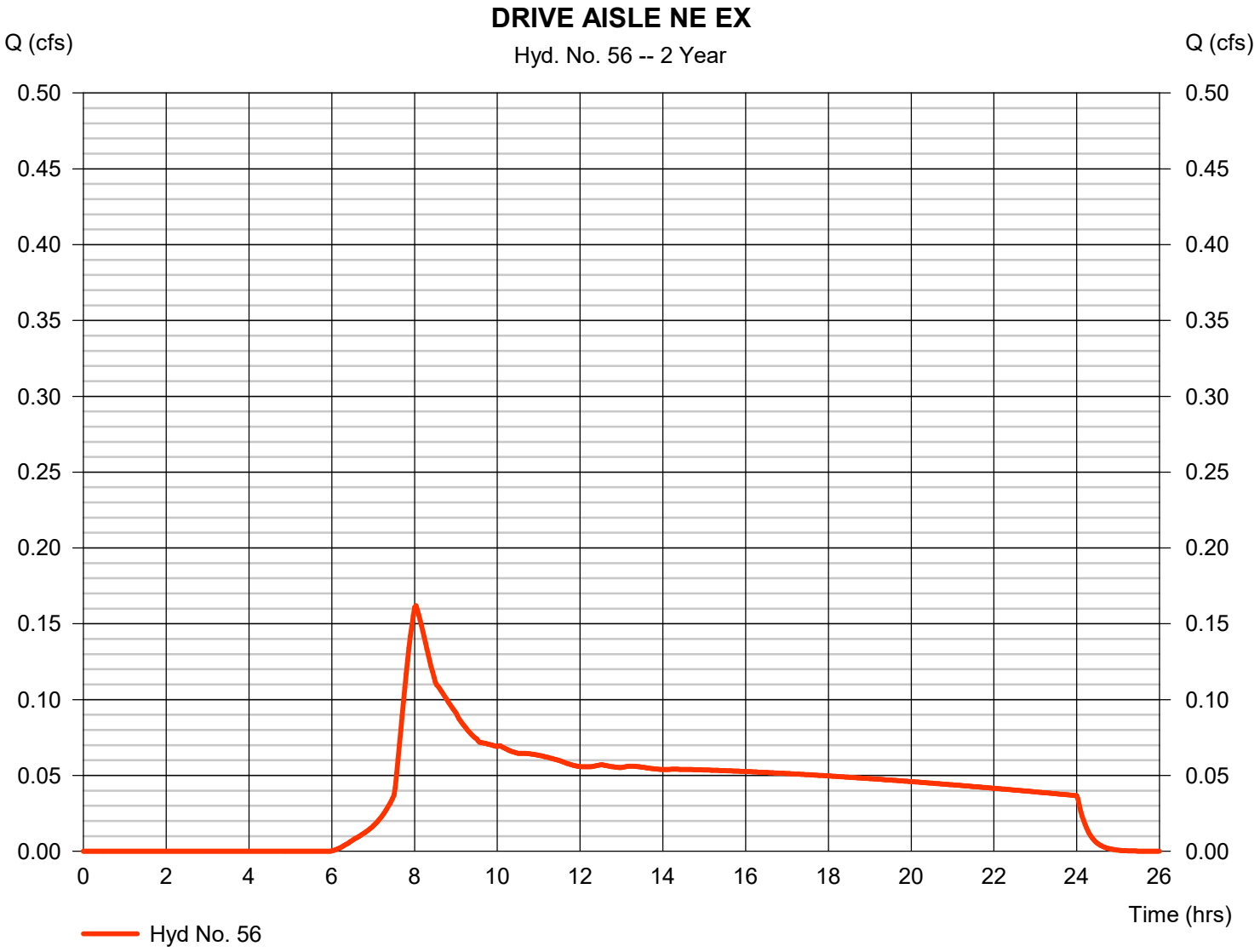
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 56

DRIVE AISLE NE EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.162 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 3,543 cuft
Drainage area	= 1.098 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

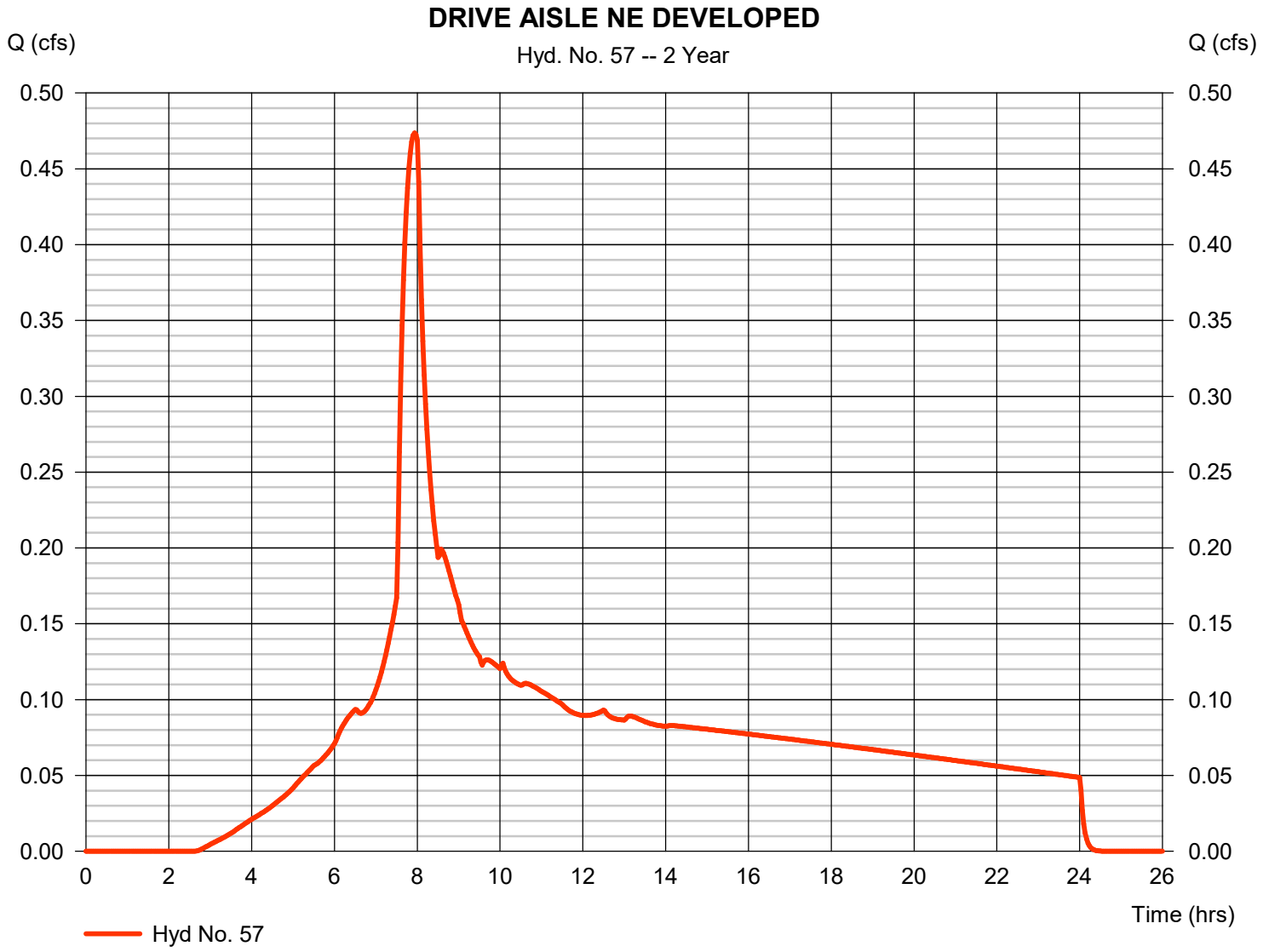
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 57

DRIVE AISLE NE DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.474 cfs
Storm frequency	= 2 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 6,761 cuft
Drainage area	= 1.100 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.733 x 98) + (0.365 x 80)] / 1.100



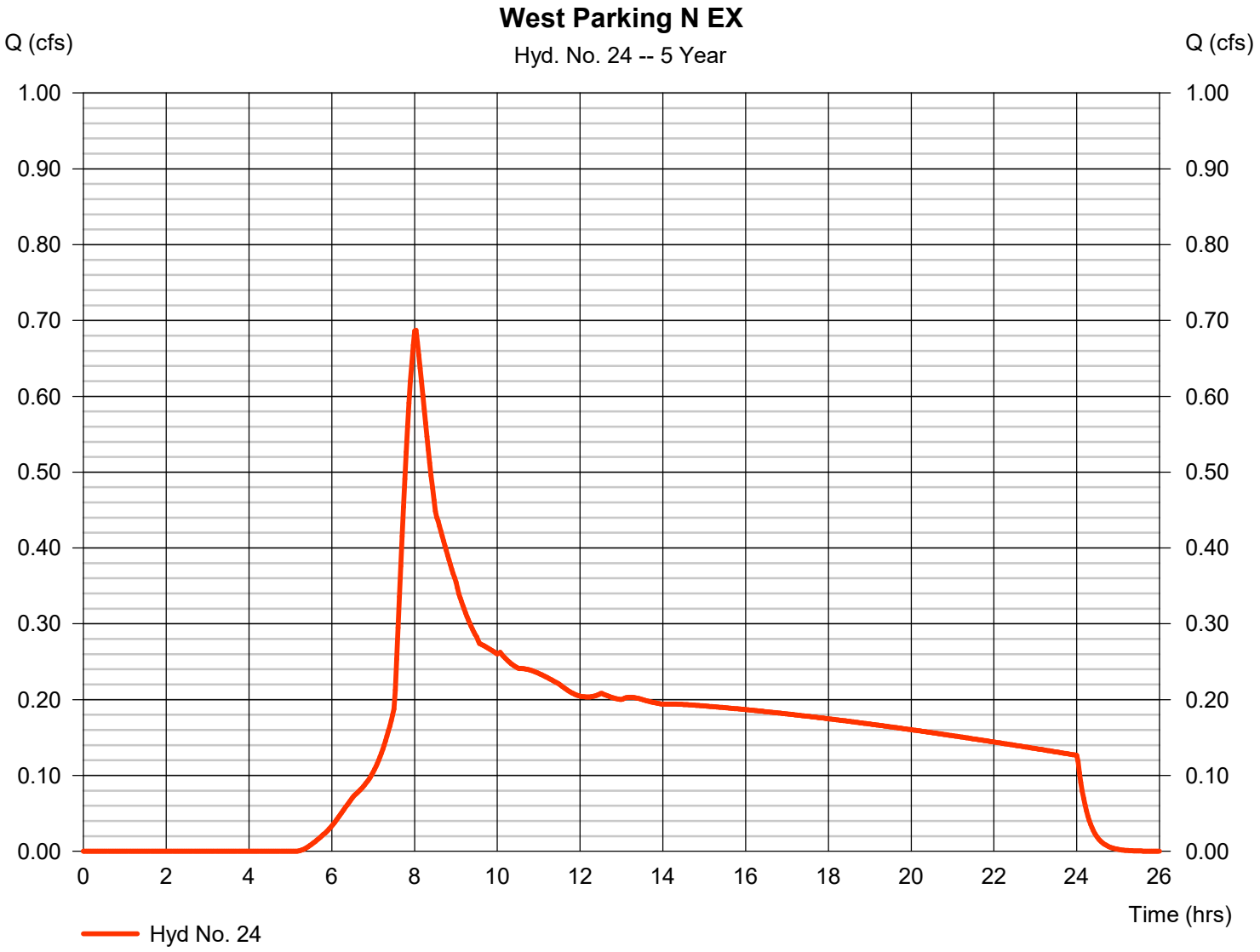
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 24

West Parking N EX

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.687 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	13,376 cuft
Drainage area	=	2.780 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

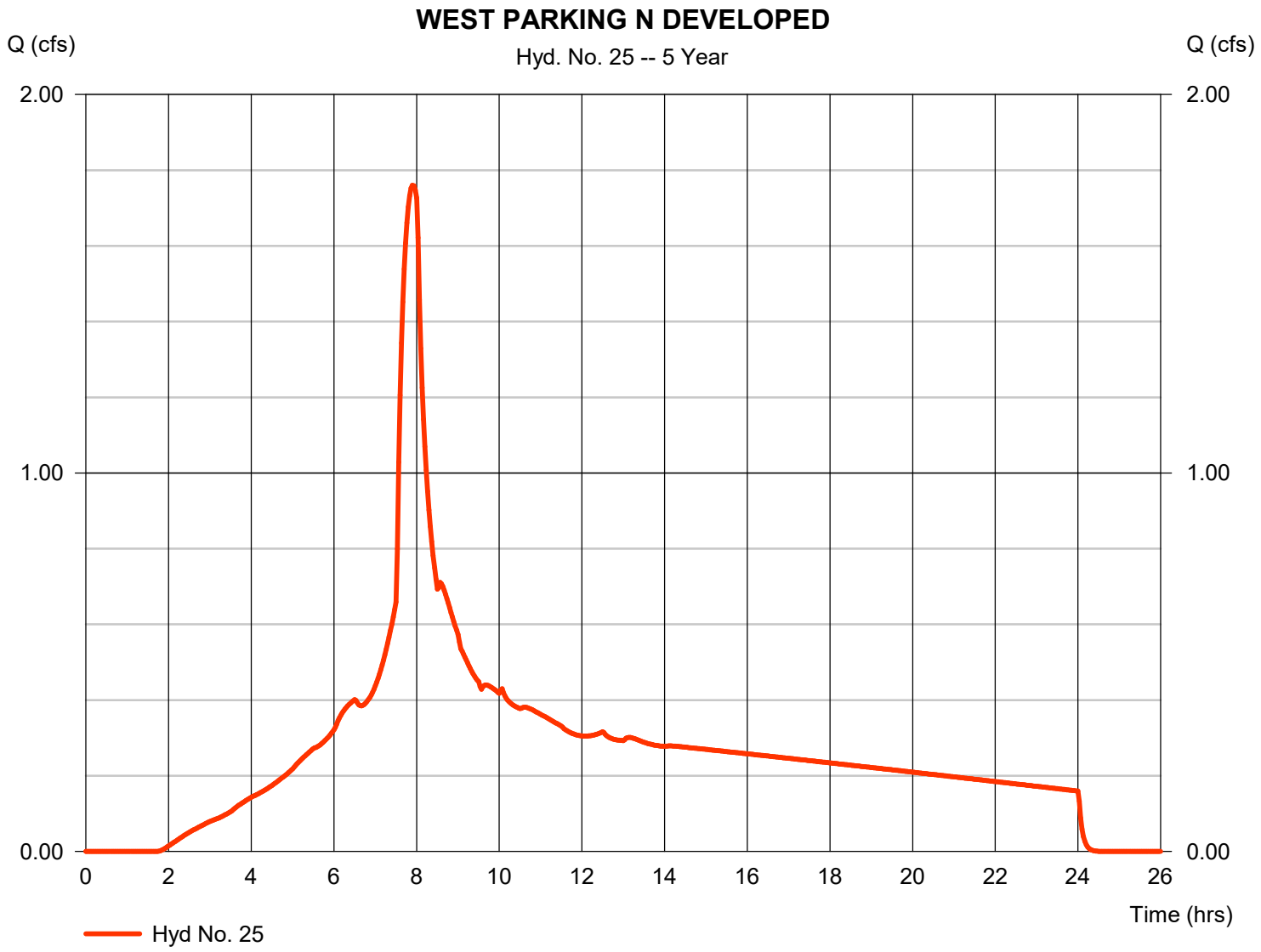
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 25

WEST PARKING N DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.761 cfs
Storm frequency	= 5 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 24,692 cuft
Drainage area	= 2.780 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.170 x 98) + (0.610 x 80)] / 2.780



Hydrograph Report

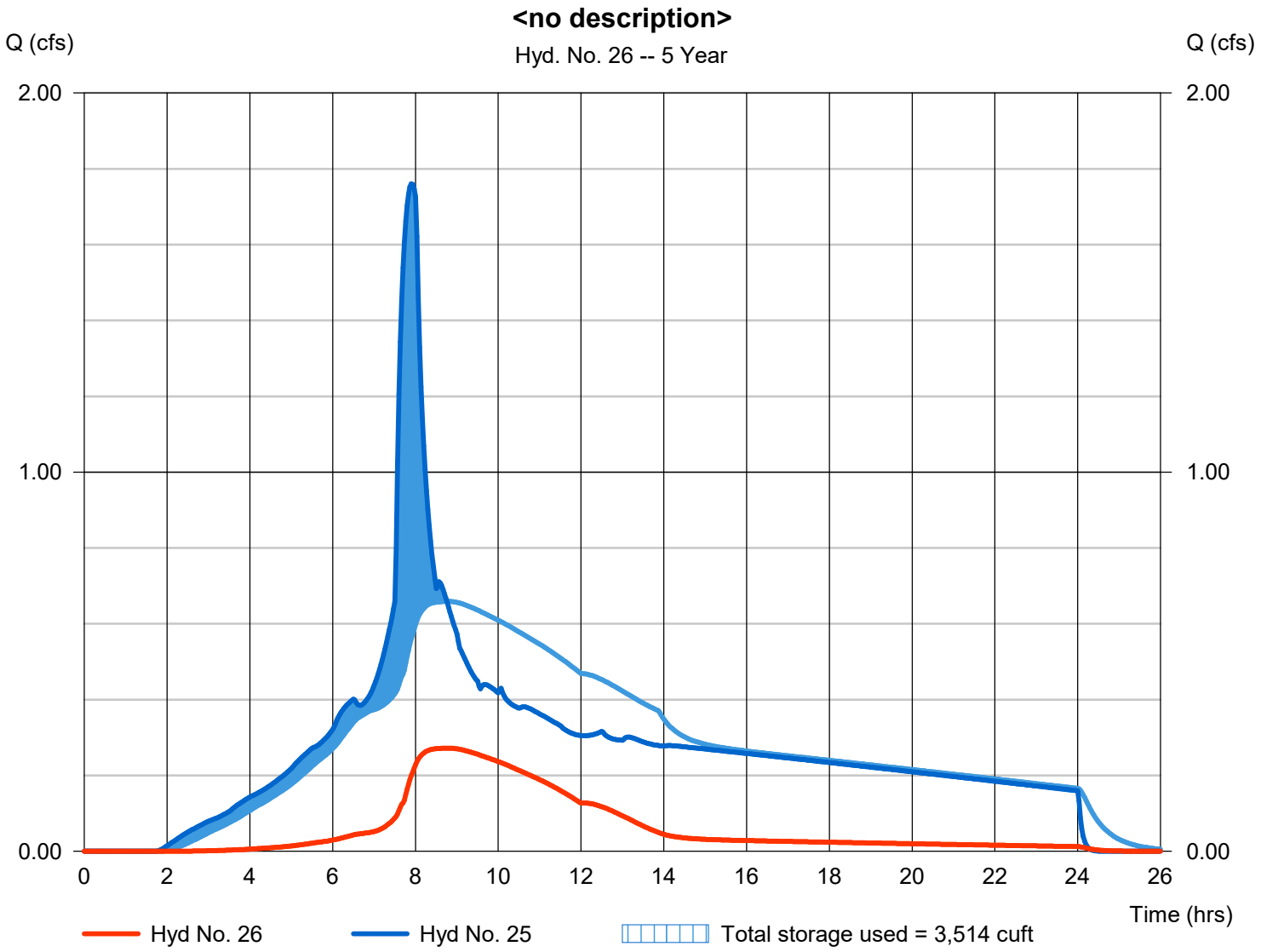
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 26

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.272 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.77 hrs
Time interval	=	2 min	Hyd. volume	=	5,367 cuft
Inflow hyd. No.	=	25 - WEST PARKING N DEVELOPED	Max. Elevation	=	100.71 ft
Reservoir name	=	WEST NORTH DETENTION	Max. Storage	=	3,514 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



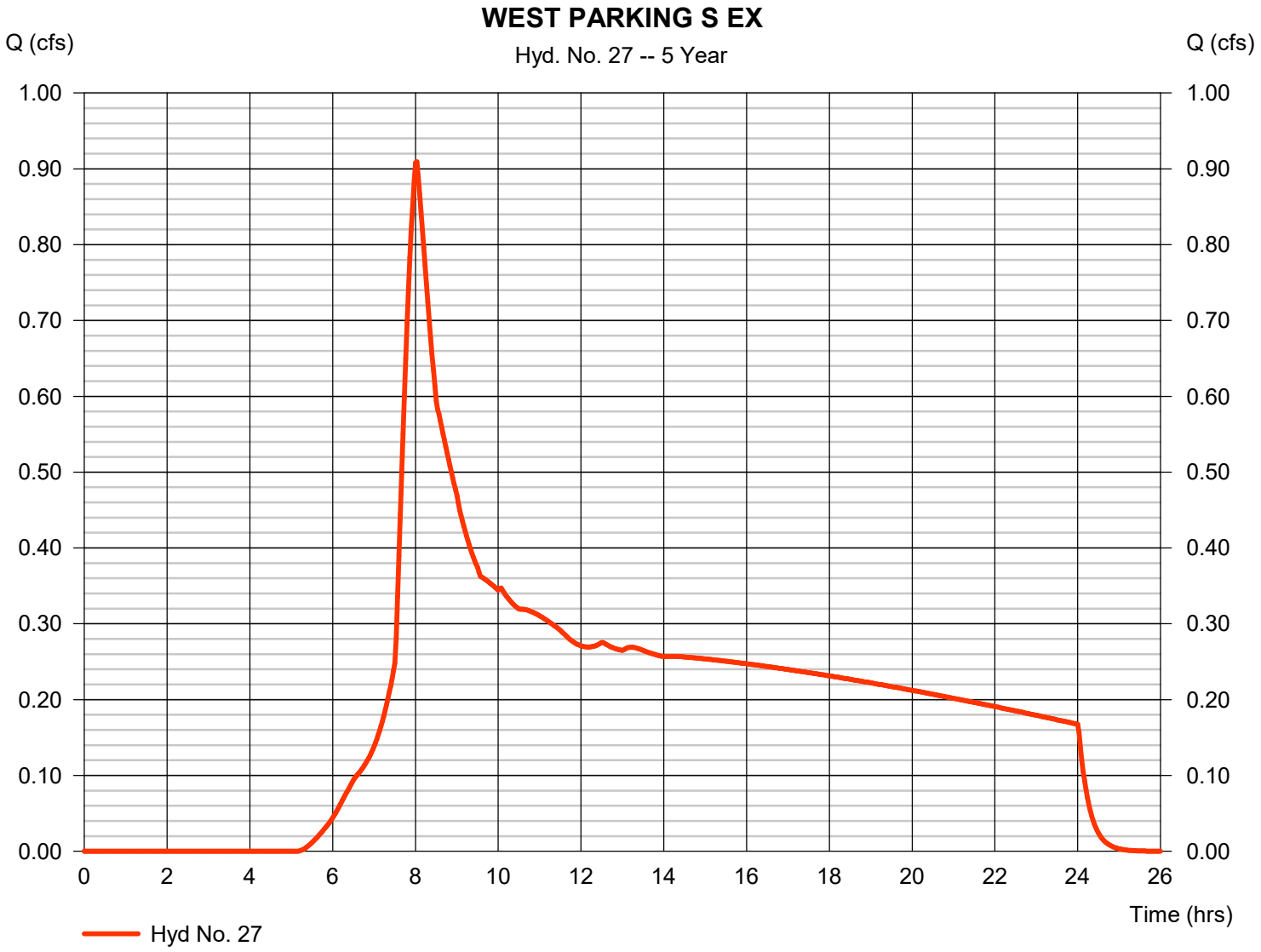
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 27

WEST PARKING S EX

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.909 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	17,706 cuft
Drainage area	=	3.680 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

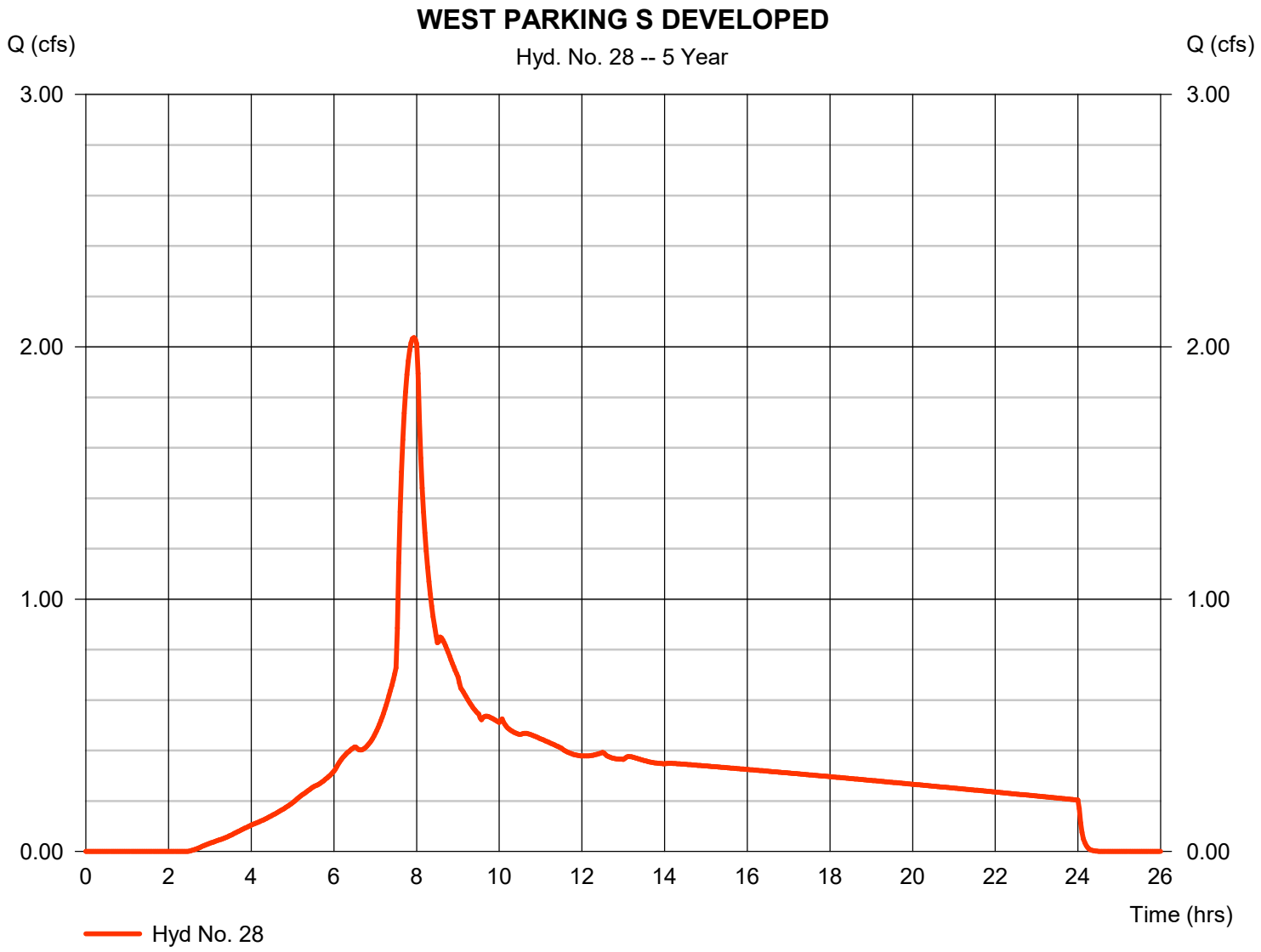
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 28

WEST PARKING S DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 2.037 cfs
Storm frequency	= 5 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 28,915 cuft
Drainage area	= 3.680 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.190 x 98) + (1.490 x 80)] / 3.680



Hydrograph Report

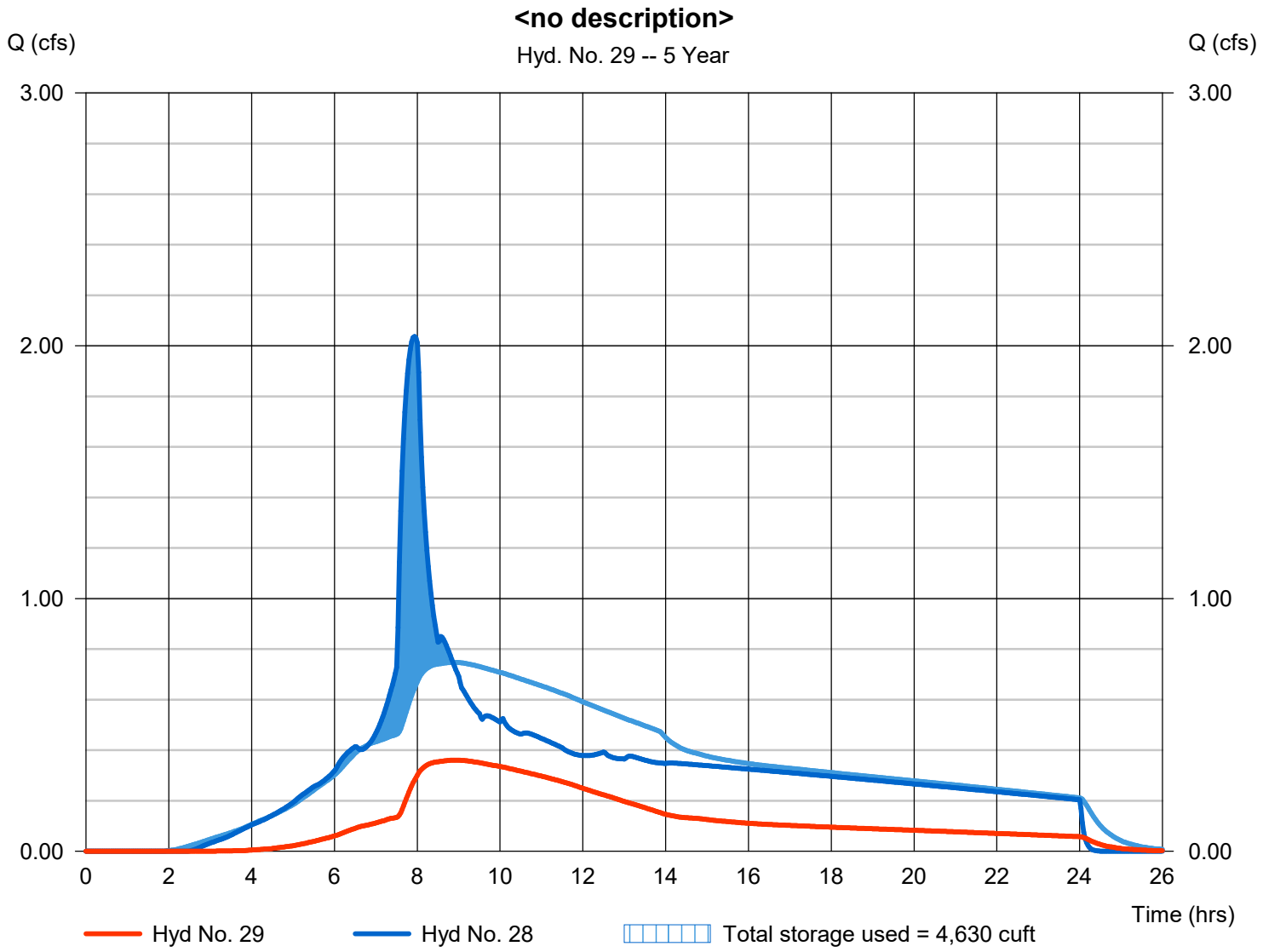
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 29

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.360 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.93 hrs
Time interval	=	2 min	Hyd. volume	=	10,625 cuft
Inflow hyd. No.	=	28 - WEST PARKING S DEVELOPED	Max. Elevation	=	100.98 ft
Reservoir name	=	WEST SOUTH DETENTION	Max. Storage	=	4,630 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



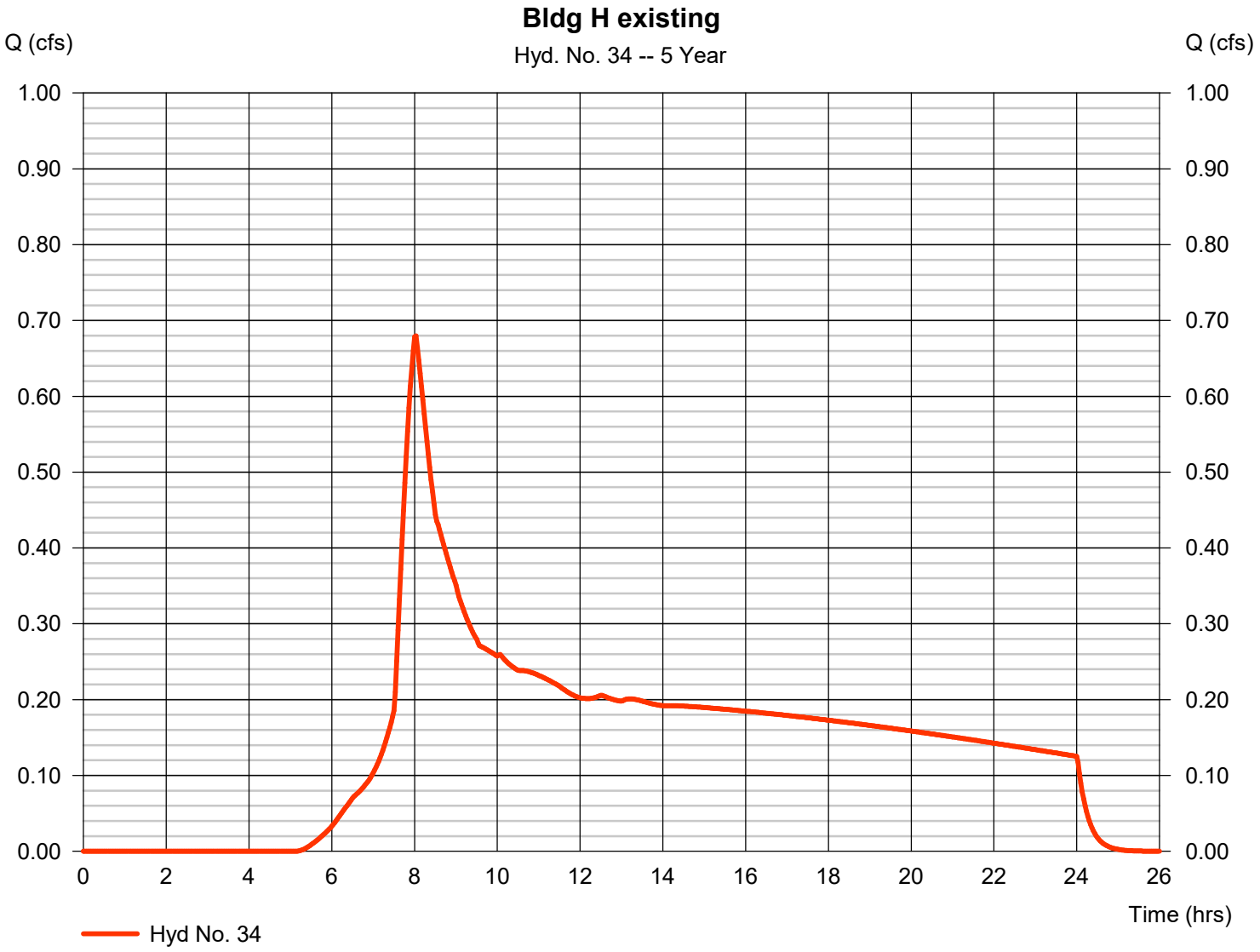
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 34

Bldg H existing

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.680 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	13,232 cuft
Drainage area	=	2.750 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

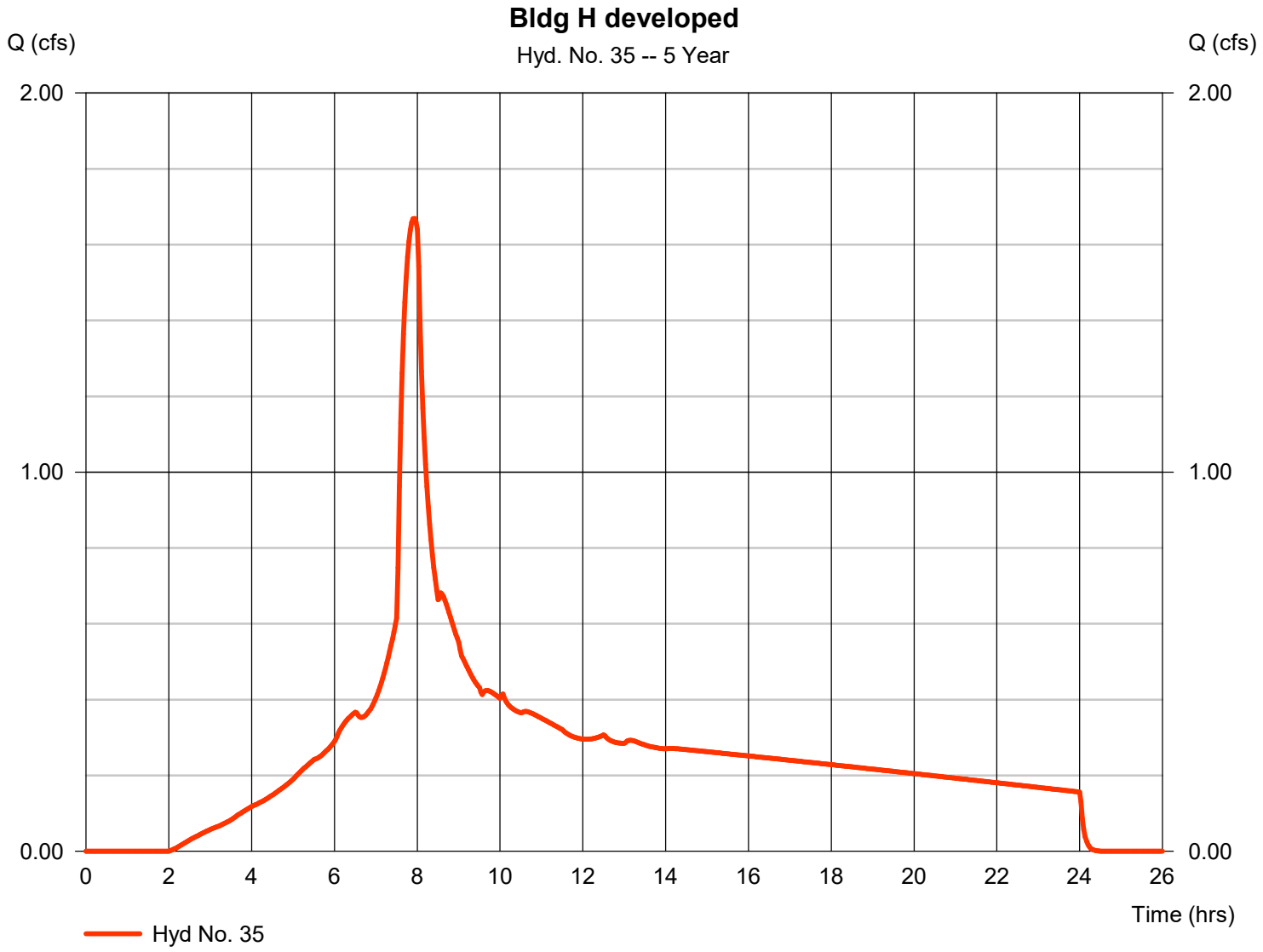
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 35

Bldg H developed

Hydrograph type	=	SBUH Runoff	Peak discharge	=	1.669 cfs
Storm frequency	=	5 yrs	Time to peak	=	7.93 hrs
Time interval	=	2 min	Hyd. volume	=	23,457 cuft
Drainage area	=	2.750 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(2.060 x 98) + (0.690 x 80)] / 2.750



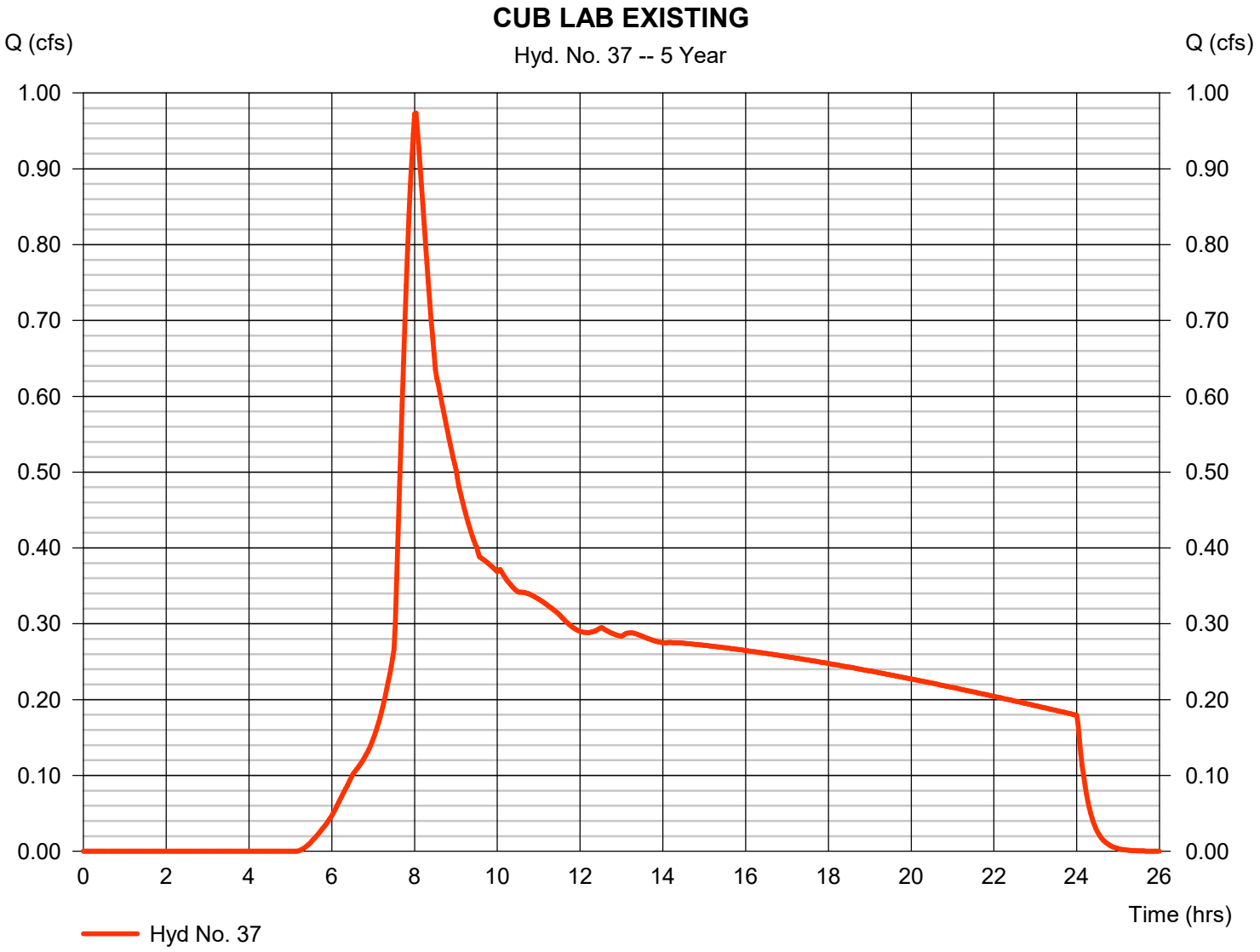
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 37

CUB LAB EXISTING

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.974 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	18,957 cuft
Drainage area	=	3.940 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

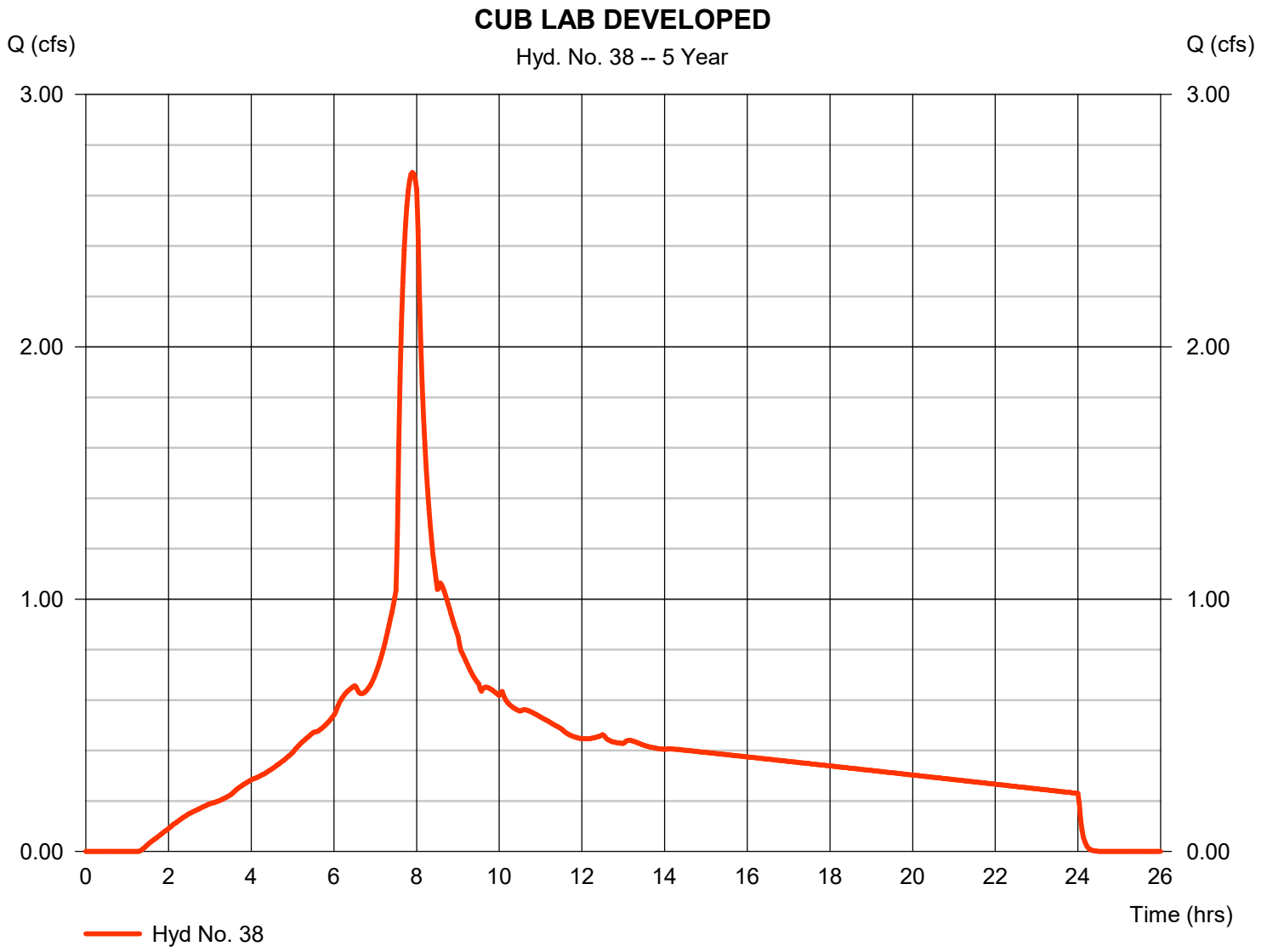
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 38

CUB LAB DEVELOPED

Hydrograph type	=	SBUH Runoff	Peak discharge	=	2.691 cfs
Storm frequency	=	5 yrs	Time to peak	=	7.90 hrs
Time interval	=	2 min	Hyd. volume	=	37,909 cuft
Drainage area	=	3.940 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(3.590 x 98) + (0.350 x 80)] / 3.940



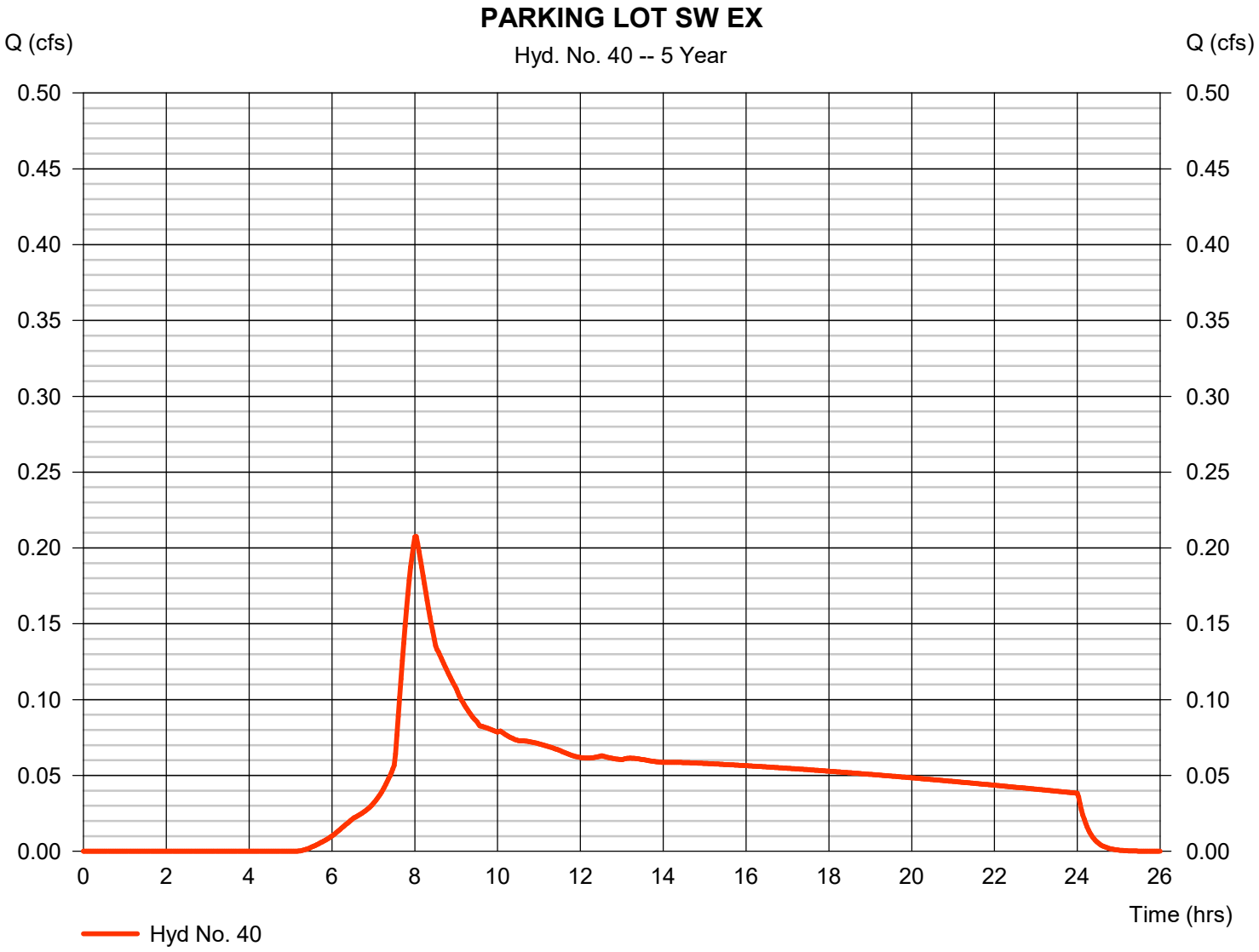
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 40

PARKING LOT SW EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.208 cfs
Storm frequency	= 5 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 4,042 cuft
Drainage area	= 0.840 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 41

PARKING LOT SW DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.554 cfs
Storm frequency	= 5 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 7,767 cuft
Drainage area	= 0.840 ac	Curve number	= 95*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.690 x 98) + (0.150 x 80)] / 0.840

Hydrograph Report

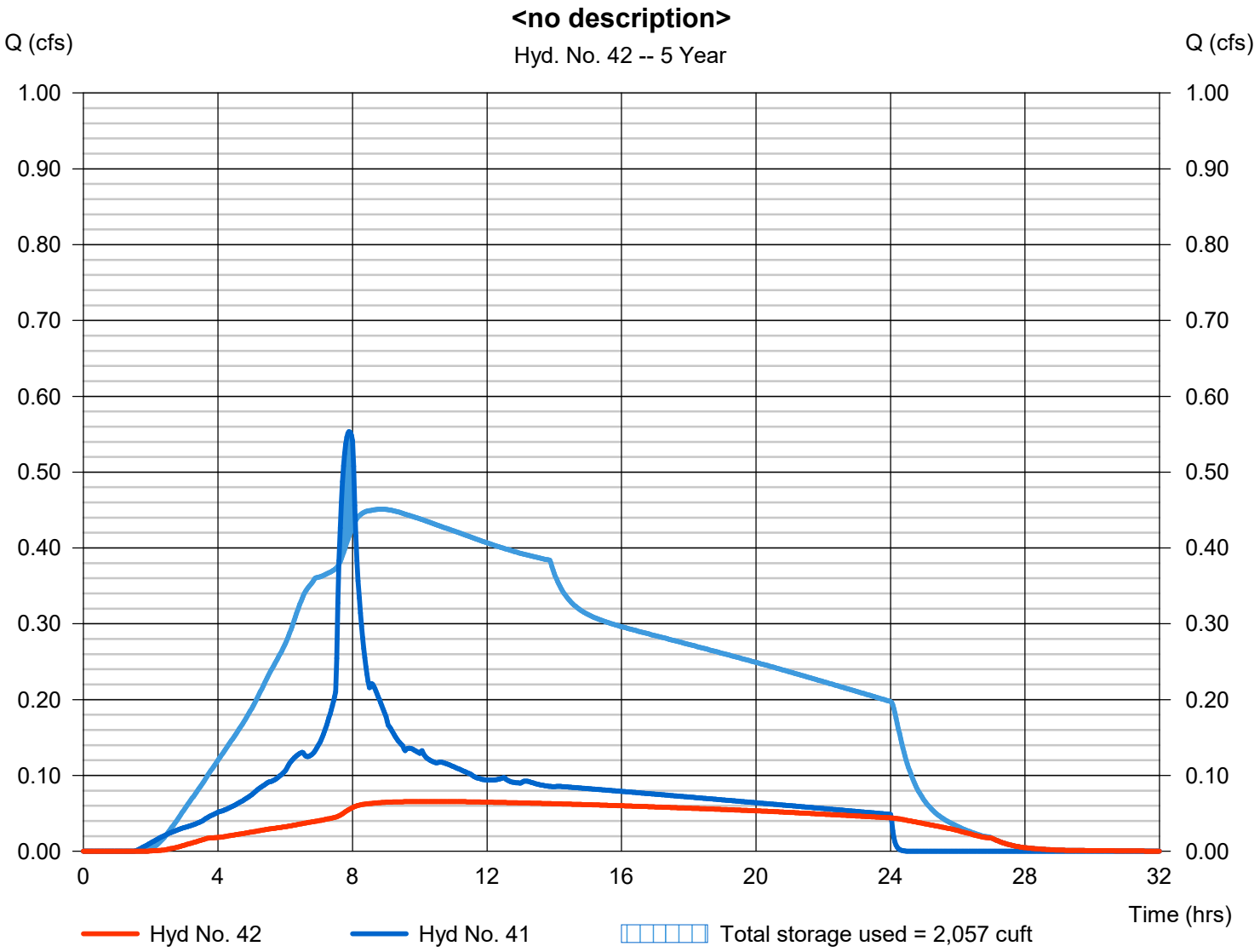
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 42

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.066 cfs
Storm frequency	= 5 yrs	Time to peak	= 10.27 hrs
Time interval	= 2 min	Hyd. volume	= 4,288 cuft
Inflow hyd. No.	= 41 - PARKING LOT SW DEVELOPED	Max. Elevation	= 101.37 ft
Reservoir name	= SW Parking Lot Detention	Max. Storage	= 2,057 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



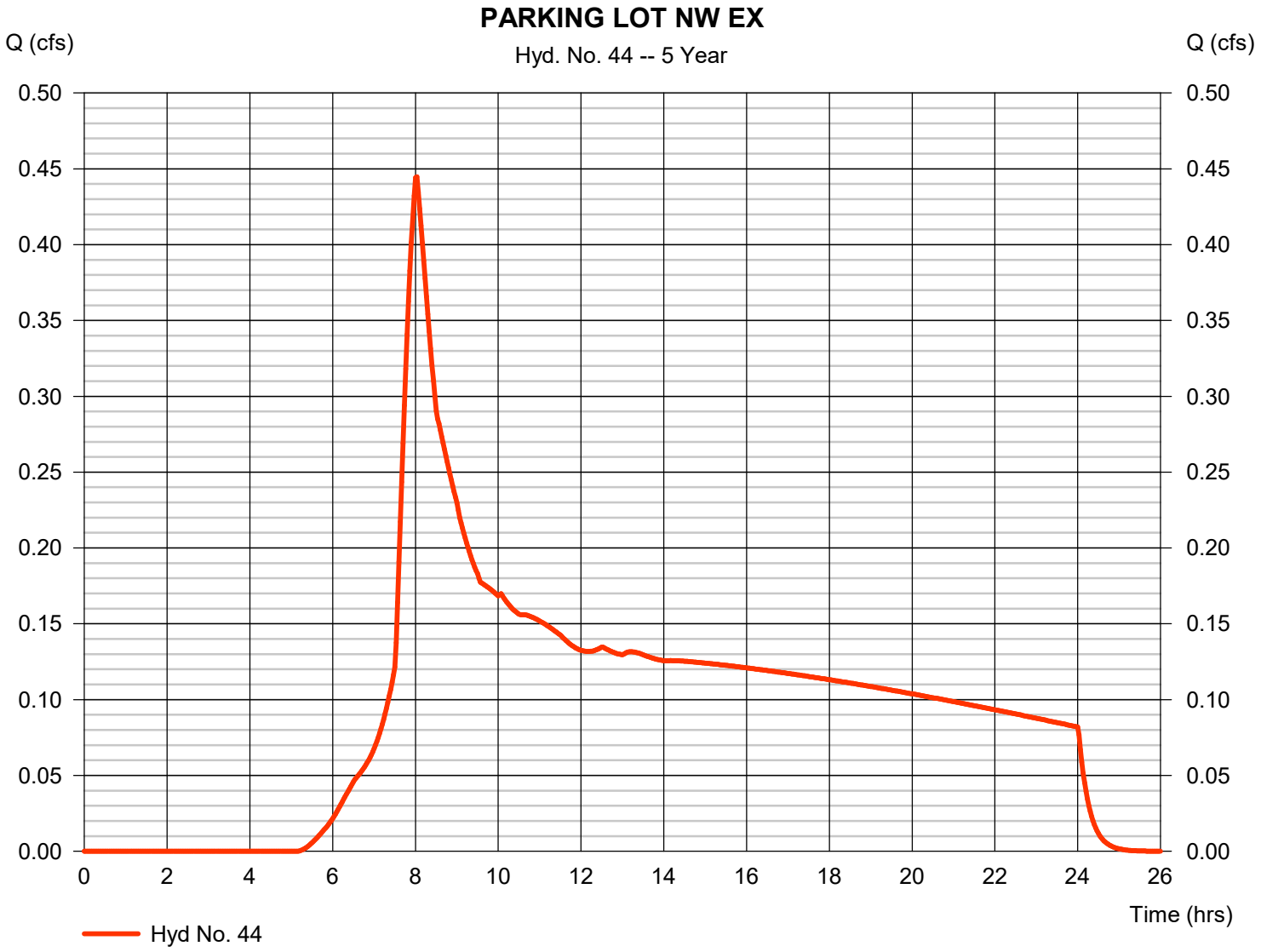
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 44

PARKING LOT NW EX

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.445 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	8,661 cuft
Drainage area	=	1.800 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 45

PARKING LOT NW DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.996 cfs
Storm frequency	= 5 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 14,143 cuft
Drainage area	= 1.800 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.130 x 98) + (0.670 x 80)] / 1.800

Hydrograph Report

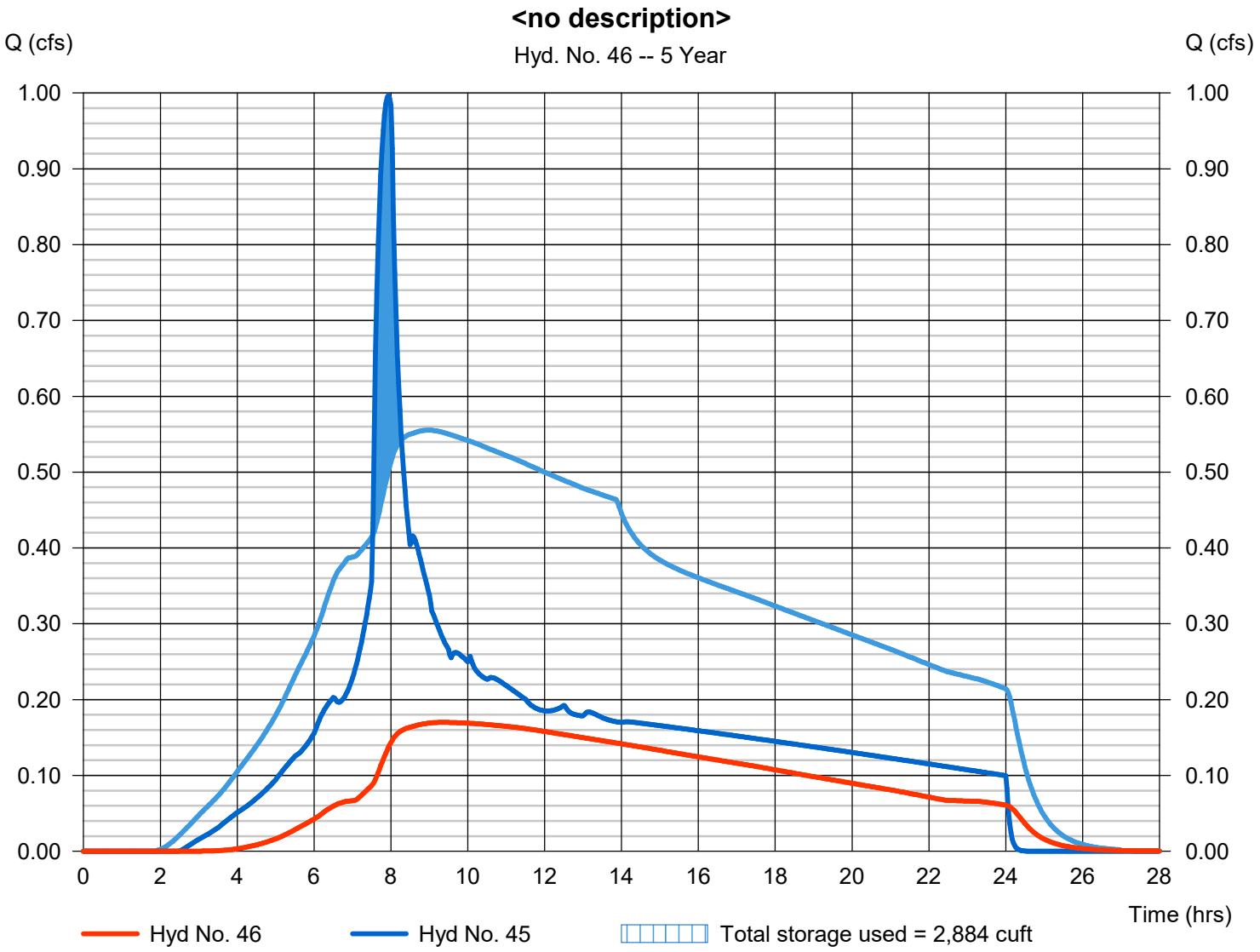
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 46

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.170 cfs
Storm frequency	=	5 yrs	Time to peak	=	9.37 hrs
Time interval	=	2 min	Hyd. volume	=	7,880 cuft
Inflow hyd. No.	=	45 - PARKING LOT NW DEVELOPED	Max. Elevation	=	100.84 ft
Reservoir name	=	NW Parking Lot Detention	Max. Storage	=	2,884 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



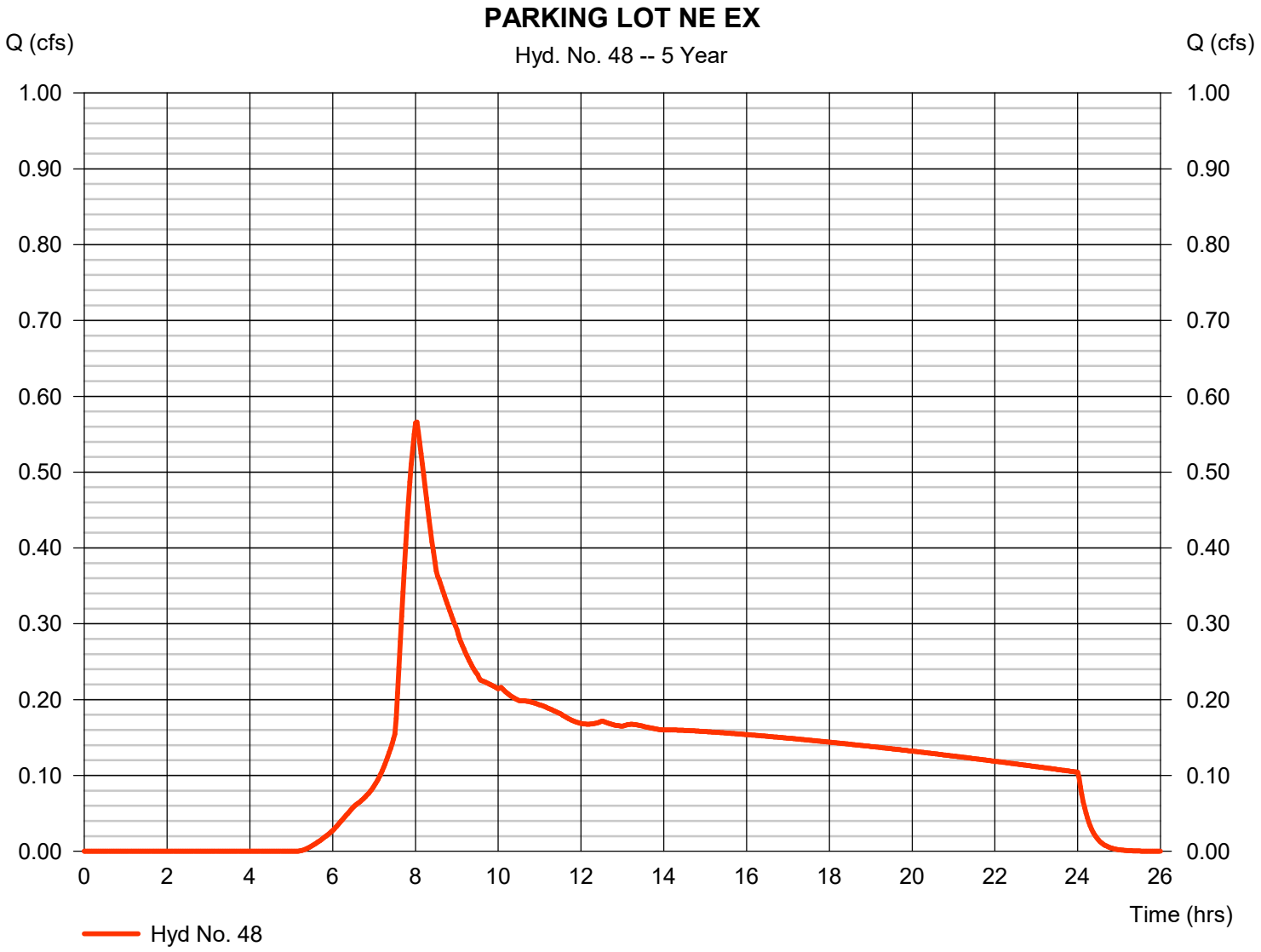
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 48

PARKING LOT NE EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.566 cfs
Storm frequency	= 5 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 11,018 cuft
Drainage area	= 2.290 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

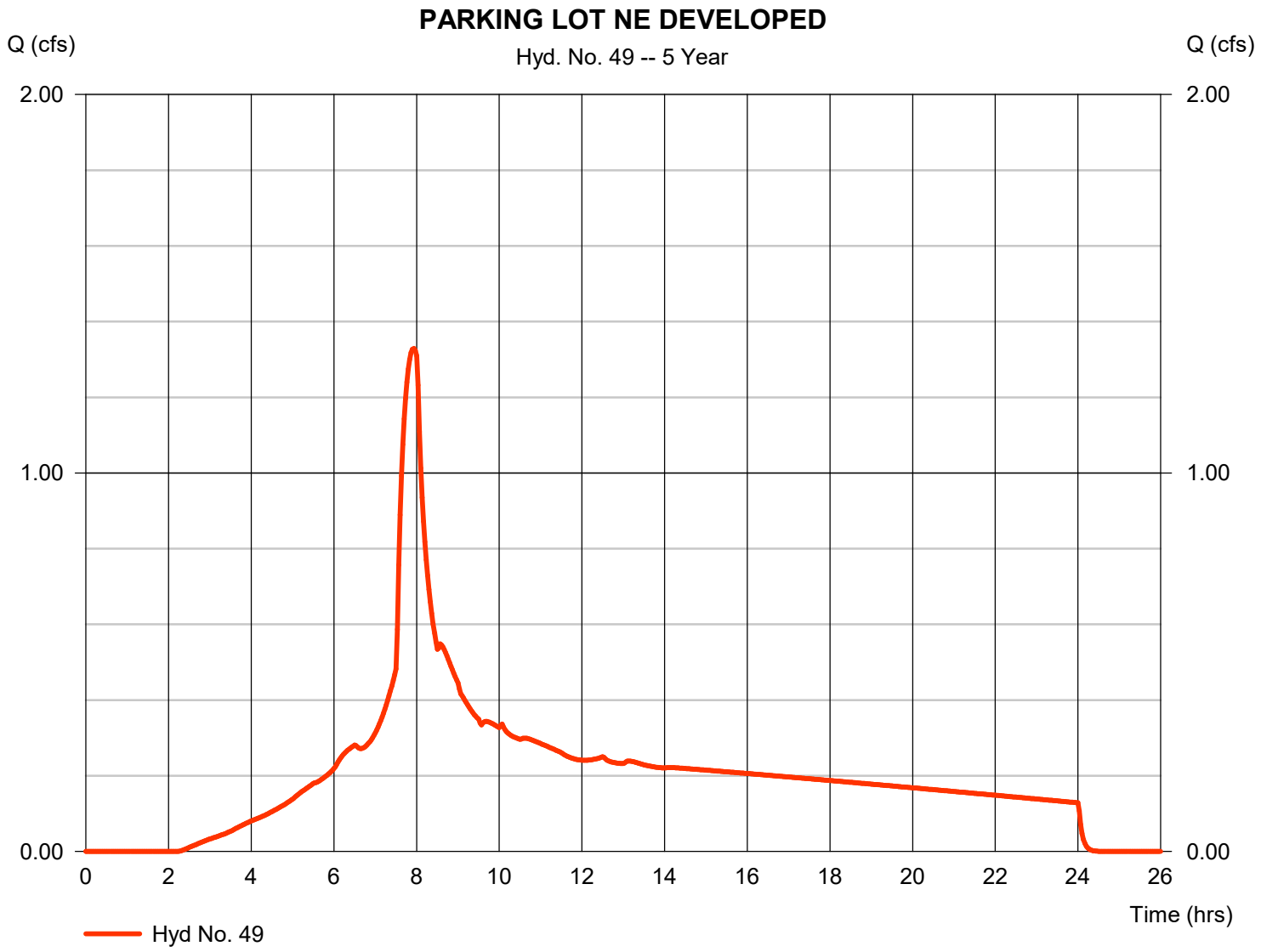
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 49

PARKING LOT NE DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.329 cfs
Storm frequency	= 5 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 18,751 cuft
Drainage area	= 2.290 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.580 x 98) + (0.710 x 80)] / 2.290



Hydrograph Report

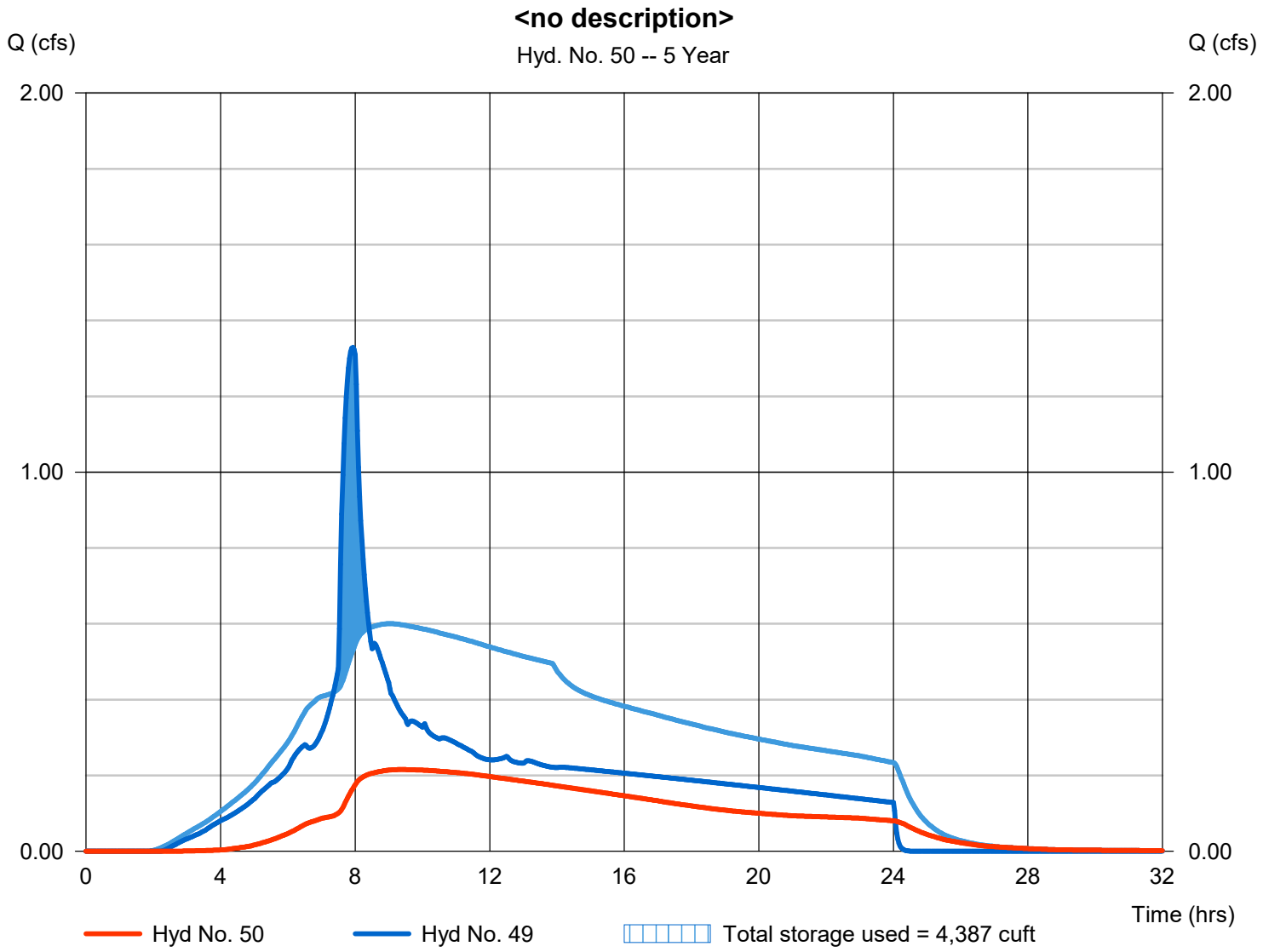
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 50

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.216 cfs
Storm frequency	=	5 yrs	Time to peak	=	9.37 hrs
Time interval	=	2 min	Hyd. volume	=	9,823 cuft
Inflow hyd. No.	=	49 - PARKING LOT NE DEVELOPED	Max. Elevation	=	100.74 ft
Reservoir name	=	NE Parking Lot Detention	Max. Storage	=	4,387 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



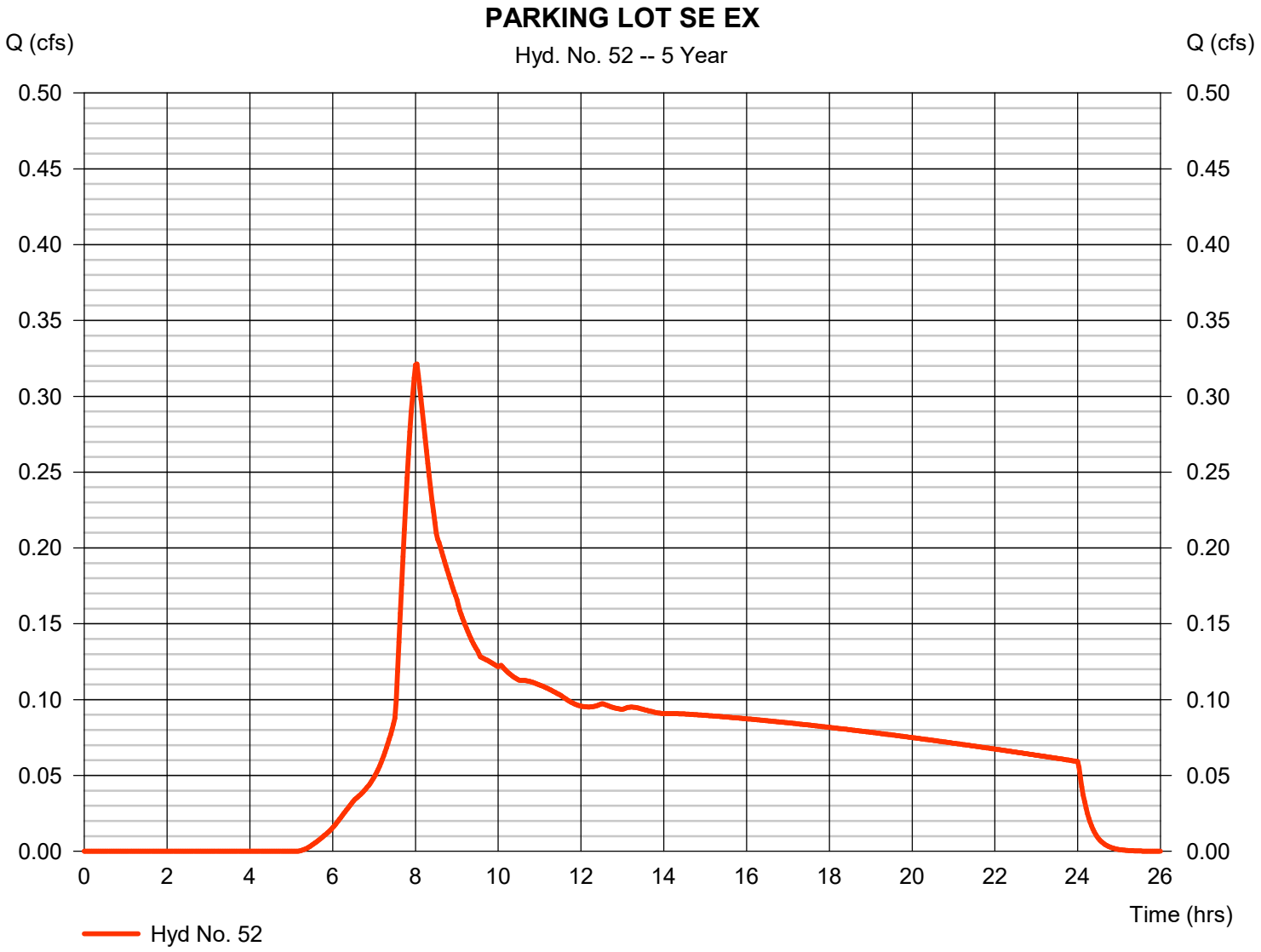
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 52

PARKING LOT SE EX

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.321 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.03 hrs
Time interval	=	2 min	Hyd. volume	=	6,255 cuft
Drainage area	=	1.300 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

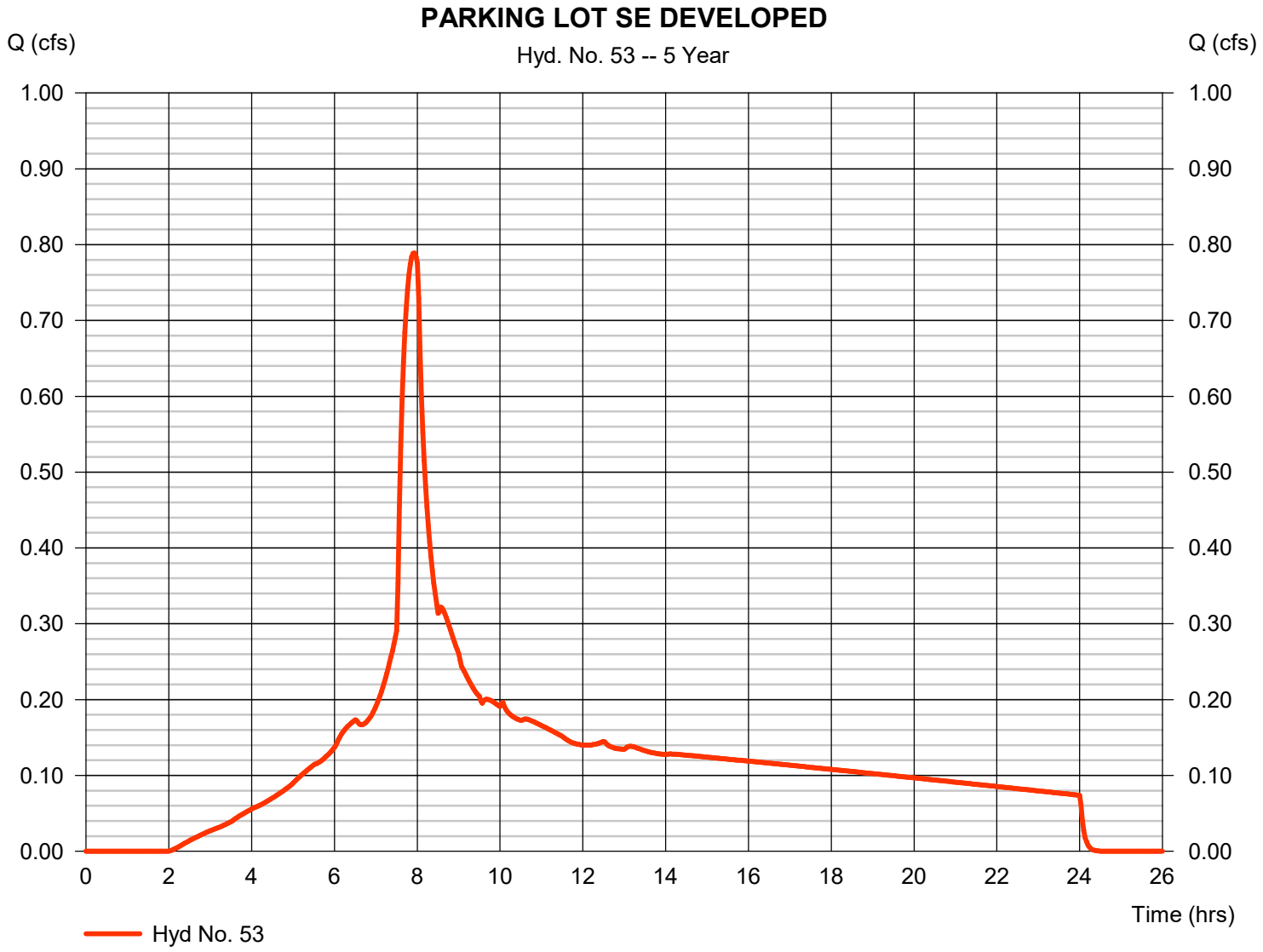
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 53

PARKING LOT SE DEVELOPED

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.789 cfs
Storm frequency	=	5 yrs	Time to peak	=	7.93 hrs
Time interval	=	2 min	Hyd. volume	=	11,089 cuft
Drainage area	=	1.300 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.920 x 98) + (0.380 x 80)] / 1.300



Hydrograph Report

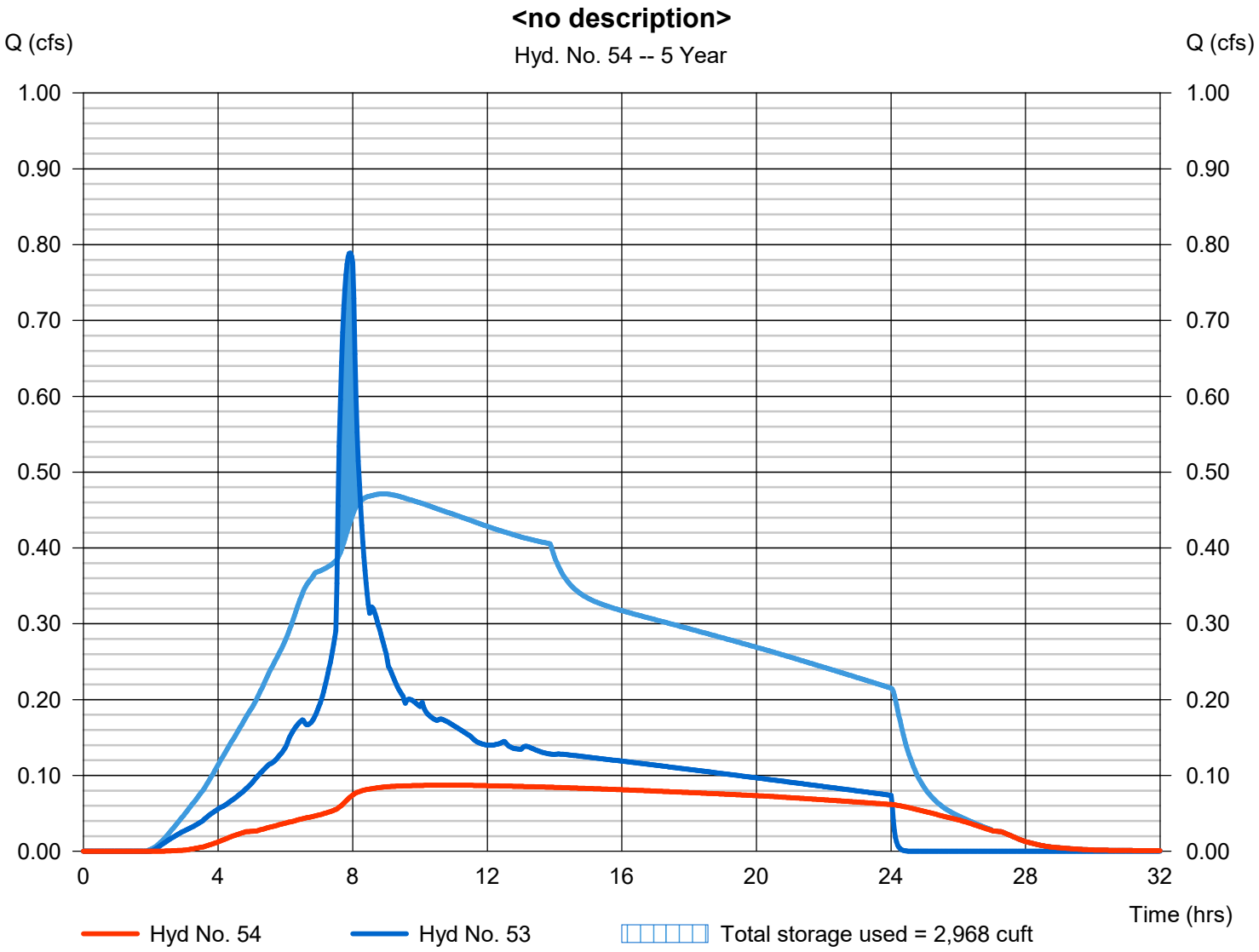
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 54

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.087 cfs
Storm frequency	= 5 yrs	Time to peak	= 10.93 hrs
Time interval	= 2 min	Hyd. volume	= 5,727 cuft
Inflow hyd. No.	= 53 - PARKING LOT SE DEVELOPED	Max. Elevation	= 101.27 ft
Reservoir name	= SE Parking Lot Detention	Max. Storage	= 2,968 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



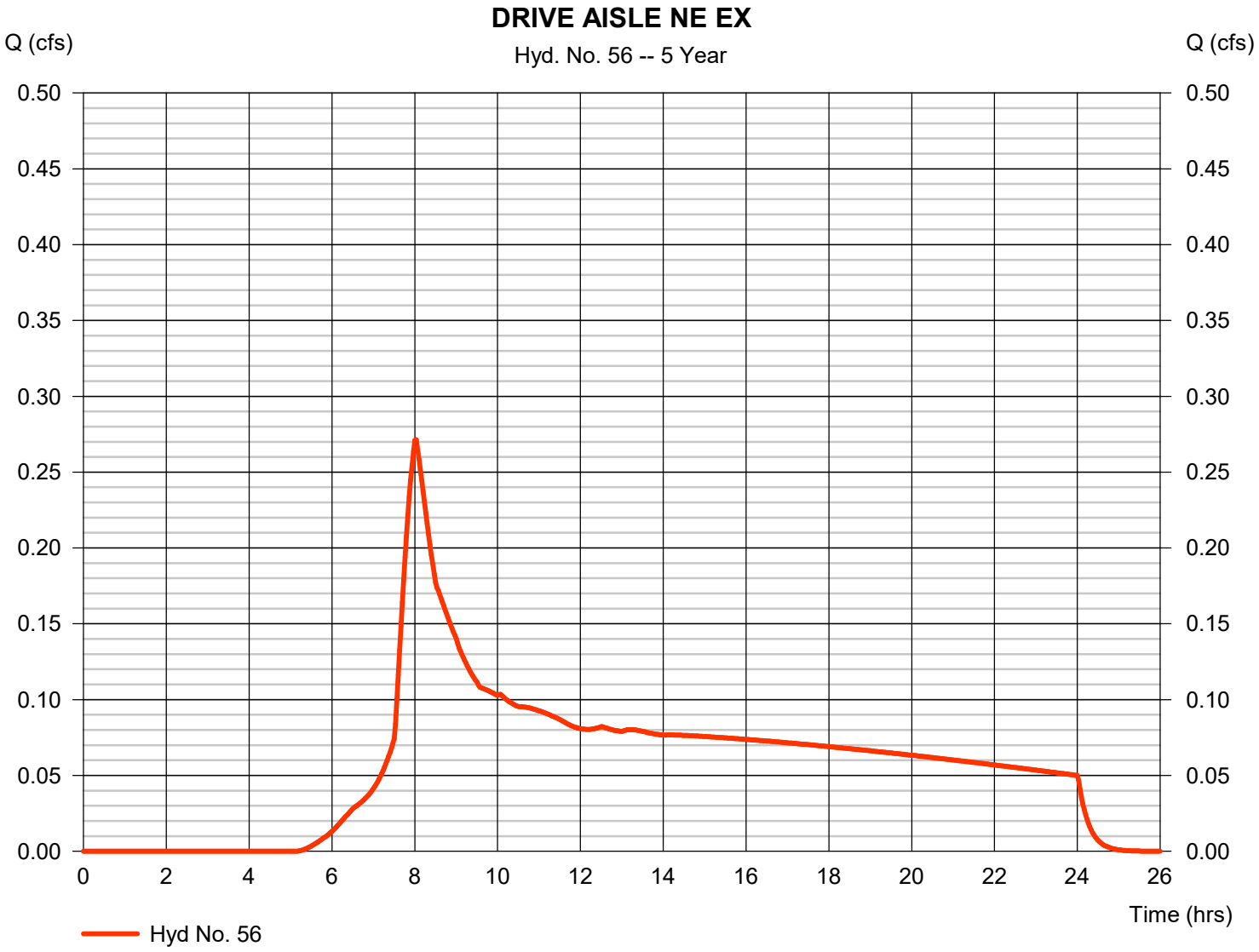
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 56

DRIVE AISLE NE EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.271 cfs
Storm frequency	= 5 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 5,283 cuft
Drainage area	= 1.098 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

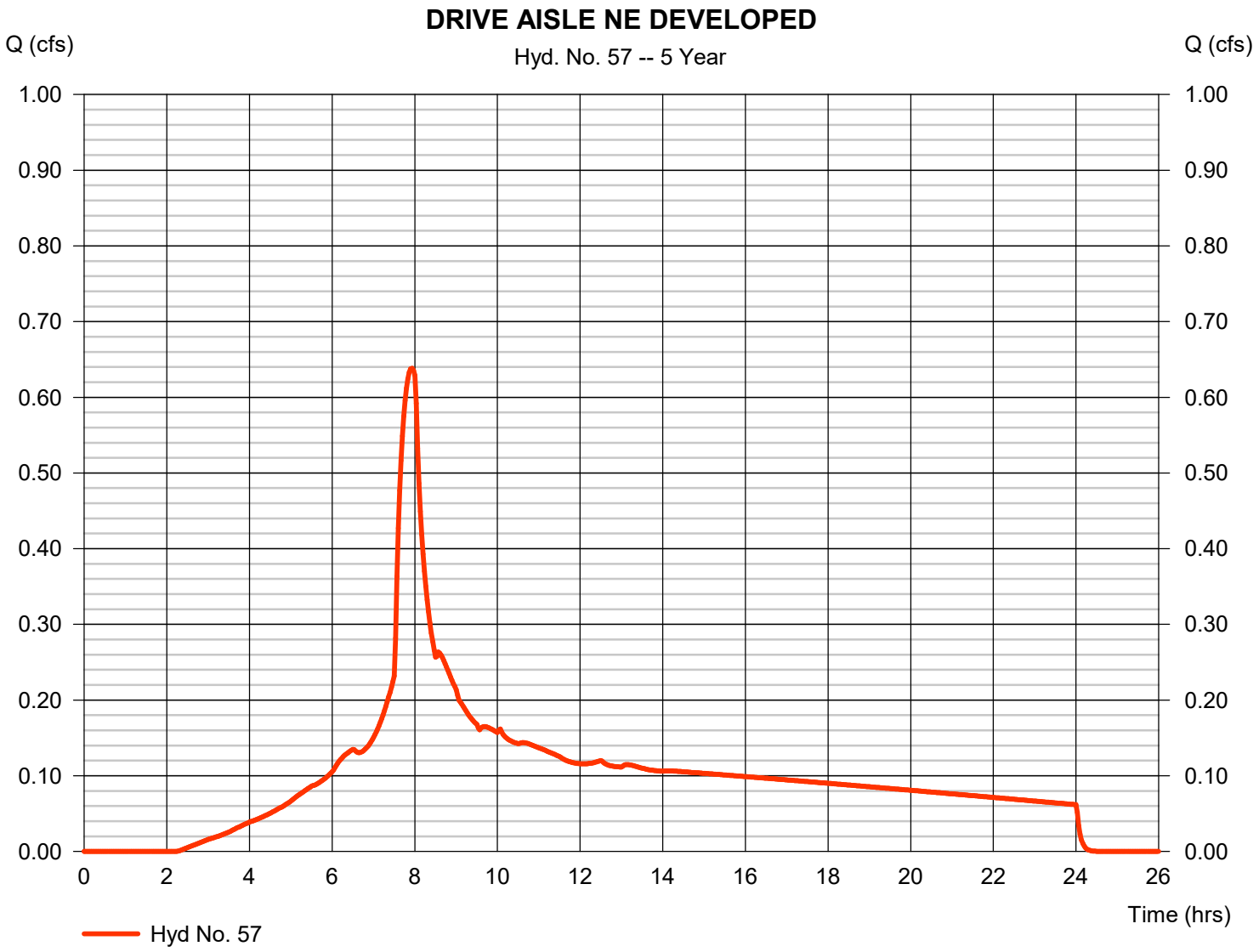
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 57

DRIVE AISLE NE DEVELOPED

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.638 cfs
Storm frequency	=	5 yrs	Time to peak	=	7.93 hrs
Time interval	=	2 min	Hyd. volume	=	9,007 cuft
Drainage area	=	1.100 ac	Curve number	=	92*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.733 x 98) + (0.365 x 80)] / 1.100



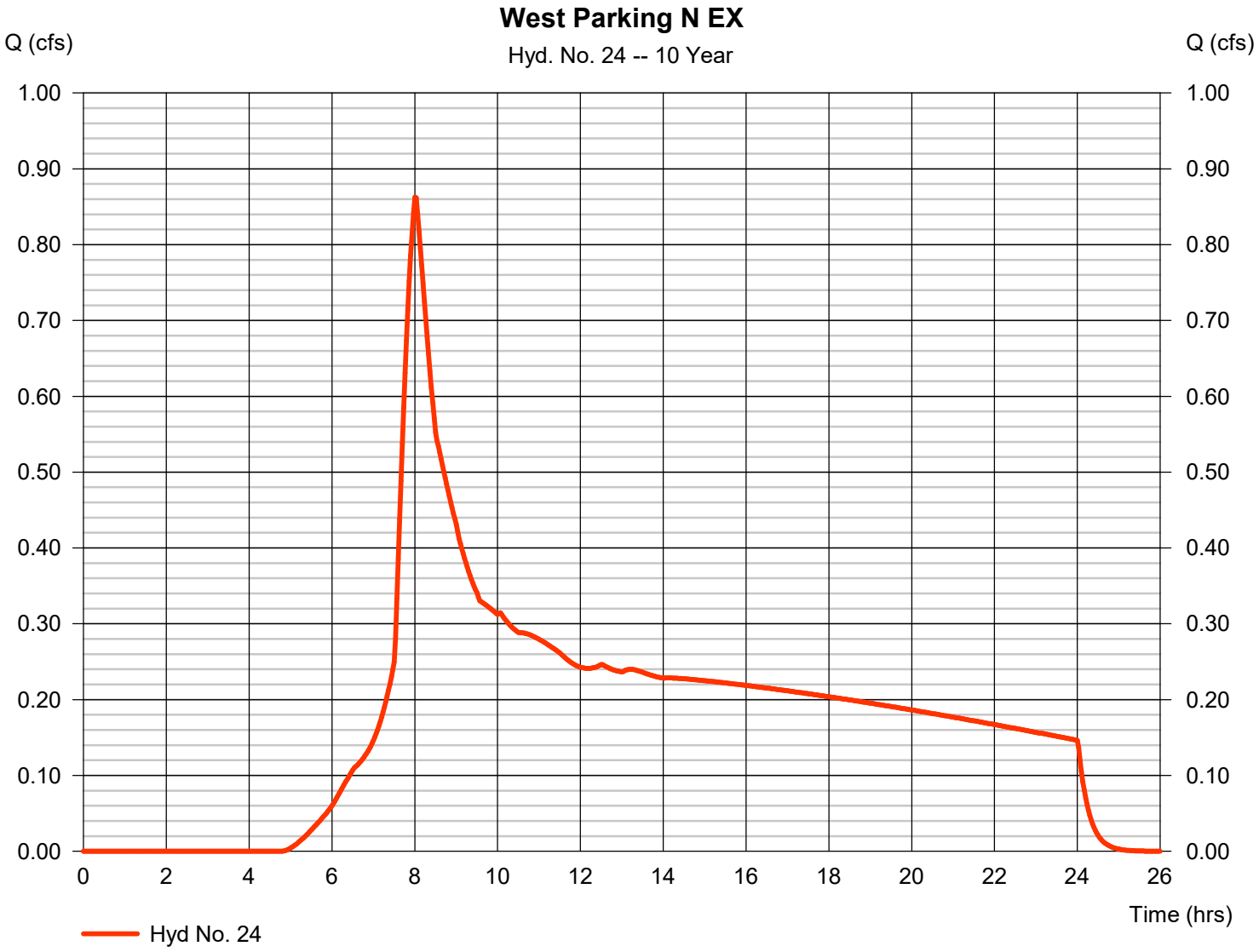
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 24

West Parking N EX

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.863 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	16,114 cuft
Drainage area	=	2.780 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

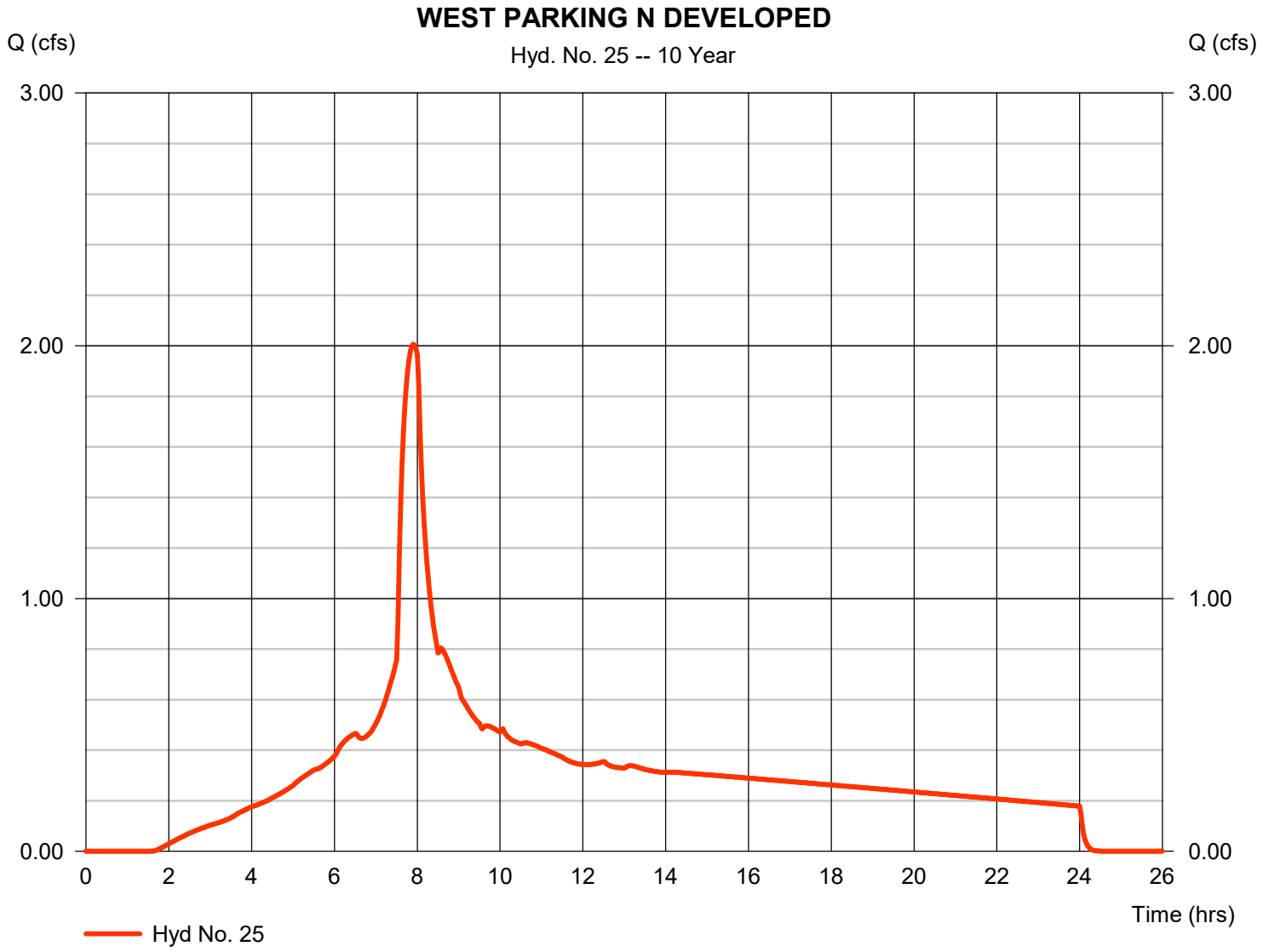
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 25

WEST PARKING N DEVELOPED

Hydrograph type	=	SBUH Runoff	Peak discharge	=	2.005 cfs
Storm frequency	=	10 yrs	Time to peak	=	7.90 hrs
Time interval	=	2 min	Hyd. volume	=	28,124 cuft
Drainage area	=	2.780 ac	Curve number	=	94*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(2.170 x 98) + (0.610 x 80)] / 2.780



Hydrograph Report

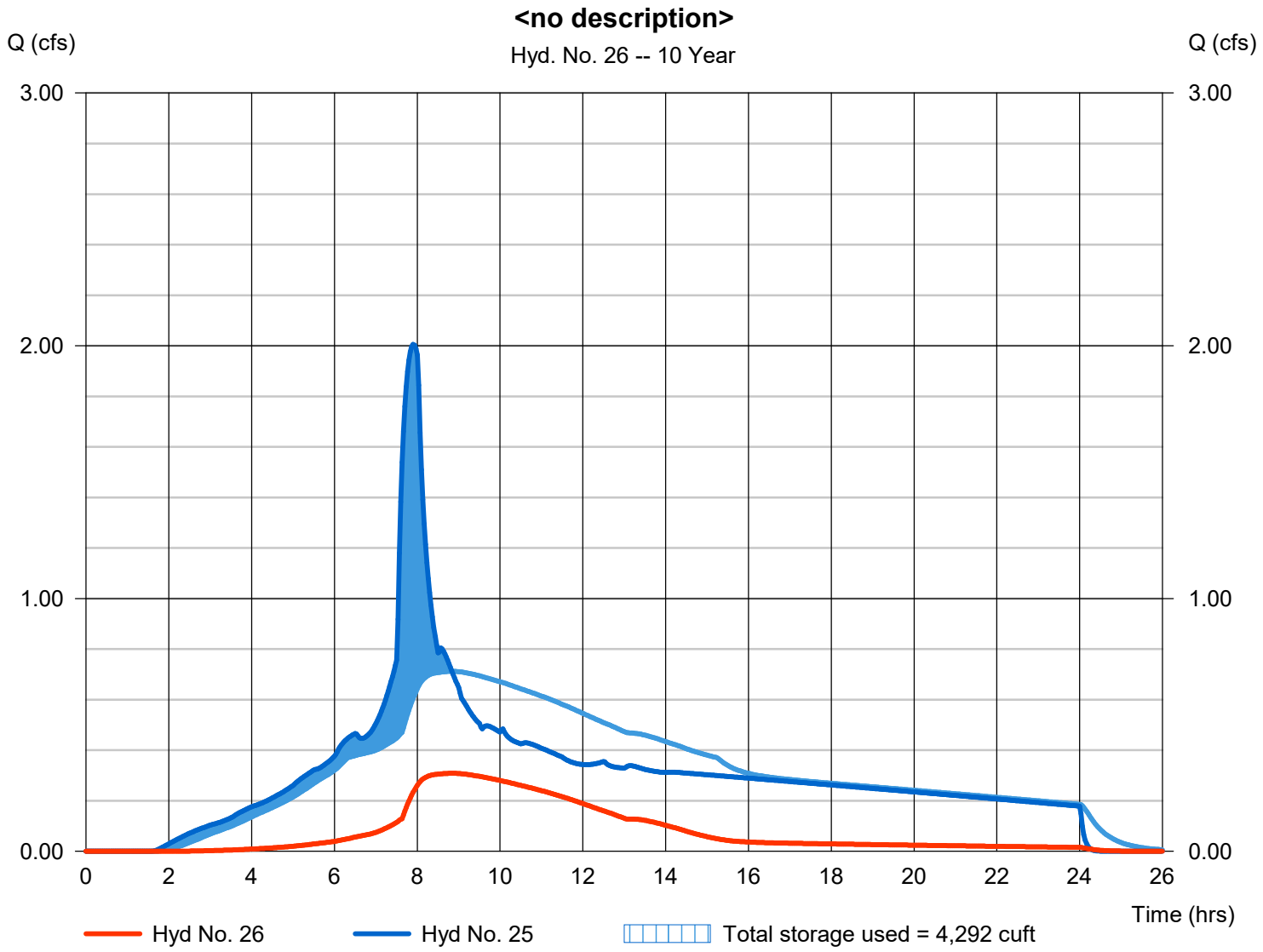
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 26

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.308 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.83 hrs
Time interval	=	2 min	Hyd. volume	=	6,904 cuft
Inflow hyd. No.	=	25 - WEST PARKING N DEVELOPED	Max. Elevation	=	100.84 ft
Reservoir name	=	WEST NORTH DETENTION	Max. Storage	=	4,292 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



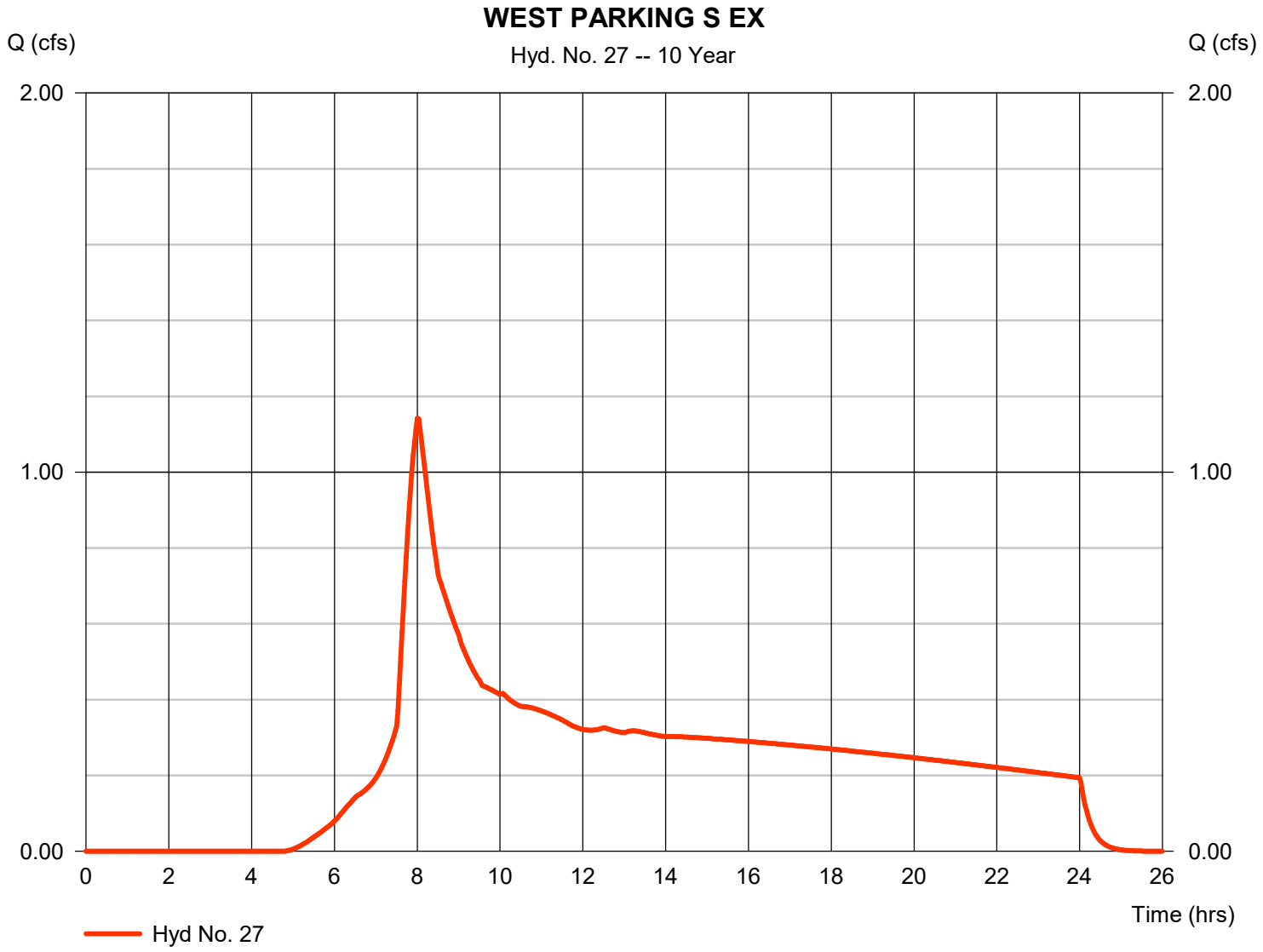
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 27

WEST PARKING S EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.142 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 21,331 cuft
Drainage area	= 3.680 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

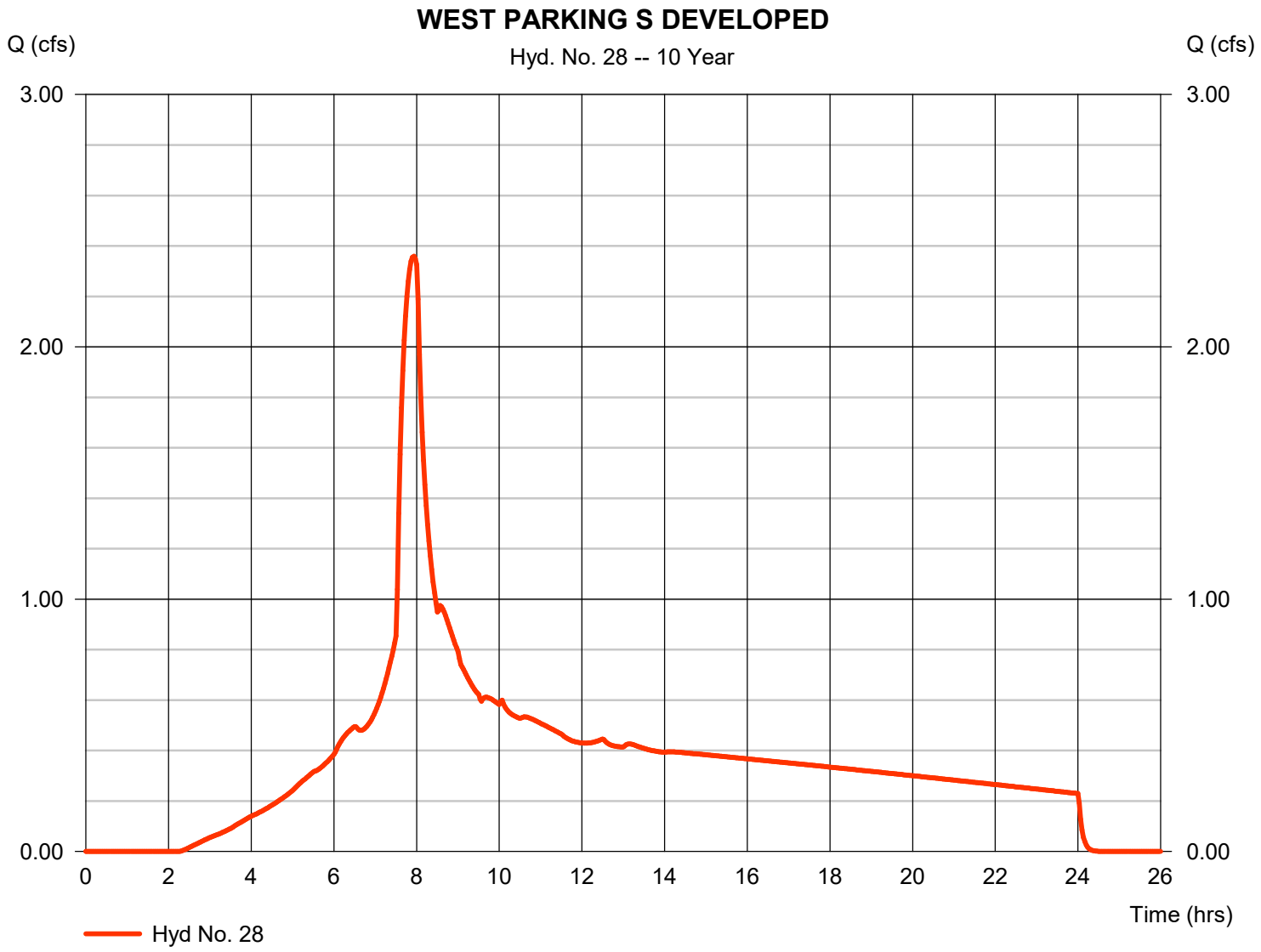
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 28

WEST PARKING S DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 2.359 cfs
Storm frequency	= 10 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 33,313 cuft
Drainage area	= 3.680 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.190 x 98) + (1.490 x 80)] / 3.680



Hydrograph Report

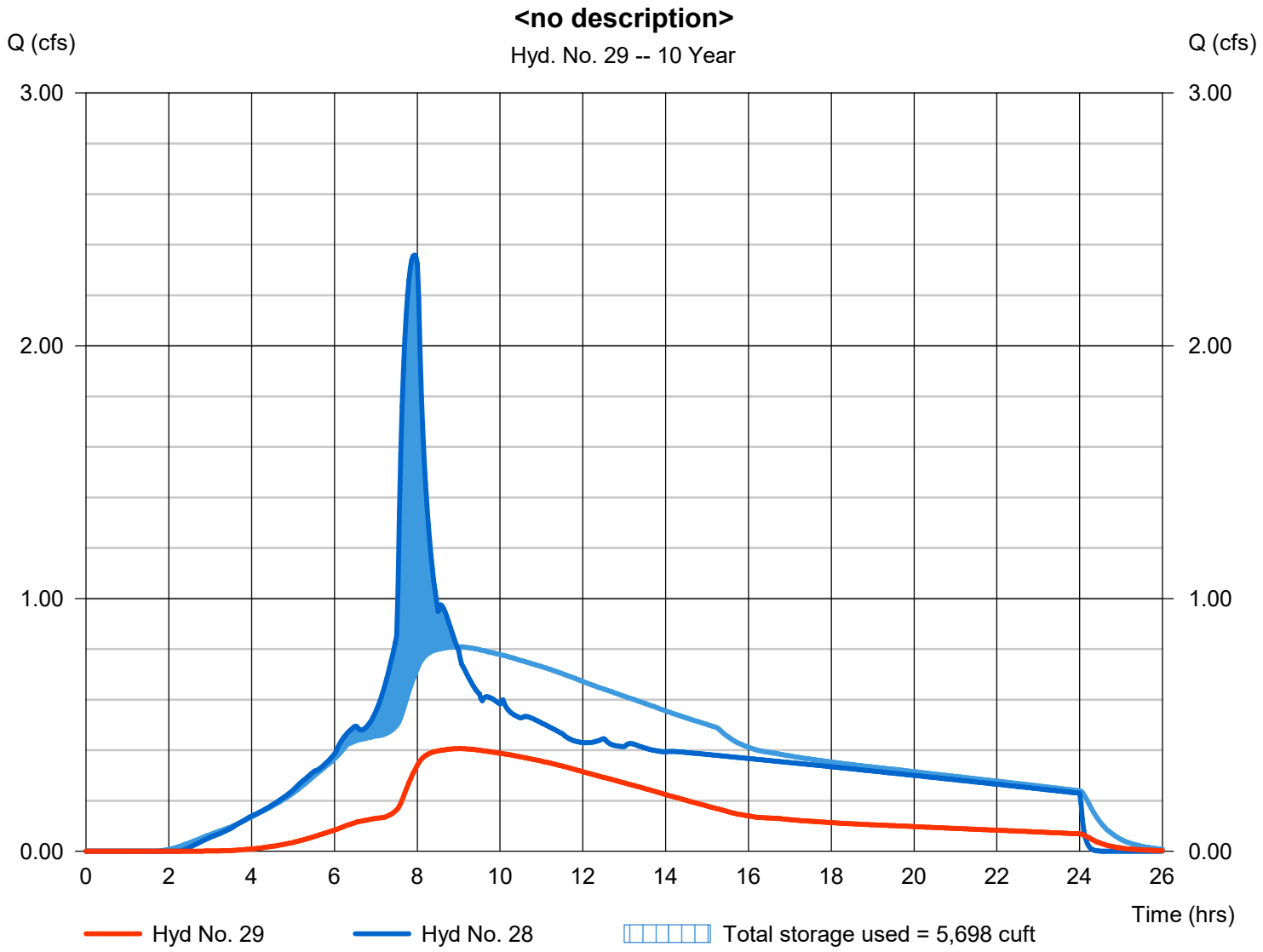
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 29

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.406 cfs
Storm frequency	=	10 yrs	Time to peak	=	9.00 hrs
Time interval	=	2 min	Hyd. volume	=	13,055 cuft
Inflow hyd. No.	=	28 - WEST PARKING S DEVELOPED	Max. Elevation	=	101.19 ft
Reservoir name	=	WEST SOUTH DETENTION	Max. Storage	=	5,698 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



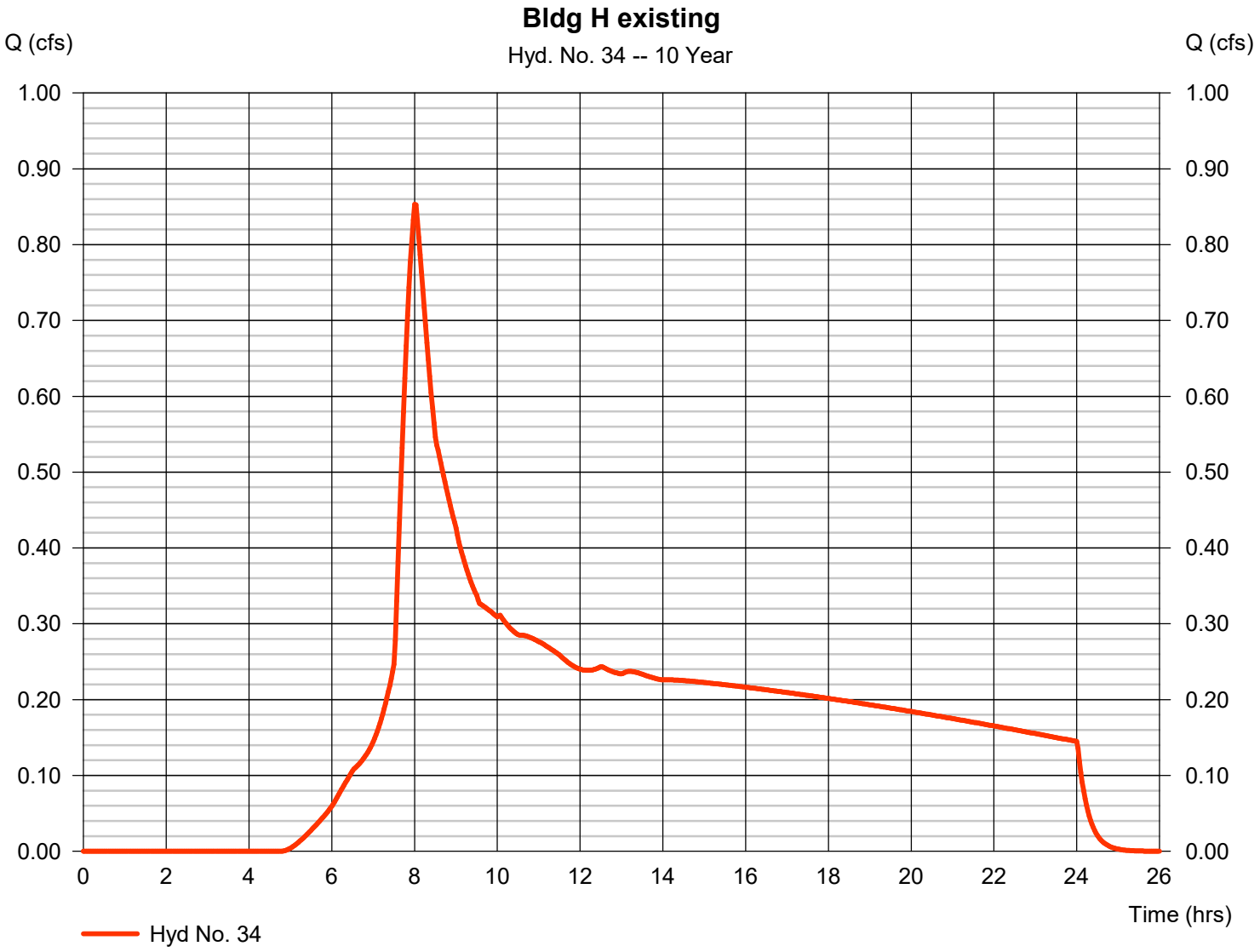
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 34

Bldg H existing

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.853 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	15,940 cuft
Drainage area	=	2.750 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

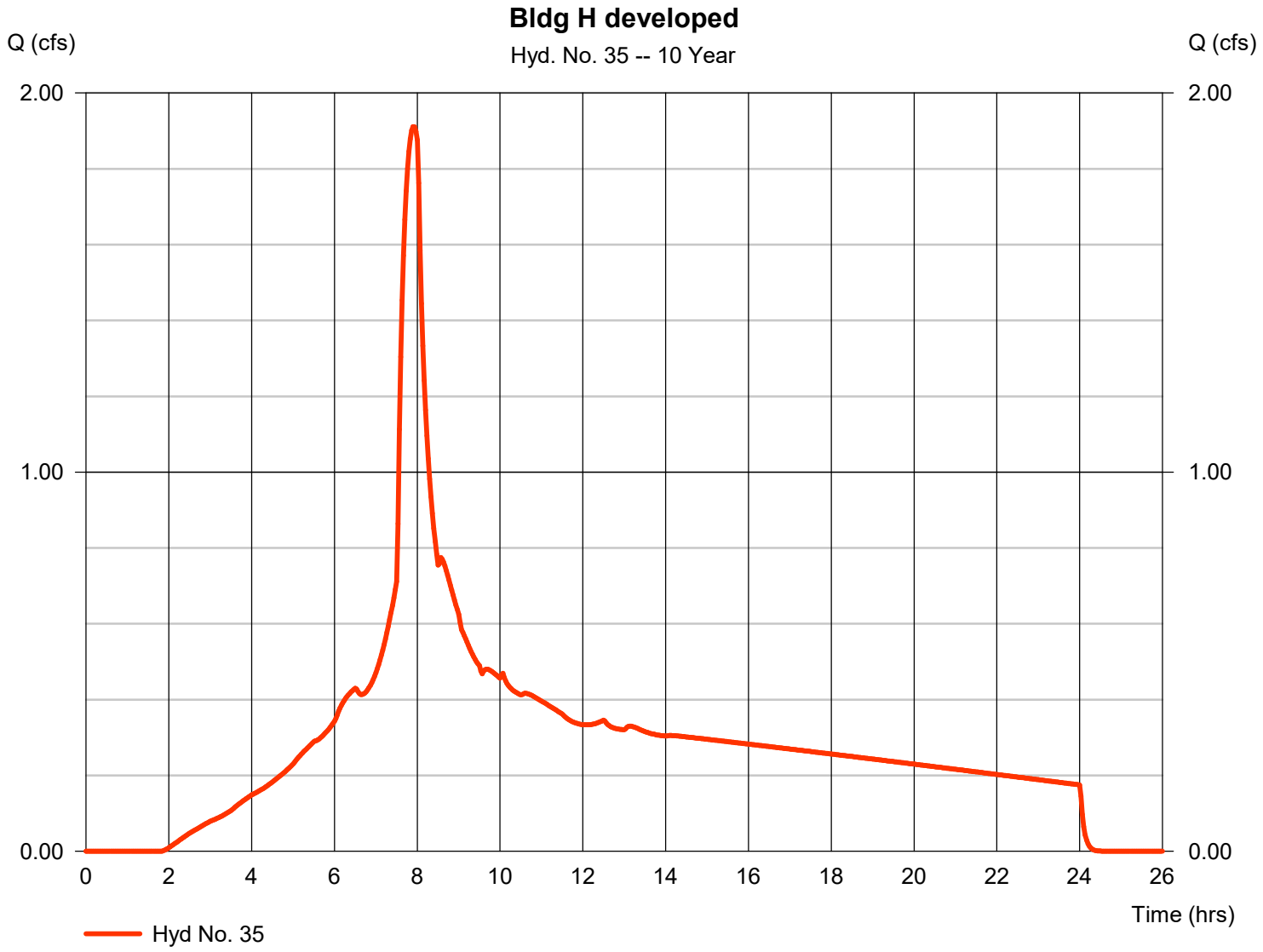
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 35

Bldg H developed

Hydrograph type	=	SBUH Runoff	Peak discharge	=	1.911 cfs
Storm frequency	=	10 yrs	Time to peak	=	7.90 hrs
Time interval	=	2 min	Hyd. volume	=	26,819 cuft
Drainage area	=	2.750 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(2.060 x 98) + (0.690 x 80)] / 2.750



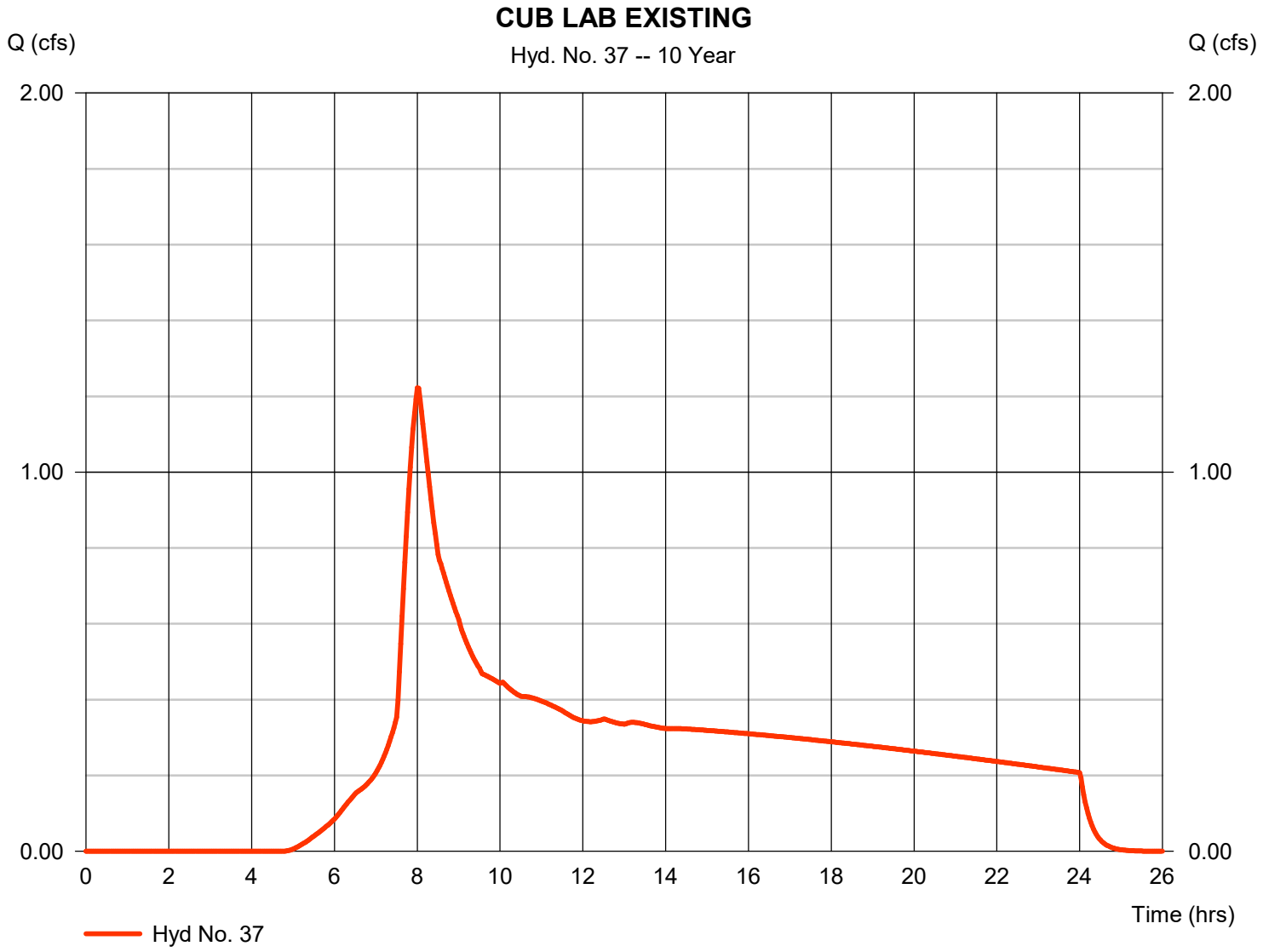
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 37

CUB LAB EXISTING

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.223 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 22,838 cuft
Drainage area	= 3.940 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

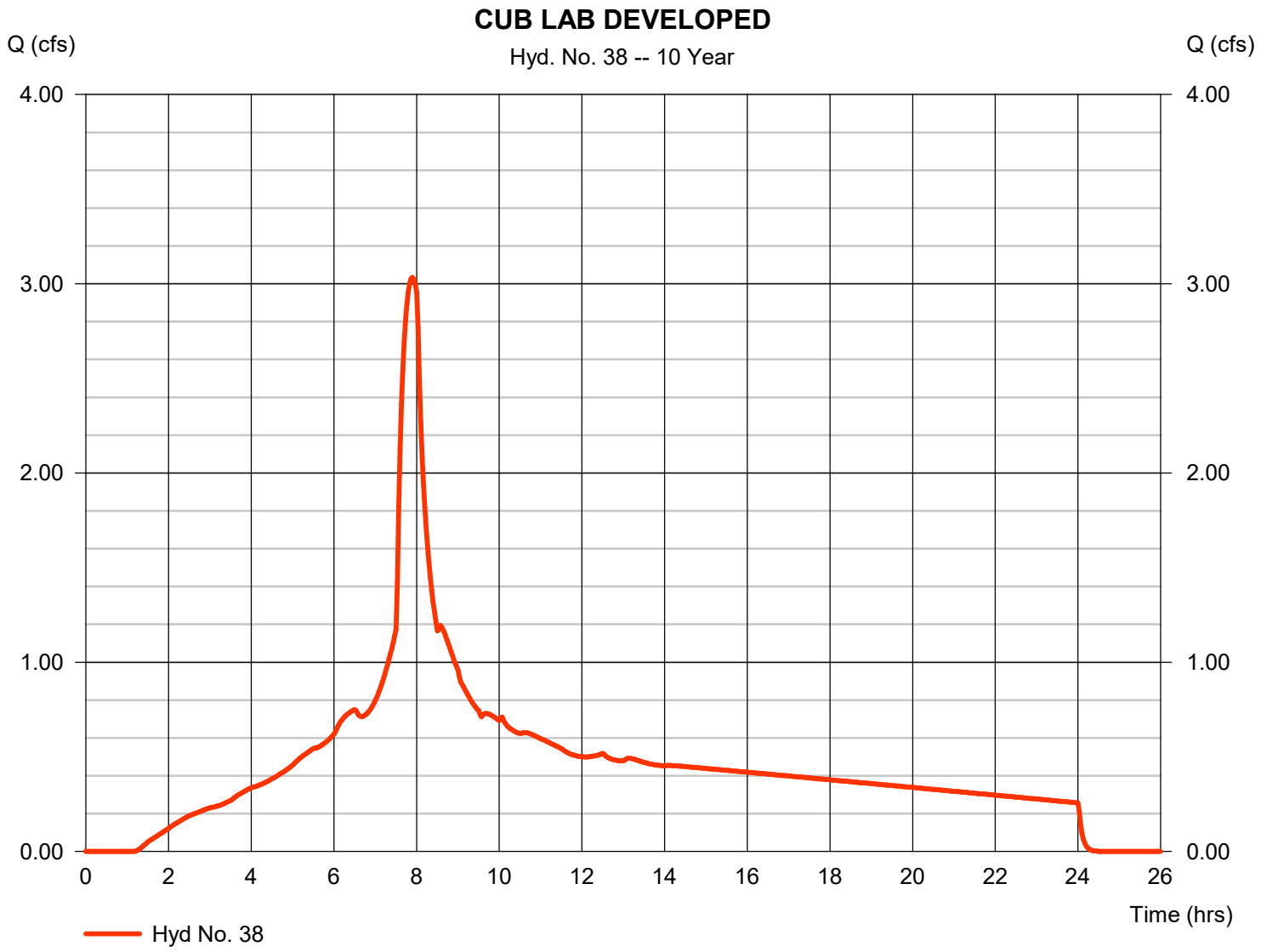
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 38

CUB LAB DEVELOPED

Hydrograph type	=	SBUH Runoff	Peak discharge	=	3.033 cfs
Storm frequency	=	10 yrs	Time to peak	=	7.90 hrs
Time interval	=	2 min	Hyd. volume	=	42,848 cuft
Drainage area	=	3.940 ac	Curve number	=	96*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(3.590 x 98) + (0.350 x 80)] / 3.940



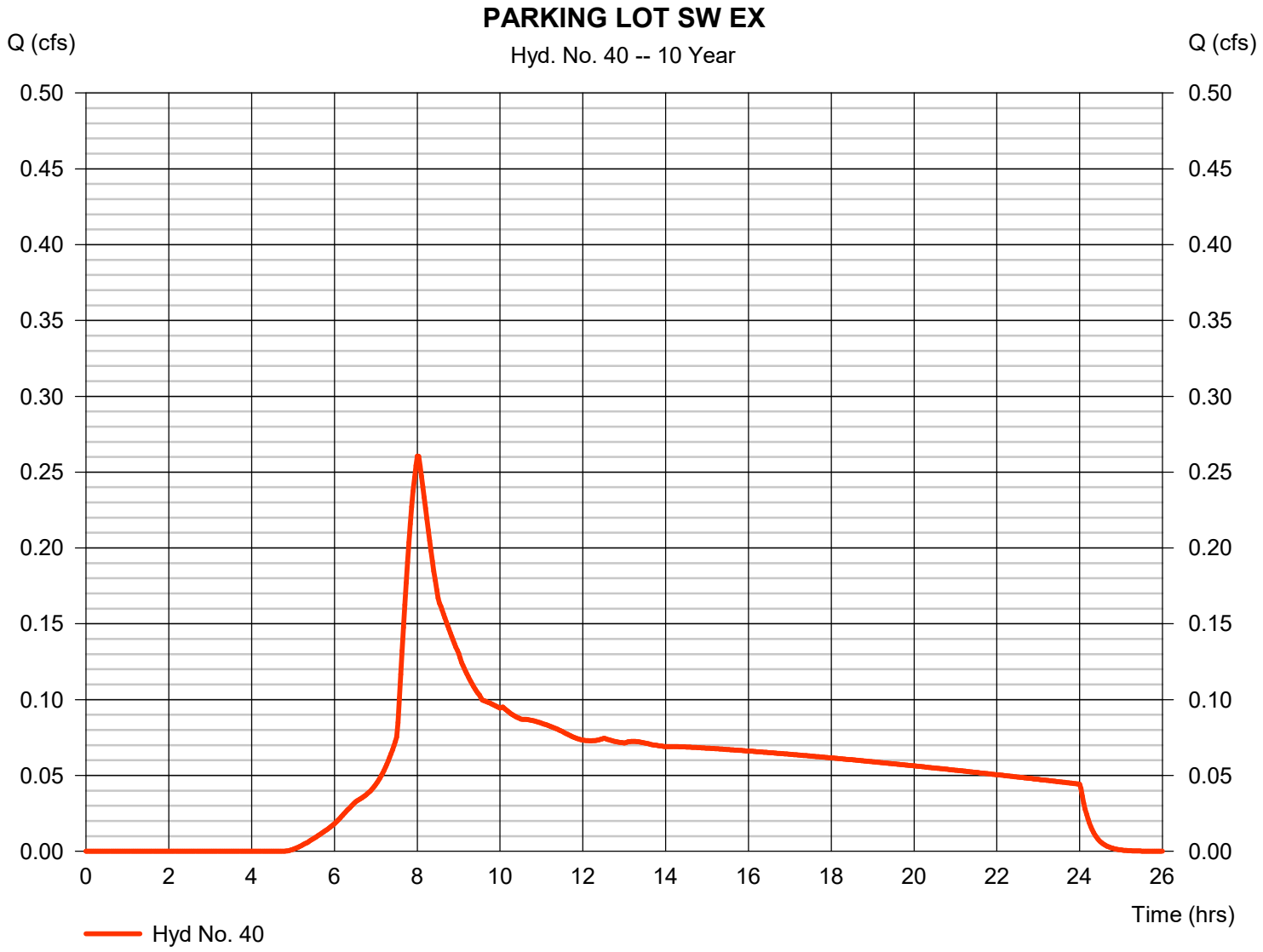
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 40

PARKING LOT SW EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.261 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 4,869 cuft
Drainage area	= 0.840 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

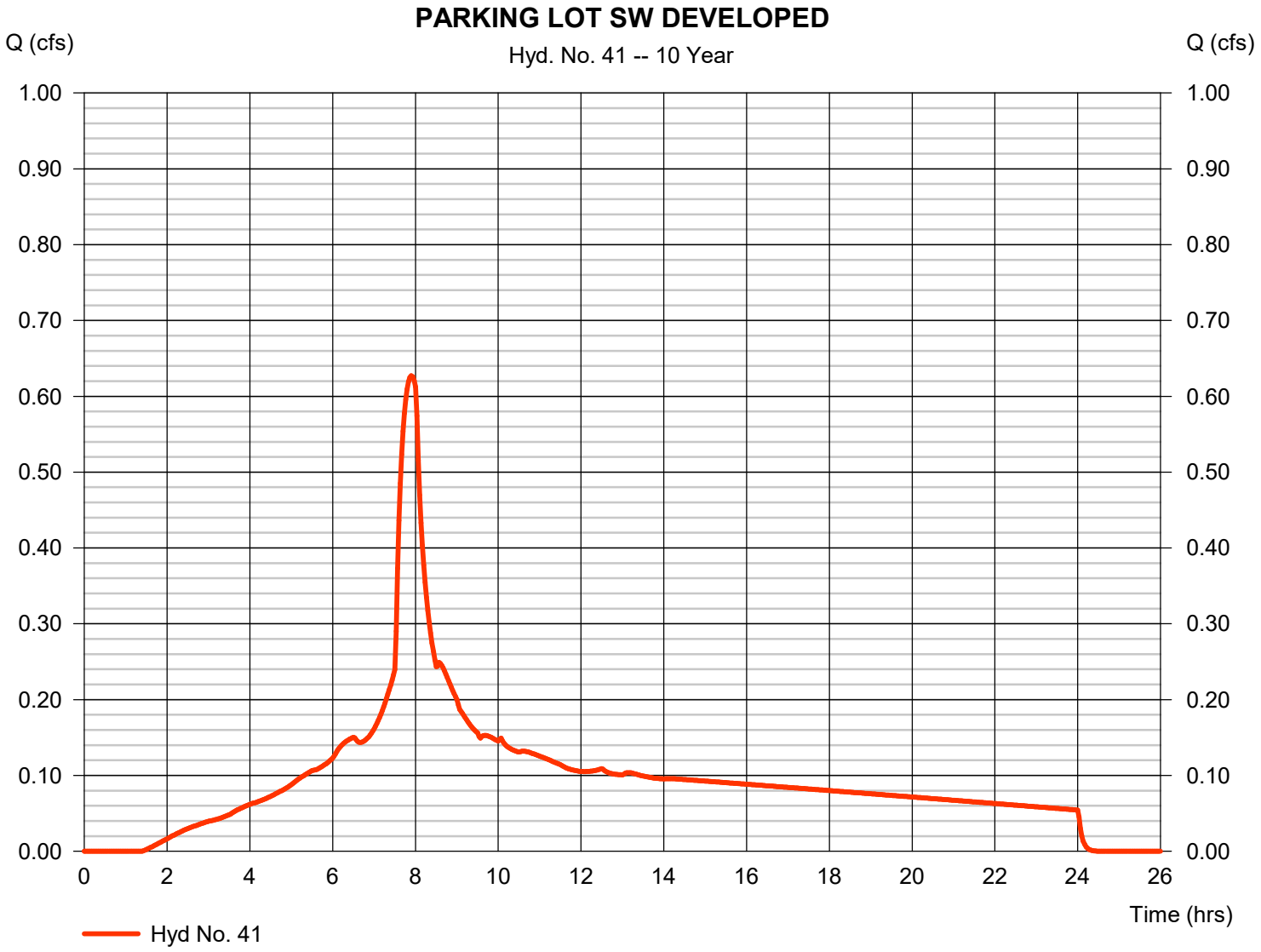
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 41

PARKING LOT SW DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.627 cfs
Storm frequency	= 10 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 8,812 cuft
Drainage area	= 0.840 ac	Curve number	= 95*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.690 x 98) + (0.150 x 80)] / 0.840



Hydrograph Report

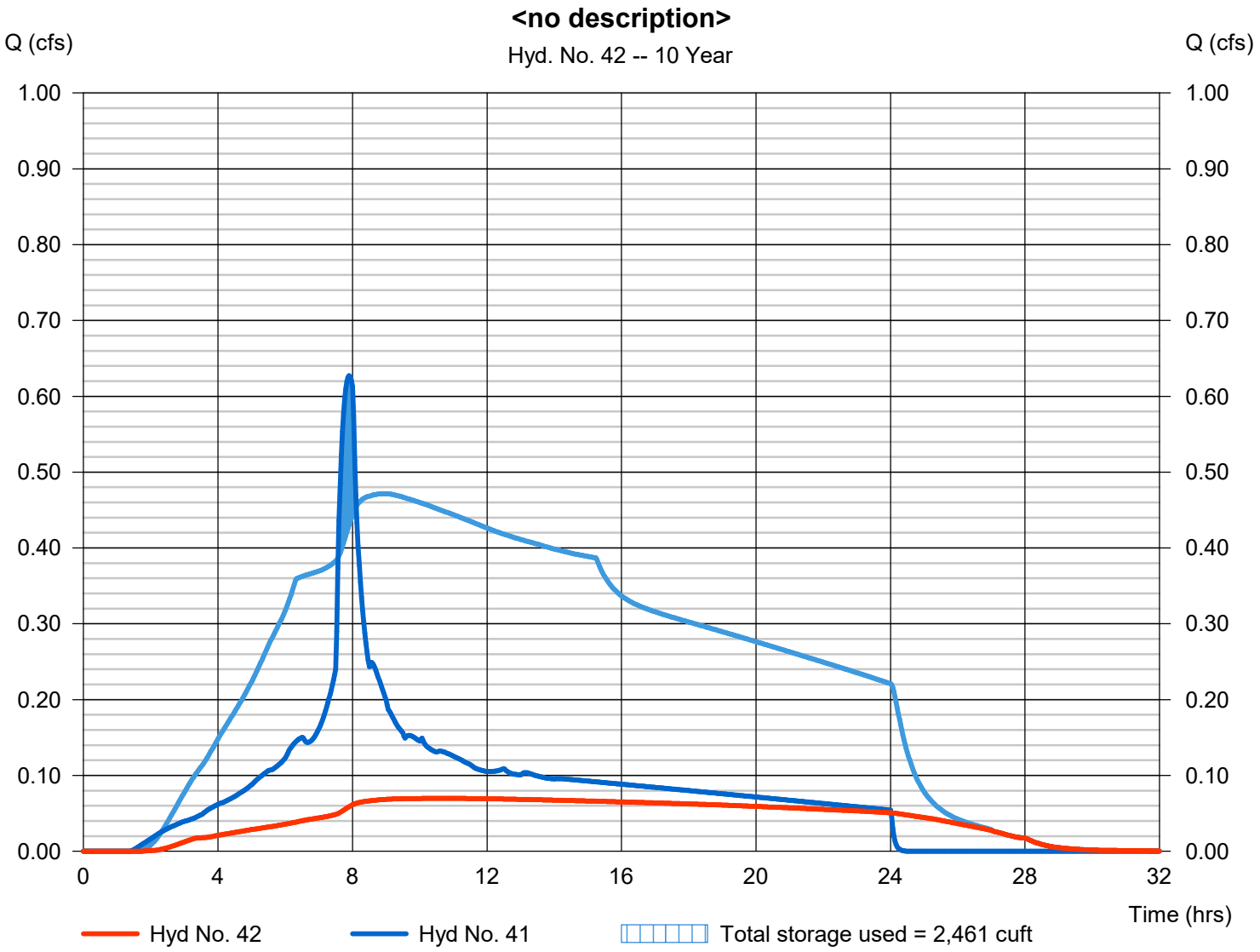
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 42

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.070 cfs
Storm frequency	= 10 yrs	Time to peak	= 10.77 hrs
Time interval	= 2 min	Hyd. volume	= 4,827 cuft
Inflow hyd. No.	= 41 - PARKING LOT SW DEVELOPED	Max. Elevation	= 101.54 ft
Reservoir name	= SW Parking Lot Detention	Max. Storage	= 2,461 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



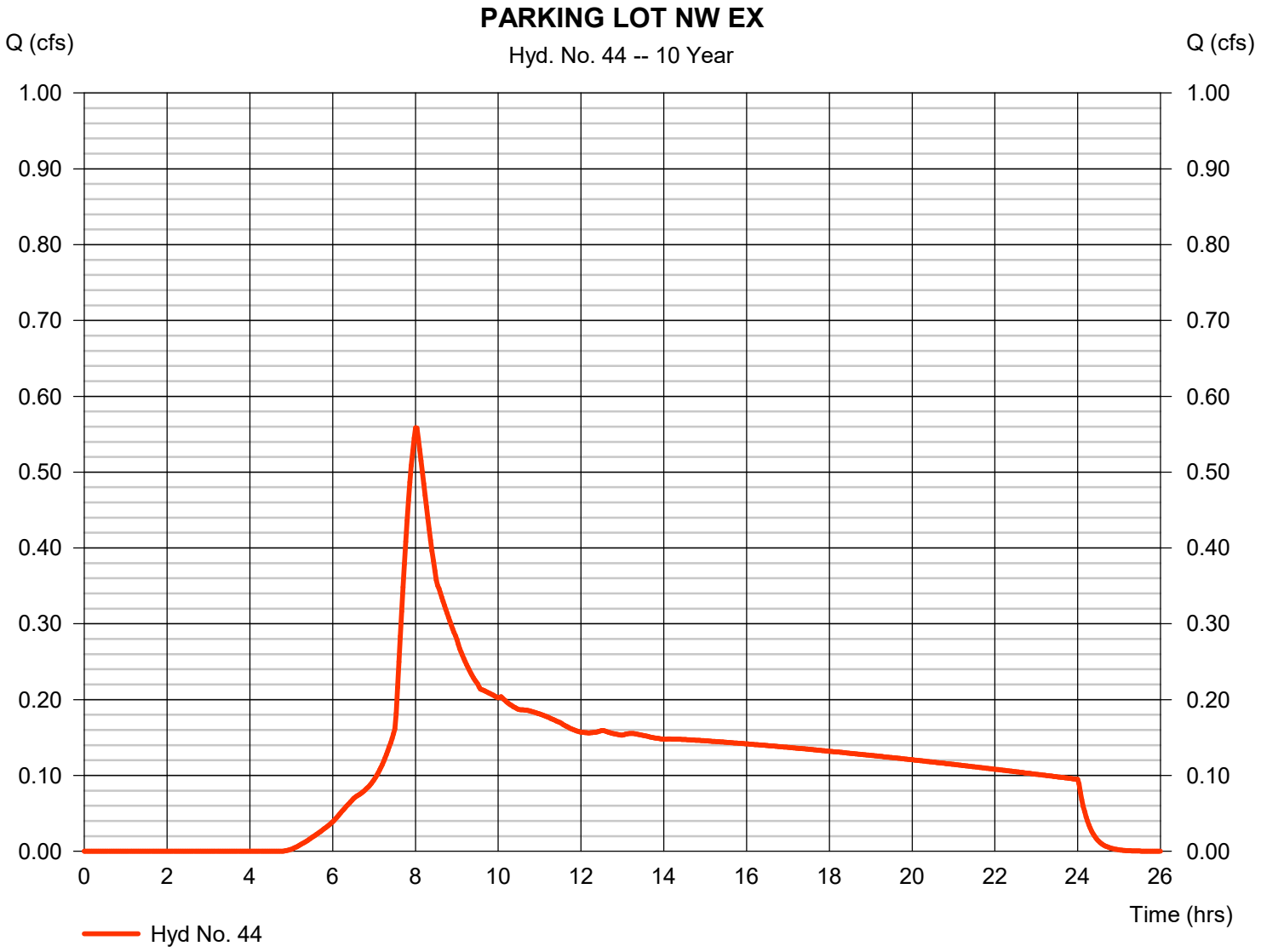
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 44

PARKING LOT NW EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.559 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 10,433 cuft
Drainage area	= 1.800 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 45

PARKING LOT NW DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.154 cfs
Storm frequency	= 10 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 16,295 cuft
Drainage area	= 1.800 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.130 x 98) + (0.670 x 80)] / 1.800

Hydrograph Report

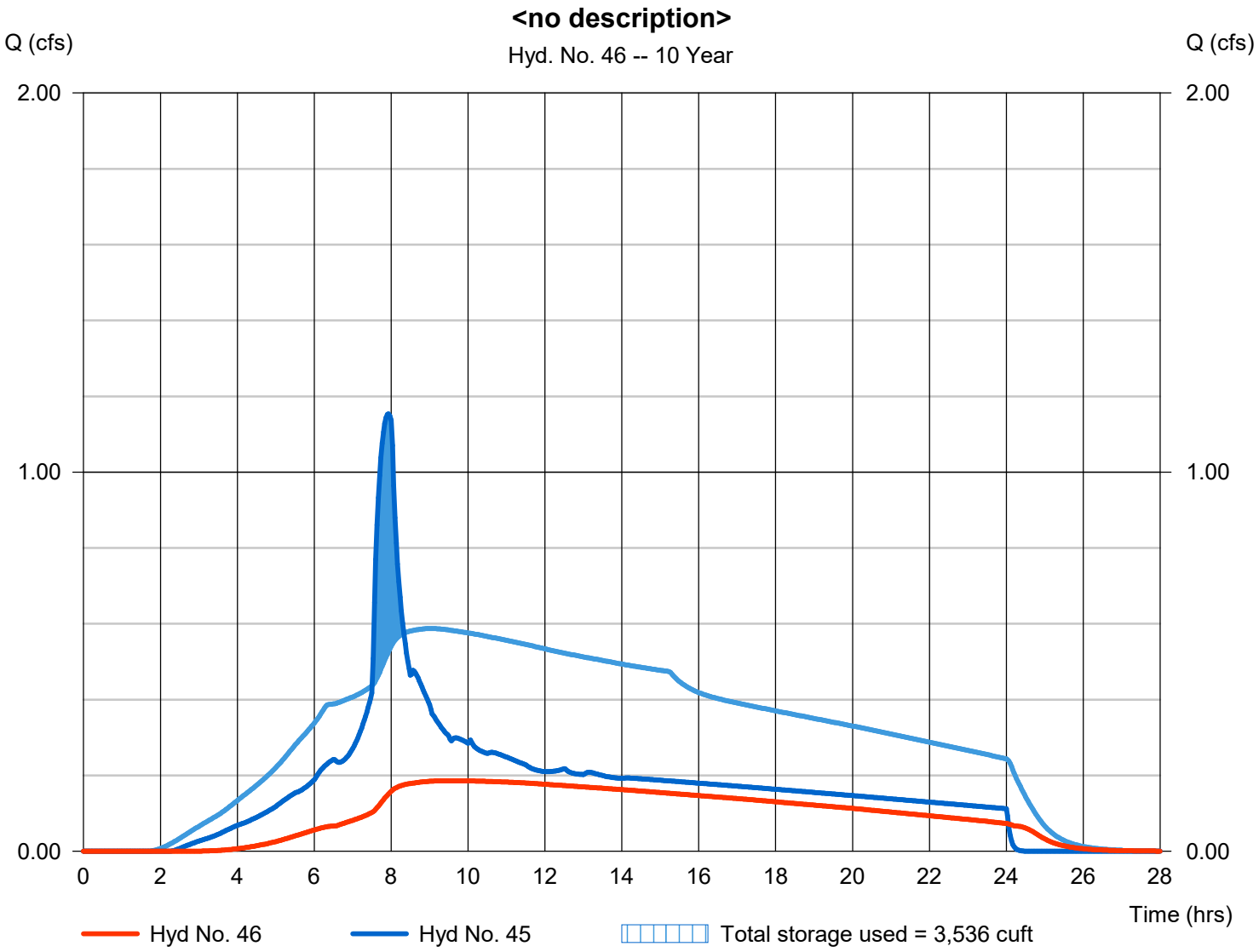
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 46

<no description>

Hydrograph type	= Reservoir	Peak discharge	= 0.186 cfs
Storm frequency	= 10 yrs	Time to peak	= 9.50 hrs
Time interval	= 2 min	Hyd. volume	= 9,310 cuft
Inflow hyd. No.	= 45 - PARKING LOT NW DEVELOPED	Max. Elevation	= 100.98 ft
Reservoir name	= NW Parking Lot Detention	Max. Storage	= 3,536 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



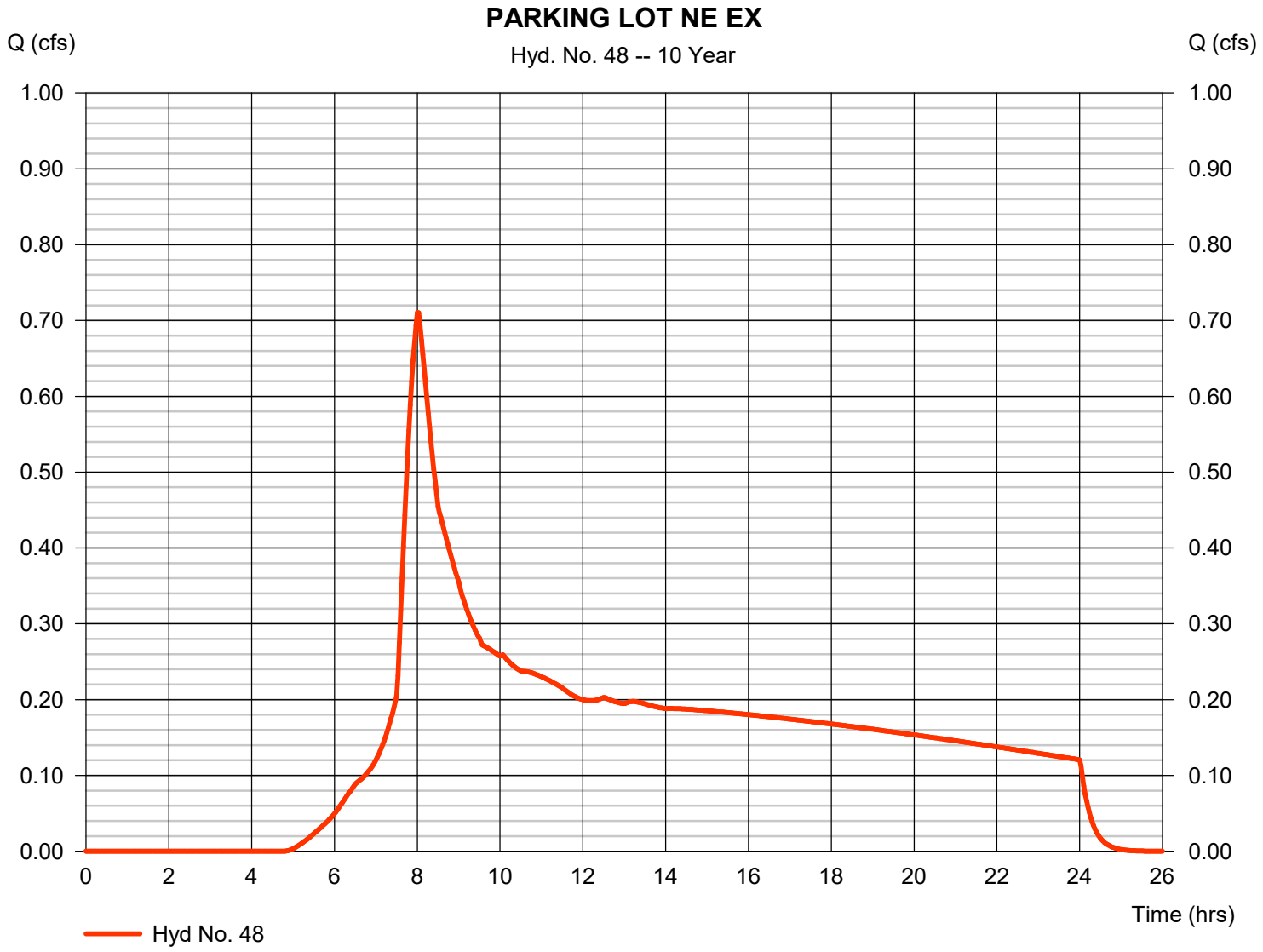
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 48

PARKING LOT NE EX

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.711 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 13,274 cuft
Drainage area	= 2.290 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

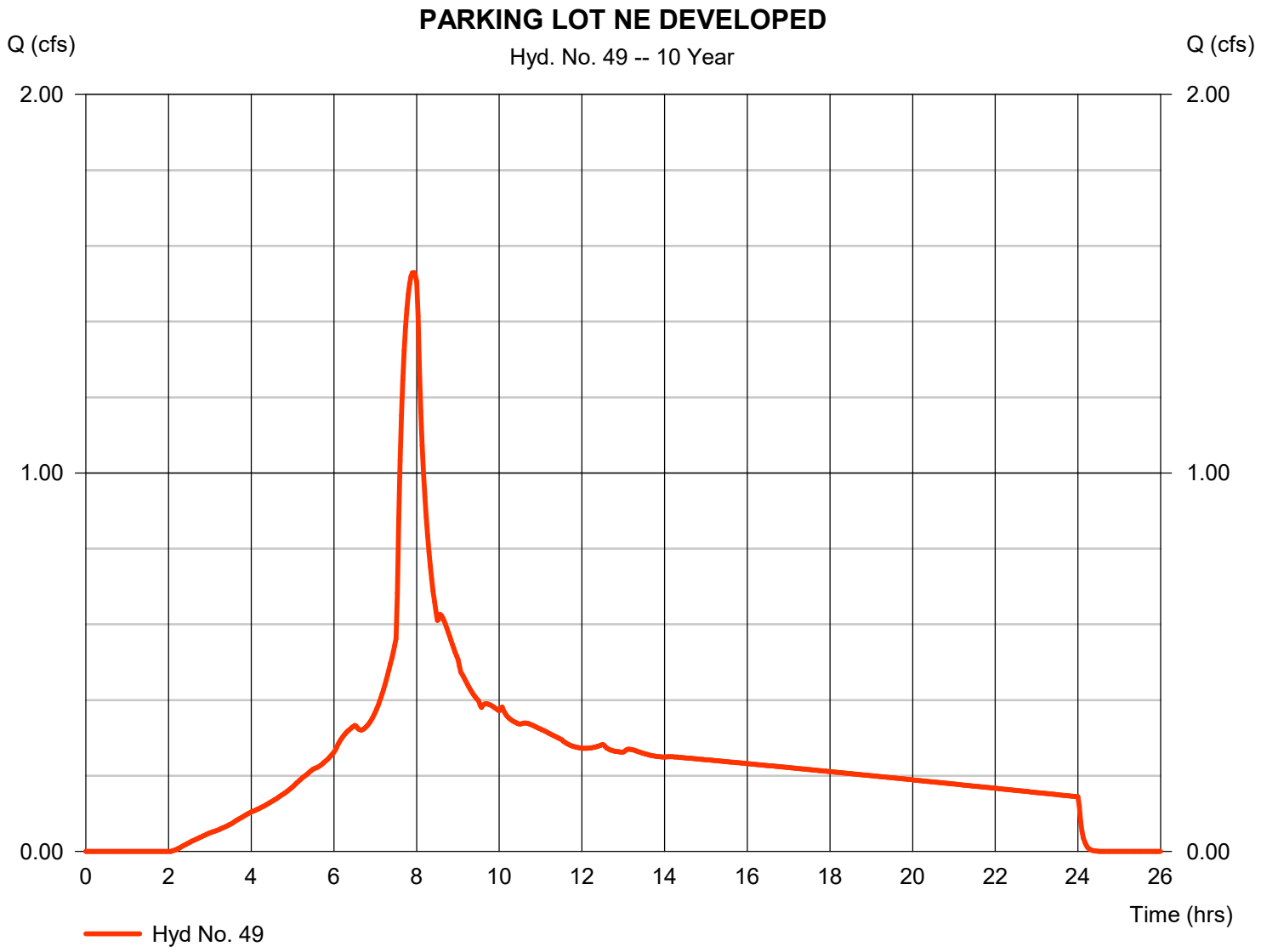
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 49

PARKING LOT NE DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.530 cfs
Storm frequency	= 10 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 21,521 cuft
Drainage area	= 2.290 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.580 x 98) + (0.710 x 80)] / 2.290



Hydrograph Report

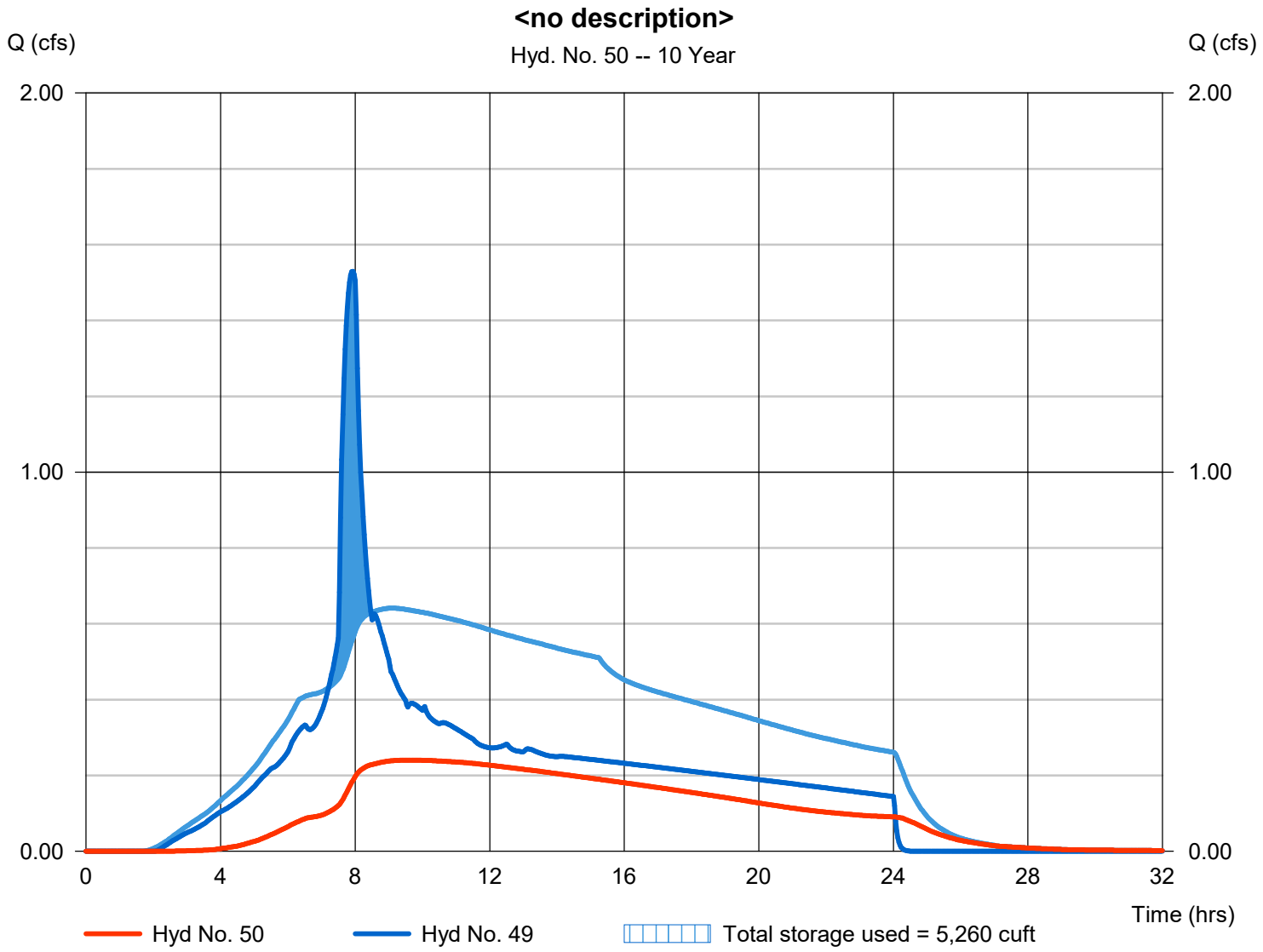
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 50

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.240 cfs
Storm frequency	=	10 yrs	Time to peak	=	9.50 hrs
Time interval	=	2 min	Hyd. volume	=	11,671 cuft
Inflow hyd. No.	=	49 - PARKING LOT NE DEVELOPED	Max. Elevation	=	100.88 ft
Reservoir name	=	NE Parking Lot Detention	Max. Storage	=	5,260 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



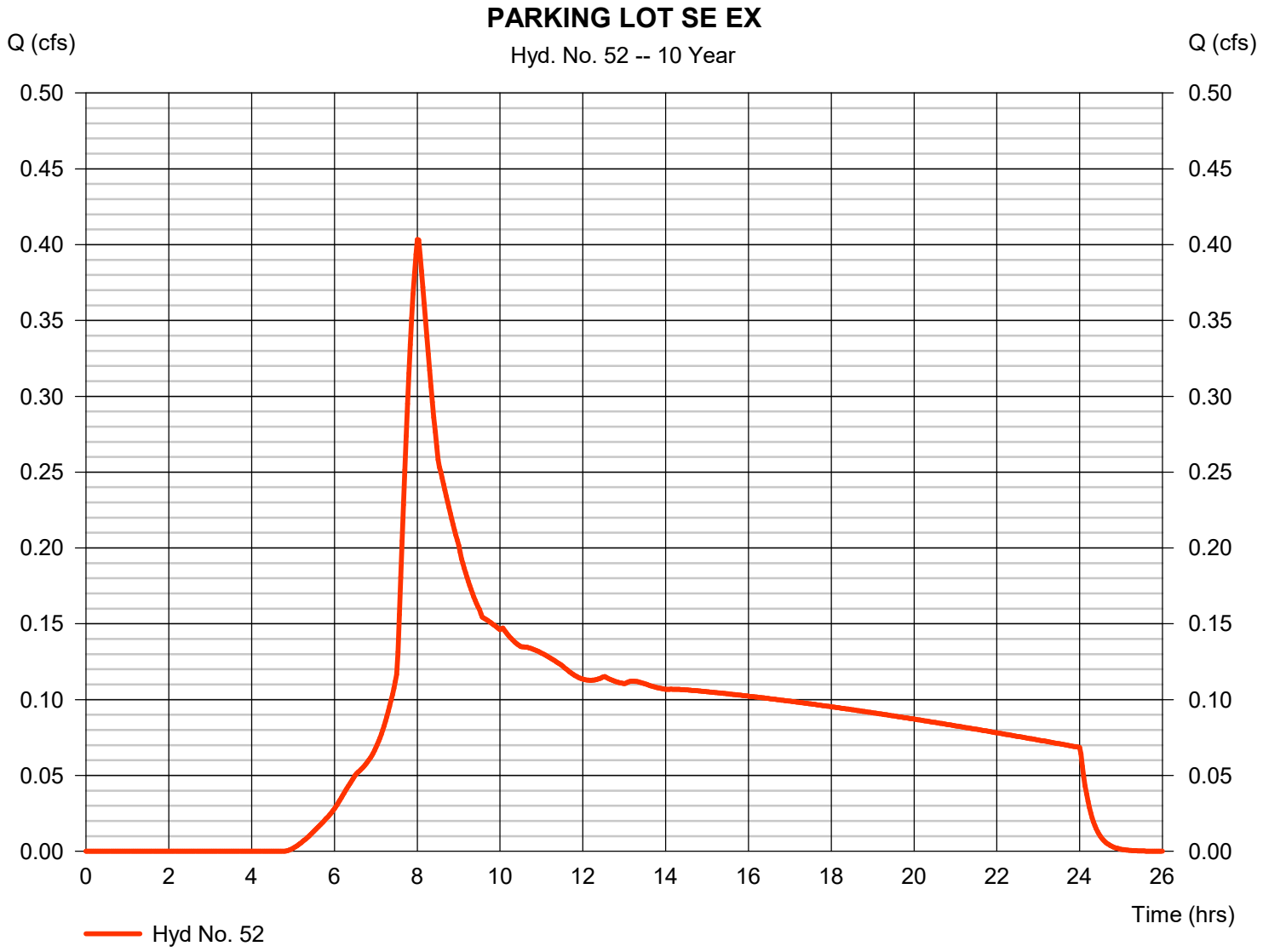
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 52

PARKING LOT SE EX

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.403 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	7,535 cuft
Drainage area	=	1.300 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

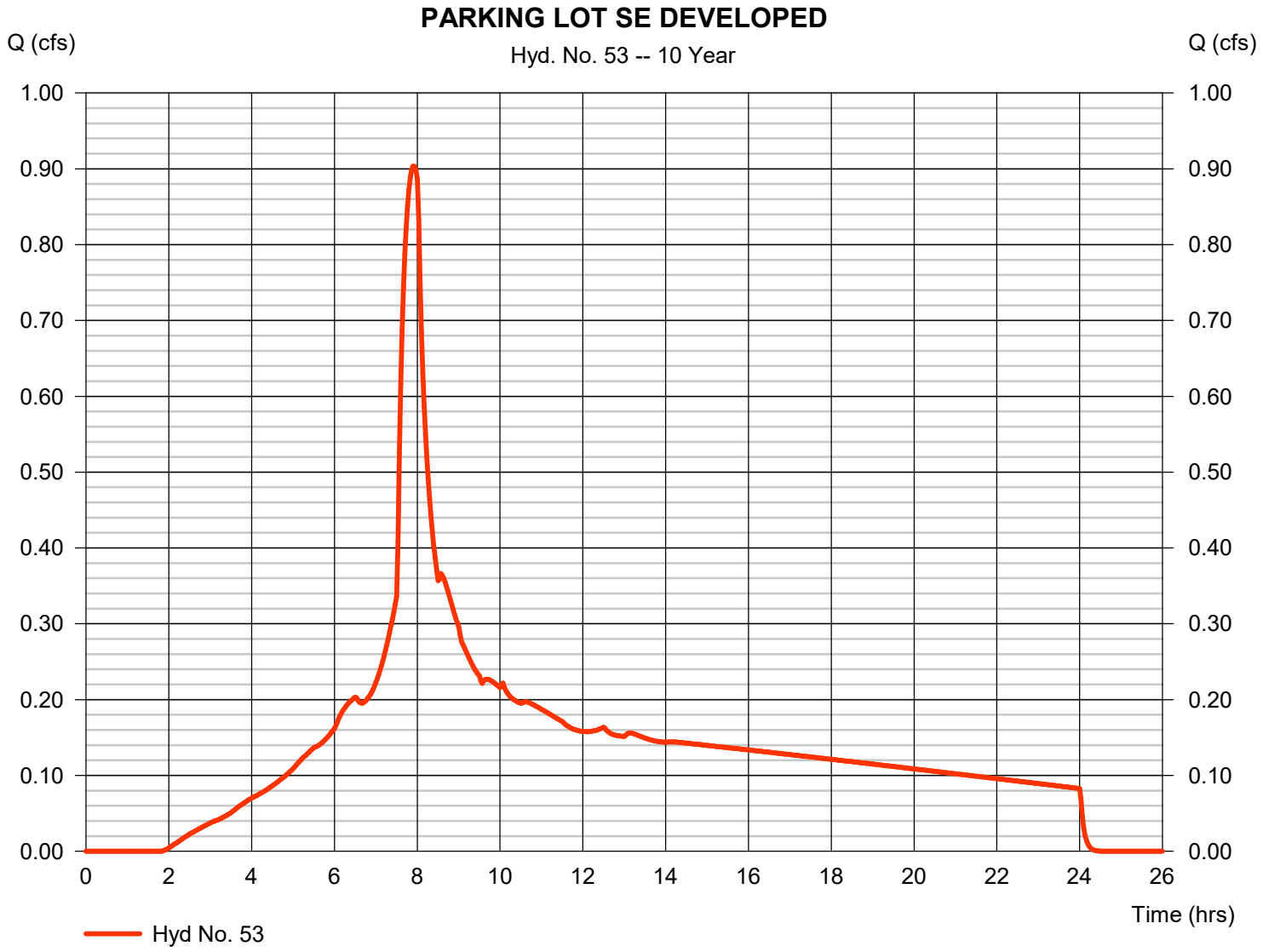
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 53

PARKING LOT SE DEVELOPED

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.903 cfs
Storm frequency	=	10 yrs	Time to peak	=	7.90 hrs
Time interval	=	2 min	Hyd. volume	=	12,678 cuft
Drainage area	=	1.300 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a

* Composite (Area/CN) = [(0.920 x 98) + (0.380 x 80)] / 1.300



Hydrograph Report

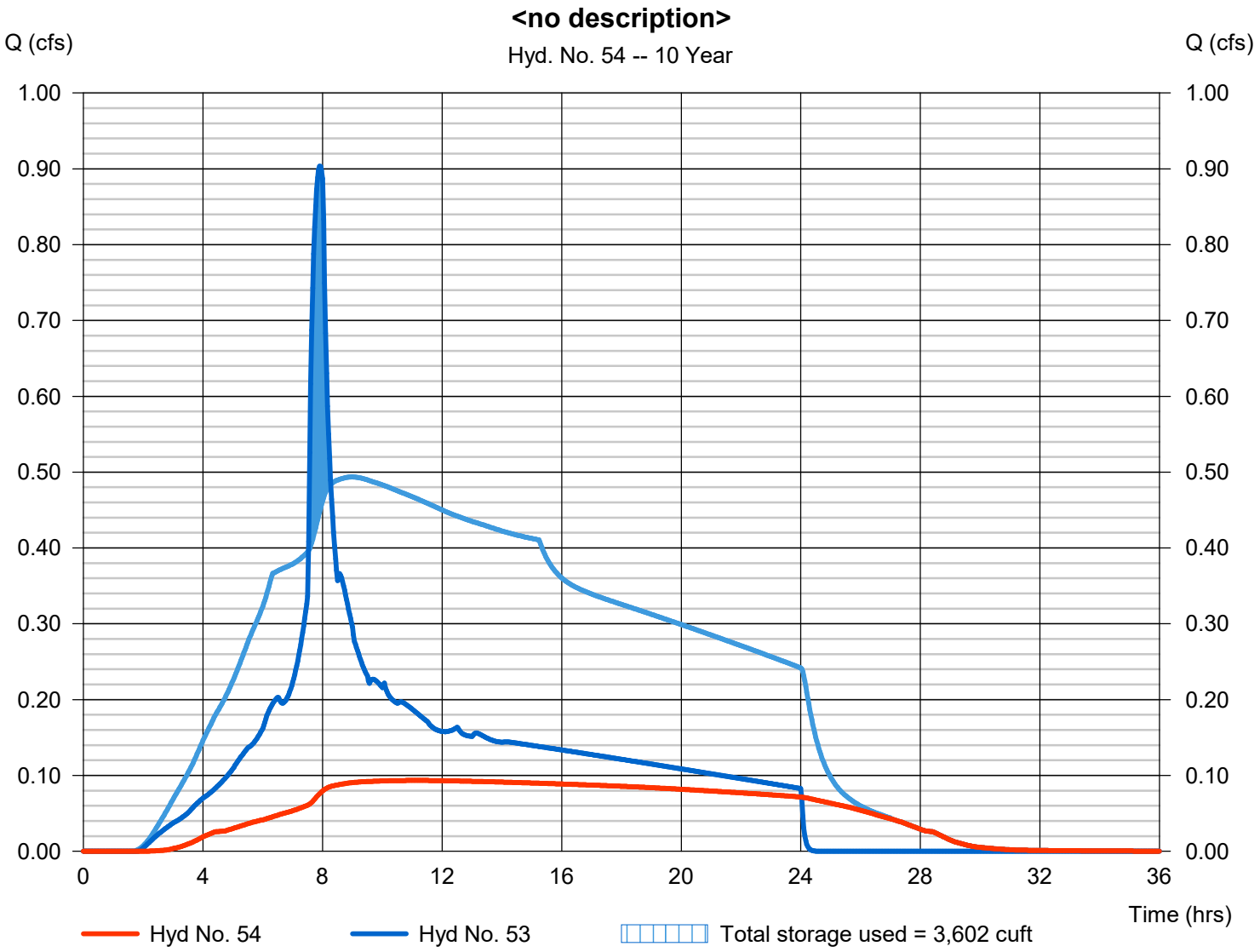
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 54

<no description>

Hydrograph type	=	Reservoir	Peak discharge	=	0.093 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.17 hrs
Time interval	=	2 min	Hyd. volume	=	6,526 cuft
Inflow hyd. No.	=	53 - PARKING LOT SE DEVELOPED	Max. Elevation	=	101.45 ft
Reservoir name	=	SE Parking Lot Detention	Max. Storage	=	3,602 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



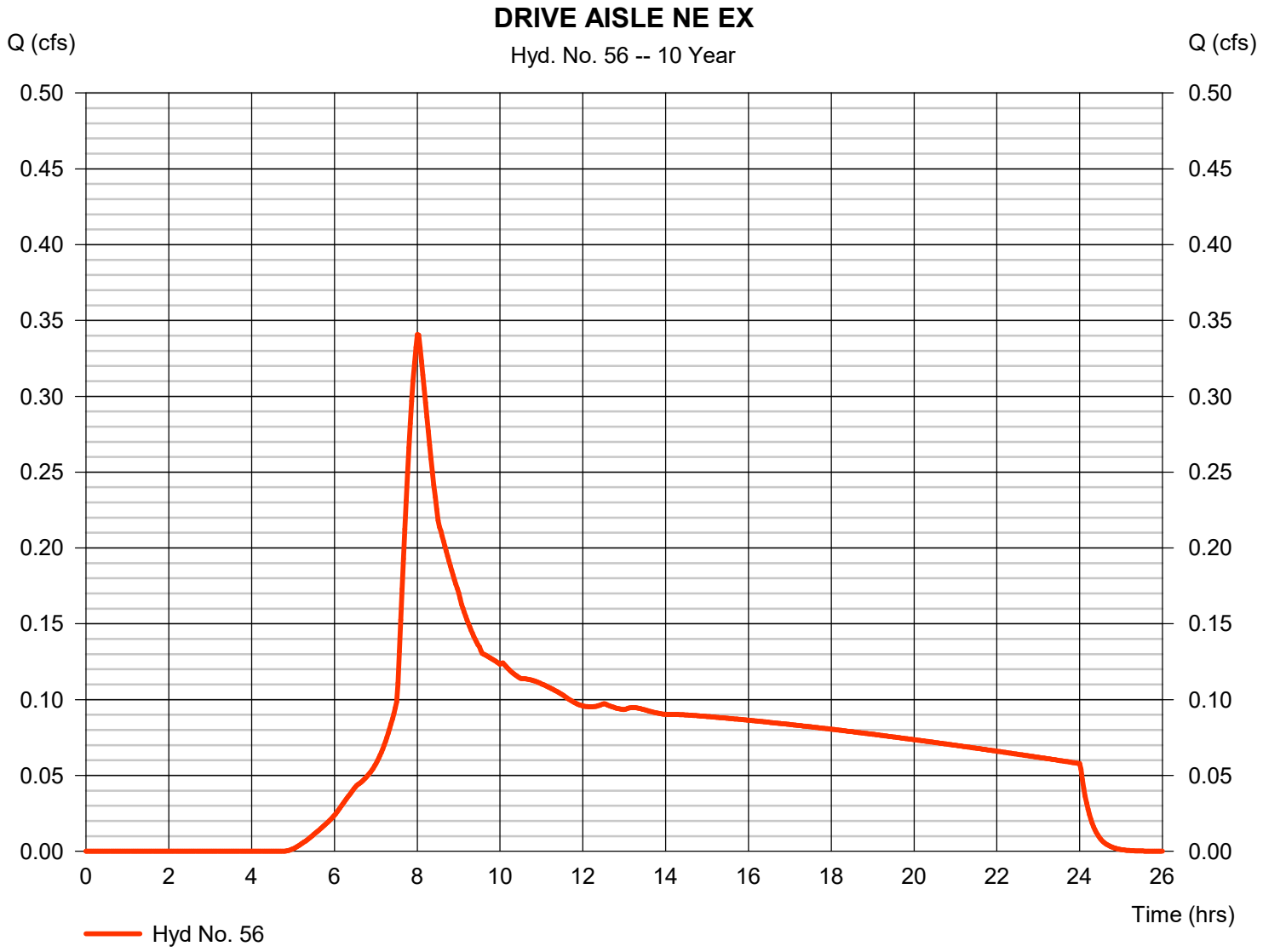
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 56

DRIVE AISLE NE EX

Hydrograph type	=	SBUH Runoff	Peak discharge	=	0.341 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	6,364 cuft
Drainage area	=	1.098 ac	Curve number	=	80
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	n/a



Hydrograph Report

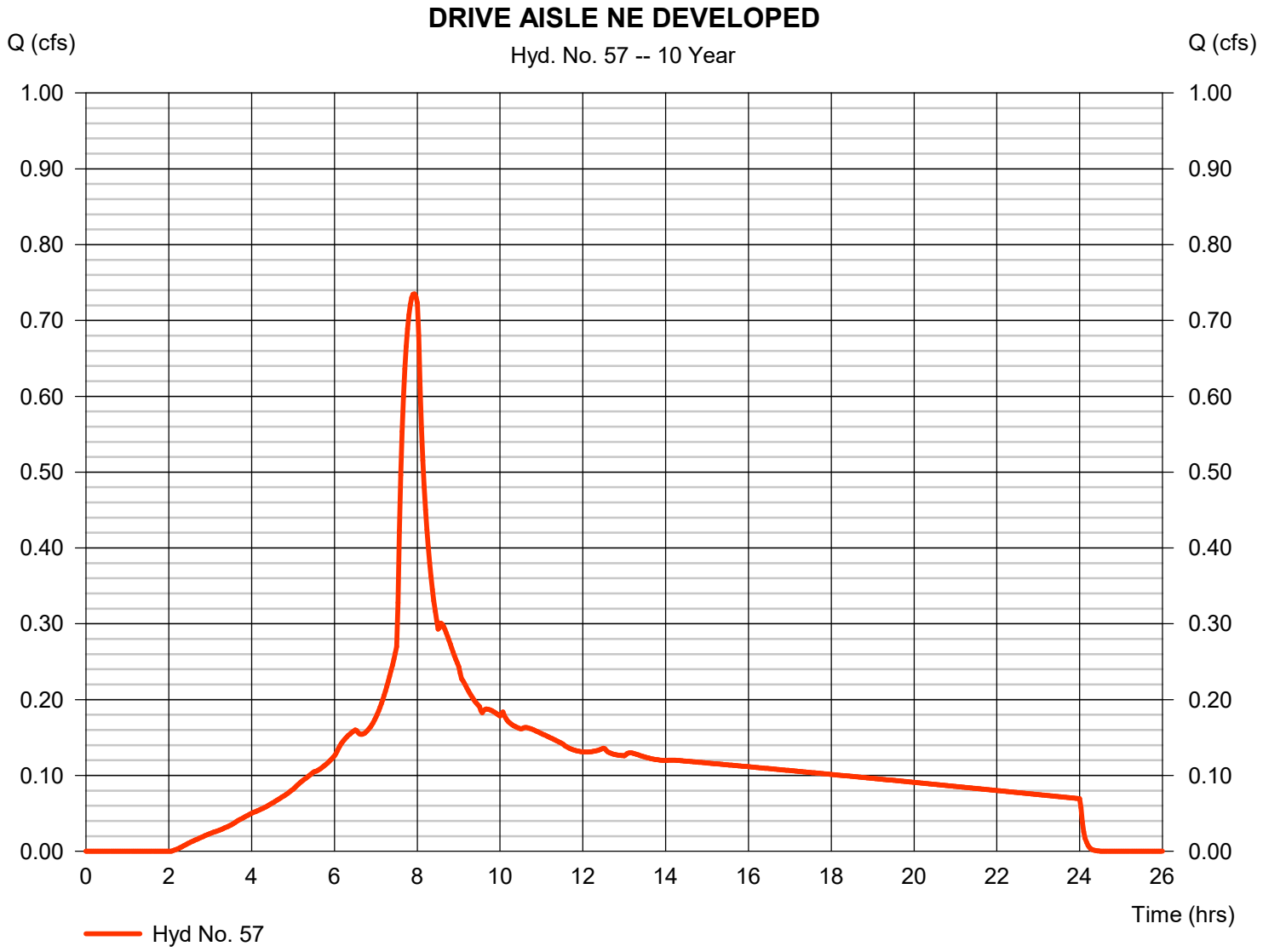
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Wednesday, 07 / 16 / 2025

Hyd. No. 57

DRIVE AISLE NE DEVELOPED

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.735 cfs
Storm frequency	= 10 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 10,338 cuft
Drainage area	= 1.100 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.733 x 98) + (0.365 x 80)] / 1.100



Appendix C

MACKENZIE.

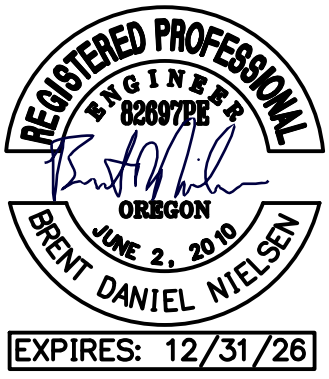
STORMWATER DRAINAGE REPORT

To
City of Tualatin

For
Lam Research Building G

Dated
August 16, 2022
Revised March 14, 2023
Revised September 6, 2023
Revised October 18, 2023
Revised December 15, 2023
Revised July 24, 2024
Revised January 21, 2025

Project Number
2220087.00



MACKENZIE
Since 1960

RiverEast Center | 1515 SE Water Avenue, Suite 100, Portland, OR 97214
PO Box 14310, Portland, OR 97293 | T 503.224.9560 | www.mcknze.com

TABLE OF CONTENTS

I. Project Introduction 1
II. Stormwater Quality Treatment 3
Drainage Basin A 3
Drainage Basin B 3
Drainage Basin C 3
Basin C Rain Gardens 3
Existing Pond C Water Quality 3
Drainage Basin D 4
Basin D Swales 4
Existing Pond D 4
SW 108th Avenue Frontage 4
III. Stormwater Quantity Management 6
Downstream Analysis 6
Existing Drywell 6
Hydromodification Flow Control 7
IV. Conclusion 12

APPENDICES

A. Storm Basin Maps
B. Water Quality Sizing
C. Detention Calculations
D. Proposed Site Plans
E. 2001 Novellus Storm Drainage Report
F. Geotechnical report

I. PROJECT INTRODUCTION

Lam Research is proposing to construct a new office building at their existing campus on SW Leveton Drive in Tualatin, Oregon. The new building will be located east of the existing Building C and south of Building B. In support of the expected additional employees on site, Lam also proposes new parking in the east and northwest portions of campus. The vicinity map and site plan below show the location and layout of the site relative to nearby geographic features.

Figure 1: Vicinity Map

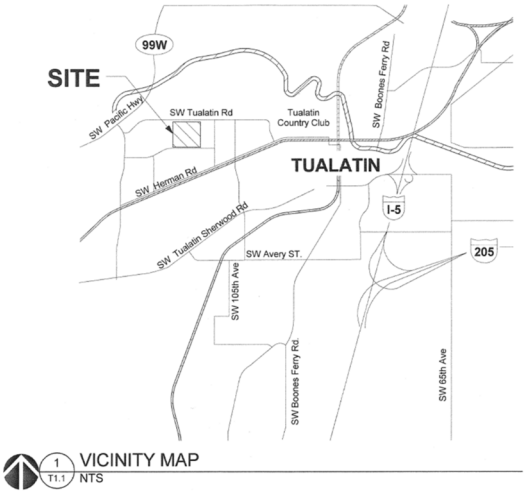
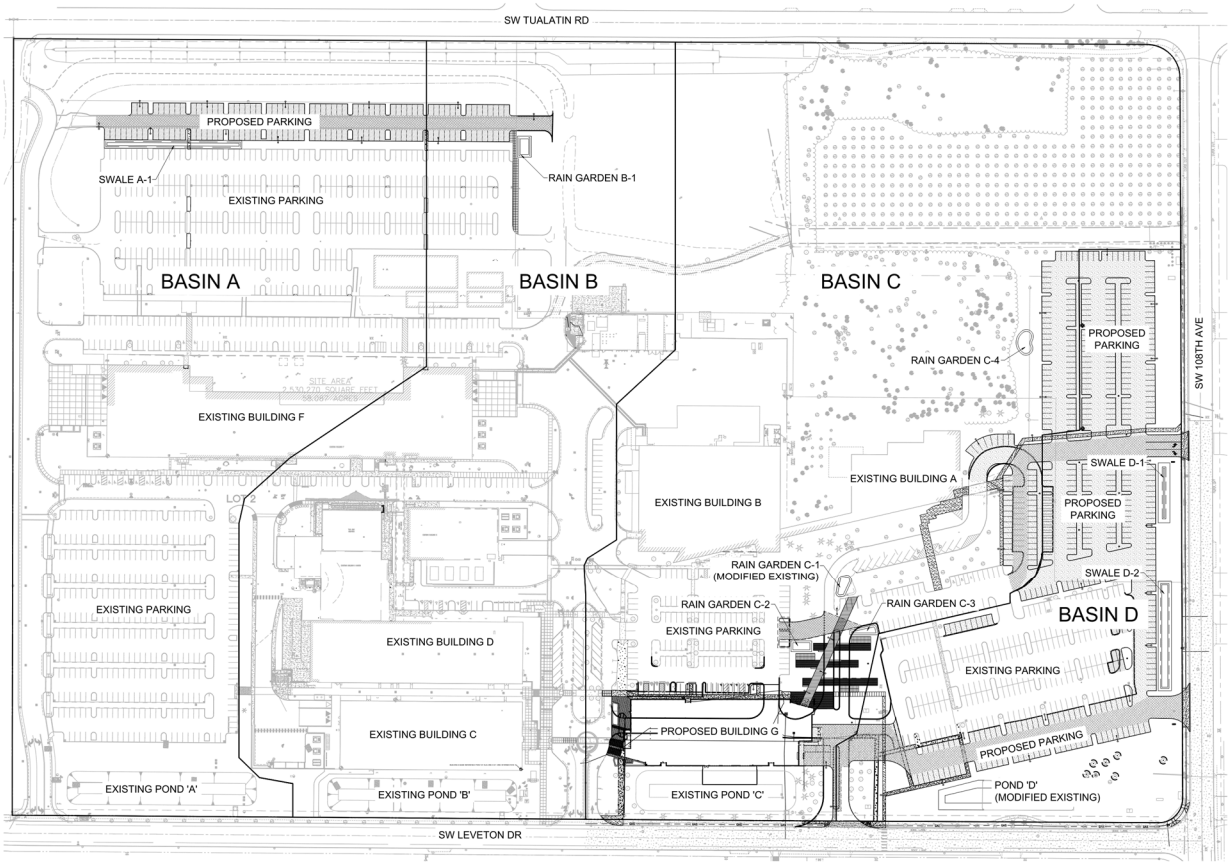


Figure 2: Overall Site Plan



Stormwater drainage and treatment will be provided in accordance with current Clean Water Services and City of Tualatin standards through a series of facilities across campus:

Basin A Water Quality:

- Proposed improvements to Basin A have been removed from the project.

Basin B Water Quality:

- Proposed improvements to Basin B have been removed from the project.

Basin C Water Quality:

- SE Parking expansion: two (2) new vegetated swales and one (1) modified extended dry basin
- New building and pedestrian plaza: existing extended dry basin

Public Sidewalk Water Quality:

- New 108th Avenue sidewalk: one (1) new vegetated planter

Overall Site Detention:

- Three (3) existing extended dry basins to remain and one (1) extended dry basin to be expanded with additional detention storage

The following summarizes the design for the proposed stormwater management approach.

II. STORMWATER QUALITY TREATMENT

Water quality treatment at the new development on the Lam Campus will be provided through a collection of existing, modified, and new facilities. The following summarizes the facilities within each drainage basin on site:

Drainage Basin C

Proposed improvements within Basin C include new parking, re-paved parking, a pedestrian plaza, and the proposed Building G footprint. Runoff from the new impervious surfaces will be routed to existing and new storm treatment facilities.

Basin C Rain Gardens

Existing Rain Garden C-1 was designed circa 2016 to treat runoff from approximately 9,967 sf modified parking south of Building A, which resulted in a facility footprint of approximately 698 sf. The rain garden is proposed to be modified to accommodate a new pedestrian path, and will be reduced to approximately 385 sf, which would result in a treatment capacity of approximately 6,417 sf. This leaves approximately 3,550 sf of existing impervious area capacity to be handled in extended dry basin Pond C.

Rain garden C-1 capacity is based on water quality sizing per the Simplified Method guidelines in Section 4.08.4.b, using a 6-percent sizing factor on the design impervious area. Hydromodification for Basin C is provided in the existing Pond C on site.

The remaining treatment capacity is provided through the existing Pond C, described below.

Existing Pond C Water Quality

The existing Pond C extended dry basin was designed circa 2001 and was sized at the time to accommodate the planned build-out of the campus, which included up to approximately 12.55 acres of total impervious area within Basin C. The water quality design storm has not been changed from the 0.36 inches rainfall that was used in the 2001 calculations.

Current site review indicates the existing Basin C provides water quality treatment for approximately 7.45 acres of existing impervious area, resulting in approximately 5.10 acres of existing impervious area runoff capacity available in the existing Pond C.

The proposed improvements result in an increase in impervious surface summarized as follows:

Existing Basin C impervious surface to remain:	251,428 sf	
New Basin C building roof footprint:	32,824 sf	
New Basin C paving and sidewalk area:	83,228 sf	
Total Basin C Proposed Impervious Area:	367,480 sf	(8.43 ac)

Therefore, the remaining available capacity in Existing Pond C is:

$$Remaining\ Capacity = 12.55\ ac - 8.43\ ac = 4.12\ ac$$

Therefore, the existing Pond C extended dry basin facility has adequate capacity to provide water quality treatment for the proposed Building G and parking development.

Drainage Basin D

Proposed improvements within Basin D include new parking to expand the existing southeast parking lot. Runoff from the new impervious surfaces will be routed to existing and new storm treatment facilities.

Basin D Swales

Proposed Swales D-1 and D-2 will be added to treat runoff from the adjacent parking lots along the east side of the Lam campus.

TABLE 1: SWALE TABLE SIZING SUMMARY		
Development Site	**Swale D-1**	**Swale D-2**
Design Impervious Area (sf)	36,094	86,079
Water Quality Volume (cf)	1,083	2,582
Water Quality Flow (cfs)	0.08	0.18
Residence Time (min)	9.24	16.35

Water quality manholes are provided ahead of Swales D-1 and D-2 per CWS standards. The manholes have been sized based on the contributory inflow up to the 20-year storm.

Existing Pond D

The existing Pond D extended dry basin was designed circa 2016 and was constructed to handle runoff from the new southeast parking lot and adjacent paving area comprising approximately 66,647 sf of existing impervious area.

The proposed improvements will add approximately 39,695 sf resulting in a total impervious area flowing to Pond D of approximately 106,342 sf. The water quality volume for Pond D is calculated as:

$$WQV = A \cdot \frac{0.36\ in}{12\frac{ft}{in}} = 106342 \cdot \frac{0.36\ in}{12\frac{ft}{in}} = 3{,}190\ cf$$

The existing Pond D currently provides approximately 2,003 cf of storage, so the pond will be expanded to the west approximately 80 feet to provide additional water quality storage volume in the pond. The existing outlet structure location at the east end of the pond will remain.

Existing Pond D Water Quality Storage:	2,003 cf
Required Pond D Water Quality Storage:	3,190 cf
Proposed Pond D Water Quality Storage:	3,200 cf

SW 108th Avenue Frontage

Proposed improvements along SW 108th Avenue include new sidewalk and planter strip along the west side of the road. The existing paving and curb will not be modified. Runoff from the new impervious surfaces will be routed to a new storm treatment facility, Planter D-3.

The streetside planter is sided per the Simplified Method guidelines, using a 12-percent water quality and hydromodification sizing factor on the design impervious area.

- New impervious area: 7,205 SF
- 12% minimum facility size: 865 SF
- Provided facility size: 902 SF

Planter calculations are provided in Appendix B of this report.

III. STORMWATER QUANTITY MANAGEMENT

Downstream Analysis

The existing Lam Research campus storm drainage system connects to the public storm system at two primary locations: to SW Leveton Drive south of the existing Pond C, and to SW 108th Avenue to the east of existing Pond D.

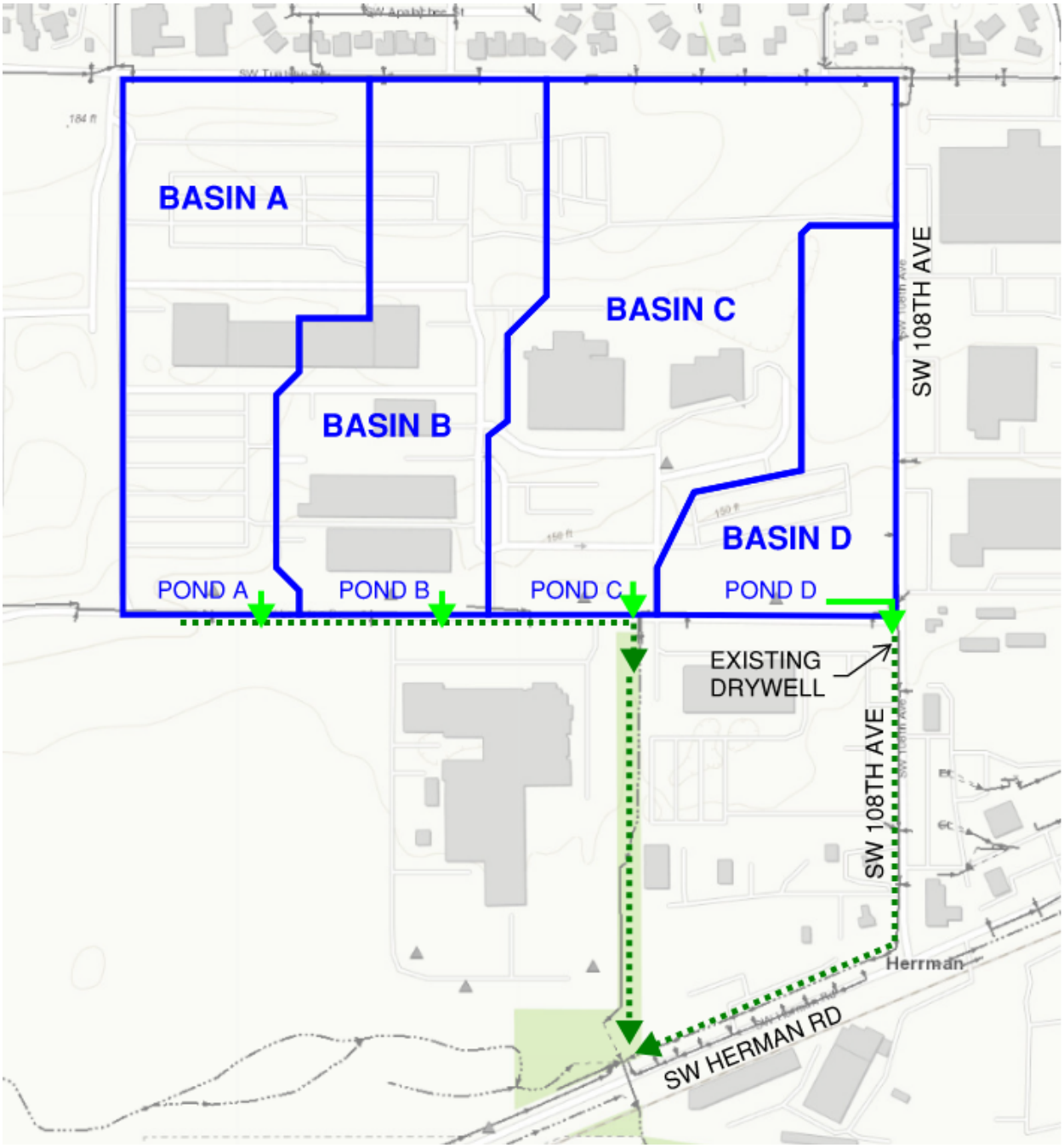
On-site drainage basins A, B, and C drain from the existing Ponds A, B, and C to the public storm pipe in SW Leveton Drive. The storm main conveys stormwater to an existing open channel in a public tract between tax lots 2S1220000400, 2S122AD00400 and 2S122AD01300. The existing channel is approximately 25 feet wide and relatively shallow and is overgrown with vegetation including dense blackberries and other shrubs. Adjacent properties drain to the channel. The flow path of the channel is relatively constrained from the vegetation. The channel leads approximately 560 feet south from Leveton Drive before entering a public conveyance pipe, then outfalls to a small pond north of Herman Road. The pipe outlets to an existing culvert under Herman Road and the adjacent railroad.

On-site drainage basin D drains to existing Pond D and connects to the existing public storm system in SW 108th Avenue near the southeast corner of the Lam Research campus. This storm pipe drains from north to south and collects runoff from the public street, and from properties along the west and east sides of 108th Avenue. At the southern end of SW 108th Avenue, the pipe system discharges to an open channel along SW Herman Road, approximately 900 feet south of the Lam Research property. The pipes transition from 12" diameter at the intersection of 108th Avenue and Leveton Drive up to 30" diameter at the intersection with Herman Road. The Herman Road pipes outfall to an open channel along the north side of the road, which lead to the pond and culvert noted above.

Existing Drywell

The City of Tualatin notes an existing drywell located at the intersection of SW Leveton Drive and SW 108th Avenue. The drywell is noted in public road record drawings (circa 1990) but limited information is provided. Based on our review of the drawings, the existing drywell was incorporated into the SW 108th Avenue storm drainage, but does not appear to have been used for primary stormwater discharge or flow reduction. The public storm piping extends beyond the Leveton Drive intersection. The proposed Lam Research development does not assume any available infiltration capacity in the drywell; therefore, any flow reduction or infiltration capacity which remains continues to be available for public use.

The storm system vicinity map below shows the drainage paths south from the Lam Research storm basins.



Hydromodification Flow Control

The proposed development at the Lam Research campus will add impervious surface to each of the four (4) drainage basins on site. Mitigation of increased peak flows will be provided through increased detention capacity in Pond D, which will be expanded toward the west.

Ponds A, B, and C, and D were designed in 2001 and 2017 under prior Clean Water Services regulations which required that runoff from the developed Lam Research site be mitigated through detention to match the pre-development peak rates for the 2-year through 25-year storm events.

Current standards require assessment of hydromodification risk based on the project site and development footprint. Per Clean Water Services standards, the proposed development falls into Category 2.

Figure 3: Project Site Hydromodification Map

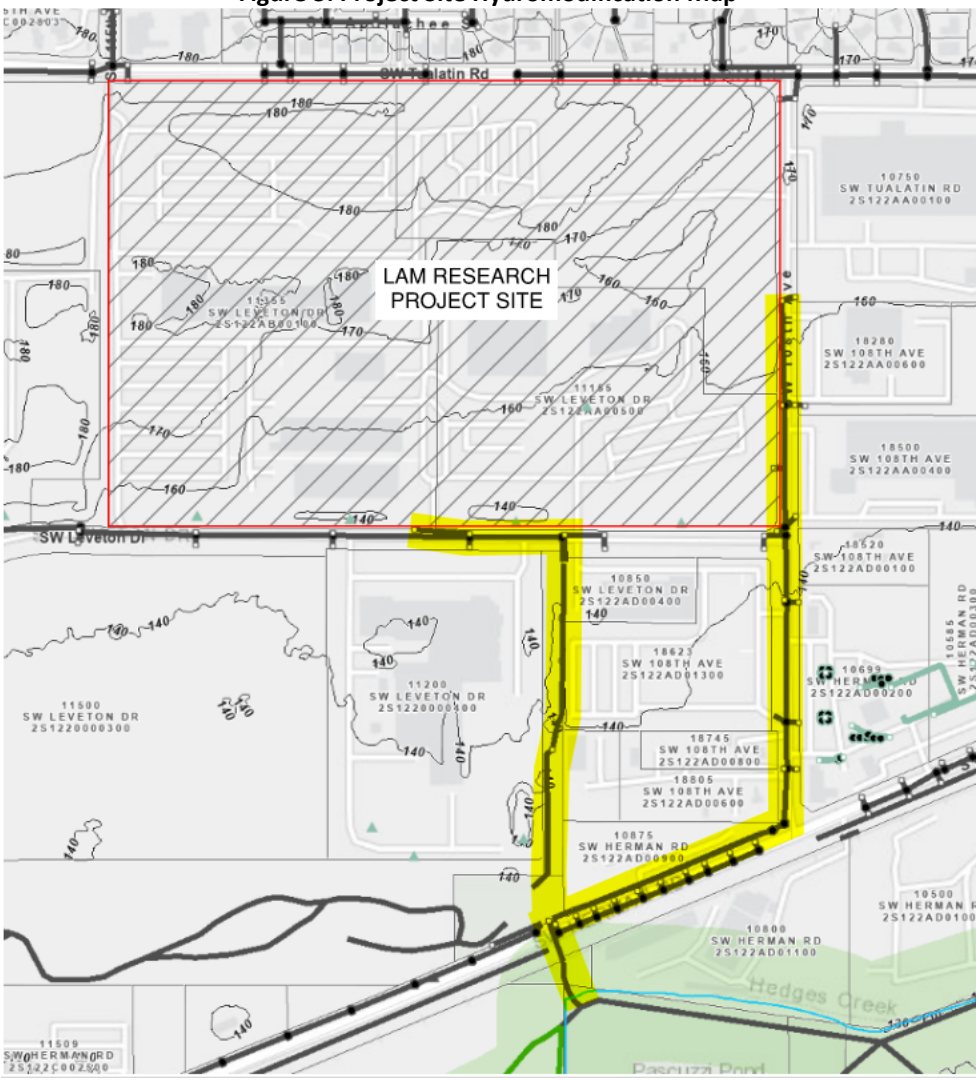


Figure 4: Hydromodification Risk Assessment

Development Class/ Risk Level	Small Project 1,000 – 12,000 SF	Medium Project >12,000 – 80,000 SF	Large Project > 80,000 SF
Expansion/High	Category 1	Category 3	Category 3
Expansion/ Moderate			
Expansion/ Low		Category 2	
Developed/ High		Category 3	
Developed/ Moderate		Category 2	Category 2
Developed/ Low			

Under current Clean Water Services Category 2 hydromodification standards, new development shall provide detention to reduce the 2-year storm developed peak flow to match one-half of the pre-developed 2-year storm peak runoff, and to match pre-development peak flows for larger storm events.

In order to calculate the required detention and mitigated release rate from the campus development under blended standards, we calculated the allowable peak flows from existing (pre-2019) development on campus and new (2022 proposed) development. Pre-development peak flows are calculated using on a curve number of 73. The following table summarizes the allowed peak flow from the site.

TABLE 3: PRE-DEVELOPMENT PEAK FLOWS					
Site Coverage	**Basin Area (ac)**	**2-year Storm Pre-Developed Maximum Allowed Flow (cfs)**	**5-year Storm Pre-Developed Peak Flow (cfs)**	**10-year Storm Pre-Developed Peak Flow (cfs)**	**25-year Storm Pre-Developed Peak Flow (cfs)**
Proposed 2022 Development Area	5.52	0.17 (50% of 2-yr peak pre-development flow, for area subject to hydromodification)	0.75	1.04	1.43
Pre-2019 Existing Campus	52.49	3.243 (2-yr peak pre-development flow, for area subject to peak flow matching)	7.21	9.87	13.63
Total Campus	58.01	3.41 (Blended 2-yr peak allowed flow)	7.96	10.91	15.06

Post-development runoff is calculated using curve numbers of 98 for impervious areas (building roofs, paving, gravel), and 74 for existing and new landscape areas. The runoff from each drainage basin on site is calculated based on the proposed site coverage, and calculated for flow through the existing detention ponds. The hydromodification sizing for the new development is completed by comparing the discharge peak flow to the pre-development peak flow for the entire site.

TABLE 4: POST-DEVELOPMENT SITE COVERAGE SUMMARY						
	Basin A (ac)	Basin B (ac)	Basin C (ac)	Basin D (ac)	Total Private Site (ac)	Road Basin (ac)
Existing Impervious	9.67	10.36	7.45	1.74	29.22	0.17
Existing Pervious	6.35	4.32	12.42	5.70	28.79	0.14
Proposed Impervious	9.67	10.43	8.34	4.50	32.94	0.17
Proposed Pervious	6.35	4.32	11.61	2.79	25.07	0.14
Total Area	16.02	14.78	20.00	7.21	58.01	0.31

The overall site flow is calculated as the combined flow from the four basins, and the Pond D storage will be adjusted to reduce the post-development total flow to match the pre-development limits listed above. Note that the Road Basin treatment planter is sized to meet hydromodification requirements, so its runoff is not included in the overall private site runoff flow control management.

Infiltration is accounted in the flow control design based on field testing performed by NV5 in conjunction with geotechnical investigations on site. Tests performed at 8 feet below existing ground level at two locations within the project area. The tests resulted in measured rates of 1 in/hr and 6 in/hr. The average of these rates is 3.5 in/hr, and we applied a factor of safety of 3 to the measured rates to account for variability in the soil conditions. The detention pond sizing includes use of a design infiltration rate of 1 in/hr from the bottom of each pond.

The following table summarizes the flow from each pond and the total private site outflow.

TABLE 5: DETAINED RELEASE FLOW SUMMARY					
	Pond A (ac)	Pond B (ac)	Pond C (ac)	Pond D	Total Site (ac)
Pre-Development Flow (cfs)[1]					2-yr: 3.41[1] 5-yr: 7.96 10-yr: 10.91 25-yr: 15.07
Post-Development Flow (cfs)	2-yr: 5.17 5-yr: 7.38 10-yr: 8.82 25-yr: 10.45	2-yr: 5.82 5-yr: 7.97 10-yr: 9.23 25-yr: 10.86	2-yr: 4.77 5-yr: 7.27 10-yr: 8.82 25-yr: 10.87	2-yr: 2.49 5-yr: 3.51 10-yr: 4.12 25-yr: 4.90	2-yr: 18.23 5-yr: 26.13 10-yr: 30.88 25-yr: 37.09
Detained Release Flow (cfs)	2-yr: 1.15 5-yr: 1.38 10-yr: 1.7 25-yr: 2.87	2-yr: 1.16 5-yr: 1.38 10-yr: 1.50 25-yr: 1.67	2-yr: 0.81 5-yr: 1.01 10-yr: 1.15 25-yr: 1.16	2-yr: 0.30 5-yr: 0.75 10-yr: 1.24 25-yr: 2.08	2-yr: 3.13 5-yr: 4.55 10-yr: 5.26 25-yr: 7.21

[1] Refer to Table 3 above for mixed peak-matching and hydromodification flow control requirements for the full site, including portions of the site which were constructed under prior CWS standards.

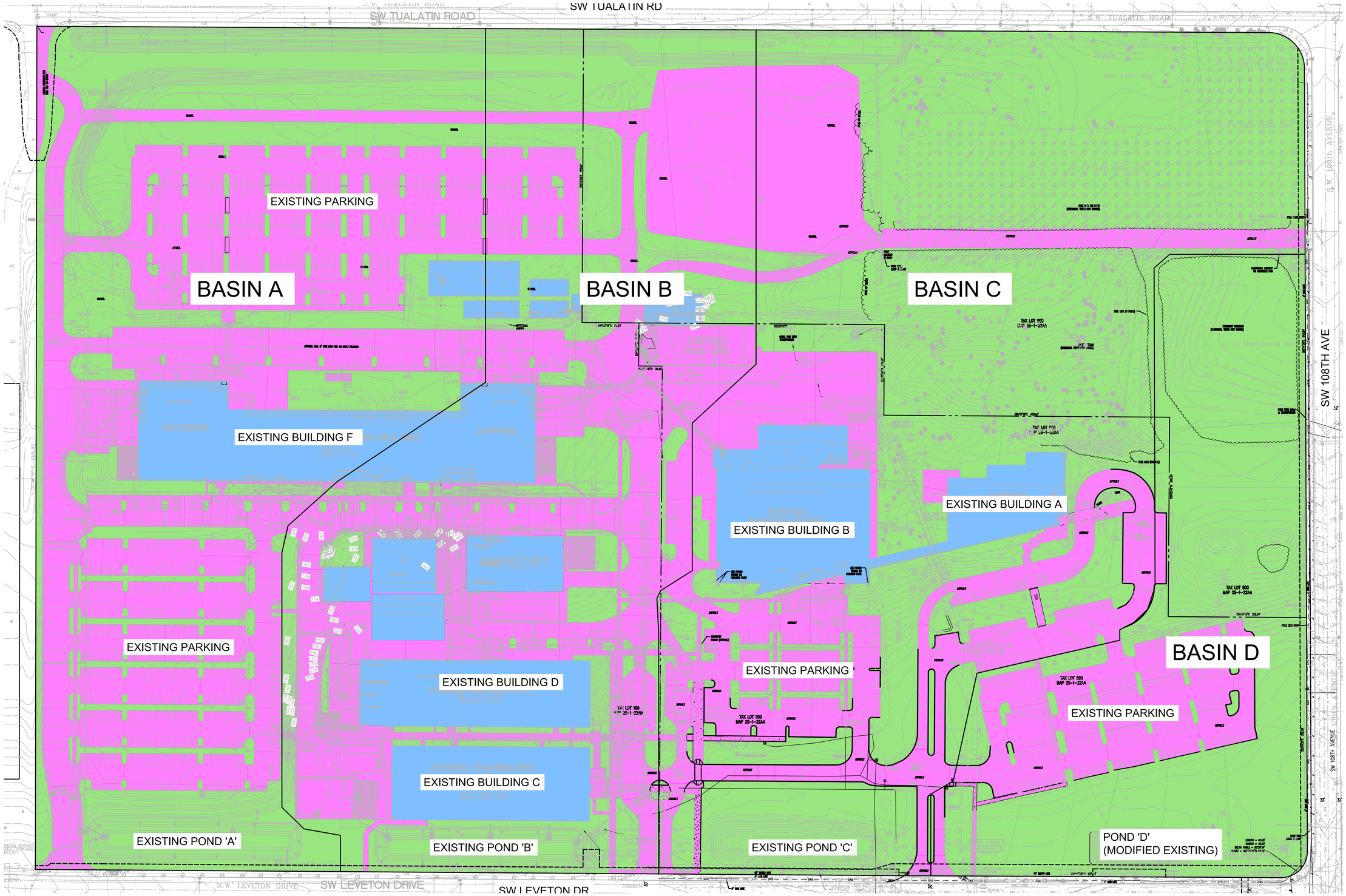
The existing Ponds A and B will remain as-is; Pond C will receive an adjusted outlet orifice; and Pond D will be expanded to provide additional detention storage. Approximately 20,600 cf of additional storage is required within Pond D, which is provided by extending the west edge of the pond approximately 80 feet.

No modifications to the existing Pond D outlet structure or orifice are required. Detailed detention calculations are provided in Appendix C of this report.

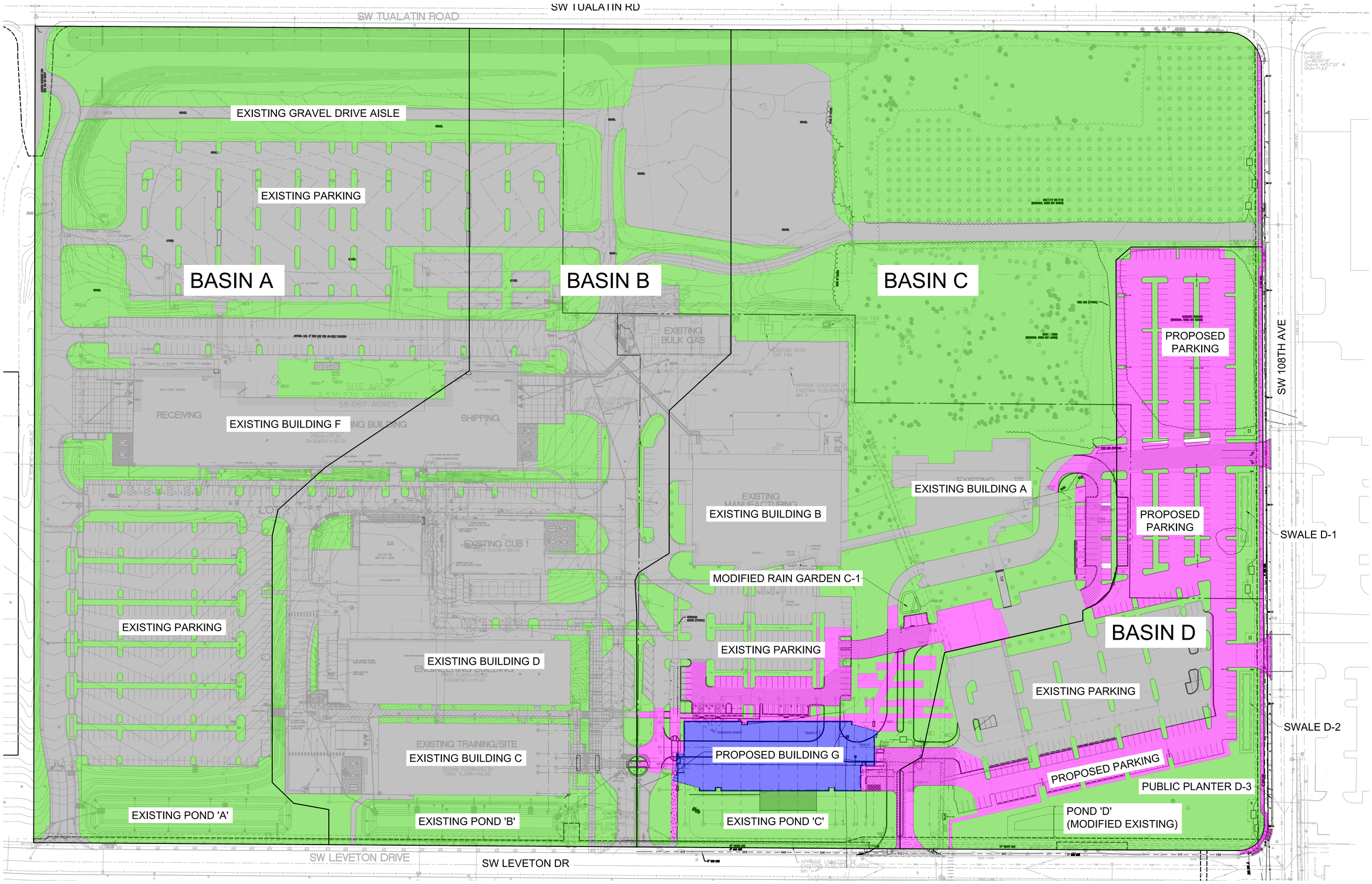
IV. CONCLUSION

The proposed building and parking expansion at Lam Research will increase the impervious area coverage on campus by approximately 4.36 ac. Stormwater runoff from the new impervious area will be treated for water quality through existing extended dry basins, new swales, and new rain gardens.

Detention will be provided to new Clean Water Services standards to meet hydromodification requirements for new impervious area. The existing detention ponds will be supplemented with expansion at Pond D to provide storage to meet new detention requirements.



EXISTING BASIN COVERAGE AREA SUMMARY						
	BASIN A	BASIN B	BASIN C	BASIN D	TOTAL SITE	ROAD BASIN
EXISTING IMPERVIOUS AREA (AC)	9.67	10.36	7.45	1.74	29.22	0.17
EXISTING PERVIOUS AREA (AC)	6.35	4.32	12.42	5.70	28.79	0.14
TOTAL BASIN AREA (AC)	16.02	14.68	19.87	7.45	58.01	0.31



PROPOSED BASIN COVERAGE AREA SUMMARY						
	BASIN A	BASIN B	BASIN C	BASIN D	PRIVATE SITE	ROAD BASIN
EXISTING PERVIOUS AREA TO REMAIN (AC)	6.35	4.32	10.09	1.01	21.77	0.14
NEW PERVIOUS AREA (AC)	0	0	1.52	1.78	3.30	0
TOTAL PERVIOUS AREA (AC)	6.35	4.32	11.61	2.79	25.07	0.14
EXISTING IMPERVIOUS AREA TO REMAIN (AC)	9.67	10.43	5.80	1.57	27.47	0
NEW IMPERVIOUS AREA (AC)	0.00	0.00	2.54	2.93	5.47	0.17
TOTAL IMPERVIOUS AREA (AC)	9.67	10.43	8.34	4.50	32.94	0.17
TOTAL BASIN AREA (AC)	16.02	14.75	19.95	7.29	58.01	0.31

APPENDIX B

WATER QUALITY SIZING

Clean Water Services

Vegetated Swale Calculator

Per 2019 Clean Water Services Design & Construction Standards (D&CS)

Project Name:	**Lam Research - Swale D-1**	By:	SJS	Checked:	BDN
Project Number:	2220087.00	Date:	8/15/2022	Date:	10/18/2023

From WQF and WQV Calculator

Required Treatment Area (A):	A =	36,094	ft^2
Water Quality Volume (WQV):	WQV =	1,083	ft^3
Water Quality Flow (WQF):	WQF =	0.08	ft^3/s

User Entry Variables

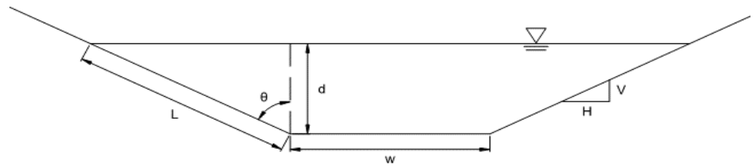
Slope	S =	0.045	ft/ft
Side Slopes	H =	4	
	V =	1	
Swale Length	L_s =	100	ft
Swale Bottom Width	w =	8	ft
Manning's N-Value	n =	0.24	

Calculations

Swale Cross-Sectional Area	A =	0.42	ft^2
	θ =	76	°
	L =	0.06	ft
Water Quality Depth	d =	0.052	ft
Velocity	v =	0.18	ft/s
Residence time	t =	9.24	min.
Manning's Equation	$AR^{2/3}$ =	0.057	
Manning's Equation	$AR^{2/3}$ =	0.058	

Equations

$$AR^{2/3} = \frac{Q * n}{1.49\sqrt{S}} \qquad A = (d * w) + d^2 tan\theta \qquad R = \frac{wd + Hd^2}{w + 2dH}$$



Vegetated Swale Design Criteria

Minimum Slope =	0.005		D&CS 4.09.4.c.4
Maximum Side Slopes =	4	:1	D&CS 4.09.4.c.8A
Minimum Swale Length =	100	feet	D&CS 4.09.4.c.3
Minimum Flat Bottom Width =	2	feet	D&CS 4.09.4.c.5
Manning's n-value =	0.24		D&CS 4.09.4.b.5
Minimum Freeboard =	1	foot	D&CS 4.09.4.b.4
Maximum Depth =	6	inches	D&CS 4.09.4.c.6
Maximum Velocity =	2	ft/s	D&CS 4.09.4.b.6
Minimum Residence Time =	9	minutes	D&CS 4.09.4.b.2

$$AR^{2/3} = \frac{Q * n}{1.49\sqrt{S}}$$

$$AR^{2/3} = dw + d^2 tan\theta \left[\frac{dw + d^2 tan\theta}{\left(w + 2\frac{d}{cos\theta}\right)^{2/3}}\right]$$

Portland 503.224.9560 Vancouver 360.695.7879 Seattle 206.749.9993
www.mcknze.com
Architecture ▪ Interiors
Planning ▪ Engineering
MACKENZIE.

Clean Water Services

Vegetated Swale Calculator

Per 2019 Clean Water Services Design & Construction Standards (D&CS)

Project Name:	**Lam Research - Swale D-2 (REV)**	By:	SJS	Checked:	BDN
Project Number:	2220087.00	Date:	8/15/2022	Date:	1/20/2025

From WQF and WQV Calculator

Required Treatment Area (A):	A =	86,079	ft^2
Water Quality Volume (WQV):	WQV =	2,582	ft^3
Water Quality Flow (WQF):	WQF =	0.18	ft^3/s

User Entry Variables

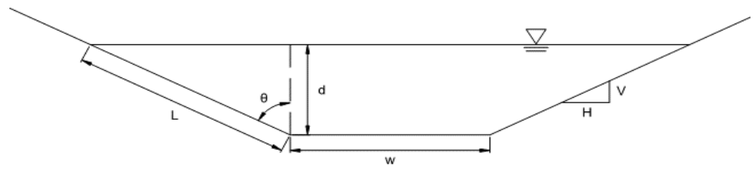
Slope	S =	0.005	ft/ft
Side Slopes	H =	4	
	V =	1	
Swale Length	L_s =	118	ft
Swale Bottom Width	w =	10	ft
Manning's N-Value	n =	0.24	

Calculations

Swale Cross-Sectional Area	A =	1.49	ft^2
	θ =	76	°
	L =	0.17	ft
Water Quality Depth	d =	0.148	ft
Velocity	v =	0.12	ft/s
Residence time	t =	16.35	min.
Manning's Equation	$AR^{2/3}$ =	0.410	
Manning's Equation	$AR^{2/3}$ =	0.410	

Equations

$$AR^{2/3} = \frac{Q * n}{1.49\sqrt{S}} \qquad A = (d * w) + d^2 tan\theta \qquad R = \frac{wd + Hd^2}{w + 2dH}$$



Vegetated Swale Design Criteria

Minimum Slope =	0.005		D&CS 4.09.4.c.4
Maximum Side Slopes =	4	:1	D&CS 4.09.4.c.8A
Minimum Swale Length =	100	feet	D&CS 4.09.4.c.3
Minimum Flat Bottom Width =	2	feet	D&CS 4.09.4.c.5
Manning's n-value =	0.24		D&CS 4.09.4.b.5
Minimum Freeboard =	1	foot	D&CS 4.09.4.b.4
Maximum Depth =	6	inches	D&CS 4.09.4.c.6
Maximum Velocity =	2	ft/s	D&CS 4.09.4.b.6
Minimum Residence Time =	9	minutes	D&CS 4.09.4.b.2

$$AR^{2/3} = \frac{Q * n}{1.49\sqrt{S}}$$

$$AR^{2/3} = dw + d^2 tan\theta \left[\frac{dw + d^2 tan\theta}{\left(w + 2\frac{d}{cos\theta}\right)^{2/3}}\right]$$

Portland 503.224.9560 Vancouver 360.695.7879 Seattle 206.749.9993
www.mcknze.com
Architecture ▪ Interiors
Planning ▪ Engineering
MACKENZIE.

Clean Water Services

Simplified LIDA Sizing
Per 2019 Clean Water Services Design & Construction Standards

Project Name:	Lam Research - Planter D-3	By:	SJS	Checked:	BDN
Project Number:	2220087.00	Date:	11/17/2022	Date:	10/18/2023

User Entry Variables

Impervious Area	7,205	ft^2
Infiltration Rate	0.5	in/hr

From WQF and WQV Calculator

Required Treatment Area (A): 7,205 ft^2

Calculations

LIDA Facility Size (WQ ONLY)	432	ft^2
LIDA Facility Size (WQ + Hydromodification)	865	ft^2
Facility Size Provided:	**902**	**ft^2**

Notes/Design Criteria

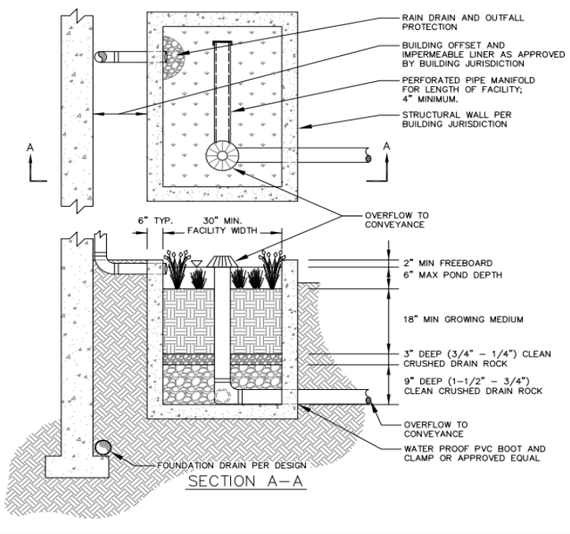
Maximum Contributing Impervious Area 15,000 ft^2
Sizing factors assume a maximum infiltration rate of 2 in/hr
If infiltration rate exceeds 2 in/hr, the simplified method may be oversizing your facility

Sizing factor = 6% CWS Design & Construction Standards - Section 4.08.4b
Sizing factor = 12% CWS Design & Construction Standards - Section 4.08.4c

LIDA Facilities to be used with Simplified Sizing

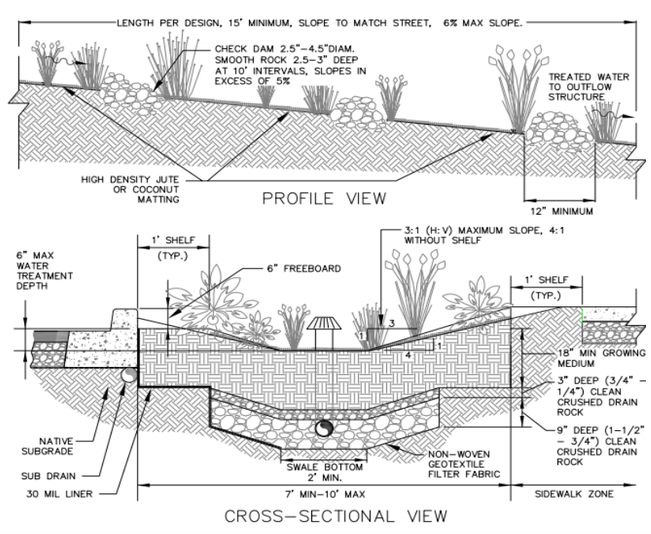
Flow-Through Planter

CWS LIDA Handbook Dwg No 794 (2016)



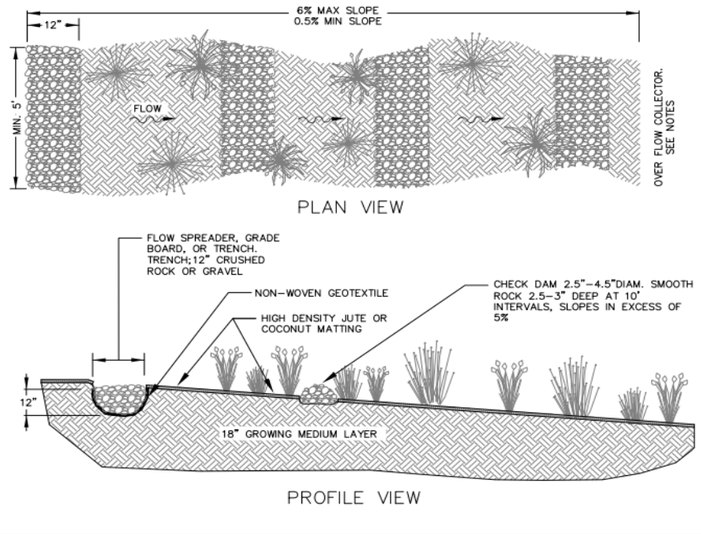
LIDA Swale

CWS LIDA Handbook Dwg No 795 (2016)



Vegetated Filter Strip

CWS LIDA Handbook Dwg No 796 (2016)



Portland 503.224.9560 Vancouver 360.695.7879 Seattle 206.749.9993
www.mcknze.com
Architecture · Interiors
Planning · Engineering
MACKENZIE.

APPENDIX C

DETENTION CALCULATIONS

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	3.584	-------	7.964	10.91	15.07	-------	-------	Pre-Dev Overall Site
2	SCS Runoff	------	-------	0.341	-------	0.758	1.038	1.434	-------	-------	Pre-Dev New/Modified Site
3	SCS Runoff	------	-------	3.243	-------	7.206	9.873	13.63	-------	-------	Pre-Dev Undisturbed Site
5	SCS Runoff	------	-------	5.165	-------	7.384	8.716	10.45	-------	-------	Basin A - Dev
6	SCS Runoff	------	-------	5.824	-------	7.968	9.233	10.86	-------	-------	Basin B - Dev
7	SCS Runoff	------	-------	4.771	-------	7.269	8.817	10.87	-------	-------	Basin C - Dev
8	SCS Runoff	------	-------	2.492	-------	3.509	4.115	4.903	-------	-------	Basin D - Dev
10	Combine	5, 6, 7, 8,	-------	18.23	-------	26.13	30.88	37.09	-------	-------	Full Site - Developed
12	Reservoir	5	-------	1.147	-------	1.498	1.701	2.872	-------	-------	Pond A Outflow
13	Reservoir	6	-------	1.157	-------	1.378	1.499	1.674	-------	-------	Pond B Outflow
14	Reservoir	7	-------	0.806	-------	1.014	1.152	1.155	-------	-------	Pond C Outflow
15	Reservoir	8	-------	0.308	-------	0.747	1.241	2.083	-------	-------	Pond D Outflow
17	Combine	12, 13, 14, 15,	-------	3.130	-------	4.554	5.258	7.212	-------	-------	Total site outflow

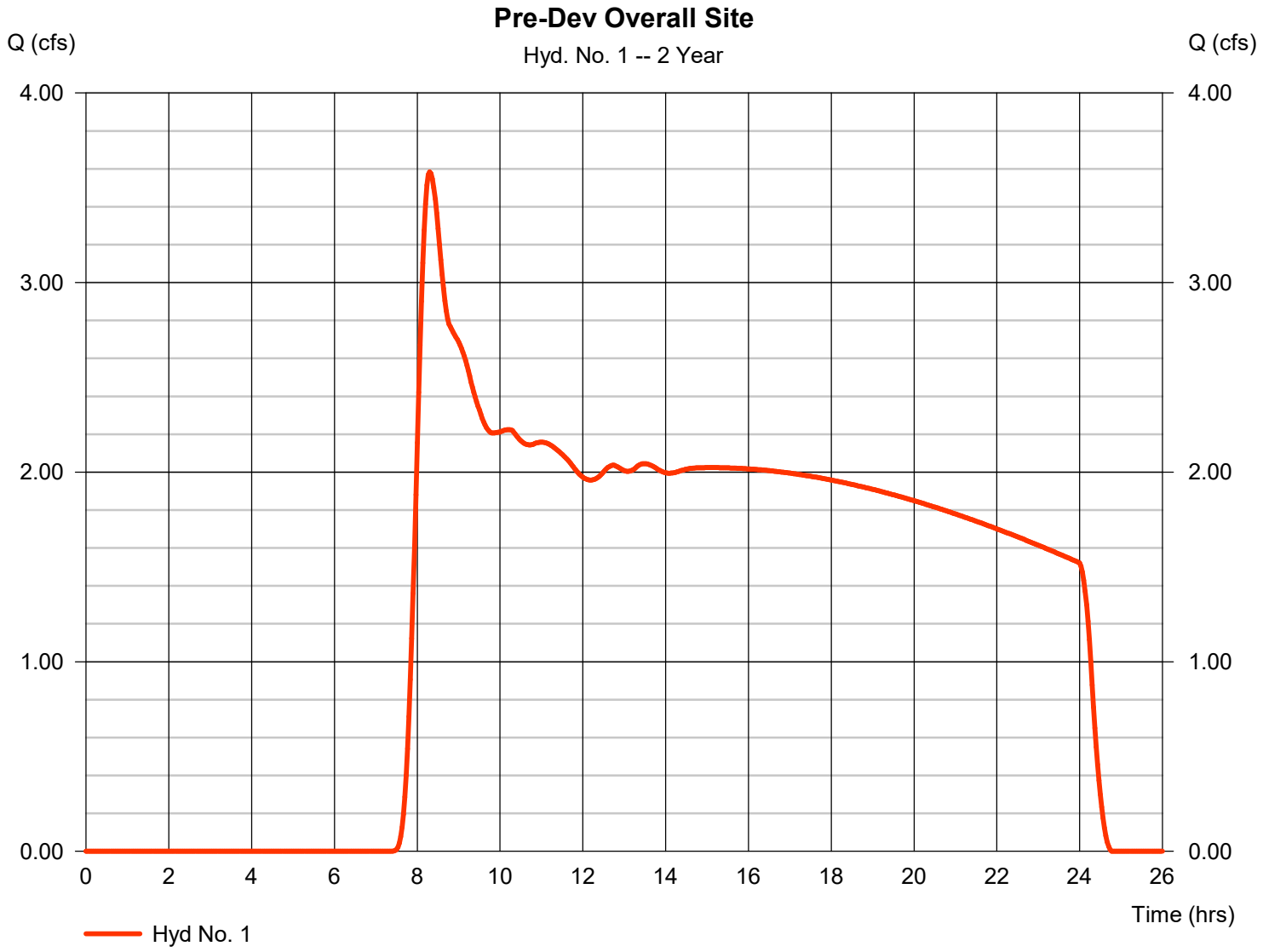
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 1

Pre-Dev Overall Site

Hydrograph type	= SCS Runoff	Peak discharge	= 3.584 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.30 hrs
Time interval	= 2 min	Hyd. volume	= 119,526 cuft
Drainage area	= 58.010 ac	Curve number	= 73
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484



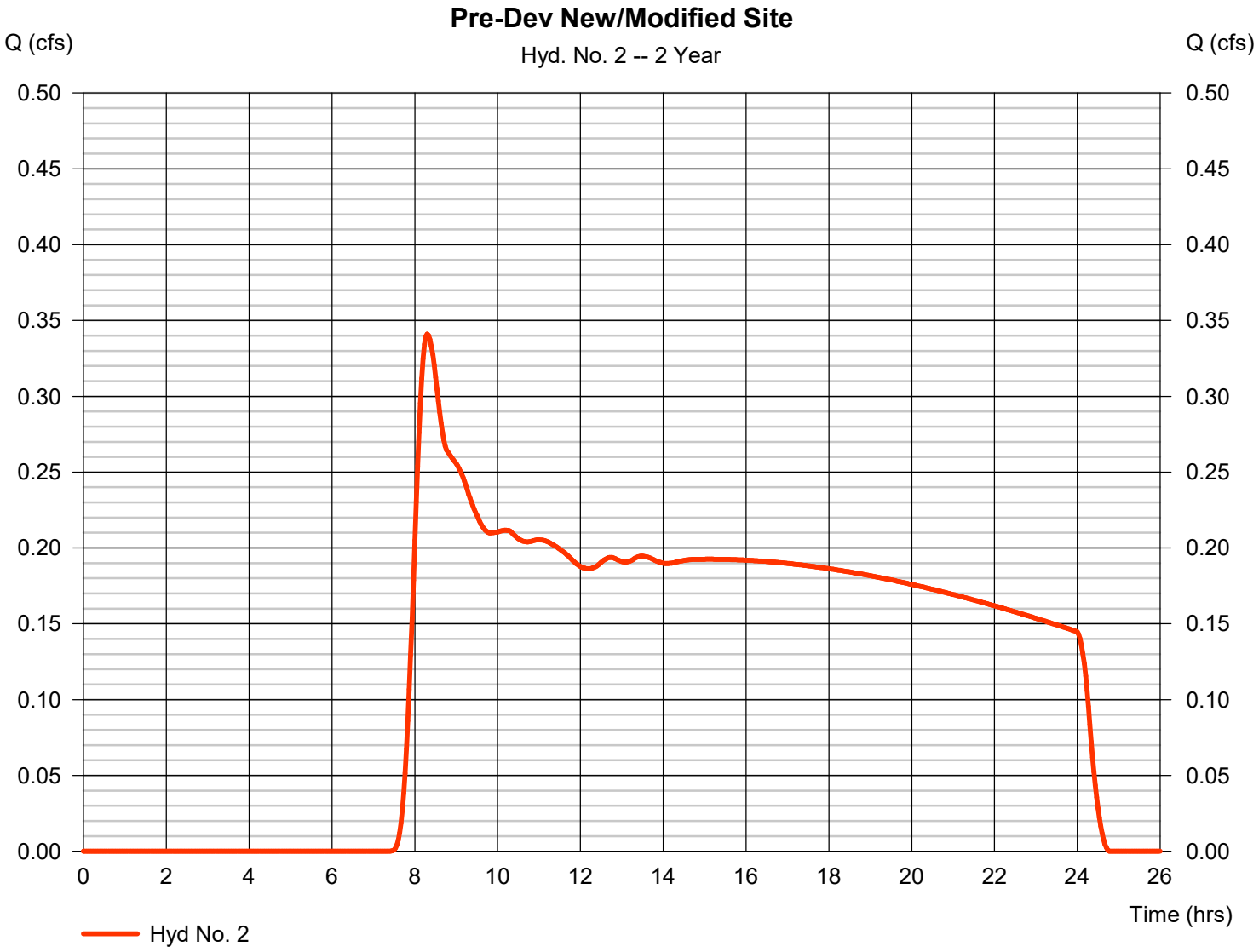
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 2

Pre-Dev New/Modified Site

Hydrograph type	= SCS Runoff	Peak discharge	= 0.341 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.30 hrs
Time interval	= 2 min	Hyd. volume	= 11,374 cuft
Drainage area	= 5.520 ac	Curve number	= 73
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484



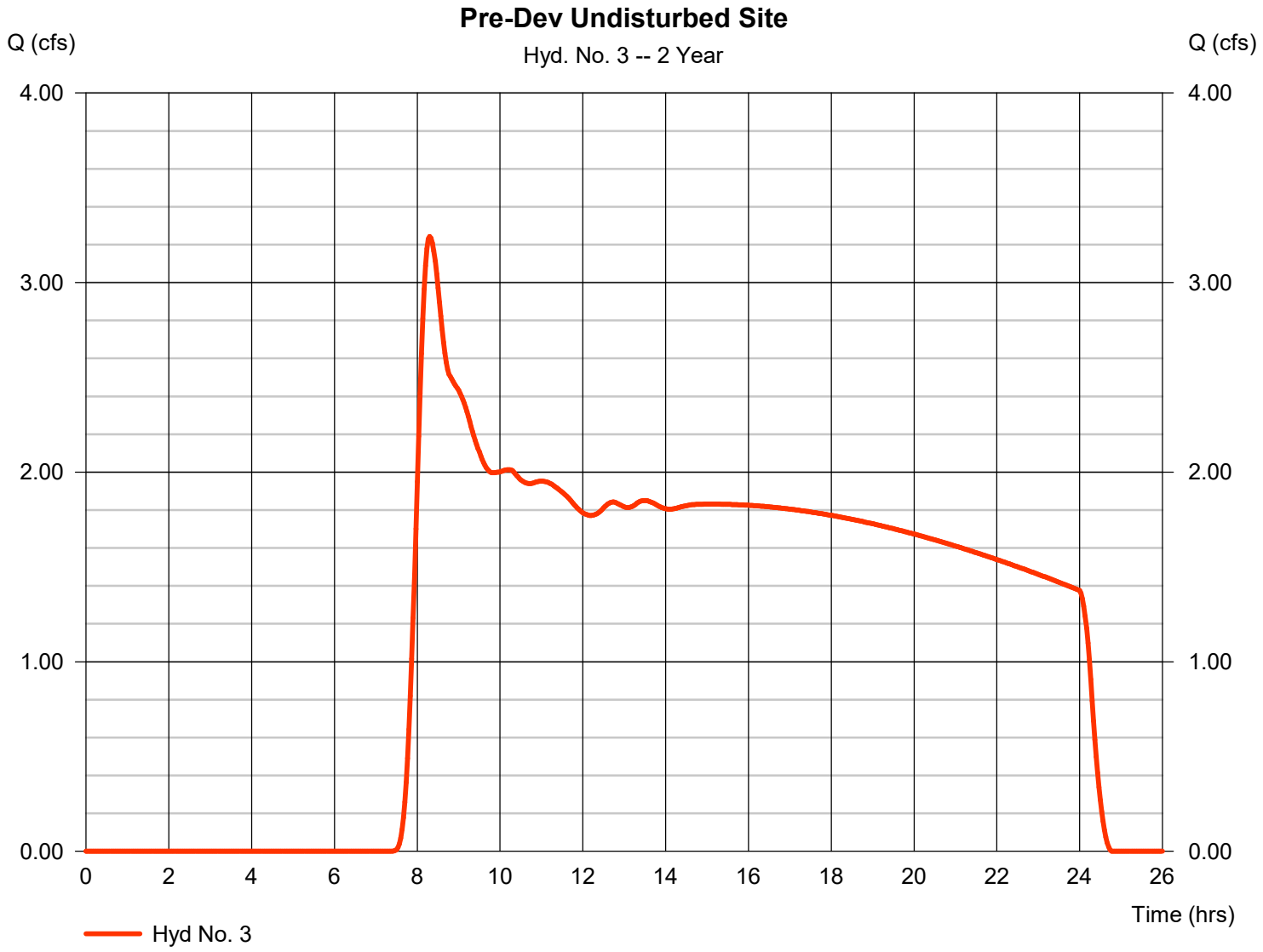
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 3

Pre-Dev Undisturbed Site

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.243 cfs
Storm frequency	=	2 yrs	Time to peak	=	8.30 hrs
Time interval	=	2 min	Hyd. volume	=	108,152 cuft
Drainage area	=	52.490 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	30.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

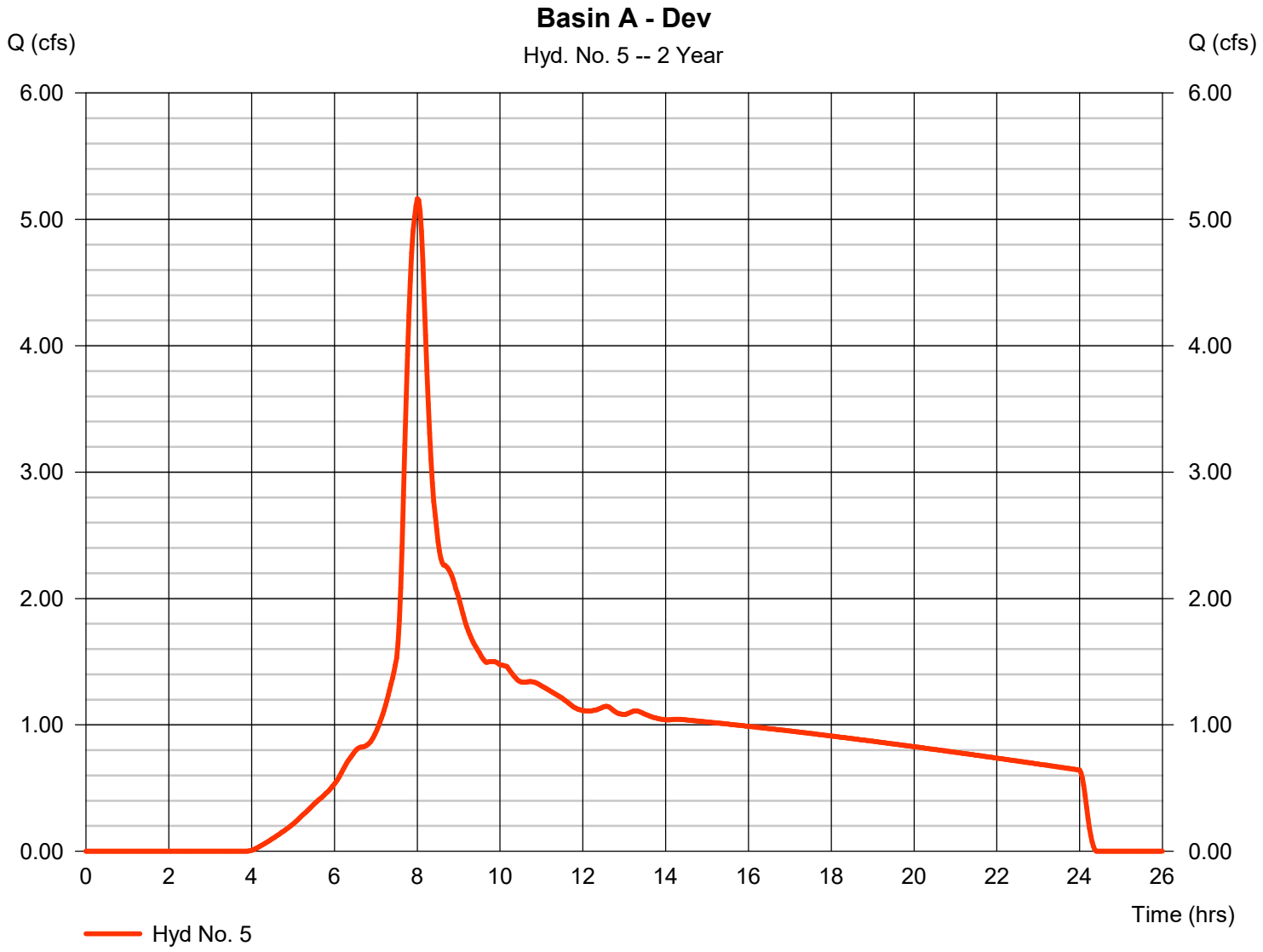
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 5

Basin A - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 5.165 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 78,328 cuft
Drainage area	= 16.020 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.250 x 98) + (8.150 x 98) + (6.350 x 74) + (0.270 x 98)] / 16.020



Hydrograph Report

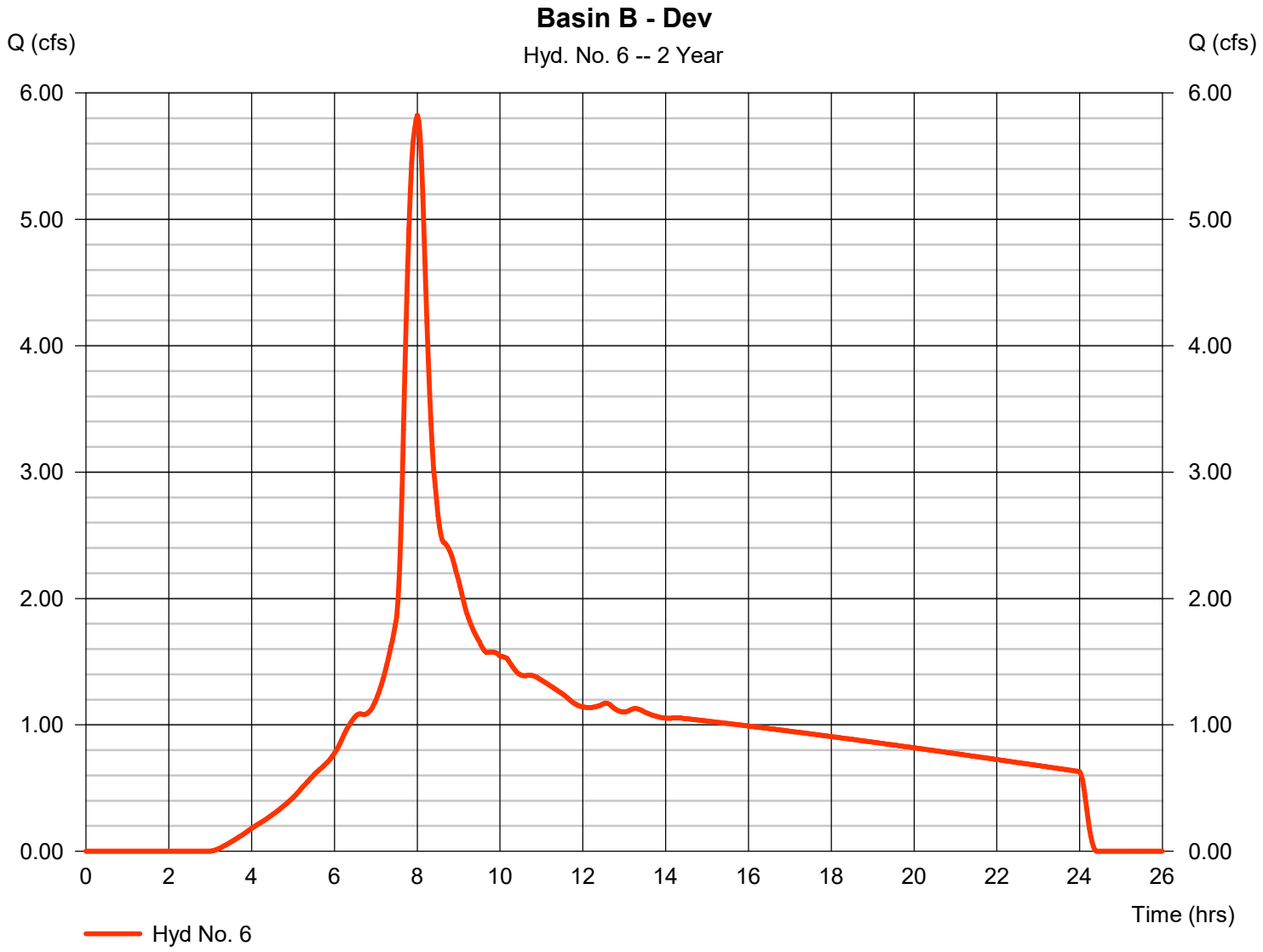
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 6

Basin B - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 5.824 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 84,239 cuft
Drainage area	= 14.780 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.350 x 98) + (7.110 x 98) + (4.320 x 74)] / 14.780



Hydrograph Report

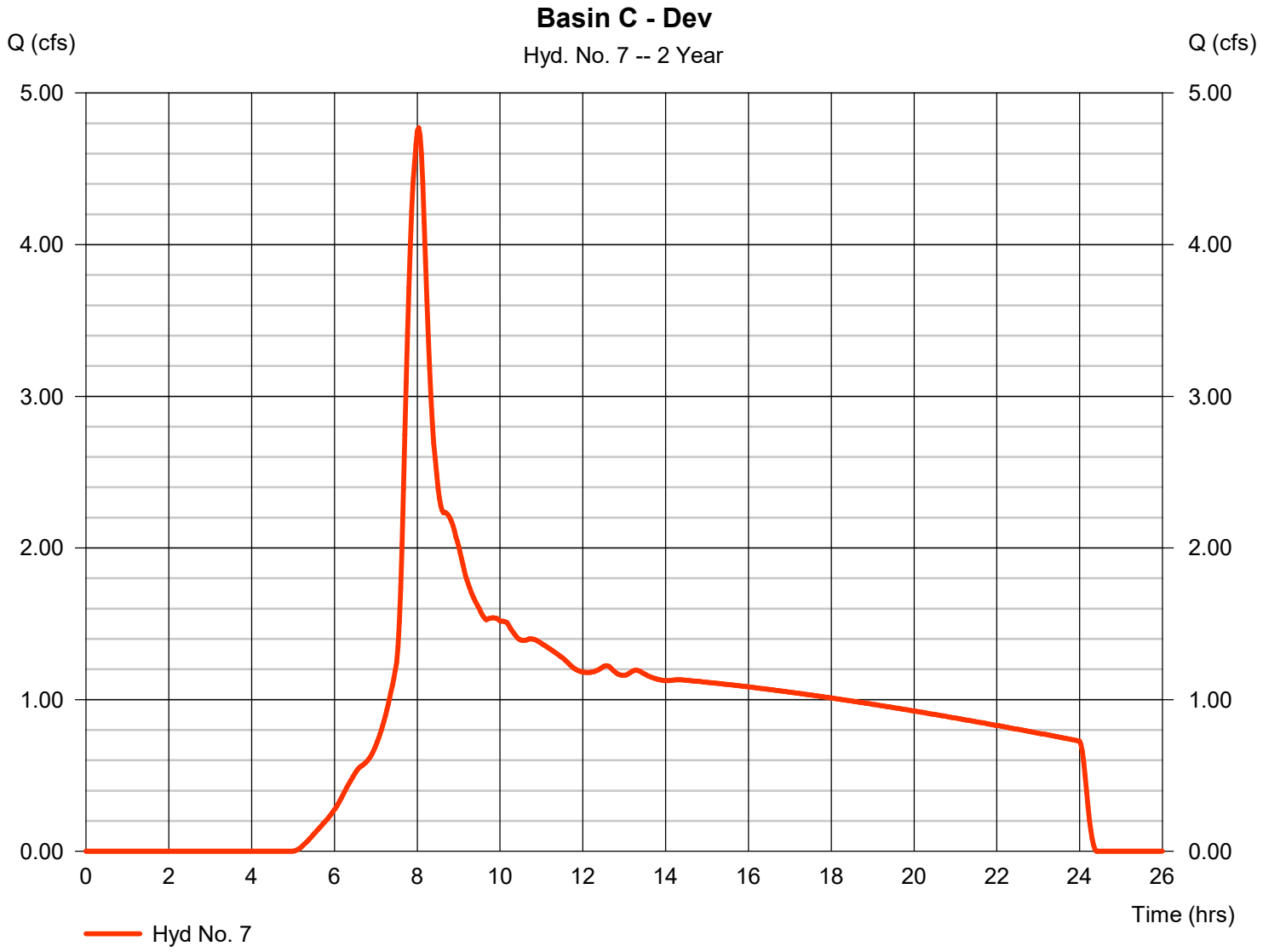
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 7

Basin C - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 4.771 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.03 hrs
Time interval	= 2 min	Hyd. volume	= 78,992 cuft
Drainage area	= 20.000 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.040 x 98) + (4.050 x 98) + (10.090 x 74) + (0.750 x 98) + (1.590 x 98) + (1.430 x 74)] / 20.000



Hydrograph Report

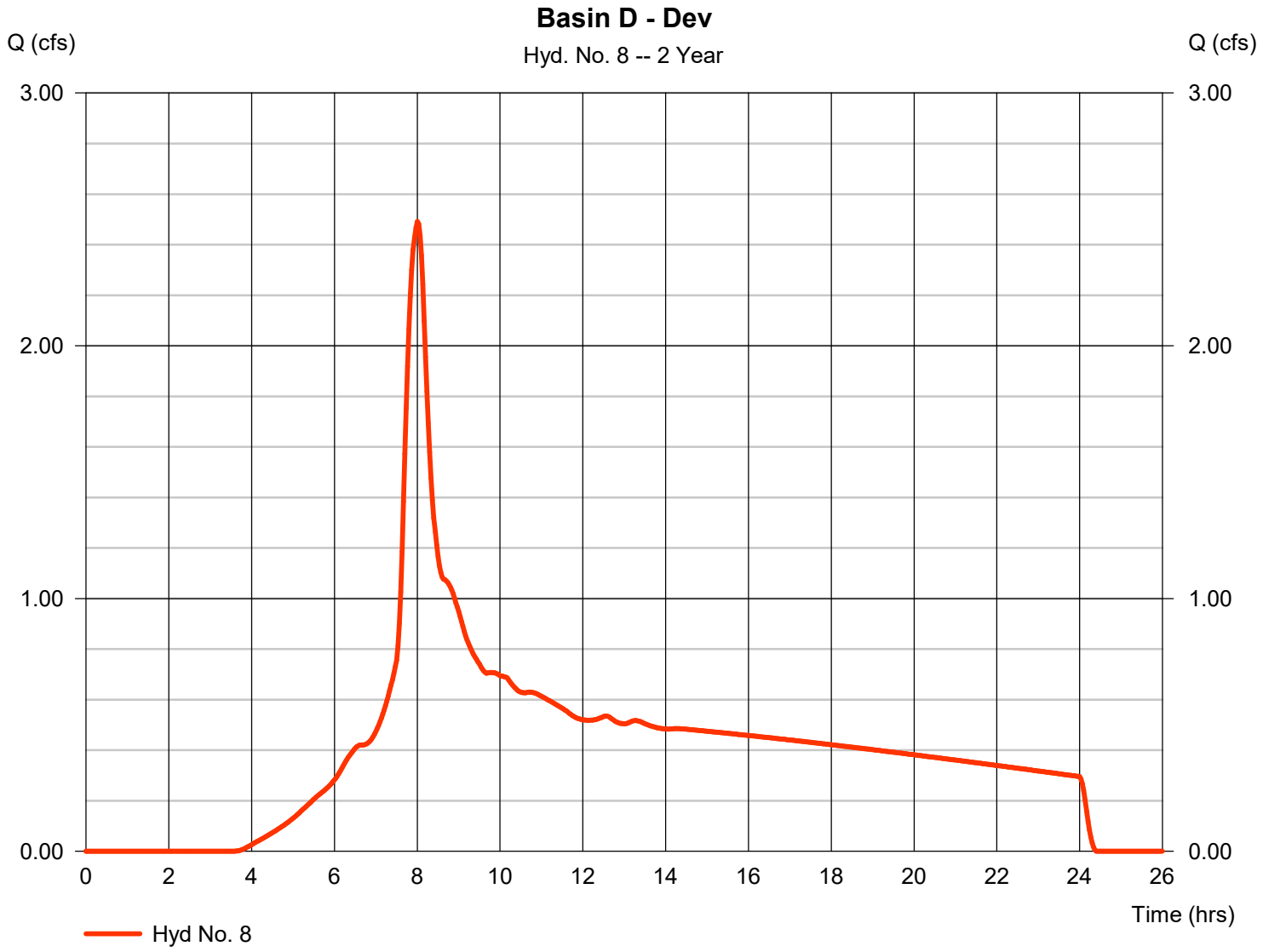
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 8

Basin D - Dev

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.492 cfs
Storm frequency	=	2 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	37,121 cuft
Drainage area	=	7.210 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	2.50 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.240 x 98) + (1.000 x 74) + (3.180 x 98) + (1.790 x 74)] / 7.210



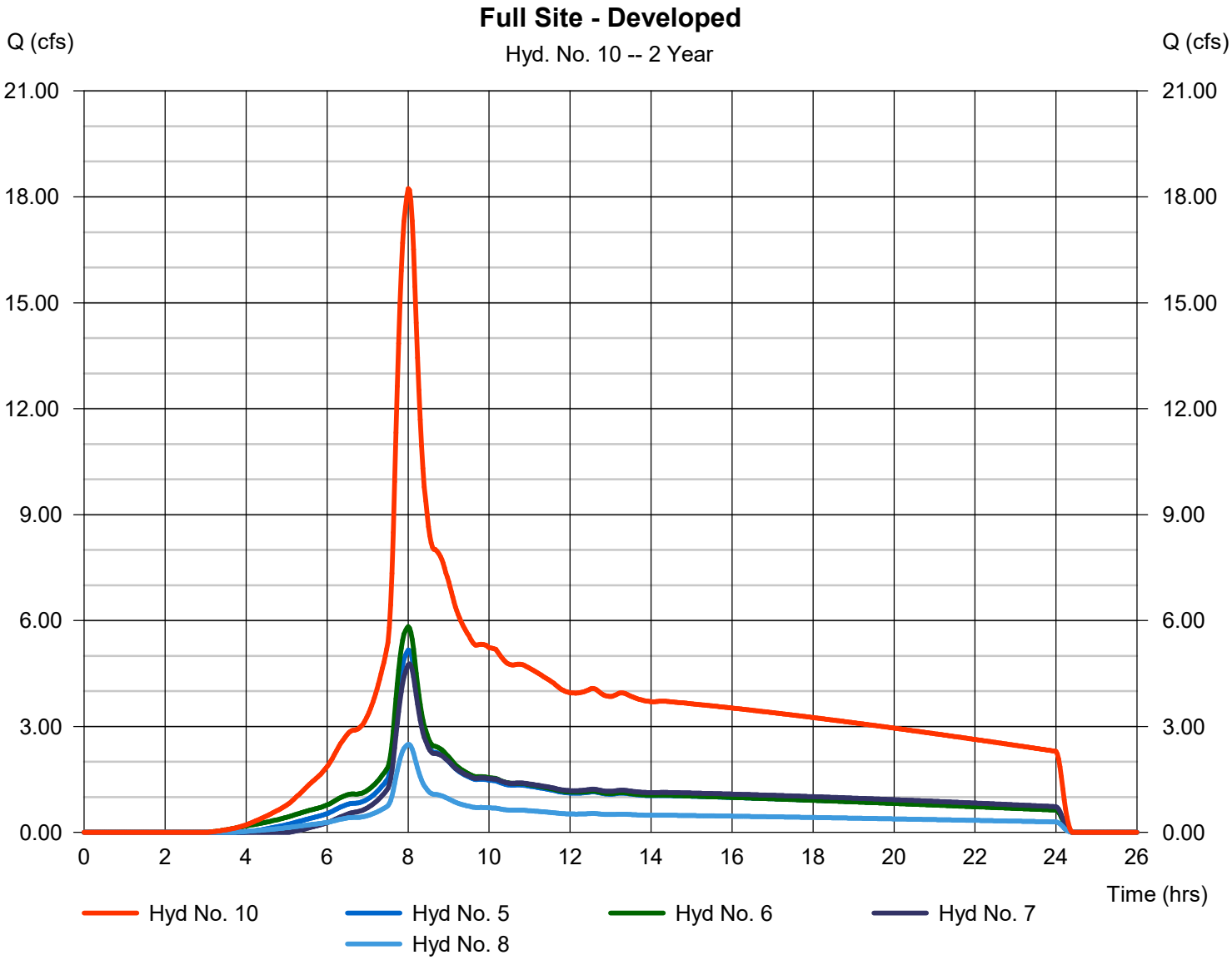
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 10

Full Site - Developed

Hydrograph type	= Combine	Peak discharge	= 18.23 cfs
Storm frequency	= 2 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 278,681 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 58.010 ac



Hydrograph Report

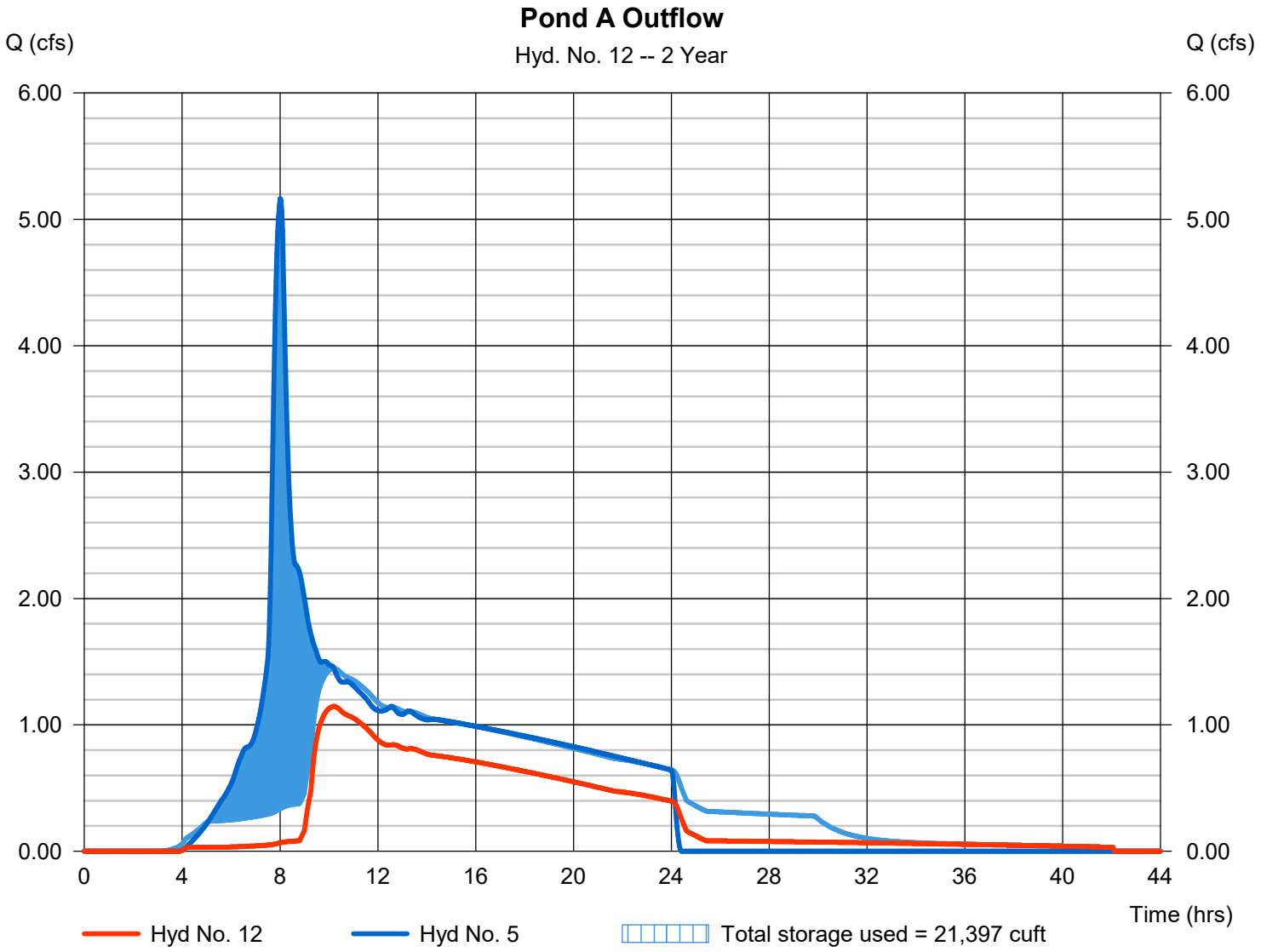
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 12

Pond A Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.147 cfs
Storm frequency	=	2 yrs	Time to peak	=	10.20 hrs
Time interval	=	2 min	Hyd. volume	=	42,892 cuft
Inflow hyd. No.	=	5 - Basin A - Dev	Max. Elevation	=	140.70 ft
Reservoir name	=	Existing Pond A	Max. Storage	=	21,397 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Pond No. 1 - Existing Pond A

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 137.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	137.00	00	0	0
0.99	137.99	00	0	0
1.00	138.00	8,904	30	30
2.00	139.00	10,849	9,860	9,889
3.00	141.00	12,851	11,835	21,724
4.00	142.00	14,909	13,866	35,590
5.00	143.00	17,024	15,953	51,543

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 5.26	1.50	0.00	0.00
Span (in)	= 5.26	1.50	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 137.55	137.65	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 2.00	2.00	0.00	0.00
Crest El. (ft)	= 139.75	141.92	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 1.000 (by Contour)			
TW Elev. (ft)	= 0.00			

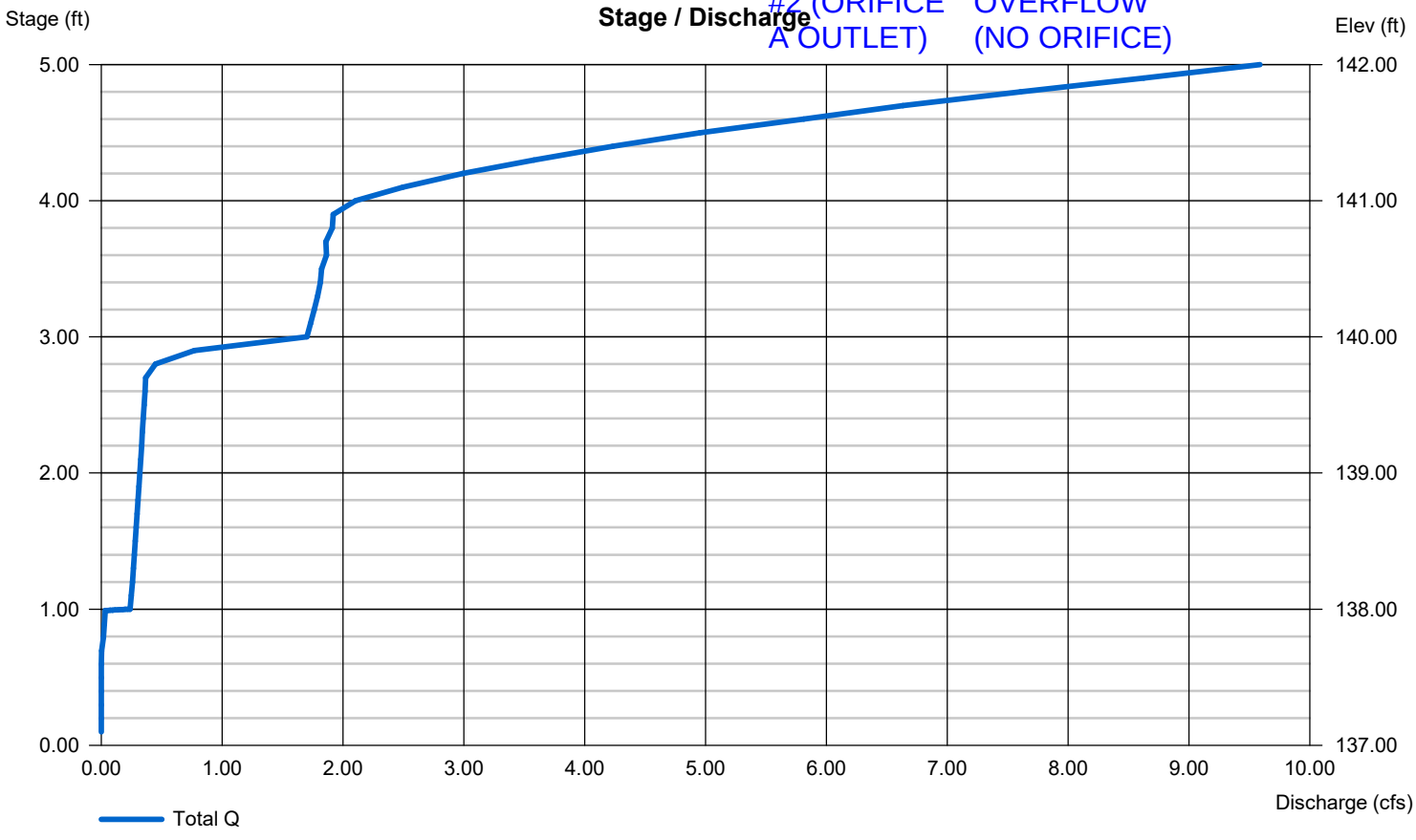
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

EX. POND A ORIFICE #2

EX. POND A ORIFICE #1

EX. POND A DITCH INLET #2 (ORIFICE A OUTLET)

EX. POND A DITCH INLET OVERFLOW (NO ORIFICE)



Hydrograph Report

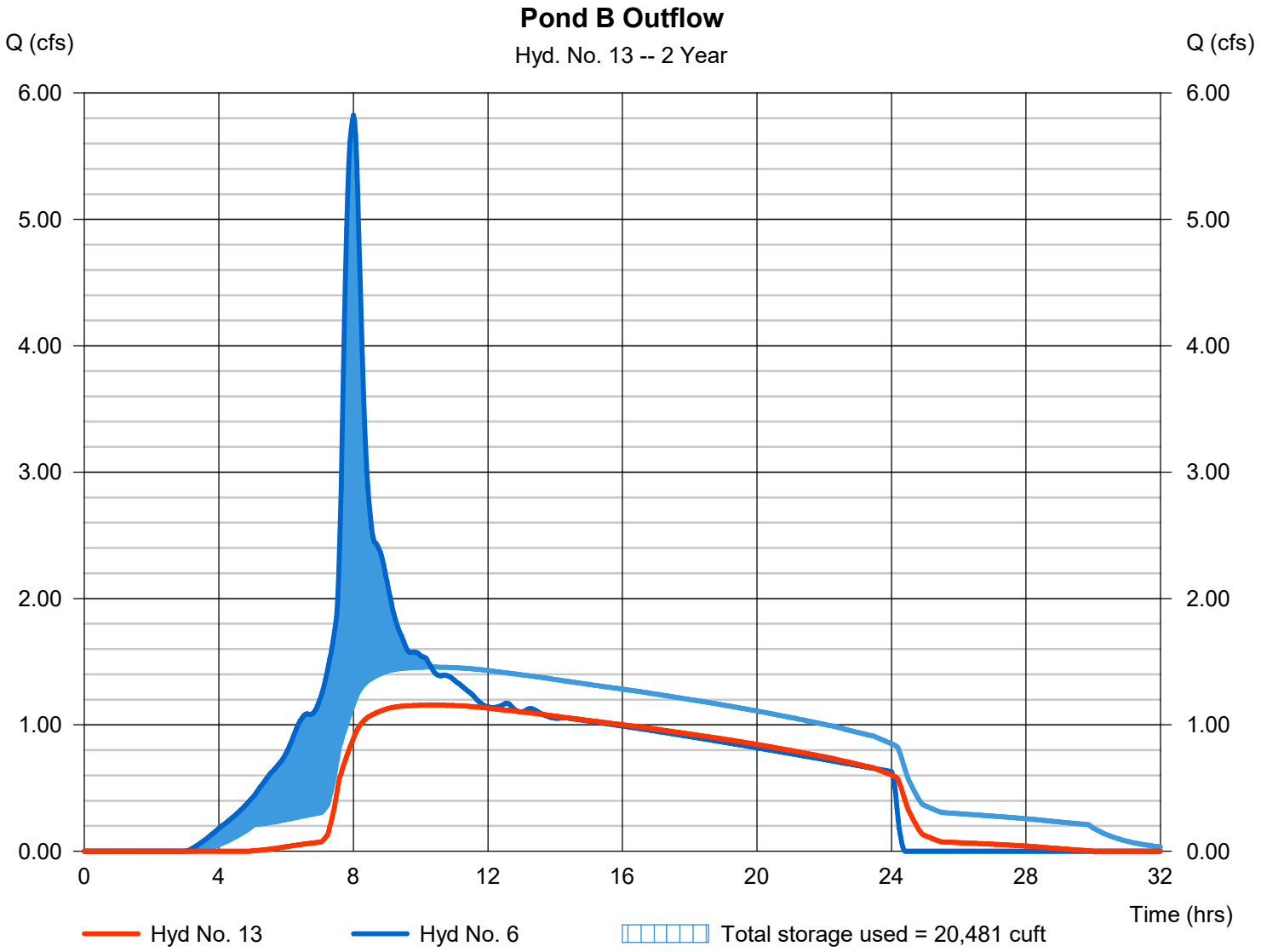
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 13

Pond B Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.157 cfs
Storm frequency	=	2 yrs	Time to peak	=	10.30 hrs
Time interval	=	2 min	Hyd. volume	=	59,625 cuft
Inflow hyd. No.	=	6 - Basin B - Dev	Max. Elevation	=	138.06 ft
Reservoir name	=	Existing Pond B	Max. Storage	=	20,481 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Tuesday, 07 / 23 / 2024

Pond No. 2 - Existing Pond B

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 135.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	135.00	00	0	0
1.00	136.00	00	0	0
1.30	136.30	8,904	892	892
2.00	137.00	10,849	6,902	7,793
3.00	138.00	12,851	11,835	19,628
4.00	139.00	14,909	13,866	33,494
5.00	140.00	17,023	15,953	49,447

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 5.48	2.14	0.00	0.00
Span (in)	= 5.48	2.14	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 136.20	136.25	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 2.00	2.00	0.00	0.00
Crest El. (ft)	= 136.75	140.97	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 1.000 (by Contour)			
TW Elev. (ft)	= 0.00			

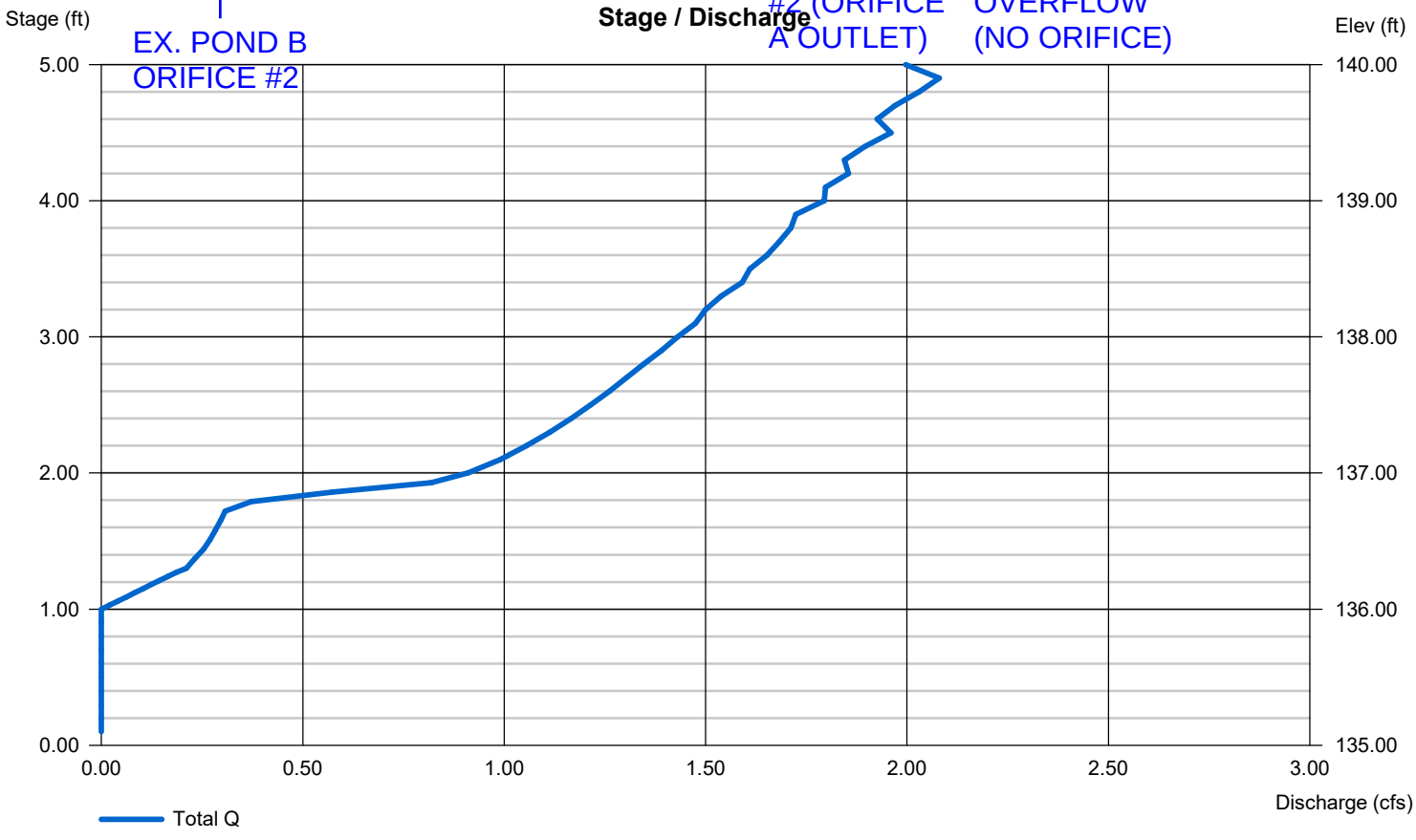
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

EX. POND B ORIFICE #2

EX. POND B ORIFICE #1

EX. POND B DITCH INLET #2 (ORIFICE A OUTLET)

EX. POND B DITCH INLET OVERFLOW (NO ORIFICE)



Hydrograph Report

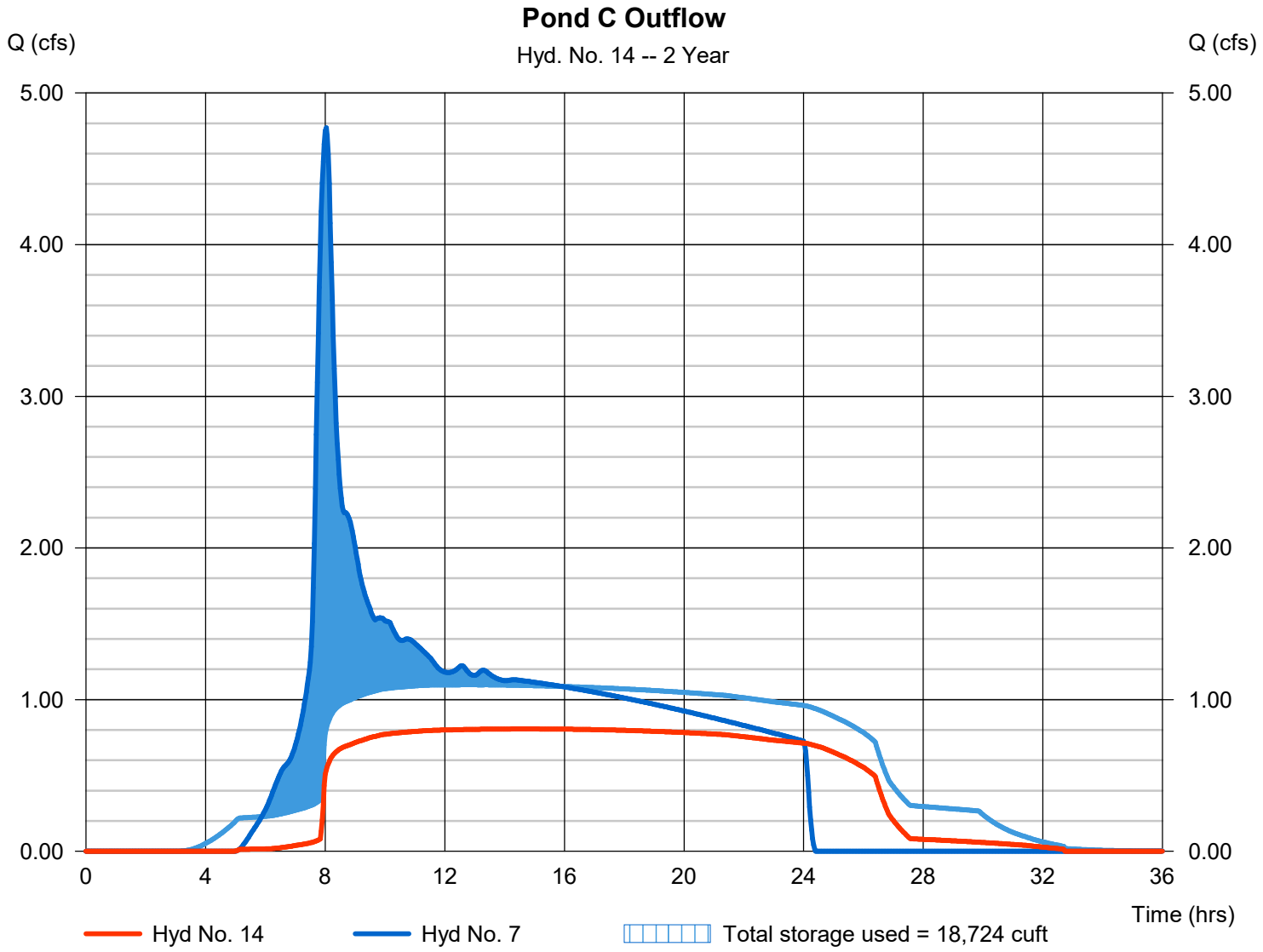
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 14

Pond C Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.806 cfs
Storm frequency	=	2 yrs	Time to peak	=	14.70 hrs
Time interval	=	2 min	Hyd. volume	=	52,482 cuft
Inflow hyd. No.	=	7 - Basin C - Dev	Max. Elevation	=	136.69 ft
Reservoir name	=	Existing Pond C	Max. Storage	=	18,724 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Tuesday, 07 / 23 / 2024

Pond No. 3 - Existing Pond C

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 133.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	133.50	00	0	0
1.49	134.99	00	0	0
1.50	135.00	8,904	30	30
2.50	136.00	10,849	9,860	9,889
3.50	137.00	14,909	12,824	22,713
4.50	138.00	17,023	15,953	38,666
5.50	139.00	21,230	19,086	57,752
6.60	140.10	24,200	24,966	82,718

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 4.44	2.10	0.00	0.00
Span (in)	= 4.44	2.10	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 134.85	134.90	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 2.00	2.00	0.00	0.00
Crest El. (ft)	= 135.52	140.06	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 1.000 (by Contour)			
TW Elev. (ft)	= 0.00			

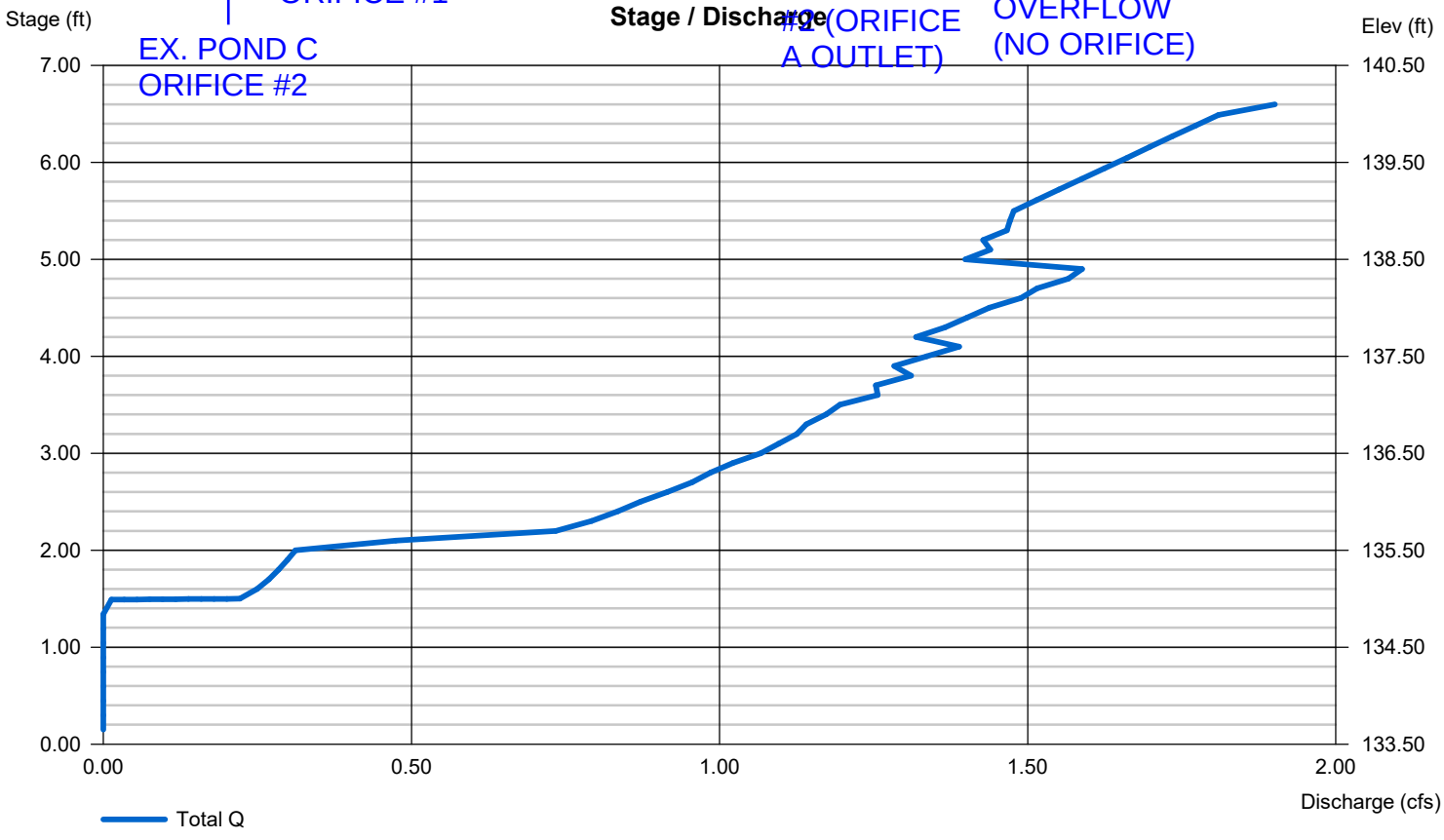
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

EX. POND C ORIFICE #2

EX. POND C ORIFICE #1

EX. POND C DITCH INLET #2 (ORIFICE A OUTLET)

EX. POND C DITCH INLET OVERFLOW (NO ORIFICE)



Hydrograph Report

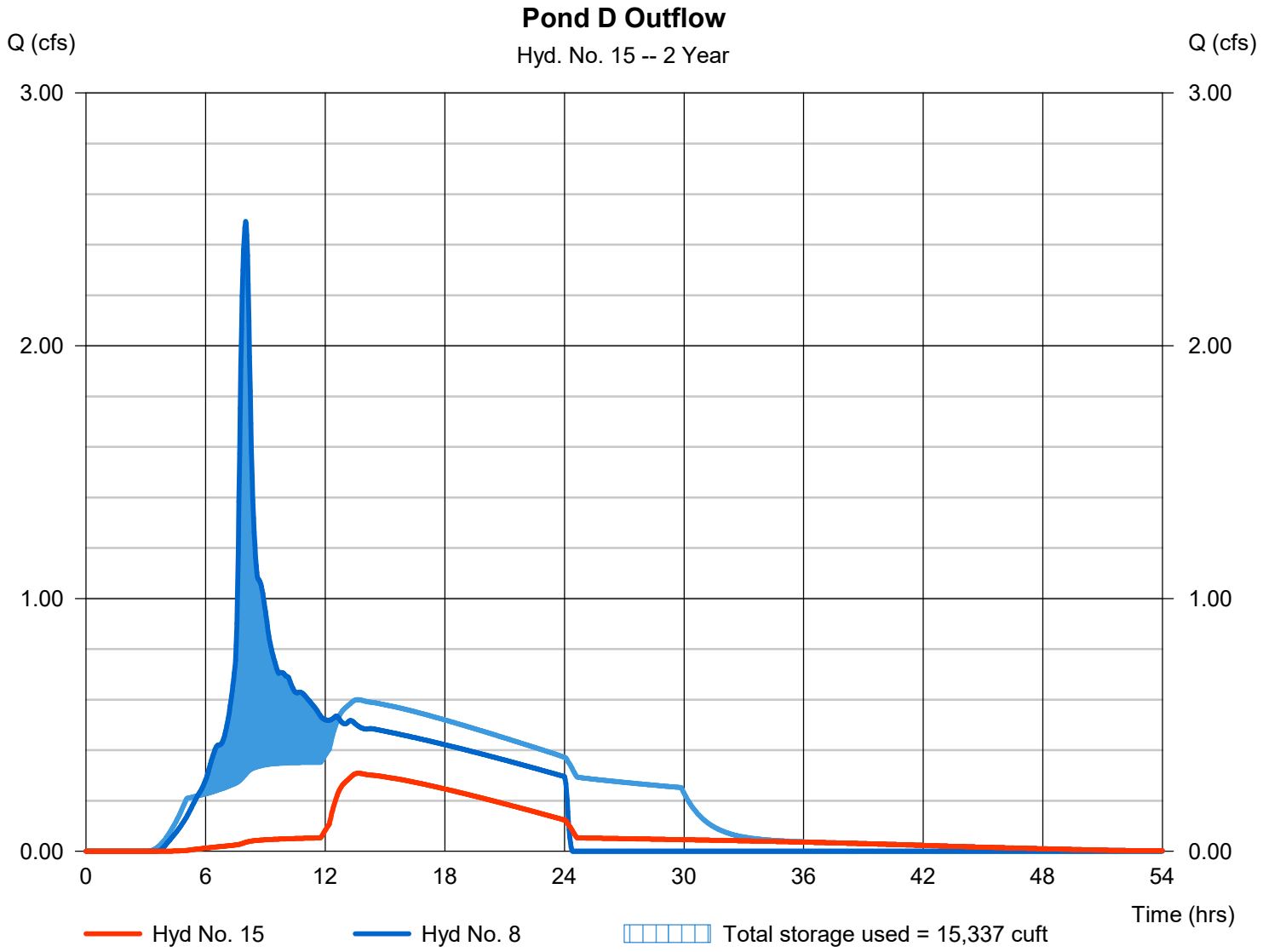
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 15

Pond D Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.308 cfs
Storm frequency	=	2 yrs	Time to peak	=	13.67 hrs
Time interval	=	2 min	Hyd. volume	=	13,876 cuft
Inflow hyd. No.	=	8 - Basin D - Dev	Max. Elevation	=	137.03 ft
Reservoir name	=	Modified Pond D	Max. Storage	=	15,337 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Tuesday, 07 / 23 / 2024

Pond No. 5 - Modified Pond D

Pond Data

Trapezoid -Bottom L x W = 190.0 x 25.0 ft, Side slope = 3.00:1, Bottom elev. = 134.63 ft, Depth = 5.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	134.63	4,750	0	0
0.50	135.13	5,404	2,538	2,538
1.00	135.63	6,076	2,869	5,407
1.50	136.13	6,766	3,210	8,617
2.00	136.63	7,474	3,559	12,176
2.50	137.13	8,200	3,918	16,094
3.00	137.63	8,944	4,285	20,379
3.50	138.13	9,706	4,662	25,041
4.00	138.63	10,486	5,047	30,088
4.50	139.13	11,284	5,442	35,530
5.00	139.63	12,100	5,845	41,375

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.16	0.00	0.00
Span (in)	= 12.00	1.16	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 133.90	134.63	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

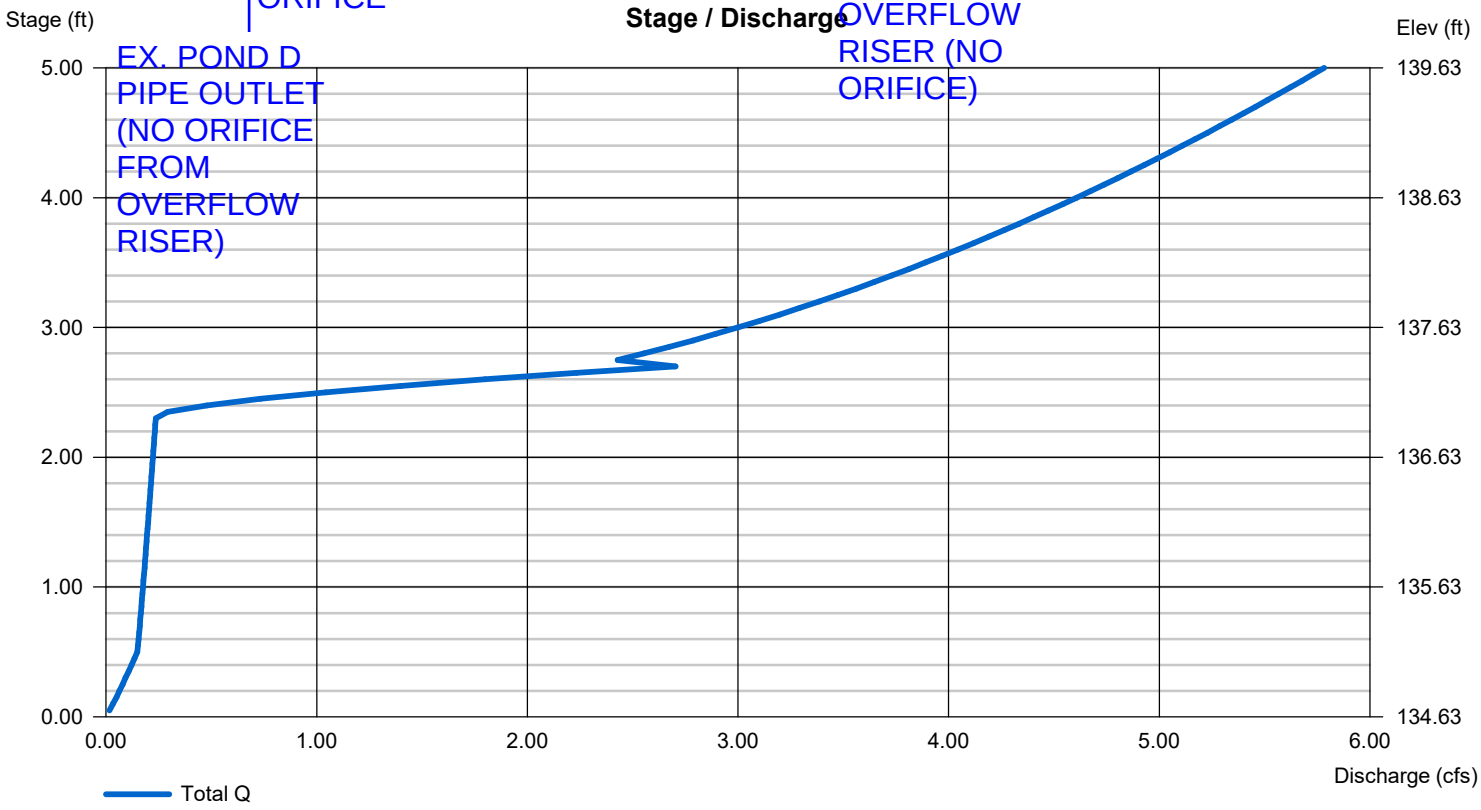
	[A]	[B]	[C]	[D]
Crest Len (ft)	= 3.14	0.00	0.00	0.00
Crest El. (ft)	= 136.95	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 1.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

EX. POND D ORIFICE

EX. POND D 12" DIAM OVERFLOW RISER (NO ORIFICE)

EX. POND D PIPE OUTLET (NO ORIFICE FROM OVERFLOW RISER)



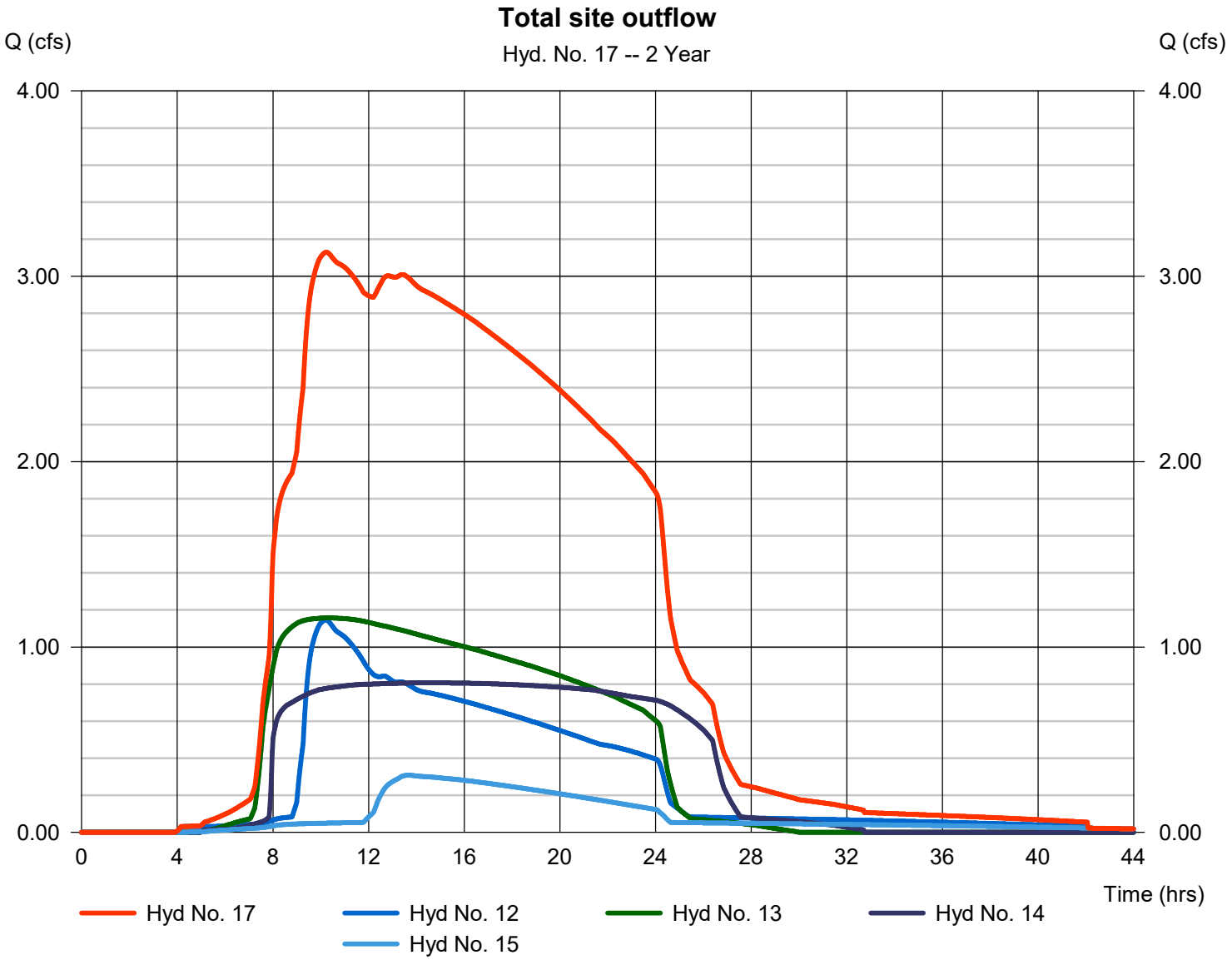
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 17

Total site outflow

Hydrograph type	= Combine	Peak discharge	= 3.130 cfs
Storm frequency	= 2 yrs	Time to peak	= 10.23 hrs
Time interval	= 2 min	Hyd. volume	= 168,876 cuft
Inflow hyds.	= 12, 13, 14, 15	Contrib. drain. area	= 0.000 ac



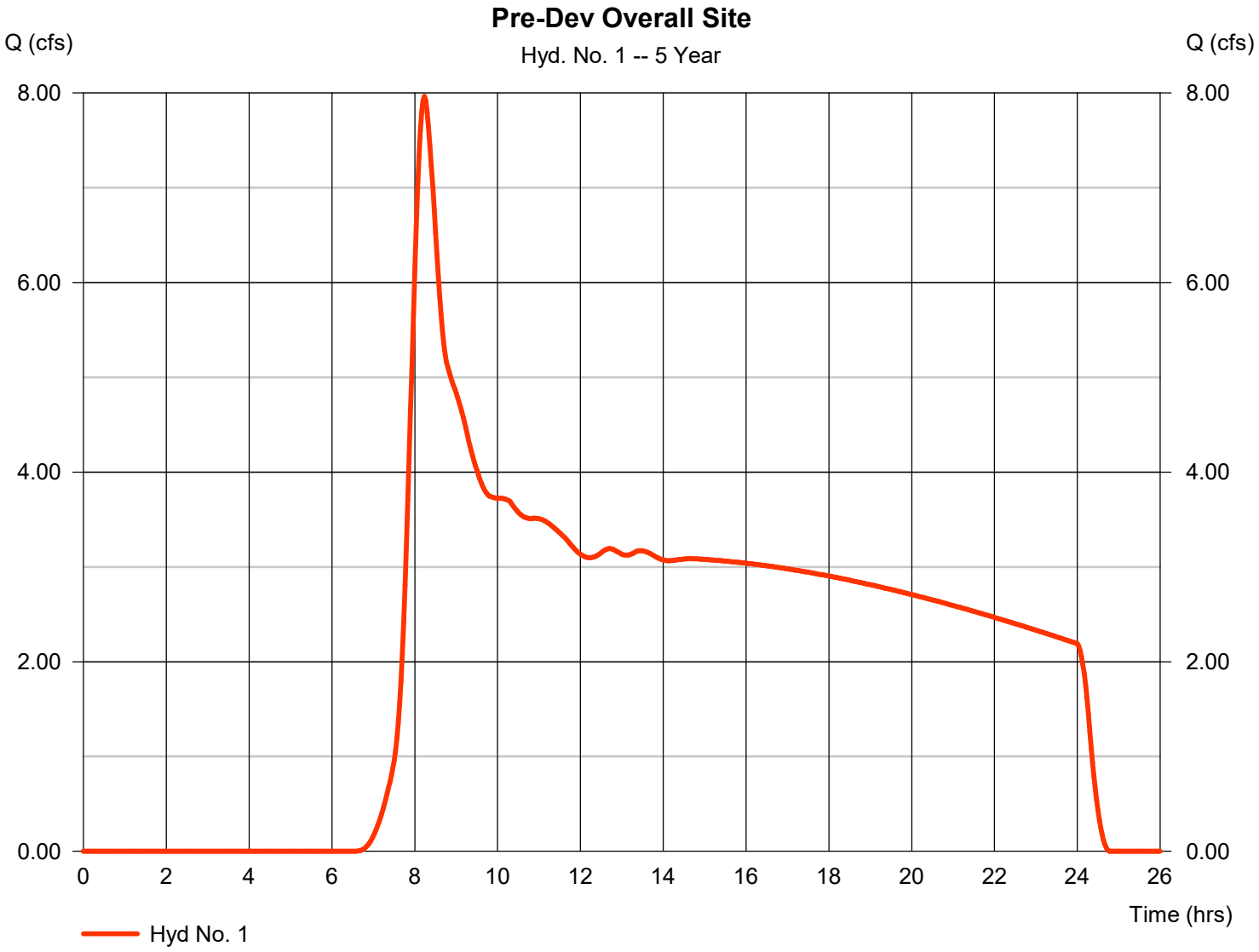
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 1

Pre-Dev Overall Site

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.964 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.23 hrs
Time interval	=	2 min	Hyd. volume	=	193,616 cuft
Drainage area	=	58.010 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	30.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 2

Pre-Dev New/Modified Site

Hydrograph type	= SCS Runoff	Peak discharge	= 0.758 cfs
Storm frequency	= 5 yrs	Time to peak	= 8.23 hrs
Time interval	= 2 min	Hyd. volume	= 18,424 cuft
Drainage area	= 5.520 ac	Curve number	= 73
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 3

Pre-Dev Undisturbed Site

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.206 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.23 hrs
Time interval	=	2 min	Hyd. volume	=	175,192 cuft
Drainage area	=	52.490 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	30.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

Hydrograph Report

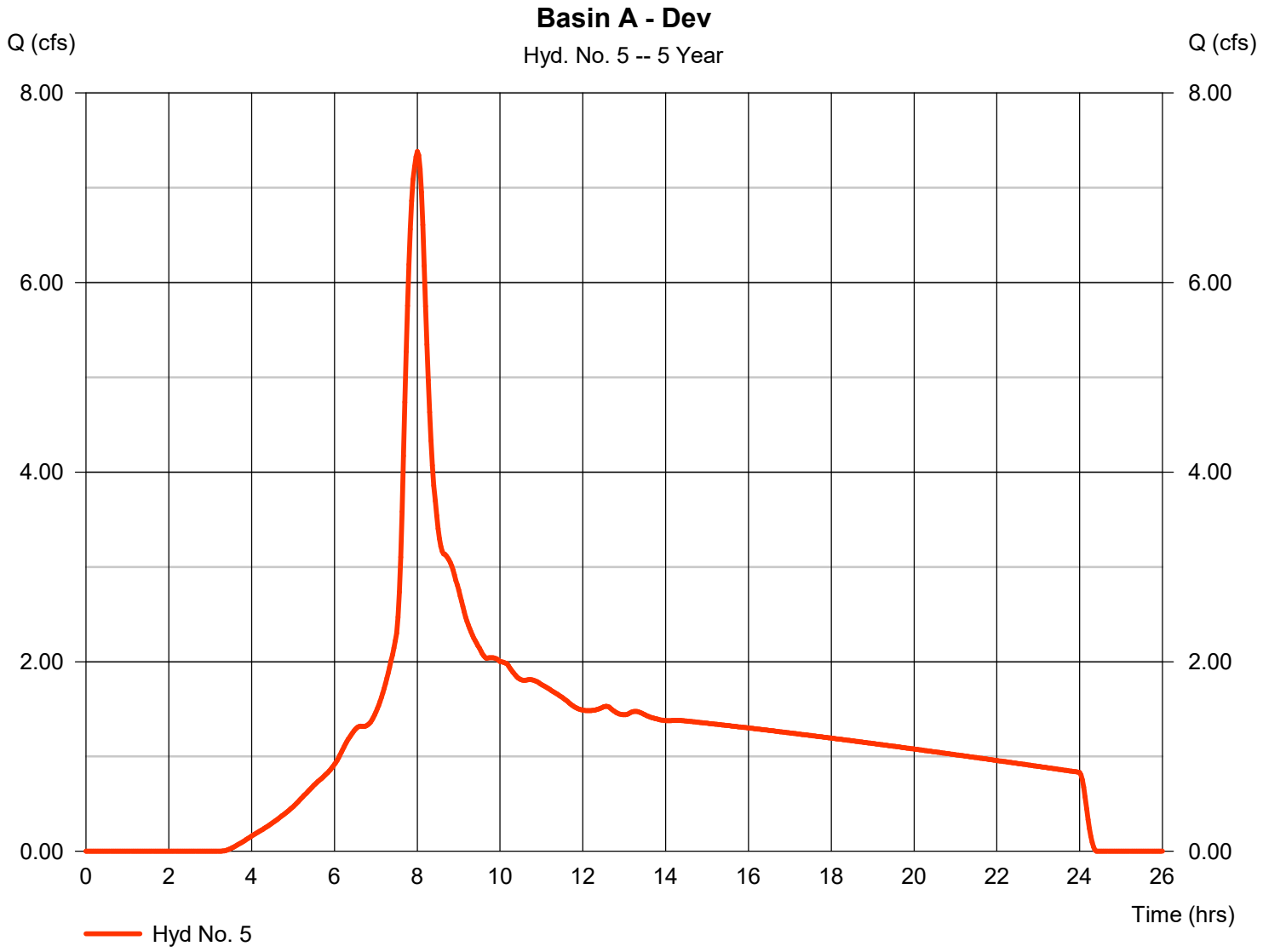
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 5

Basin A - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 7.384 cfs
Storm frequency	= 5 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 108,144 cuft
Drainage area	= 16.020 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.250 x 98) + (8.150 x 98) + (6.350 x 74) + (0.270 x 98)] / 16.020



Hydrograph Report

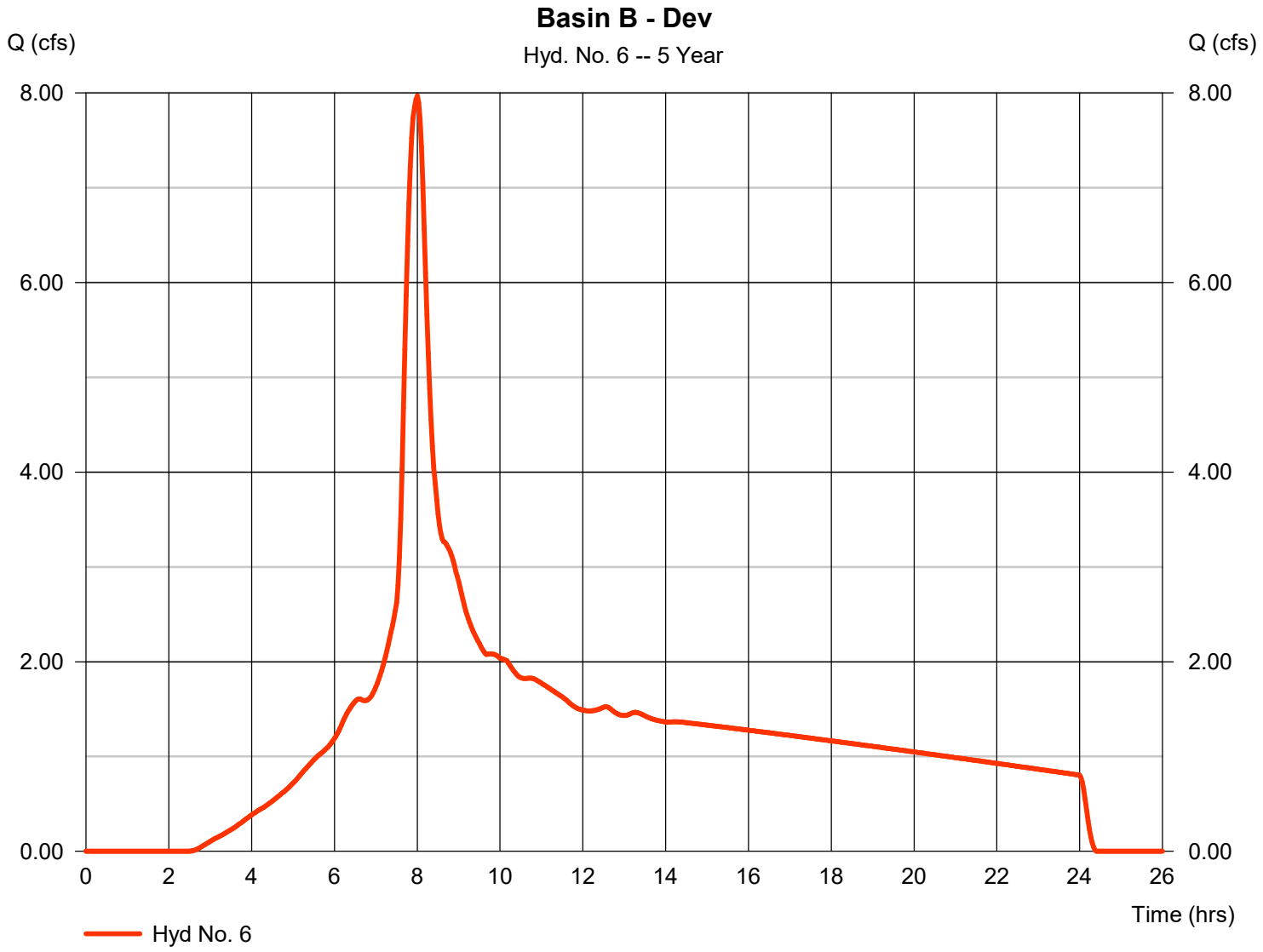
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 6

Basin B - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 7.968 cfs
Storm frequency	= 5 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 113,228 cuft
Drainage area	= 14.780 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.350 x 98) + (7.110 x 98) + (4.320 x 74)] / 14.780



Hydrograph Report

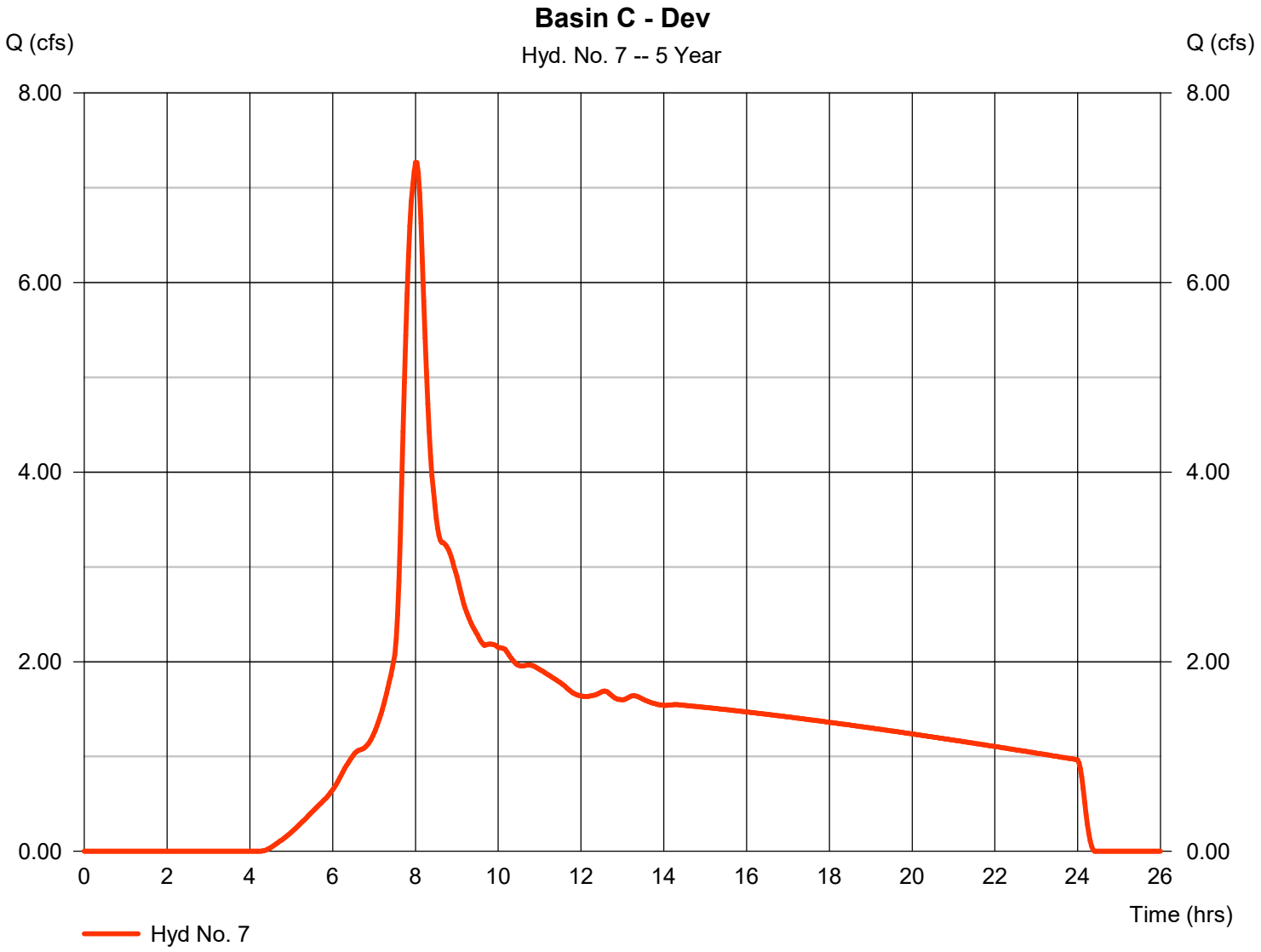
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 7

Basin C - Dev

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.269 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	113,181 cuft
Drainage area	=	20.000 ac	Curve number	=	84*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.040 x 98) + (4.050 x 98) + (10.090 x 74) + (0.750 x 98) + (1.590 x 98) + (1.430 x 74)] / 20.000



Hydrograph Report

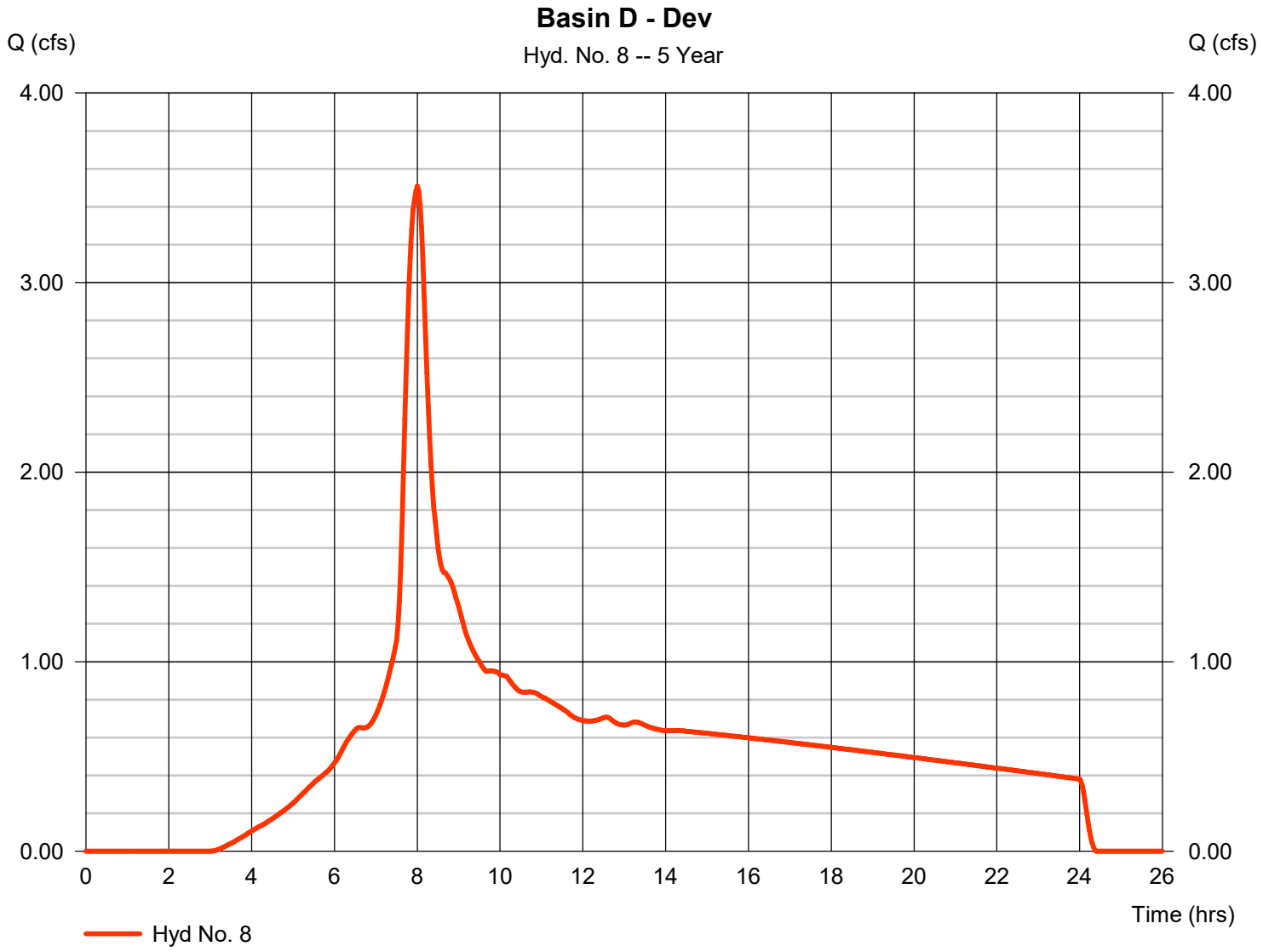
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 8

Basin D - Dev

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.509 cfs
Storm frequency	=	5 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	50,793 cuft
Drainage area	=	7.210 ac	Curve number	=	89*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.10 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.240 x 98) + (1.000 x 74) + (3.180 x 98) + (1.790 x 74)] / 7.210



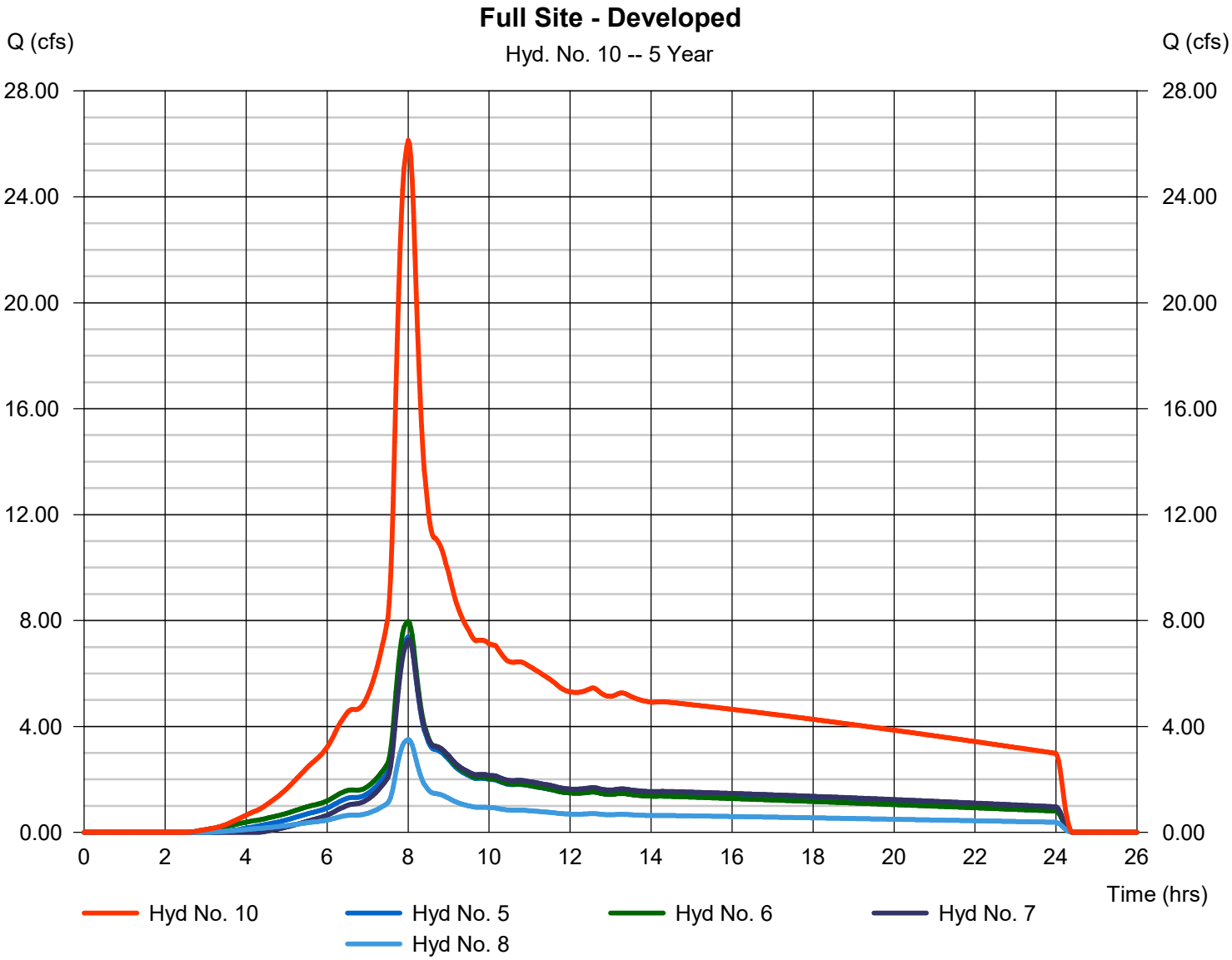
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 10

Full Site - Developed

Hydrograph type	= Combine	Peak discharge	= 26.13 cfs
Storm frequency	= 5 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 385,346 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 58.010 ac



Hydrograph Report

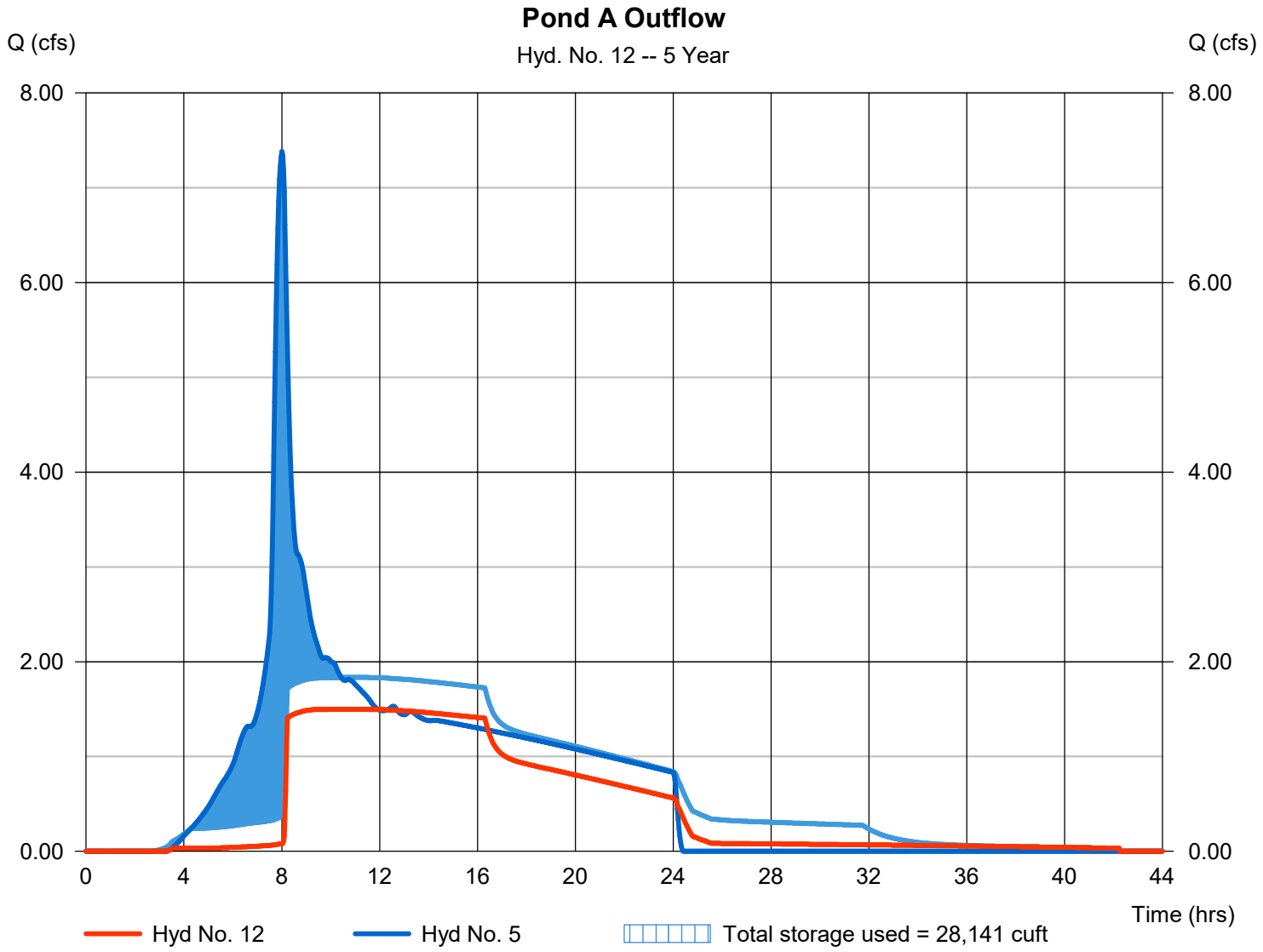
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 12

Pond A Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.498 cfs
Storm frequency	=	5 yrs	Time to peak	=	10.47 hrs
Time interval	=	2 min	Hyd. volume	=	71,261 cuft
Inflow hyd. No.	=	5 - Basin A - Dev	Max. Elevation	=	141.46 ft
Reservoir name	=	Existing Pond A	Max. Storage	=	28,141 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

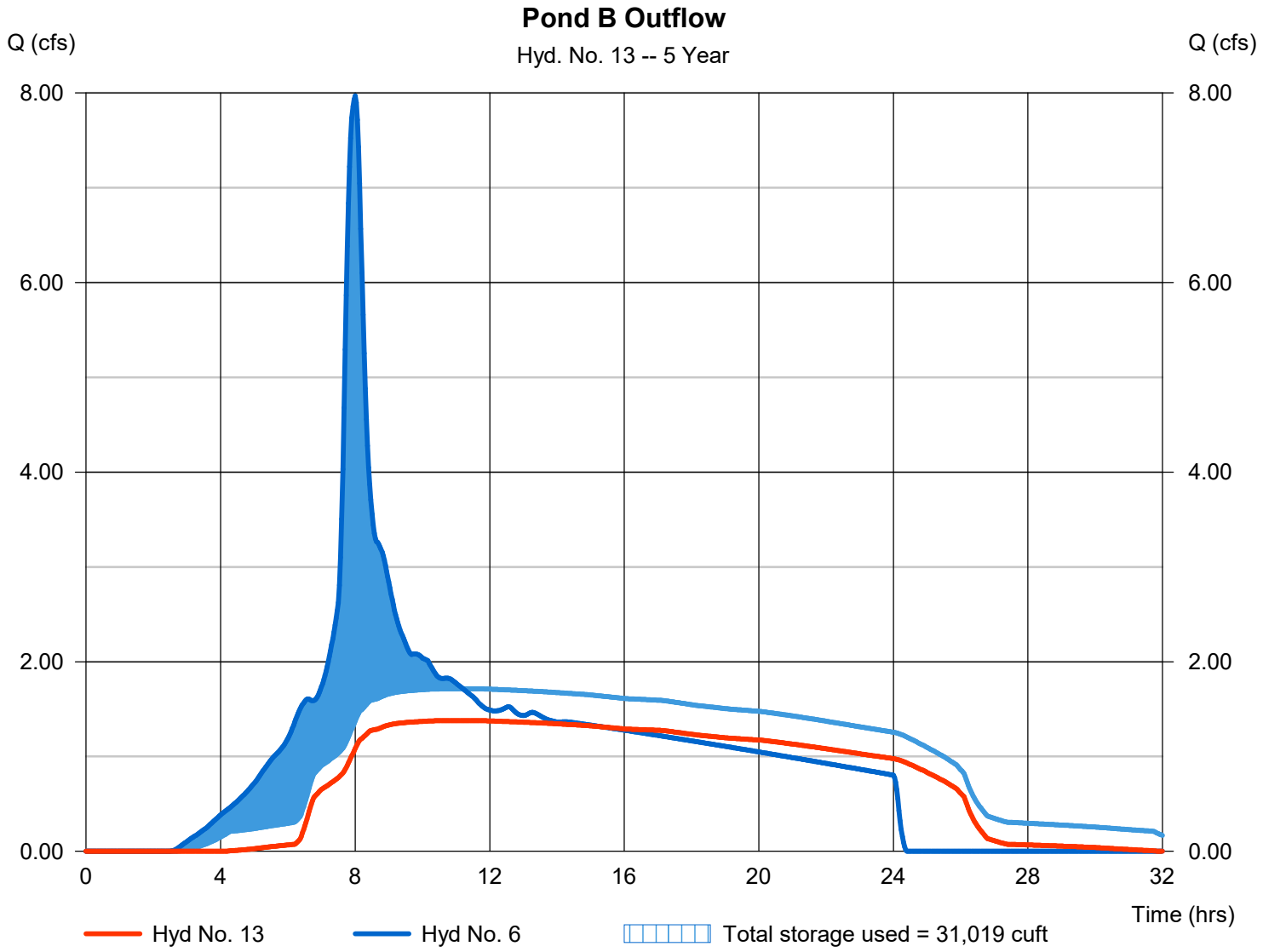
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 13

Pond B Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.378 cfs
Storm frequency	=	5 yrs	Time to peak	=	11.20 hrs
Time interval	=	2 min	Hyd. volume	=	84,041 cuft
Inflow hyd. No.	=	6 - Basin B - Dev	Max. Elevation	=	138.82 ft
Reservoir name	=	Existing Pond B	Max. Storage	=	31,019 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

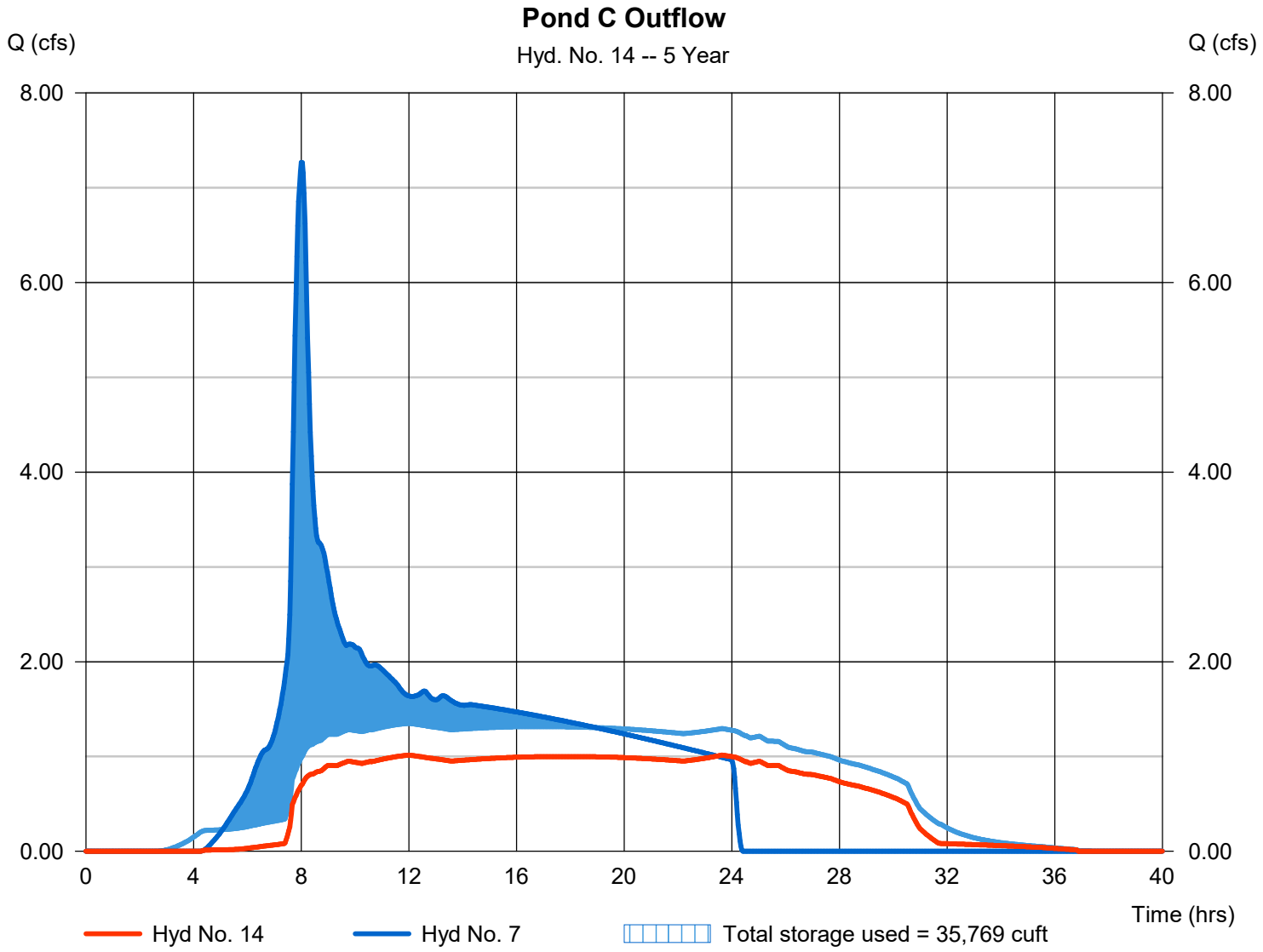
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 14

Pond C Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.014 cfs
Storm frequency	=	5 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	77,350 cuft
Inflow hyd. No.	=	7 - Basin C - Dev	Max. Elevation	=	137.60 ft
Reservoir name	=	Existing Pond C	Max. Storage	=	35,769 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

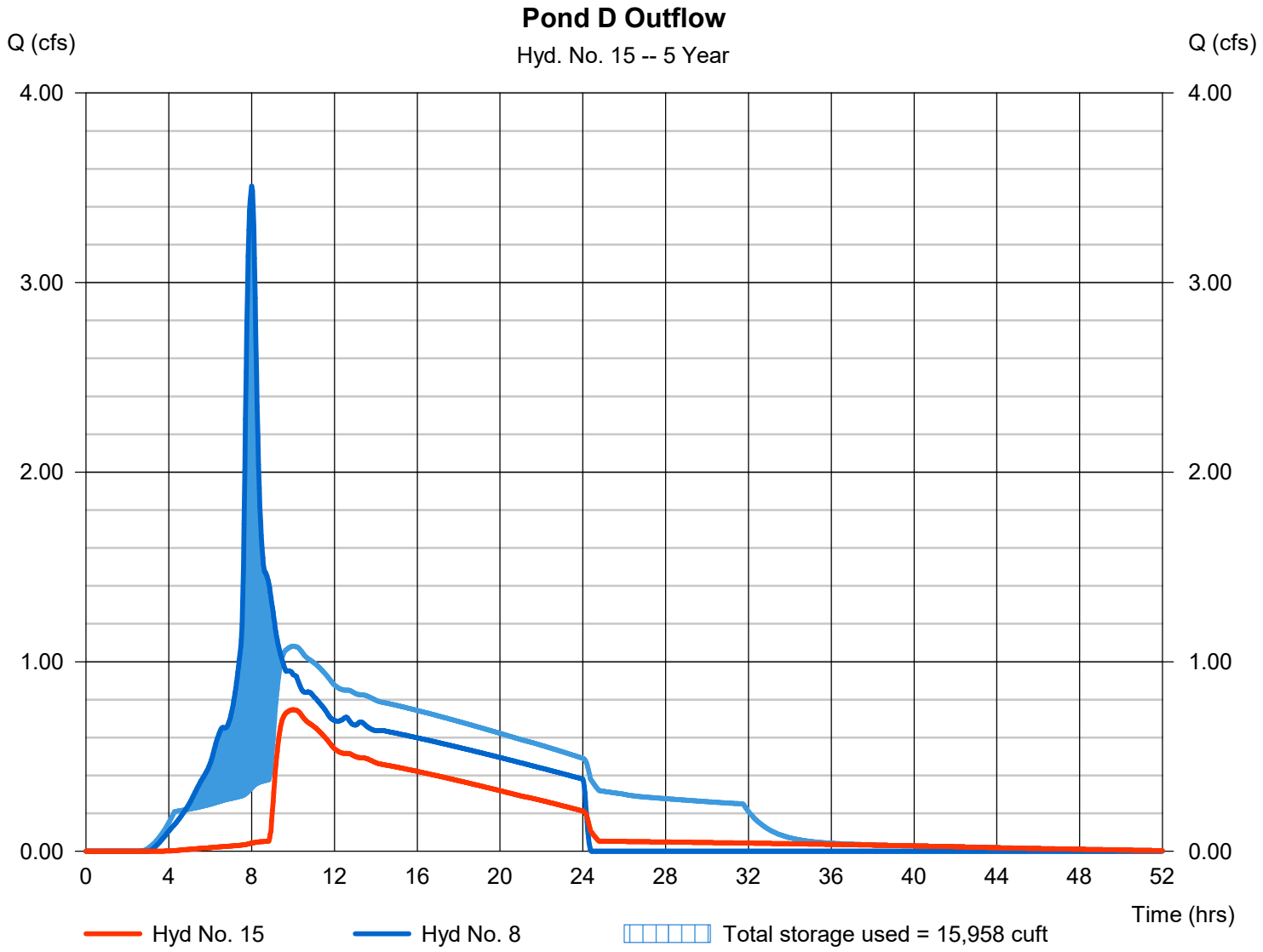
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 15

Pond D Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	0.747 cfs
Storm frequency	=	5 yrs	Time to peak	=	9.97 hrs
Time interval	=	2 min	Hyd. volume	=	26,786 cuft
Inflow hyd. No.	=	8 - Basin D - Dev	Max. Elevation	=	137.11 ft
Reservoir name	=	Modified Pond D	Max. Storage	=	15,958 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



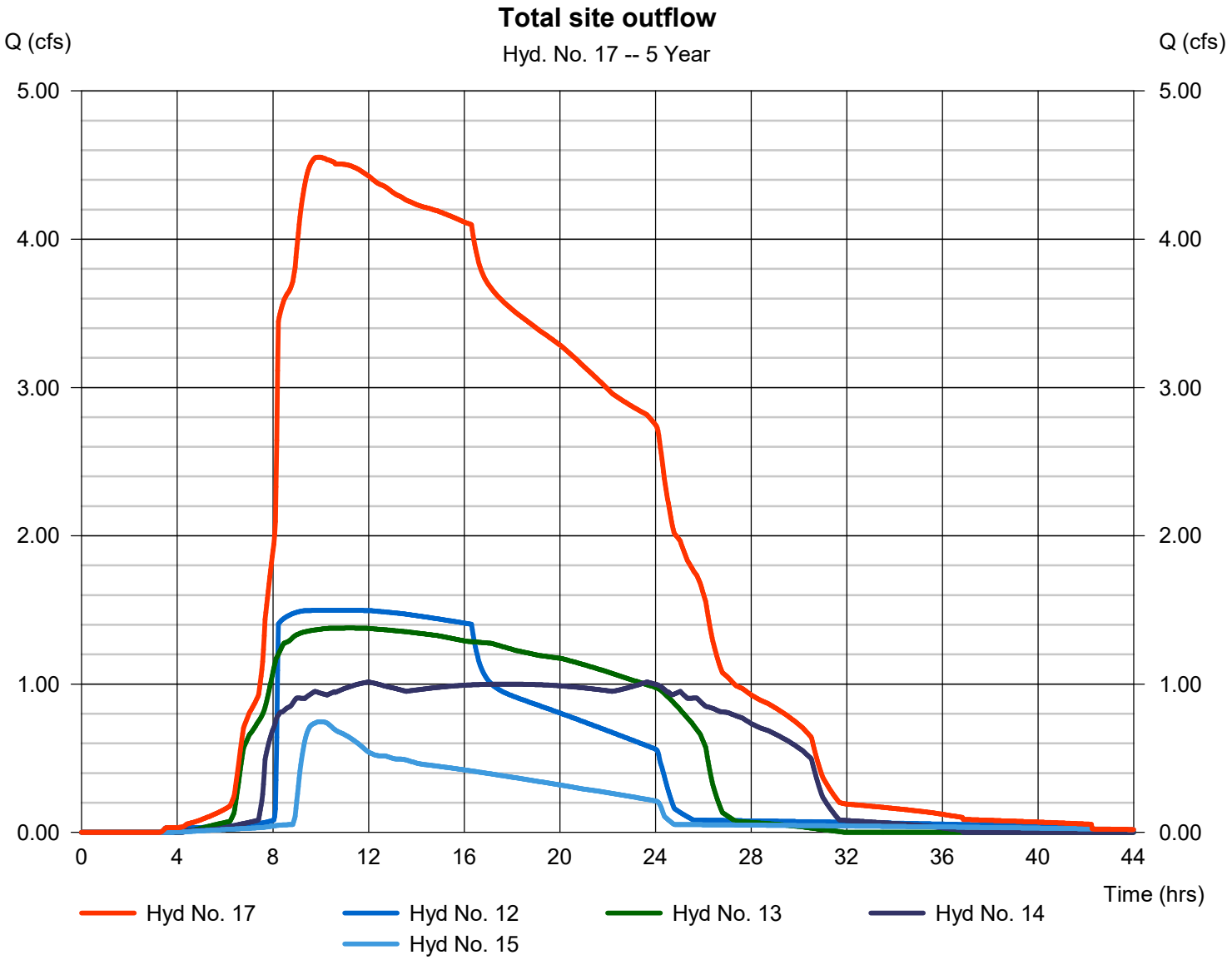
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 17

Total site outflow

Hydrograph type	= Combine	Peak discharge	= 4.554 cfs
Storm frequency	= 5 yrs	Time to peak	= 9.93 hrs
Time interval	= 2 min	Hyd. volume	= 259,437 cuft
Inflow hyds.	= 12, 13, 14, 15	Contrib. drain. area	= 0.000 ac



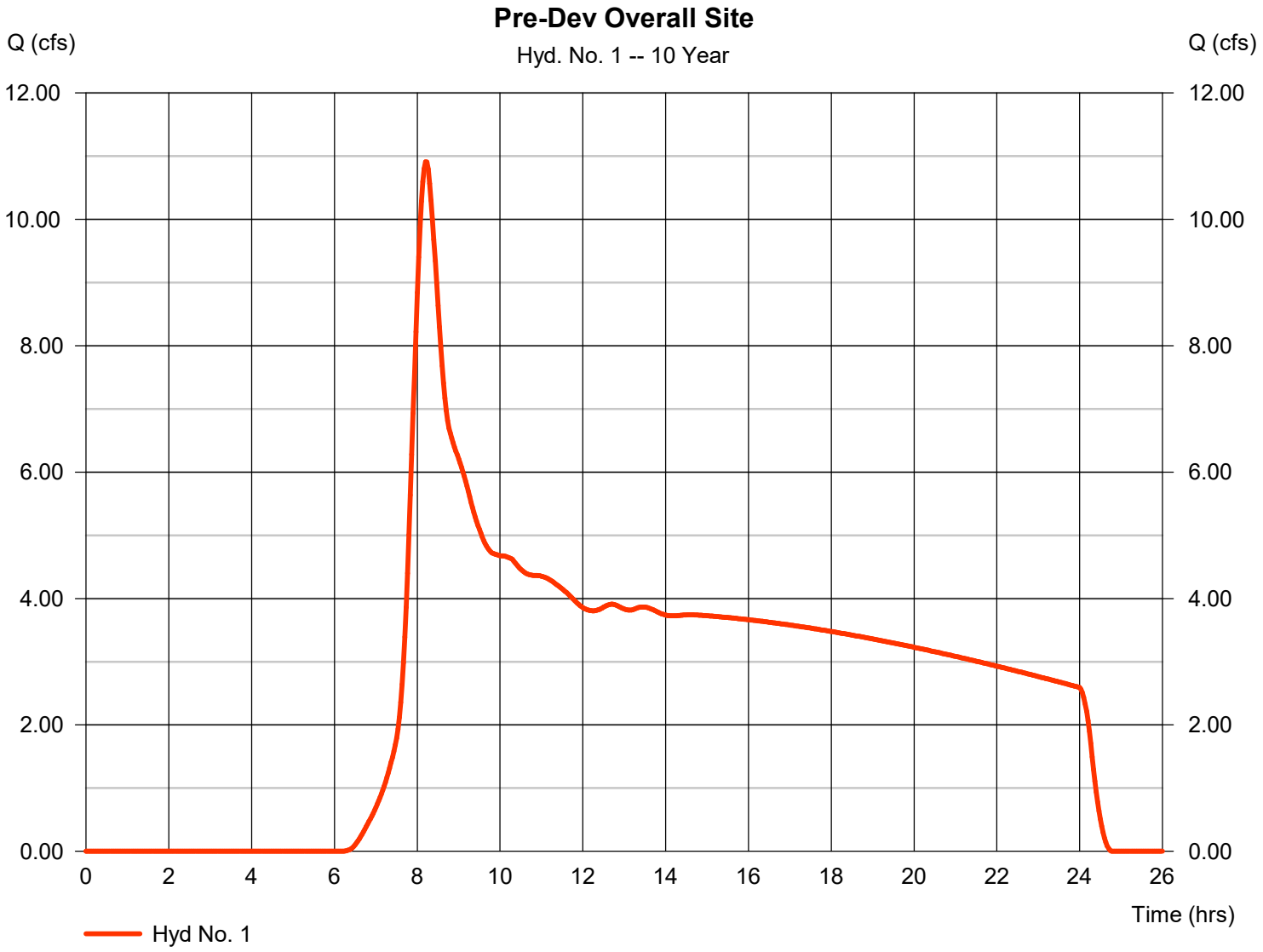
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 1

Pre-Dev Overall Site

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.91 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.20 hrs
Time interval	=	2 min	Hyd. volume	=	241,352 cuft
Drainage area	=	58.010 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	30.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484



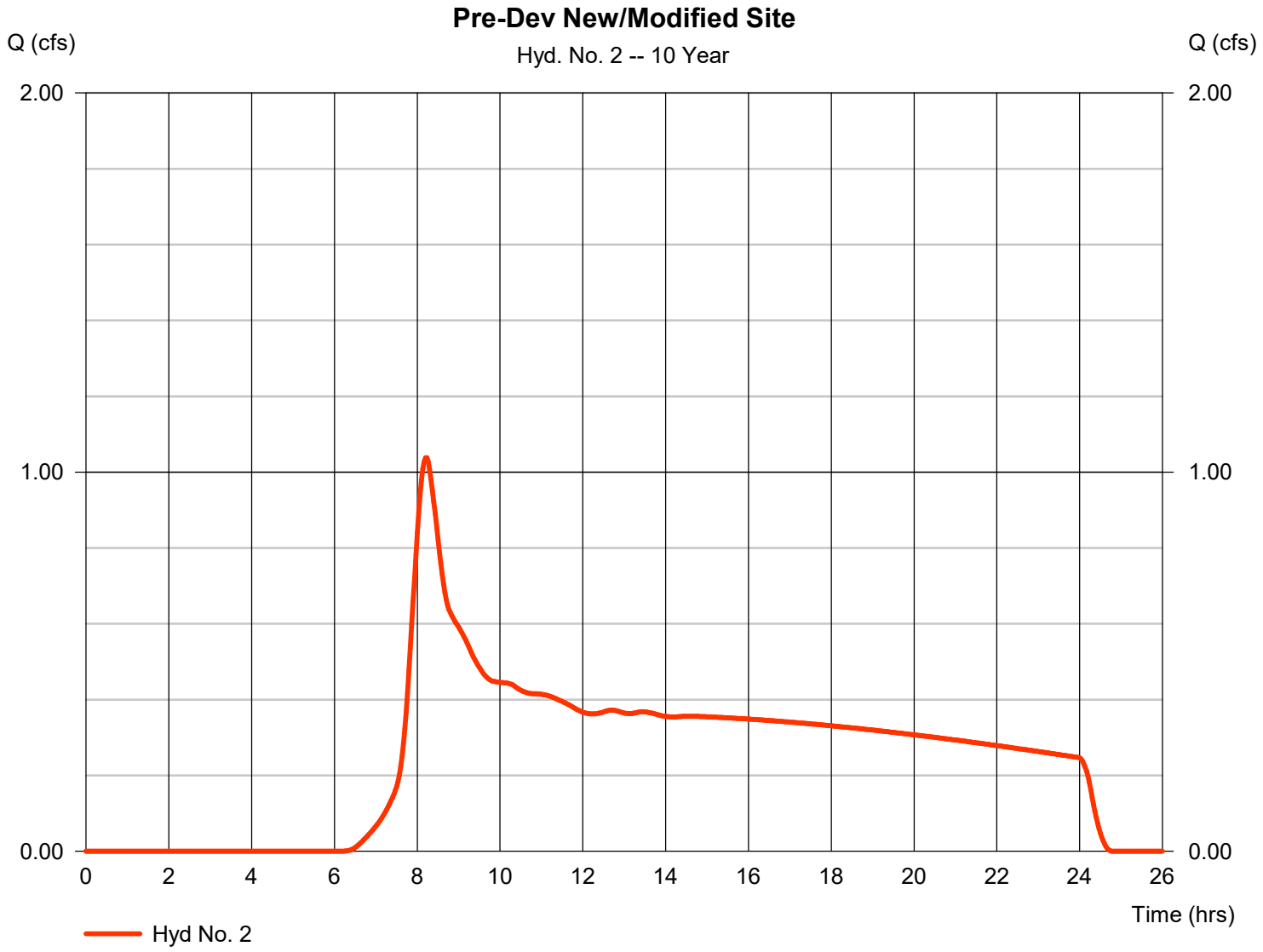
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 2

Pre-Dev New/Modified Site

Hydrograph type	= SCS Runoff	Peak discharge	= 1.038 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.20 hrs
Time interval	= 2 min	Hyd. volume	= 22,966 cuft
Drainage area	= 5.520 ac	Curve number	= 73
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 3

Pre-Dev Undisturbed Site

Hydrograph type	=	SCS Runoff	Peak discharge	=	9.873 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.20 hrs
Time interval	=	2 min	Hyd. volume	=	218,386 cuft
Drainage area	=	52.490 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	30.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

Hydrograph Report

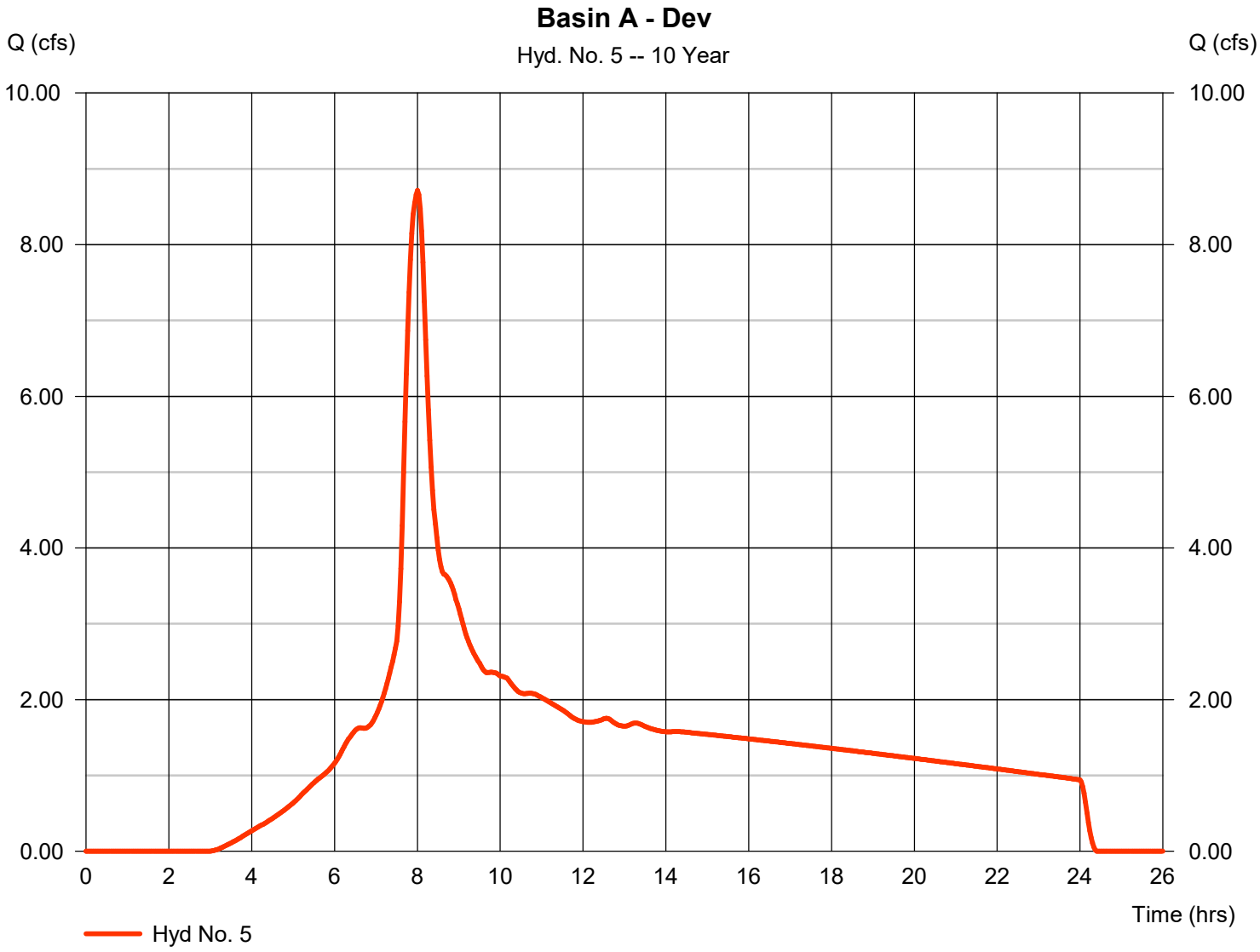
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 5

Basin A - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 8.716 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 126,049 cuft
Drainage area	= 16.020 ac	Curve number	= 88*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.250 x 98) + (8.150 x 98) + (6.350 x 74) + (0.270 x 98)] / 16.020



Hydrograph Report

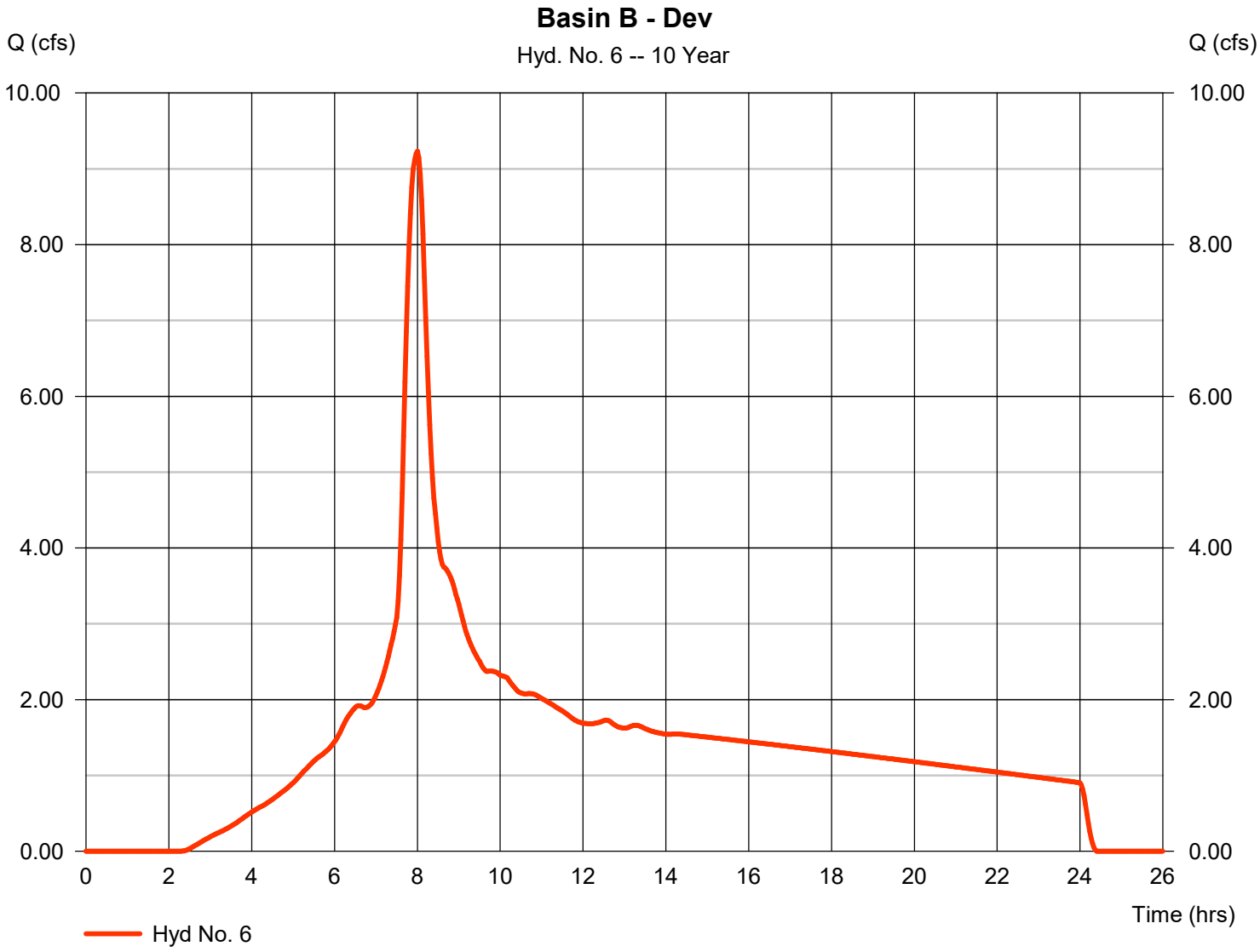
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 6

Basin B - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 9.233 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 130,452 cuft
Drainage area	= 14.780 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.350 x 98) + (7.110 x 98) + (4.320 x 74)] / 14.780



Hydrograph Report

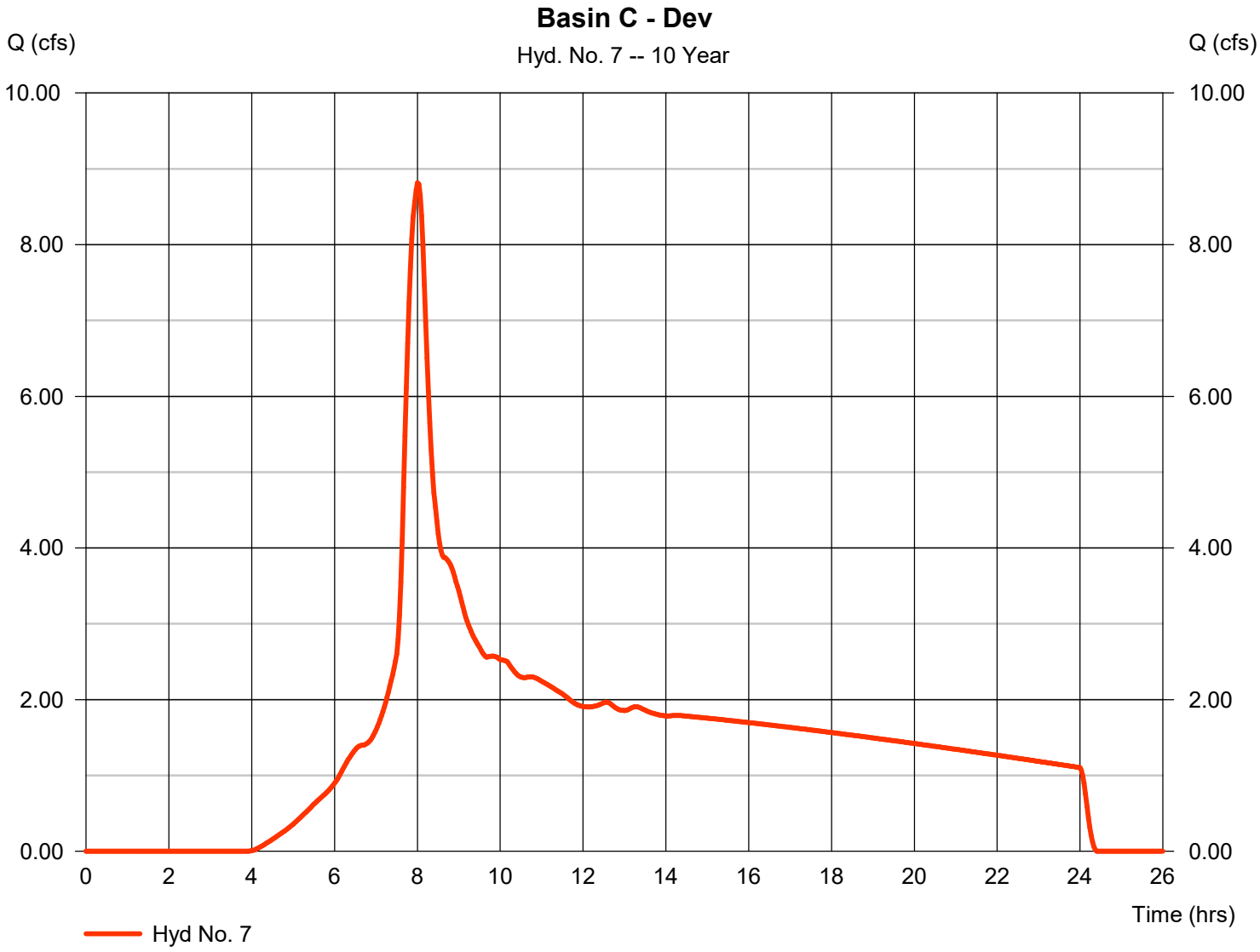
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 7

Basin C - Dev

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.817 cfs
Storm frequency	=	10 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	134,048 cuft
Drainage area	=	20.000 ac	Curve number	=	84*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.45 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.040 x 98) + (4.050 x 98) + (10.090 x 74) + (0.750 x 98) + (1.590 x 98) + (1.430 x 74)] / 20.000



Hydrograph Report

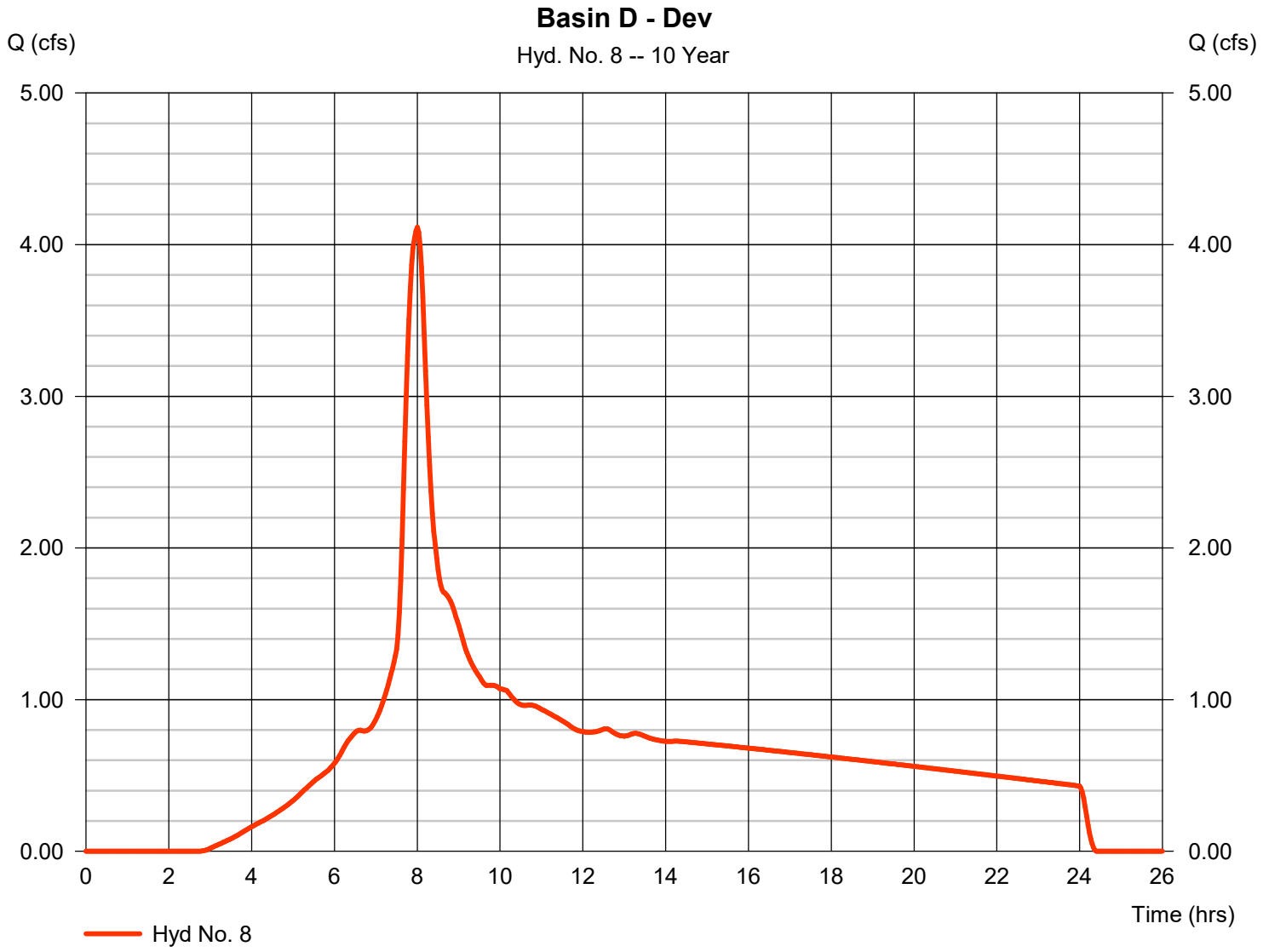
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 8

Basin D - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 4.115 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 58,972 cuft
Drainage area	= 7.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.240 x 98) + (1.000 x 74) + (3.180 x 98) + (1.790 x 74)] / 7.210



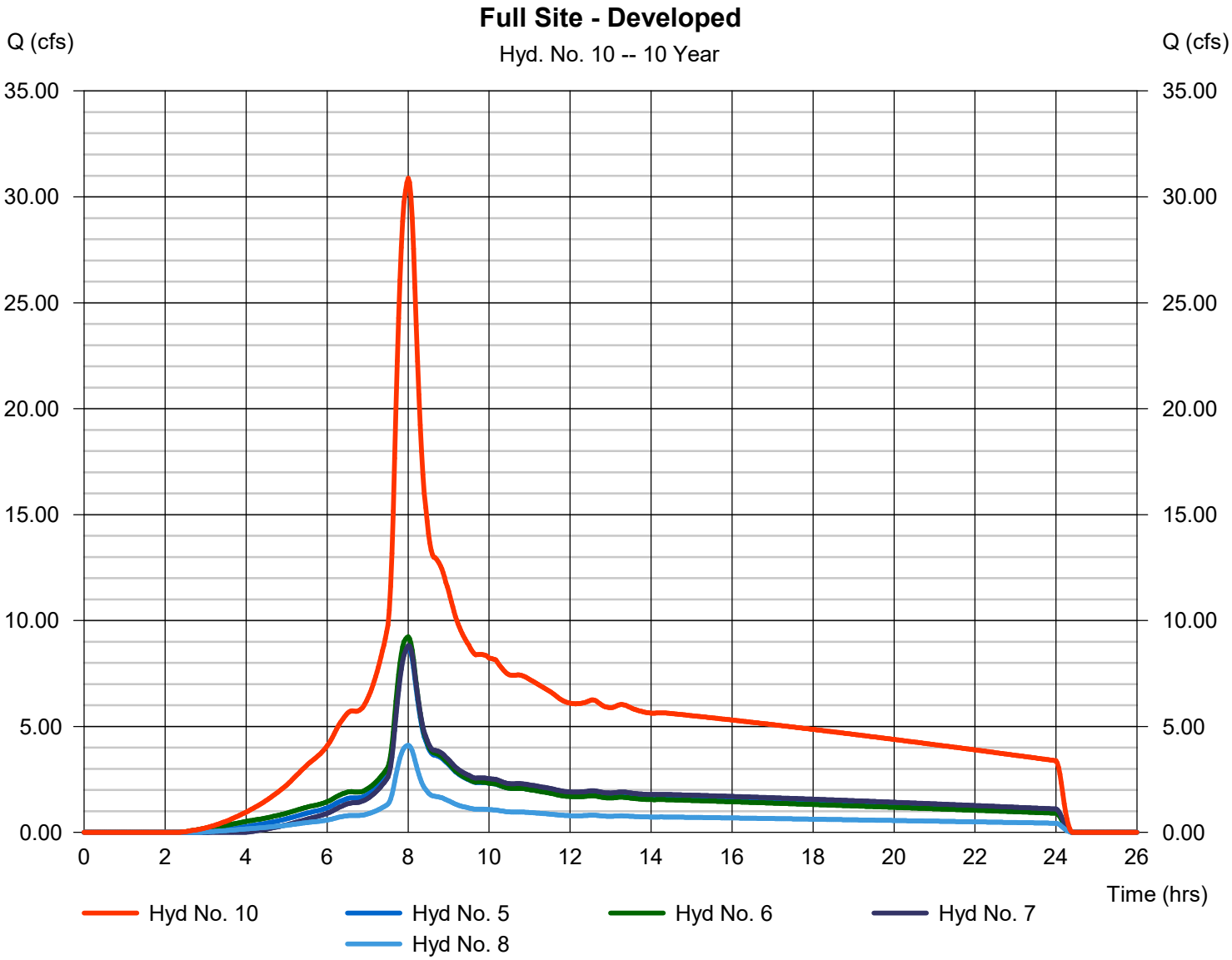
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 10

Full Site - Developed

Hydrograph type	= Combine	Peak discharge	= 30.88 cfs
Storm frequency	= 10 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 449,521 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 58.010 ac



Hydrograph Report

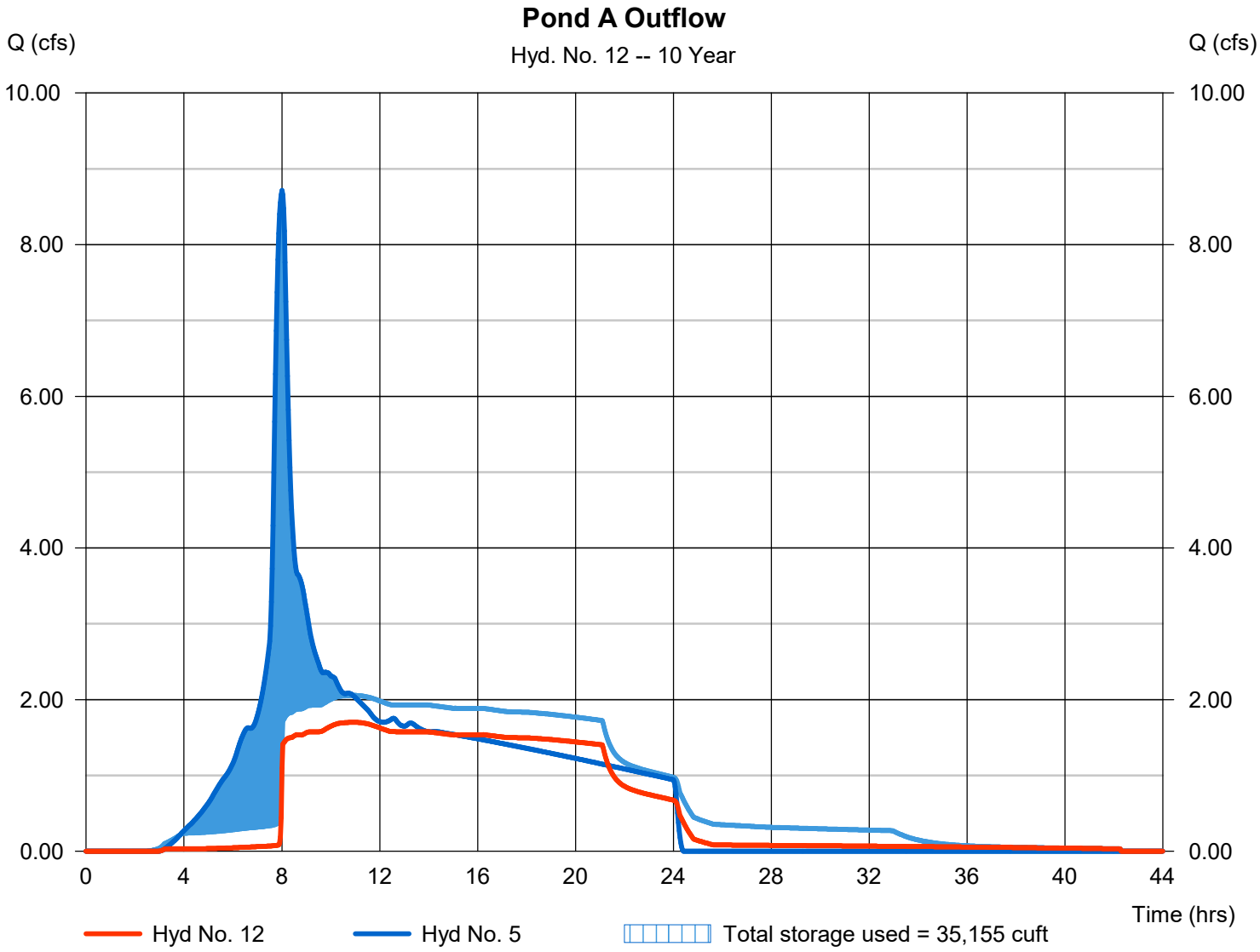
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 12

Pond A Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.701 cfs
Storm frequency	=	10 yrs	Time to peak	=	10.93 hrs
Time interval	=	2 min	Hyd. volume	=	87,750 cuft
Inflow hyd. No.	=	5 - Basin A - Dev	Max. Elevation	=	141.97 ft
Reservoir name	=	Existing Pond A	Max. Storage	=	35,155 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

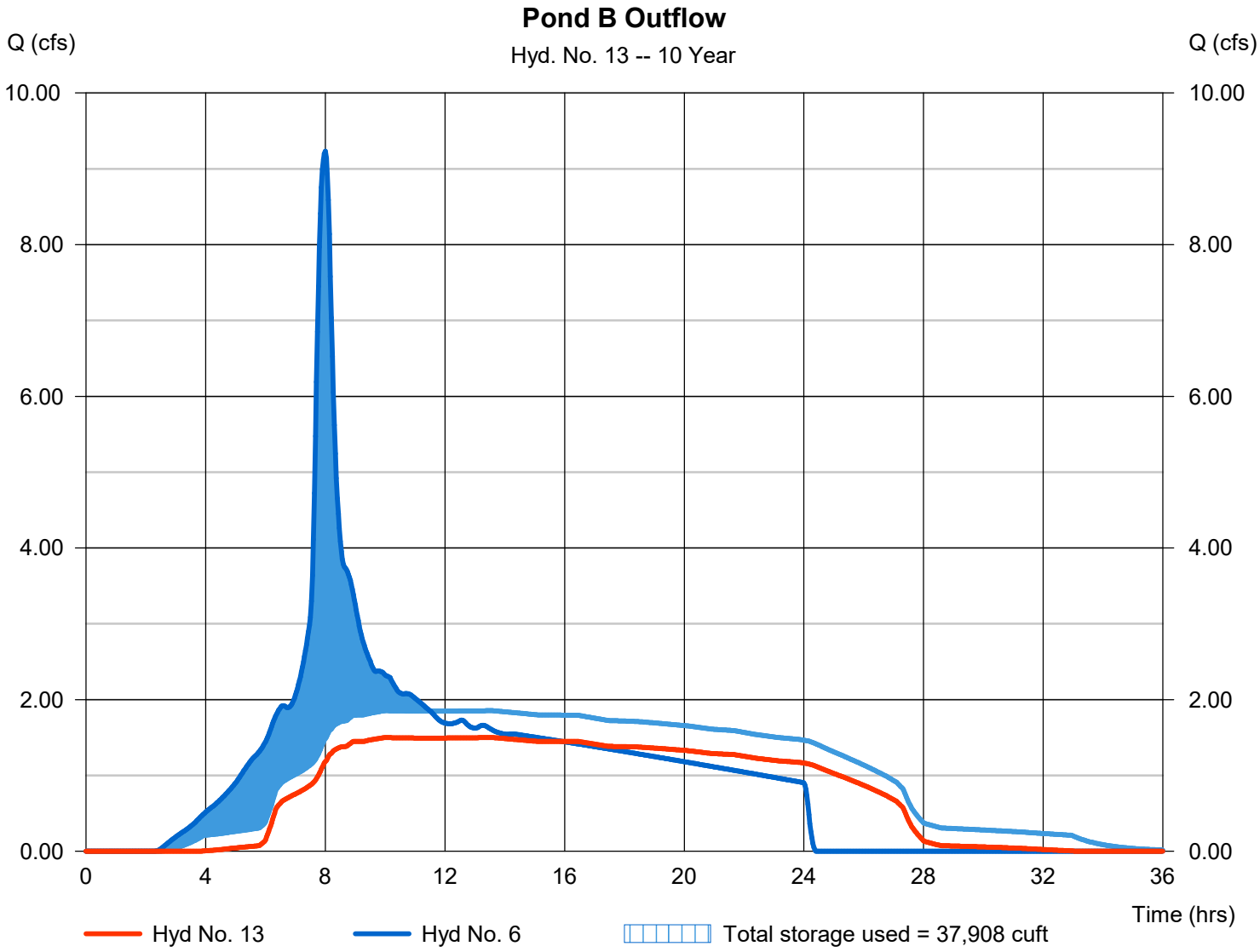
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 13

Pond B Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.499 cfs
Storm frequency	=	10 yrs	Time to peak	=	10.00 hrs
Time interval	=	2 min	Hyd. volume	=	98,360 cuft
Inflow hyd. No.	=	6 - Basin B - Dev	Max. Elevation	=	139.20 ft
Reservoir name	=	Existing Pond B	Max. Storage	=	37,908 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

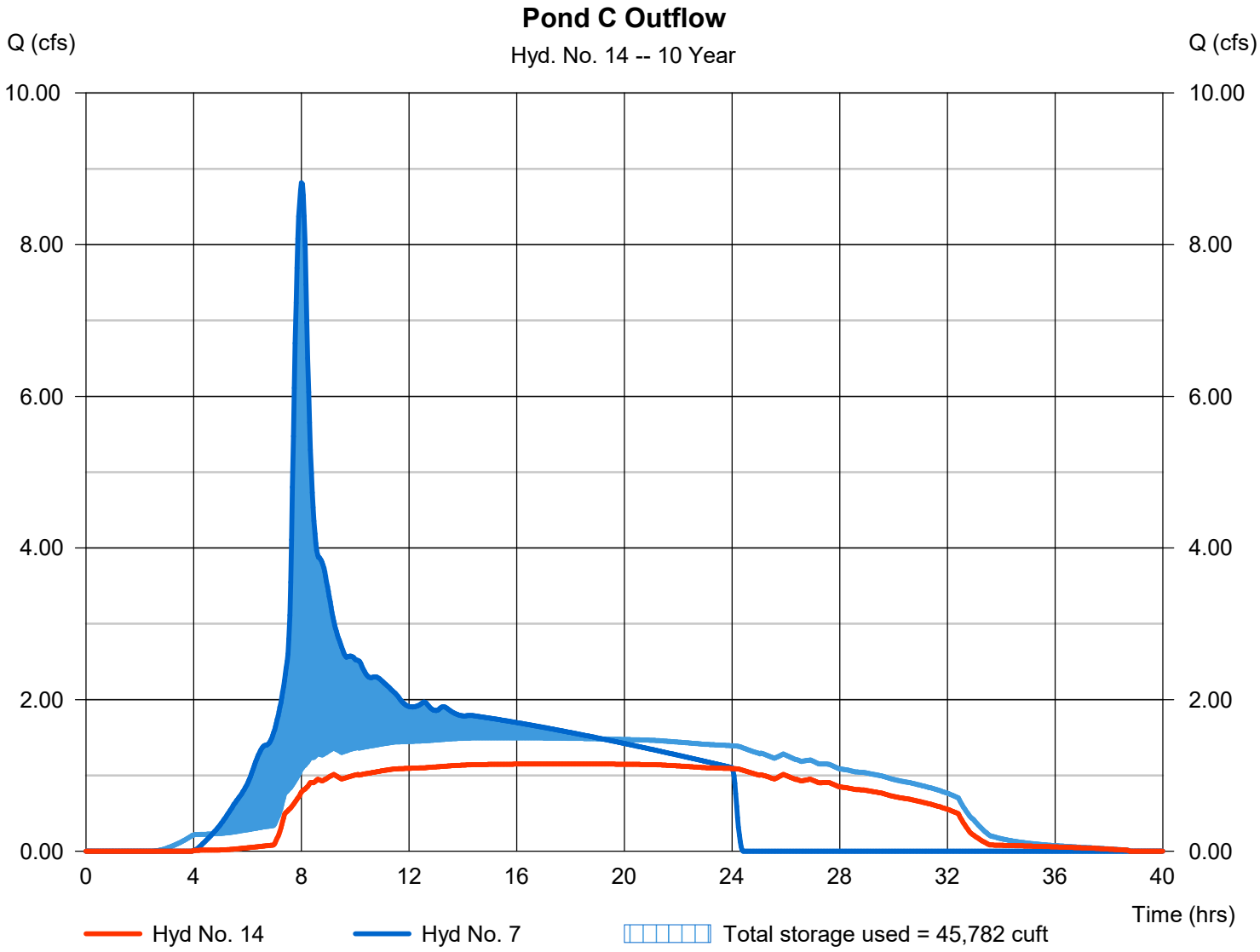
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 14

Pond C Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.152 cfs
Storm frequency	=	10 yrs	Time to peak	=	17.77 hrs
Time interval	=	2 min	Hyd. volume	=	92,680 cuft
Inflow hyd. No.	=	7 - Basin C - Dev	Max. Elevation	=	138.37 ft
Reservoir name	=	Existing Pond C	Max. Storage	=	45,782 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

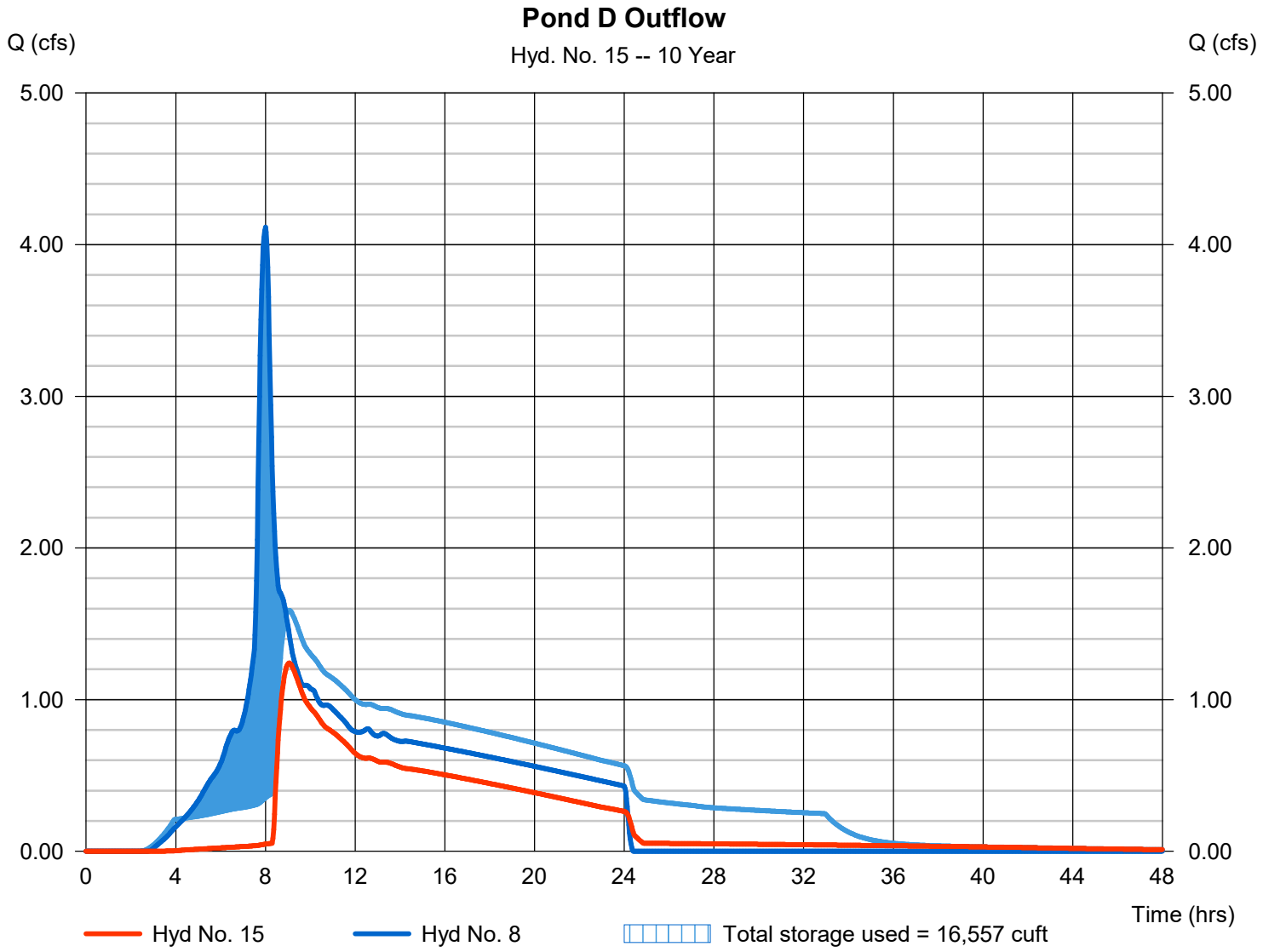
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 15

Pond D Outflow

Hydrograph type	= Reservoir	Peak discharge	= 1.241 cfs
Storm frequency	= 10 yrs	Time to peak	= 9.07 hrs
Time interval	= 2 min	Hyd. volume	= 34,639 cuft
Inflow hyd. No.	= 8 - Basin D - Dev	Max. Elevation	= 137.18 ft
Reservoir name	= Modified Pond D	Max. Storage	= 16,557 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



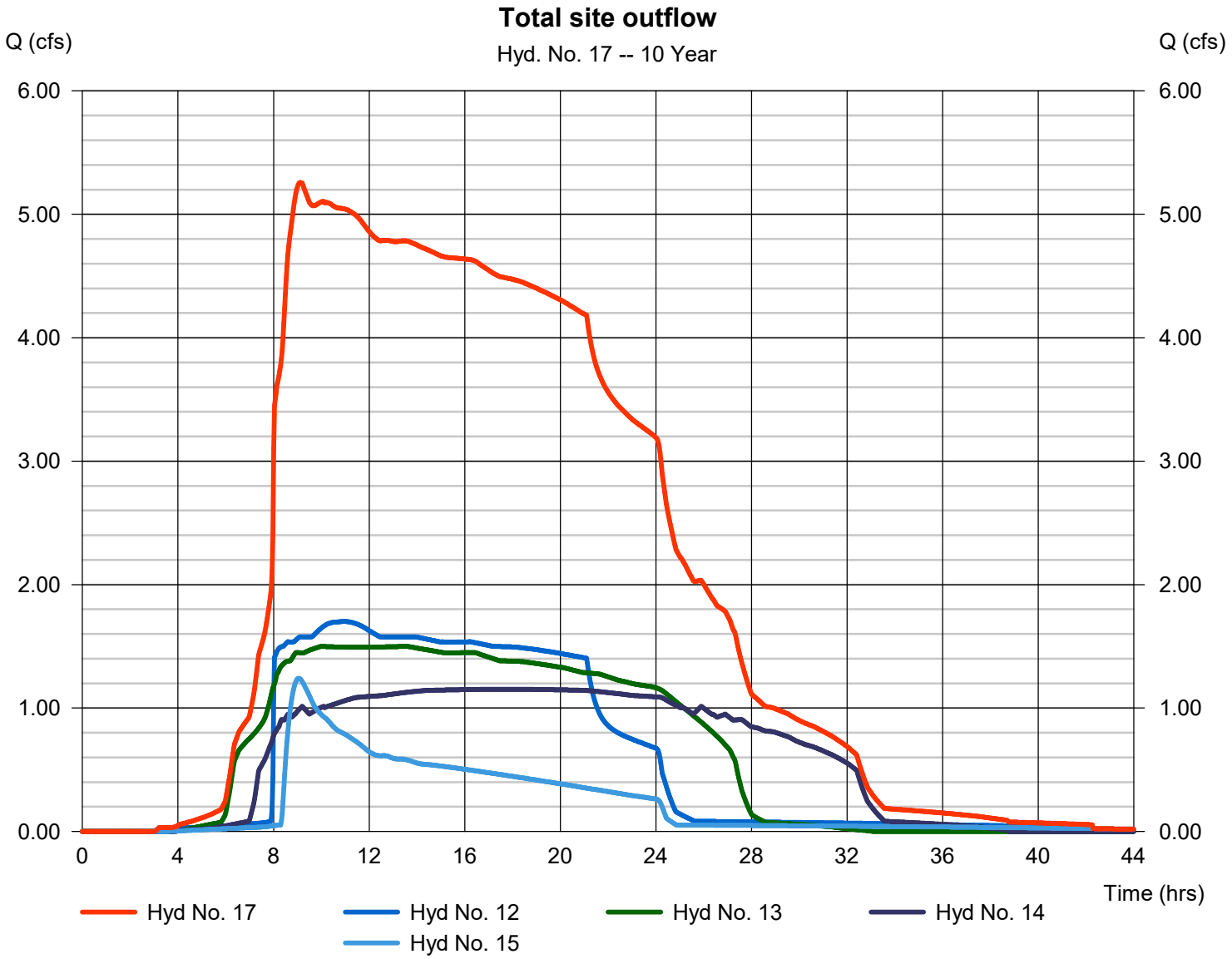
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 17

Total site outflow

Hydrograph type	= Combine	Peak discharge	= 5.258 cfs
Storm frequency	= 10 yrs	Time to peak	= 9.13 hrs
Time interval	= 2 min	Hyd. volume	= 313,428 cuft
Inflow hyds.	= 12, 13, 14, 15	Contrib. drain. area	= 0.000 ac



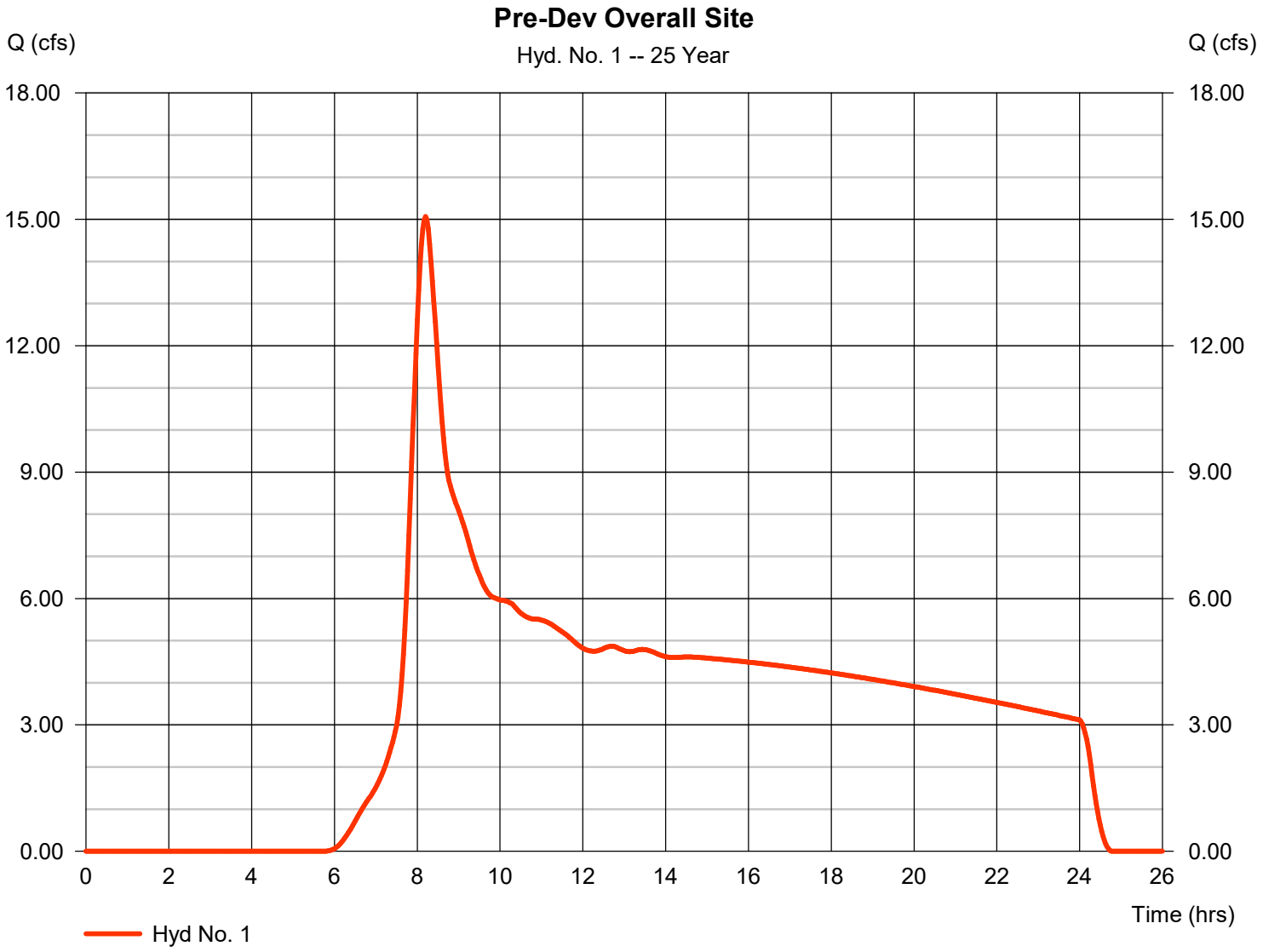
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 1

Pre-Dev Overall Site

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.07 cfs
Storm frequency	=	25 yrs	Time to peak	=	8.20 hrs
Time interval	=	2 min	Hyd. volume	=	306,623 cuft
Drainage area	=	58.010 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	30.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484



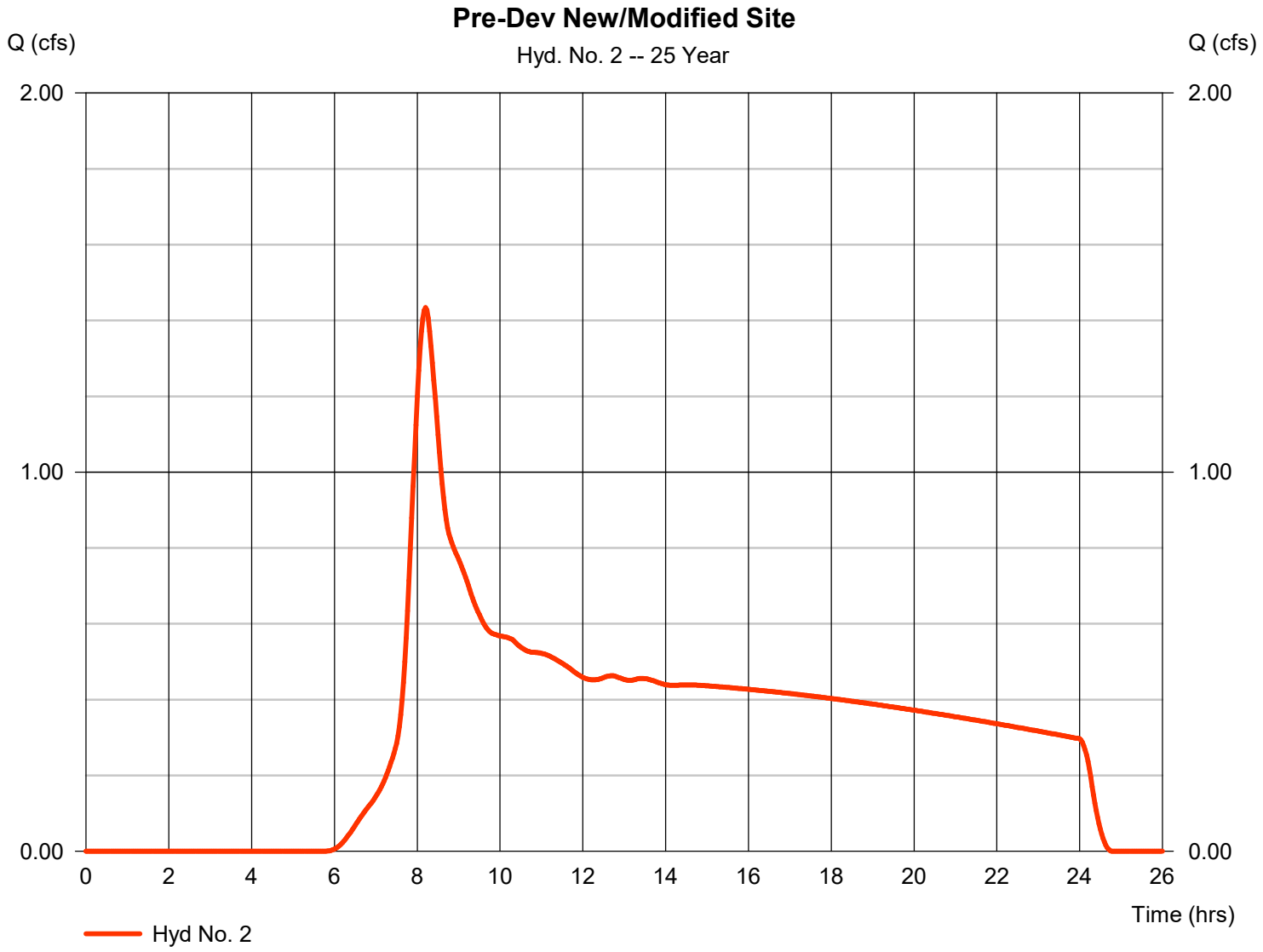
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 2

Pre-Dev New/Modified Site

Hydrograph type	= SCS Runoff	Peak discharge	= 1.434 cfs
Storm frequency	= 25 yrs	Time to peak	= 8.20 hrs
Time interval	= 2 min	Hyd. volume	= 29,177 cuft
Drainage area	= 5.520 ac	Curve number	= 73
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 3

Pre-Dev Undisturbed Site

Hydrograph type	=	SCS Runoff	Peak discharge	=	13.63 cfs
Storm frequency	=	25 yrs	Time to peak	=	8.20 hrs
Time interval	=	2 min	Hyd. volume	=	277,445 cuft
Drainage area	=	52.490 ac	Curve number	=	73
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	30.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

Hydrograph Report

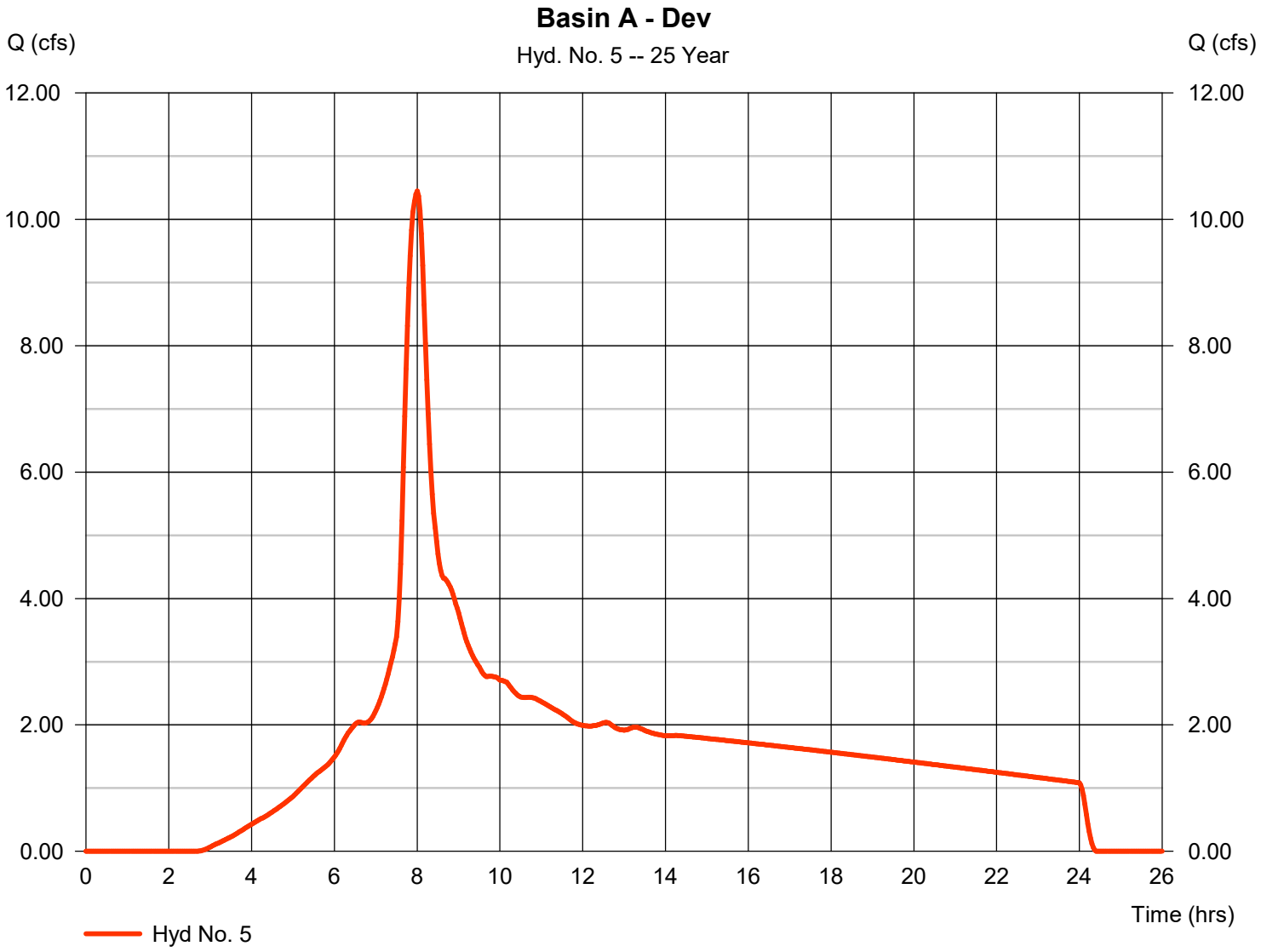
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 5

Basin A - Dev

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.45 cfs
Storm frequency	=	25 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	149,470 cuft
Drainage area	=	16.020 ac	Curve number	=	88*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.250 x 98) + (8.150 x 98) + (6.350 x 74) + (0.270 x 98)] / 16.020



Hydrograph Report

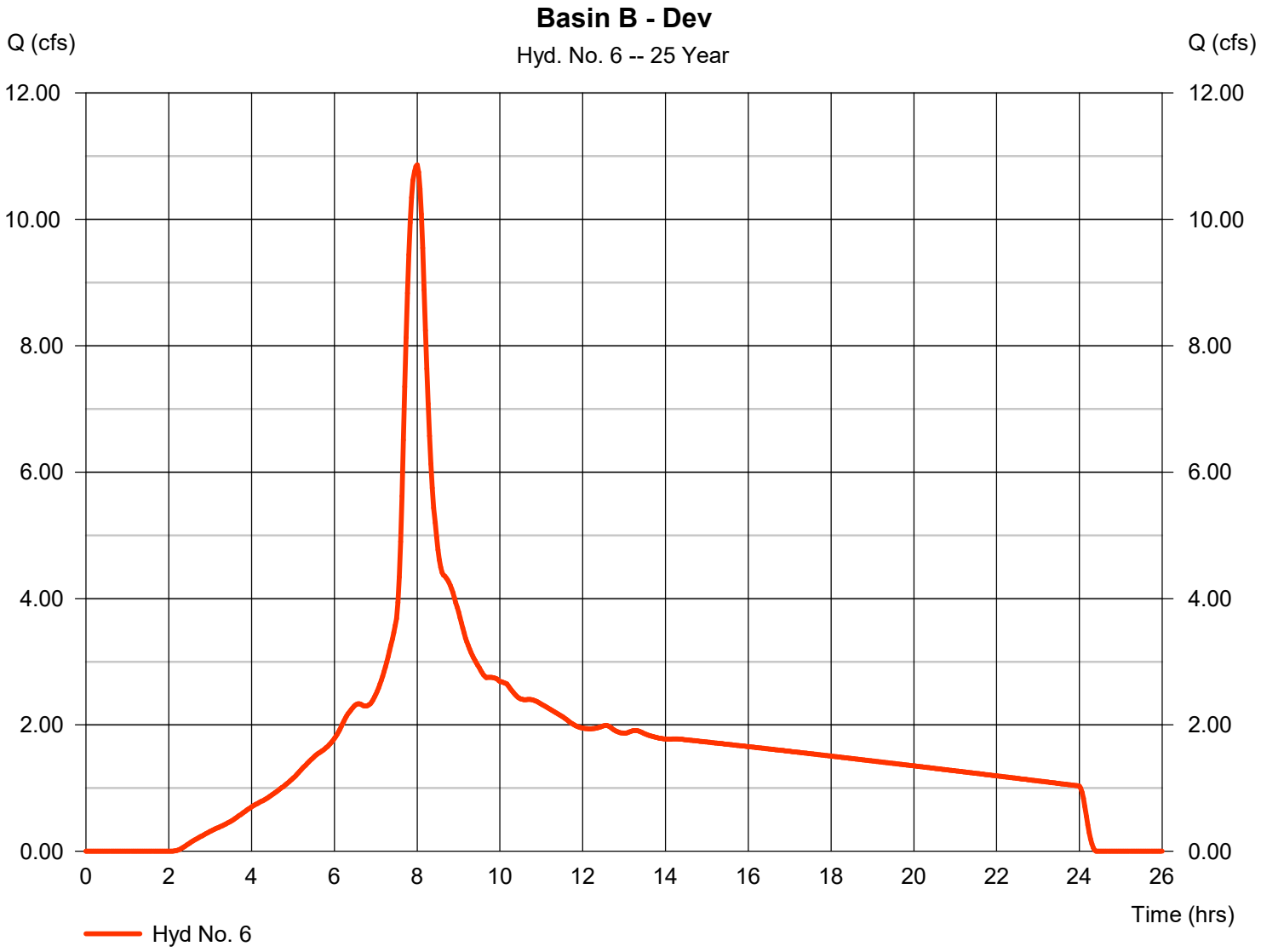
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 6

Basin B - Dev

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.86 cfs
Storm frequency	=	25 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	152,834 cuft
Drainage area	=	14.780 ac	Curve number	=	91*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.350 x 98) + (7.110 x 98) + (4.320 x 74)] / 14.780



Hydrograph Report

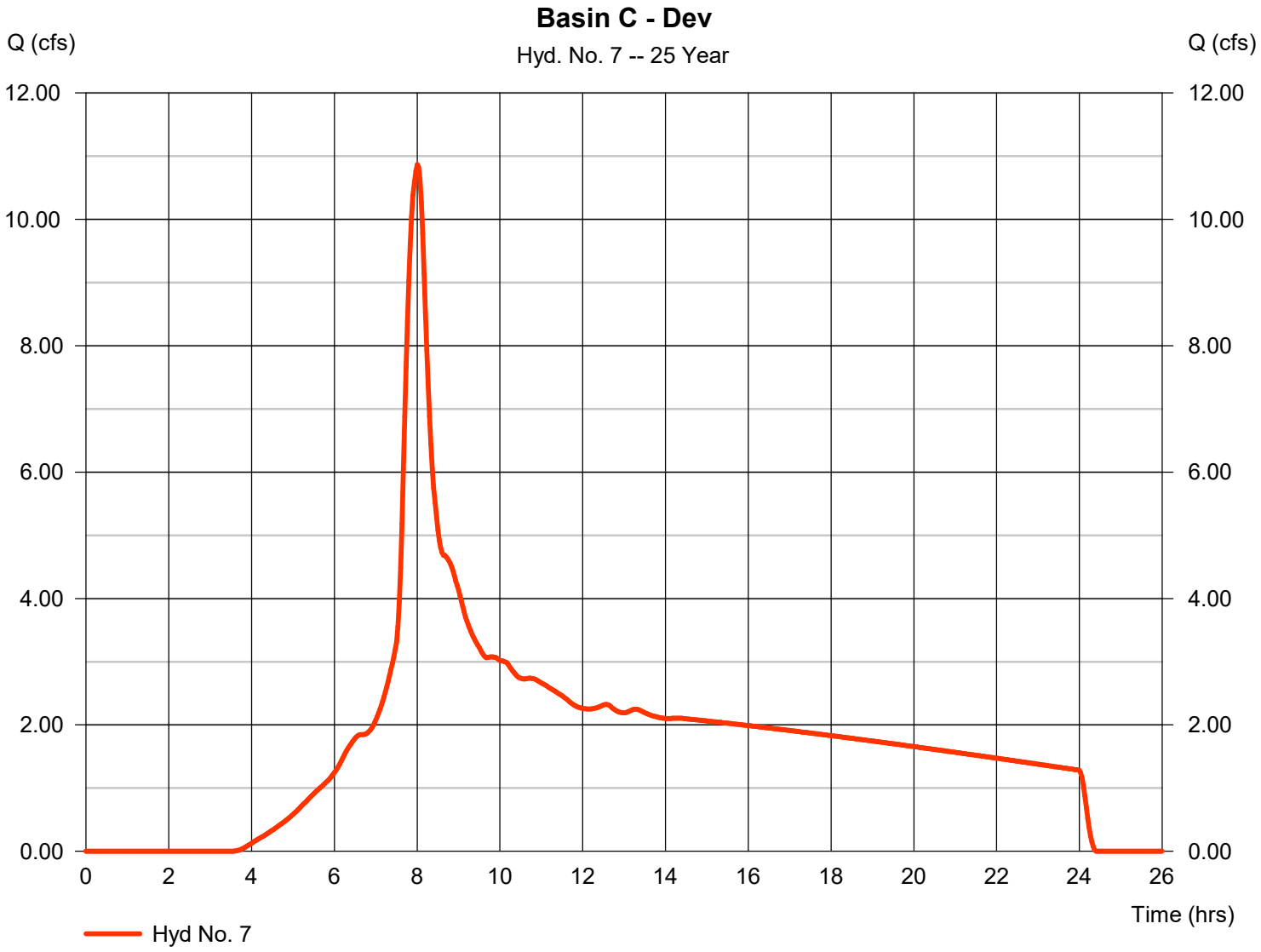
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 7

Basin C - Dev

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.87 cfs
Storm frequency	=	25 yrs	Time to peak	=	8.00 hrs
Time interval	=	2 min	Hyd. volume	=	161,617 cuft
Drainage area	=	20.000 ac	Curve number	=	84*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.00 min
Total precip.	=	3.90 in	Distribution	=	Type IA
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.040 x 98) + (4.050 x 98) + (10.090 x 74) + (0.750 x 98) + (1.590 x 98) + (1.430 x 74)] / 20.000



Hydrograph Report

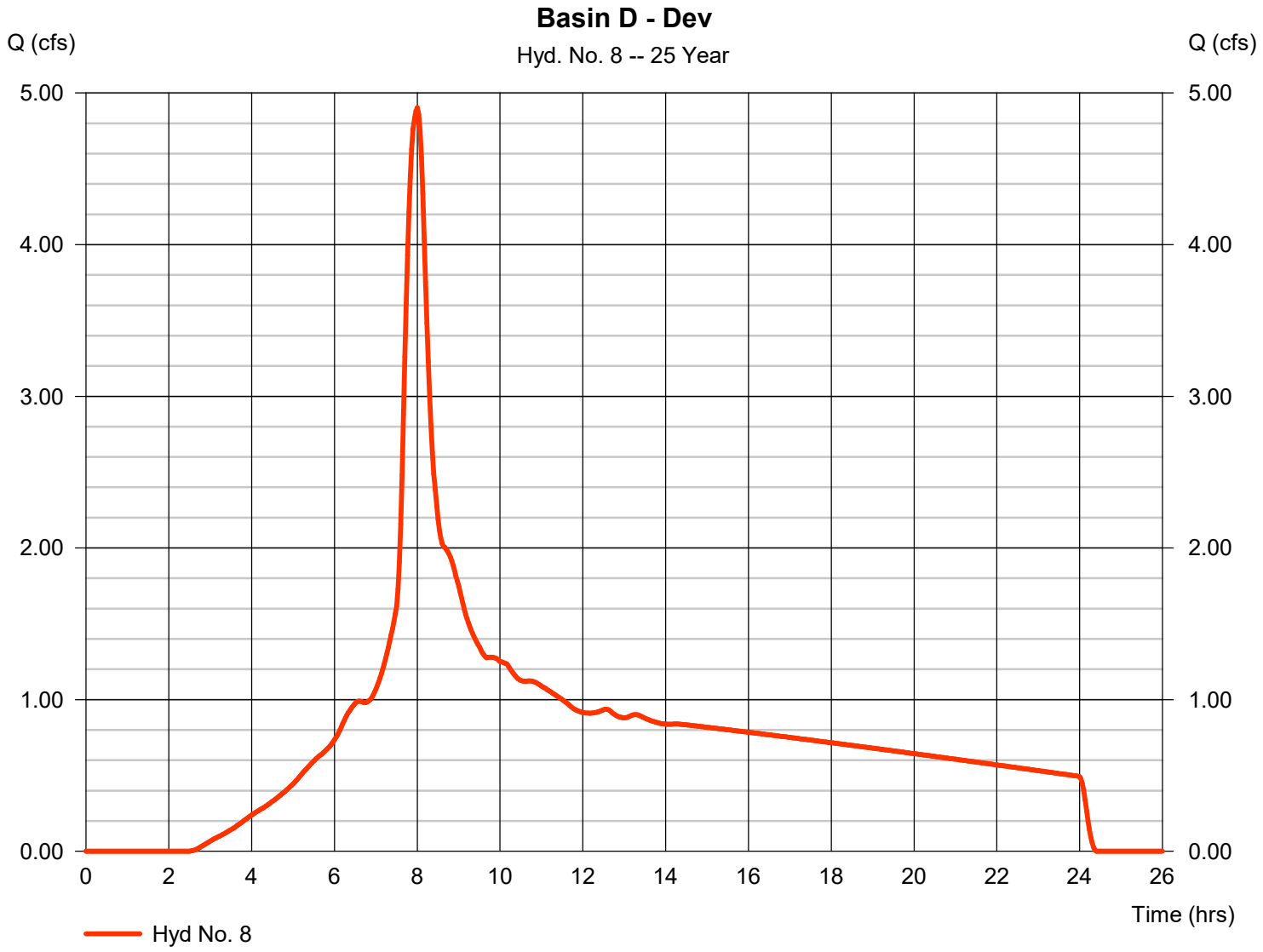
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 8

Basin D - Dev

Hydrograph type	= SCS Runoff	Peak discharge	= 4.903 cfs
Storm frequency	= 25 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 69,647 cuft
Drainage area	= 7.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.240 x 98) + (1.000 x 74) + (3.180 x 98) + (1.790 x 74)] / 7.210



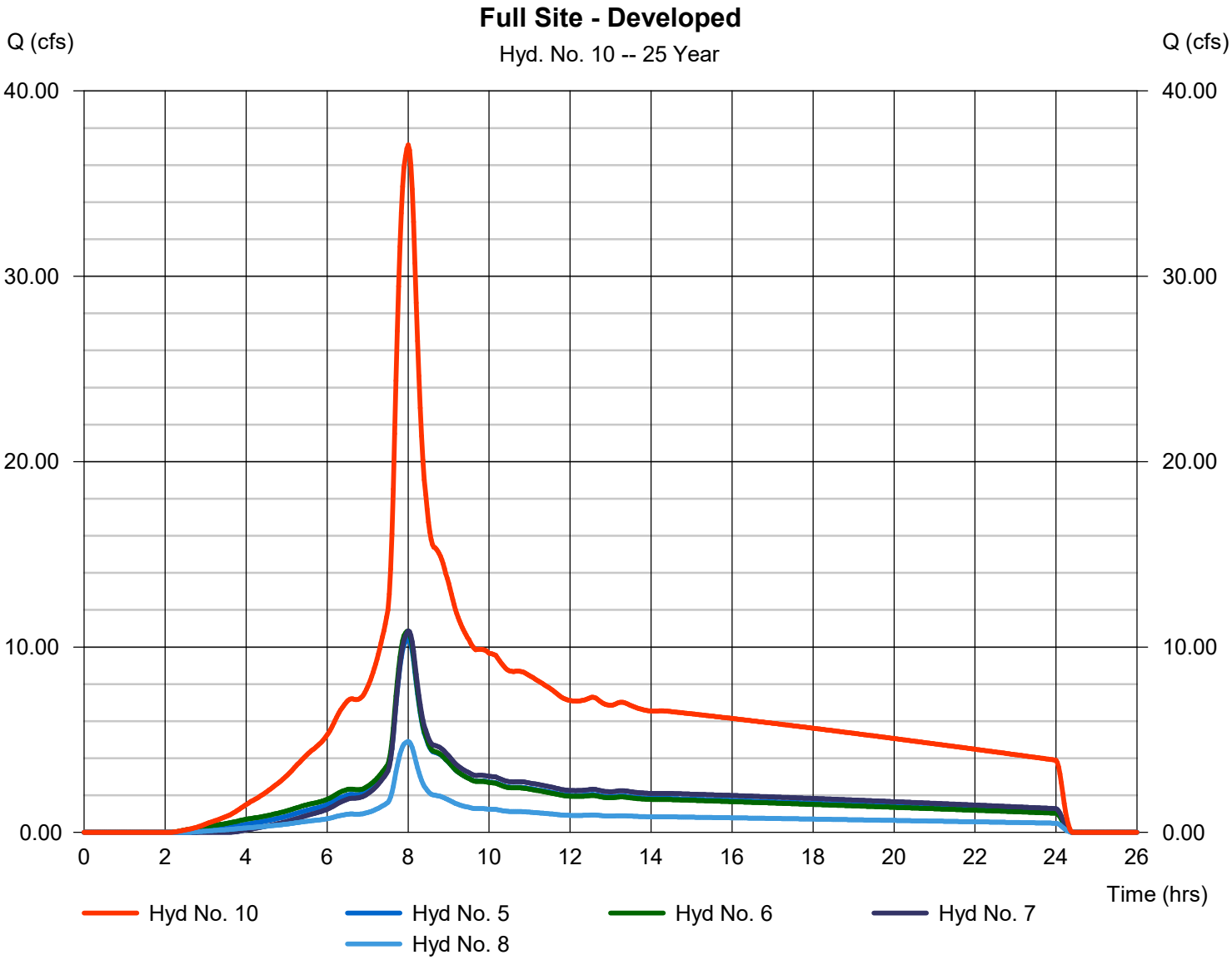
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 10

Full Site - Developed

Hydrograph type	= Combine	Peak discharge	= 37.09 cfs
Storm frequency	= 25 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 533,568 cuft
Inflow hyds.	= 5, 6, 7, 8	Contrib. drain. area	= 58.010 ac



Hydrograph Report

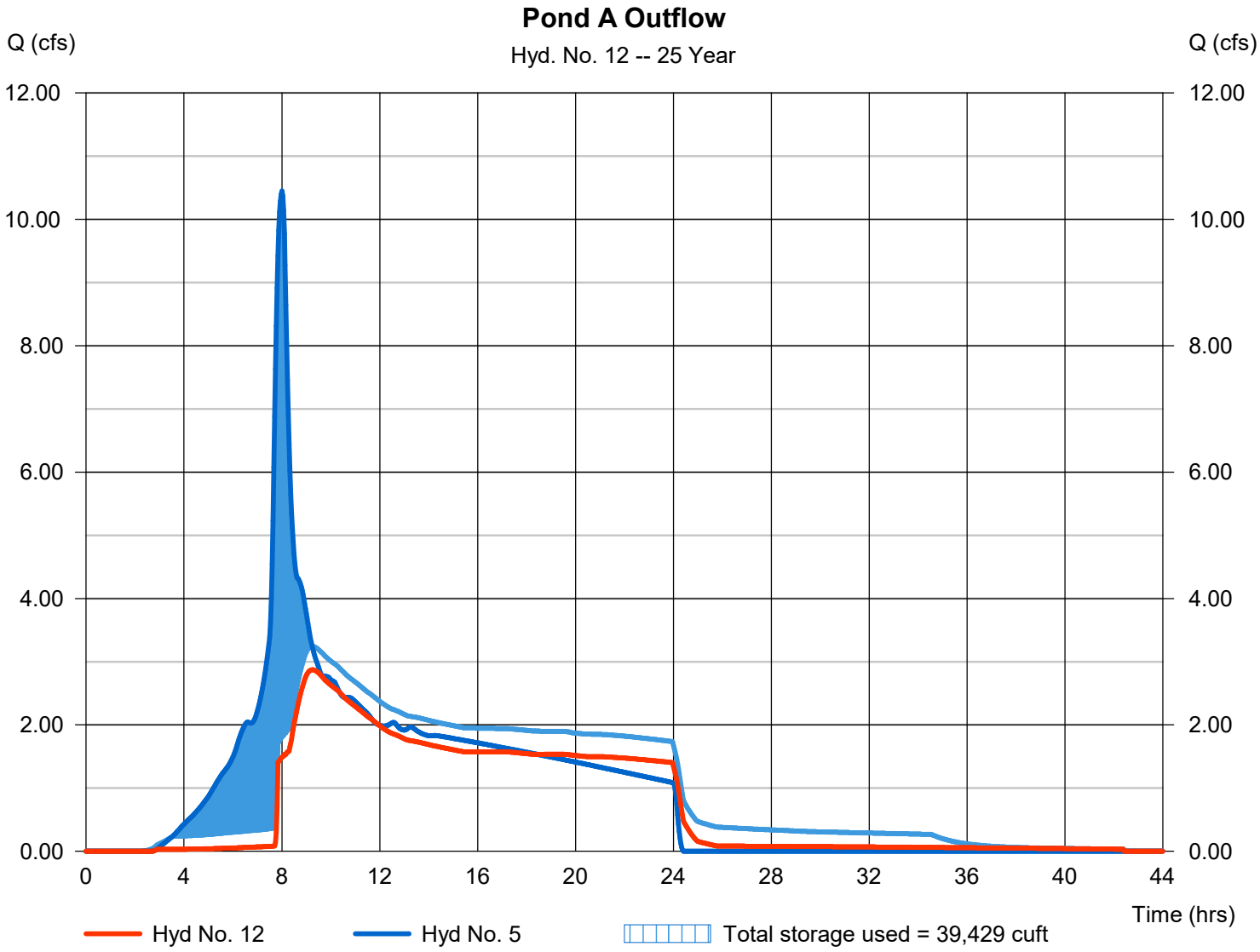
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 12

Pond A Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	2.872 cfs
Storm frequency	=	25 yrs	Time to peak	=	9.27 hrs
Time interval	=	2 min	Hyd. volume	=	109,867 cuft
Inflow hyd. No.	=	5 - Basin A - Dev	Max. Elevation	=	142.24 ft
Reservoir name	=	Existing Pond A	Max. Storage	=	39,429 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

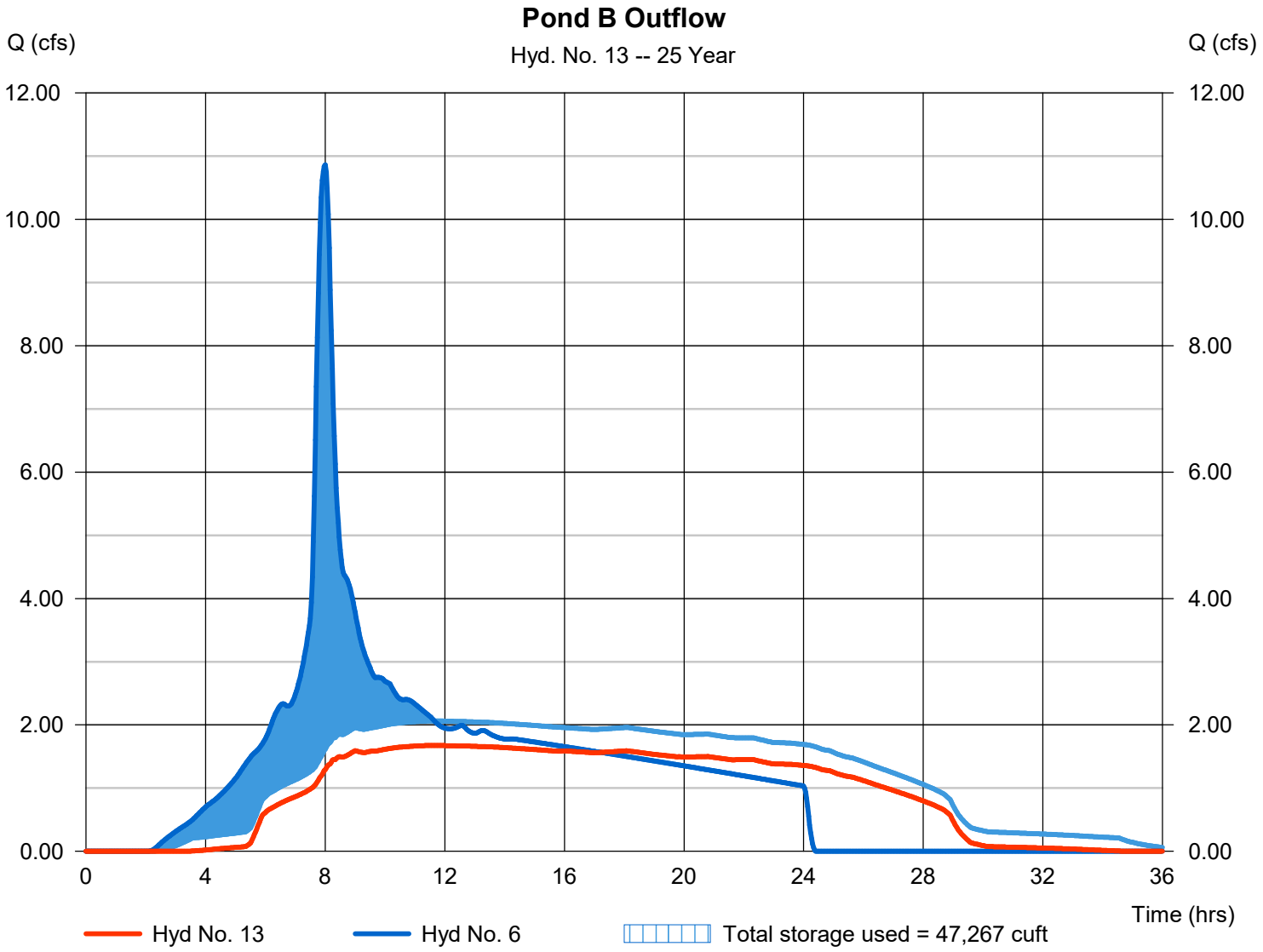
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 13

Pond B Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.674 cfs
Storm frequency	=	25 yrs	Time to peak	=	11.67 hrs
Time interval	=	2 min	Hyd. volume	=	116,856 cuft
Inflow hyd. No.	=	6 - Basin B - Dev	Max. Elevation	=	139.86 ft
Reservoir name	=	Existing Pond B	Max. Storage	=	47,267 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

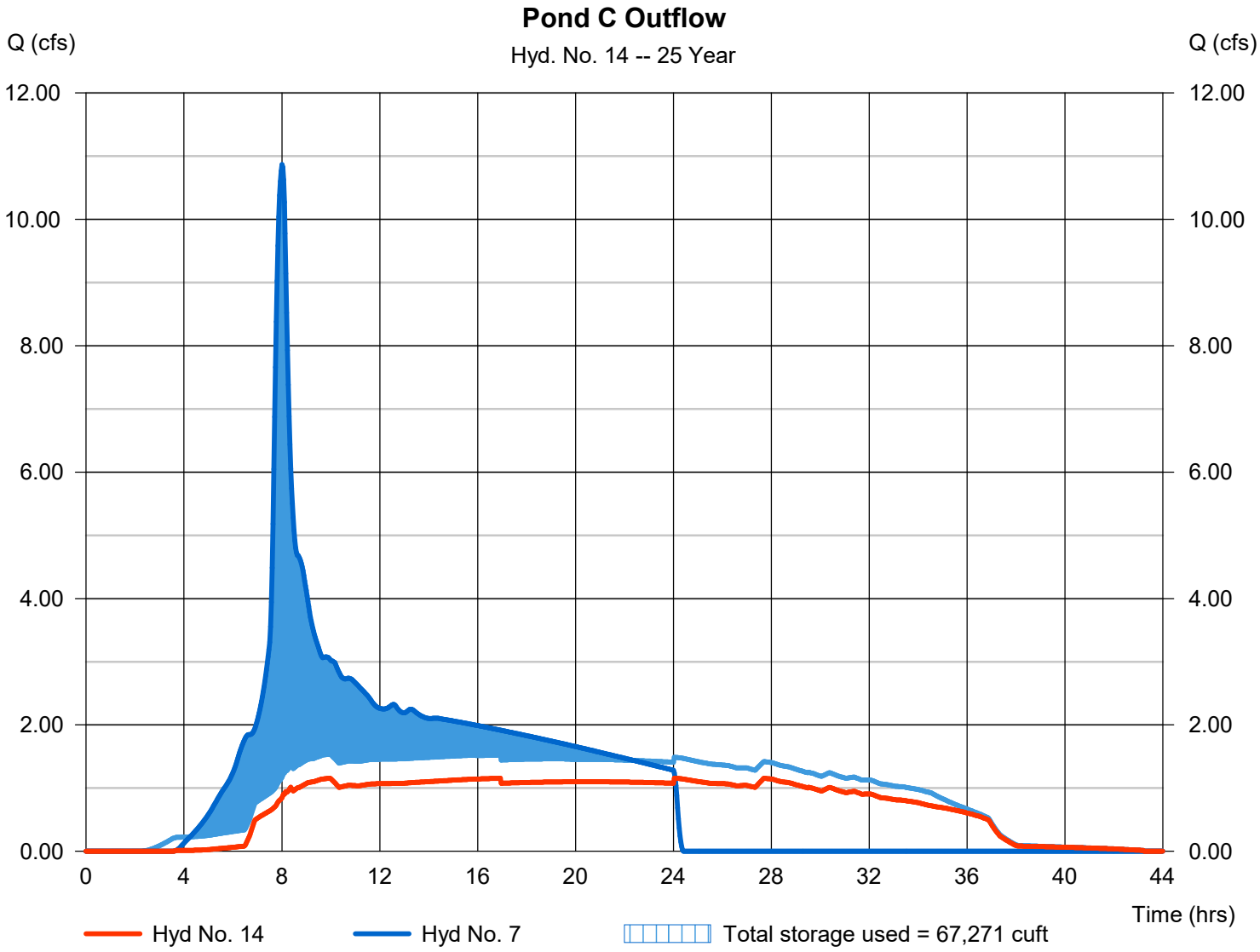
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 14

Pond C Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	1.155 cfs
Storm frequency	=	25 yrs	Time to peak	=	27.70 hrs
Time interval	=	2 min	Hyd. volume	=	110,758 cuft
Inflow hyd. No.	=	7 - Basin C - Dev	Max. Elevation	=	139.42 ft
Reservoir name	=	Existing Pond C	Max. Storage	=	67,271 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

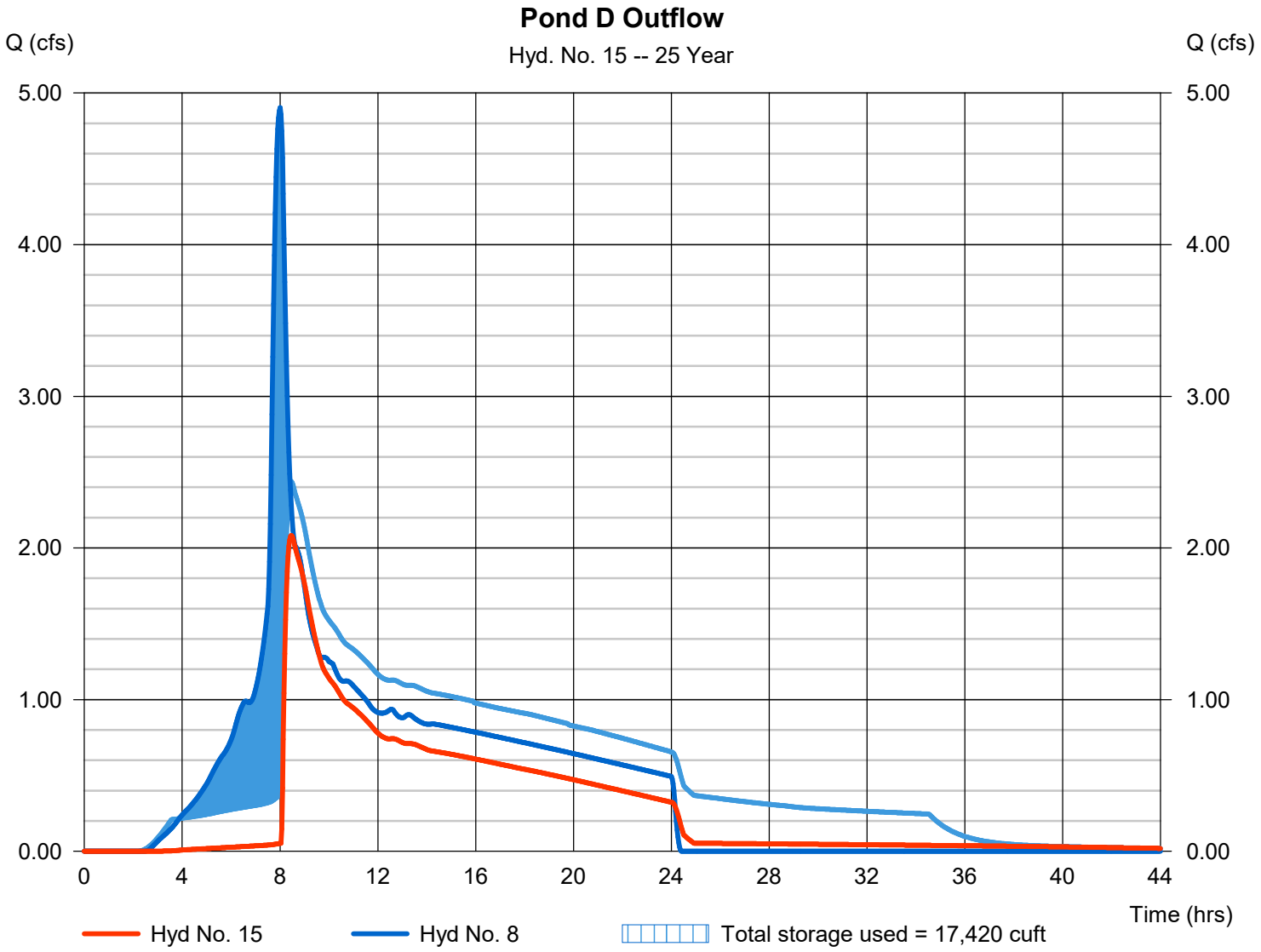
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 15

Pond D Outflow

Hydrograph type	=	Reservoir	Peak discharge	=	2.083 cfs
Storm frequency	=	25 yrs	Time to peak	=	8.47 hrs
Time interval	=	2 min	Hyd. volume	=	44,957 cuft
Inflow hyd. No.	=	8 - Basin D - Dev	Max. Elevation	=	137.28 ft
Reservoir name	=	Modified Pond D	Max. Storage	=	17,420 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



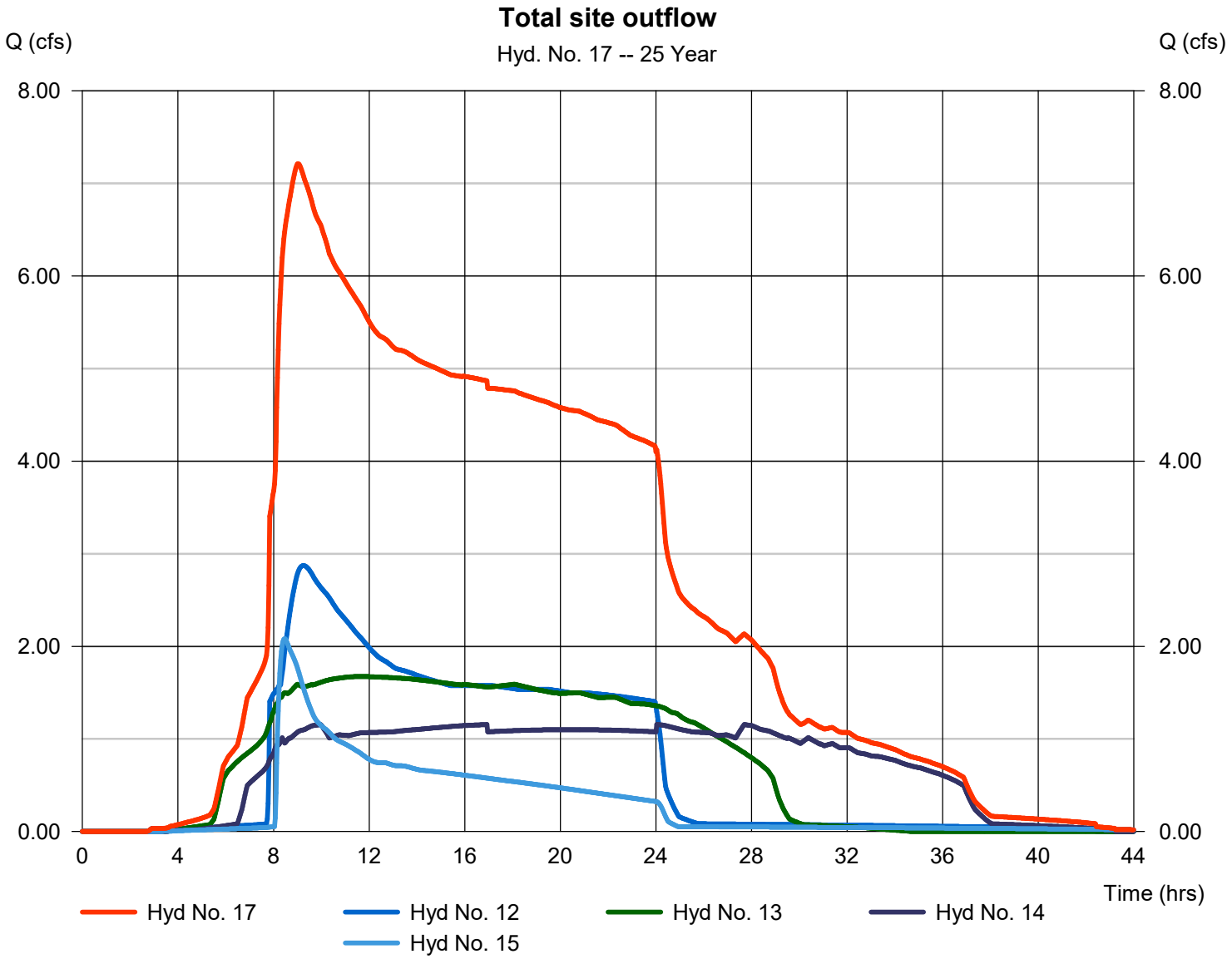
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Hyd. No. 17

Total site outflow

Hydrograph type	=	Combine	Peak discharge	=	7.212 cfs
Storm frequency	=	25 yrs	Time to peak	=	9.03 hrs
Time interval	=	2 min	Hyd. volume	=	382,439 cuft
Inflow hyds.	=	12, 13, 14, 15	Contrib. drain. area	=	0.000 ac



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 07 / 23 / 2024

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	6.3201	2.1000	0.6144	--------
3	0.0000	0.0000	0.0000	--------
5	7.9532	1.6000	0.6153	--------
10	12.9652	3.7000	0.6766	--------
25	16.1446	4.6000	0.6900	--------
50	23.8777	6.0000	0.7457	--------
100	24.1258	5.6000	0.7114	--------

File name: CWS IDF curve.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1.90	1.37	1.10	0.94	0.83	0.75	0.69	0.63	0.59	0.56	0.53	0.50
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	2.49	1.76	1.41	1.20	1.06	0.95	0.87	0.80	0.75	0.70	0.66	0.63
10	3.00	2.21	1.79	1.52	1.34	1.20	1.09	1.01	0.94	0.88	0.82	0.78
25	3.39	2.54	2.07	1.77	1.56	1.40	1.28	1.18	1.09	1.02	0.96	0.91
50	3.99	3.02	2.47	2.10	1.84	1.65	1.50	1.37	1.27	1.19	1.11	1.05
100	4.50	3.42	2.80	2.40	2.12	1.90	1.73	1.59	1.48	1.38	1.30	1.23

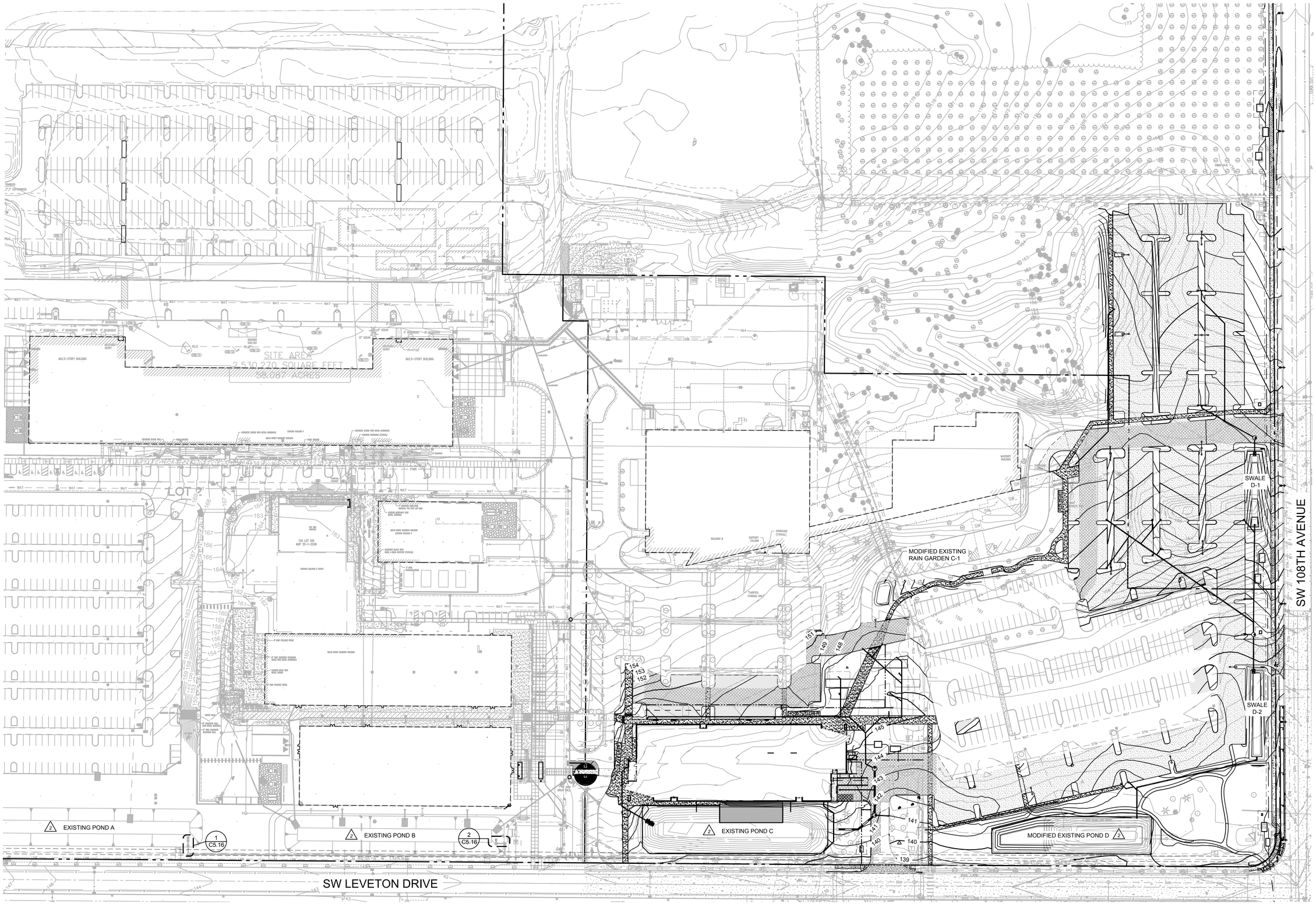
Tc = time in minutes. Values may exceed 60.

Reports & Calc Templates\Calc Templates\Stormwater\Hydraflow Stormwater Precipitation Data\CWS precipitation.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.50	0.00	3.10	3.45	3.90	4.20	4.50
SCS 6-Hr	0.00	1.05	0.00	1.25	1.55	1.70	1.80	1.90
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

APPENDIX D

PROPOSED SITE PLANS



1 C1.30 OVERALL UTILITY PLAN
1" = 60'-0"

60 0 30 60 120 240 1:1

(IN FEET)
1 inch = **60** ft.

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Lam RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

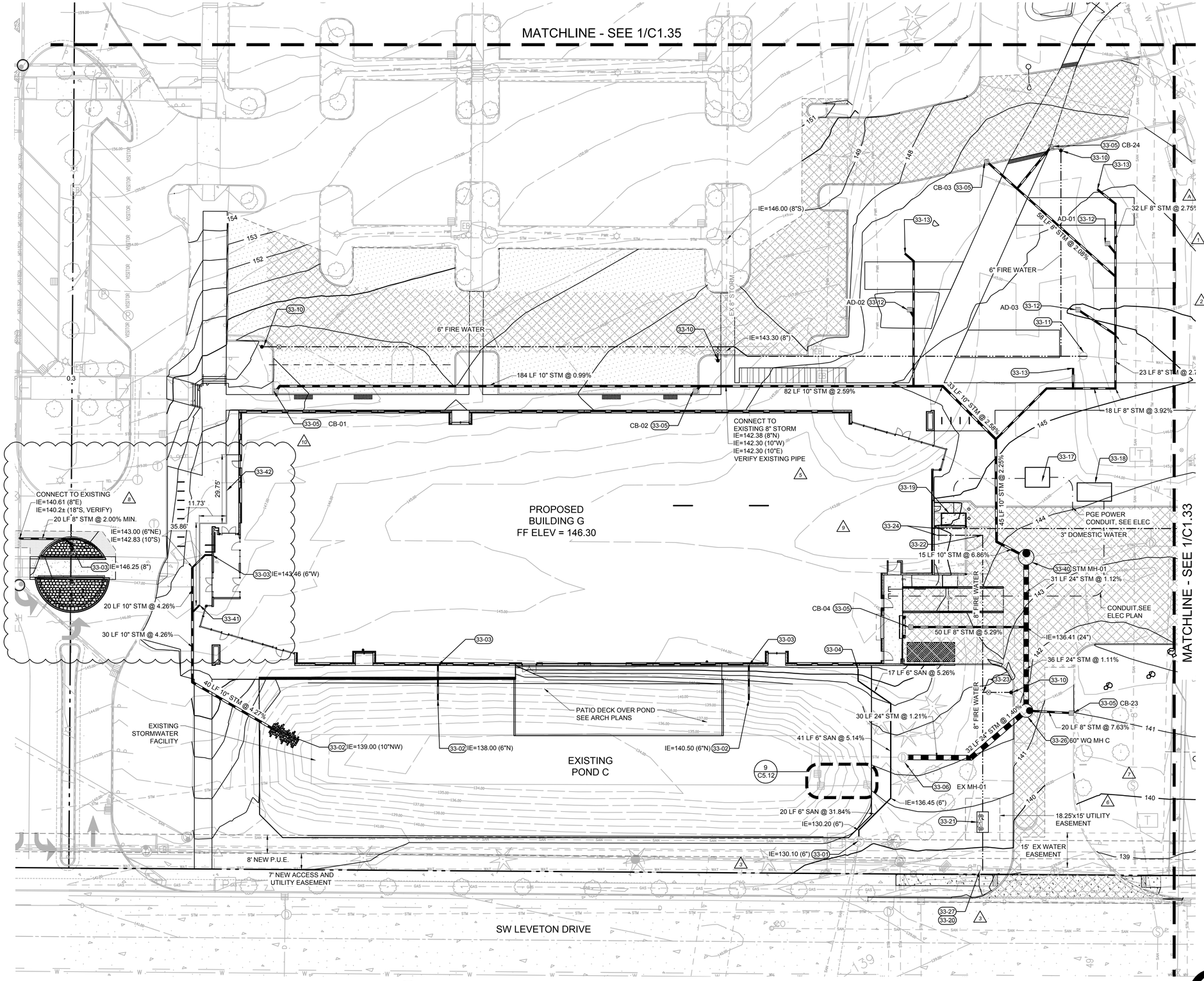
Delta	Issued As	Issue Date
2	PLAN CHECK	08/30/2023

SHEET TITLE:
OVERALL UTILITY PLAN

SHEET:
C1.30

JOB NO. **2220087.00**

CONSTRUCTION SET 2/20/24



KEYNOTES

33-01	CONNECT SEWER TO EXISTING MANHOLE
33-02	6" ROOF DRAIN OUTFALL WITH RIPRAP, SEE DETAIL 14/C5.11
33-03	ROOF DRAIN CONNECTION TO PLUMBING
33-04	CONNECT SEWER LATERAL TO PLUMBING
33-05	CATCH BASIN, SEE DETAIL 13/C5.11
33-06	CONNECT STORM TO EXISTING MANHOLE
33-10	FIRE HYDRANT (PRIVATE), SEE DETAIL 6/C5.12
33-11	CONNECT TO EXISTING FIRE LINE
33-12	AREA DRAIN, SEE DETAIL 15/C5.11
33-13	CONNECT TO RELOCATED SHELTER DOWNSPOUT
33-14	MODIFIED STORMWATER BASIN, SEE CWS DETAILS 2 AND 3/C5.14, REFER TO LANDSCAPE PLAN FOR REPLANTING
33-17	ELECTRICAL TRANSFORMER, SEE ELEC PLANS
33-18	GENERATOR, SEE ELEC PLANS
33-19	ELECTRICAL GEAR ENCLOSURE, SEE ELEC PLANS
33-20	8" HOT TAP CONNECT TO 18" PUBLIC WATER MAIN (TO BE PERFORMED BY COT APPROVED CONTRACTOR)
33-21	8" DOUBLE CHECK VALVE ASSEMBLY (DCVA) IN VAULT, PER DETAIL 5/C5.13
33-22	8" 90-DEGREE BEND, MECHANICAL JOINT RESTRAINT PER DETAIL 5/C5.12
33-23	8"X6" HYDRANT TEE, MECHANICAL JOINT RESTRAINT PER DETAIL 5/C5.12
33-24	CONNECT WATER TO PLUMBING
33-26	60" WATER QUALITY MANHOLE WITH SNOUT, SEE CWS DETAILS 6 AND 7/C5.14
33-40	STORM MANHOLE PER DETAIL 10/C5.13
33-41	TRENCH DRAIN CATCH BASIN WITH 6" PIPE CONNECTION TO STORM DRAIN. IE OUT=144.7+/-
33-42	4" TRENCH DRAIN, ACO KS100 WITH SLOPING CHANNEL AND 447D STAINLESS GRATE, CLASS B, HEEL SAFE AND ADA COMPLIANT

STORM DRAINAGE STRUCTURES	
STRUCTURE	DETAILS
60" WQ MH C	RIM = 141.66 IE IN (24"N) = 136.00 IE IN (8"E) = 136.67 IE OUT (24"SW) = 136.00
AD-01	RIM = 145.06 IE OUT (8"SE) = 142.80
AD-02	RIM = 145.15 IE OUT (8"SE) = 142.26
AD-03	RIM = 144.90 IE OUT (8"SE) = 142.51
CB-01	RIM = 147.80 IE OUT (10"NE) = 144.45
CB-02	RIM = 147.21 IE OUT (8"NE) = 143.69
CB-03	RIM = 146.38 IE OUT (8"SE) = 143.72
CB-04	RIM = 142.36 IE OUT (8"E) = 139.74
CB-23	RIM = 140.70 IE OUT (8"W) = 138.17
CB-24	RIM = 146.54 IE OUT (8"SW) = 143.84
EX MH-01	RIM = 142.53 IE IN (24"E) = 135.20 IE OUT (18"W) = 135.20
STM MH-01	RIM = 143.62 IE IN (10"NW) = 137.00 IE IN (21"E) = 137.00 IE OUT (24"S) = 136.75

1 C1.31 BUILDING G UTILITY PLAN
1" = 20'-0"

20 0 10 20 40 80 1:1

(IN FEET)
1 inch = 20 ft.

KEY MAP
SCALE: NTS

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Lam RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE		
Delta	Issued As	Issue Date
A	PR #01	1/17/2023
1	PLANCHECK	06/21/2023
2	PLAN CHECK	08/30/2023
3	PLAN CHECK	10/18/2023
4	PLAN CHECK	12/15/2023
5	RFI 002	01/08/2024
6	PLAN CHECK	02/15/2024
7	RFI 087	04/08/2024
8	RFI 076	04/15/2024
9	RFI 087	04/26/2024
10	PR 02	05/24/2024

C1.36
C1.37

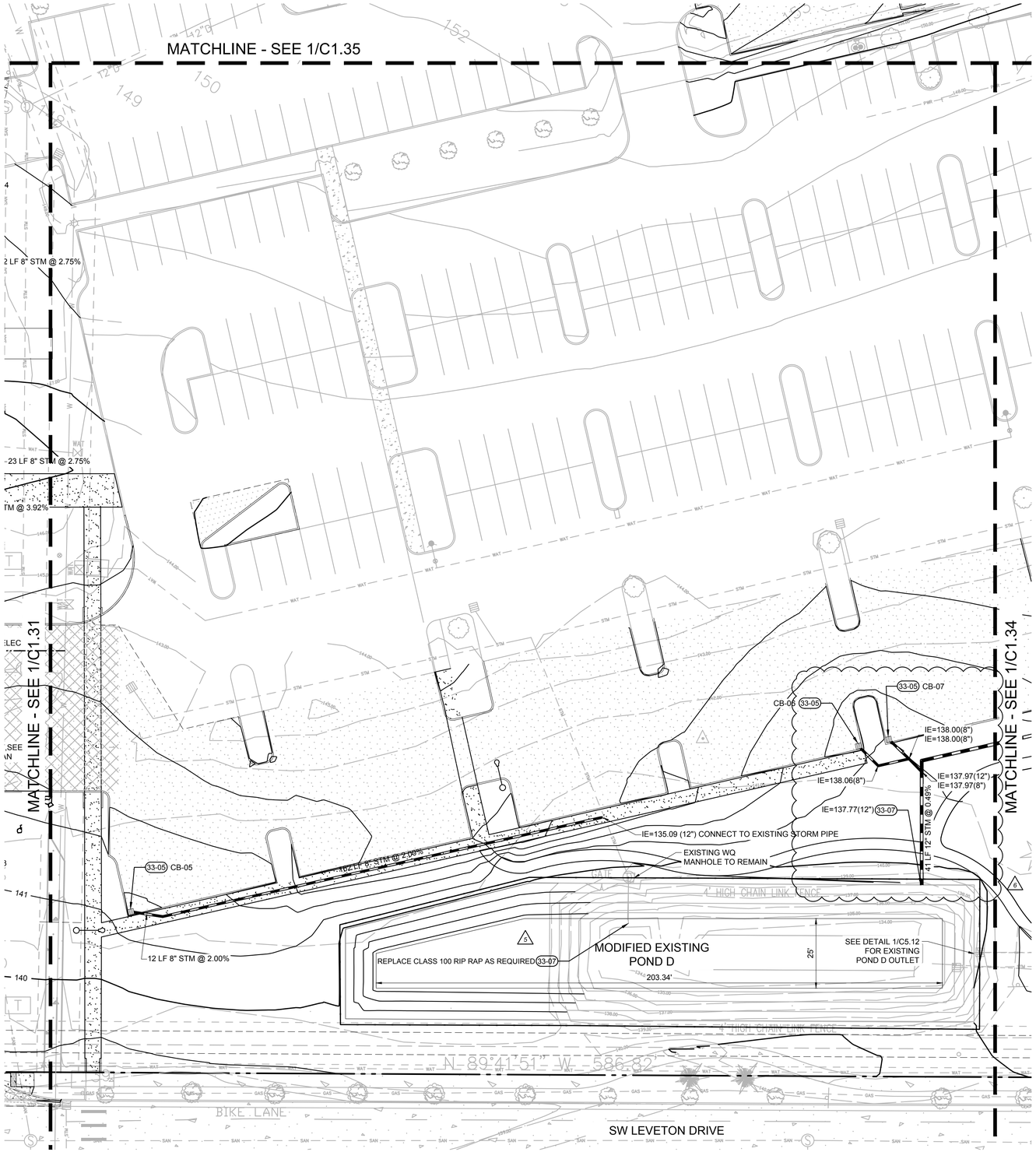
C1.31
C1.33
C1.34
C1.35

SHEET TITLE:
BUILDING G UTILITY PLAN

SHEET:
C1.31

JOB NO. **2220087.00**

CONSTRUCTION SET 2/20/24



KEYNOTES

33-05	CATCH BASIN, SEE DETAIL 13/C5.11
33-07	PIPE OUTFALL WITH RIPRAP, SEE DETAIL 8/C5.14
33-26	60" WATER QUALITY MANHOLE WITH SNOUT, SEE CWS DETAILS 6 AND 7/C5.14

STORM DRAINAGE STRUCTURES	
STRUCTURE	DETAILS
CB-05	RIM = 140.79 IE IN (8"E) = 138.33
CB-06	RIM = 140.60 IE OUT (8"SE) = 138.11
CB-07	RIM = 140.50 IE OUT (8"SE) = 138.05
EX MH 02	RIM = 141.38 IE IN (12"W) = 133.13 IE OUT (12"E) = 133.13
RISER-04	RIM = 142.41 IE OUT (12"S) = 139.61
WQ MH D-2	RIM = 146.63 IE IN (8"W) = 142.77 IE IN (12"N) = 142.77 IE OUT (12"S) = 142.77

1 C1.33 EAST PARKING EXPANSION UTILITY PLAN
1" = 20'-0"
1:1
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

NOTE: ELEVATIONS SHOWN ARE BASED ON NVGD29 VERTICAL DATUM UPDATE TO NAVD88 FOR AS-BUILT DRAWINGS PER CITY REQUIREMENT.

KEY MAP
SCALE: NTS

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

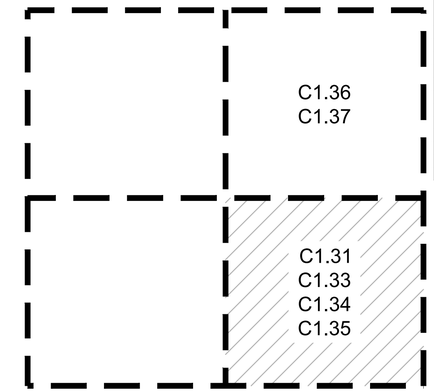
Lam RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE		
Delta	Issued As	Issue Date
3	PLAN CHECK	10/18/2023
4	PLAN CHECK	12/15/2023
5	PLAN CHECK	01/17/2024
6	RFI 052	02/26/2024

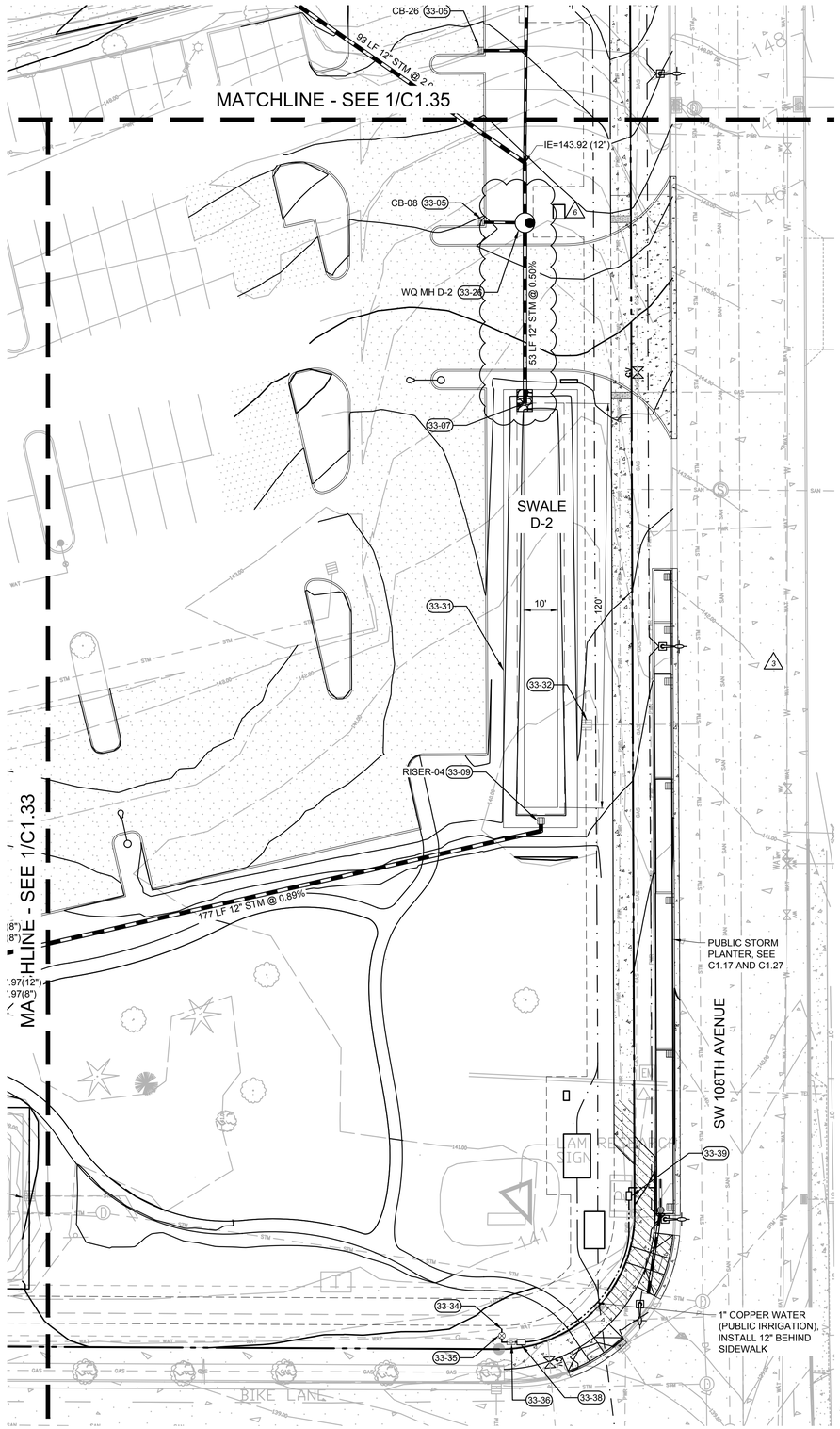


SHEET TITLE:
EAST PARKING EXPANSION UTILITY PLAN

SHEET:
C1.33

JOB NO. **2220087.00**

CONSTRUCTION SET 2/20/24



1 C1.34 EAST PARKING EXPANSION UTILITY PLAN

1" = 20'-0" 20 0 10 20 40 80 1:1

(IN FEET)
1 inch = **20** ft.

NOTE: ELEVATIONS SHOWN ARE BASED ON NVGD29 VERTICAL DATUM UPDATE TO NAVD88 FOR AS-BUILT DRAWINGS PER CITY REQUIREMENT.

KEYNOTES

	33-05	CATCH BASIN, SEE DETAIL 13/C5.11
	33-07	PIPE OUTFALL WITH RIPRAP, SEE DETAIL 8/C5.14
	33-08	STORMWATER BASIN, SEE CWS DETAIL 2/C5.14
	33-09	OVERFLOW OUTLET, SEE CWS DETAIL 8/C5.15
	33-14	MODIFIED STORMWATER BASIN, SEE CWS DETAILS 2 AND 3/C5.14, REFER TO LANDSCAPE PLAN FOR REPLANTING
	33-26	60" WATER QUALITY MANHOLE WITH SNOUT, SEE CWS DETAILS 6 AND 7/C5.14
3	33-31	WATER QUALITY SWALE PER DETAIL 4/C5.14
	33-34	2" HOT TAP TO 18" CITY MAIN WITH HIGH PRESSURE SADDLE (BY CONTRACTOR)
	33-35	2" GATE VALVE WITH RISER AND CAST IRON VALVE BOX TOP
	33-36	2" PRV AND 1" METER IN 17"X30" VAULT, SEE 9/C5.13
	33-38	1" RPBA BACKFLOW INSTALLED IN INSULATED (NOT HEATED) ABOVE-GROUND ENCLOSURE, SEE CITY DETAIL 607/C5.13
	33-39	IRRIGATION CONTROLLER IN LOCKING VALVE BOX WITH DRAIN ROCK FLOOR. RAINBIRD TBOS-BT1, BATTERY-OPERATED, 4-STATION CONTROLLER

4

STORM DRAINAGE STRUCTURES	
STRUCTURE	DETAILS
CB-05	RIM = 140.79 IE IN (8"E) = 138.33
CB-06	RIM = 140.60 IE OUT (8"SE) = 138.11
CB-07	RIM = 140.50 IE OUT (8"SE) = 138.05
EX MH 02	RIM = 141.38 IE IN (12"W) = 133.13 IE OUT (12"E) = 133.13
RISER-04	RIM = 142.41 IE OUT (12"S) = 139.61
WQ MH D-2	RIM = 146.63 IE IN (8"W) = 142.77 IE IN (12"N) = 142.77 IE OUT (12"S) = 142.77

5
6

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

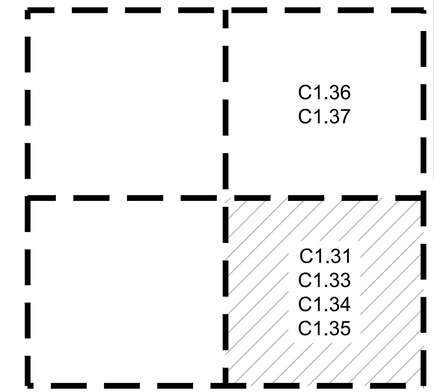
Lam RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE		
Delta	Issued As	Issue Date
2	PLAN CHECK	08/30/2023
3	PLAN CHECK	10/18/2023
4	PLAN CHECK	01/12/2024
5	RFI 028	02/05/2024
6	RFI 038	02/22/2024



SHEET TITLE:
EAST PARKING EXPANSION UTILITY PLAN

SHEET:
C1.34

KEY MAP
SCALE: NTS

2

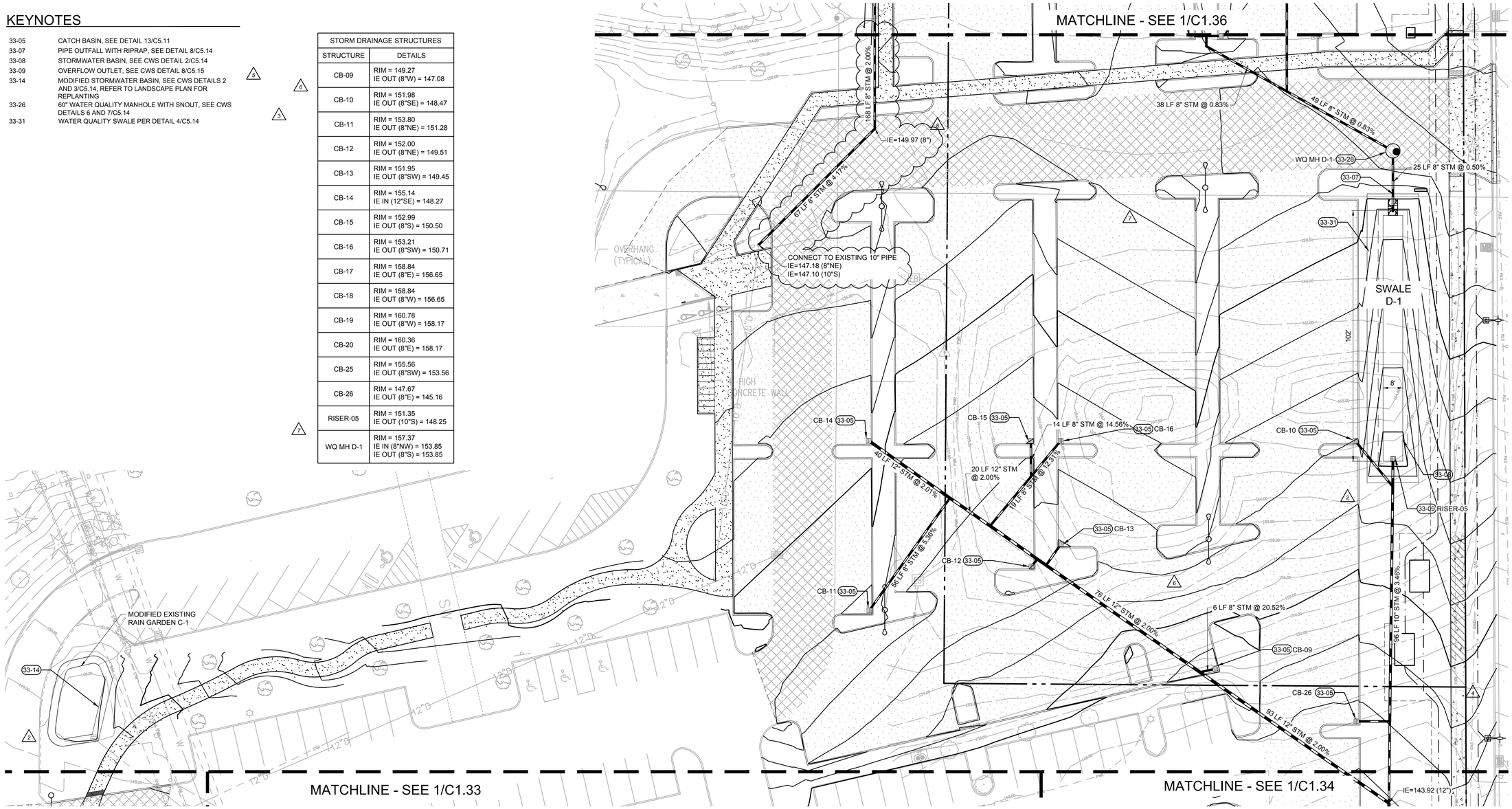
JOB NO. **2220087.00**

CONSTRUCTION SET 2/20/24

KEYNOTES

33-05	CATCH BASIN, SEE DETAIL 13/C5.11
33-07	PIPE OUTFALL WITH RIPRAP, SEE DETAIL 8/C5.14
33-08	STORMWATER BASIN, SEE CWS DETAIL 2/C5.14
33-09	OVERFLOW OUTLET, SEE CWS DETAIL 8/C5.15
33-14	MODIFIED STORMWATER BASIN, SEE CWS DETAILS 2 AND 3/C5.14, REFER TO LANDSCAPE PLAN FOR REPLANTING
33-26	60" WATER QUALITY MANHOLE WITH SNOUT, SEE CWS DETAILS 6 AND 7/C5.14
33-31	WATER QUALITY SWALE PER DETAIL 4/C5.14

STORM DRAINAGE STRUCTURES	
STRUCTURE	DETAILS
CB-09	RIM = 149.27 IE OUT (8"W) = 147.08
CB-10	RIM = 151.98 IE OUT (8"SE) = 148.47
CB-11	RIM = 153.80 IE OUT (8"NE) = 151.28
CB-12	RIM = 152.00 IE OUT (8"NE) = 149.51
CB-13	RIM = 151.95 IE OUT (8"SW) = 149.45
CB-14	RIM = 155.14 IE IN (12"SE) = 148.27
CB-15	RIM = 152.99 IE OUT (8"S) = 150.50
CB-16	RIM = 153.21 IE OUT (8"SW) = 150.71
CB-17	RIM = 158.84 IE OUT (8"E) = 156.65
CB-18	RIM = 158.84 IE OUT (8"W) = 156.65
CB-19	RIM = 160.78 IE OUT (8"W) = 158.17
CB-20	RIM = 160.36 IE OUT (8"E) = 158.17
CB-25	RIM = 155.56 IE OUT (8"SW) = 153.56
CB-26	RIM = 147.67 IE OUT (8"E) = 145.16
RISER-05	RIM = 151.35 IE OUT (10"S) = 148.25
WQ MH D-1	RIM = 157.37 IE IN (8"NW) = 153.85 IE OUT (8"S) = 153.85



1 C1.35 EAST PARKING EXPANSION UTILITY PLAN

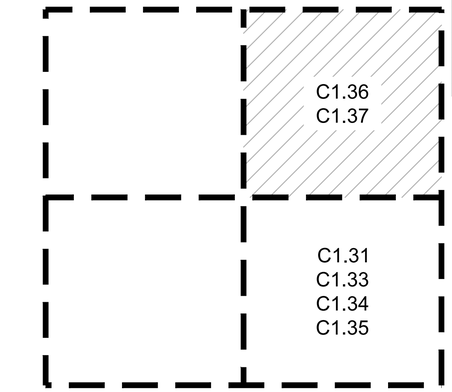
1" = 20'-0"

1:1

20 0 10 20 40 80

(IN FEET)
1 inch = **20** ft.

NOTE: ELEVATIONS SHOWN ARE BASED ON NVGD29 VERTICAL DATUM UPDATE TO NAVD88 FOR AS-BUILT DRAWINGS PER CITY REQUIREMENT.



KEY MAP
SCALE: NTS

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

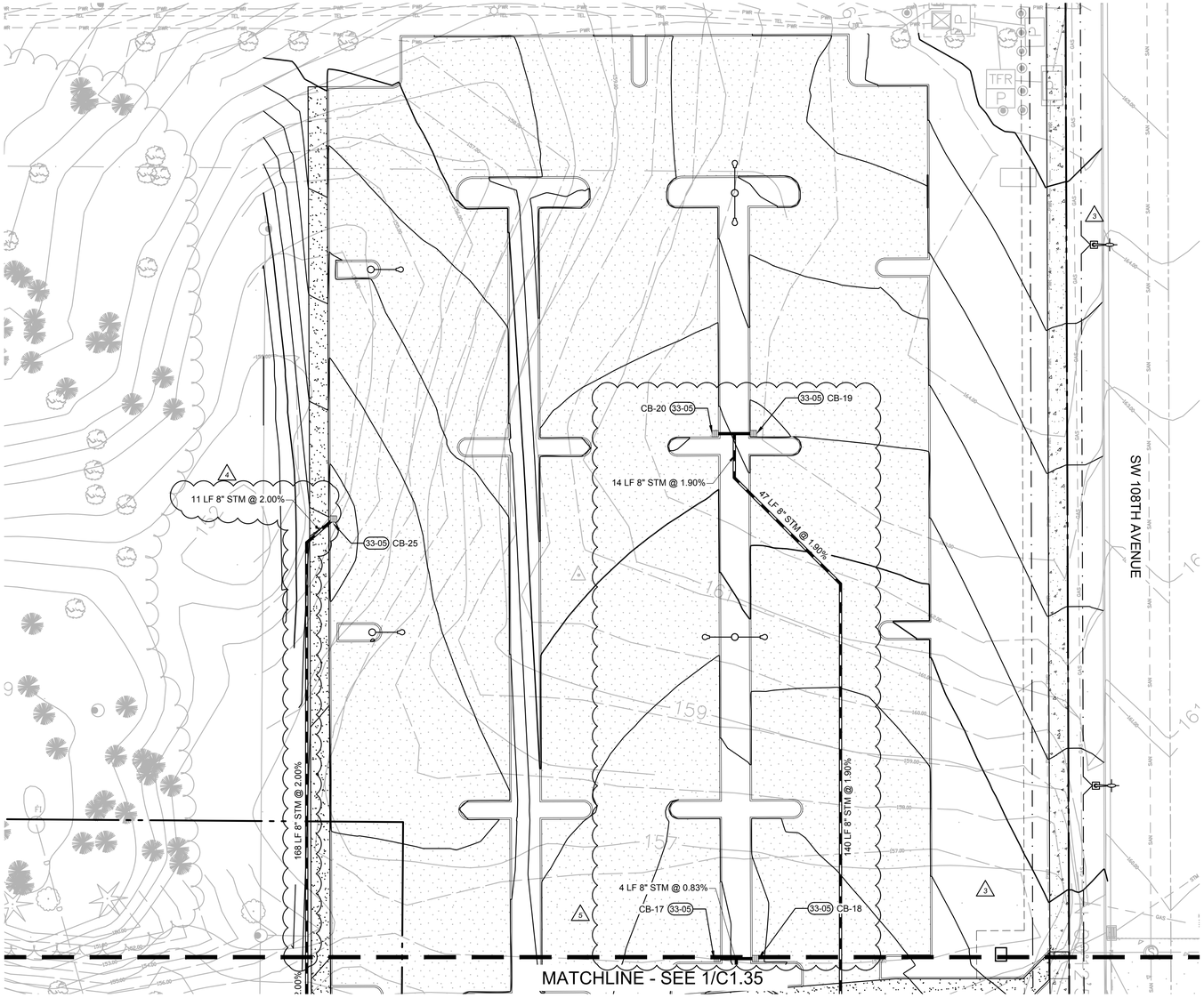
REVISION SCHEDULE		
Delta	Issued As	Issue Date
2	PLAN CHECK	08/30/2023
3	PLAN CHECK	10/18/2023
4	PLAN CHECK	02/15/2024
5	RFI 123	06/21/2024
6	RFI 124	06/21/2024
7	RFI 127	06/21/2024
8	RFI 120	06/28/2024

SHEET TITLE:
EAST PARKING EXPANSION UTILITY PLAN

SHEET:
C1.35

JOB NO. **2220087.00**

CONSTRUCTION SET 2/20/24



1 C1.36 EAST PARKING EXPANSION UTILITY PLAN

1" = 20'-0" 1:1

20 0 10 20 40 80

(IN FEET)
1 inch = **20** ft.

NOTE: ELEVATIONS SHOWN ARE BASED ON NVGD29 VERTICAL DATUM UPDATE TO NAVD88 FOR AS-BUILT DRAWINGS PER CITY REQUIREMENT.

KEYNOTES

33-05 CATCH BASIN, SEE DETAIL 13/C5.11

STORM DRAINAGE STRUCTURES	
STRUCTURE	DETAILS
CB-17	RIM = 158.84 IE OUT (8"E) = 156.65
CB-18	RIM = 158.84 IE OUT (8"W) = 156.65
CB-19	RIM = 160.78 IE OUT (8"W) = 158.17
CB-20	RIM = 160.36 IE OUT (8"E) = 158.17
CB-25	RIM = 155.56 IE OUT (8"SW) = 153.56

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

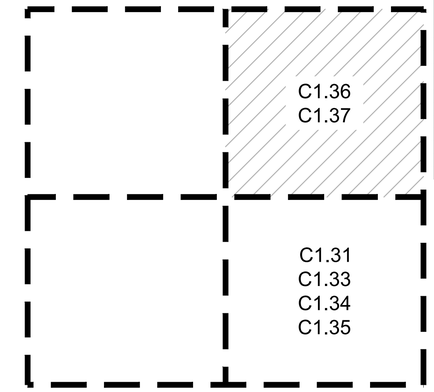
Lam RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE		
Delta	Issued As	Issue Date
2	PLAN CHECK	08/30/2023
3	PLAN CHECK	02/15/2024
4	RFI 120	06/28/2024
5	RFI 127	06/21/2024



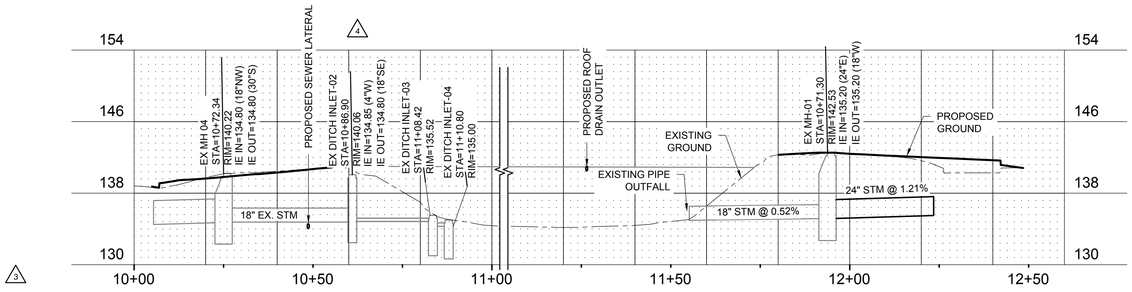
SHEET TITLE:
EAST PARKING EXPANSION UTILITY PLAN

SHEET:
C1.36

KEY MAP
SCALE: NTS

JOB NO. **2220087.00**

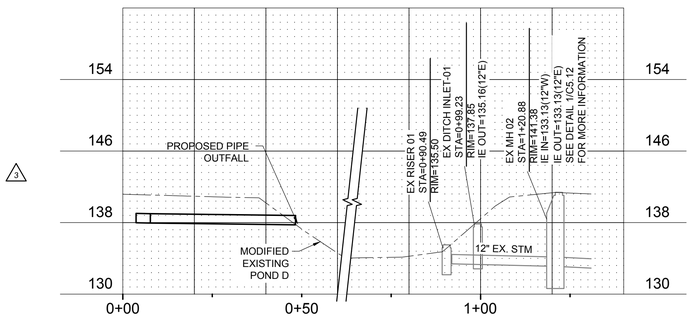
CONSTRUCTION SET 2/20/24



1 C1.37 EXISTING POND PROFILES - POND C

1" = 20'-0"

1:1



2 C1.37 EXISTING POND PROFILES - MODIFIED POND D

1" = 20'-0"

1:1

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client

LAM RESEARCH

Lam RESEARCH

Project

LAM RESEARCH
TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED

THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

Delta	Issued As	Issue Date
2	PLAN CHECK	08/30/2023
3	PLAN CHECK	10/18/2023
4	PLAN CHECK	01/17/2024

SHEET TITLE:

EXISTING POND PROFILES

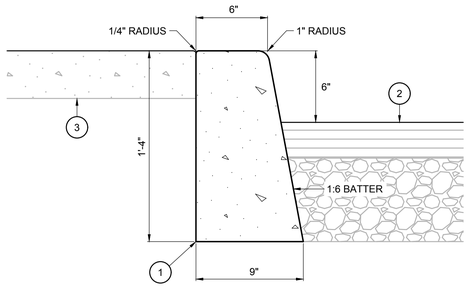
SHEET:

C1.37

2

JOB NO. **2220087.00**

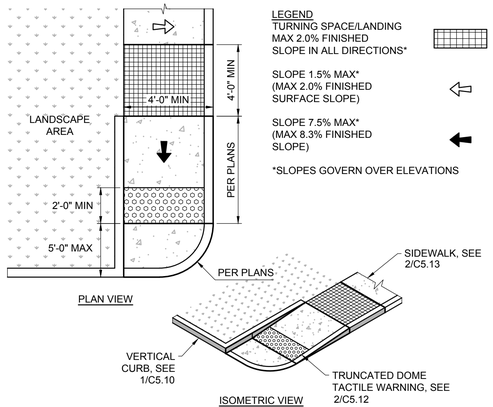
CONSTRUCTION SET 2/20/24



KEYNOTES:
1. CONCRETE FOR CURBING PER PROJECT SPECIFICATIONS
2. PAVEMENT SECTION PER CIVIL PLANS
3. SEE PLANS FOR IMPROVEMENTS AT BACK OF CURB. WHERE SIDEWALK OCCURS, THE SIDEWALK AND TOP OF CURB SHALL BE FLUSH. WHERE ABUTTING A PLANTER AREA, THE FINAL GRADE SHALL BE 1" MINIMUM BELOW TOP OF CURB, OR AS DIRECTED BY THE LANDSCAPE ARCHITECT

1 C5.10 VERTICAL CURB

NTS



LEGEND
TURNING SPACE/LANDING MAX 2.0% FINISHED SLOPE IN ALL DIRECTIONS*

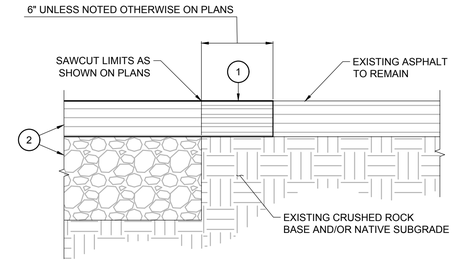
SLOPE 1.5% MAX* (MAX 2.0% FINISHED SURFACE SLOPE)

SLOPE 7.5% MAX* (MAX 8.3% FINISHED SLOPE)

*SLOPES GOVERN OVER ELEVATIONS

2 C5.10 CORNER CURB RAMP

NTS

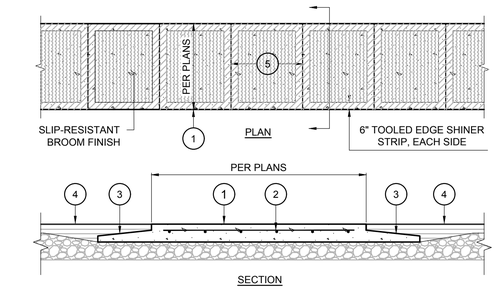


KEYNOTES:
1. ADDITIONALWIDTH OF EXISTING ASPHALT PAVEMENT TO BE SAWCUT AND REMOVED BEYOND THE SAWCUT LIMITS SHOWN ON PLANS
2. PROPOSED ASPHALT PAVEMENT SECTION PER 5/C5.10

NOTES:
A. DO NOT DISTURB THE EXISTING CRUSHED ROCK BASE OR NATIVE SUBGRADE UNDER THE ADDITIONAL WIDTH OF SAWCUT OR EXISTING ASPHALT PAVEMENT
B. PAVEMENT REPLACEMENT WITHIN THE ADDITIONAL SAWCUT LIMITS SHALL MATCH EXISTING OR PROPOSED SECTION, WHICHEVER IS GREATER

3 C5.10 ASPHALT PAVEMENT SAWCUT

NTS



KEYNOTES:
1. CONCRETE CROSSWALK: CONCRETE THICKNESS AND AGGREGATE BASE SECTION TO MATCH HEAVY DUTY VEHICULAR PAVEMENT SECTION PER PLANS
2. #4 REBAR AT 1'-0" ON CENTER, EACH WAY
3. ASPHALT TO CONCRETE TRANSITION PER
4. ADJACENT PAVEMENT SECTION PER PLANS. APPLY SEALANT AT JOINT
5. CONTROL AND EXPANSION JOINTS PER SIDEWALK DETAIL

NOTES:
A. CONCRETE AND REBAR PER PROJECT SPECIFICATIONS

4 C5.10 CONCRETE CROSSWALK

NTS

KEYNOTES:
1. ASPHALT PAVEMENT SECTION PER PROJECT SPECIFICATIONS
2. CRUSHED ROCK BASE SECTION PER PROJECT SPECIFICATIONS
3. COMPACTED SUBGRADE PER GEOTECHNICAL RECOMMENDATIONS

NOTES:
A. SEE PLANS FOR LOCATIONS OF LIGHT AND HEAVY DUTY PAVEMENTS. IF NONE SPECIFIED, USE LIGHT DUTY IN PASSENGER VEHICLE PARKING STALLS ONLY AND HEAVY DUTY IN ALL OTHER LOCATIONS
B. SEE PROJECT GEOTECHNICAL REPORT FOR PAVEMENT AND SUBGRADE PREPARATION RECOMMENDATIONS

5 C5.10 ASPHALT PAVEMENT SECTION

NTS

KEYNOTES:
1. CONCRETE PAVEMENT SECTION PER PROJECT SPECIFICATIONS
2. CRUSHED ROCK BASE SECTION PER PROJECT SPECIFICATIONS
3. COMPACTED SUBGRADE PER GEOTECHNICAL RECOMMENDATIONS

NOTES:
A. SEE PLANS FOR LOCATIONS OF LIGHT AND HEAVY DUTY PAVEMENTS. IF NONE SPECIFIED, USE LIGHT DUTY IN PASSENGER VEHICLE PARKING STALLS ONLY AND HEAVY DUTY IN ALL OTHER LOCATIONS
B. SEE PROJECT GEOTECHNICAL REPORT FOR PAVEMENT AND SUBGRADE PREPARATION RECOMMENDATIONS

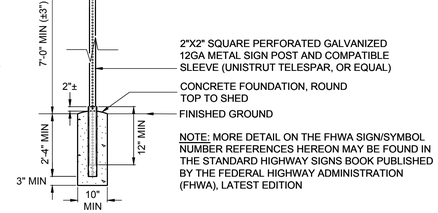
6 C5.10 CONCRETE PAVEMENT SECTION

NTS

KEYNOTES:
1. 4" WIDE WHITE STRIPE
2. WHITE RETROREFLECTIVE PAVEMENT MARKING SYMBOL (FHWA 3B-22) WITH BLUE RETRONREFLECTIVE BACKGROUND (41" TALL x 36" WIDE WITH 4" STROKE WIDTH). OFFSET BACKGROUND LIMIT 4" FROM SYMBOL
3. YELLOW RETRONREFLECTIVE "NO PARKING" PAVEMENT MARKING LEGEND ("NO" SHALL BE 12" TALL x 18" WIDE AND "PARKING" SHALL BE 12" TALL x 60" WIDE)
4. ACCESSIBLE PARKING SPACE SIGNAGE PER DETAIL HEREON. MAINTAIN 48" CLEAR ACCESS AROUND SIGN. ENSURE NO INTERFERENCE WITH PARKING STALL OVERHANG
5. WHEEL STOP PER DETAIL 3/C5.12
6. SEE PLANS FOR PROPOSED CURB/SIDEWALK/RAMPS/ETC IMPROVEMENTS TO ACCOMMODATE ACCESSIBLE PARKING STALL ACCESS

7 C5.10 ACCESSIBLE PARKING STALL

NTS



NOTE: MORE DETAIL ON THE FHWA SIGN/SYMBOL NUMBER REFERENCES HEREON MAY BE FOUND IN THE STANDARD HIGHWAY SIGNS BOOK PUBLISHED BY THE FEDERAL HIGHWAY ADMINISTRATION (FHWA), LATEST EDITION

KEYNOTES:
1. 4" CONCRETE OVER 2" ROCK BASE. CONCRETE AND BASE PER SPECIFICATIONS
2. CONCRETE VERTICAL CURB PER 1/C5.10

NOTES:
A. CHANNEL SLOPE TO MATCH SLOPE OF ADJACENT PAVEMENT
B. WHERE CHANNEL IS IN-LINE WITH CURB AND GUTTER, CONTINUE CROSS SECTION OF CURB AND GUTTER THROUGH LENGTH OF CHANNEL
C. SECTION MAY BE CONSTRUCTED MONOLITHICALLY

8 C5.10 CONCRETE CURB CHANNEL

NTS

KEYNOTES:
1. CONCRETE CURB PER 1/C5.10 . CONCRETE FOR CURBING PER PROJECT SPECIFICATIONS

NOTES:
A. IF CURBING IS REINFORCED, BEND REINFORCEMENT TO PASS UNDER CURB BREAK WHILE MAINTAINING 3" COVER ON REBAR

9 C5.10 CURB BREAK-ONSITE CURBS

NTS

KEYNOTES:
1. 48" MIN DIAMETER PRECAST CONCRETE MANHOLE WITH ECCENTRIC CONE
2. 48" MIN DIAMETER PRECAST CONCRETE FLAT TOP MANHOLE (USED WHEN LESS THAN 60" AVAILABLE FROM PIPE INVERT TO RIM). CONCENTRIC LID SHALL BE USED AND STEPS SHALL BE OMITTED WHEN DEPTH FROM RIM TO INVERT IS LESS THAN 3 FEET
3. PRECAST CONCRETE GRADE RING AS REQUIRED TO ACCOMMODATE PAVING SECTION (12" TOTAL, MAX)
4. MANHOLE FRAME AND COVER PER PROJECT SPECIFICATIONS, RIM ELEVATION PER PLANS
5. 6 1/2" MIN LONG MANHOLE STEPS AT 12" ON CENTER PER PROJECT SPECIFICATIONS. LOCATE WITHIN 24" OF COVER AND FLOOR OF MANHOLE, AND A MINIMUM OF 5" FROM PRECAST SECTION JOINT
6. PIPE SIZE, INVERT, AND SLOPE PER PLANS
7. PAVING SECTION PER PLANS

NOTES:
A. MANHOLE DIAMETER SHALL BE INCREASED, IF REQUIRED, TO PROVIDE A MINIMUM OF 12" SEPARATION BETWEEN PIPE CONNECTIONS, OR WHEN ANY PIPE DIAMETER IS GREATER THAN 1/2 THE DIAMETER OF THE MANHOLE
B. MANHOLE ACCESS COVER SHALL NOT BE LOCATED DIRECTLY OVER A PIPE CONNECTION UNLESS DIRECTED OTHERWISE BY THE ENGINEER
C. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF ALL MANHOLES FOR REVIEW AND APPROVAL BY THE ENGINEER PRIOR TO PROCURING MATERIALS
D. SELECTED MANHOLE SHALL MEET THE CRITERIA OF THE PROJECT SPECIFICATIONS AND BE INSTALLED ACCORDINGLY
E. INLET AND OUTLET PIPES CONNECTIONS SHALL BE COMPLIANT WITH PROJECT SPECIFICATIONS OR THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION, WHICHEVER IS MOST STRINGENT

10 C5.10 STORM SEWER MANHOLES

NTS

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

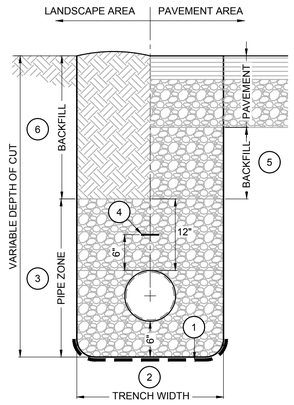
Delta	Issued As	Issue Date
1	PLAN CHECK	10/18/2023

SHEET TITLE:
CIVIL DETAILS

SHEET:
C5.10

JOB NO. **2220087.00**

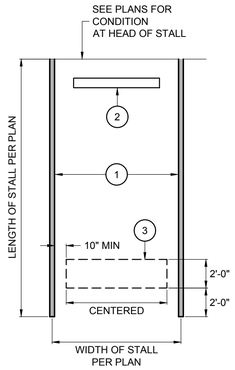
CONSTRUCTION SET 2/20/24



KEYNOTES:
1. INSTALL TRENCH STABILIZATION AS NECESSARY TO OBTAIN COMPACTION
2. TRENCH WIDTH SHALL ACCOMMODATE THE PIPE DIAMETER PLUS ONE ADDITIONAL PIPE DIAMETER ON EITHER SIDE OF THE PIPE, BUT IN NO CASE LESS THAN 6 INCHES OR MORE THAN 18 INCHES
3. PIPE ZONE TO CONSIST OF IMPORTED GRANULAR MATERIAL
4. TRACER WIRE PER PROJECT SPECIFICATIONS
5. BACKFILL IN PAVEMENT AREAS WITH IMPORTED GRANULAR MATERIAL TO PAVEMENT SUBGRADE ELEVATION
6. BACKFILL IN LANDSCAPE AREAS WITH NATIVE MATERIAL TO PLANTER SUBGRADE ELEVATION. MOUND TOP TO SHED AT 2% EACH DIRECTION

NOTES:
A. THIS DETAIL IS FOR USE ON PRIVATE PROPERTY ONLY. TRENCHING AND BACKFILL REQUIREMENTS FOR WORK IN THE PUBLIC RIGHT-OF-WAY SHALL BE COMPLIANT WITH THE STANDARDS OF THE AUTHORITY HAVING JURISDICTION
B. SEE GEOTECHNICAL REPORT AND PROJECT SPECIFICATIONS FOR RECOMMENDED MATERIALS AND FURTHER REQUIREMENTS (i.e. SIZE AND GRADATION OF GRANULAR MATERIALS, MINIMUM COMPACTION, MAXIMUM LIFT PLACEMENT, TRACER WIRE, ETC.)
C. IF GROUNDWATER IS ENCOUNTERED, CONSULT THE GEOTECHNICAL ENGINEER OF RECORD FOR ADDITIONAL RECOMMENDATIONS WITH REGARD TO TRENCHING, PIPE PLACEMENT, AND BACKFILL
D. REFER TO PROJECT SPECIFICATIONS FOR MINIMUM PIPE COVER AND ALTERNATE MATERIAL REQUIREMENTS. CONTRACTOR SHALL PREVENT CONSTRUCTION VEHICLES FROM DRIVING OVER PIPING WITH LESS THAN 12" COVER AT ANY POINT IN TIME DURING CONSTRUCTION

11 C5.11 UTILITY TRENCH BEDDING & BACKFILL
NTS



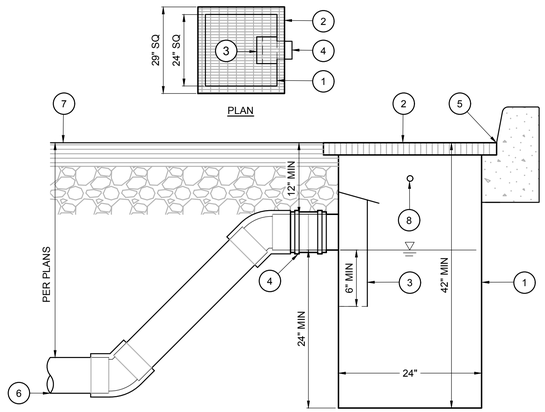
KEYNOTES:
1. 4" WIDE WHITE STRIPE
2. WHEEL STOP PER DETAIL 3/C5.12 , WHERE CALLED OUT ON PLANS
3. 8" (MIN) TALL WHITE PAVEMENT MARKING(S), 2" MIN STROKE, ORIENTED TO BOTTOM EDGE OF ZONE INDICATED, WHERE CALLED OUT ON PLANS. COMMON MARKINGS SHOWN BELOW

NOTES:
A. PAINT MATERIALS AND APPLICATION PER PROJECT SPECIFICATIONS

COMPACT
CARPOOL

COMMON PARKING STALL DESIGNATIONS

12 C5.11 PARKING STALL STRIPING
NTS

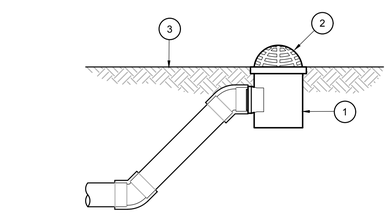


KEYNOTES:
1. PREFABRICATED, ASPHALT DIPPED, 10 GAUGE STEEL SUMPED CATCH BASIN WITH INTEGRAL GRATE FRAME
2. GRATE: HEAVY DUTY CAST IRON (ASTM A 48, CLASS 30B) BICYCLE SAFE
3. SEDIMENT TRAP WITH HINGED LID
4. INSTALL FLEXIBLE CLAMPED COUPLING ON INTEGRAL CATCH BASIN OUTLET. IMMEDIATELY TURN DOWN PIPING AT 45 DEGREES TO INTERSECT WITH THE SITE PIPING
5. LOCATE CATCH BASIN SUCH THAT THE EDGE OF GRATE FRAME IS INLINE WITH THE ABUTTING CURBLINE (WHERE APPLIES).
6. PIPE SIZE, INVERT, AND SLOPE PER PLANS
7. PAVING SECTION PER PLANS
8. 1/2 INCH TO 1 INCH DIAMETER WEEPHOLES, MINIMUM 1 PER SIDE. CONTRACTOR SHALL VERIFY COMPLIANCE WITH LOCAL JURISDICTION PRIOR TO PROCURING MATERIALS

NOTES:
A. ALL PRODUCTS USED SHALL BE COMPLIANT WITH BOTH THE UNIFORM AND LOCAL JURISDICTION PLUMBING CODES
B. WHERE ABUTTING CURBING, GRATE SHALL BE ORIENTED SO THAT THE ELONGATED PATTERN IS PERPENDICULAR TO THE CURB FACE

13 C5.11 STEEL CATCH BASIN
NTS

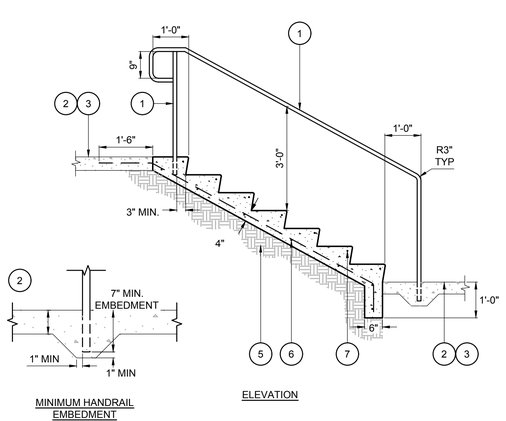
14 C5.11 NOT USED
NTS

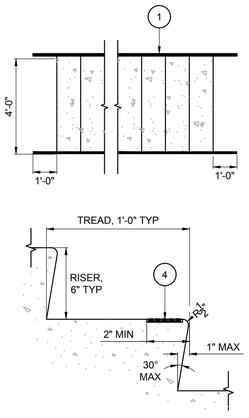


KEYNOTES:
1. PREFABRICATED PLASTIC SUMPED CATCH WITH OUTLET ADAPTER SIZED TO MATCH STORM LEADER PIPE. STORM LEADER TO BE 4 INCH DIAMETER UNLESS NOTED AS OTHERWISE ON PLANS
2. BLACK ATRIUM GRATE TO MATCH DRAIN BODY SIZE. GRATE SHALL BE 9 INCH SQUARE UNLESS NOTED AS OTHERWISE ON PLANS. MINIMUM OPEN SURFACE AREA FOR 9 INCH SQUARE GRATE SHALL BE 31.5 SQUARE INCHES, UNLESS OTHERWISE APPROVED BY THE ENGINEER
3. LANDSCAPE AREA PER PLANS. GRATE RIM ELEVATION SHALL BE SET FLUSH WITH FINAL LANDSCAPE GRADE, ALLOWING ATRIUM PORTION OF GRATE TO BE UNOBSTRUCTED

NOTES:
A. DRAIN BODY, GRATE, AND ADAPTERS SHALL BE PROCURED FROM THE SAME MANUFACTURER AND ASSEMBLED PER MANUFACTURER'S RECOMMENDATIONS

15 C5.11 LANDSCAPE AREA DRAIN
NTS

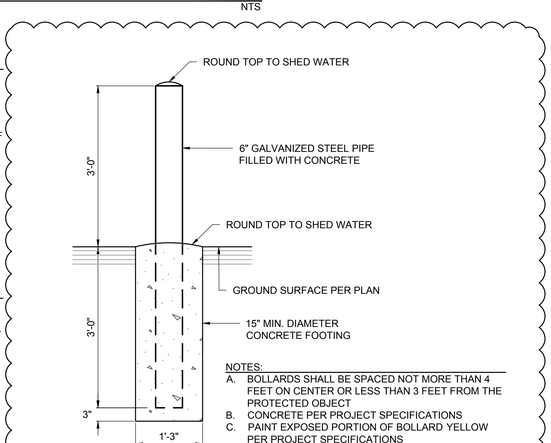




16 C5.11 CONCRETE STAIR
NTS

KEYNOTES:
1. 1-1/4" DIAMETER PIPE RAIL. BRUSH FINISH OR POWDERCOAT BLACK - COORDINATE WITH OWNER
2. CONCRETE SIDEWALK PER DETAIL
3. LANDINGS SHALL BE A SOLID SURFACE WITH WIDTH NOT LESS THAN THE WIDTH OF THE STAIRWAY THEY SERVE. LANDING SLOPE SHALL NOT EXCEED 2.0% IN ANY DIRECTION
4. VISUALLY CONTRASTING, SLIP RESISTANT NOSING
5. PROVIDE COMPACTED FILL PER GEOTECHNICAL REQUIREMENTS
6. #3 REBAR AT 18" OC EACH WAY, TYP.
7. #3 NOSE BAR, TYP.
8. CONCRETE CHEEK WALL WHERE STAIR IS ADJACENT TO LANDSCAPING

NOTES:
A. NUMBER OF RISERS PER PLANS
B. WHERE LENGTH OF STAIRWAY IS GREATER THAN 8', PROVIDE INTERMEDIATE VERTICAL POSTS AT EVEN SPACING, 4' MAXIMUM
C. MAINTAIN 4'-0" MINIMUM CLEAR BETWEEN HANDRAILS
D. TREADS TO BE SLOPED TO PROVIDE POSITIVE DRAINAGE, BUT AT NO POINT TO EXCEED 2.0%
E. SEE PROJECT SPECIFICATIONS FOR CONCRETE REQUIREMENTS



NOTES:
A. BOLLARDS SHALL BE SPACED NOT MORE THAN 4 FEET ON CENTER OR LESS THAN 3 FEET FROM THE PROTECTED OBJECT
B. CONCRETE PER PROJECT SPECIFICATIONS
C. PAINT EXPOSED PORTION OF BOLLARD YELLOW PER PROJECT SPECIFICATIONS

17 C5.11 6" PIPE BOLLARD
NTS

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Lam RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

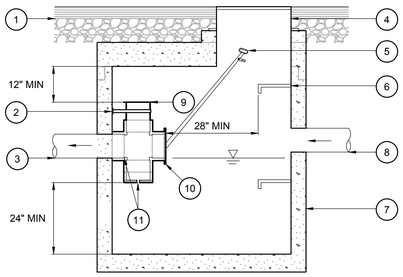
Delta	Issued As	Issue Date
1	PLAN CHECK	10/18/2023
2	RFI 39-R1	04/04/2024

SHEET TITLE:
CIVIL DETAILS

SHEET:
C5.11

JOB NO. **2220087.00**

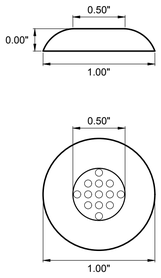
CONSTRUCTION SET 2/20/24



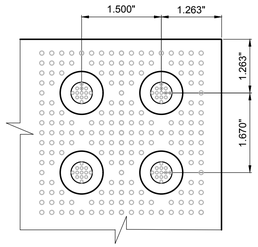
KEYNOTES:
1. PAVING SECTION PER PLANS
2. SECURE PIPE STACK TO MANHOLE WITH RUST PROOF TIE STRAPS AND BOLTS
3. OUTLET PIPE SIZE, INVERT, AND SLOPE PER PLANS
4. STANDARD MANHOLE FRAME AND COVER. RIM ELEVATION PER PLANS
5. LIFT HANDLE FOR SHEAR GATE, SEE DETAIL 10/C5.12
6. MANHOLE STEP PER DETAIL 10/C5.10
7. MANHOLE PER DETAIL 10/C5.10
8. INLET PIPE SIZE, INVERT, AND SLOPE PER PLANS
9. OVERFLOW SIZE AND ELEVATION = 12", 136.95
10. EXISTING SHEAR GATE
11. ORIFICE 1 SIZE AND ELEVATION = 1.16", 134.63

NOTE:
A. DETAIL REFLECTS EXISTING CONDITIONS. NO CHANGES ARE PROPOSED WITH THIS PERMIT.

1 C5.12 EXISTING POND D FLOW CONTROL MANHOLE
NTS



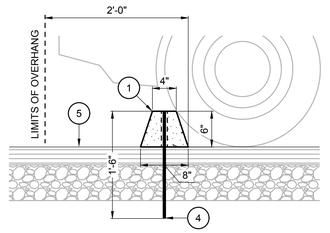
TRUNCATED DOME DETAIL



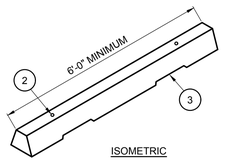
TRUNCATED DOME PANEL

NOTES:
A. PLACE CAST-IN-PLACE TRUNCATED DOME DETECTABLE WARNING TEXTURE IN THE LOWER 24" FOR THE FULL WIDTH OF THE RAMP
B. ARRANGE DOMES USING AN INLINE PATTERN AS SHOWN IN THE DETAIL ABOVE
C. COLOR OF DOME TEXTURE (OR PANELS) TO BE SAFETY YELLOW, UNLESS NOTED OTHERWISE ON PLANS
D. SURFACE APPLIED PANELS SHALL ONLY BE ALLOWED IN RETROFIT CONDITIONS AND WITH THE PRIOR APPROVAL OF THE ENGINEER

2 C5.12 TRUNCATED DOMES
NTS



SECTION

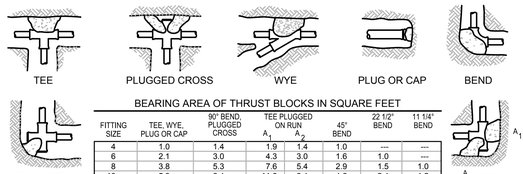


ISOMETRIC

KEYNOTES:
1. PRECAST WHEEL STOP. DIMENSIONS SHOWN ARE MINIMUMS
2. DOWEL HOLES (2 MINIMUM)
3. DRAINAGE SLOTS (2 MINIMUM)
4. DOWEL INTO PAVEMENT (2 MINIMUM). #4 REBAR OR PER MANUFACTURER'S RECOMMENDATIONS
5. FINISHED GROUND PER PLANS

NOTES:
A. INSTALL WHEEL STOP PER MANUFACTURER'S RECOMMENDATIONS

3 C5.12 PRECAST WHEEL STOP
NTS



BEARING AREA OF THRUST BLOCKS IN SQUARE FEET

FITTING SIZE	TEE, WYE, PLUG OR CAP	90° BEND, PLUGGED CROSS	TEE PLUGGED ON RUN A1	TEE PLUGGED ON RUN A2	45° BEND	22 1/2° BEND	11 1/4° BEND
4	1.0	1.4	1.9	1.4	1.0	---	---
6	2.1	3.0	4.3	3.0	1.6	1.0	---
8	3.8	5.3	7.6	5.4	2.9	1.5	1.0
10	5.9	8.4	11.8	8.4	4.6	2.4	1.2
12	8.5	12.0	17.0	12.0	6.6	3.4	1.7
14	11.5	16.3	23.0	16.3	8.9	4.6	2.3
16	15.0	21.3	30.0	21.3	11.6	6.0	3.0
18	19.0	27.0	38.0	27.0	14.6	7.6	3.8
20	23.5	33.3	47.0	33.3	18.1	9.4	4.7
24	34.0	48.0	68.0	48.0	26.2	13.6	6.8

NOTES:
1. CONCRETE THRUST BLOCKING TO BE POURED AGAINST UNDISTURBED EARTH
2. KEEP CONCRETE CLEAR OF JOINT AND ACCESSORIES.
3. THE REQUIRED THRUST BEARING AREAS FOR SPECIAL CONNECTIONS ARE SHOWN ENCIRCLED ON THE PLANS: E.G. 15 INDICATES 15 SQUARE FEET BEARING AREA REQUIRED.
4. IF NOT SHOWN ON PLANS REQUIRED BEARING AREAS AT FITTING SHALL BE AS INDICATED BELOW.
5. BEARING AREAS AND SPECIAL BLOCKING DETAILS SHOWN ON PLANS TAKE PRECEDENCE OVER BEARING AREAS AND BLOCKING DETAILS SHOWN ON THIS STANDARD DETAIL.
6. ABOVE BEARING AREAS BASED ON TEST PRESSURE OF 150 P.S.I. AND AN ALLOWABLE SOIL BEARING PRESSURE STRESS OF 2,000 POUNDS PER SQUARE FOOT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURES AND SOIL BEARING STRESSES, USE THE FOLLOWING EQUATION:

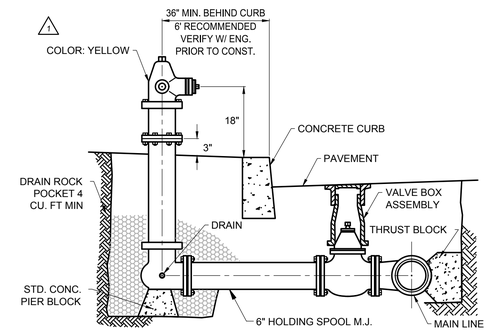
BEARING AREA = (TEST PRESSURE/150) x (2000/SOIL BEARING STRESS) x (TABLE VALUE)

4 C5.12 WATERLINE THRUST BLOCKING
N.T.S.

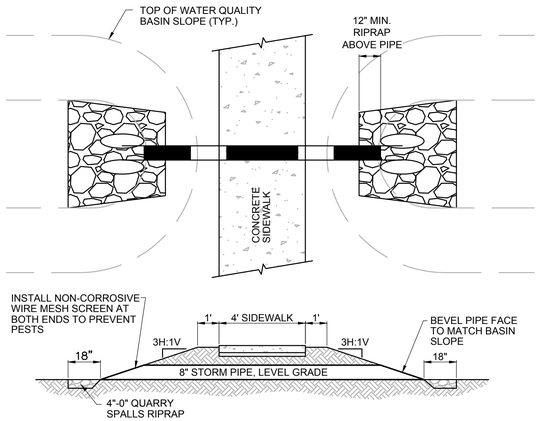
PIPE SIZE	FITTING TYPE	MINIMUM MECHANICAL JOINT RESTRAINT LENGTH		
		36"+ COVER	30" COVER	24" COVER
3"	90°	16'	19'	24'
3"	45°	7'	8'	10'
8"	90°	27'	37'	45'
8"	45°	11'	16'	19'
8"	8" X 8" TEE	20'	15'X15'X20'	20'X20'X13'
8"	8" X 6" TEE	20'	10'X10'X5'	12'X12'X7'
6"	90°	21'	29'	35'
6"	45°	9'	12'	15'

NOTE:
1. IF PIPE LENGTH IS LESS THAN MINIMUM RESTRAINT LENGTH, RESTRAIN THE FULL PIPE LENGTH. PIPE RESTRAINT DESIGN IS BASED ON MEGA-LUG. DESIGN TEST PRESSURE=200 PSI, DESIGN SAFETY FACTOR=1.5, SOIL TYPE GM, DEPTH OF BURY 3'
2. DEPTH OF BURY SHALL BE 3' MINIMUM, TYPICAL. WHERE UTILITY EXCAVATION ENCOUNTERS BEDROCK, DEPTH OF BURY MAY BE REDUCED TO 24" MINIMUM

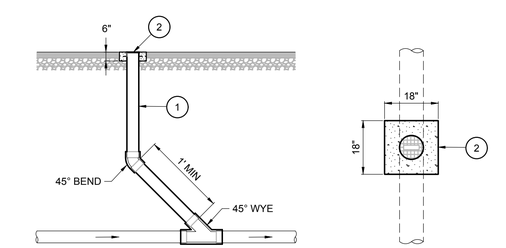
5 C5.12 MECHANICAL JOINT RESTRAINT
N.T.S.



6 C5.12 PRIVATE FIRE HYDRANT
NTS



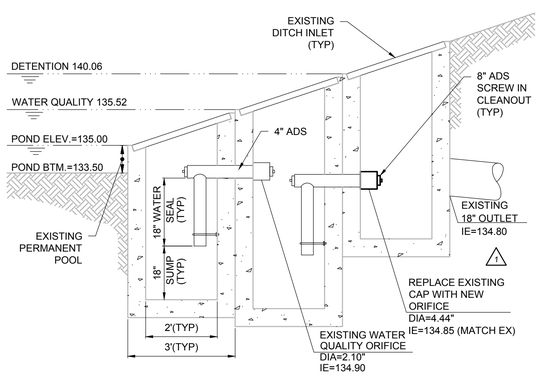
7 C5.12 CULVERT CROSSING
N.T.S.



KEYNOTES:
1. CLEANOUT PIPING AND FITTINGS TO BE OF THE SAME SIZE (8" MAX) AND MATERIAL AS THE PIPING IT IS SERVING
2. CLEANOUT LID & FRAME: HEAVY DUTY CAST IRON ACCESS BOX, SCORIATED CAST IRON COVER, THREADED BRONZE PLUGS, MOUNTED IN 4,000 PSI CONCRETE COLLAR.

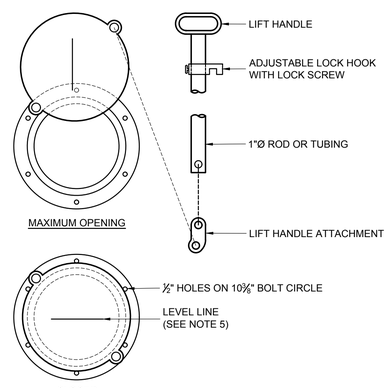
NOTES:
A. CONCRETE COLLAR MAY BE OMITTED IN LANDSCAPE AREAS. USE PLASTIC PIPE CAP AND SET 3 INCHES ABOVE GRADE

8 C5.12 CLEANOUT
NTS



NOTE: POND OUTLET DETAILS SHOWN REFLECT EXISTING CONDITIONS.
NO MODIFICATIONS ARE PROPOSED WITH THIS PERMIT.

9 C5.12 EXISTING POND C OUTLET DETAIL
N.T.S.



NOTES
A. THE FRAME AND LADDER OR STEPS ARE TO BE OFFSET SO THAT: THE SHEAR GATE IS VISIBLE FROM THE TOP; THE CLIMB-DOWN SPACE IS CLEAR OF RISER AND GATE; THE FRAME IS CLEAR OF THE CURB (IF APPLICABLE)
B. THE SHEAR GATE SHALL BE MADE OF ALUMINUM ALLOY IN ACCORDANCE WITH ASTM B 26M AND ASTM B 275, DESIGNATION ZG32A; OR CAST IRON IN ACCORDANCE WITH ASTM A 48, CLASS 30B
C. THE LIFT HANDLE SHALL BE MADE OF SIMILAR METAL TO THE GATE (TO PREVENT GALVANIC CORROSION)
D. A NEOPRENE RUBBER GASKET IS REQUIRED BETWEEN THE PIPE MOUNTING FLANGE AND THE GATE FLANGE
E. INSTALL THE GATE SO THAT THE LEVEL-LINE IS LEVEL WHEN THE GATE IS CLOSED
F. THE MATING SURFACES OF THE LID AND THE BODY SHALL BE MACHINED TO PROPER FIT
G. ALL SHEAR GATE BOLTS SHALL BE STAINLESS STEEL
H. THE SHEAR GATE MAXIMUM OPENING SHALL BE CONTROLLED BY LIMITED HINGE MOVEMENT, A STOP TAB, OR SOME OTHER DEVICE
I. ALTERNATIVE SHEAR GATE DESIGNS ARE ACCEPTABLE, IF MATERIAL SPECIFICATIONS ARE MET AND FLANGE BOLT PATTERN MATCHES. CONTRACTOR TO SUBMIT SHOP DRAWINGS TO ENGINEER PRIOR TO PROCURING PRODUCT OR CONSTRUCTION

10 C5.12 SHEAR GATE
NTS

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

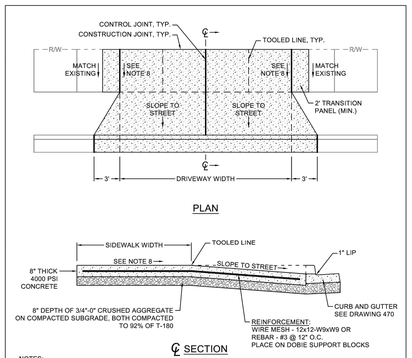
Delta	Issued As	Issue Date
1	PLANCHECK	10/18/2023
2	PLANCHECK	12/15/2023

SHEET TITLE:
CIVIL DETAILS

SHEET:
C5.12

JOB NO. **2220087.00**

CONSTRUCTION SET 2/20/24



PLAN

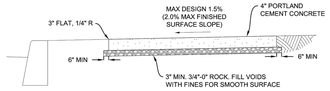
℄ SECTION

NOTES:

1. CONTROL JOINTS SHALL BE WEAKENED PLANE TYPE FORMED TO A DEPTH 2-3/4" WITH TOOLED EDGES (1/4"R EDGE, 3" FLAT) EXCEPT IN CURB AND GUTTER (1/4"R EDGE ONLY). NO MESH ACROSS CONTROL JOINTS.
2. TOOLED LINES ARE FOR COMESTIC PURPOSES ONLY, 1/4"R EDGE, 3" FLAT.
3. FOR LOCATION AND WIDTH OF DRIVEWAYS, MEET THE REQUIREMENTS OF THE TUALATIN DEVELOPMENT CODE.
4. FINISH CONCRETE APPROACH RAMP WITH BRUSH FINISH TRANSVERSE TO CENTERLINE.
5. POUR APPROACH SLAB AND WINGS (BOTH 8" THICK) MONOLITHIC WITH CURB AND GUTTER IF SO DIRECTED BY ENGINEER.
6. BEFORE OPENING TO TRAFFIC, ATTAIN 4,000 PSI COMPRESSIVE STRENGTH, ENTRAINED AIR 4% - 7%.
7. REMOVE THE CURB AND GUTTER IN ITS ENTIRETY AND POUR BACK AS A MONOLITHIC POUR IF AN EXISTING CURB AND GUTTER IS MODIFIED AS PART OF A DRIVEWAY APPROACH.
8. SIDEWALK CROSS SLOPE TO BE MAX 1.5% DESIGN SLOPE (2.0% MAX FINISHED SURFACE SLOPE).

1 C5.13

CITY OF TUALATIN, OR	COMMERCIAL DRIVEWAY APPROACH CURBSIDE PLANTER STRIP	
REVISED: 11/2020	SCALE: NOT TO SCALE	DRAWING NO. 440
EFFECTIVE: 12/2020	DRAFTED BY: C. FERGESON	
	APPROVED BY: K. MCMILLAN	



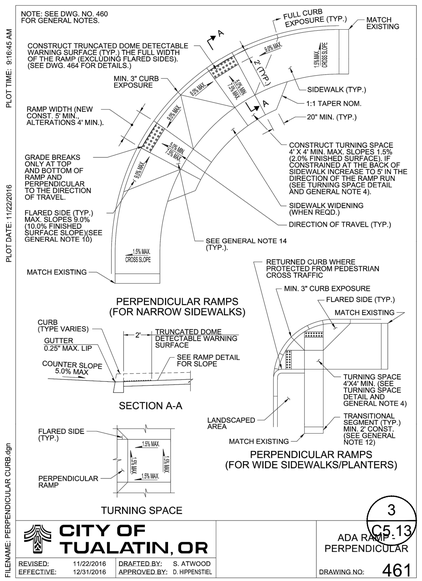
CROSS SECTION

NOTES:

1. PLATE COMPACT THE SIDEWALK SUBGRADE AND BASE ROCK TO SATISFACTION OF THE CITY ENGINEER. DO NOT COMPACT EARLIER THAN 7 DAYS AFTER CONSTRUCTING CURB OR BEFORE COMPLETING THE PLACEMENT OF PAVEMENT BASE ROCK. FILL VOIDS WITH FINES WHERE NECESSARY TO PROVIDE SMOOTH SURFACE.
2. USE PORTLAND CEMENT CONCRETE WITH 4-7% AIR ENTRAINMENT AND A 28 DAY COMPRESSIVE STRENGTH OF AT LEAST 3,300 PSI.
3. CONSTRUCT TRANSVERSE CONTROL JOINTS OF THE WEAKENED PLANE TYPE, 1-1/2" CONCRETE DEPTH AND SPACE AT 5' INTERVALS AND AT POINTS OF TANGENCY.
4. FORM CONTROL JOINTS WITH A SMOOTH FACE SQUARE TO THE SIDEWALK.
5. WHERE A STRUCTURE IS SURROUNDED BY OR IS ADJACENT TO THE SIDEWALK (EXCLUDING CURB), PROVIDE SEPARATION WITH ½" PREMOLDED ASPHALT-IMPREGNATED, NON-EXTRUDING EXPANSION JOINT MATERIAL.
6. BROOM FINISH THE SURFACE TRANSVERSE TO THE DIRECTION OF TRAFFIC.
7. FINISH ALL EDGES WITH ½" RADIUS EDGER WITH 3" FLAT.
8. WHERE PRACTICAL, ALIGN SIDEWALK CONTROL JOINTS WITH CURB JOINTS.
9. IN ACCORDANCE WITH THE UNITED STATES ACCESS BOARD PROPOSED PUBLIC RIGHTS-OF-WAY ACCESSIBILITY GUIDELINES, IF THE EXISTING ADJACENT SIDEWALK PANEL CROSS SLOPE IS GREATER THAN 2.0%, CONSTRUCT A TRANSITIONAL PANEL THAT IS AT LEAST 2' LONG BETWEEN THE NEW SIDEWALK PANEL AND THE EXISTING SIDEWALK. EXTEND TRANSITION PANEL TO THE NEAREST CONTROL JOINT IF LESS THAN 2' OF THE EXISTING PANEL REMAINS.

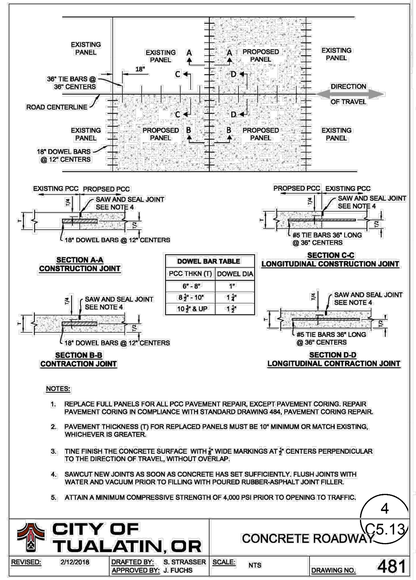
2 C5.13

CITY OF TUALATIN, OR	CONCRETE SIDEWALK	
REVISED: 7/23/2018	DRAFTED BY: S. STRASSER	SCALE: NTS
	APPROVED BY: J. FUCHS	DRAWING NO. 475



3 C5.13

CITY OF TUALATIN, OR	ADA RAMP - PERPENDICULAR	
REVISED: 11/22/2016	DRAFTED BY: S. ATWOOD	DRAWING NO: 461
EFFECTIVE: 12/31/2016	APPROVED BY: D. HIPPENSTIEL	



SECTION A-A CONSTRUCTION JOINT

DOWEL BAR TABLE	
PCC THKN (T)	DOWEL DIA
6" - 8"	1"
8 ½" - 10"	1 ½"
10 ½" & UP	1 ¾"

SECTION C-C LONGITUDINAL CONSTRUCTION JOINT

SECTION B-B CONTRACTION JOINT

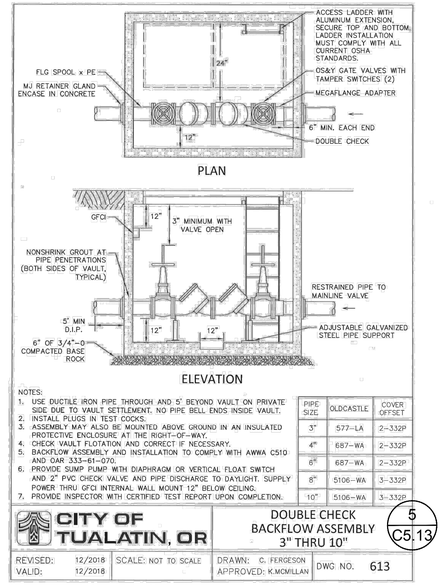
SECTION D-D LONGITUDINAL CONTRACTION JOINT

NOTES:

1. REPLACE FULL PANELS FOR ALL PCC PAVEMENT REPAIR, EXCEPT PAVEMENT CORING. REPAIR PAVEMENT CORING IN COMPLIANCE WITH STANDARD DRAWING 484, PAVEMENT CORING REPAIR.
2. PAVEMENT THICKNESS (T) FOR REPLACED PANELS MUST BE 10" MINIMUM OR MATCH EXISTING, WHICHEVER IS GREATER.
3. TINE FINISH THE CONCRETE SURFACE WITH ¾" WIDE MARKINGS AT 2" CENTERS PERPENDICULAR TO THE DIRECTION OF TRAVEL, WITHOUT OVERLAP.
4. SAWCUT NEW JOINTS AS SOON AS CONCRETE HAS SET SUFFICIENTLY, FLUSH JOINTS WITH WATER AND VACUUM PRIOR TO FILLING WITH POURED RUBBER-ASPHALT JOINT FILLER.
5. ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI PRIOR TO OPENING TO TRAFFIC.

4 C5.13

CITY OF TUALATIN, OR	CONCRETE ROADWAY	
REVISED: 2/12/2018	DRAFTED BY: S. STRASSER	SCALE: NTS
	APPROVED BY: J. FUCHS	DRAWING NO. 481



PLAN

ELEVATION

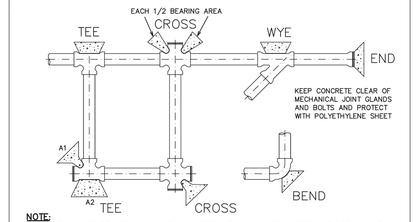
NOTES:

1. USE DUCTILE IRON PIPE THROUGH AND 5' BEYOND VAULT ON PRIVATE SIDE DUE TO VAULT SETTLEMENT, NO PIPE BELL ENDS INSIDE VAULT.
2. INSTALL PLUGS IN TEST COCKS.
3. ASSEMBLY MAY ALSO BE MOUNTED ABOVE GROUND IN AN INSULATED PROTECTIVE ENCLOSURE AT THE RIGHT-OF-WAY.
4. CHECK VAULT FLOTATION AND CORRECT IF NECESSARY.
5. BACKFLOW ASSEMBLY AND INSTALLATION TO COMPLY WITH AWWA C510 AND OAR 333-61-070.
6. PROVIDE SUMP PUMP WITH DIAPHRAGM OR VERTICAL FLOAT SWITCH AND 2" PVC CHECK VALVE AND PIPE DISCHARGE TO DAYLIGHT. SUPPLY POWER THRU GFCI INTERNAL WALL MOUNT 12" BELOW CEILING.
7. PROVIDE INSPECTOR WITH CERTIFIED TEST REPORT UPON COMPLETION.

PIPE SIZE	OLDCASTLE	COVER OFFSET
3"	577-LA	2-332P
4"	687-WA	2-332P
6"	687-WA	2-332P
8"	5106-WA	3-332P
10"	5106-WA	3-332P

5 C5.13

CITY OF TUALATIN, OR	DOUBLE CHECK BACKFLOW ASSEMBLY 3" THRU 10"	
REVISED: 12/2018	SCALE: NOT TO SCALE	DRAWN: C. FERGESON
VALID: 12/2018		APPROVED: K.MCMILLAN
		DWG NO. 613



NOTE:
THRUST BLOCKS TO BE USED ONLY WHEN CONNECTING TO AN UNKNOWN LENGTH OF PIPE AND AT ALL LIVE TAPS. OTHERWISE, USE APPROVED MJ RETAINER GLANDS AND RESTRAINED PIPE.

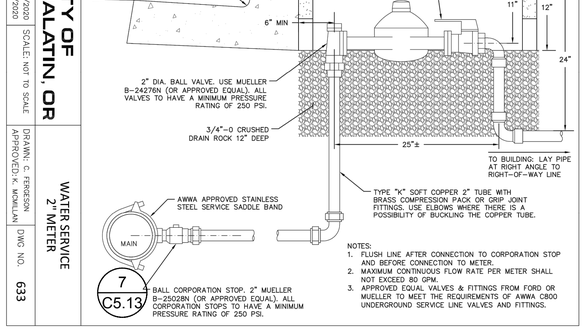
FITTING SIZE INCHES	BEARING AREA SQ. FT. BEND 90° CROSS TEE A1	TEE A2	TEE WYE END	BEND 45°	BEND 22.5°	BEND 11.25°
3	1.31	1.85	0.92	0.71	0.36	0.18
4	1.92	2.71	1.36	1.04	0.53	0.27
6	3.97	5.61	2.80	2.15	1.09	0.55
8	6.82	9.65	4.82	3.69	1.88	0.95
10	10.26	14.52	7.26	5.55	2.83	1.42
12	14.51	20.53	10.26	7.86	4.00	2.01
14	19.50	27.58	13.79	10.55	5.38	2.70
16	25.22	35.67	17.83	13.65	6.96	3.50
18	31.68	44.80	22.40	17.14	8.74	4.39
20	38.87	54.97	27.48	21.03	10.72	5.39
24	55.45	78.42	39.21	30.01	15.30	7.69

DESIGN CRITERIA:

1. TEST PRESSURE 150 LB/SQ.IN., CONCRETE 3300-1 1/2", AFTER POURING BLOCK DO NOT APPLY TEST PRESSURE FOR AT LEAST FIVE DAYS.
2. SAFETY FACTOR 1.5, SOIL SANDY SILT WITH BEARING STRENGTH 3,000 LB/SQ.FT.
3. CONCRETE POURED AGAINST UNDISTURBED SOIL OR SOIL COMPACTED TO AT LEAST 92% MODIFIED PROCTOR DENSITY, T-180.
4. SUBMIT BEARING AREA CALCULATIONS WITH CHANGE IN SOIL OR TEST PRESSURE.

6 C5.13

CITY OF TUALATIN, OR	PIPE JOINT RESTRAINT BEARING THRUST BLOCKS	
REVISED: 11/2020	SCALE: NOT TO SCALE	DRAWN: C. FERGESON
VALID: 12/2020		APPROVED: K.MCMILLAN
		DWG NO. 620

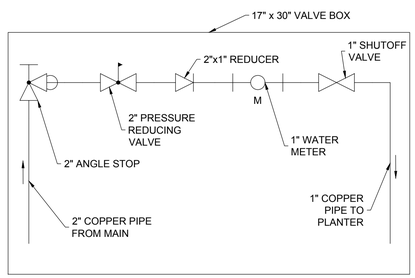


NOTES:

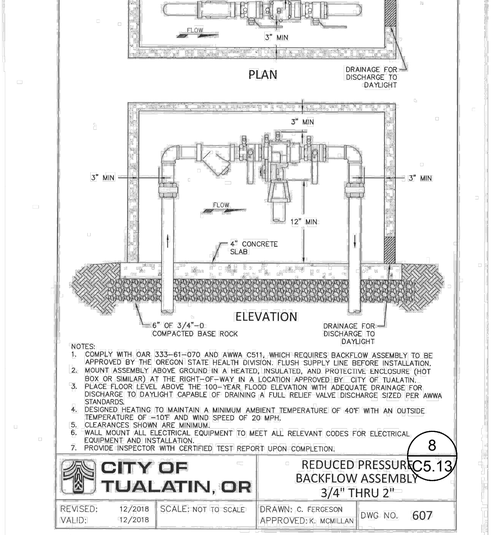
1. FLUSH LINE AFTER CONNECTION TO CORPORATION STOP AND BEFORE CONNECTION TO METER.
2. MAXIMUM CONTINUOUS FLOW RATE PER METER SHALL NOT EXCEED 80 GPM.
3. APPROVED EQUAL VALVES & FITTINGS FROM FORD OR MUELLER TO MEET THE REQUIREMENTS OF AWWA C800 UNDERGROUND SERVICE LINE VALVES AND FITTINGS.

7 C5.13 BALL CORPORATION STOP. 2" MUELLER B-25028N (OR APPROVED EQUAL). ALL CORPORATION STOPS TO HAVE A MINIMUM PRESSURE RATING OF 250 PSI.

CITY OF TUALATIN, OR	WATER SERVICE 2" METER	
REVISED: 09/2020	DRAWN: C. FERGESON	DWG NO. 633
VALID: 10/2020	APPROVED: K. MCMILLAN	
	SCALE: NOT TO SCALE	



9 C5.13 PUBLIC IRRIGATION SCHEMATIC DETAIL
NTS



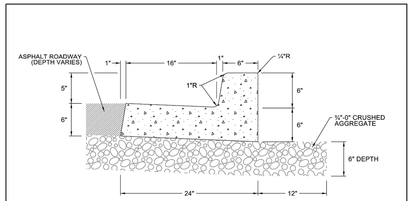
ELEVATION

NOTES:

1. COMPLY WITH OAR 333-61-070 AND AWWA C511, WHICH REQUIRES BACKFLOW ASSEMBLY TO BE APPROVED BY THE OREGON STATE HEALTH DIVISION. FLUSH SUPPLY LINE BEFORE INSTALLATION.
2. MOUNT ASSEMBLY ABOVE GROUND IN A HEATED, INSULATED, AND PROTECTIVE ENCLOSURE (HOT BOX OR SIMILAR) AT THE RIGHT-OF-WAY IN A LOCATION APPROVED BY CITY OF TUALATIN.
3. PLACE FLOOR LEVEL ABOVE THE 100-YEAR FLOOD ELEVATION WITH ADEQUATE DRAINAGE FOR DISCHARGE TO DAYLIGHT CAPABLE OF DRAINING A FULL RELIEF VALVE DISCHARGE SIZED PER AWWA STANDARDS.
4. DESIGNED HEATING TO MAINTAIN A MINIMUM AMBIENT TEMPERATURE OF 40°F WITH AN OUTSIDE TEMPERATURE OF -10°F AND WIND SPEED OF 20 MPH.
5. CLEARANCES SHOWN ARE MINIMUM.
6. WALL MOUNT ALL ELECTRICAL EQUIPMENT TO MEET ALL RELEVANT CODES FOR ELECTRICAL EQUIPMENT AND INSTALLATION.
7. PROVIDE INSPECTOR WITH CERTIFIED TEST REPORT UPON COMPLETION.

8 C5.13

CITY OF TUALATIN, OR	REDUCED PRESSURE BACKFLOW ASSEMBLY 3/4" THRU 2"	
REVISED: 12/2018	SCALE: NOT TO SCALE	DRAWN: C. FERGESON
VALID: 12/2018		APPROVED: K. MCMILLAN
		DWG NO. 607



NOTES:

1. CONCRETE, 4%-7% AIR, SHALL ATTAIN 3300 PSI COMPRESSIVE STRENGTH AT 28 DAYS.
2. CONTROL JOINTS OF THE WEAKENED PLANE TYPE, DOWN THROUGH THE CURB TO HALF THE DEPTH OF THE GUTTER, SHALL BE SPACED AT 15' INTERVALS AND AT POINTS OF TANGENCY. FINISH THE EXPOSED EDGE WITH 1/4" RADIUS EDGER. DO NOT USE EXPANSION JOINTS.
3. CONSTRUCTION JOINTS SHALL BE FORMED WITH A SMOOTH FACE SQUARE TO THE CURB AND DOWN THROUGH HALF THE DEPTH OF THE GUTTER. FINISH FUTURE EXPOSED EDGE WITH 1/4" RADIUS EDGER. THE LOWER HALF OF THE GUTTER CROSS SECTION SHALL BE LEFT WITH A ROUGH EXPOSED AGGREGATE SURFACE TO INTERLOCK WITH A FUTURE EXTENSION OF THE CURB AND GUTTER.
4. BASE ROCK UNDER THE CURB AND ALSO PLACED 12" BEYOND THE BACK OF THE CURB SHALL BE COMPACTED TO 91% OF T-180 MAXIMUM DENSITY.
5. DRAINAGE WEEP HOLES OF 3" DIAMETER PVC SCHEDULE 40 PIPE SHALL BE PLACED THROUGH THE CURB 1/2" ABOVE THE GUTTER INVERT AND EXTEND 3" BEYOND THE BACK OF THE CURB AT POSITIONS SHOWN ON THE PLANS, LOW POINTS IN THE CURB, OR WHERE DETERMINED BY THE ENGINEER.
6. THE BACK OF THE CURB SHALL BE BACKFILLED NOT EARLIER THAN 7 DAYS AFTER CONCRETE PLACEMENT AND PRIOR TO THE COMPACTION OF BASE AND TOP COURSE ROCK AND PAVEMENT.
7. THE EXPOSED SURFACES SHALL BE BROOM FINISHED IN THE DIRECTION OF GUTTER FLOW.

9 C5.13

CITY OF TUALATIN, OR	CURB AND GUTTER	
REVISED: 04/07/2017	SCALE:	DRAFTED BY: M. PALMER
EFFECTIVE: 04/24/2017		APPROVED BY: J. FUCHS
		DRAWING NO. 470

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

Client
LAM RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED

THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

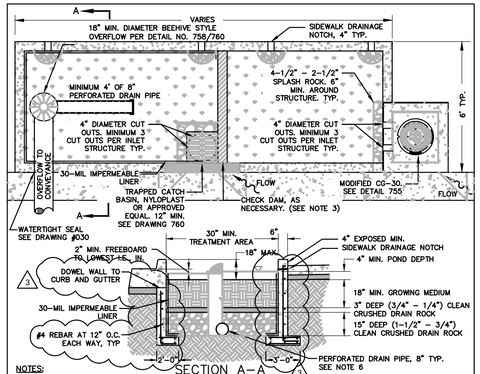
REVISION SCHEDULE		
Delta	Issued As	Issue Date
1	PLAN CHECK	12/15/2023
2	PLAN CHECK	01/12/2024
3	RFI 021	02/12/2024

SHEET TITLE:
CITY OF TUALATIN DETAILS

SHEET:
C5.13

JOB NO. **2220087.00**

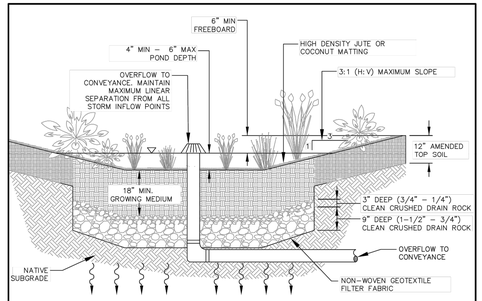
CONSTRUCTION SET 2/20/24



NOTES:

1. THIS DETAIL REPRESENTS A FLOW THROUGH PLANTER WITH FULL LENGTH CONCRETE WALLS AND FLOOR. FOR INFILTRATION PLANTER CONCRETE WALLS W/FOOTING WILL BE REQUIRED AS SHOWN ON DRAWING #750.
2. WALL'S STRUCTURAL DESIGN AND DIMENSIONS DETERMINED BY ENGINEER.
3. PROVIDE PROTECTION FROM ALL VEHICLE TRAFFIC, EQUIPMENT STAGING, AND FOOT TRAFFIC IN PROPOSED FACILITY AREAS PRIOR TO, DURING, AND AFTER CONSTRUCTION.
4. SIDEWALK ELEVATION MUST BE SET ABOVE CHECK DAM AND INLET/OUTLET ELEVATIONS TO ALLOW OVERFLOW TO DRAIN TO STREET OR PIPED OVERFLOW SYSTEM AS APPLICABLE.
5. PLANTER SHALL BE FLAT BOTTOM IN ALL DIRECTIONS TO WITHIN 1 INCH. CHECK DAMS SHALL BE PLACED ACCORDING TO INDIVIDUAL PROJECT PLANS PER DETAIL 762. PROVIDE 2" MIN FREEBOARD.
6. STREET SIDE CURB NOTCHES TO BE LOCATED AS IDENTIFIED ON PROJECT PLANS.
7. SIDEWALK CURB NOTCH: 1" LOWER THAN SIDEWALK, SLOPED TO FACILITY. SIDEWALK DRAINAGE NOTCHES SHALL ALIGN WITH SIDEWALK CONTRACTION JOINTS AND LOW POINTS.
8. PERFORATED PIPE IN INFILTRATION FACILITIES: BOTTOM OF PIPE SHALL BE SET AT 2 1/2" ABOVE SUBGRADE. PERFORATED PIPE IN FLOW THROUGH FACILITIES: BOTTOM OF PIPE SHALL BE SET AT BASE OF DRAIN ROCK LAYER.
9. HYDRANTS, UTILITY POLES, OR ANY UTILITY BOXES PLACED WITHIN PLANTER MUST BE APPROVED BY JURISDICTION IN WRITING.
10. ACTUAL ELEVATIONS AND DIMENSIONS TO BE CONSTRUCTED AS IDENTIFIED ON PROJECT PLANS.
11. ENSURE THAT A DOWNSTREAM CATCH BASIN IS IN PLACE FOR EMERGENCY OVERFLOW.

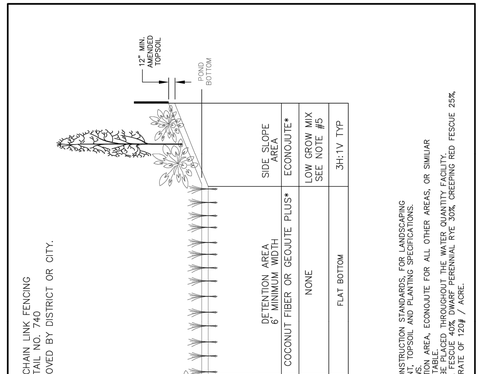
STREET SIDE PLANTER WITHOUT STREET PARKING (WITH PROJECT SPECIFIC MODIFICATIONS) — 1 / C5.14
DRAWING NO. 745 — REVISED 10-31-19



NOTES:

1. PROVIDE OVERFLOW CONVEYANCE SYSTEM, OVERFLOW CONVEYANCE HEIGHT TO ALLOW 4" MINIMUM - 6" MAXIMUM PONDING, PIPING TO A MINIMUM OF THE PLUMBING CODE OR CONVEY THE 25 YEAR STORM.
2. IF USING THE NATIVE SOIL INFILTRATION FOR SIZING, THE RATE SHALL BE DETERMINED BY ASTM STANDARD TESTING METHODS.
3. FLOW DISSIPATERS SHOULD BE USED IF ENTRY SLOPE TO THE BASIN IS GREATER THAN 3:1. FLOW DISSIPATERS SHALL BE CONSTRUCTED OUT OF ROCK OR GRAVEL PER DESIGN FLOW VELOCITY AT ENTRY OF THE FACILITY.
4. TREATMENT AREA SHALL HAVE HIGH DENSITY JUTE OR COCONUT MATTING OVER 18" MINIMUM OF GROWING MEDIUM OR BASE STABILIZATION METHOD AS APPROVED BY THE DISTRICT.
5. VEGETATION TO BE USED IN WET AREAS OF THE BASIN IS PER APPENDIX "A" FOR THE WET MOISTURE CONDITIONS.
6. VEGETATION TO BE USED IN OTHER AREAS OF BASIN CONFORMS TO PLANT LIST OF THIS HANDBOOK AS APPROVED BY DISTRICT.

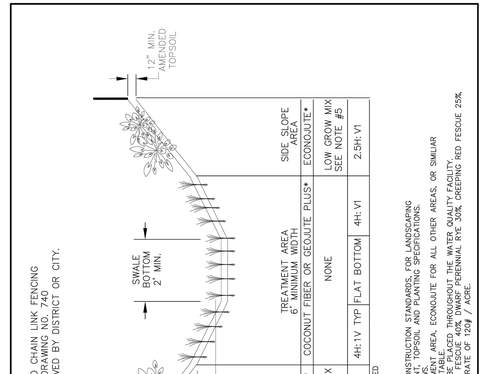
NON-STRUCTURAL INFILTRATION PLANTER/RAIN GARDEN — 2 / C5.14
DRAWING NO. 725 — REVISED 10-31-19



NOTES:

1. REFER TO CHAPTER 4, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS APPROVED BY CWS.
3. JUTE MATTING- GEOJUTE PLUS IN DETENTION AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILAR
4. 12" INCHES OF AMENDED TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUANTITY FACILITY.
5. FREEBOARD AREA SEED MIX, DWARF PERENNIAL RYE 30%, CREEPING RED FESCUE 25%, COLONIAL BENT GRASS 5% APPLY AT A RATE OF 120# / ACRE.

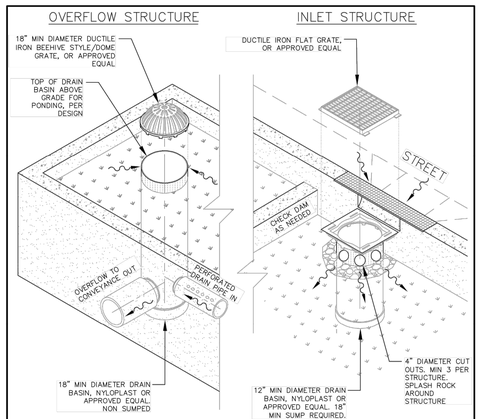
DETENTION POND — 3 / C5.14
DRAWING NO. 700 — REVISED 10-31-19



NOTES:

1. REFER TO CHAPTER 4, CWS DESIGN & CONSTRUCTION STANDARDS, FOR LANDSCAPING REQUIREMENTS INCLUDING TREE PLACEMENT, TOPSOIL AND PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS APPROVED BY CWS.
3. JUTE MATTING- GEOJUTE PLUS IN DETENTION AREA, ECONOJUTE FOR ALL OTHER AREAS, OR SIMILAR
4. 12" INCHES OF AMENDED TOPSOIL SHALL BE PLACED THROUGHOUT THE WATER QUALITY FACILITY.
5. FREEBOARD AREA SEED MIX, DWARF PERENNIAL RYE 30%, CREEPING RED FESCUE 25%, COLONIAL BENT GRASS 5% APPLY AT A RATE OF 120# / ACRE.

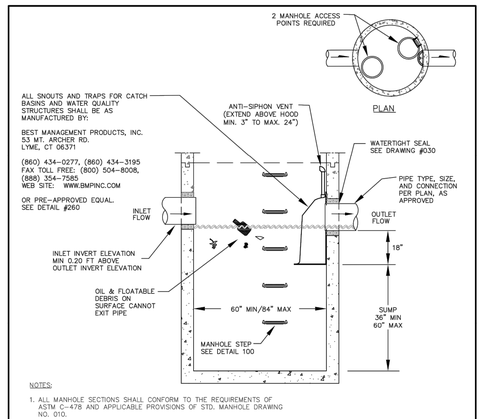
WATER QUALITY SWALE — 4 / C5.14
DRAWING NO. 705 — REVISED 10-31-19



NOTE:

1. PLACE STRUCTURE ON 3/4" TO 0" BASE ROCK PLACED OVER NATIVE SUBGRADE.

OVERFLOW/INLET STRUCTURE — 5 / C5.14
DRAWING NO. 760 — REVISED 10-31-19



NOTES:

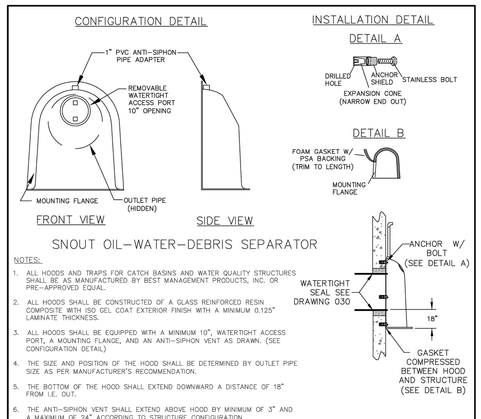
1. ALL MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STD. MANHOLE DRAWING NO. 010.
2. INLET AND OUTLET PIPE NOT TO EXCEED 18" DIA.
3. PROVIDE SPECIAL DETAIL FOR SNOUT, EXCEEDING 18" DIA.
4. THE SIZE AND POSITION OF THE HOOD SHALL BE DETERMINED BY THE OUTLET PIPE SIZE AS PER MANUFACTURER'S RECOMMENDATIONS.
5. ANCHORING HARDWARE FOR THE HOOD SHALL BE EMBEDDED INTO CONCRETE, ANCHORING INTO GROUT IS NOT AUTHORIZED.
6. THE SURFACE OF THE STRUCTURE WHERE THE HOOD IS MOUNTED SHALL BE FINISHED SMOOTH AND FREE OF LOOSE MATERIAL.
7. INSTALL PER MANUFACTURER'S INSTRUCTIONS.
8. ALL MANHOLE FLAT TOPS SHALL CONFORM TO ASTM C-478 AND ARE DESIGNED TO MEET H-20 TRAFFIC LOADING.

SUMP VOLUME AVAILABLE PER DEPTH OF SUMP	36" MINIMUM	60" MAXIMUM
60" M.H.=	58.9 CF	98.1 CF
72" M.H.=	84.8 CF	141.3 CF
84" M.H.=	115.4 CF	192.4 CF

PROVIDE SPECIAL DETAIL FOR VOLUME REQUIREMENTS EXCEEDING 192.4 CF

SUMP VOLUME REQUIREMENTS
20 CF/1.0 CFS OF INFLOW
58.9 CF MINIMUM REQUIRED

WATER QUALITY MANHOLE (SNOUT) A — 6 / C5.14
DRAWING NO. 250 — REVISED 10-31-19



NOTES:

1. ALL HOODS AND TRAPS FOR CATCH BASINS AND WATER QUALITY STRUCTURES SHALL BE AS MANUFACTURED BY BEST MANAGEMENT PRODUCTS, INC. OR PRE-APPROVED EQUAL.
2. ALL HOODS SHALL BE CONSTRUCTED OF A GLASS REINFORCED RESIN COMPOSITE WITH ISO GEL COAT EXTERIOR FINISH WITH A MINIMUM 0.125" LAMINATE THICKNESS.
3. ALL HOODS SHALL BE EQUIPPED WITH A MINIMUM 10", WATERTIGHT ACCESS PORT, A MOUNTING FLANGE, AND AN ANTI-SIPHON VENT AS DRAWN. (SEE CONFIGURATION DETAIL)
4. THE SIZE AND POSITION OF THE HOOD SHALL BE DETERMINED BY OUTLET PIPE SIZE AS PER MANUFACTURER'S RECOMMENDATION.
5. THE BOTTOM OF THE HOOD SHALL EXTEND DOWNWARD A DISTANCE OF 18" FROM I.E. OUT.
6. THE ANTI-SIPHON VENT SHALL EXTEND ABOVE HOOD BY MINIMUM OF 3" AND A MAXIMUM OF 24" ACCORDING TO STRUCTURE CONFIGURATION.
7. THE SURFACE OF THE STRUCTURE WHERE THE HOOD IS MOUNTED SHALL BE FINISHED SMOOTH AND FREE OF LOOSE MATERIAL.
8. THE HOOD SHALL BE SECURELY ATTACHED TO STRUCTURE WALL WITH STAINLESS STEEL BOLTS AND OIL-RESISTANT GASKET.
9. ANCHOR BOLTS SHALL BE INSTALLED INTO THE CONCRETE OF THE STRUCTURE'S WALL. (NOT WITHIN GROUT)
10. INSTALLATION INSTRUCTIONS SHALL BE FURNISHED WITH MANUFACTURER SUPPLIED INSTALLATION KIT.
    KIT SHALL INCLUDE:
    A. INSTALLATION INSTRUCTIONS
    B. PVC ANTI-SIPHON VENT PIPE AND ADAPTER
    C. OIL-RESISTANT CRUSHED CELL FOAM GASKET WITH PSA BACKING
    D. 3/8" STAINLESS STEEL BOLTS
    E. ANCHOR SHIELDS

BEST MANAGEMENT PRODUCTS, INC.
53 MT. ARCHER RD.
LYME, CT 06371
TOLL FREE: (800) 504-8008 (888) 354-7585
WEB SITE: WWW.BMPINC.COM

WHEN ORDERING, SPECIFY IF THE STRUCTURE IN WHICH THE HOOD WILL BE ATTACHED IS FLAT OR ROUND.

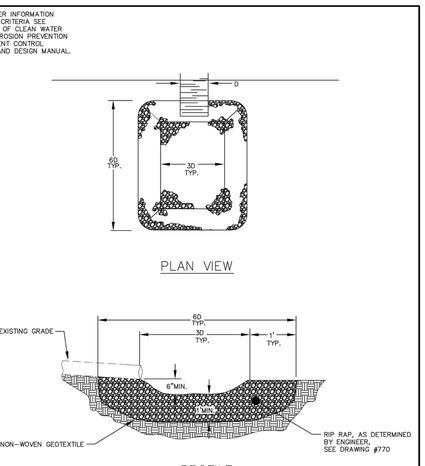
WATER QUALITY MANHOLE (SNOUT) B — 7 / C5.14
DRAWING NO. 260 — REVISED 10-31-19

PROJECT SPECIFIC MANHOLES:		
MANHOLE ID	WQ MH DIAM	WQ MH SUMP
WQ MH A-1	60"	3'
WQ MH D-1	60"	3'
WQ MH D-2	60"	3'
WQ MH C	60"	5'
EX WQ MH POND D	60"	5'

2

1 NOTE: THESE SUMP DEPTHS ARE IN ADDITION TO THE 18" BELOW THE IE OF THE OUTLET PIPE.

FOR FURTHER INFORMATION ON DESIGN CRITERIA SEE CHAPTER 4 OF CLEAN WATER SERVICES EROSION PREVENTION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL.



NOTE:

1. ADDITIONAL BMP'S ARE REQUIRED WHEN DISCHARGING SEDIMENT LADEN WATER.

OUTLET PROTECTION RIP RAP — 8 / C5.14
DRAWING NO. 820 — REVISED 10-31-19

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknzie.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

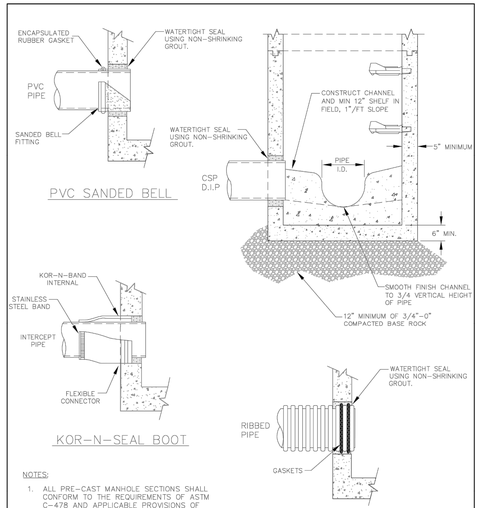
Delta	Issued As	Issue Date
1	PLANCHECK	10/18/2023
2	RFI 087	04/26/2024
3	RFI 138	07/03/2024

SHEET TITLE:
CWS DETAILS

SHEET:
C5.14

JOB NO.
2220087.00

CONSTRUCTION SET 2/20/24

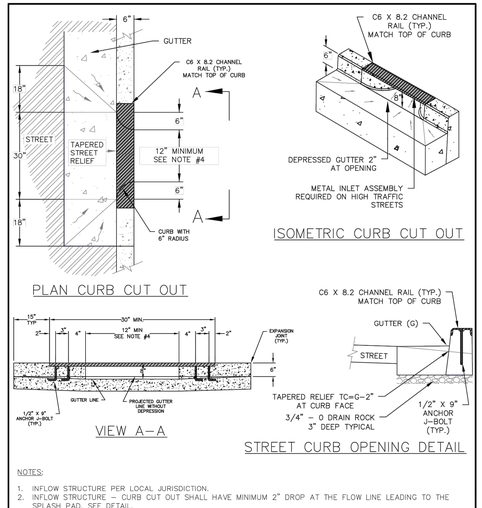


NOTES:

1. ALL PRE-CAST MANHOLE SECTIONS SHALL CONFORM TO THE REQUIREMENTS OF ASTM C-478 AND APPLICABLE PROVISIONS OF STANDARD DRAWING NO. 010.
2. ALTERNATE METHODS TO BE APPROVED BY CITY/DISTRICT.
3. BOOTS TO BE SIZED PER MANUFACTURER'S RECOMMENDATIONS/SPECIFICATIONS.

MANHOLE CONNECTIONS — 1 / C5.15 — REVISED 10-31-19

DRAWING NO. 030

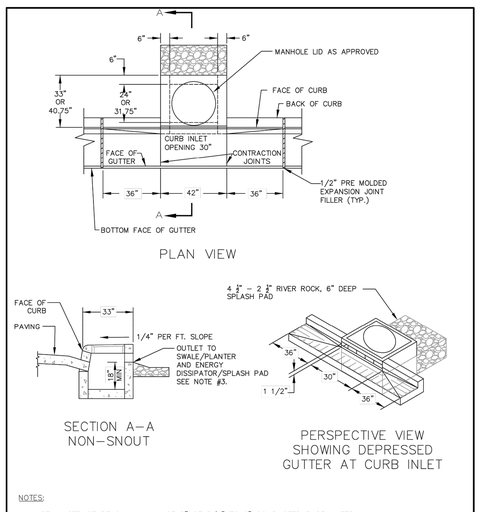


NOTES:

1. INFLOW STRUCTURE PER LOCAL JURISDICTION.
2. INFLOW STRUCTURE – CURB CUT OUT SHALL HAVE MINIMUM 2" DROP AT THE FLOW LINE LEADING TO THE SPLASH PAD, SEE DETAIL.
3. CURB PROFILE PER LOCAL JURISDICTION.
4. CURB CUT OUT TO MATCH INLET GRATE DIMENSION.

CURB CUT OUT TOP RAIL — 2 / C5.15 — REVISED 10-31-19

DRAWING NO. 753

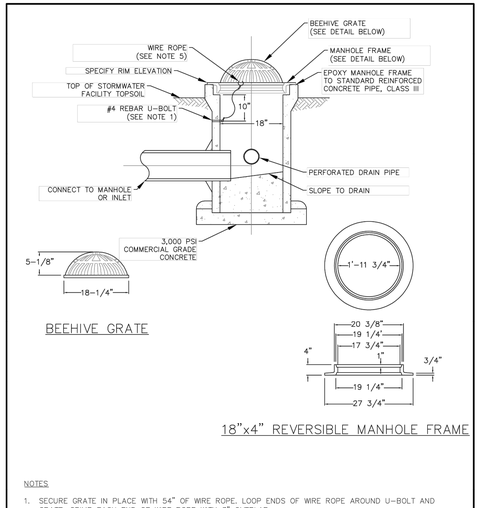


NOTES:

1. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4" TO 0" COMPACTED BASE MATERIAL.
2. INSTALL ENERGY DISSIPATER/SPLASH PAD AT OUTFALL OF STRUCTURE.
3. FOUR INCH DIAMETER CUT OUTS, MINIMUM 3 CUT OUTS EVENLY SPACED PER INLET STRUCTURE, TYPICAL.

MODIFIED CG-30 INLET WITH SUMP — 3 / C5.15 — REVISED 10-31-19

DRAWING NO. 755

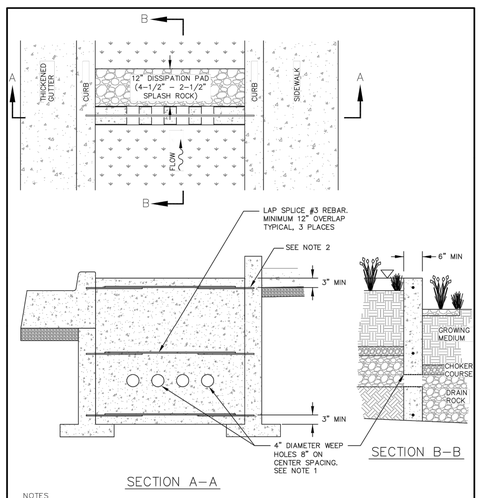


NOTES

1. SECURE GRATE IN PLACE WITH 54" OF WIRE ROPE, LOOP ENDS OF WIRE ROPE AROUND U-BOLT AND GRATE. CRIMP EACH END OF WIRE ROPE WITH 3" OVERLAP.
2. DRILL 2" DEEP HOLES INTO PIPE AND EPOXY #4 REBAR U-BOLT (2"X 4") IN HOLES.
3. GRATE TO BE CAST IRON, ASTM A48 CL30.
4. SIZE INLET BASED ON CALCULATED FLOWS AND MANUFACTURERS RECOMMENDATIONS.
5. WIRE ROPE BETWEEN 1/8"-3/16" DIAMETER, STAINLESS STEEL, 7 STRANDS OF 19 WIRES.

BEEHIVE INLET — 4 / C5.15 — REVISED 10-31-19

DRAWING NO. 758

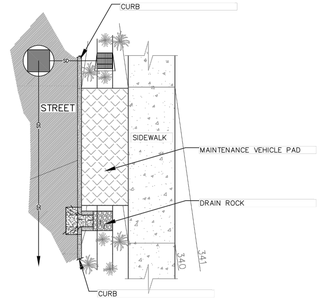


NOTES

1. WEEP HOLES TO BE PLACED WITHIN DRAIN ROCK LAYER. TOP OF WEEP HOLE TO BE SAME ELEVATION AS THE TOP OF DRAIN ROCK LAYER, ON LOWEST SIDE OF CHECK DAM.
2. MINIMUM 3" REBAR EMBEDMENT FOR CURB AND PLANTER WALL.
3. CHECK DAM SPACING SHALL PROVIDE A MINIMUM OF 2" FREEBOARD, AND AN 18" MAXIMUM DROP FROM ANY ADJACENT CURB TO TOP OF FACILITY GROWING MEDIUM.

CONCRETE CHECK DAM — 5 / C5.15 — REVISED 10-31-19

DRAWING NO. 762



NOTES:

1. PUBLICLY MAINTAINED WATER QUALITY FACILITIES SHALL BE PROVIDED WITH MAINTENANCE ACCESS PER R&O CHAPTER 4.07.6.
2. PROVIDE ACCESS FOR ROADSIDE WATER QUALITY FACILITY AS ILLUSTRATED, OR PER LOCAL JURISDICTION. DESIGN FOR TRAFFIC VOLUME AND/OR SIGHT DISTANCE MAY BE REQUIRED. MINIMUM 20' LONG, 7' WIDE PERVIOUS OR IMPERVIOUS PAVEMENT CAPABLE OF SUPPORTING A TYPICAL MAINTENANCE VEHICLE SHALL BE LOCATED WITHIN 10' OF ANY SUMPED STRUCTURES.
3. IF PERVIOUS PAVERS ARE USED, A STRUCTURAL BORDER SHALL BE DESIGNED TO PREVENT SHIFTING OF THE PAVERS.

PUBLIC WATER QUALITY FACILITY ACCESS — 6 / C5.15 — REVISED 10-31-19

DRAWING NO. 765

RIPRAP:

- ROCK FOR RIPRAP SHALL BE ANGULAR IN SHAPE.
- THICKNESS OF A SINGLE ROCK SHALL NOT BE LESS THAN ONE-THIRD ITS LENGTH.
- ROUNDED ROCK WILL NOT BE ACCEPTED UNLESS APPROVED BY THE DISTRICT.

RIPRAP INSTALLATION:

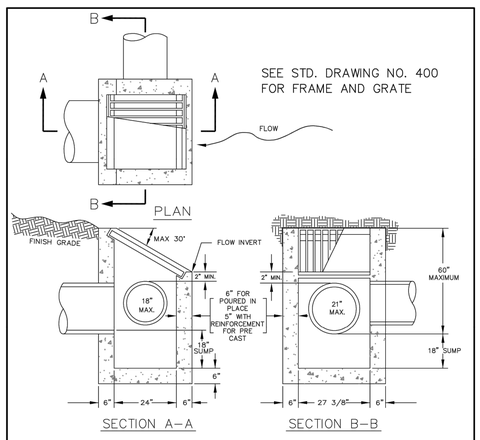
- EXCAVATE BELOW FINISH GRADE TO DEPTH & DIMENSIONS SHOWN ON APPROVED PLANS.
- INSTALL WOVEN GEOTEXTILE FABRIC.
- PLACE RIP RAP TO FINISH GRADE.

- GRADE RIPRAP SHALL BE THE CLASS AND SIZE OF ROCK ACCORDING TO THE FOLLOWING:

CLASS 50	CLASS 100	CLASS 200	CLASS 700	CLASS 2000	PERCENT (BY WEIGHT)
		WEIGHT OF ROCK (LBS)			
50-30	100-60	200-140	700-500	2000-1400	20
30-15	60-25	140-80	500-200	1400-700	30
15-2	25-2	80-8	200-20	700-40	40
2-0	2-0	8-0	20-0	40-0	10

RIP RAP DETAILS — 7 / C5.15 — REVISED 10-31-19

DRAWING NO. 790



NOTES:

1. ALL PRE CAST SECTIONS SHALL CONFORM TO REQUIREMENTS OF ASTM C-478.
2. INSTALL STRUCTURE ON MINIMUM OF 8" OF 3/4" – 0" COMPACTED BASE MATERIAL.
3. PRE CAST REINFORCEMENT SHALL BE REBAR MEETING ASTM A615 GRADE 60 OR WELDED WIRE MEETING ASTM A497
4. ALL POURED IN PLACE CONCRETE SHALL HAVE A 28 DAY STRENGTH OF 3000 PSI AND SLUMP OF 2" TO 4".
5. PRE-CAST STRUCTURE'S CONFORMING TO O.D.O.T. TYPE G-2 CATCH BASIN DESIGN/WITH DITCH INLET TOP ARE AN ACCEPTABLE ALTERNATE. ALL GRATE MATERIALS SHALL MEET C.W.S. STANDARDS AS SHOWN ON DETAIL #400

DITCH INLET — 8 / C5.15 — REVISED 10-31-19

DRAWING NO. 390

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

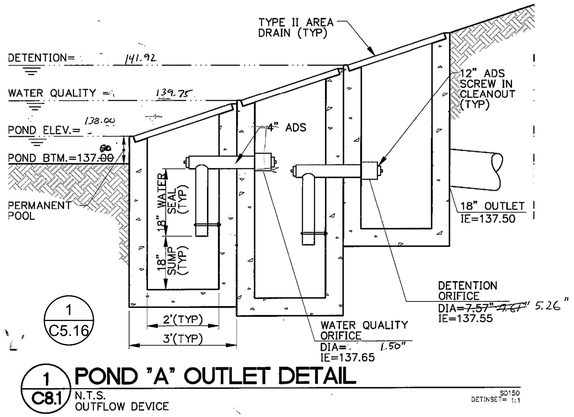
Delta	Issued As	Issue Date
1	PLAN CHECK	10/18/2023

SHEET TITLE:
CWS DETAILS

SHEET:
C5.15

JOB NO. **2220087.00**

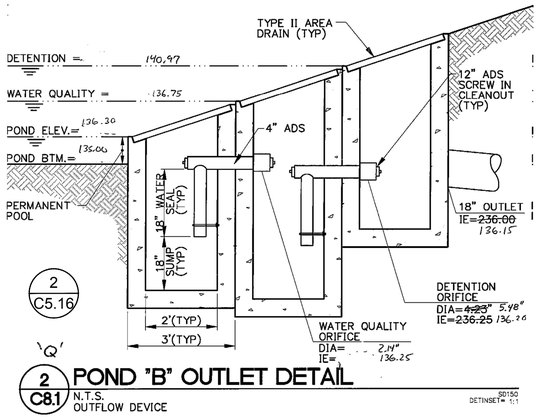
CONSTRUCTION SET 2/20/24



1 C8.1 **POND "A" OUTLET DETAIL**

N.T.S.
OUTFLOW DEVICE

DETAIL SHOWN IS FROM 2001 NOVELLUS CAMPUS DEVELOPMENT, NO CHANGES TO OUTLET STRUCTURE ARE PROPOSED WITH NEW CONSTRUCTION.



2 C8.1 **POND "B" OUTLET DETAIL**

N.T.S.
OUTFLOW DEVICE

DETAIL SHOWN IS FROM 2001 NOVELLUS CAMPUS DEVELOPMENT, NO CHANGES TO OUTLET STRUCTURE ARE PROPOSED WITH NEW CONSTRUCTION.

Architecture ▪ Interiors
Planning ▪ Engineering

Portland, OR
503.224.9560
Vancouver, WA
360.695.7879
Seattle, WA
206.749.9993
www.mcknze.com

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Client
LAM RESEARCH

Project
LAM RESEARCH TUALATIN

NEW OFFICE BUILDING

© MACKENZIE 2023
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISION SCHEDULE

Delta	Issued As	Issue Date
1	PLAN CHECK	10/18/2023

SHEET TITLE:
NOVELLUS STORM POND DETAILS

1

SHEET:
C5.16

JOB NO. **2220087.00**

CONSTRUCTION SET 2/20/24

APPENDIX E

2001 NOVELLUS STORM REPORT

Storm Calculations

Novellus

Tualatin, Oregon

Project Number:000321
Dated: 2/14/01
REVISED: 3/6/01

Description:

Novellus is located on the northwest corner of SW Leveton Drive and SW 108th Avenue. The site is comprised of approximately 58 acres. The site currently has two buildings remaining from the previous Oki site. The two buildings were purchased by Novellus along with the property.

Water quality will be provided for all of the site including the existing impervious areas. Water quality will be provided to meet USA requirements which are to treat the "summer" storm or the first 0.36" of rainfall falling in a four hour period. Dry detention ponds with a permanent pool will be the method employed to accomplish treatment. The ponds are sized for full build out of the Novellus Master Plan as submitted in the Industrial Master Plan with the City of Tualatin.

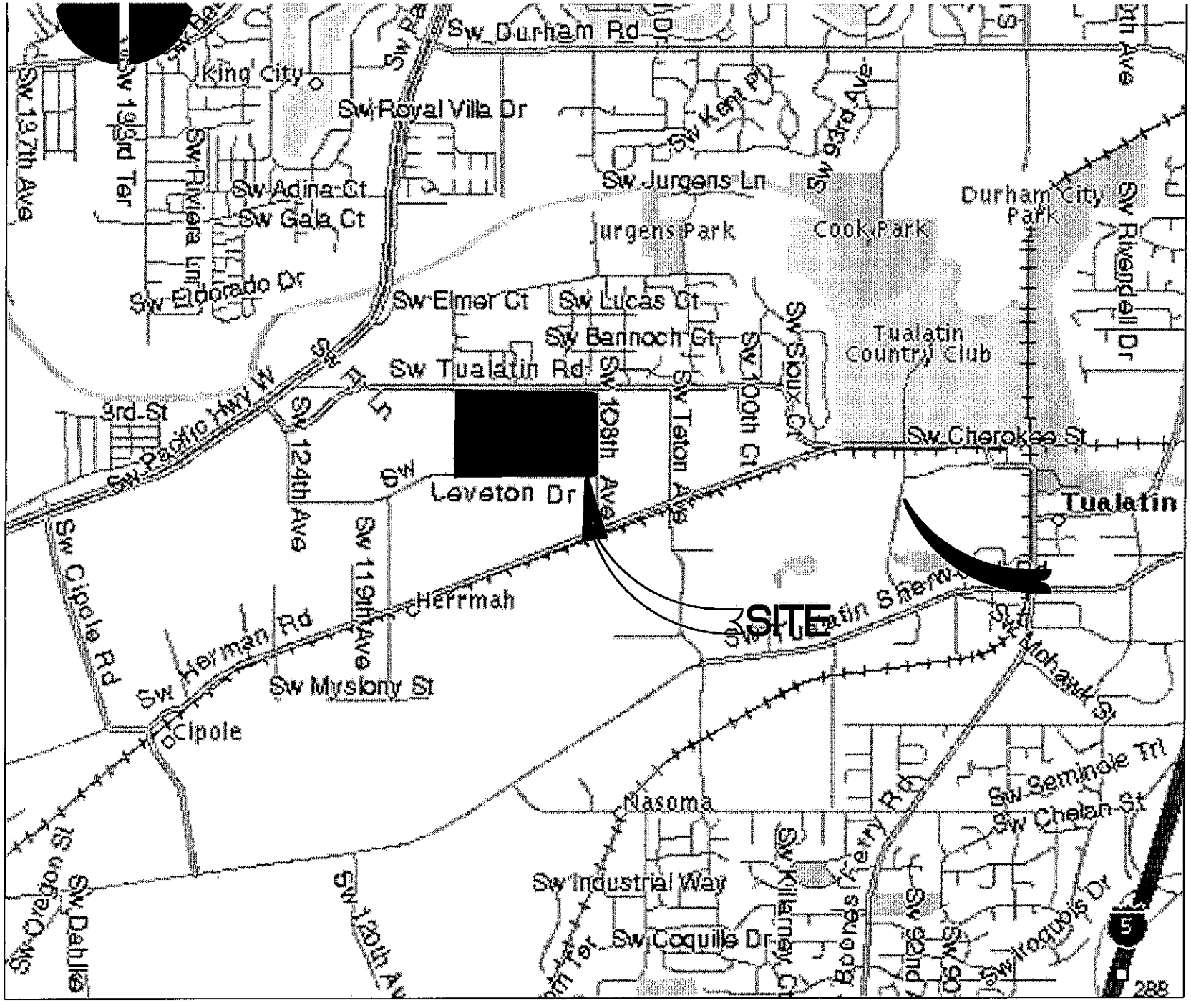
Detention will be provided to limit runoff from the site to match existing runoff for storms upto the 25yr event. Each pond will serve approximately 25% of the full built out site. The SCS based software program "WaterWorks" has been used to design the detention ponds.

All pipes have been designed to convey the 25yr storm using SCS methodology.

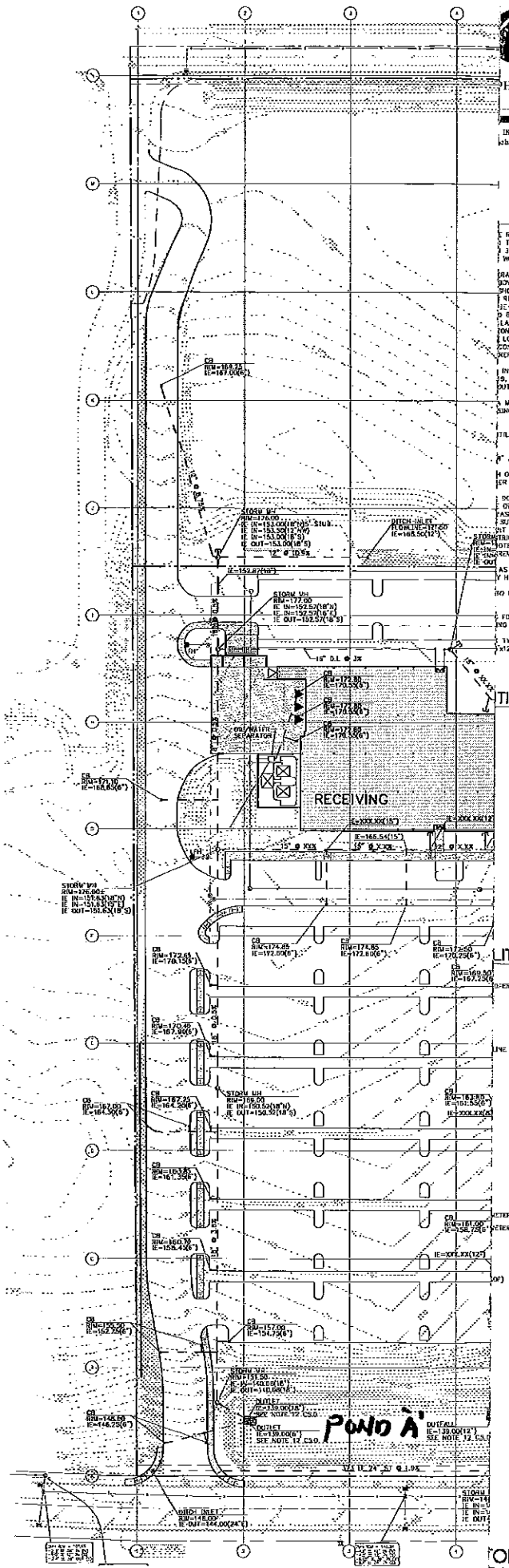
Table of Contents

A. Vicinity Map
B. Site Map
C. Areas with full 'build-out'
D. Water Quality Volumes required
E. Detention Summary
F. SCS Soils Map
G. SCS Soils Classification
H, SCS Curve Number
I. Pond 'A' Total Volume
J. Pond 'A' Detention Volume
K. Water Quality Orifice Sizing
L. Pond 'A' Pond Outlet
M. Pond 'A' computer detention calc's
N. Pond 'B' Total Volume
O. Pond 'B' Detention Volume
P. Water Quality Orifice Sizing
Q. Pond 'B' Pond Outlet
R. Pond 'B' computer detention calc's
S. Pond 'C' Total Volume
T. Pond 'C' Detention Volume
U. Water Quality Orifice Sizing
V. Pond 'C' Pond Outlet
W. Pond 'C' computer detention calc's
X. Pipe sizing areas
Y. Computer volumes for pipe sizing
Z. Pipe sizing calc's

Attachment 'A' Drainage Map



`A' VICINITY MAP



HIC SCALE

IN FEET)
ch = 50 ft.

E REQUIREMENTS OF THE CITY OF TUALATIN,
THE CURRENT EDITION OF THE UNIFORM
BUILDING CODE. ALL WORK WITHIN THE
WORKS PERMIT.

RALLY DIAGRAMMATIC. THEY DO NOT
OW REQUIRED FOR INSTALLATION IN THE
SHOW EVERY DIMENSION, COMPONENT
REQUIRED TO COMPLETE THE PROJECT.
E-CHECKED AND COORDINATED WITH
D BEFORE BEGINNING CONSTRUCTION.
LAYING WITHIN THE LIMITS OF EXCAVATION
ION, SIZE AND LOCATION BY UNCOVERING.
LOCAL PUBLIC AUTHORITIES WITH
CONSTRUCTION. CONTRACTOR TO NOTIFY
EPANCIES.

IN THE CURRENT UNIFORM PLUMBING CODE
5, AND CHAPTER 11, SECTION 1103.0.4.
UTS ARE SHOWN ON THE PLANS.

MANNING'S "N" VALUE = 0.013.
ING CONCENTRIC PIPE TO PIPE AND

ITILITIES LOCATED WITHIN THE BUILDING AND

" AT 2.0% MIN. UNLESS NOTED OTHERWISE.

H OF EXISTING UTILITIES BY POTHOLING PRIOR
ER OF DISCREPANCIES.

DOMESTIC WATER METER VAULT AND BACKFLOW
DETECTOR CHECK VALVE (FIRE) VAULT.
ASE OF FIRE VAULT AND INSTALL 2" PVC DRAIN
SUMP PUMP TO DAYLIGHT AT NEAREST CURB.
UT FROM BUILDING ELECTRICAL ROOM TO
TRICAL SERVICE.
TECTION CONTRACTOR FOR FLOW SENSOR
REVENTS.

AS A BACKGROUND SCREEN ON THIS SHEET IS
Y HICKMAN AND ASSOCIATES.

IRRIGATION CONTROLLER, SEE SPECIFICATIONS

FOR PIPING WITHIN THE BUILDING AND UP TO
NG ANY FOUNDATION DRAINAGE PIPING.

TYPE II RIP-RAP AT 12" AND LARGER STORM
x12" THICK TYPE II RIP-RAP AT 10" AND

TILITY LEGEND

FW

U.N.

LITY LEGEND

PERTY LINE

INE (SITE)

ETER

ETER

ORM SEWER PLAN
RAL REVIEW: 02/01/01

NOVELLUS

SWINERTON BUILDERS

Project
NOVELLUS
TUALATIN FACILITY

Tualatin, Oregon

Architecture, Structural Engineer
Civil Engineer
Group Mackenzie
0690 SW Bancroft Street
Portland, Oregon 97201
Phone: (503)224-9580
FAX: (503)228-1285

Group Mackenzie Consultants

Landscape Architect
Greenworks PC
Phone: (503)222-5612
FAX: (503)222-2283

Safety & Health Consultant
Miller Safety
Phone: (503)243-1040
FAX: (503)243-1470

Design Builder
Westwood Swinerton
3030 SW Moody Avenue
Suite 250
Portland, Oregon 97201
Phone: (503)222-2000
FAX: (503)478-2600

Westwood Consultants

Mechanical Engineer
Southland Industries
Phone: (503)255-7118
FAX: (503)255-7955

Mechanical Consultant
Kinetics
Phone: (503)224-3500
FAX: (503)224-8521

Electrical Engineer
Oregon Electric
Phone: (503)234-9900
FAX: (503)231-3587

Electrical Consultant
Glumac International
Phone: (503)227-5280
FAX: (503)274-7674

REGISTERED PROFESSIONAL ENGINEER #19178
OREGON JULY 15, 1995 ROBERT L. FRENTRESS JR.
EXPIRES: 12/31/01

© GROUP MACKENZIE 2000
ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF GROUP MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISIONS:

REVISION NO.	LAST REVISION THIS SHEET	REVISION EDITION CLOSING DATE

SHEET TITLE:
SITE
STORM
SEWER
PLAN
PHASE I

FIRST ISSUED:
LAST ISSUED:
DRAWN BY:
CHECKED BY:

SHEET C5.0

GROUP MACKENZIE JOB NO. 000321
CONSULTANT JOB NO.

D:\0003211\SHTS\C-05.DWG 02/01/01 12:53 1:50

'B'

'C' AREAS W/ FULL 'BUILD-OUT'

POND 'A'

TOTAL AREA	= 598,000 ϕ	= 13.72 Ac
PERVIOUS AREA (15%)	= 89,700 ϕ	= 2.06 Ac
IMPERVIOUS AREA (85%)	= 508,300 ϕ	= 11.66 Ac

POND 'B'

TOTAL AREA	= 598,600 ϕ	= 13.72 Ac
PERVIOUS AREA	= 89,700 ϕ	= 2.06 Ac
IMPERVIOUS	= 508,300 ϕ	= 11.66 Ac

POND 'C'

TOTAL AREA	= 643,500 ϕ	= 14.77 Ac
PERVIOUS AREA	= 96,525 ϕ	= 2.22 Ac
IMPERVIOUS AREA	= 546,975 ϕ	= 12.55 Ac

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©1999 GROUP MACKENZIE. ALL RIGHTS RESERVED

'D' WQ VOLUMES REQUIRED

POND 'A'

$$VOL = 508,300\ ft^2 \times 0.36\ in \times \frac{1ft}{12\ in} = 15,250\ ft^3$$

POND 'B'

$$VOL = 508,300\ ft^2 \times 0.36\ in \times \frac{1ft}{12\ in} = 15,249\ ft^3$$

POND 'C'

$$VOL = 546,975\ ft^2 \times 0.36\ in \times \frac{1ft}{12\ in} = 16,409\ ft^3$$

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

'E' DETENTION SUMMARY

POND 'A'

	EXIST. (cfs)	DEVELOP. (cfs)	RELEASE (cfs)	PEAK STAGE	
2 YR	1.36	5.52	1.36	140.80	
10 YR	2.90	7.93	1.58	141.99	
25 YR	5.52	9.08	1.59	142.00	

POND 'B'

	EXIST. (cfs)	DEVEL. (cfs)	RELEASE (cfs)	PEAK STAGE	
2 YR	1.36	5.73	1.36	138.97	
10 YR	2.90	8.23	1.67	140.91	
25 YR	3.71	9.42	1.78	140.97	

POND 'C'

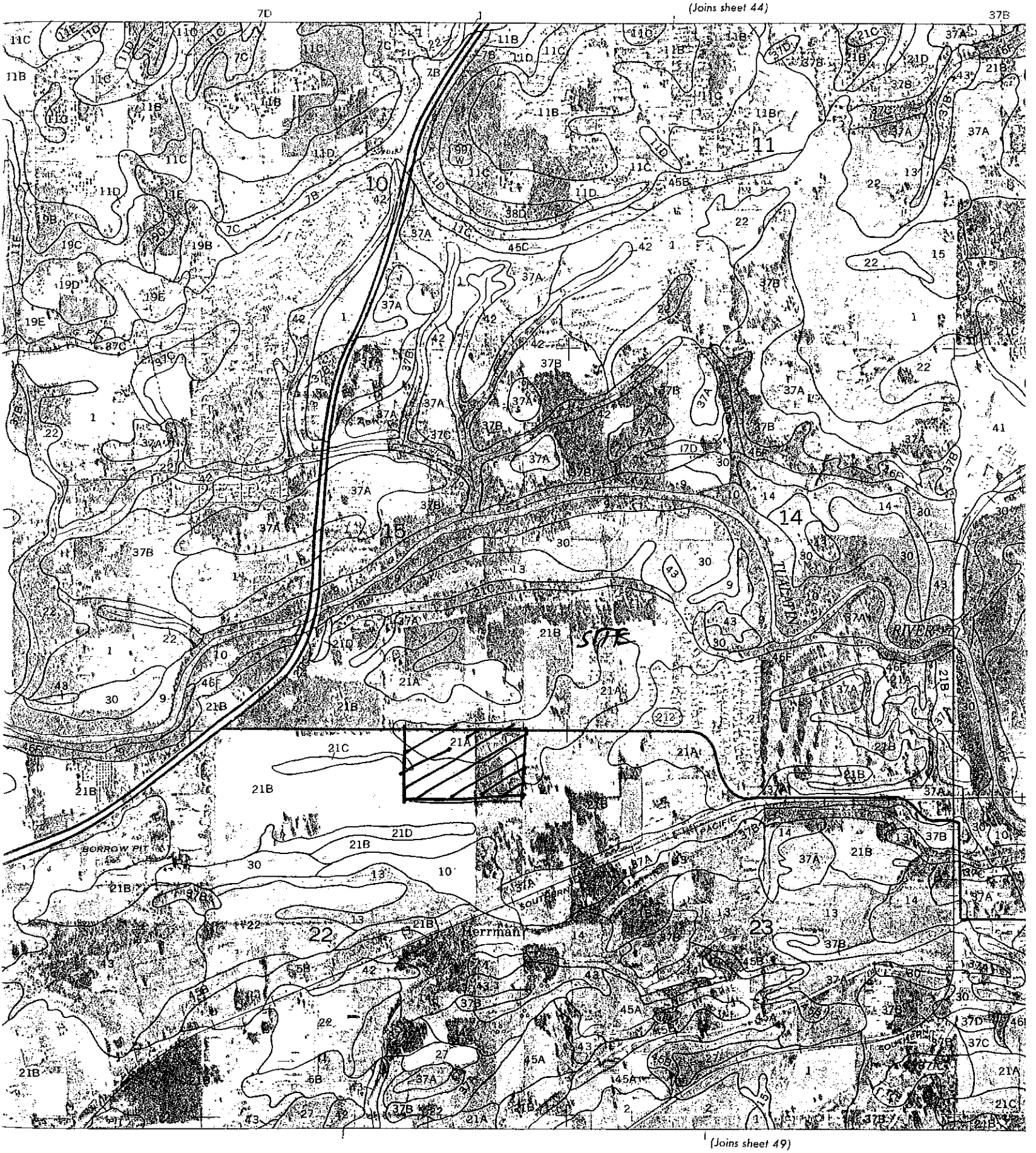
	EXIST. (cfs)	DEVEL. (cfs)	RELEASE (cfs)	PEAK STAGE	
2 YR	1.46	6.14	1.46	137.70	
10 YR	3.12	8.82	1.76	138.98	
25 YR	3.99	10.10	1.98	140.66	

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

OREGON — SHEET NUMBER 47



0 1 Mile

0 5000 Feet

ale 1:20000

'F' SOILS MAP

TABLE 13.—*Soil and*

[Absence of an entry indicates the feature is not a concern. See Glossary for descriptions of such

Soil name and map symbol	Hydrologic group	Flooding		
		Frequency	Duration	Months
Aloha: 1	C	None		
Amity: 2	C	None		
Astoria: 3E, 3F	B	None		
Briedwell: 4B, 5B, 5C, 5D	B	None		
Carlton: 6B, 6C	B	None		
Cascade: 7B, 7C, 7D, 7E, 7F	C	None		
Chehalem: 8C	C	None		
Chehalis: 9, 10	B	Common	Brief	Nov-Mar
Cornelius: [1] 11B, [1] 11C, [1] 11D, [1] 11E, [1] 11F:				
Cornelius part	C	None		
Kinton part	C	None		
Cornelius Variant: 12A, 12B, 12C	C	None		
Cove: 13, 14	D	Common	Brief	Dec-Apr
Dayton: 15	D	None		
Delena: 16C	D	None		
Goble: 17B, 17C, 17D, 17E, 18E, 18F	C	None		
Helvetia: 19B, 19C, 19D, 19E	C	None		
Hembre: 20E, 20F, 20G	B	None		
Hillsboro: 21A, 21B, 21C, 21D	B	None		
Huberly: 22	D	None		
Jory: 23B, 23C, 23D, 23E, 23F	C	None		
Kilchis: [1] 24G:				
Kilchis part	C	None		
Klickitat part	B	None		

"H" SCS CN #

Table III-1.3 SCS Western Washington Runoff Curve Numbers
(Published by SCS in 1982) Runoff curve numbers for selected agricultur. suburban and urban land use for Type 1A rainfall distribution, 24-hour storm duration.

LAND USE DESCRIPTION		CURVE NUMBERS BY HYDROLOGIC SOIL GROUP A	B	C	D
Cultivated land(1):	winter condition	86	91	94	95
Mountain open areas:	low growing brush & grasslands	74	82	89	92
Meadow or pasture:		65	78	85	89
Wood or forest land:	undisturbed	42	64	76	81
Wood or forest land:	young second growth or brush	55	72	81	86
Orchard:	with cover crop	81	88	92	94
Open spaces, lawns, parks, golf courses, cemeteries, landscaping.					
Good condition:	grass cover on ≥75% of the area	68	80	86	90
Fair condition:	grass cover on 50-75% of the area	77	85	90	92
Gravel roads & parking lots:		76	85	89	91
Dirt roads & parking lots:		72	82	87	89
Impervious surfaces, pavement, roofs etc.		98	98	98	98
Open water bodies:	lakes, wetlands, ponds etc.	100	100	100	100
Single family residential(2):					
Dwelling Unit/Gross Acre	%Impervious(3)				
1.0 DU/GA	15				
1.5 DU/GA	20				
2.0 DU/GA	25				
2.5 DU/GA	30				
3.0 DU/GA	34				
3.5 DU/GA	38				
4.0 DU/GA	42				
4.5 DU/GA	46				
5.0 DU/GA	48				
5.5 DU/GA	50				
6.0 DU/GA	52				
6.5 DU/GA	54				
7.0 DU/GA	56				
PUD's, condos, apartments, commercial businesses & industrial areas	%impervious must be computed				
		Separate curve number shall be selected for pervious & impervious portions of the site or basin			

(1) For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Sec. 4, Hydrology, Chapter 9, August 1972.
(2) Assumes roof and driveway runoff is directed into street/storm system.
(3) The remaining pervious areas (lawn) are considered to be in good condition for these curve numbers.

'I' - POND 'A' TOTAL VOLUME

ELEV. (FT)	AREA (SF)	VOL (EF)	Cumm. VOL (CF)	
138	7015			
139	8904	7960	7960	
140	10,849	9876	17,836	← WQ VOL @ 139.75
141	12,851	11,850	29,686	
142	14,909	13,880	43,566	
143	17,024	15,967	59,532	

WQ RELEASE RATE

$$\frac{15{,}250\ ft^3}{48\ HRS} \times \frac{1\ HR}{3600\ s} = 0.088\ CS$$

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

'J' - POND 'A' DETENTION VOLUME

ELEV (FT)	AREA (SF)	VOL (CF)	CUMM VOL (CF)
139.75	10,363		
140	10,849	2652	2652
141	12,851	11,850	14,501
142	14,909	13,880	28,382
143	17,024	15,967	41,348

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

'K' - WQ ORIFICE 'A'

$Q = CA(2gh)^{1/2}$

$A = \dfrac{Q}{C(2gh)^{1/2}}$

$A = \dfrac{0.088}{0.62(2 \times 32.2 \times 2.10)^{1/2}}$

$A = 0.01224$

$d = \sqrt{\dfrac{4A}{\pi}} = 0.125' = \underline{1.50'' \ \phi}$

$Q = 0.088$

$C = 0.62$

$g = 32.2$

$h = 139.75 - 137.65 = 2.10'$

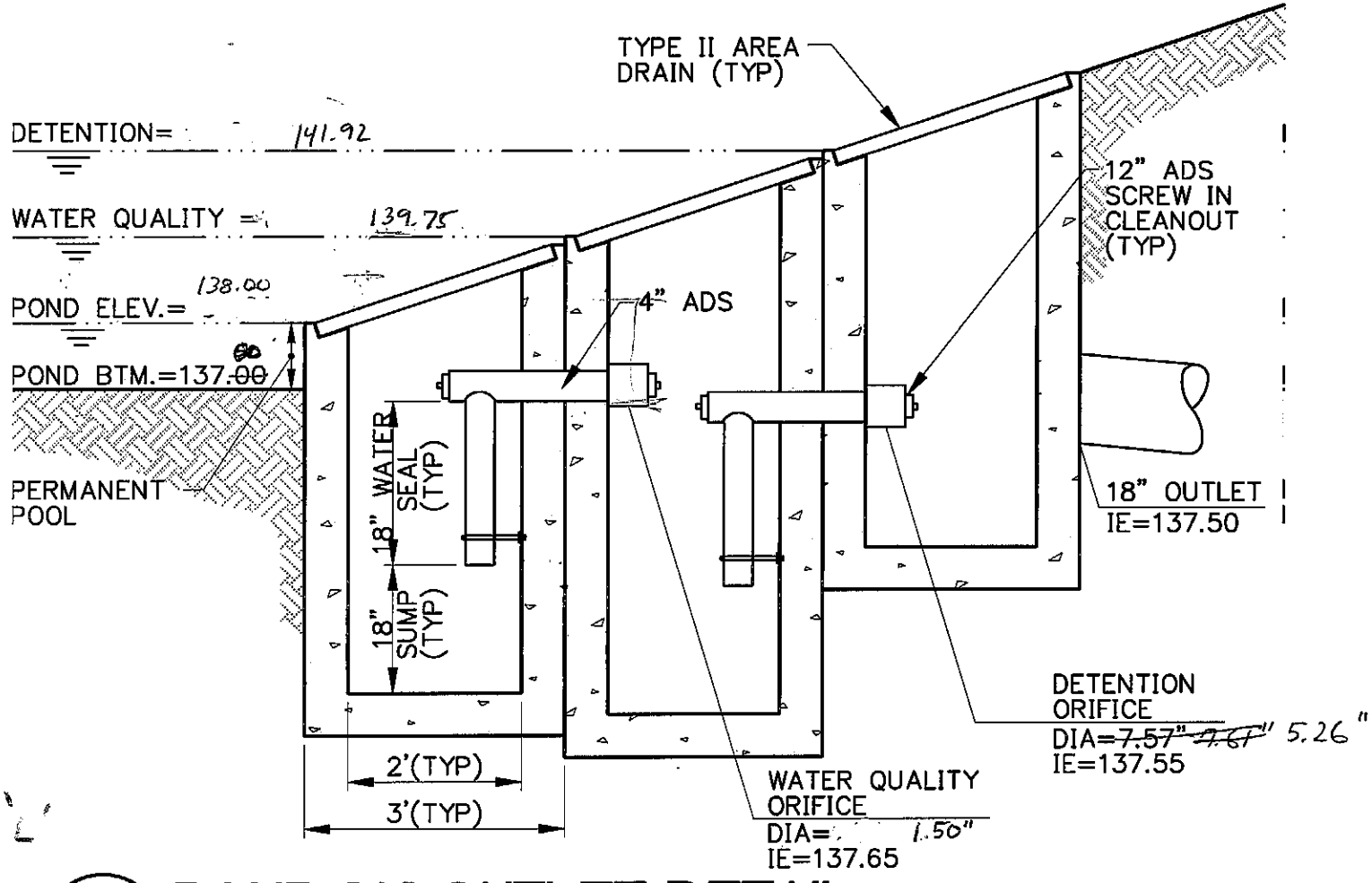
$A = \dfrac{\pi d^2}{4}$

$d = \sqrt{\dfrac{4A}{\pi}}$

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED



1 C8.1 POND "A" OUTLET DETAIL

N.T.S.
OUTFLOW DEVICE

SD150
DETINSET= 1:1

BASIN SUMMARY

BASIN ID: D10 NAME: DEVELOPED 10YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.45 inches AREA..: 2.06 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 17.67 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 11.66 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0020
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 7.93 cfs VOL: 3.40 Ac-ft TIME: 480 min

BASIN ID: D2 NAME: DEVELOPED 2YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 2.50 inches AREA..: 2.06 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 17.67 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 11.66 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0020
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 5.52 cfs VOL: 2.36 Ac-ft TIME: 480 min

BASIN ID: D25 NAME: DEVELOPED 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.90 inches AREA..: 2.06 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 17.67 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 11.66 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0020
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 9.08 cfs VOL: 3.90 Ac-ft TIME: 480 min

BASIN SUMMARY

BASIN ID: E10 NAME: EXISTING 10YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres
RAINFALL TYPE....: TYPE1A
PRECIPITATION....: 3.45 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 38.83 min
ABSTRACTION COEFF: 0.20
BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 13.72 Acres
CN....: 80.00
IMPERVIOUS AREA
AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 2.90 cfs VOL: 1.83 Ac-ft TIME: 490 min

BASIN ID: E2 NAME: EXISTING 2YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres
RAINFALL TYPE....: TYPE1A
PRECIPITATION....: 2.50 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 38.83 min
ABSTRACTION COEFF: 0.20
BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 13.72 Acres
CN....: 80.00
IMPERVIOUS AREA
AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 1.36 cfs VOL: 1.02 Ac-ft TIME: 490 min

BASIN ID: E25 NAME: EXISTING 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres
RAINFALL TYPE....: TYPE1A
PRECIPITATION....: 3.90 inches
TIME INTERVAL....: 10.00 min
TIME OF CONC.....: 38.83 min
ABSTRACTION COEFF: 0.20
BASEFLOWS: 0.00 cfs
PERVIOUS AREA
AREA..: 13.72 Acres
CN....: 80.00
IMPERVIOUS AREA
AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 3.71 cfs VOL: 2.24 Ac-ft TIME: 490 min

HYDROGRAPH SUMMARY

HYD NUM	PEAK RUNOFF RATE cfs	TIME OF PEAK min.	VOLUME OF HYDRO cf\AcFt	Contrib Area Acres
1	1.356	490	44270 cf	13.72
2	2.902	490	79526 cf	13.72
3	3.714	490	97581 cf	13.72
5	5.522	480	102758 cf	13.72
6	7.929	480	148087 cf	13.72
7	9.079	480	169790 cf	13.72
10	1.355	700	102983 cf	13.72
11	1.584	630	35096 cf	13.72
12	1.570	530	27536 cf	13.72

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 137.55
Elev: 137.55 ft Orifice Diameter: 5.2617 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
137.55	0.0000	0.0000	0.0000	139.10	3837	0.9354	13.725	140.70	24218	1.3334	82.059
137.60	0.0000	0.1680	0.1680	139.20	5022	0.9651	17.704	140.80	25606	1.3544	86.707
137.70	0.0000	0.2910	0.2910	139.30	6207	0.9939	21.683	140.90	26994	1.3751	91.355
137.80	0.0000	0.3757	0.3757	139.40	7392	1.0219	25.661	141.00	28382	1.3955	96.002
137.90	0.0000	0.4445	0.4445	139.50	8577	1.0491	29.637	141.10	29979	1.4156	101.34
138.00	0.0000	0.5040	0.5040	139.60	9761	1.0757	33.614	141.20	31575	1.4354	106.69
138.10	0.0000	0.5572	0.5572	139.70	10946	1.1016	37.589	141.30	33172	1.4549	112.03
138.20	0.0000	0.6057	0.6057	139.80	12131	1.1270	41.564	141.40	34768	1.4742	117.37
138.30	0.0000	0.6507	0.6507	139.90	13316	1.1517	45.539	141.50	36365	1.4932	122.71
138.40	0.0000	0.6927	0.6927	140.00	14501	1.1760	49.513	141.60	37962	1.5120	128.05
138.50	0.0000	0.7323	0.7323	140.10	15889	1.1997	54.163	141.70	39558	1.5305	133.39
138.60	0.0000	0.7699	0.7699	140.20	17277	1.2230	58.814	141.80	41155	1.5489	138.73
138.70	0.0000	0.8057	0.8057	140.30	18665	1.2459	63.464	141.90	42751	1.5670	144.07
138.80	530.40	0.8400	2.6080	140.40	20053	1.2684	68.113				
138.90	1591	0.8729	6.1769	140.50	21442	1.2904	72.762				
139.00	2652	0.9047	9.7447	140.60	22830	1.3121	77.411				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 1.36 INFLOW Q (cfs): 5.52
PEAK STAGE (ft): 140.80 PEAK OUTFLOW : 1.36
PEAK TIME: 700.00 min.
INFLOW HYD No. : 5 OUTFLOW HYD No.: 10

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	137.55	50.00
0.0001	0.0062	0.0000	0.0063	0.0001	0.0062	137.55	60.00
0.0062	0.0358	0.0000	0.0420	0.0062	0.0358	137.55	70.00
0.0358	0.0902	0.0000	0.1259	0.0358	0.0902	137.55	80.00
0.0902	0.1532	0.0000	0.2434	0.0902	0.1532	137.55	90.00
0.1532	0.2163	0.0000	0.3695	0.1532	0.2163	137.55	100.00
0.2163	0.2756	0.0000	0.4919	0.2163	0.2756	137.55	110.00
0.2756	0.3295	0.0000	0.6051	0.2756	0.3295	137.55	120.00
0.3295	0.3947	0.0000	0.7242	0.3295	0.3947	137.55	130.00
0.3947	0.4686	0.0000	0.8633	0.3947	0.4686	137.55	140.00
0.4686	0.5284	0.0000	0.9970	0.4686	0.5284	137.55	150.00
0.5284	0.5757	0.0000	1.1042	0.5284	0.5757	137.55	160.00
0.5757	0.6188	0.0000	1.1946	0.5757	0.6188	137.55	170.00
0.6188	0.6554	0.0000	1.2742	0.6188	0.6554	137.55	180.00
0.6554	0.6842	0.0000	1.3396	0.6554	0.6842	137.55	190.00
0.6842	0.7129	0.0000	1.3971	0.6842	0.7129	137.55	200.00
0.7129	0.7378	0.0000	1.4507	0.7129	0.7378	137.55	210.00
0.7378	0.7566	0.0000	1.4944	0.7378	0.7566	137.55	220.00
0.7566	0.7773	0.0000	1.5339	0.7566	0.7773	137.55	230.00
0.7773	0.7952	0.0000	1.5725	0.7773	0.7952	137.55	240.00
0.7952	0.8366	0.0000	1.6319	0.7952	0.8366	137.55	250.00
0.8366	0.8912	0.0304	1.7583	0.8063	0.9520	138.70	260.00
0.8912	0.9280	0.1435	1.9627	0.8085	1.1543	138.71	270.00
0.9280	0.9574	0.3419	2.2273	0.8123	1.4150	138.72	280.00
0.9574	0.9756	0.5977	2.5306	0.8173	1.7133	138.73	290.00
0.9756	0.9904	0.8904	2.8563	0.8230	2.0334	138.75	300.00
0.9904	1.1189	1.2043	3.3136	0.8291	2.4846	138.77	310.00
1.1189	1.3095	1.6469	4.0754	0.8376	3.2377	138.79	320.00
1.3095	1.4235	2.3919	5.1249	0.8458	4.2791	138.82	330.00
1.4235	1.4938	3.4237	6.3410	0.8554	5.4856	138.85	340.00
1.4938	1.5398	4.6191	7.6527	0.8666	6.7861	138.88	350.00
1.5398	1.5727	5.9077	9.0202	0.8784	8.1418	138.92	360.00
1.5727	1.5694	7.2514	10.393	0.8904	9.5031	138.96	370.00
1.5694	1.5448	8.6005	11.715	0.9025	10.812	138.99	380.00
1.5448	1.5328	9.8993	12.977	0.9129	12.064	139.03	390.00
1.5328	1.5311	11.141	14.205	0.9226	13.283	139.06	400.00
1.5311	1.5386	12.351	15.421	0.9320	14.489	139.09	410.00
1.5386	1.5435	13.548	16.630	0.9411	15.689	139.12	420.00
1.5435	1.9599	14.739	18.242	0.9500	17.292	139.15	430.00
1.9599	2.6167	16.330	20.907	0.9620	19.945	139.19	440.00
2.6167	3.0001	18.963	24.580	0.9813	23.599	139.26	450.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
3.0001	3.8181	22.591	29.410	1.0074	28.402	139.35	460.00
3.8181	4.8896	27.362	36.069	1.0407	35.029	139.47	470.00
4.8896	5.5224	33.944	44.356	1.0849	43.271	139.64	480.00
5.5224	5.0947	42.133	52.750	1.1376	51.613	139.84	490.00
5.0947	4.0608	50.426	59.582	1.1867	58.395	140.05	500.00
4.0608	3.4876	57.174	64.722	1.2209	63.501	140.19	510.00
3.4876	3.1022	62.255	68.845	1.2461	67.599	140.30	520.00
3.1022	2.8252	66.333	72.261	1.2659	70.995	140.39	530.00
2.8252	2.6735	69.713	75.211	1.2820	73.929	140.46	540.00
2.6735	2.4188	72.633	77.726	1.2959	76.430	140.53	550.00
2.4188	2.1056	75.122	79.647	1.3075	78.339	140.58	560.00
2.1056	1.9318	77.023	81.060	1.3164	79.744	140.62	570.00
1.9318	1.8402	78.421	82.193	1.3228	80.870	140.65	580.00
1.8402	1.7861	79.542	83.169	1.3280	81.841	140.67	590.00
1.7861	1.7572	80.508	84.052	1.3324	82.719	140.70	600.00
1.7572	1.7089	81.383	84.849	1.3364	83.512	140.71	610.00
1.7089	1.6498	82.172	85.531	1.3400	84.191	140.73	620.00
1.6498	1.6177	82.848	86.115	1.3431	84.772	140.75	630.00
1.6177	1.5965	83.427	86.641	1.3457	85.295	140.76	640.00
1.5965	1.5897	83.947	87.133	1.3481	85.785	140.77	650.00
1.5897	1.5869	84.435	87.612	1.3503	86.261	140.78	660.00
1.5869	1.5149	84.909	88.011	1.3524	86.658	140.79	670.00
1.5149	1.4041	85.304	88.223	1.3542	86.869	140.80	680.00
1.4041	1.3427	85.514	88.260	1.3552	86.905	140.80	690.00
1.3427	1.3131	85.550	88.206	1.3553	86.850	140.80	700.00
1.3131	1.2929	85.495	88.101	1.3551	86.746	140.80	710.00
1.2929	1.2822	85.392	87.967	1.3546	86.612	140.80	720.00
1.2822	1.2808	85.258	87.821	1.3540	86.467	140.80	730.00
1.2808	1.2764	85.114	87.671	1.3534	86.318	140.79	740.00
1.2764	1.2744	84.965	87.516	1.3527	86.163	140.79	750.00
1.2744	1.2780	84.811	87.364	1.3520	86.012	140.79	760.00
1.2780	1.2762	84.660	87.214	1.3513	85.863	140.79	770.00
1.2762	1.2757	84.513	87.065	1.3506	85.714	140.78	780.00
1.2757	1.2081	84.364	86.848	1.3499	85.498	140.78	790.00
1.2081	1.0987	84.149	86.456	1.3490	85.107	140.77	800.00
1.0987	1.0378	83.759	85.896	1.3472	84.549	140.77	810.00
1.0378	1.0040	83.204	85.246	1.3447	83.901	140.75	820.00
1.0040	0.9854	82.559	84.549	1.3418	83.207	140.74	830.00
0.9854	0.9752	81.868	83.829	1.3386	82.490	140.72	840.00
0.9752	1.0037	81.155	83.134	1.3354	81.798	140.71	850.00
1.0037	1.0582	80.466	82.528	1.3322	81.196	140.69	860.00
1.0582	1.0890	79.866	82.014	1.3295	80.684	140.68	870.00
1.0890	1.1022	79.357	81.548	1.3271	80.221	140.67	880.00
1.1022	1.1142	78.896	81.112	1.3250	79.787	140.66	890.00
1.1142	1.1212	78.464	80.700	1.3230	79.377	140.65	900.00
1.1212	1.1211	78.056	80.298	1.3211	78.977	140.64	910.00
1.1211	1.1257	77.658	79.904	1.3193	78.585	140.63	920.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.1257	1.1285	77.268	79.522	1.3175	78.204	140.63	930.00
1.1285	1.1261	76.889	79.143	1.3157	77.828	140.62	940.00
1.1261	1.1293	76.513	78.769	1.3140	77.455	140.61	950.00
1.1293	1.1314	76.143	78.403	1.3123	77.091	140.60	960.00
1.1314	1.0216	75.780	77.933	1.3106	76.623	140.59	970.00
1.0216	0.8577	75.314	77.194	1.3084	75.885	140.58	980.00
0.8577	0.7661	74.580	76.204	1.3050	74.899	140.57	990.00
0.7661	0.7108	73.599	75.076	1.3004	73.775	140.55	1000.00
0.7108	0.6842	72.480	73.875	1.2951	72.580	140.52	1010.00
0.6842	0.6695	71.290	72.644	1.2895	71.355	140.50	1020.00
0.6695	0.7299	70.071	71.470	1.2837	70.187	140.47	1030.00
0.7299	0.8367	68.908	70.475	1.2782	69.197	140.44	1040.00
0.8367	0.8966	67.923	69.657	1.2735	68.383	140.42	1050.00
0.8966	0.9303	67.113	68.940	1.2696	67.671	140.41	1060.00
0.9303	0.9493	66.404	68.284	1.2662	67.018	140.39	1070.00
0.9493	0.9601	65.755	67.664	1.2631	66.401	140.38	1080.00
0.9601	0.9319	65.141	67.033	1.2601	65.773	140.36	1090.00
0.9319	0.8776	64.516	66.325	1.2571	65.068	140.35	1100.00
0.8776	0.8474	63.815	65.540	1.2536	64.286	140.33	1110.00
0.8474	0.9641	63.036	64.848	1.2499	63.598	140.32	1120.00
0.9641	0.8960	62.351	64.211	1.2465	62.965	140.30	1130.00
0.8960	0.7289	61.721	63.346	1.2434	62.103	140.29	1140.00
0.7289	0.7691	60.863	62.361	1.2392	61.122	140.27	1150.00
0.7691	0.7874	59.888	61.444	1.2344	60.210	140.25	1160.00
0.7874	0.7977	58.980	60.565	1.2299	59.335	140.23	1170.00
0.7977	0.8079	58.110	59.715	1.2256	58.490	140.21	1180.00
0.8079	0.8094	57.268	58.885	1.2214	57.664	140.19	1190.00
0.8094	0.8104	56.447	58.067	1.2173	56.849	140.18	1200.00
0.8104	0.8153	55.636	57.262	1.2132	56.049	140.16	1210.00
0.8153	0.8139	54.839	56.469	1.2092	55.259	140.14	1220.00
0.8139	0.8132	54.054	55.681	1.2052	54.476	140.12	1230.00
0.8132	0.8173	53.275	54.905	1.2013	53.704	140.11	1240.00
0.8173	0.8153	52.507	54.139	1.1974	52.942	140.09	1250.00
0.8153	0.8143	51.748	53.378	1.1935	52.184	140.07	1260.00
0.8143	0.8182	50.995	52.627	1.1896	51.438	140.06	1270.00
0.8182	0.8162	50.252	51.886	1.1858	50.701	140.04	1280.00
0.8162	0.8152	49.519	51.150	1.1820	49.968	140.03	1290.00
0.8152	0.8190	48.790	50.424	1.1783	49.245	140.01	1300.00
0.8190	0.8169	48.071	49.707	1.1744	48.533	139.99	1310.00
0.8169	0.8159	47.363	48.995	1.1700	47.825	139.98	1320.00
0.8159	0.7808	46.660	48.256	1.1657	47.091	139.96	1330.00
0.7808	0.7266	45.930	47.437	1.1612	46.276	139.94	1340.00
0.7266	0.6963	45.119	46.542	1.1562	45.386	139.92	1350.00
0.6963	0.6752	44.235	45.607	1.1508	44.456	139.90	1360.00
0.6752	0.6677	43.311	44.654	1.1450	43.509	139.87	1370.00
0.6677	0.6637	42.370	43.701	1.1391	42.562	139.85	1380.00
0.6637	0.6571	41.429	42.750	1.1332	41.617	139.83	1390.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.6571	0.6578	40.489	41.804	1.1273	40.677	139.80	1400.00
0.6578	0.6583	39.556	40.872	1.1213	39.751	139.78	1410.00
0.6583	0.6543	38.635	39.948	1.1154	38.832	139.75	1420.00
0.6543	0.6565	37.723	39.034	1.1096	37.924	139.73	1430.00
0.6565	0.6577	36.820	38.135	1.1038	37.031	139.71	1440.00
0.6577	0.5109	35.933	37.101	1.0980	36.003	139.69	1450.00
0.5109	0.2855	34.912	35.709	1.0913	34.617	139.66	1460.00
0.2855	0.1596	33.535	33.980	1.0823	32.898	139.63	1470.00
0.1596	0.0892	31.827	32.076	1.0709	31.005	139.58	1480.00
0.0892	0.0499	29.947	30.086	1.0583	29.027	139.53	1490.00
0.0499	0.0279	27.982	28.060	1.0450	27.015	139.48	1500.00
0.0279	0.0156	25.984	26.027	1.0312	24.996	139.43	1510.00
0.0156	0.0087	23.979	24.003	1.0172	22.986	139.38	1520.00
0.0087	0.0049	21.983	21.997	1.0031	20.993	139.33	1530.00
0.0049	0.0027	20.005	20.012	0.9889	19.023	139.28	1540.00
0.0027	0.0015	18.049	18.053	0.9746	17.078	139.23	1550.00
0.0015	0.0008	16.118	16.120	0.9604	15.160	139.18	1560.00
0.0008	0.0005	14.214	14.215	0.9461	13.269	139.14	1570.00
0.0005	0.0003	12.337	12.338	0.9319	11.406	139.09	1580.00
0.0003	0.0001	10.489	10.489	0.9175	9.5714	139.04	1590.00
0.0001	0.0001	8.6683	8.6685	0.9032	7.7654	139.00	1600.00
0.0001	0.0000	6.8783	6.8784	0.8871	5.9913	138.94	1610.00
0.0000	0.0000	5.1201	5.1202	0.8712	4.2490	138.89	1620.00
0.0000	0.0000	3.3938	3.3939	0.8551	2.5387	138.85	1630.00
0.0000	0.0000	1.7001	1.7001	0.8387	0.8614	138.80	1640.00
0.0000	0.0000	0.0547	0.0547	0.8067	-0.7521	138.70	1650.00

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 137.55
Elev: 137.55 ft Orifice Diameter: 5.2617 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
137.55	0.0000	0.0000	0.0000	139.10	3837	0.9354	13.725	140.70	24218	1.3334	82.059
137.60	0.0000	0.1680	0.1680	139.20	5022	0.9651	17.704	140.80	25606	1.3544	86.707
137.70	0.0000	0.2910	0.2910	139.30	6207	0.9939	21.683	140.90	26994	1.3751	91.355
137.80	0.0000	0.3757	0.3757	139.40	7392	1.0219	25.661	141.00	28382	1.3955	96.002
137.90	0.0000	0.4445	0.4445	139.50	8577	1.0491	29.637	141.10	29979	1.4156	101.34
138.00	0.0000	0.5040	0.5040	139.60	9761	1.0757	33.614	141.20	31575	1.4354	106.69
138.10	0.0000	0.5572	0.5572	139.70	10946	1.1016	37.589	141.30	33172	1.4549	112.03
138.20	0.0000	0.6057	0.6057	139.80	12131	1.1270	41.564	141.40	34768	1.4742	117.37
138.30	0.0000	0.6507	0.6507	139.90	13316	1.1517	45.539	141.50	36365	1.4932	122.71
138.40	0.0000	0.6927	0.6927	140.00	14501	1.1760	49.513	141.60	37962	1.5120	128.05
138.50	0.0000	0.7323	0.7323	140.10	15889	1.1997	54.163	141.70	39558	1.5305	133.39
138.60	0.0000	0.7699	0.7699	140.20	17277	1.2230	58.814	141.80	41155	1.5489	138.73
138.70	0.0000	0.8057	0.8057	140.30	18665	1.2459	63.464	141.90	42751	1.5670	144.07
138.80	530.40	0.8400	2.6080	140.40	20053	1.2684	68.113				
138.90	1591	0.8729	6.1769	140.50	21442	1.2904	72.762				
139.00	2652	0.9047	9.7447	140.60	22830	1.3121	77.411				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 2.90 INFLOW Q (cfs): 7.93
PEAK STAGE (ft): 141.99 PEAK OUTFLOW : 1.58
PEAK TIME: 630.00 min.
INFLOW HYD No. : 6 OUTFLOW HYD No.: 11

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0019	0.0000	0.0019	0.0000	0.0019	137.55	40.00
0.0019	0.0209	0.0000	0.0229	0.0019	0.0209	137.55	50.00
0.0209	0.0630	0.0000	0.0839	0.0209	0.0630	137.55	60.00
0.0630	0.1440	0.0000	0.2070	0.0630	0.1440	137.55	70.00
0.1440	0.2565	0.0000	0.4005	0.1440	0.2565	137.55	80.00
0.2565	0.3646	0.0000	0.6211	0.2565	0.3646	137.55	90.00
0.3646	0.4624	0.0000	0.8270	0.3646	0.4624	137.55	100.00
0.4624	0.5481	0.0000	1.0104	0.4624	0.5481	137.55	110.00
0.5481	0.6221	0.0000	1.1701	0.5481	0.6221	137.55	120.00
0.6221	0.7143	0.0000	1.3364	0.6221	0.7143	137.55	130.00
0.7143	0.8201	0.0000	1.5344	0.7143	0.8201	137.55	140.00
0.8201	0.9008	0.0142	1.7351	0.8060	0.9291	138.70	150.00
0.9008	0.9604	0.1211	1.9823	0.8080	1.1743	138.71	160.00
0.9604	1.0135	0.3615	2.3355	0.8127	1.5228	138.72	170.00
1.0135	1.0568	0.7035	2.7738	0.8193	1.9544	138.74	180.00
1.0568	1.0886	1.1269	3.2723	0.8275	2.4447	138.76	190.00
1.0886	1.1211	1.6078	3.8176	0.8369	2.9807	138.79	200.00
1.1211	1.1484	2.1373	4.4068	0.8434	3.5634	138.81	210.00
1.1484	1.1673	2.7146	5.0303	0.8488	4.1814	138.83	220.00
1.1673	1.1896	3.3269	5.6838	0.8545	4.8293	138.84	230.00
1.1896	1.2085	3.9688	6.3669	0.8605	5.5064	138.86	240.00
1.2085	1.2628	4.6396	7.1110	0.8667	6.2442	138.88	250.00
1.2628	1.3370	5.3707	7.9705	0.8735	7.0970	138.90	260.00
1.3370	1.3845	6.2159	8.9374	0.8811	8.0563	138.93	270.00
1.3845	1.4213	7.1667	9.9725	0.8897	9.0828	138.95	280.00
1.4213	1.4427	8.1840	11.048	0.8988	10.149	138.98	290.00
1.4427	1.4610	9.2414	12.145	0.9078	11.237	139.01	300.00
1.4610	1.6480	10.321	13.430	0.9162	12.514	139.04	310.00
1.6480	1.9273	11.588	15.163	0.9260	14.237	139.07	320.00
1.9273	2.0950	13.298	17.320	0.9392	16.381	139.11	330.00
2.0950	2.1991	15.426	19.720	0.9552	18.765	139.17	340.00
2.1991	2.2669	17.792	22.258	0.9728	21.285	139.23	350.00
2.2669	2.3136	20.294	24.875	0.9910	23.884	139.29	360.00
2.3136	2.3054	22.874	27.493	1.0094	26.484	139.36	370.00
2.3054	2.2653	25.456	30.027	1.0275	29.000	139.42	380.00
2.2653	2.2436	27.955	32.464	1.0448	31.419	139.48	390.00
2.2436	2.2370	30.358	34.838	1.0610	33.777	139.54	400.00
2.2370	2.2440	32.701	37.182	1.0768	36.105	139.60	410.00
2.2440	2.2474	35.013	39.504	1.0920	38.412	139.66	420.00
2.2474	2.8471	37.305	42.400	1.1069	41.293	139.72	430.00
2.8471	3.7928	40.168	46.808	1.1252	45.683	139.79	440.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
3.7928	4.3398	44.530	52.663	1.1526	51.510	139.90	450.00
4.3398	5.5086	50.324	60.172	1.1862	58.986	140.04	460.00
5.5086	7.0369	57.762	70.308	1.2239	69.084	140.20	470.00
7.0369	7.9294	67.811	82.777	1.2730	81.504	140.42	480.00
7.9294	7.3040	80.173	95.407	1.3309	94.076	140.69	490.00
7.3040	5.8151	92.689	105.81	1.3870	104.42	140.96	500.00
5.8151	4.9882	102.99	113.80	1.4270	112.37	141.16	510.00
4.9882	4.4319	110.91	120.33	1.4561	118.88	141.31	520.00
4.4319	4.0321	117.40	125.86	1.4795	124.38	141.43	530.00
4.0321	3.8122	122.88	130.73	1.4991	129.23	141.53	540.00
3.8122	3.4466	127.71	134.97	1.5161	133.46	141.62	550.00
3.4466	2.9985	131.92	138.37	1.5307	136.84	141.70	560.00
2.9985	2.7496	135.30	141.04	1.5424	139.50	141.76	570.00
2.7496	2.6178	137.95	143.32	1.5515	141.77	141.81	580.00
2.6178	2.5397	140.21	145.37	1.5592	143.81	141.86	590.00
2.5397	2.4974	142.24	147.28	1.5661	145.71	141.90	600.00
2.4974	2.4279	144.14	149.06	1.5725	147.49	141.93	610.00
2.4279	2.3430	145.91	150.68	1.5784	149.11	141.96	620.00
2.3430	2.2966	147.52	152.16	1.5839	150.58	141.99	630.00
2.2966	2.2658	150.58	155.14	0.0000	155.14	0.00	640.00
2.2658	2.2555	155.14	159.66	0.0000	159.66	0.00	650.00
2.2555	2.2507	159.66	164.17	0.0000	164.17	0.00	660.00
2.2507	2.1480	164.17	168.57	0.0000	168.57	0.00	670.00
2.1480	1.9905	168.57	172.70	0.0000	172.70	0.00	680.00
1.9905	1.9030	172.70	176.60	0.0000	176.60	0.00	690.00
1.9030	1.8606	176.60	180.36	0.0000	180.36	0.00	700.00
1.8606	1.8315	180.36	184.05	0.0000	184.05	0.00	710.00
1.8315	1.8159	184.05	187.70	0.0000	187.70	0.00	720.00
1.8159	1.8136	187.70	191.33	0.0000	191.33	0.00	730.00
1.8136	1.8069	191.33	194.95	0.0000	194.95	0.00	740.00
1.8069	1.8037	194.95	198.56	0.0000	198.56	0.00	750.00
1.8037	1.8084	198.56	202.17	0.0000	202.17	0.00	760.00
1.8084	1.8056	202.17	205.79	0.0000	205.79	0.00	770.00
1.8056	1.8045	205.79	209.40	0.0000	209.40	0.00	780.00
1.8045	1.7086	209.40	212.91	0.0000	212.91	0.00	790.00
1.7086	1.5536	212.91	216.17	0.0000	216.17	0.00	800.00
1.5536	1.4672	216.17	219.19	0.0000	219.19	0.00	810.00
1.4672	1.4192	219.19	222.08	0.0000	222.08	0.00	820.00
1.4192	1.3927	222.08	224.89	0.0000	224.89	0.00	830.00
1.3927	1.3781	224.89	227.66	0.0000	227.66	0.00	840.00
1.3781	1.4182	227.66	230.46	0.0000	230.46	0.00	850.00
1.4182	1.4949	230.46	233.37	0.0000	233.37	0.00	860.00
1.4949	1.5382	233.37	236.40	0.0000	236.40	0.00	870.00
1.5382	1.5567	236.40	239.50	0.0000	239.50	0.00	880.00
1.5567	1.5733	239.50	242.63	0.0000	242.63	0.00	890.00
1.5733	1.5830	242.63	245.79	0.0000	245.79	0.00	900.00
1.5830	1.5827	245.79	248.95	0.0000	248.95	0.00	910.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.5827	1.5888	248.95	252.12	0.0000	252.12	0.00	920.00
1.5888	1.5926	252.12	255.30	0.0000	255.30	0.00	930.00
1.5926	1.5890	255.30	258.49	0.0000	258.49	0.00	940.00
1.5890	1.5933	258.49	261.67	0.0000	261.67	0.00	950.00
1.5933	1.5960	261.67	264.86	0.0000	264.86	0.00	960.00
1.5960	1.4409	264.86	267.89	0.0000	267.89	0.00	970.00
1.4409	1.2096	267.89	270.55	0.0000	270.55	0.00	980.00
1.2096	1.0804	270.55	272.84	0.0000	272.84	0.00	990.00
1.0804	1.0023	272.84	274.92	0.0000	274.92	0.00	1000.00
1.0023	0.9647	274.92	276.88	0.0000	276.88	0.00	1010.00
0.9647	0.9438	276.88	278.79	0.0000	278.79	0.00	1020.00
0.9438	1.0289	278.79	280.77	0.0000	280.77	0.00	1030.00
1.0289	1.1794	280.77	282.97	0.0000	282.97	0.00	1040.00
1.1794	1.2636	282.97	285.42	0.0000	285.42	0.00	1050.00
1.2636	1.3110	285.42	287.99	0.0000	287.99	0.00	1060.00
1.3110	1.3376	287.99	290.64	0.0000	290.64	0.00	1070.00
1.3376	1.3527	290.64	293.33	0.0000	293.33	0.00	1080.00
1.3527	1.3129	293.33	296.00	0.0000	296.00	0.00	1090.00
1.3129	1.2363	296.00	298.55	0.0000	298.55	0.00	1100.00
1.2363	1.1936	298.55	300.98	0.0000	300.98	0.00	1110.00
1.1936	1.3577	300.98	303.53	0.0000	303.53	0.00	1120.00
1.3577	1.2617	303.53	306.15	0.0000	306.15	0.00	1130.00
1.2617	1.0264	306.15	308.43	0.0000	308.43	0.00	1140.00
1.0264	1.0829	308.43	310.54	0.0000	310.54	0.00	1150.00
1.0829	1.1085	310.54	312.74	0.0000	312.74	0.00	1160.00
1.1085	1.1230	312.74	314.97	0.0000	314.97	0.00	1170.00
1.1230	1.1372	314.97	317.23	0.0000	317.23	0.00	1180.00
1.1372	1.1392	317.23	319.50	0.0000	319.50	0.00	1190.00
1.1392	1.1405	319.50	321.78	0.0000	321.78	0.00	1200.00
1.1405	1.1474	321.78	324.07	0.0000	324.07	0.00	1210.00
1.1474	1.1453	324.07	326.36	0.0000	326.36	0.00	1220.00
1.1453	1.1442	326.36	328.65	0.0000	328.65	0.00	1230.00
1.1442	1.1498	328.65	330.95	0.0000	330.95	0.00	1240.00
1.1498	1.1470	330.95	333.24	0.0000	333.24	0.00	1250.00
1.1470	1.1455	333.24	335.54	0.0000	335.54	0.00	1260.00
1.1455	1.1509	335.54	337.83	0.0000	337.83	0.00	1270.00
1.1509	1.1479	337.83	340.13	0.0000	340.13	0.00	1280.00
1.1479	1.1464	340.13	342.43	0.0000	342.43	0.00	1290.00
1.1464	1.1517	342.43	344.72	0.0000	344.72	0.00	1300.00
1.1517	1.1487	344.72	347.02	0.0000	347.02	0.00	1310.00
1.1487	1.1472	347.02	349.32	0.0000	349.32	0.00	1320.00
1.1472	1.0977	349.32	351.57	0.0000	351.57	0.00	1330.00
1.0977	1.0214	351.57	353.68	0.0000	353.68	0.00	1340.00
1.0214	0.9789	353.68	355.69	0.0000	355.69	0.00	1350.00
0.9789	0.9491	355.69	357.61	0.0000	357.61	0.00	1360.00
0.9491	0.9386	357.61	359.50	0.0000	359.50	0.00	1370.00
0.9386	0.9327	359.50	361.37	0.0000	361.37	0.00	1380.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.9327	0.9235	361.37	363.23	0.0000	363.23	0.00	1390.00
0.9235	0.9245	363.23	365.08	0.0000	365.08	0.00	1400.00
0.9245	0.9251	365.08	366.93	0.0000	366.93	0.00	1410.00
0.9251	0.9194	366.93	368.77	0.0000	368.77	0.00	1420.00
0.9194	0.9224	368.77	370.61	0.0000	370.61	0.00	1430.00
0.9224	0.9241	370.61	372.46	0.0000	372.46	0.00	1440.00
0.9241	0.7177	372.46	374.10	0.0000	374.10	0.00	1450.00
0.7177	0.4011	374.10	375.22	0.0000	375.22	0.00	1460.00
0.4011	0.2242	375.22	375.84	0.0000	375.84	0.00	1470.00
0.2242	0.1253	375.84	376.19	0.0000	376.19	0.00	1480.00
0.1253	0.0700	376.19	376.39	0.0000	376.39	0.00	1490.00
0.0700	0.0391	376.39	376.50	0.0000	376.50	0.00	1500.00

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 137.55
Elev: 137.55 ft Orifice Diameter: 5.2617 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
137.55	0.0000	0.0000	0.0000	139.10	3837	0.9354	13.725	140.70	24218	1.3334	82.059
137.60	0.0000	0.1680	0.1680	139.20	5022	0.9651	17.704	140.80	25606	1.3544	86.707
137.70	0.0000	0.2910	0.2910	139.30	6207	0.9939	21.683	140.90	26994	1.3751	91.355
137.80	0.0000	0.3757	0.3757	139.40	7392	1.0219	25.661	141.00	28382	1.3955	96.002
137.90	0.0000	0.4445	0.4445	139.50	8577	1.0491	29.637	141.10	29979	1.4156	101.34
138.00	0.0000	0.5040	0.5040	139.60	9761	1.0757	33.614	141.20	31575	1.4354	106.69
138.10	0.0000	0.5572	0.5572	139.70	10946	1.1016	37.589	141.30	33172	1.4549	112.03
138.20	0.0000	0.6057	0.6057	139.80	12131	1.1270	41.564	141.40	34768	1.4742	117.37
138.30	0.0000	0.6507	0.6507	139.90	13316	1.1517	45.539	141.50	36365	1.4932	122.71
138.40	0.0000	0.6927	0.6927	140.00	14501	1.1760	49.513	141.60	37962	1.5120	128.05
138.50	0.0000	0.7323	0.7323	140.10	15889	1.1997	54.163	141.70	39558	1.5305	133.39
138.60	0.0000	0.7699	0.7699	140.20	17277	1.2230	58.814	141.80	41155	1.5489	138.73
138.70	0.0000	0.8057	0.8057	140.30	18665	1.2459	63.464	141.90	42751	1.5670	144.07
138.80	530.40	0.8400	2.6080	140.40	20053	1.2684	68.113				
138.90	1591	0.8729	6.1769	140.50	21442	1.2904	72.762				
139.00	2652	0.9047	9.7447	140.60	22830	1.3121	77.411				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 3.71 INFLOW Q (cfs): 9.08
PEAK STAGE (ft): 141.92 PEAK OUTFLOW : 1.57
PEAK TIME: 530.00 min.
INFLOW HYD No. : 7 OUTFLOW HYD No.: 12

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0088	0.0000	0.0088	0.0000	0.0088	137.55	40.00
0.0088	0.0452	0.0000	0.0540	0.0088	0.0452	137.55	50.00
0.0452	0.1056	0.0000	0.1508	0.0452	0.1056	137.55	60.00
0.1056	0.2104	-0.0000	0.3160	0.1056	0.2104	137.55	70.00
0.2104	0.3506	0.0000	0.5611	0.2104	0.3506	137.55	80.00
0.3506	0.4795	0.0000	0.8301	0.3506	0.4795	137.55	90.00
0.4795	0.5923	0.0000	1.0718	0.4795	0.5923	137.55	100.00
0.5923	0.6890	0.0000	1.2813	0.5923	0.6890	137.55	110.00
0.6890	0.7709	0.0000	1.4598	0.6890	0.7709	137.55	120.00
0.7709	0.8746	0.0000	1.6455	0.7709	0.8746	137.55	130.00
0.8746	0.9944	0.0676	1.9367	0.8070	1.1297	138.70	140.00
0.9944	1.0837	0.3178	2.3959	0.8119	1.5841	138.72	150.00
1.0837	1.1479	0.7636	2.9952	0.8205	2.1747	138.74	160.00
1.1479	1.2047	1.3430	3.6956	0.8317	2.8638	138.78	170.00
1.2047	1.2502	2.0215	4.4763	0.8423	3.6340	138.81	180.00
1.2502	1.2826	2.7845	5.3172	0.8495	4.4678	138.83	190.00
1.2826	1.3162	3.6106	6.2093	0.8572	5.3522	138.85	200.00
1.3162	1.3440	4.4868	7.1470	0.8653	6.2817	138.88	210.00
1.3440	1.3624	5.4078	8.1142	0.8739	7.2404	138.90	220.00
1.3624	1.3851	6.3580	9.1054	0.8824	8.2230	138.93	230.00
1.3851	1.4041	7.3319	10.121	0.8912	9.2299	138.96	240.00
1.4041	1.4642	8.3298	11.198	0.9001	10.298	138.99	250.00
1.4642	1.5479	9.3890	12.401	0.9090	11.492	139.01	260.00
1.5479	1.6023	10.574	13.724	0.9182	12.806	139.04	270.00
1.6023	1.6463	11.878	15.126	0.9283	14.198	139.08	280.00
1.6463	1.6727	13.259	16.578	0.9389	15.639	139.11	290.00
1.6727	1.6944	14.690	18.057	0.9497	17.107	139.15	300.00
1.6944	1.9105	16.147	19.751	0.9606	18.791	139.18	310.00
1.9105	2.2325	17.818	21.961	0.9729	20.988	139.23	320.00
2.2325	2.4245	19.999	24.656	0.9889	23.667	139.28	330.00
2.4245	2.5427	22.659	27.626	1.0079	26.619	139.35	340.00
2.5427	2.6187	25.590	30.751	1.0285	29.723	139.42	350.00
2.6187	2.6704	28.673	33.962	1.0497	32.913	139.50	360.00
2.6704	2.6589	31.842	37.171	1.0710	36.100	139.58	370.00
2.6589	2.6109	35.008	40.278	1.0919	39.186	139.66	380.00
2.6109	2.5841	38.074	43.269	1.1118	42.157	139.74	390.00
2.5841	2.5751	41.027	46.186	1.1307	45.055	139.81	400.00
2.5751	2.5817	43.907	49.063	1.1487	47.915	139.89	410.00
2.5817	2.5844	46.748	51.914	1.1662	50.748	139.96	420.00
2.5844	3.2716	49.566	55.422	1.1823	54.240	140.03	430.00
3.2716	4.3554	53.039	60.667	1.2001	59.466	140.10	440.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE (ft)	TIME (min)
<---------- cfs min ---------->							
4.3554	4.9805	58.240	67.576	1.2262	66.350	140.21	450.00
4.9805	6.3168	65.090	76.387	1.2598	75.128	140.36	460.00
6.3168	8.0629	73.826	88.206	1.3014	86.904	140.55	470.00
8.0629	9.0790	85.549	102.69	1.3553	101.34	140.80	480.00
9.0790	8.3587	99.920	117.36	1.4155	115.94	141.10	490.00
8.3587	6.6523	114.47	129.48	1.4690	128.02	141.37	500.00
6.6523	5.7040	126.50	138.86	1.5119	137.35	141.60	510.00
5.7040	5.0661	135.80	146.57	1.5441	145.03	141.77	520.00
5.0661	4.6075	143.46	153.13	1.5702	151.56	141.92	530.00
4.6075	4.3549	151.56	160.53	0.0000	160.53	0.00	540.00
4.3549	3.9363	160.53	168.82	0.0000	168.82	0.00	550.00
3.9363	3.4238	168.82	176.18	0.0000	176.18	0.00	560.00
3.4238	3.1390	176.18	182.74	0.0000	182.74	0.00	570.00
3.1390	2.9880	182.74	188.87	0.0000	188.87	0.00	580.00
2.9880	2.8984	188.87	194.75	0.0000	194.75	0.00	590.00
2.8984	2.8497	194.75	200.50	0.0000	200.50	0.00	600.00
2.8497	2.7700	200.50	206.12	0.0000	206.12	0.00	610.00
2.7700	2.6728	206.12	211.56	0.0000	211.56	0.00	620.00
2.6728	2.6196	211.56	216.86	0.0000	216.86	0.00	630.00
2.6196	2.5842	216.86	222.06	0.0000	222.06	0.00	640.00
2.5842	2.5722	222.06	227.22	0.0000	227.22	0.00	650.00
2.5722	2.5664	227.22	232.35	0.0000	232.35	0.00	660.00
2.5664	2.4491	232.35	237.37	0.0000	237.37	0.00	670.00
2.4491	2.2693	237.37	242.09	0.0000	242.09	0.00	680.00
2.2693	2.1693	242.09	246.53	0.0000	246.53	0.00	690.00
2.1693	2.1209	246.53	250.82	0.0000	250.82	0.00	700.00
2.1209	2.0876	250.82	255.03	0.0000	255.03	0.00	710.00
2.0876	2.0695	255.03	259.18	0.0000	259.18	0.00	720.00
2.0695	2.0668	259.18	263.32	0.0000	263.32	0.00	730.00
2.0668	2.0590	263.32	267.45	0.0000	267.45	0.00	740.00
2.0590	2.0552	267.45	271.56	0.0000	271.56	0.00	750.00
2.0552	2.0604	271.56	275.68	0.0000	275.68	0.00	760.00
2.0604	2.0571	275.68	279.79	0.0000	279.79	0.00	770.00
2.0571	2.0557	279.79	283.91	0.0000	283.91	0.00	780.00
2.0557	1.9463	283.91	287.91	0.0000	287.91	0.00	790.00
1.9463	1.7696	287.91	291.62	0.0000	291.62	0.00	800.00
1.7696	1.6712	291.62	295.06	0.0000	295.06	0.00	810.00
1.6712	1.6164	295.06	298.35	0.0000	298.35	0.00	820.00
1.6164	1.5861	298.35	301.55	0.0000	301.55	0.00	830.00
1.5861	1.5694	301.55	304.71	0.0000	304.71	0.00	840.00
1.5694	1.6150	304.71	307.89	0.0000	307.89	0.00	850.00
1.6150	1.7023	307.89	311.21	0.0000	311.21	0.00	860.00
1.7023	1.7514	311.21	314.66	0.0000	314.66	0.00	870.00
1.7514	1.7724	314.66	318.19	0.0000	318.19	0.00	880.00
1.7724	1.7913	318.19	321.75	0.0000	321.75	0.00	890.00
1.7913	1.8022	321.75	325.35	0.0000	325.35	0.00	900.00
1.8022	1.8018	325.35	328.95	0.0000	328.95	0.00	910.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.8018	1.8087	328.95	332.56	0.0000	332.56	0.00	920.00
1.8087	1.8129	332.56	336.18	0.0000	336.18	0.00	930.00
1.8129	1.8087	336.18	339.80	0.0000	339.80	0.00	940.00
1.8087	1.8135	339.80	343.43	0.0000	343.43	0.00	950.00
1.8135	1.8165	343.43	347.06	0.0000	347.06	0.00	960.00
1.8165	1.6399	347.06	350.51	0.0000	350.51	0.00	970.00
1.6399	1.3766	350.51	353.53	0.0000	353.53	0.00	980.00
1.3766	1.2295	353.53	356.13	0.0000	356.13	0.00	990.00
1.2295	1.1406	356.13	358.50	0.0000	358.50	0.00	1000.00
1.1406	1.0978	358.50	360.74	0.0000	360.74	0.00	1010.00
1.0978	1.0740	360.74	362.91	0.0000	362.91	0.00	1020.00
1.0740	1.1708	362.91	365.16	0.0000	365.16	0.00	1030.00
1.1708	1.3419	365.16	367.67	0.0000	367.67	0.00	1040.00
1.3419	1.4378	367.67	370.45	0.0000	370.45	0.00	1050.00
1.4378	1.4915	370.45	373.38	0.0000	373.38	0.00	1060.00
1.4915	1.5218	373.38	376.39	0.0000	376.39	0.00	1070.00
1.5218	1.5389	376.39	379.46	0.0000	379.46	0.00	1080.00
1.5389	1.4935	379.46	382.49	0.0000	382.49	0.00	1090.00
1.4935	1.4064	382.49	385.39	0.0000	385.39	0.00	1100.00
1.4064	1.3578	385.39	388.15	0.0000	388.15	0.00	1110.00
1.3578	1.5444	388.15	391.05	0.0000	391.05	0.00	1120.00
1.5444	1.4352	391.05	394.03	0.0000	394.03	0.00	1130.00
1.4352	1.1675	394.03	396.64	0.0000	396.64	0.00	1140.00
1.1675	1.2317	396.64	399.04	0.0000	399.04	0.00	1150.00
1.2317	1.2608	399.04	401.53	0.0000	401.53	0.00	1160.00
1.2608	1.2772	401.53	404.07	0.0000	404.07	0.00	1170.00
1.2772	1.2934	404.07	406.64	0.0000	406.64	0.00	1180.00
1.2934	1.2956	406.64	409.23	0.0000	409.23	0.00	1190.00
1.2956	1.2970	409.23	411.82	0.0000	411.82	0.00	1200.00
1.2970	1.3048	411.82	414.42	0.0000	414.42	0.00	1210.00
1.3048	1.3024	414.42	417.03	0.0000	417.03	0.00	1220.00
1.3024	1.3012	417.03	419.63	0.0000	419.63	0.00	1230.00
1.3012	1.3075	419.63	422.24	0.0000	422.24	0.00	1240.00
1.3075	1.3042	422.24	424.85	0.0000	424.85	0.00	1250.00
1.3042	1.3025	424.85	427.46	0.0000	427.46	0.00	1260.00
1.3025	1.3086	427.46	430.07	0.0000	430.07	0.00	1270.00
1.3086	1.3052	430.07	432.68	0.0000	432.68	0.00	1280.00
1.3052	1.3034	432.68	435.29	0.0000	435.29	0.00	1290.00
1.3034	1.3094	435.29	437.90	0.0000	437.90	0.00	1300.00
1.3094	1.3060	437.90	440.52	0.0000	440.52	0.00	1310.00
1.3060	1.3042	440.52	443.13	0.0000	443.13	0.00	1320.00
1.3042	1.2479	443.13	445.68	0.0000	445.68	0.00	1330.00
1.2479	1.1612	445.68	448.09	0.0000	448.09	0.00	1340.00
1.1612	1.1128	448.09	450.37	0.0000	450.37	0.00	1350.00
1.1128	1.0789	450.37	452.56	0.0000	452.56	0.00	1360.00
1.0789	1.0669	452.56	454.70	0.0000	454.70	0.00	1370.00
1.0669	1.0603	454.70	456.83	0.0000	456.83	0.00	1380.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.0603	1.0497	456.83	458.94	0.0000	458.94	0.00	1390.00
1.0497	1.0508	458.94	461.04	0.0000	461.04	0.00	1400.00
1.0508	1.0515	461.04	463.14	0.0000	463.14	0.00	1410.00
1.0515	1.0450	463.14	465.24	0.0000	465.24	0.00	1420.00
1.0450	1.0484	465.24	467.33	0.0000	467.33	0.00	1430.00
1.0484	1.0503	467.33	469.43	0.0000	469.43	0.00	1440.00
1.0503	0.8158	469.43	471.30	0.0000	471.30	0.00	1450.00
0.8158	0.4559	471.30	472.57	0.0000	472.57	0.00	1460.00
0.4559	0.2548	472.57	473.28	0.0000	473.28	0.00	1470.00
0.2548	0.1424	473.28	473.68	0.0000	473.68	0.00	1480.00
0.1424	0.0796	473.68	473.90	0.0000	473.90	0.00	1490.00
0.0796	0.0445	473.90	474.02	0.0000	474.02	0.00	1500.00

'N' - POND 'B' TOTAL VOLUME

ELEV (FT)	AREA (SF)	VOL (CF)	CUMM VOL (CF)	
135	7015			
136	8904	7960	7960	
137	10,849	9877	17,836	← WQ VOL @ 136.75'
138	12,851	11,850	29,686	
139	14,909	15,966	45,652	
140	17,023	15,966	61,618	

WQ RELEASE RATE

$$\frac{15,249\ ft^3}{48\ HRS} \times \frac{1\ HR}{3600\ s} = 0.088\ cfs$$

GROUP MACKENZIE
0690 SW Bancroft St / PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

'D' - POND 'B' DETENTION VOLUME

ELEV (FT)	AREA (SF)	VOL (CF)	CUMM. VOL. (CF)
136.75	10,363		
137	10,849	2652	2652
138	12,851	11,850	14,502
139	14,909	13,880	28,382
140	17,023	15,452	43,834

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

'P' WQ ORIFICE 'B'

$Q = CA(2gh)^{1/2}$

$A = \dfrac{Q}{C(2gh)^{1/2}}$

$A = \dfrac{0.088\ cfs}{0.62\left(2 \times 32.2 \times 0.5\right)^{1/2}}$

$A = 0.025\ \Phi$

$d = \sqrt{\dfrac{4A}{\pi}} = 0.178' = \underline{\underline{2.14''\ \phi}}$

$Q = 0.088\ cfs$

$C = 0.6$

$h = 136.75 - 136.25 = 0.5'$

$g = 32.2$

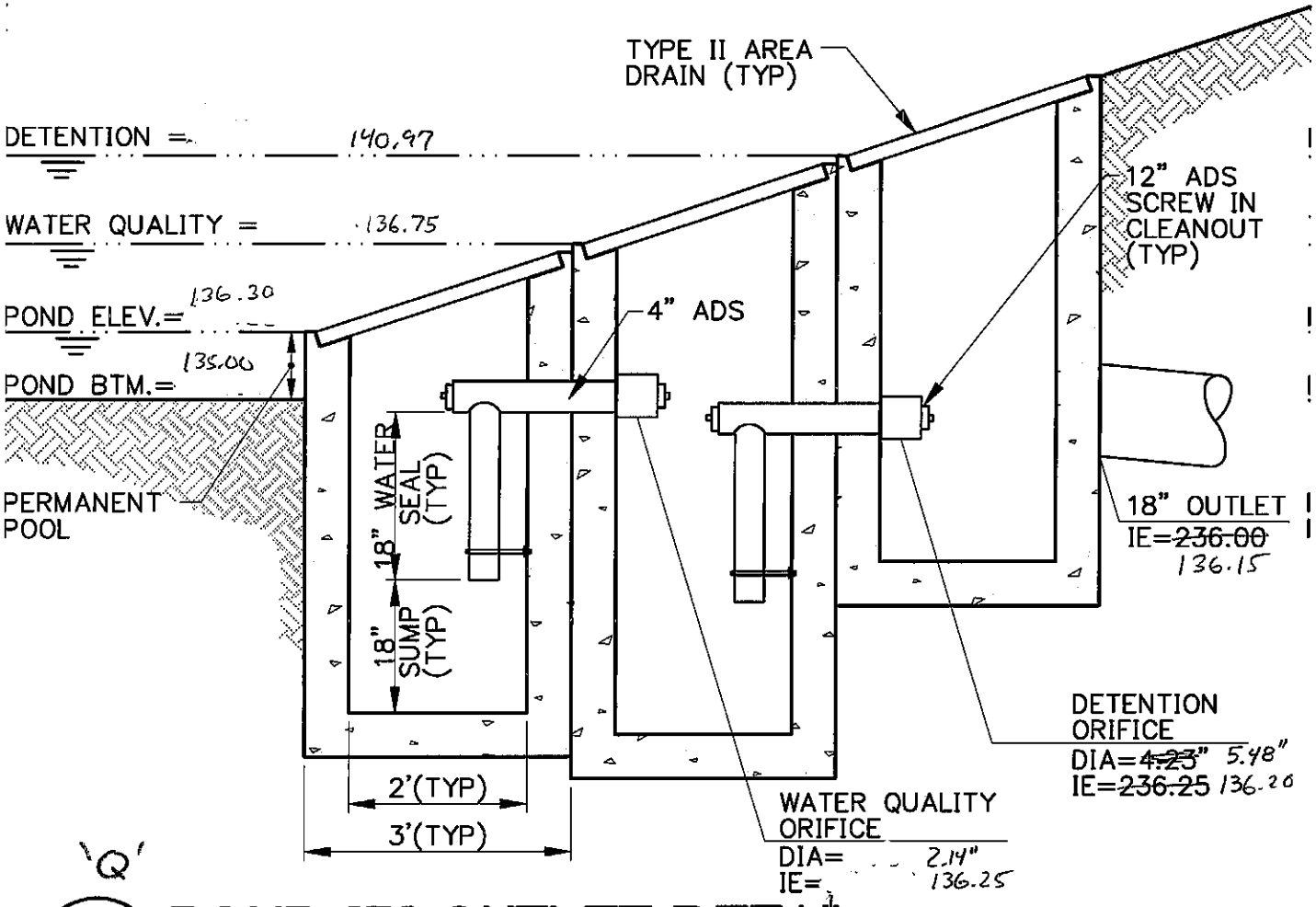
$A = \dfrac{\pi d^2}{4}$

$d = \sqrt{\dfrac{4A}{\pi}}$

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED



'Q'

2 C8.1 POND "B" OUTLET DETAIL

N.T.S.
OUTFLOW DEVICE

SD150
DETINSET= 1:1

BASIN SUMMARY

BASIN ID: D10 NAME: DEVELOPED 10YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.45 inches AREA..: 2.06 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 14.80 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 11.66 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0200
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 8.23 cfs VOL: 3.40 Ac-ft TIME: 480 min

BASIN ID: D2 NAME: DEVELOPED 2YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 2.50 inches AREA..: 2.06 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 14.80 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 11.66 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0200
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 5.73 cfs VOL: 2.36 Ac-ft TIME: 480 min

BASIN ID: D25 NAME: DEVELOPED 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.90 inches AREA..: 2.06 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 14.80 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 11.66 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0200
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 9.42 cfs VOL: 3.90 Ac-ft TIME: 480 min

BASIN SUMMARY

BASIN ID: E10 NAME: EXISTING 10YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.45 inches AREA..: 13.72 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 38.83 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 2.90 cfs VOL: 1.83 Ac-ft TIME: 490 min

BASIN ID: E2 NAME: EXISTING 2YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 2.50 inches AREA..: 13.72 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 38.83 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 1.36 cfs VOL: 1.02 Ac-ft TIME: 490 min

BASIN ID: E25 NAME: EXISTING 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 13.72 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.90 inches AREA..: 13.72 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 38.83 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 3.71 cfs VOL: 2.24 Ac-ft TIME: 490 min

HYDROGRAPH SUMMARY

HYD NUM	PEAK RUNOFF RATE cfs	TIME OF PEAK min.	VOLUME OF HYDRO cf\AcFt	Contrib Area Acres
1	1.356	490	44270 cf	13.72
2	2.902	490	79526 cf	13.72
3	3.714	490	97581 cf	13.72
5	5.734	480	102758 cf	13.72
6	8.230	480	148087 cf	13.72
7	9.422	480	169790 cf	13.72
10	1.356	690	102847 cf	13.72
11	1.670	800	148142 cf	13.72
12	1.779	660	39111 cf	13.72

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 136.20
Elev: 136.20 ft Orifice Diameter: 5.4785 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
136.20	0.0000	0.0000	0.0000	137.90	13317	1.0620	45.452	139.60	37653	1.5019	127.01
136.30	0.0000	0.2576	0.2576	138.00	14502	1.0928	49.433	139.70	39198	1.5238	132.19
136.40	0.0000	0.3643	0.3643	138.10	15890	1.1227	54.089	139.80	40744	1.5454	137.36
136.50	0.0000	0.4461	0.4461	138.20	17278	1.1519	58.745	139.90	42289	1.5667	142.53
136.60	0.0000	0.5151	0.5151	138.30	18666	1.1803	63.400	140.00	43834	1.5877	147.70
136.70	0.0000	0.5759	0.5759	138.40	20054	1.2081	68.055	140.10	45251	1.6085	152.44
136.80	530.40	0.6309	2.3989	138.50	21442	1.2352	72.709	140.20	46667	1.6290	157.19
136.90	1591	0.6815	5.9855	138.60	22830	1.2618	77.362	140.30	48084	1.6492	161.93
137.00	2652	0.7285	9.5685	138.70	24218	1.2878	82.014	140.40	49500	1.6692	166.67
137.10	3837	0.7727	13.563	138.80	25606	1.3133	86.667	140.50	50917	1.6890	171.41
137.20	5022	0.8145	17.554	138.90	26994	1.3384	91.318	140.60	52334	1.7085	176.15
137.30	6207	0.8542	21.544	139.00	28382	1.3629	95.970	140.70	53750	1.7278	180.90
137.40	7392	0.8922	25.532	139.10	29927	1.3870	101.14	140.80	55167	1.7469	185.64
137.50	8577	0.9287	29.519	139.20	31472	1.4107	106.32	140.90	56583	1.7658	190.38
137.60	9762	0.9637	33.504	139.30	33018	1.4341	111.49				
137.70	10947	0.9975	37.488	139.40	34563	1.4570	116.67				
137.80	12132	1.0303	41.470	139.50	36108	1.4796	121.84				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 1.36 INFLOW Q (cfs): 5.73
PEAK STAGE (ft): 138.97 PEAK OUTFLOW : 1.36
PEAK TIME: 690.00 min.
INFLOW HYD No. : 5 OUTFLOW HYD No.: 10

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	136.20	50.00
0.0001	0.0071	0.0000	0.0072	0.0001	0.0071	136.20	60.00
0.0071	0.0405	0.0000	0.0476	0.0071	0.0405	136.20	70.00
0.0405	0.1004	0.0000	0.1409	0.0405	0.1004	136.20	80.00
0.1004	0.1674	0.0000	0.2677	0.1004	0.1674	136.20	90.00
0.1674	0.2325	0.0000	0.3999	0.1674	0.2325	136.20	100.00
0.2325	0.2922	0.0000	0.5246	0.2325	0.2922	136.20	110.00
0.2922	0.3455	0.0000	0.6377	0.2922	0.3455	136.20	120.00
0.3455	0.4121	0.0000	0.7576	0.3455	0.4121	136.20	130.00
0.4121	0.4879	0.0000	0.8999	0.4121	0.4879	136.20	140.00
0.4879	0.5466	0.0000	1.0345	0.4879	0.5466	136.20	150.00
0.5466	0.5916	0.0000	1.1382	0.5466	0.5916	136.20	160.00
0.5916	0.6329	0.0152	1.2397	0.5764	0.6633	136.70	170.00
0.6329	0.6676	0.0847	1.3853	0.5786	0.8067	136.70	180.00
0.6676	0.6944	0.2238	1.5859	0.5829	1.0030	136.71	190.00
0.6944	0.7222	0.4142	1.8308	0.5888	1.2420	136.72	200.00
0.7222	0.7459	0.6460	2.1141	0.5960	1.5181	136.74	210.00
0.7459	0.7634	0.9137	2.4231	0.6043	1.8187	136.75	220.00
0.7634	0.7836	1.2053	2.7523	0.6134	2.1389	136.77	230.00
0.7836	0.8010	1.5159	3.1005	0.6231	2.4774	136.79	240.00
0.8010	0.8455	1.8454	3.4918	0.6320	2.8598	136.80	250.00
0.8455	0.9035	2.2224	3.9714	0.6374	3.3340	136.81	260.00
0.9035	0.9394	2.6899	4.5328	0.6441	3.8888	136.83	270.00
0.9394	0.9673	3.2369	5.1435	0.6519	4.4916	136.84	280.00
0.9673	0.9831	3.8312	5.7815	0.6604	5.1211	136.86	290.00
0.9831	0.9963	4.4519	6.4312	0.6693	5.7620	136.88	300.00
0.9963	1.1404	5.0837	7.2204	0.6783	6.5421	136.89	310.00
1.1404	1.3477	5.8533	8.3415	0.6888	7.6527	136.92	320.00
1.3477	1.4589	6.9494	9.7560	0.7033	9.0527	136.95	330.00
1.4589	1.5216	8.3309	11.311	0.7217	10.590	136.99	340.00
1.5216	1.5601	9.8499	12.932	0.7398	12.192	137.03	350.00
1.5601	1.5875	11.434	14.582	0.7575	13.824	137.07	360.00
1.5875	1.5763	13.049	16.213	0.7754	15.437	137.11	370.00
1.5763	1.5447	14.645	17.766	0.7923	16.974	137.15	380.00
1.5447	1.5310	16.165	19.241	0.8084	18.433	137.19	390.00
1.5310	1.5300	17.609	20.670	0.8232	19.847	137.22	400.00
1.5300	1.5391	19.010	22.079	0.8373	21.241	137.26	410.00
1.5391	1.5444	20.390	23.474	0.8512	22.623	137.29	420.00
1.5444	2.0207	21.758	25.323	0.8645	24.459	137.33	430.00
2.0207	2.7418	23.577	28.339	0.8820	27.457	137.37	440.00
2.7418	3.1175	26.547	32.407	0.9098	31.497	137.45	450.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
3.1175	3.9947	30.551	37.663	0.9461	36.717	137.55	460.00
3.9947	5.1321	35.726	44.853	0.9910	43.862	137.68	470.00
5.1321	5.7341	42.812	53.679	1.0493	52.629	137.86	480.00
5.7341	5.1376	51.516	62.388	1.1133	61.274	138.07	490.00
5.1376	3.9324	60.107	69.177	1.1673	68.010	138.25	500.00
3.9324	3.3411	66.802	74.075	1.2078	72.867	138.40	510.00
3.3411	2.9739	71.631	77.946	1.2361	76.710	138.50	520.00
2.9739	2.7215	75.452	81.147	1.2581	79.889	138.59	530.00
2.7215	2.6003	78.613	83.935	1.2759	82.659	138.65	540.00
2.6003	2.3457	81.368	86.314	1.2914	85.022	138.71	550.00
2.3457	2.0240	83.718	88.088	1.3043	86.783	138.76	560.00
2.0240	1.8663	85.469	89.360	1.3140	88.046	138.80	570.00
1.8663	1.7945	86.725	90.386	1.3207	89.065	138.83	580.00
1.7945	1.7557	87.739	91.289	1.3262	89.963	138.85	590.00
1.7557	1.7379	88.632	92.125	1.3311	90.794	138.87	600.00
1.7379	1.6924	89.459	92.889	1.3355	91.554	138.89	610.00
1.6924	1.6330	90.214	93.539	1.3396	92.200	138.91	620.00
1.6330	1.6047	90.857	94.095	1.3430	92.752	138.92	630.00
1.6047	1.5870	91.406	94.597	1.3459	93.251	138.93	640.00
1.5870	1.5841	91.903	95.074	1.3486	93.725	138.94	650.00
1.5841	1.5836	92.374	95.542	1.3511	94.191	138.95	660.00
1.5836	1.5029	92.838	95.924	1.3535	94.571	138.96	670.00
1.5029	1.3821	93.215	96.100	1.3555	94.744	138.97	680.00
1.3821	1.3230	93.388	96.093	1.3564	94.737	138.97	690.00
1.3230	1.2991	93.380	96.002	1.3564	94.646	138.97	700.00
1.2991	1.2830	93.290	95.872	1.3559	94.516	138.97	710.00
1.2830	1.2757	93.161	95.720	1.3552	94.364	138.97	720.00
1.2757	1.2775	93.010	95.563	1.3544	94.209	138.97	730.00
1.2775	1.2741	92.855	95.407	1.3536	94.053	138.96	740.00
1.2741	1.2730	92.700	95.247	1.3528	93.894	138.96	750.00
1.2730	1.2778	92.543	95.093	1.3520	93.741	138.96	760.00
1.2778	1.2759	92.390	94.944	1.3511	93.593	138.95	770.00
1.2759	1.2755	92.242	94.794	1.3504	93.443	138.95	780.00
1.2755	1.1982	92.094	94.567	1.3496	93.218	138.95	790.00
1.1982	1.0780	91.869	94.146	1.3484	92.797	138.94	800.00
1.0780	1.0187	91.451	93.548	1.3462	92.202	138.93	810.00
1.0187	0.9897	90.859	92.867	1.3430	91.524	138.92	820.00
0.9897	0.9756	90.185	92.150	1.3394	90.810	138.90	830.00
0.9756	0.9689	89.475	91.419	1.3356	90.083	138.89	840.00
0.9689	1.0047	88.752	90.725	1.3317	89.394	138.87	850.00
1.0047	1.0666	88.066	90.137	1.3280	88.809	138.86	860.00
1.0666	1.0976	87.484	89.648	1.3249	88.323	138.85	870.00
1.0976	1.1084	87.001	89.207	1.3222	87.885	138.84	880.00
1.1084	1.1190	86.565	88.792	1.3199	87.473	138.83	890.00
1.1190	1.1246	86.155	88.398	1.3177	87.081	138.82	900.00
1.1246	1.1228	85.765	88.013	1.3156	86.697	138.81	910.00
1.1228	1.1272	85.384	87.634	1.3135	86.320	138.80	920.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.1272	1.1296	85.009	87.265	1.3114	85.954	138.79	930.00
1.1296	1.1263	84.645	86.901	1.3094	85.591	138.78	940.00
1.1263	1.1299	84.284	86.540	1.3074	85.232	138.78	950.00
1.1299	1.1320	83.927	86.189	1.3055	84.883	138.77	960.00
1.1320	1.0060	83.580	85.718	1.3036	84.414	138.76	970.00
1.0060	0.8262	83.113	84.945	1.3010	83.644	138.75	980.00
0.8262	0.7373	82.348	83.911	1.2968	82.614	138.74	990.00
0.7373	0.6885	81.323	82.749	1.2911	81.458	138.71	1000.00
0.6885	0.6694	80.173	81.531	1.2847	80.247	138.69	1010.00
0.6694	0.6600	78.969	80.298	1.2779	79.020	138.66	1020.00
0.6600	0.7340	77.749	79.143	1.2711	77.872	138.64	1030.00
0.7340	0.8542	76.607	78.195	1.2647	76.931	138.61	1040.00
0.8542	0.9139	75.671	77.439	1.2593	76.180	138.59	1050.00
0.9139	0.9437	74.925	76.783	1.2551	75.527	138.57	1060.00
0.9437	0.9587	74.276	76.179	1.2513	74.927	138.56	1070.00
0.9587	0.9663	73.679	75.604	1.2479	74.356	138.55	1080.00
0.9663	0.9309	73.112	75.009	1.2446	73.764	138.54	1090.00
0.9309	0.8693	72.523	74.323	1.2413	73.082	138.52	1100.00
0.8693	0.8389	71.844	73.553	1.2374	72.315	138.51	1110.00
0.8389	0.9767	71.082	72.898	1.2329	71.665	138.49	1120.00
0.9767	0.8924	70.436	72.305	1.2292	71.076	138.48	1130.00
0.8924	0.7030	69.850	71.446	1.2257	70.220	138.46	1140.00
0.7030	0.7621	68.999	70.464	1.2207	69.243	138.45	1150.00
0.7621	0.7865	68.028	69.577	1.2150	68.362	138.43	1160.00
0.7865	0.7988	67.152	68.737	1.2099	67.528	138.41	1170.00
0.7988	0.8099	66.323	67.931	1.2049	66.726	138.39	1180.00
0.8099	0.8106	65.526	67.147	1.2002	65.947	138.37	1190.00
0.8106	0.8111	64.751	66.373	1.1955	65.177	138.35	1200.00
0.8111	0.8164	63.986	65.614	1.1909	64.423	138.34	1210.00
0.8164	0.8142	63.236	64.867	1.1864	63.681	138.32	1220.00
0.8142	0.8133	62.499	64.126	1.1820	62.944	138.31	1230.00
0.8133	0.8179	61.767	63.398	1.1775	62.220	138.29	1240.00
0.8179	0.8153	61.047	62.681	1.1731	61.507	138.27	1250.00
0.8153	0.8142	60.339	61.968	1.1687	60.799	138.26	1260.00
0.8142	0.8187	59.635	61.268	1.1644	60.104	138.24	1270.00
0.8187	0.8161	58.943	60.578	1.1602	59.418	138.23	1280.00
0.8161	0.8150	58.262	59.893	1.1560	58.737	138.21	1290.00
0.8150	0.8195	57.585	59.220	1.1518	58.068	138.20	1300.00
0.8195	0.8169	56.921	58.557	1.1476	57.409	138.19	1310.00
0.8169	0.8157	56.266	57.898	1.1435	56.755	138.17	1320.00
0.8157	0.7756	55.615	57.207	1.1394	56.067	138.16	1330.00
0.7756	0.7162	54.932	56.424	1.1351	55.289	138.14	1340.00
0.7162	0.6868	54.159	55.562	1.1302	54.431	138.13	1350.00
0.6868	0.6674	53.307	54.661	1.1248	53.536	138.11	1360.00
0.6674	0.6628	52.417	53.747	1.1191	52.628	138.09	1370.00
0.6628	0.6606	51.515	52.838	1.1133	51.725	138.07	1380.00
0.6606	0.6547	50.617	51.932	1.1075	50.825	138.05	1390.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.6547	0.6567	49.723	51.035	1.1017	49.933	138.03	1400.00
0.6567	0.6578	48.837	50.152	1.0960	49.056	138.01	1410.00
0.6578	0.6535	47.966	49.277	1.0898	48.187	137.99	1420.00
0.6535	0.6564	47.104	48.414	1.0831	47.331	137.97	1430.00
0.6564	0.6579	46.254	47.569	1.0765	46.492	137.95	1440.00
0.6579	0.4897	45.422	46.570	1.0700	45.500	137.93	1450.00
0.4897	0.2424	44.437	45.169	1.0623	44.107	137.90	1460.00
0.2424	0.1200	43.056	43.418	1.0513	42.367	137.87	1470.00
0.1200	0.0594	41.330	41.509	1.0374	40.472	137.82	1480.00
0.0594	0.0294	39.450	39.538	1.0221	38.516	137.77	1490.00
0.0294	0.0146	37.510	37.554	1.0060	36.548	137.73	1500.00
0.0146	0.0072	35.559	35.581	0.9896	34.591	137.68	1510.00
0.0072	0.0036	33.618	33.629	0.9730	32.656	137.63	1520.00
0.0036	0.0018	31.700	31.705	0.9563	30.749	137.58	1530.00
0.0018	0.0009	29.809	29.812	0.9395	28.872	137.53	1540.00
0.0009	0.0004	27.950	27.951	0.9228	27.028	137.48	1550.00
0.0004	0.0002	26.122	26.123	0.9059	25.217	137.44	1560.00
0.0002	0.0001	24.328	24.328	0.8892	23.439	137.39	1570.00
0.0001	0.0001	22.566	22.567	0.8723	21.694	137.35	1580.00
0.0001	0.0000	20.839	20.839	0.8557	19.983	137.30	1590.00
0.0000	0.0000	19.144	19.144	0.8387	18.306	137.26	1600.00
0.0000	0.0000	17.484	17.484	0.8220	16.662	137.22	1610.00
0.0000	0.0000	15.857	15.857	0.8051	15.051	137.18	1620.00
0.0000	0.0000	14.263	14.263	0.7883	13.475	137.14	1630.00
0.0000	0.0000	12.703	12.703	0.7717	11.931	137.10	1640.00
0.0000	0.0000	11.177	11.177	0.7546	10.422	137.06	1650.00
0.0000	0.0000	9.6842	9.6842	0.7380	8.9463	137.02	1660.00
0.0000	0.0000	8.2259	8.2259	0.7203	7.5056	136.98	1670.00
0.0000	0.0000	6.8042	6.8042	0.7014	6.1028	136.94	1680.00
0.0000	0.0000	5.4198	5.4198	0.6830	4.7368	136.90	1690.00
0.0000	0.0000	4.0729	4.0729	0.6639	3.4091	136.87	1700.00
0.0000	0.0000	2.7639	2.7639	0.6451	2.1188	136.83	1710.00
0.0000	0.0000	1.4963	1.4963	0.6225	0.8739	136.78	1720.00
0.0000	0.0000	0.2890	0.2890	0.5849	-0.2960	136.72	1730.00

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 136.20
Elev: 136.20 ft Orifice Diameter: 5.4785 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
136.20	0.0000	0.0000	0.0000	137.90	13317	1.0620	45.452	139.60	37653	1.5019	127.01
136.30	0.0000	0.2576	0.2576	138.00	14502	1.0928	49.433	139.70	39198	1.5238	132.19
136.40	0.0000	0.3643	0.3643	138.10	15890	1.1227	54.089	139.80	40744	1.5454	137.36
136.50	0.0000	0.4461	0.4461	138.20	17278	1.1519	58.745	139.90	42289	1.5667	142.53
136.60	0.0000	0.5151	0.5151	138.30	18666	1.1803	63.400	140.00	43834	1.5877	147.70
136.70	0.0000	0.5759	0.5759	138.40	20054	1.2081	68.055	140.10	45251	1.6085	152.44
136.80	530.40	0.6309	2.3989	138.50	21442	1.2352	72.709	140.20	46667	1.6290	157.19
136.90	1591	0.6815	5.9855	138.60	22830	1.2618	77.362	140.30	48084	1.6492	161.93
137.00	2652	0.7285	9.5685	138.70	24218	1.2878	82.014	140.40	49500	1.6692	166.67
137.10	3837	0.7727	13.563	138.80	25606	1.3133	86.667	140.50	50917	1.6890	171.41
137.20	5022	0.8145	17.554	138.90	26994	1.3384	91.318	140.60	52334	1.7085	176.15
137.30	6207	0.8542	21.544	139.00	28382	1.3629	95.970	140.70	53750	1.7278	180.90
137.40	7392	0.8922	25.532	139.10	29927	1.3870	101.14	140.80	55167	1.7469	185.64
137.50	8577	0.9287	29.519	139.20	31472	1.4107	106.32	140.90	56583	1.7658	190.38
137.60	9762	0.9637	33.504	139.30	33018	1.4341	111.49				
137.70	10947	0.9975	37.488	139.40	34563	1.4570	116.67				
137.80	12132	1.0303	41.470	139.50	36108	1.4796	121.84				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 2.90 INFLOW Q (cfs): 8.23
PEAK STAGE (ft): 140.41 PEAK OUTFLOW : 1.67
PEAK TIME: 800.00 min.
INFLOW HYD No. : 6 OUTFLOW HYD No.: 11

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0022	0.0000	0.0022	0.0000	0.0022	136.20	40.00
0.0022	0.0238	0.0000	0.0260	0.0022	0.0238	136.20	50.00
0.0238	0.0705	0.0000	0.0944	0.0238	0.0705	136.20	60.00
0.0705	0.1595	0.0000	0.2300	0.0705	0.1595	136.20	70.00
0.1595	0.2804	0.0000	0.4399	0.1595	0.2804	136.20	80.00
0.2804	0.3921	0.0000	0.6725	0.2804	0.3921	136.20	90.00
0.3921	0.4901	0.0000	0.8823	0.3921	0.4901	136.20	100.00
0.4901	0.5742	0.0000	1.0643	0.4901	0.5742	136.20	110.00
0.5742	0.6457	0.0000	1.2199	0.5742	0.6457	136.20	120.00
0.6457	0.7394	0.0677	1.4528	0.5780	0.8747	136.70	130.00
0.7394	0.8479	0.2898	1.8770	0.5849	1.2921	136.72	140.00
0.8479	0.9262	0.6945	2.4686	0.5975	1.8711	136.74	150.00
0.9262	0.9816	1.2561	3.1639	0.6150	2.5489	136.77	160.00
0.9816	1.0317	1.9159	3.9292	0.6330	3.2962	136.80	170.00
1.0317	1.0721	2.6526	4.7564	0.6436	4.1128	136.83	180.00
1.0721	1.1008	3.4578	5.6306	0.6551	4.9755	136.85	190.00
1.1008	1.1318	4.3083	6.5409	0.6672	5.8737	136.87	200.00
1.1318	1.1577	5.1938	7.4834	0.6799	6.8035	136.90	210.00
1.1577	1.1746	6.1113	8.4436	0.6922	7.7514	136.92	220.00
1.1746	1.1964	7.0467	9.4178	0.7046	8.7131	136.95	230.00
1.1964	1.2146	7.9958	10.407	0.7173	9.6896	136.98	240.00
1.2146	1.2737	8.9598	11.448	0.7298	10.718	137.00	250.00
1.2737	1.3532	9.9771	12.604	0.7412	11.863	137.03	260.00
1.3532	1.3994	11.109	13.861	0.7539	13.108	137.06	270.00
1.3994	1.4340	12.340	15.173	0.7677	14.406	137.09	280.00
1.4340	1.4521	13.624	16.510	0.7815	15.729	137.12	290.00
1.4521	1.4683	14.933	17.854	0.7954	17.058	137.15	300.00
1.4683	1.6787	16.249	19.396	0.8093	18.587	137.19	310.00
1.6787	1.9830	17.762	21.423	0.8248	20.599	137.23	320.00
1.9830	2.1467	19.754	23.884	0.8448	23.039	137.28	330.00
2.1467	2.2398	22.170	26.557	0.8685	25.688	137.34	340.00
2.2398	2.2969	24.795	29.331	0.8937	28.438	137.40	350.00
2.2969	2.3352	27.519	32.151	0.9188	31.232	137.47	360.00
2.3352	2.3149	30.288	34.939	0.9437	33.995	137.54	370.00
2.3149	2.2642	33.027	37.606	0.9679	36.638	137.61	380.00
2.2642	2.2399	35.648	40.152	0.9903	39.162	137.68	390.00
2.2399	2.2342	38.150	42.624	1.0113	41.613	137.74	400.00
2.2342	2.2436	40.582	45.059	1.0314	44.028	137.80	410.00
2.2436	2.2477	42.977	47.469	1.0506	46.418	137.86	420.00
2.2477	2.9341	45.349	50.531	1.0694	49.461	137.92	430.00
2.9341	3.9727	48.368	55.275	1.0929	54.182	138.00	440.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
3.9727	4.5081	53.059	61.540	1.1233	60.416	138.10	450.00
4.5081	5.7611	59.254	69.523	1.1621	68.361	138.24	460.00
5.7611	7.3831	67.151	80.296	1.2099	79.086	138.41	470.00
7.3831	8.2300	77.814	93.427	1.2714	92.156	138.64	480.00
8.2300	7.3623	90.813	106.41	1.3428	105.06	138.92	490.00
7.3623	5.6284	103.66	116.65	1.4050	115.24	139.18	500.00
5.6284	4.7761	113.79	124.20	1.4507	122.75	139.37	510.00
4.7761	4.2464	121.26	130.29	1.4835	128.80	139.52	520.00
4.2464	3.8824	127.29	135.42	1.5094	133.91	139.63	530.00
3.8824	3.7062	132.38	139.97	1.5310	138.44	139.73	540.00
3.7062	3.3412	136.89	143.94	1.5498	142.39	139.82	550.00
3.3412	2.8814	140.82	147.04	1.5661	145.48	139.90	560.00
2.8814	2.6556	143.90	149.44	1.5787	147.86	139.96	570.00
2.6556	2.5522	146.27	151.48	1.5884	149.89	140.00	580.00
2.5522	2.4959	148.29	153.34	1.5973	151.74	140.05	590.00
2.4959	2.4696	150.14	155.10	1.6054	153.50	140.09	600.00
2.4696	2.4040	151.88	156.76	1.6130	155.14	140.12	610.00
2.4040	2.3189	153.52	158.25	1.6202	156.63	140.16	620.00
2.3189	2.2779	155.00	159.60	1.6266	157.97	140.19	630.00
2.2779	2.2521	156.34	160.87	1.6323	159.23	140.22	640.00
2.2521	2.2472	157.60	162.10	1.6377	160.46	140.24	650.00
2.2472	2.2459	158.82	163.31	1.6430	161.67	140.27	660.00
2.2459	2.1308	160.02	164.39	1.6481	162.75	140.29	670.00
2.1308	1.9591	161.09	165.18	1.6527	163.53	140.32	680.00
1.9591	1.8748	161.87	165.71	1.6560	164.05	140.33	690.00
1.8748	1.8405	162.39	166.11	1.6582	164.45	140.34	700.00
1.8405	1.8174	162.79	166.45	1.6599	164.79	140.35	710.00
1.8174	1.8066	163.13	166.75	1.6613	165.09	140.36	720.00
1.8066	1.8087	163.43	167.04	1.6626	165.38	140.37	730.00
1.8087	1.8035	163.72	167.33	1.6638	165.67	140.37	740.00
1.8035	1.8016	164.00	167.61	1.6650	165.94	140.38	750.00
1.8016	1.8080	164.28	167.88	1.6661	166.22	140.38	760.00
1.8080	1.8050	164.55	168.16	1.6673	166.50	140.39	770.00
1.8050	1.8040	164.83	168.44	1.6685	166.77	140.40	780.00
1.8040	1.6945	165.10	168.60	1.6696	166.93	140.40	790.00
1.6945	1.5242	165.26	168.48	1.6703	166.81	140.41	800.00
1.5242	1.4402	165.14	168.10	1.6698	166.43	140.40	810.00
1.4402	1.3989	164.76	167.60	1.6682	165.93	140.39	820.00
1.3989	1.3787	164.27	167.04	1.6661	165.38	140.38	830.00
1.3787	1.3691	163.72	166.46	1.6638	164.80	140.37	840.00
1.3691	1.4195	163.14	165.93	1.6613	164.27	140.36	850.00
1.4195	1.5067	162.61	165.53	1.6591	163.87	140.35	860.00
1.5067	1.5503	162.22	165.27	1.6574	163.62	140.34	870.00
1.5503	1.5653	161.96	165.07	1.6563	163.42	140.34	880.00
1.5653	1.5800	161.76	164.91	1.6555	163.25	140.33	890.00
1.5800	1.5877	161.60	164.77	1.6548	163.11	140.33	900.00
1.5877	1.5850	161.46	164.63	1.6542	162.97	140.32	910.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.5850	1.5909	161.32	164.50	1.6536	162.84	140.32	920.00
1.5909	1.5941	161.19	164.38	1.6531	162.72	140.32	930.00
1.5941	1.5892	161.07	164.25	1.6526	162.60	140.32	940.00
1.5892	1.5940	160.95	164.13	1.6521	162.48	140.31	950.00
1.5940	1.5968	160.83	164.02	1.6515	162.37	140.31	960.00
1.5968	1.4188	160.72	163.73	1.6511	162.08	140.31	970.00
1.4188	1.1652	160.43	163.01	1.6499	161.37	140.30	980.00
1.1652	1.0397	159.72	161.92	1.6468	160.28	140.29	990.00
1.0397	0.9708	158.63	160.64	1.6422	159.00	140.27	1000.00
0.9708	0.9437	157.37	159.28	1.6367	157.64	140.24	1010.00
0.9437	0.9304	156.01	157.89	1.6309	156.26	140.21	1020.00
0.9304	1.0346	154.63	156.60	1.6250	154.97	140.18	1030.00
1.0346	1.2040	153.35	155.59	1.6194	153.97	140.15	1040.00
1.2040	1.2880	152.36	154.85	1.6151	153.23	140.13	1050.00
1.2880	1.3299	151.62	154.24	1.6119	152.63	140.12	1060.00
1.3299	1.3508	151.02	153.70	1.6093	152.09	140.10	1070.00
1.3508	1.3614	150.48	153.19	1.6069	151.59	140.09	1080.00
1.3614	1.3114	149.98	152.66	1.6047	151.05	140.08	1090.00
1.3114	1.2245	149.45	151.98	1.6024	150.38	140.07	1100.00
1.2245	1.1816	148.78	151.19	1.5995	149.59	140.06	1110.00
1.1816	1.3755	147.99	150.55	1.5960	148.95	140.04	1120.00
1.3755	1.2567	147.36	149.99	1.5932	148.40	140.03	1130.00
1.2567	0.9899	146.81	149.06	1.5908	147.46	140.01	1140.00
0.9899	1.0730	145.88	147.94	1.5868	146.35	140.00	1150.00
1.0730	1.1073	144.77	146.95	1.5823	145.37	139.97	1160.00
1.1073	1.1245	143.79	146.02	1.5783	144.44	139.95	1170.00
1.1245	1.1400	142.87	145.13	1.5745	143.56	139.94	1180.00
1.1400	1.1409	141.99	144.27	1.5709	142.70	139.92	1190.00
1.1409	1.1415	141.13	143.41	1.5674	141.85	139.90	1200.00
1.1415	1.1489	140.28	142.57	1.5639	141.01	139.89	1210.00
1.1489	1.1457	139.45	141.74	1.5604	140.18	139.87	1220.00
1.1457	1.1443	138.63	140.92	1.5570	139.36	139.85	1230.00
1.1443	1.1507	137.81	140.10	1.5536	138.55	139.84	1240.00
1.1507	1.1470	137.00	139.29	1.5503	137.74	139.82	1250.00
1.1470	1.1453	136.20	138.49	1.5470	136.94	139.81	1260.00
1.1453	1.1516	135.40	137.70	1.5437	136.15	139.79	1270.00
1.1516	1.1479	134.61	136.91	1.5404	135.37	139.78	1280.00
1.1479	1.1461	133.83	136.13	1.5371	134.59	139.76	1290.00
1.1461	1.1524	133.06	135.36	1.5338	133.82	139.75	1300.00
1.1524	1.1486	132.29	134.59	1.5306	133.06	139.73	1310.00
1.1486	1.1469	131.53	133.83	1.5274	132.30	139.72	1320.00
1.1469	1.0904	130.78	133.01	1.5243	131.49	139.70	1330.00
1.0904	1.0068	129.97	132.07	1.5208	130.55	139.69	1340.00
1.0068	0.9654	129.03	131.00	1.5168	129.48	139.67	1350.00
0.9654	0.9381	127.97	129.88	1.5123	128.36	139.65	1360.00
0.9381	0.9316	126.86	128.73	1.5076	127.22	139.63	1370.00
0.9316	0.9285	125.72	127.58	1.5027	126.07	139.60	1380.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.9285	0.9200	124.57	126.42	1.4978	124.93	139.58	1390.00
0.9200	0.9229	123.43	125.28	1.4929	123.78	139.56	1400.00
0.9229	0.9244	122.29	124.14	1.4880	122.65	139.54	1410.00
0.9244	0.9182	121.17	123.01	1.4831	121.53	139.52	1420.00
0.9182	0.9222	120.05	121.89	1.4783	120.41	139.49	1430.00
0.9222	0.9243	118.94	120.79	1.4734	119.31	139.47	1440.00
0.9243	0.6880	117.85	119.46	1.4686	117.99	139.45	1450.00
0.6880	0.3406	116.53	117.55	1.4628	116.09	139.43	1460.00
0.3406	0.1686	114.64	115.15	1.4545	113.69	139.39	1470.00
0.1686	0.0835	112.25	112.50	1.4438	111.06	139.34	1480.00
0.0835	0.0413	109.62	109.75	1.4321	108.32	139.29	1490.00
0.0413	0.0205	106.90	106.96	1.4198	105.54	139.24	1500.00
0.0205	0.0101	104.13	104.16	1.4072	102.76	139.18	1510.00
0.0101	0.0050	101.36	101.38	1.3944	99.982	139.13	1520.00
0.0050	0.0025	98.601	98.608	1.3816	97.226	139.08	1530.00
0.0025	0.0012	95.858	95.861	1.3688	94.493	139.02	1540.00
0.0012	0.0006	93.137	93.139	1.3551	91.784	138.97	1550.00
0.0006	0.0003	90.443	90.444	1.3408	89.104	138.91	1560.00
0.0003	0.0001	87.777	87.778	1.3264	86.451	138.85	1570.00
0.0001	0.0001	85.139	85.139	1.3122	83.827	138.80	1580.00
0.0001	0.0000	82.529	82.529	1.2978	81.232	138.74	1590.00
0.0000	0.0000	79.948	79.948	1.2834	78.665	138.68	1600.00
0.0000	0.0000	77.396	77.396	1.2691	76.127	138.63	1610.00
0.0000	0.0000	74.872	74.872	1.2548	73.617	138.57	1620.00
0.0000	0.0000	72.377	72.377	1.2404	71.136	138.52	1630.00
0.0000	0.0000	69.910	69.910	1.2261	68.684	138.47	1640.00
0.0000	0.0000	67.472	67.472	1.2118	66.261	138.41	1650.00
0.0000	0.0000	65.063	65.063	1.1974	63.866	138.36	1660.00
0.0000	0.0000	62.683	62.683	1.1831	61.500	138.31	1670.00
0.0000	0.0000	60.331	60.331	1.1687	59.162	138.26	1680.00
0.0000	0.0000	58.008	58.008	1.1544	56.853	138.21	1690.00
0.0000	0.0000	55.713	55.713	1.1400	54.573	138.16	1700.00
0.0000	0.0000	53.448	53.448	1.1257	52.322	138.11	1710.00
0.0000	0.0000	51.211	51.211	1.1113	50.099	138.06	1720.00
0.0000	0.0000	49.002	49.002	1.0970	47.905	138.01	1730.00
0.0000	0.0000	46.824	46.824	1.0809	45.743	137.96	1740.00
0.0000	0.0000	44.679	44.679	1.0642	43.615	137.91	1750.00
0.0000	0.0000	42.567	42.567	1.0473	41.520	137.85	1760.00
0.0000	0.0000	40.489	40.489	1.0307	39.459	137.80	1770.00
0.0000	0.0000	38.445	38.445	1.0137	37.431	137.75	1780.00
0.0000	0.0000	36.434	36.434	0.9971	35.437	137.70	1790.00
0.0000	0.0000	34.457	34.457	0.9801	33.477	137.65	1800.00
0.0000	0.0000	32.513	32.513	0.9635	31.550	137.60	1810.00
0.0000	0.0000	30.603	30.603	0.9465	29.657	137.55	1820.00
0.0000	0.0000	28.727	28.727	0.9299	27.797	137.50	1830.00
0.0000	0.0000	26.884	26.884	0.9129	25.971	137.46	1840.00
0.0000	0.0000	25.075	25.075	0.8962	24.179	137.41	1850.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0000	23.299	23.299	0.8793	22.420	137.37	1860.00
0.0000	0.0000	21.557	21.557	0.8626	20.695	137.32	1870.00
0.0000	0.0000	19.849	19.849	0.8458	19.003	137.28	1880.00
0.0000	0.0000	18.174	18.174	0.8289	17.345	137.24	1890.00
0.0000	0.0000	16.533	16.533	0.8123	15.721	137.19	1900.00
0.0000	0.0000	14.926	14.926	0.7953	14.130	137.15	1910.00
0.0000	0.0000	13.352	13.352	0.7786	12.573	137.11	1920.00
0.0000	0.0000	11.811	11.811	0.7617	11.049	137.08	1930.00
0.0000	0.0000	10.305	10.305	0.7449	9.5597	137.04	1940.00
0.0000	0.0000	8.8313	8.8313	0.7284	8.1029	137.00	1950.00
0.0000	0.0000	7.3937	7.3937	0.7093	6.6844	136.96	1960.00
0.0000	0.0000	5.9938	5.9938	0.6906	5.3031	136.92	1970.00
0.0000	0.0000	4.6313	4.6313	0.6718	3.9595	136.88	1980.00
0.0000	0.0000	3.3066	3.3066	0.6529	2.6537	136.84	1990.00
0.0000	0.0000	2.0192	2.0192	0.6345	1.3847	136.81	2000.00
0.0000	0.0000	0.7843	0.7843	0.6003	0.1840	136.74	2010.00
0.0000	0.0000	0.0000	0.0000	0.1840	-0.1840	136.70	2020.00

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 136.20
Elev: 136.20 ft Orifice Diameter: 5.4785 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
136.20	0.0000	0.0000	0.0000	137.90	13317	1.0620	45.452	139.60	37653	1.5019	127.01
136.30	0.0000	0.2576	0.2576	138.00	14502	1.0928	49.433	139.70	39198	1.5238	132.19
136.40	0.0000	0.3643	0.3643	138.10	15890	1.1227	54.089	139.80	40744	1.5454	137.36
136.50	0.0000	0.4461	0.4461	138.20	17278	1.1519	58.745	139.90	42289	1.5667	142.53
136.60	0.0000	0.5151	0.5151	138.30	18666	1.1803	63.400	140.00	43834	1.5877	147.70
136.70	0.0000	0.5759	0.5759	138.40	20054	1.2081	68.055	140.10	45251	1.6085	152.44
136.80	530.40	0.6309	2.3989	138.50	21442	1.2352	72.709	140.20	46667	1.6290	157.19
136.90	1591	0.6815	5.9855	138.60	22830	1.2618	77.362	140.30	48084	1.6492	161.93
137.00	2652	0.7285	9.5685	138.70	24218	1.2878	82.014	140.40	49500	1.6692	166.67
137.10	3837	0.7727	13.563	138.80	25606	1.3133	86.667	140.50	50917	1.6890	171.41
137.20	5022	0.8145	17.554	138.90	26994	1.3384	91.318	140.60	52334	1.7085	176.15
137.30	6207	0.8542	21.544	139.00	28382	1.3629	95.970	140.70	53750	1.7278	180.90
137.40	7392	0.8922	25.532	139.10	29927	1.3870	101.14	140.80	55167	1.7469	185.64
137.50	8577	0.9287	29.519	139.20	31472	1.4107	106.32	140.90	56583	1.7658	190.38
137.60	9762	0.9637	33.504	139.30	33018	1.4341	111.49				
137.70	10947	0.9975	37.488	139.40	34563	1.4570	116.67				
137.80	12132	1.0303	41.470	139.50	36108	1.4796	121.84				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 3.71 INFLOW Q (cfs): 9.42
PEAK STAGE (ft): 140.97 PEAK OUTFLOW : 1.78
PEAK TIME: 660.00 min.
INFLOW HYD No. : 7 OUTFLOW HYD No.: 12

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0101	0.0000	0.0101	0.0000	0.0101	136.20	40.00
0.0101	0.0511	0.0000	0.0612	0.0101	0.0511	136.20	50.00
0.0511	0.1172	0.0000	0.1684	0.0511	0.1172	136.20	60.00
0.1172	0.2314	0.0000	0.3486	0.1172	0.2314	136.20	70.00
0.2314	0.3813	0.0000	0.6127	0.2314	0.3813	136.20	80.00
0.3813	0.5133	0.0000	0.8946	0.3813	0.5133	136.20	90.00
0.5133	0.6254	0.0000	1.1387	0.5133	0.6254	136.20	100.00
0.6254	0.7193	0.0480	1.3927	0.5774	0.8152	136.70	110.00
0.7193	0.7978	0.2321	1.7492	0.5832	1.1660	136.71	120.00
0.7978	0.9030	0.5723	2.2730	0.5937	1.6793	136.73	130.00
0.9030	1.0258	1.0701	2.9989	0.6092	2.3897	136.76	140.00
1.0258	1.1121	1.7590	3.8970	0.6306	3.2663	136.80	150.00
1.1121	1.1713	2.6232	4.9067	0.6431	4.2635	136.82	160.00
1.1713	1.2245	3.6063	6.0021	0.6572	5.3449	136.85	170.00
1.2245	1.2665	4.6725	7.1635	0.6724	6.4911	136.88	180.00
1.2665	1.2954	5.8030	8.3649	0.6881	7.6768	136.91	190.00
1.2954	1.3274	6.9731	9.5958	0.7037	8.8922	136.95	200.00
1.3274	1.3536	8.1725	10.854	0.7196	10.134	136.98	210.00
1.3536	1.3698	9.3991	12.123	0.7348	11.388	137.01	220.00
1.3698	1.3920	10.639	13.401	0.7486	12.652	137.05	230.00
1.3920	1.4103	11.890	14.692	0.7626	13.929	137.08	240.00
1.4103	1.4760	13.153	16.039	0.7765	15.263	137.11	250.00
1.4760	1.5658	14.472	17.514	0.7905	16.723	137.14	260.00
1.5658	1.6191	15.918	19.102	0.8058	18.297	137.18	270.00
1.6191	1.6610	17.475	20.755	0.8219	19.933	137.22	280.00
1.6610	1.6838	19.095	22.440	0.8382	21.601	137.26	290.00
1.6838	1.7030	20.747	24.133	0.8548	23.279	137.30	300.00
1.7030	1.9460	22.408	26.057	0.8708	25.186	137.34	310.00
1.9460	2.2967	24.297	28.540	0.8889	27.651	137.39	320.00
2.2967	2.4840	26.739	31.520	0.9116	30.609	137.45	330.00
2.4840	2.5893	29.670	34.744	0.9383	33.805	137.53	340.00
2.5893	2.6528	32.839	38.081	0.9663	37.115	137.61	350.00
2.6528	2.6948	36.120	41.468	0.9944	40.474	137.69	360.00
2.6948	2.6693	39.452	44.816	1.0221	43.794	137.77	370.00
2.6693	2.6091	42.745	48.023	1.0488	46.974	137.86	380.00
2.6091	2.5794	45.901	51.089	1.0737	50.015	137.94	390.00
2.5794	2.5714	48.919	54.070	1.0965	52.973	138.01	400.00
2.5714	2.5808	51.858	57.010	1.1155	55.894	138.08	410.00
2.5808	2.5843	54.760	59.925	1.1340	58.791	138.14	420.00
2.5843	3.3711	57.639	63.595	1.1522	62.443	138.20	430.00
3.3711	4.5616	61.268	69.201	1.1745	68.026	138.28	440.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
4.5616	5.1730	66.818	76.553	1.2079	75.345	138.40	450.00
5.1730	6.6055	74.095	85.873	1.2503	84.623	138.56	460.00
6.6055	8.4586	83.321	98.385	1.3021	97.083	138.76	470.00
8.4586	9.4219	95.715	113.60	1.3681	112.23	139.02	480.00
9.4219	8.4243	110.79	128.64	1.4373	127.20	139.31	490.00
8.4243	6.4378	125.70	140.56	1.5026	139.06	139.60	500.00
6.4378	5.4605	137.50	149.40	1.5524	147.85	139.83	510.00
5.4605	4.8532	146.26	156.57	1.5884	154.99	140.00	520.00
4.8532	4.4357	153.37	162.66	1.6195	161.04	140.15	530.00
4.4357	4.2333	159.39	168.06	1.6454	166.41	140.28	540.00
4.2333	3.8155	164.75	172.79	1.6681	171.13	140.39	550.00
3.8155	3.2899	169.44	176.54	1.6878	174.86	140.49	560.00
3.2899	3.0315	173.15	179.47	1.7032	177.77	140.57	570.00
3.0315	2.9129	176.06	182.00	1.7151	180.29	140.63	580.00
2.9129	2.8482	178.56	184.32	1.7253	182.60	140.69	590.00
2.8482	2.8179	180.86	186.53	1.7347	184.79	140.74	600.00
2.8179	2.7427	183.05	188.61	1.7435	186.87	140.78	610.00
2.7427	2.6453	185.11	190.50	1.7518	188.75	140.83	620.00
2.6453	2.5983	186.99	192.23	1.7593	190.48	140.87	630.00
2.5983	2.5685	188.71	193.88	1.7662	192.11	140.90	640.00
2.5685	2.5626	190.34	195.47	1.7726	193.70	140.94	650.00
2.5626	2.5609	191.92	197.04	1.7789	195.26	140.97	660.00
2.5609	2.4294	195.26	200.25	0.0000	200.25	0.00	670.00
2.4294	2.2335	200.25	204.91	0.0000	204.91	0.00	680.00
2.2335	2.1372	204.91	209.29	0.0000	209.29	0.00	690.00
2.1372	2.0979	209.29	213.52	0.0000	213.52	0.00	700.00
2.0979	2.0714	213.52	217.69	0.0000	217.69	0.00	710.00
2.0714	2.0589	217.69	221.82	0.0000	221.82	0.00	720.00
2.0589	2.0611	221.82	225.94	0.0000	225.94	0.00	730.00
2.0611	2.0551	225.94	230.06	0.0000	230.06	0.00	740.00
2.0551	2.0527	230.06	234.16	0.0000	234.16	0.00	750.00
2.0527	2.0599	234.16	238.28	0.0000	238.28	0.00	760.00
2.0599	2.0563	238.28	242.39	0.0000	242.39	0.00	770.00
2.0563	2.0551	242.39	246.50	0.0000	246.50	0.00	780.00
2.0551	1.9302	246.50	250.49	0.0000	250.49	0.00	790.00
1.9302	1.7361	250.49	254.16	0.0000	254.16	0.00	800.00
1.7361	1.6403	254.16	257.53	0.0000	257.53	0.00	810.00
1.6403	1.5932	257.53	260.77	0.0000	260.77	0.00	820.00
1.5932	1.5702	260.77	263.93	0.0000	263.93	0.00	830.00
1.5702	1.5591	263.93	267.06	0.0000	267.06	0.00	840.00
1.5591	1.6165	267.06	270.23	0.0000	270.23	0.00	850.00
1.6165	1.7157	270.23	273.57	0.0000	273.57	0.00	860.00
1.7157	1.7652	273.57	277.05	0.0000	277.05	0.00	870.00
1.7652	1.7822	277.05	280.60	0.0000	280.60	0.00	880.00
1.7822	1.7989	280.60	284.18	0.0000	284.18	0.00	890.00
1.7989	1.8075	284.18	287.78	0.0000	287.78	0.00	900.00
1.8075	1.8043	287.78	291.39	0.0000	291.39	0.00	910.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.8043	1.8110	291.39	295.01	0.0000	295.01	0.00	920.00
1.8110	1.8146	295.01	298.64	0.0000	298.64	0.00	930.00
1.8146	1.8089	298.64	302.26	0.0000	302.26	0.00	940.00
1.8089	1.8143	302.26	305.88	0.0000	305.88	0.00	950.00
1.8143	1.8173	305.88	309.51	0.0000	309.51	0.00	960.00
1.8173	1.6148	309.51	312.95	0.0000	312.95	0.00	970.00
1.6148	1.3260	312.95	315.89	0.0000	315.89	0.00	980.00
1.3260	1.1832	315.89	318.40	0.0000	318.40	0.00	990.00
1.1832	1.1048	318.40	320.68	0.0000	320.68	0.00	1000.00
1.1048	1.0739	320.68	322.86	0.0000	322.86	0.00	1010.00
1.0739	1.0587	322.86	325.00	0.0000	325.00	0.00	1020.00
1.0587	1.1772	325.00	327.23	0.0000	327.23	0.00	1030.00
1.1772	1.3699	327.23	329.78	0.0000	329.78	0.00	1040.00
1.3699	1.4655	329.78	332.61	0.0000	332.61	0.00	1050.00
1.4655	1.5130	332.61	335.59	0.0000	335.59	0.00	1060.00
1.5130	1.5368	335.59	338.64	0.0000	338.64	0.00	1070.00
1.5368	1.5488	338.64	341.73	0.0000	341.73	0.00	1080.00
1.5488	1.4919	341.73	344.77	0.0000	344.77	0.00	1090.00
1.4919	1.3929	344.77	347.65	0.0000	347.65	0.00	1100.00
1.3929	1.3441	347.65	350.39	0.0000	350.39	0.00	1110.00
1.3441	1.5647	350.39	353.30	0.0000	353.30	0.00	1120.00
1.5647	1.4294	353.30	356.29	0.0000	356.29	0.00	1130.00
1.4294	1.1259	356.29	358.85	0.0000	358.85	0.00	1140.00
1.1259	1.2204	358.85	361.19	0.0000	361.19	0.00	1150.00
1.2204	1.2594	361.19	363.67	0.0000	363.67	0.00	1160.00
1.2594	1.2789	363.67	366.21	0.0000	366.21	0.00	1170.00
1.2789	1.2965	366.21	368.79	0.0000	368.79	0.00	1180.00
1.2965	1.2975	368.79	371.38	0.0000	371.38	0.00	1190.00
1.2975	1.2982	371.38	373.98	0.0000	373.98	0.00	1200.00
1.2982	1.3065	373.98	376.58	0.0000	376.58	0.00	1210.00
1.3065	1.3029	376.58	379.19	0.0000	379.19	0.00	1220.00
1.3029	1.3012	379.19	381.80	0.0000	381.80	0.00	1230.00
1.3012	1.3084	381.80	384.41	0.0000	384.41	0.00	1240.00
1.3084	1.3042	384.41	387.02	0.0000	387.02	0.00	1250.00
1.3042	1.3023	387.02	389.62	0.0000	389.62	0.00	1260.00
1.3023	1.3094	389.62	392.24	0.0000	392.24	0.00	1270.00
1.3094	1.3051	392.24	394.85	0.0000	394.85	0.00	1280.00
1.3051	1.3031	394.85	397.46	0.0000	397.46	0.00	1290.00
1.3031	1.3102	397.46	400.07	0.0000	400.07	0.00	1300.00
1.3102	1.3059	400.07	402.69	0.0000	402.69	0.00	1310.00
1.3059	1.3038	402.69	405.30	0.0000	405.30	0.00	1320.00
1.3038	1.2396	405.30	407.84	0.0000	407.84	0.00	1330.00
1.2396	1.1445	407.84	410.23	0.0000	410.23	0.00	1340.00
1.1445	1.0975	410.23	412.47	0.0000	412.47	0.00	1350.00
1.0975	1.0664	412.47	414.63	0.0000	414.63	0.00	1360.00
1.0664	1.0590	414.63	416.76	0.0000	416.76	0.00	1370.00
1.0590	1.0554	416.76	418.87	0.0000	418.87	0.00	1380.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.0554	1.0458	418.87	420.97	0.0000	420.97	0.00	1390.00
1.0458	1.0490	420.97	423.07	0.0000	423.07	0.00	1400.00
1.0490	1.0507	423.07	425.17	0.0000	425.17	0.00	1410.00
1.0507	1.0437	425.17	427.26	0.0000	427.26	0.00	1420.00
1.0437	1.0482	427.26	429.35	0.0000	429.35	0.00	1430.00
1.0482	1.0505	429.35	431.45	0.0000	431.45	0.00	1440.00
1.0505	0.7819	431.45	433.28	0.0000	433.28	0.00	1450.00
0.7819	0.3871	433.28	434.45	0.0000	434.45	0.00	1460.00
0.3871	0.1916	434.45	435.03	0.0000	435.03	0.00	1470.00
0.1916	0.0949	435.03	435.32	0.0000	435.32	0.00	1480.00
0.0949	0.0470	435.32	435.46	0.0000	435.46	0.00	1490.00
0.0470	0.0233	435.46	435.53	0.0000	435.53	0.00	1500.00

'S' - POND 'C' TOTAL VOLUME

ELEV (FT)	AREA (SF)	VOL (CF)	Cumm VOL (CF)	
133.5	6500			
134	7015	3379	3379	
135	8904	7960	11,339	
136	10,849	9697	21,036	← WQ VOL @ 135.52
137	14,909	12879	33,915	
138	17,023	15966	49881	
139	21,230	19,127	69,007	

WQ RELEASE RATE

$$\frac{16{,}409\ ft^3}{48\ HRS} \times \frac{1\ HR}{3600\ s} = 0.095\ cfs$$

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

'T' - POND 'C' DETENTION VOLUME

ELEV (FT)	AREA (SF)	VOL (CF)	CUMM. VOL (CF)
135.52	9,915		
136	10,849	4983	4983
137	14,909	12,879	17,862
138	17,023	15,966	33,828
139	21,230	19,127	52,955

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED

'U' - WQ ORIFICE 'C'

$Q = CA(2gh)^{1/2}$

$A = \dfrac{Q}{C(2gh)^{1/2}}$

$A = \dfrac{0.095}{0.62(2 \times 32.2 \times 0.62)^{1/2}}$

$A = 0.024\ \text{ft}^2$

$Q = 0.095$ cfs

$C = 0.62$

$g = 32.2$

$h = 135.52' - 134.90' = 0.62'$

$A = \dfrac{\pi d^2}{4}$

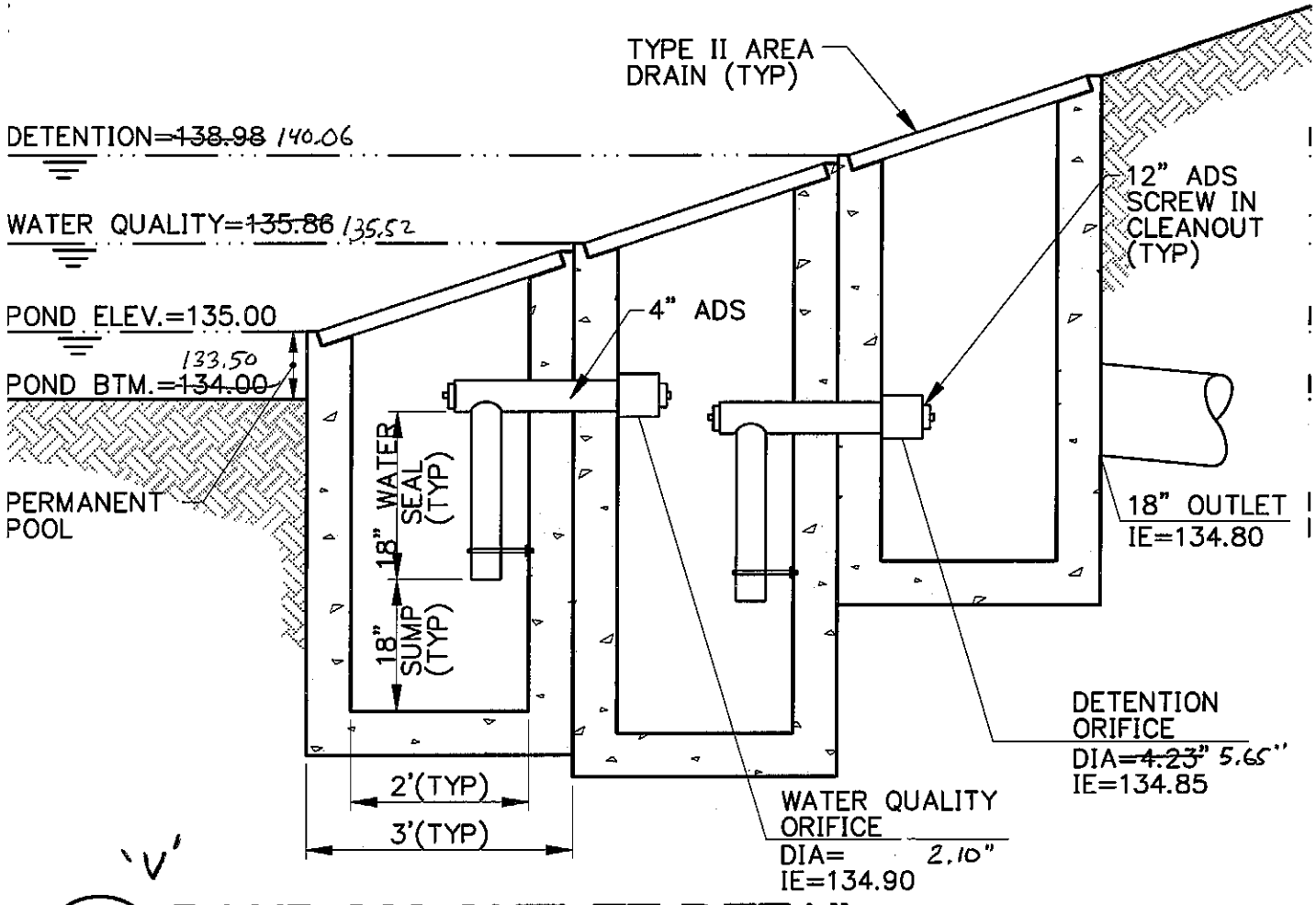
$d = \sqrt{\dfrac{4A}{\pi}}$

$d = \sqrt{\dfrac{4A}{\pi}} \quad 0.178' = 2.10''\ \phi$

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©2000 GROUP MACKENZIE. ALL RIGHTS RESERVED



3 C8.1 POND "C" OUTLET DETAIL

N.T.S.
OUTFLOW DEVICE

SD150
DETINSET= 1:1

BASIN SUMMARY

BASIN ID: D10 NAME: DEVELOPED 10YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 14.77 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.45 inches AREA..: 2.32 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 14.80 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 12.45 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0200
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 8.82 cfs VOL: 3.65 Ac-ft TIME: 480 min

BASIN ID: D2 NAME: DEVELOPED 2YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 14.77 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 2.50 inches AREA..: 2.32 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 14.80 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 12.45 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0200
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 6.14 cfs VOL: 2.53 Ac-ft TIME: 480 min

BASIN ID: D25 NAME: DEVELOPED 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 14.77 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.90 inches AREA..: 2.32 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 14.80 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 12.45 Acres
CN....: 98.00
TcReach - Sheet L: 30.00 ns:0.2400 p2yr: 2.50 s:0.0200
TcReach - Sheet L: 150.00 ns:0.0110 p2yr: 2.50 s:0.0200
TcReach - Channel L:1700.00 kc:42.00 s:0.0100
PEAK RATE: 10.10 cfs VOL: 4.18 Ac-ft TIME: 480 min

BASIN SUMMARY

BASIN ID: E10 NAME: EXISTING 10YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 14.77 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.45 inches AREA..: 14.77 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 38.83 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 3.12 cfs VOL: 1.97 Ac-ft TIME: 490 min

BASIN ID: E2 NAME: EXISTING 2YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 14.77 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 2.50 inches AREA..: 14.77 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 38.83 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 1.46 cfs VOL: 1.09 Ac-ft TIME: 490 min

BASIN ID: E25 NAME: EXISTING 25YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 14.77 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERVIOUS AREA
PRECIPITATION....: 3.90 inches AREA..: 14.77 Acres
TIME INTERVAL....: 10.00 min CN....: 80.00
TIME OF CONC.....: 38.83 min IMPERVIOUS AREA
ABSTRACTION COEFF: 0.20 AREA..: 0.00 Acres
CN....: 98.00
TcReach - Sheet L: 300.00 ns:0.2400 p2yr: 2.50 s:0.0400
TcReach - Shallow L: 300.00 ks:10.00 s:0.0400
TcReach - Channel L:1400.00 kc:17.00 s:0.0400
PEAK RATE: 4.00 cfs VOL: 2.41 Ac-ft TIME: 490 min

NOVELLUS

HYDROGRAPH SUMMARY

HYD NUM	PEAK RUNOFF RATE cfs	TIME OF PEAK min.	VOLUME OF HYDRO cf\AcFt	Contrib Area Acres
1	1.460	490	47658 cf	14.77
2	3.124	490	85612 cf	14.77
3	3.999	490	105049 cf	14.77
5	6.139	480	110109 cf	14.77
6	8.822	480	158818 cf	14.77
7	10.104	480	182151 cf	14.77
10	1.460	690	110176 cf	14.77
11	1.760	800	158945 cf	14.77
12	1.976	800	182266 cf	14.77

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 134.85
Elev: 134.85 ft Orifice Diameter: 5.6484 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
134.85	0.0000	0.0000	0.0000	136.90	16574	1.2396	56.487	139.00	52955	1.7638	178.28
134.90	0.0000	0.1936	0.1936	137.00	17862	1.2695	60.810	139.10	53960	1.7849	181.65
135.00	0.0000	0.3353	0.3353	137.10	19459	1.2987	66.161	139.20	54964	1.8058	185.02
135.10	0.0000	0.4329	0.4329	137.20	21055	1.3272	71.511	139.30	55969	1.8264	188.39
135.20	0.0000	0.5122	0.5122	137.30	22652	1.3552	76.861	139.40	56973	1.8468	191.76
135.30	0.0000	0.5808	0.5808	137.40	24248	1.3826	82.211	139.50	57978	1.8670	195.13
135.40	0.0000	0.6421	0.6421	137.50	25845	1.4094	87.559	139.60	58982	1.8870	198.49
135.50	0.0000	0.6980	0.6980	137.60	27442	1.4358	92.908	139.70	59987	1.9067	201.86
135.60	830.50	0.7498	3.5181	137.70	29038	1.4616	98.256	139.80	60991	1.9263	205.23
135.70	1869	0.7982	7.0270	137.80	30635	1.4871	103.60	139.90	61996	1.9456	208.60
135.80	2907	0.8439	10.533	137.90	32231	1.5121	108.95	140.00	63000	1.9648	211.96
135.90	3945	0.8872	14.037	138.00	33828	1.5366	114.30	140.10	64500	1.9838	216.98
136.00	4983	0.9285	17.538	138.10	35741	1.5608	120.70	140.20	66000	2.0026	222.00
136.10	6271	0.9680	21.871	138.20	37653	1.5847	127.10	140.30	67500	2.0212	227.02
136.20	7559	1.0060	26.202	138.30	39566	1.6082	133.50	140.40	69000	2.0397	232.04
136.30	8847	1.0426	30.532	138.40	41479	1.6313	139.89	140.50	70500	2.0580	237.06
136.40	10135	1.0779	34.860	138.50	43392	1.6541	146.29	140.60	72000	2.0761	242.08
136.50	11423	1.1121	39.187	138.60	45304	1.6766	152.69	140.70	73500	2.0941	247.09
136.60	12710	1.1453	43.513	138.70	47217	1.6988	159.09	140.80	75000	2.1119	252.11
136.70	13998	1.1776	47.839	138.80	49130	1.7207	165.49	140.90	76500	2.1296	257.13
136.80	15286	1.2090	52.163	138.90	51042	1.7424	171.88				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 1.46 INFLOW Q (cfs): 6.14
PEAK STAGE (ft): 137.70 PEAK OUTFLOW : 1.46
PEAK TIME: 690.00 min.
INFLOW HYD No. : 5 OUTFLOW HYD No.: 10

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0001	0.0000	0.0001	0.0000	0.0001	134.85	50.00
0.0001	0.0076	0.0000	0.0076	0.0001	0.0076	134.85	60.00
0.0076	0.0433	0.0000	0.0508	0.0076	0.0433	134.85	70.00
0.0433	0.1072	0.0000	0.1504	0.0433	0.1072	134.85	80.00
0.1072	0.1787	0.0000	0.2859	0.1072	0.1787	134.85	90.00
0.1787	0.2482	0.0000	0.4269	0.1787	0.2482	134.85	100.00
0.2482	0.3120	0.0000	0.5602	0.2482	0.3120	134.85	110.00
0.3120	0.3689	0.0000	0.6809	0.3120	0.3689	134.85	120.00
0.3689	0.4400	0.0000	0.8089	0.3689	0.4400	134.85	130.00
0.4400	0.5209	0.0000	0.9609	0.4400	0.5209	134.85	140.00
0.5209	0.5837	0.0000	1.1046	0.5209	0.5837	134.85	150.00
0.5837	0.6317	0.0000	1.2153	0.5837	0.6317	134.85	160.00
0.6317	0.6758	0.0000	1.3075	0.6317	0.6758	134.85	170.00
0.6758	0.7129	0.0000	1.3887	0.6758	0.7129	134.85	180.00
0.7129	0.7415	0.0146	1.4689	0.6983	0.7706	135.50	190.00
0.7415	0.7711	0.0713	1.5839	0.6994	0.8845	135.50	200.00
0.7711	0.7965	0.1830	1.7506	0.7015	1.0492	135.51	210.00
0.7965	0.8151	0.3447	1.9563	0.7045	1.2518	135.51	220.00
0.8151	0.8367	0.5436	2.1954	0.7082	1.4872	135.52	230.00
0.8367	0.8552	0.7747	2.4667	0.7125	1.7542	135.53	240.00
0.8552	0.9028	1.0367	2.7947	0.7174	2.0773	135.54	250.00
0.9028	0.9647	1.3540	3.2215	0.7234	2.4981	135.55	260.00
0.9647	1.0030	1.7670	3.7348	0.7311	3.0037	135.56	270.00
1.0030	1.0328	2.2633	4.2992	0.7404	3.5588	135.58	280.00
1.0328	1.0497	2.8084	4.8909	0.7504	4.1406	135.60	290.00
1.0497	1.0638	3.3822	5.4956	0.7584	4.7372	135.62	300.00
1.0638	1.2177	3.9706	6.2521	0.7666	5.4855	135.63	310.00
1.2177	1.4390	4.7085	7.3653	0.7770	6.5883	135.66	320.00
1.4390	1.5578	5.7961	8.7929	0.7922	8.0007	135.69	330.00
1.5578	1.6247	7.1898	10.372	0.8109	9.5614	135.73	340.00
1.6247	1.6659	8.7301	12.021	0.8312	11.189	135.77	350.00
1.6659	1.6953	10.337	13.699	0.8520	12.847	135.82	360.00
1.6953	1.6835	11.974	15.353	0.8725	14.481	135.87	370.00
1.6835	1.6500	13.588	16.922	0.8924	16.029	135.91	380.00
1.6500	1.6357	15.119	18.404	0.9107	17.494	135.96	390.00
1.6357	1.6349	16.566	19.836	0.9279	18.908	136.00	400.00
1.6349	1.6449	17.967	21.247	0.9410	20.306	136.03	410.00
1.6449	1.6508	19.352	22.648	0.9537	21.694	136.06	420.00
1.6508	2.1604	20.728	24.539	0.9664	23.573	136.10	430.00
2.1604	2.9320	22.590	27.682	0.9829	26.699	136.14	440.00
2.9320	3.3346	25.689	31.956	1.0102	30.946	136.21	450.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
3.3346	4.2741	29.900	37.508	1.0459	36.462	136.31	460.00
4.2741	5.4928	35.372	45.139	1.0906	44.048	136.44	470.00
5.4928	6.1390	42.899	54.530	1.1493	53.381	136.61	480.00
6.1390	5.5016	52.163	63.804	1.2177	62.586	136.83	490.00
5.5016	4.2117	61.307	71.021	1.2792	69.741	137.03	500.00
4.2117	3.5791	68.424	76.214	1.3178	74.897	137.17	510.00
3.5791	3.1862	73.552	80.317	1.3449	78.972	137.26	520.00
3.1862	2.9163	77.606	83.709	1.3660	82.343	137.34	530.00
2.9163	2.7867	80.959	86.662	1.3832	85.279	137.40	540.00
2.7867	2.5141	83.881	89.182	1.3980	87.784	137.46	550.00
2.5141	2.1695	86.373	91.057	1.4105	89.647	137.50	560.00
2.1695	2.0007	88.227	92.397	1.4197	90.977	137.54	570.00
2.0007	1.9238	89.551	93.476	1.4263	92.049	137.56	580.00
1.9238	1.8824	90.618	94.424	1.4315	92.993	137.58	590.00
1.8824	1.8634	91.556	95.302	1.4362	93.866	137.60	600.00
1.8634	1.8147	92.426	96.104	1.4404	94.663	137.62	610.00
1.8147	1.7511	93.219	96.785	1.4443	95.341	137.63	620.00
1.7511	1.7209	93.893	97.365	1.4475	95.918	137.65	630.00
1.7209	1.7020	94.467	97.890	1.4503	96.440	137.66	640.00
1.7020	1.6989	94.987	98.388	1.4529	96.935	137.67	650.00
1.6989	1.6985	95.480	98.877	1.4553	97.422	137.68	660.00
1.6985	1.6120	95.964	99.275	1.4576	97.817	137.68	670.00
1.6120	1.4825	96.358	99.452	1.4595	97.993	137.69	680.00
1.4825	1.4191	96.532	99.434	1.4604	97.974	137.70	690.00
1.4191	1.3936	96.513	99.326	1.4603	97.866	137.69	700.00
1.3936	1.3764	96.406	99.176	1.4598	97.716	137.69	710.00
1.3764	1.3686	96.257	99.002	1.4590	97.543	137.69	720.00
1.3686	1.3705	96.085	98.824	1.4582	97.366	137.69	730.00
1.3705	1.3669	95.908	98.646	1.4573	97.189	137.68	740.00
1.3669	1.3658	95.732	98.465	1.4565	97.008	137.68	750.00
1.3658	1.3710	95.553	98.289	1.4556	96.834	137.68	760.00
1.3710	1.3690	95.379	98.119	1.4548	96.664	137.67	770.00
1.3690	1.3686	95.210	97.948	1.4539	96.494	137.67	780.00
1.3686	1.2857	95.041	97.695	1.4531	96.242	137.67	790.00
1.2857	1.1567	94.790	97.233	1.4519	95.781	137.66	800.00
1.1567	1.0932	94.331	96.581	1.4497	95.131	137.65	810.00
1.0932	1.0620	93.685	95.840	1.4465	94.393	137.64	820.00
1.0620	1.0469	92.950	95.059	1.4430	93.616	137.63	830.00
1.0469	1.0398	92.177	94.264	1.4392	92.825	137.61	840.00
1.0398	1.0783	91.389	93.507	1.4354	92.072	137.60	850.00
1.0783	1.1447	90.640	92.863	1.4317	91.432	137.58	860.00
1.1447	1.1780	90.003	92.326	1.4285	90.897	137.57	870.00
1.1780	1.1896	89.472	91.839	1.4259	90.413	137.56	880.00
1.1896	1.2010	88.990	91.380	1.4235	89.957	137.55	890.00
1.2010	1.2070	88.536	90.944	1.4212	89.523	137.54	900.00
1.2070	1.2052	88.103	90.516	1.4191	89.097	137.54	910.00
1.2052	1.2099	87.680	90.095	1.4170	88.678	137.53	920.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE (ft)	TIME (min)
<---------- cfs min ---------->							
1.2099	1.2126	87.263	89.685	1.4149	88.270	137.52	930.00
1.2126	1.2090	86.857	89.279	1.4129	87.866	137.51	940.00
1.2090	1.2129	86.455	88.877	1.4109	87.466	137.51	950.00
1.2129	1.2152	86.057	88.485	1.4090	87.076	137.50	960.00
1.2152	1.0799	85.669	87.964	1.4070	86.557	137.49	970.00
1.0799	0.8869	85.153	87.120	1.4044	85.715	137.48	980.00
0.8869	0.7915	84.315	85.994	1.4002	84.593	137.47	990.00
0.7915	0.7392	83.199	84.730	1.3945	83.335	137.44	1000.00
0.7392	0.7186	81.947	83.405	1.3882	82.016	137.42	1010.00
0.7186	0.7085	80.635	82.062	1.3816	80.680	137.40	1020.00
0.7085	0.7880	79.306	80.802	1.3747	79.427	137.37	1030.00
0.7880	0.9171	78.059	79.764	1.3683	78.396	137.35	1040.00
0.9171	0.9812	77.033	78.931	1.3630	77.568	137.33	1050.00
0.9812	1.0132	76.209	78.203	1.3588	76.845	137.31	1060.00
1.0132	1.0293	75.489	77.532	1.3551	76.177	137.30	1070.00
1.0293	1.0375	74.825	76.892	1.3516	75.540	137.29	1080.00
1.0375	0.9995	74.192	76.229	1.3483	74.881	137.28	1090.00
0.9995	0.9333	73.536	75.469	1.3449	74.124	137.26	1100.00
0.9333	0.9008	72.783	74.617	1.3409	73.276	137.25	1110.00
0.9008	1.0488	71.940	73.889	1.3365	72.553	137.23	1120.00
1.0488	0.9582	71.220	73.227	1.3327	71.894	137.22	1130.00
0.9582	0.7548	70.565	72.278	1.3293	70.949	137.21	1140.00
0.7548	0.8183	69.625	71.198	1.3242	69.874	137.19	1150.00
0.8183	0.8446	68.555	70.218	1.3185	68.899	137.17	1160.00
0.8446	0.8577	67.586	69.288	1.3133	67.975	137.15	1170.00
0.8577	0.8697	66.667	68.394	1.3084	67.086	137.13	1180.00
0.8697	0.8705	65.782	67.522	1.3036	66.219	137.12	1190.00
0.8705	0.8710	64.920	66.661	1.2990	65.362	137.10	1200.00
0.8710	0.8767	64.068	65.816	1.2943	64.521	137.09	1210.00
0.8767	0.8744	63.231	64.983	1.2898	63.693	137.07	1220.00
0.8744	0.8734	62.408	64.155	1.2852	62.870	137.05	1230.00
0.8734	0.8783	61.589	63.341	1.2808	62.060	137.04	1240.00
0.8783	0.8756	60.784	62.538	1.2763	61.262	137.02	1250.00
0.8756	0.8744	59.990	61.740	1.2720	60.468	137.01	1260.00
0.8744	0.8793	59.200	60.954	1.2672	59.687	136.99	1270.00
0.8793	0.8765	58.425	60.181	1.2618	58.919	136.97	1280.00
0.8765	0.8753	57.663	59.415	1.2565	58.158	136.96	1290.00
0.8753	0.8801	56.907	58.662	1.2512	57.411	136.94	1300.00
0.8801	0.8773	56.165	57.923	1.2460	56.677	136.92	1310.00
0.8773	0.8761	55.436	57.189	1.2410	55.948	136.90	1320.00
0.8761	0.8330	54.712	56.421	1.2358	55.185	136.89	1330.00
0.8330	0.7692	53.955	55.557	1.2304	54.327	136.87	1340.00
0.7692	0.7377	53.102	54.609	1.2243	53.385	136.85	1350.00
0.7377	0.7168	52.167	53.622	1.2177	52.404	136.83	1360.00
0.7168	0.7119	51.193	52.622	1.2107	51.411	136.81	1370.00
0.7119	0.7096	50.208	51.629	1.2036	50.426	136.78	1380.00
0.7096	0.7032	49.229	50.642	1.1964	49.446	136.76	1390.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE (ft)	TIME (min)
<---------- cfs min ---------->							
0.7032	0.7054	48.256	49.665	1.1893	48.476	136.74	1400.00
0.7054	0.7066	47.293	48.705	1.1822	47.523	136.71	1410.00
0.7066	0.7019	46.348	47.756	1.1753	46.581	136.69	1420.00
0.7019	0.7050	45.413	46.820	1.1682	45.651	136.67	1430.00
0.7050	0.7066	44.490	45.902	1.1613	44.741	136.65	1440.00
0.7066	0.5260	43.586	44.819	1.1545	43.664	136.63	1450.00
0.5260	0.2604	42.518	43.304	1.1465	42.158	136.60	1460.00
0.2604	0.1289	41.023	41.412	1.1349	40.277	136.57	1470.00
0.1289	0.0638	39.157	39.349	1.1205	38.229	136.53	1480.00
0.0638	0.0316	37.124	37.220	1.1046	36.115	136.48	1490.00
0.0316	0.0156	35.027	35.074	1.0878	33.987	136.43	1500.00
0.0156	0.0077	32.916	32.939	1.0708	31.868	136.38	1510.00
0.0077	0.0038	30.815	30.826	1.0535	29.773	136.33	1520.00
0.0038	0.0019	28.737	28.743	1.0362	27.706	136.28	1530.00
0.0019	0.0009	26.688	26.691	1.0187	25.672	136.23	1540.00
0.0009	0.0005	24.671	24.672	1.0013	23.671	136.19	1550.00
0.0005	0.0002	22.687	22.688	0.9838	21.704	136.14	1560.00
0.0002	0.0001	20.737	20.738	0.9665	19.771	136.10	1570.00
0.0001	0.0001	18.822	18.823	0.9488	17.874	136.05	1580.00
0.0001	0.0000	16.942	16.942	0.9315	16.011	136.01	1590.00
0.0000	0.0000	15.100	15.100	0.9105	14.190	135.96	1600.00
0.0000	0.0000	13.301	13.301	0.8890	12.412	135.90	1610.00
0.0000	0.0000	11.545	11.545	0.8671	10.678	135.85	1620.00
0.0000	0.0000	9.8320	9.8320	0.8457	8.9864	135.80	1630.00
0.0000	0.0000	8.1626	8.1626	0.8237	7.3389	135.76	1640.00
0.0000	0.0000	6.5366	6.5366	0.8023	5.7343	135.71	1650.00
0.0000	0.0000	4.9539	4.9539	0.7804	4.1735	135.66	1660.00
0.0000	0.0000	3.4147	3.4147	0.7589	2.6558	135.62	1670.00
0.0000	0.0000	1.9219	1.9219	0.7340	1.1879	135.57	1680.00
0.0000	0.0000	0.4809	0.4809	0.7070	-0.2262	135.52	1690.00

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 134.85
Elev: 134.85 ft Orifice Diameter: 5.6484 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
134.85	0.0000	0.0000	0.0000	136.90	16574	1.2396	56.487	139.00	52955	1.7638	178.28
134.90	0.0000	0.1936	0.1936	137.00	17862	1.2695	60.810	139.10	53960	1.7849	181.65
135.00	0.0000	0.3353	0.3353	137.10	19459	1.2987	66.161	139.20	54964	1.8058	185.02
135.10	0.0000	0.4329	0.4329	137.20	21055	1.3272	71.511	139.30	55969	1.8264	188.39
135.20	0.0000	0.5122	0.5122	137.30	22652	1.3552	76.861	139.40	56973	1.8468	191.76
135.30	0.0000	0.5808	0.5808	137.40	24248	1.3826	82.211	139.50	57978	1.8670	195.13
135.40	0.0000	0.6421	0.6421	137.50	25845	1.4094	87.559	139.60	58982	1.8870	198.49
135.50	0.0000	0.6980	0.6980	137.60	27442	1.4358	92.908	139.70	59987	1.9067	201.86
135.60	830.50	0.7498	3.5181	137.70	29038	1.4616	98.256	139.80	60991	1.9263	205.23
135.70	1869	0.7982	7.0270	137.80	30635	1.4871	103.60	139.90	61996	1.9456	208.60
135.80	2907	0.8439	10.533	137.90	32231	1.5121	108.95	140.00	63000	1.9648	211.96
135.90	3945	0.8872	14.037	138.00	33828	1.5366	114.30	140.10	64500	1.9838	216.98
136.00	4983	0.9285	17.538	138.10	35741	1.5608	120.70	140.20	66000	2.0026	222.00
136.10	6271	0.9680	21.871	138.20	37653	1.5847	127.10	140.30	67500	2.0212	227.02
136.20	7559	1.0060	26.202	138.30	39566	1.6082	133.50	140.40	69000	2.0397	232.04
136.30	8847	1.0426	30.532	138.40	41479	1.6313	139.89	140.50	70500	2.0580	237.06
136.40	10135	1.0779	34.860	138.50	43392	1.6541	146.29	140.60	72000	2.0761	242.08
136.50	11423	1.1121	39.187	138.60	45304	1.6766	152.69	140.70	73500	2.0941	247.09
136.60	12710	1.1453	43.513	138.70	47217	1.6988	159.09	140.80	75000	2.1119	252.11
136.70	13998	1.1776	47.839	138.80	49130	1.7207	165.49	140.90	76500	2.1296	257.13
136.80	15286	1.2090	52.163	138.90	51042	1.7424	171.88				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 3.12 INFLOW Q (cfs): 8.82
PEAK STAGE (ft): 138.98 PEAK OUTFLOW : 1.76
PEAK TIME: 800.00 min.
INFLOW HYD No. : 6 OUTFLOW HYD No.: 11

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0023	0.0000	0.0023	0.0000	0.0023	134.85	40.00
0.0023	0.0255	0.0000	0.0278	0.0023	0.0255	134.85	50.00
0.0255	0.0753	0.0000	0.1008	0.0255	0.0753	134.85	60.00
0.0753	0.1703	0.0000	0.2456	0.0753	0.1703	134.85	70.00
0.1703	0.2994	0.0000	0.4697	0.1703	0.2994	135.50	80.00
0.2994	0.4187	0.0000	0.7181	0.2994	0.4187	135.50	90.00
0.4187	0.5234	0.0000	0.9421	0.4187	0.5234	135.50	100.00
0.5234	0.6131	0.0000	1.1365	0.5234	0.6131	135.50	110.00
0.6131	0.6895	0.0000	1.3026	0.6131	0.6895	135.50	120.00
0.6895	0.7895	0.0000	1.4789	0.6895	0.7895	135.50	130.00
0.7895	0.9053	0.0898	1.7845	0.6997	1.0848	135.50	140.00
0.9053	0.9889	0.3797	2.2739	0.7051	1.5688	135.51	150.00
0.9889	1.0481	0.8548	2.8918	0.7140	2.1778	135.53	160.00
1.0481	1.1016	1.4526	3.6024	0.7252	2.8772	135.55	170.00
1.1016	1.1447	2.1391	4.3854	0.7380	3.6474	135.58	180.00
1.1447	1.1754	2.8958	5.2158	0.7516	4.4642	135.60	190.00
1.1754	1.2085	3.7014	6.0852	0.7629	5.3224	135.63	200.00
1.2085	1.2361	4.5477	6.9923	0.7747	6.2176	135.65	210.00
1.2361	1.2542	5.4306	7.9208	0.7871	7.1338	135.68	220.00
1.2542	1.2775	6.3342	8.8659	0.7996	8.0662	135.70	230.00
1.2775	1.2969	7.2545	9.8289	0.8118	9.0171	135.73	240.00
1.2969	1.3600	8.1930	10.850	0.8241	10.026	135.76	250.00
1.3600	1.4449	9.1885	11.993	0.8373	11.156	135.79	260.00
1.4449	1.4942	10.305	13.244	0.8516	12.392	135.82	270.00
1.4942	1.5311	11.525	14.551	0.8669	13.684	135.85	280.00
1.5311	1.5505	12.801	15.882	0.8828	15.000	135.89	290.00
1.5505	1.5680	14.101	17.220	0.8985	16.321	135.93	300.00
1.5680	1.7930	15.407	18.768	0.9141	17.854	135.97	310.00
1.7930	2.1184	16.922	20.834	0.9313	19.903	136.01	320.00
2.1184	2.2939	18.953	23.365	0.9500	22.415	136.05	330.00
2.2939	2.3939	21.442	26.130	0.9728	25.157	136.11	340.00
2.3939	2.4554	24.160	29.009	0.9968	28.013	136.18	350.00
2.4554	2.4969	26.991	31.944	1.0213	30.922	136.24	360.00
2.4969	2.4756	29.877	34.849	1.0458	33.803	136.31	370.00
2.4756	2.4218	32.734	37.631	1.0693	36.562	136.38	380.00
2.4218	2.3962	35.471	40.289	1.0914	39.197	136.44	390.00
2.3962	2.3906	38.085	42.872	1.1122	41.760	136.50	400.00
2.3906	2.4010	40.628	45.419	1.1319	44.288	136.56	410.00
2.4010	2.4058	43.136	47.943	1.1511	46.792	136.62	420.00
2.4058	3.1411	45.622	51.169	1.1698	49.999	136.68	430.00
3.1411	4.2539	48.806	56.201	1.1933	55.008	136.75	440.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
4.2539	4.8282	53.779	62.861	1.2292	61.631	136.87	450.00
4.8282	6.1720	60.357	71.358	1.2740	70.084	137.02	460.00
6.1720	7.9120	68.764	82.848	1.3196	81.528	137.17	470.00
7.9120	8.8222	80.149	96.884	1.3791	95.504	137.39	480.00
8.8222	7.8936	94.056	110.77	1.4483	109.32	137.65	490.00
7.8936	6.0356	107.81	121.74	1.5138	120.23	137.91	500.00
6.0356	5.1224	118.67	129.82	1.5591	128.27	138.09	510.00
5.1224	4.5550	126.68	136.35	1.5890	134.76	138.22	520.00
4.5550	4.1650	133.15	141.87	1.6127	140.26	138.32	530.00
4.1650	3.9765	138.63	146.77	1.6326	145.14	138.41	540.00
3.9765	3.5852	143.49	151.05	1.6500	149.40	138.48	550.00
3.5852	3.0921	147.73	154.41	1.6650	152.74	138.55	560.00
3.0921	2.8499	151.07	157.01	1.6768	155.33	138.60	570.00
2.8499	2.7391	153.65	159.24	1.6858	157.55	138.64	580.00
2.7391	2.6789	155.86	161.27	1.6935	159.58	138.68	590.00
2.6789	2.6508	157.88	163.21	1.7005	161.51	138.71	600.00
2.6508	2.5806	159.80	165.03	1.7071	163.33	138.74	610.00
2.5806	2.4893	161.61	166.68	1.7133	164.97	138.77	620.00
2.4893	2.4454	163.25	168.19	1.7190	166.47	138.79	630.00
2.4454	2.4178	164.74	169.61	1.7241	167.88	138.82	640.00
2.4178	2.4127	166.15	170.98	1.7289	169.25	138.84	650.00
2.4127	2.4114	167.52	172.35	1.7335	170.61	138.86	660.00
2.4114	2.2879	168.87	173.57	1.7381	171.83	138.88	670.00
2.2879	2.1036	170.09	174.48	1.7422	172.74	138.90	680.00
2.1036	2.0131	171.00	175.11	1.7453	173.37	138.91	690.00
2.0131	1.9763	171.62	175.61	1.7474	173.86	138.92	700.00
1.9763	1.9516	172.11	176.04	1.7490	174.29	138.93	710.00
1.9516	1.9400	172.54	176.43	1.7504	174.68	138.94	720.00
1.9400	1.9423	172.93	176.81	1.7518	175.06	138.94	730.00
1.9423	1.9368	173.31	177.19	1.7530	175.44	138.95	740.00
1.9368	1.9348	173.68	177.55	1.7543	175.80	138.96	750.00
1.9348	1.9418	174.04	177.92	1.7555	176.16	138.96	760.00
1.9418	1.9386	174.41	178.29	1.7567	176.53	138.97	770.00
1.9386	1.9376	174.77	178.65	1.7579	176.89	138.97	780.00
1.9376	1.8200	175.13	178.89	1.7591	177.13	138.98	790.00
1.8200	1.6371	175.37	178.83	1.7599	177.07	138.98	800.00
1.6371	1.5469	175.31	178.49	1.7597	176.73	138.98	810.00
1.5469	1.5026	174.97	178.02	1.7586	176.26	138.98	820.00
1.5026	1.4810	174.51	177.49	1.7570	175.73	138.97	830.00
1.4810	1.4706	173.98	176.93	1.7553	175.17	138.96	840.00
1.4706	1.5249	173.42	176.42	1.7534	174.66	138.95	850.00
1.5249	1.6185	172.91	176.06	1.7517	174.30	138.94	860.00
1.6185	1.6653	172.55	175.84	1.7505	174.09	138.94	870.00
1.6653	1.6815	172.34	175.68	1.7498	173.93	138.93	880.00
1.6815	1.6974	172.18	175.56	1.7492	173.81	138.93	890.00
1.6974	1.7056	172.07	175.47	1.7488	173.72	138.93	900.00
1.7056	1.7027	171.97	175.38	1.7485	173.63	138.93	910.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.7027	1.7091	171.88	175.29	1.7482	173.55	138.93	920.00
1.7091	1.7127	171.80	175.22	1.7480	173.47	138.93	930.00
1.7127	1.7074	171.72	175.14	1.7477	173.40	138.92	940.00
1.7074	1.7126	171.65	175.07	1.7475	173.32	138.92	950.00
1.7126	1.7156	171.57	175.00	1.7472	173.26	138.92	960.00
1.7156	1.5244	171.51	174.75	1.7470	173.00	138.92	970.00
1.5244	1.2519	171.26	174.03	1.7461	172.29	138.92	980.00
1.2519	1.1171	170.54	172.91	1.7437	171.17	138.91	990.00
1.1171	1.0431	169.43	171.59	1.7400	169.85	138.89	1000.00
1.0431	1.0140	168.11	170.17	1.7355	168.43	138.87	1010.00
1.0140	0.9997	166.70	168.72	1.7307	166.99	138.85	1020.00
0.9997	1.1117	165.26	167.37	1.7258	165.65	138.82	1030.00
1.1117	1.2937	163.92	166.33	1.7213	164.61	138.80	1040.00
1.2937	1.3840	162.89	165.57	1.7177	163.85	138.79	1050.00
1.3840	1.4290	162.14	164.95	1.7151	163.23	138.77	1060.00
1.4290	1.4515	161.52	164.40	1.7130	162.69	138.76	1070.00
1.4515	1.4629	160.98	163.89	1.7112	162.18	138.76	1080.00
1.4629	1.4092	160.47	163.34	1.7094	161.63	138.75	1090.00
1.4092	1.3158	159.93	162.65	1.7075	160.94	138.74	1100.00
1.3158	1.2697	159.24	161.82	1.7052	160.12	138.73	1110.00
1.2697	1.4782	158.42	161.16	1.7024	159.46	138.72	1120.00
1.4782	1.3504	157.76	160.59	1.7001	158.89	138.71	1130.00
1.3504	1.0637	157.19	159.61	1.6981	157.91	138.70	1140.00
1.0637	1.1531	156.21	158.43	1.6947	156.74	138.68	1150.00
1.1531	1.1900	155.04	157.39	1.6907	155.70	138.66	1160.00
1.1900	1.2084	154.01	156.41	1.6871	154.72	138.65	1170.00
1.2084	1.2252	153.04	155.47	1.6837	153.79	138.63	1180.00
1.2252	1.2261	152.11	154.56	1.6804	152.88	138.62	1190.00
1.2261	1.2268	151.20	153.65	1.6773	151.98	138.60	1200.00
1.2268	1.2347	150.30	152.76	1.6741	151.09	138.59	1210.00
1.2347	1.2313	149.42	151.88	1.6710	150.21	138.57	1220.00
1.2313	1.2298	148.55	151.01	1.6679	149.34	138.56	1230.00
1.2298	1.2367	147.67	150.14	1.6648	148.48	138.55	1240.00
1.2367	1.2328	146.81	149.28	1.6618	147.62	138.53	1250.00
1.2328	1.2310	145.96	148.43	1.6588	146.77	138.52	1260.00
1.2310	1.2377	145.11	147.58	1.6558	145.93	138.51	1270.00
1.2377	1.2337	144.27	146.74	1.6528	145.09	138.49	1280.00
1.2337	1.2319	143.44	145.91	1.6498	144.26	138.48	1290.00
1.2319	1.2386	142.61	145.08	1.6469	143.43	138.47	1300.00
1.2386	1.2346	141.79	144.26	1.6439	142.62	138.46	1310.00
1.2346	1.2327	140.98	143.45	1.6410	141.80	138.44	1320.00
1.2327	1.1720	140.17	142.57	1.6381	140.93	138.43	1330.00
1.1720	1.0821	139.30	141.55	1.6350	139.92	138.42	1340.00
1.0821	1.0377	138.29	140.41	1.6314	138.77	138.40	1350.00
1.0377	1.0083	137.15	139.19	1.6272	137.57	138.38	1360.00
1.0083	1.0014	135.94	137.95	1.6229	136.33	138.36	1370.00
1.0014	0.9980	134.71	136.71	1.6184	135.09	138.34	1380.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.9980	0.9889	133.48	135.46	1.6139	133.85	138.32	1390.00
0.9889	0.9920	132.24	134.22	1.6094	132.61	138.31	1400.00
0.9920	0.9936	131.01	132.99	1.6049	131.39	138.29	1410.00
0.9936	0.9870	129.79	131.77	1.6004	130.17	138.27	1420.00
0.9870	0.9913	128.57	130.55	1.5960	128.95	138.25	1430.00
0.9913	0.9935	127.36	129.35	1.5915	127.76	138.23	1440.00
0.9935	0.7395	126.17	127.90	1.5871	126.32	138.21	1450.00
0.7395	0.3661	124.73	125.84	1.5818	124.26	138.19	1460.00
0.3661	0.1812	122.68	123.23	1.5741	121.66	138.16	1470.00
0.1812	0.0897	120.09	120.36	1.5644	118.80	138.12	1480.00
0.0897	0.0444	117.24	117.38	1.5537	115.83	138.07	1490.00
0.0444	0.0220	114.28	114.35	1.5424	112.81	138.02	1500.00
0.0220	0.0109	111.28	111.31	1.5298	109.78	137.97	1510.00
0.0109	0.0054	108.26	108.28	1.5159	106.76	137.92	1520.00
0.0054	0.0027	105.26	105.27	1.5018	103.77	137.86	1530.00
0.0027	0.0013	102.28	102.29	1.4878	100.80	137.80	1540.00
0.0013	0.0007	99.324	99.326	1.4737	97.852	137.75	1550.00
0.0007	0.0003	96.392	96.393	1.4597	94.934	137.69	1560.00
0.0003	0.0002	93.488	93.488	1.4456	92.043	137.64	1570.00
0.0002	0.0001	90.611	90.612	1.4315	89.180	137.58	1580.00
0.0001	0.0000	87.763	87.763	1.4174	86.345	137.53	1590.00
0.0000	0.0000	84.942	84.942	1.4033	83.539	137.48	1600.00
0.0000	0.0000	82.150	82.150	1.3892	80.760	137.42	1610.00
0.0000	0.0000	79.385	79.385	1.3752	78.010	137.37	1620.00
0.0000	0.0000	76.649	76.649	1.3611	75.288	137.32	1630.00
0.0000	0.0000	73.941	73.941	1.3470	72.594	137.27	1640.00
0.0000	0.0000	71.261	71.261	1.3329	69.928	137.22	1650.00
0.0000	0.0000	68.609	68.609	1.3188	67.291	137.17	1660.00
0.0000	0.0000	65.986	65.986	1.3047	64.681	137.12	1670.00
0.0000	0.0000	63.390	63.390	1.2906	62.100	137.07	1680.00
0.0000	0.0000	60.823	60.823	1.2766	59.547	137.02	1690.00
0.0000	0.0000	58.286	58.286	1.2608	57.025	136.97	1700.00
0.0000	0.0000	55.782	55.782	1.2434	54.538	136.91	1710.00
0.0000	0.0000	53.313	53.313	1.2258	52.087	136.85	1720.00
0.0000	0.0000	50.878	50.878	1.2085	49.670	136.80	1730.00
0.0000	0.0000	48.479	48.479	1.1909	47.288	136.74	1740.00
0.0000	0.0000	46.114	46.114	1.1735	44.941	136.69	1750.00
0.0000	0.0000	43.785	43.785	1.1560	42.629	136.63	1760.00
0.0000	0.0000	41.490	41.490	1.1386	40.352	136.58	1770.00
0.0000	0.0000	39.231	39.231	1.1211	38.110	136.53	1780.00
0.0000	0.0000	37.006	37.006	1.1036	35.902	136.48	1790.00
0.0000	0.0000	34.816	34.816	1.0862	33.730	136.42	1800.00
0.0000	0.0000	32.661	32.661	1.0687	31.593	136.37	1810.00
0.0000	0.0000	30.541	30.541	1.0512	29.490	136.32	1820.00
0.0000	0.0000	28.456	28.456	1.0338	27.423	136.28	1830.00
0.0000	0.0000	26.406	26.406	1.0163	25.390	136.23	1840.00
0.0000	0.0000	24.391	24.391	0.9989	23.392	136.18	1850.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0000	22.411	22.411	0.9813	21.430	136.14	1860.00
0.0000	0.0000	20.466	20.466	0.9640	19.502	136.09	1870.00
0.0000	0.0000	18.555	18.555	0.9464	17.609	136.05	1880.00
0.0000	0.0000	16.680	16.680	0.9291	15.751	136.00	1890.00
0.0000	0.0000	14.843	14.843	0.9074	13.936	135.95	1900.00
0.0000	0.0000	13.050	13.050	0.8859	12.164	135.90	1910.00
0.0000	0.0000	11.300	11.300	0.8640	10.436	135.85	1920.00
0.0000	0.0000	9.5935	9.5935	0.8426	8.7509	135.80	1930.00
0.0000	0.0000	7.9302	7.9302	0.8207	7.1095	135.75	1940.00
0.0000	0.0000	6.3102	6.3102	0.7993	5.5109	135.70	1950.00
0.0000	0.0000	4.7336	4.7336	0.7773	3.9563	135.66	1960.00
0.0000	0.0000	3.2004	3.2004	0.7559	2.4446	135.61	1970.00
0.0000	0.0000	1.7145	1.7145	0.7301	0.9844	135.56	1980.00
0.0000	0.0000	0.2811	0.2811	0.7033	-0.4222	135.51	1990.00

ROUTING REPORT

STORAGE LIST ID No. A
Description:

MULTIPLE ORIFICE ID No. A
Description:
Outlet Elev: 134.85
Elev: 134.85 ft Orifice Diameter: 5.6484 in.

ROUTING CURVE

STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min	STAGE (ft)	STORAGE (cf)	OUTFLOW (cfs)	O+2S cfs-min
134.85	0.0000	0.0000	0.0000	136.90	16574	1.2396	56.487	139.00	52955	1.7638	178.28
134.90	0.0000	0.1936	0.1936	137.00	17862	1.2695	60.810	139.10	53960	1.7849	181.65
135.00	0.0000	0.3353	0.3353	137.10	19459	1.2987	66.161	139.20	54964	1.8058	185.02
135.10	0.0000	0.4329	0.4329	137.20	21055	1.3272	71.511	139.30	55969	1.8264	188.39
135.20	0.0000	0.5122	0.5122	137.30	22652	1.3552	76.861	139.40	56973	1.8468	191.76
135.30	0.0000	0.5808	0.5808	137.40	24248	1.3826	82.211	139.50	57978	1.8670	195.13
135.40	0.0000	0.6421	0.6421	137.50	25845	1.4094	87.559	139.60	58982	1.8870	198.49
135.50	0.0000	0.6980	0.6980	137.60	27442	1.4358	92.908	139.70	59987	1.9067	201.86
135.60	830.50	0.7498	3.5181	137.70	29038	1.4616	98.256	139.80	60991	1.9263	205.23
135.70	1869	0.7982	7.0270	137.80	30635	1.4871	103.60	139.90	61996	1.9456	208.60
135.80	2907	0.8439	10.533	137.90	32231	1.5121	108.95	140.00	63000	1.9648	211.96
135.90	3945	0.8872	14.037	138.00	33828	1.5366	114.30	140.10	64500	1.9838	216.98
136.00	4983	0.9285	17.538	138.10	35741	1.5608	120.70	140.20	66000	2.0026	222.00
136.10	6271	0.9680	21.871	138.20	37653	1.5847	127.10	140.30	67500	2.0212	227.02
136.20	7559	1.0060	26.202	138.30	39566	1.6082	133.50	140.40	69000	2.0397	232.04
136.30	8847	1.0426	30.532	138.40	41479	1.6313	139.89	140.50	70500	2.0580	237.06
136.40	10135	1.0779	34.860	138.50	43392	1.6541	146.29	140.60	72000	2.0761	242.08
136.50	11423	1.1121	39.187	138.60	45304	1.6766	152.69	140.70	73500	2.0941	247.09
136.60	12710	1.1453	43.513	138.70	47217	1.6988	159.09	140.80	75000	2.1119	252.11
136.70	13998	1.1776	47.839	138.80	49130	1.7207	165.49	140.90	76500	2.1296	257.13
136.80	15286	1.2090	52.163	138.90	51042	1.7424	171.88				

LEVEL POOL ROUTING TABLE

MATCH Q (cfs) : 4.00 INFLOW Q (cfs): 10.10
PEAK STAGE (ft): 140.06 PEAK OUTFLOW : 1.98
PEAK TIME: 800.00 min.
INFLOW HYD No. : 7 OUTFLOW HYD No.: 12

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0108	0.0000	0.0108	0.0000	0.0108	134.85	40.00
0.0108	0.0546	0.0000	0.0654	0.0108	0.0546	135.50	50.00
0.0546	0.1252	0.0000	0.1798	0.0546	0.1252	135.50	60.00
0.1252	0.2471	0.0000	0.3723	0.1252	0.2471	135.50	70.00
0.2471	0.4071	0.0000	0.6542	0.2471	0.4071	135.50	80.00
0.4071	0.5481	0.0000	0.9552	0.4071	0.5481	135.50	90.00
0.5481	0.6678	0.0000	1.2158	0.5481	0.6678	135.50	100.00
0.6678	0.7681	0.0000	1.4358	0.6678	0.7681	135.50	110.00
0.7681	0.8518	0.0687	1.6886	0.6993	0.9893	135.50	120.00
0.8518	0.9641	0.2859	2.1019	0.7034	1.3985	135.51	130.00
0.9641	1.0953	0.6876	2.7470	0.7109	2.0362	135.52	140.00
1.0953	1.1875	1.3136	3.5963	0.7226	2.8737	135.55	150.00
1.1875	1.2507	2.1358	4.5739	0.7380	3.8359	135.58	160.00
1.2507	1.3074	3.0818	5.6399	0.7542	4.8857	135.61	170.00
1.3074	1.3523	4.1170	6.7767	0.7687	6.0081	135.64	180.00
1.3523	1.3831	5.2239	7.9594	0.7842	7.1752	135.67	190.00
1.3831	1.4173	6.3750	9.1755	0.8002	8.3753	135.70	200.00
1.4173	1.4453	7.5595	10.422	0.8158	9.6063	135.74	210.00
1.4453	1.4626	8.7745	11.682	0.8318	10.851	135.77	220.00
1.4626	1.4863	10.003	12.952	0.8478	12.104	135.81	230.00
1.4863	1.5058	11.241	14.233	0.8633	13.370	135.84	240.00
1.5058	1.5760	12.491	15.572	0.8789	14.693	135.88	250.00
1.5760	1.6719	13.799	17.046	0.8949	16.152	135.92	260.00
1.6719	1.7289	15.239	18.640	0.9121	17.728	135.96	270.00
1.7289	1.7740	16.798	20.301	0.9302	19.371	136.00	280.00
1.7740	1.7986	18.425	21.998	0.9452	21.053	136.04	290.00
1.7986	1.8195	20.092	23.710	0.9605	22.750	136.08	300.00
1.8195	2.0796	21.774	25.673	0.9757	24.698	136.12	310.00
2.0796	2.4549	23.705	28.239	0.9928	27.246	136.17	320.00
2.4549	2.6557	26.232	31.342	1.0148	30.327	136.22	330.00
2.6557	2.7687	29.286	34.711	1.0408	33.670	136.30	340.00
2.7687	2.8373	32.602	38.208	1.0682	37.140	136.37	350.00
2.8373	2.8828	36.044	41.764	1.0959	40.668	136.45	360.00
2.8828	2.8561	39.544	45.283	1.1235	44.160	136.53	370.00
2.8561	2.7921	43.009	48.658	1.1502	47.507	136.61	380.00
2.7921	2.7608	46.332	51.885	1.1751	50.710	136.69	390.00
2.7608	2.7527	49.512	55.025	1.1985	53.827	136.77	400.00
2.7527	2.7632	52.606	58.122	1.2208	56.901	136.84	410.00
2.7632	2.7674	55.658	61.189	1.2425	59.947	136.91	420.00
2.7674	3.6107	58.683	65.061	1.2636	63.798	136.98	430.00
3.6107	4.8868	62.512	71.009	1.2858	69.723	137.06	440.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
4.8868	5.5430	68.406	78.835	1.3177	77.518	137.17	450.00
5.5430	7.0799	76.159	88.782	1.3586	87.424	137.31	460.00
7.0799	9.0687	86.015	102.16	1.4087	100.75	137.50	470.00
9.0687	10.104	99.281	118.45	1.4735	116.98	137.75	480.00
10.104	9.0361	115.43	134.57	1.5468	133.03	138.04	490.00
9.0361	6.9063	131.42	147.36	1.6064	145.76	138.29	500.00
6.9063	5.8589	144.10	156.87	1.6522	155.22	138.49	510.00
5.8589	5.2080	153.53	164.60	1.6854	162.91	138.64	520.00
5.2080	4.7606	161.20	171.17	1.7119	169.46	138.76	530.00
4.7606	4.5438	167.72	177.03	1.7342	175.29	138.86	540.00
4.5438	4.0957	173.54	182.18	1.7538	180.43	138.95	550.00
4.0957	3.5317	178.65	186.28	1.7772	184.50	139.06	560.00
3.5317	3.2545	182.70	189.48	1.8026	187.68	139.18	570.00
3.2545	3.1274	185.86	192.24	1.8221	190.42	139.28	580.00
3.1274	3.0582	188.58	194.77	1.8387	192.93	139.36	590.00
3.0582	3.0257	191.07	197.16	1.8538	195.30	139.43	600.00
3.0257	2.9452	193.43	199.41	1.8681	197.54	139.51	610.00
2.9452	2.8406	195.66	201.44	1.8813	199.56	139.57	620.00
2.8406	2.7903	197.67	203.30	1.8932	201.41	139.63	630.00
2.7903	2.7584	199.50	205.05	1.9041	203.15	139.69	640.00
2.7584	2.7522	201.23	206.74	1.9142	204.83	139.74	650.00
2.7522	2.7505	202.90	208.41	1.9240	206.48	139.79	660.00
2.7505	2.6094	204.55	209.91	1.9335	207.98	139.84	670.00
2.6094	2.3990	206.03	211.04	1.9421	209.10	139.88	680.00
2.3990	2.2956	207.15	211.85	1.9485	209.90	139.91	690.00
2.2956	2.2535	207.94	212.49	1.9530	210.54	139.94	700.00
2.2535	2.2251	208.58	213.06	1.9567	211.11	139.96	710.00
2.2251	2.2117	209.15	213.58	1.9599	211.62	139.97	720.00
2.2117	2.2142	209.66	214.09	1.9629	212.12	139.99	730.00
2.2142	2.2077	210.16	214.58	1.9654	212.61	140.00	740.00
2.2077	2.2052	210.65	215.06	1.9673	213.09	140.01	750.00
2.2052	2.2130	211.12	215.54	1.9691	213.57	140.02	760.00
2.2130	2.2092	211.60	216.02	1.9709	214.05	140.03	770.00
2.2092	2.2080	212.08	216.50	1.9727	214.52	140.04	780.00
2.2080	2.0738	212.55	216.83	1.9745	214.86	140.05	790.00
2.0738	1.8653	212.88	216.82	1.9758	214.84	140.06	800.00
1.8653	1.7624	212.87	216.50	1.9757	214.52	140.06	810.00
1.7624	1.7118	212.55	216.02	1.9745	214.05	140.05	820.00
1.7118	1.6871	212.07	215.47	1.9727	213.50	140.04	830.00
1.6871	1.6753	211.53	214.89	1.9706	212.92	140.03	840.00
1.6753	1.7370	210.95	214.36	1.9684	212.40	140.02	850.00
1.7370	1.8436	210.43	214.01	1.9664	212.04	140.01	860.00
1.8436	1.8968	210.08	213.82	1.9651	211.85	140.00	870.00
1.8968	1.9151	209.89	213.70	1.9642	211.74	140.00	880.00
1.9151	1.9331	209.77	213.62	1.9635	211.66	139.99	890.00
1.9331	1.9424	209.70	213.57	1.9631	211.61	139.99	900.00
1.9424	1.9390	209.65	213.53	1.9628	211.56	139.99	910.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.9390	1.9461	209.60	213.49	1.9625	211.52	139.99	920.00
1.9461	1.9501	209.56	213.46	1.9623	211.50	139.99	930.00
1.9501	1.9440	209.53	213.43	1.9621	211.46	139.99	940.00
1.9440	1.9498	209.50	213.40	1.9620	211.43	139.99	950.00
1.9498	1.9531	209.47	213.38	1.9618	211.41	139.98	960.00
1.9531	1.7354	209.45	213.14	1.9617	211.18	139.98	970.00
1.7354	1.4251	209.22	212.38	1.9603	210.42	139.98	980.00
1.4251	1.2717	208.46	211.16	1.9560	209.20	139.95	990.00
1.2717	1.1873	207.25	209.71	1.9491	207.76	139.92	1000.00
1.1873	1.1542	205.82	208.17	1.9409	206.22	139.88	1010.00
1.1542	1.1379	204.29	206.58	1.9320	204.65	139.83	1020.00
1.1379	1.2653	202.73	205.13	1.9229	203.21	139.78	1030.00
1.2653	1.4723	201.30	204.03	1.9146	202.12	139.74	1040.00
1.4723	1.5751	200.21	203.26	1.9082	201.35	139.71	1050.00
1.5751	1.6262	199.45	202.65	1.9037	200.74	139.68	1060.00
1.6262	1.6518	198.84	202.12	1.9002	200.22	139.67	1070.00
1.6518	1.6647	198.32	201.64	1.8971	199.74	139.65	1080.00
1.6647	1.6036	197.85	201.12	1.8943	199.22	139.64	1090.00
1.6036	1.4972	197.33	200.43	1.8912	198.54	139.62	1100.00
1.4972	1.4448	196.65	199.60	1.8873	197.71	139.60	1110.00
1.4448	1.6818	195.83	198.95	1.8823	197.07	139.58	1120.00
1.6818	1.5365	195.19	198.41	1.8785	196.53	139.56	1130.00
1.5365	1.2102	194.66	197.40	1.8753	195.53	139.54	1140.00
1.2102	1.3118	193.66	196.18	1.8694	194.31	139.51	1150.00
1.3118	1.3538	192.45	195.11	1.8621	193.25	139.48	1160.00
1.3538	1.3747	191.40	194.13	1.8558	192.27	139.44	1170.00
1.3747	1.3937	190.42	193.19	1.8499	191.34	139.42	1180.00
1.3937	1.3948	189.49	192.28	1.8443	190.44	139.39	1190.00
1.3948	1.3955	188.60	191.39	1.8388	189.55	139.36	1200.00
1.3955	1.4045	187.72	190.52	1.8335	188.68	139.33	1210.00
1.4045	1.4006	186.86	189.66	1.8282	187.83	139.31	1220.00
1.4006	1.3988	186.01	188.81	1.8230	186.99	139.28	1230.00
1.3988	1.4066	185.17	187.97	1.8178	186.16	139.26	1240.00
1.4066	1.4021	184.34	187.15	1.8127	185.34	139.23	1250.00
1.4021	1.4000	183.53	186.33	1.8077	184.53	139.21	1260.00
1.4000	1.4076	182.72	185.53	1.8027	183.73	139.19	1270.00
1.4076	1.4030	181.93	184.74	1.7978	182.94	139.16	1280.00
1.4030	1.4009	181.15	183.95	1.7929	182.16	139.14	1290.00
1.4009	1.4085	180.37	183.18	1.7881	181.39	139.12	1300.00
1.4085	1.4039	179.61	182.42	1.7833	180.64	139.09	1310.00
1.4039	1.4017	178.86	181.67	1.7786	179.89	139.07	1320.00
1.4017	1.3327	178.11	180.85	1.7739	179.07	139.05	1330.00
1.3327	1.2304	177.31	179.87	1.7688	178.10	139.02	1340.00
1.2304	1.1799	176.34	178.75	1.7632	176.98	139.00	1350.00
1.1799	1.1465	175.23	177.55	1.7594	175.79	138.98	1360.00
1.1465	1.1385	174.04	176.32	1.7555	174.57	138.96	1370.00
1.1385	1.1347	172.81	175.09	1.7514	173.34	138.94	1380.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
1.1347	1.1243	171.59	173.85	1.7473	172.10	138.92	1390.00
1.1243	1.1278	170.36	172.61	1.7431	170.87	138.90	1400.00
1.1278	1.1296	169.13	171.39	1.7390	169.65	138.88	1410.00
1.1296	1.1221	167.91	170.16	1.7348	168.43	138.87	1420.00
1.1221	1.1270	166.70	168.95	1.7307	167.22	138.85	1430.00
1.1270	1.1295	165.49	167.75	1.7266	166.02	138.83	1440.00
1.1295	0.8407	164.30	166.27	1.7226	164.54	138.81	1450.00
0.8407	0.4162	162.83	164.08	1.7175	162.37	138.79	1460.00
0.4162	0.2060	160.66	161.28	1.7101	159.57	138.75	1470.00
0.2060	0.1020	157.87	158.18	1.7005	156.48	138.71	1480.00
0.1020	0.0505	154.79	154.94	1.6898	153.25	138.66	1490.00
0.0505	0.0250	151.57	151.65	1.6786	149.97	138.61	1500.00
0.0250	0.0124	148.30	148.34	1.6670	146.67	138.56	1510.00
0.0124	0.0061	145.01	145.03	1.6554	143.38	138.51	1520.00
0.0061	0.0030	141.73	141.74	1.6437	140.10	138.45	1530.00
0.0030	0.0015	138.47	138.47	1.6320	136.84	138.40	1540.00
0.0015	0.0007	135.22	135.22	1.6203	133.60	138.35	1550.00
0.0007	0.0004	131.99	131.99	1.6085	130.39	138.30	1560.00
0.0004	0.0002	128.79	128.79	1.5967	127.19	138.25	1570.00
0.0002	0.0001	125.61	125.61	1.5850	124.02	138.20	1580.00
0.0001	0.0000	122.45	122.45	1.5732	120.88	138.15	1590.00
0.0000	0.0000	119.32	119.32	1.5615	117.75	138.10	1600.00
0.0000	0.0000	116.20	116.20	1.5497	114.65	138.05	1610.00
0.0000	0.0000	113.12	113.12	1.5380	111.58	138.01	1620.00
0.0000	0.0000	110.05	110.05	1.5241	108.53	137.95	1630.00
0.0000	0.0000	107.02	107.02	1.5101	105.51	137.89	1640.00
0.0000	0.0000	104.01	104.01	1.4960	102.52	137.84	1650.00
0.0000	0.0000	101.04	101.04	1.4819	99.554	137.78	1660.00
0.0000	0.0000	98.086	98.086	1.4678	96.619	137.72	1670.00
0.0000	0.0000	95.165	95.165	1.4537	93.711	137.67	1680.00
0.0000	0.0000	92.271	92.271	1.4397	90.832	137.62	1690.00
0.0000	0.0000	89.406	89.406	1.4255	87.981	137.56	1700.00
0.0000	0.0000	86.569	86.569	1.4115	85.158	137.51	1710.00
0.0000	0.0000	83.760	83.760	1.3974	82.363	137.46	1720.00
0.0000	0.0000	80.980	80.980	1.3833	79.596	137.40	1730.00
0.0000	0.0000	78.227	78.227	1.3692	76.858	137.35	1740.00
0.0000	0.0000	75.503	75.503	1.3552	74.148	137.30	1750.00
0.0000	0.0000	72.807	72.807	1.3410	71.466	137.25	1760.00
0.0000	0.0000	70.138	70.138	1.3270	68.811	137.20	1770.00
0.0000	0.0000	67.499	67.499	1.3128	66.186	137.15	1780.00
0.0000	0.0000	64.887	64.887	1.2988	63.588	137.10	1790.00
0.0000	0.0000	62.303	62.303	1.2847	61.019	137.05	1800.00
0.0000	0.0000	59.748	59.748	1.2707	58.477	137.00	1810.00
0.0000	0.0000	57.224	57.224	1.2534	55.971	136.95	1820.00
0.0000	0.0000	54.735	54.735	1.2360	53.499	136.89	1830.00
0.0000	0.0000	52.280	52.280	1.2185	51.062	136.83	1840.00
0.0000	0.0000	49.861	49.861	1.2010	48.660	136.77	1850.00

LEVEL POOL ROUTING TABLE

LEVEL POOL ROUTING TABLE

I1	I2	2S1	SUM	O1	O2+2S2	STAGE	TIME
<---------- cfs min ---------->						(ft)	(min)
0.0000	0.0000	47.476	47.476	1.1836	46.293	136.72	1860.00
0.0000	0.0000	45.126	45.126	1.1661	43.960	136.66	1870.00
0.0000	0.0000	42.812	42.812	1.1487	41.663	136.61	1880.00
0.0000	0.0000	40.532	40.532	1.1311	39.401	136.56	1890.00
0.0000	0.0000	38.287	38.287	1.1138	37.173	136.50	1900.00
0.0000	0.0000	36.077	36.077	1.0962	34.981	136.45	1910.00
0.0000	0.0000	33.902	33.902	1.0789	32.823	136.40	1920.00
0.0000	0.0000	31.762	31.762	1.0613	30.700	136.35	1930.00
0.0000	0.0000	29.656	29.656	1.0439	28.613	136.30	1940.00
0.0000	0.0000	27.586	27.586	1.0263	26.560	136.26	1950.00
0.0000	0.0000	25.551	25.551	1.0090	24.542	136.21	1960.00
0.0000	0.0000	23.550	23.550	0.9914	22.559	136.16	1970.00
0.0000	0.0000	21.585	21.585	0.9740	20.611	136.12	1980.00
0.0000	0.0000	19.654	19.654	0.9565	18.698	136.07	1990.00
0.0000	0.0000	17.759	17.759	0.9390	16.820	136.03	2000.00
0.0000	0.0000	15.900	15.900	0.9200	14.980	135.98	2010.00
0.0000	0.0000	14.082	14.082	0.8983	13.183	135.93	2020.00
0.0000	0.0000	12.307	12.307	0.8766	11.430	135.88	2030.00
0.0000	0.0000	10.575	10.575	0.8550	9.7201	135.83	2040.00
0.0000	0.0000	8.8868	8.8868	0.8333	8.0535	135.78	2050.00
0.0000	0.0000	7.2419	7.2419	0.8116	6.4303	135.73	2060.00
0.0000	0.0000	5.6403	5.6403	0.7900	4.8503	135.68	2070.00
0.0000	0.0000	4.0821	4.0821	0.7682	3.3139	135.64	2080.00
0.0000	0.0000	2.5678	2.5678	0.7461	1.8218	135.59	2090.00
0.0000	0.0000	1.1031	1.1031	0.7187	0.3845	135.54	2100.00
0.0000	0.0000	0.0000	0.0000	0.3845	-0.3845	135.50	2110.00

PIPES HAVE BEEN DESIGNED TO CONVEY THE 25 YR STORM FOR EXISTING AND FUTURE EXPANSION. FLOWS WERE GENERATED USING THE SCS BASED SOFTWARE PROGRAM "WATERWORKS"

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

By _____
Date _____
Job # _____
Sht. _____ of _____

©1999 GROUP MACKENZIE. ALL RIGHTS RESERVED

AREAS FOR PIPE SIZING - 'X'

ID	AREA (AC)
CB	
#1	0.26
#2	0.07
#3	0.05
#4	0.05
#5	0.24
#6	0.09
#7	0.08
#8	0.08
#9	0.10
#10	0.12
#11	0.11
#12	0.11
#13	0.11
#14	0.20
#15	0.21
#16	0.21
#17	0.11
#18	0.11
#19	0.06
#20	0.06
#21	

ID	AREA (AC)
#21	0.26
#22	0.10
#23	0.25
#24	0.25
#25	0.15
#26	0.19
#27	0.14
#28	0.10
#29	0.16
#30	0.17
#31	0.13
#32	0.03
#33	0.03
#34	0.06
#35	0.21
#36	0.12
#37	0.17
#38	0.19
#38A	0.12
#39	0.15
#40	0.36
#41	0.15

ID	AREA (AC)
#42	0.21
#43	0.36
#44	0.07
#45	0.20
#46	0.25
#47	0.29
#48	0.26
#49	0.13
#50	0.18
#51	0.11
#52	0.18
#53	0.21
#54	0.12
#55	0.15
#56	0.03
#57	0.04
DITCH INLET	
#1	0.46
#2	1.0
#3	0.28

By _____

Date _____

Job # _____

Sht. _____ of _____

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

©1999 GROUP MACKENZIE. ALL RIGHTS RESERVED

AREAS FOR PIPE SIZING

ID	AREA (Ac)
RD	
#1	0.06
#2	0.06
#3	0.06
#4	0.06
#5	0.06
#6	0.06
#7	0.06
#8	0.06
#9	0.06
#10	0.23
#11	0.22
#12	0.08
#13	0.08
#14	0.08
#15	0.20
#16	0.20
#17	0.15
#18	0.15
#19	0.28
#20	0.28
#21	0.28

ID	AREA (Ac)
#22	0.15
#23	0.15
#24	0.15
#25	0.15
#26	0.15
#27	0.15
FUTURE	
#1	3.40
#2	3.50
#3	0.35

By _____

Date _____

Job # _____

Sht. _____ of _____

GROUP MACKENZIE
0690 SW Bancroft St/PO Box 69039 Portland, OR 97201-0039
Tel: 503.224.9560 Net: info@grpmack.com Fax: 503.228.1285

©1999 GROUP MACKENZIE. ALL RIGHTS RESERVED

PIPE SIZING

BASIN RESULT SUMMARY

BASIN	-----VOLUME----		-RATE-	----TIME-----		Hydrograph	Area
ID	---cf--	Ac-ft	--cfs-	-min-	hours	Methodology	Acres
CB1	3459	0.08	0.21	480	8.00	SBUH Method	0.26
CB10	1597	0.04	0.10	480	8.00	SBUH Method	0.12
CB11	1464	0.03	0.09	480	8.00	SBUH Method	0.11
CB12	1464	0.03	0.09	480	8.00	SBUH Method	0.11
CB13	1464	0.03	0.09	480	8.00	SBUH Method	0.11
CB14	2661	0.06	0.16	480	8.00	SBUH Method	0.20
CB15	2794	0.06	0.17	480	8.00	SBUH Method	0.21
CB16	2794	0.06	0.17	480	8.00	SBUH Method	0.21
CB17	1464	0.03	0.09	480	8.00	SBUH Method	0.11
CB18	1464	0.03	0.09	480	8.00	SBUH Method	0.11
CB19	798	0.02	0.05	480	8.00	SBUH Method	0.06
CB2	931	0.02	0.06	480	8.00	SBUH Method	0.07
CB20	798	0.02	0.05	480	8.00	SBUH Method	0.06
CB21	3459	0.08	0.21	480	8.00	SBUH Method	0.26
CB22	1331	0.03	0.08	480	8.00	SBUH Method	0.10
CB23	3326	0.08	0.20	480	8.00	SBUH Method	0.25
CB24	3326	0.08	0.20	480	8.00	SBUH Method	0.25
CB25	1996	0.05	0.12	480	8.00	SBUH Method	0.15
CB26	2528	0.06	0.15	480	8.00	SBUH Method	0.19
CB27	1863	0.04	0.11	480	8.00	SBUH Method	0.14
CB28	1331	0.03	0.08	480	8.00	SBUH Method	0.10
CB29	2129	0.05	0.13	480	8.00	SBUH Method	0.16
CB3	665	0.02	0.04	480	8.00	SBUH Method	0.05
CB30	2262	0.05	0.14	480	8.00	SBUH Method	0.17
CB31	1730	0.04	0.11	480	8.00	SBUH Method	0.13
CB32	399	0.01	0.02	480	8.00	SBUH Method	0.03
CB33	399	0.01	0.02	480	8.00	SBUH Method	0.03
CB34	798	0.02	0.05	480	8.00	SBUH Method	0.06
CB35	2794	0.06	0.17	480	8.00	SBUH Method	0.21
CB36	1597	0.04	0.10	480	8.00	SBUH Method	0.12
CB37	2262	0.05	0.14	480	8.00	SBUH Method	0.17
CB38	2528	0.06	0.15	480	8.00	SBUH Method	0.19
CB38A	1597	0.04	0.10	480	8.00	SBUH Method	0.12
CB39	1996	0.05	0.12	480	8.00	SBUH Method	0.15
CB4	665	0.02	0.04	480	8.00	SBUH Method	0.05
CB40	4790	0.11	0.29	480	8.00	SBUH Method	0.36
CB41	1996	0.05	0.12	480	8.00	SBUH Method	0.15
CB42	2794	0.06	0.17	480	8.00	SBUH Method	0.21
CB43	4790	0.11	0.29	480	8.00	SBUH Method	0.36
CB44	931	0.02	0.06	480	8.00	SBUH Method	0.07
CB45	2661	0.06	0.16	480	8.00	SBUH Method	0.20
CB46	3326	0.08	0.20	480	8.00	SBUH Method	0.25
CB47	3859	0.09	0.24	480	8.00	SBUH Method	0.29
CB48	3459	0.08	0.21	480	8.00	SBUH Method	0.26
CB49	1730	0.04	0.11	480	8.00	SBUH Method	0.13
CB5	3193	0.07	0.20	480	8.00	SBUH Method	0.24
CB50	2395	0.05	0.15	480	8.00	SBUH Method	0.18

PIPE SIZING

BASIN RESULT SUMMARY

BASIN ID	VOLUME cf	VOLUME Ac-ft	RATE cfs	TIME min	TIME hours	Hydrograph Methodology	Area Acres
CB51	1464	0.03	0.09	480	8.00	SBUH Method	0.11
CB52	2395	0.05	0.15	480	8.00	SBUH Method	0.18
CB53	2794	0.06	0.17	480	8.00	SBUH Method	0.21
CB54	1597	0.04	0.10	480	8.00	SBUH Method	0.12
CB55	1996	0.05	0.12	480	8.00	SBUH Method	0.15
CB56	399	0.01	0.02	480	8.00	SBUH Method	0.03
CB57	532	0.01	0.03	480	8.00	SBUH Method	0.04
CB6	1197	0.03	0.07	480	8.00	SBUH Method	0.09
CB7	1064	0.02	0.07	480	8.00	SBUH Method	0.08
CB8	1064	0.02	0.07	480	8.00	SBUH Method	0.08
CB9	1331	0.03	0.08	480	8.00	SBUH Method	0.10
DI1	6120	0.14	0.37	480	8.00	SBUH Method	0.46
DI3	3725	0.09	0.23	480	8.00	SBUH Method	0.28
FUT1	45238	1.04	2.77	480	8.00	SBUH Method	3.40
FUT2	46568	1.07	2.85	480	8.00	SBUH Method	3.50
FUT3	4657	0.11	0.29	480	8.00	SBUH Method	0.35
RD1	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD10	3060	0.07	0.19	480	8.00	SBUH Method	0.23
RD11	2927	0.07	0.18	480	8.00	SBUH Method	0.22
RD12	1064	0.02	0.07	480	8.00	SBUH Method	0.08
RD13	1064	0.02	0.07	480	8.00	SBUH Method	0.08
RD14	1064	0.02	0.07	480	8.00	SBUH Method	0.08
RD15	2661	0.06	0.16	480	8.00	SBUH Method	0.20
RD16	2661	0.06	0.16	480	8.00	SBUH Method	0.20
RD17	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD18	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD19	3725	0.09	0.23	480	8.00	SBUH Method	0.28
RD2	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD20	3725	0.09	0.23	480	8.00	SBUH Method	0.28
RD21	3725	0.09	0.23	480	8.00	SBUH Method	0.28
RD22	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD23	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD24	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD25	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD26	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD27	1996	0.05	0.12	480	8.00	SBUH Method	0.15
RD3	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD4	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD5	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD6	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD7	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD8	798	0.02	0.05	480	8.00	SBUH Method	0.06
RD9	798	0.02	0.05	480	8.00	SBUH Method	0.06

STORM SEWERS

By: _____
Date: _____
Ck'd _____
Date: _____

SEWER LOCATION				TIME (Min.)		In./Hr.	AREA (Acres)				RUNOFF (C.F.S.) (i) (Σ(c·A))	SEWER DESIGN				PROFILE		
STREET		M.H. #	TO M.H. #	INCR. TIME	TOTAL TIME (To Upper End)	INTENSITY (i)	INCR. AREA	COEF. OF RUNOFF (c)	INCR. EQUIV. (c·A)	~~TOTAL EQUIV. AREA INCREM. Σ(c·A) cfs~~		SLOPE (%)	DIAMETER (IN.)	CAPACITY (C.F.S.)	VELOCITY (F.P.S.), n=0.012	LENGTH (FT.)	GROUND ELEV. / INVERT ELEV. UPPER	GROUND ELEV. / INVERT ELEV. LOWER
1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CB #1	(1)									0.21	0.21	4.16	6"	1.24				
DI #1	(2)									0.37	0.37	3.83	12"	7.35				
FUT #1	(3)									2.77	2.77	0.5	18"	8.04				
(1) + (2) + (3) =	(4)										3.35	0.5	18"	8.04				
RO #1	(5)									0.05	0.05	10	6"	0.61				
RO #2	(6)									0.05	0.10	0.5	10"	1.68				
RO #3	(7)									0.05	0.15	0.5	12"	2.73				
RO #4	(8)									0.05	0.20	0.5	15"	4.95				
RO #5	(9)									0.05	0.25	0.5	15"	4.95				
RO #6	(10)									0.05	0.30	0.5	15"	4.95				
	(11)								n=0.013		0.30	3.94	16"	15.23				
(4) + (11) =	(12)										3.65	0.5	18"	8.04				
CB # 2, 3, 4	(13)									0.14	0.14	1.0	6"	0.61				

Z, - PIPE SIZING CALCS

STORM SEWERS

By: _____
Date: _____
Ck'd _____
Date: _____

SEWER LOCATION			TIME (Min.)		In./Hr.	AREA (Acres)					SEWER DESIGN				PROFILE		
STREET	M.H. #	TO M.H. #	INCR. TIME	TOTAL TIME (To Upper End)	INTENSITY (I)	INCR. AREA	COEF. OF RUNOFF (c)	INCR. EQUIV. (c·A)	~~TOTAL EQUIV. AREA~~ INCREM. Sum (c·A) cfs	RUNOFF (C.F.S.) (I) W (c·A)	SLOPE (%)	DIAMETER (IN.)	CAPACITY (C.F.S.)	VELOCITY (F.P.S.), n=0.012	LENGTH (ft.)	GROUND ELEV. / INVERT ELEV. UPPER	GROUND ELEV. / INVERT ELEV. LOWER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
										3.79	0.5	18"	8.04				
(13) + (13) = (14)									0.20	3.99	0.5	18"	8.04				
CB #5 (15)																	
									0.05	0.05	1.0	6"	0.61				
1 RD #7 (16)									0.05	0.10	0.5	10"	1.68				
RD #8 (17)									0.07	0.17	0.5	10"	1.68				
CB #6 (18)									0.05	0.22	0.5	12"	2.73				
RD #9 (19)									0.07	0.29	0.5	15"	4.95				
CB #7 (20)									0.07	0.36	0.5	15"	4.95				
CB #8 (21)									0.37	0.73	0.84	15"	4.95				
RD #10, 11 (22)																	
										4.72	0.5	18"	8.04				
(15) + (22) = (23)									0.08	4.80	0.5	18"	8.04				
CB #9 (24)									0.10	4.90	0.5	18"	8.04				
CB #10 (25)									0.27	5.17	7.05	18"	8.04				
CB # 11, 12, 13 (26)									0.16	5.33	7.05	18"	8.04				
CB #14 (27)									0.17	5.50	7.05	18"	8.04				
CB #15 (28)																	

STORM SEWERS

By: _____
Date: _____
Ck'd _____
Date: _____

SEWER LOCATION			TIME (Min.)		In./Hr.	AREA (Acres)				RUNOFF (C.F.S.) (I) W (C)	SEWER DESIGN				PROFILE		
STREET	M.H. #	TO M.H. #	INCR. TIME	TOTAL TIME (To Upper End)	INTENSITY (I)	INCR. AREA	COEF. OF RUNOFF (C)	INCR. EQUIV. (C·A)	~~TOTAL EQUIV. AREA Incrsn, Sect) cfs~~		SLOPE (%)	DIAMETER (IN.)	CAPACITY (C.F.S.)	VELOCITY (F.P.S.), n = 0.012	LENGTH (FT.)	GROUND ELEV. / INVERT ELEV. UPPER	INVERT ELEV. LOWER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CB #16, 17, 18 (29)									0.35	5.85	7.05	18"	30				
CB, #19, 20 (30)									0.10	0.10	1.0	6"	0.62				
CB #21 (31)									0.21	0.21	2.0	6"	0.86				
CB #22 (32)									0.08	0.29	3.46	8"	2.44				
CB #23 (33)									0.20	0.49	3.46	8"	2.44				
CB #24 (34)									0.20	0.69	4.63	10"	5.10				
CB #25 (35)									0.12	0.81	4.63	10"	5.10				
CB #26 (36)									0.10	0.91	2.5	12"	6.10				
CB #27 (37)									0.11	1.02	2.5	12"	6.10				
CB #28, 29 (38)									0.22	1.24	2.5	12"	6.10				
CB #30 (39)									0.14	0.14	6.13%	6"	1.51				
CB #31 (40)									0.11	0.25	11.6%	8"	4.46				
CB #32, 33 (41)									0.04	0.29	11.6%	8"	4.46				
CB #34 (42)									0.05	0.34	11.6%	8"	4.46				

STORM SEWERS

By: _____
Date: _____
Ck'd _____
Date: _____

SEWER LOCATION			TIME (Min.)		In. / Hr.	AREA (Acres)					SEWER DESIGN				PROFILE		
STREET	M.H. #	TO M.H. #	INCR. TIME	TOTAL TIME (To Upper End)	INTENSITY (I)	INCR. AREA	COEF. OF RUNOFF (c)	INCR. EQUIV. (c·A)	~~TOTAL EQUIV. AREA (Increm. Sum) cf~~	RUNOFF (C.F.S.) (I) (c·A)	SLOPE (%)	DIAMETER (IN.)	CAPACITY (C.F.S.)	VELOCITY (F.P.S.), n = 0.012	LENGTH (FT.)	GROUND ELEV. / INVERT ELEV. UPPER	GROUND ELEV. / INVERT ELEV. LOWER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CB #35 RD # 22 (42)									0.29	0.63	0.5	10"	1.68				
RD #23 (43)									0.12	0.75	0.5	12"	2.73				
RD #24 (44)									0.12	0.87	0.5	12"	2.73				
(44) + (42) = (45)										1.50	1.68	12"	5.0				
CB # 36, 37 (46)									0.24	0.24	0.5	8"	0.93				
DI #3 (47)									0.23	0.23	0.5	12"	2.73				
FUTURE #2 (48)									2.85	3.08	5.14	18"	25.8				
CB #38 (49)									0.15	3.23	5.11	18"	25.8				
CB #38A (50)									0.10	3.33	5.14	18"	25.8				
CB #39 (51)									0.09	3.42	2.76	18"	18.9				
CB #40, 41 (52)									0.41	3.83	1.50	18"	13.9				

STORM SEWERS

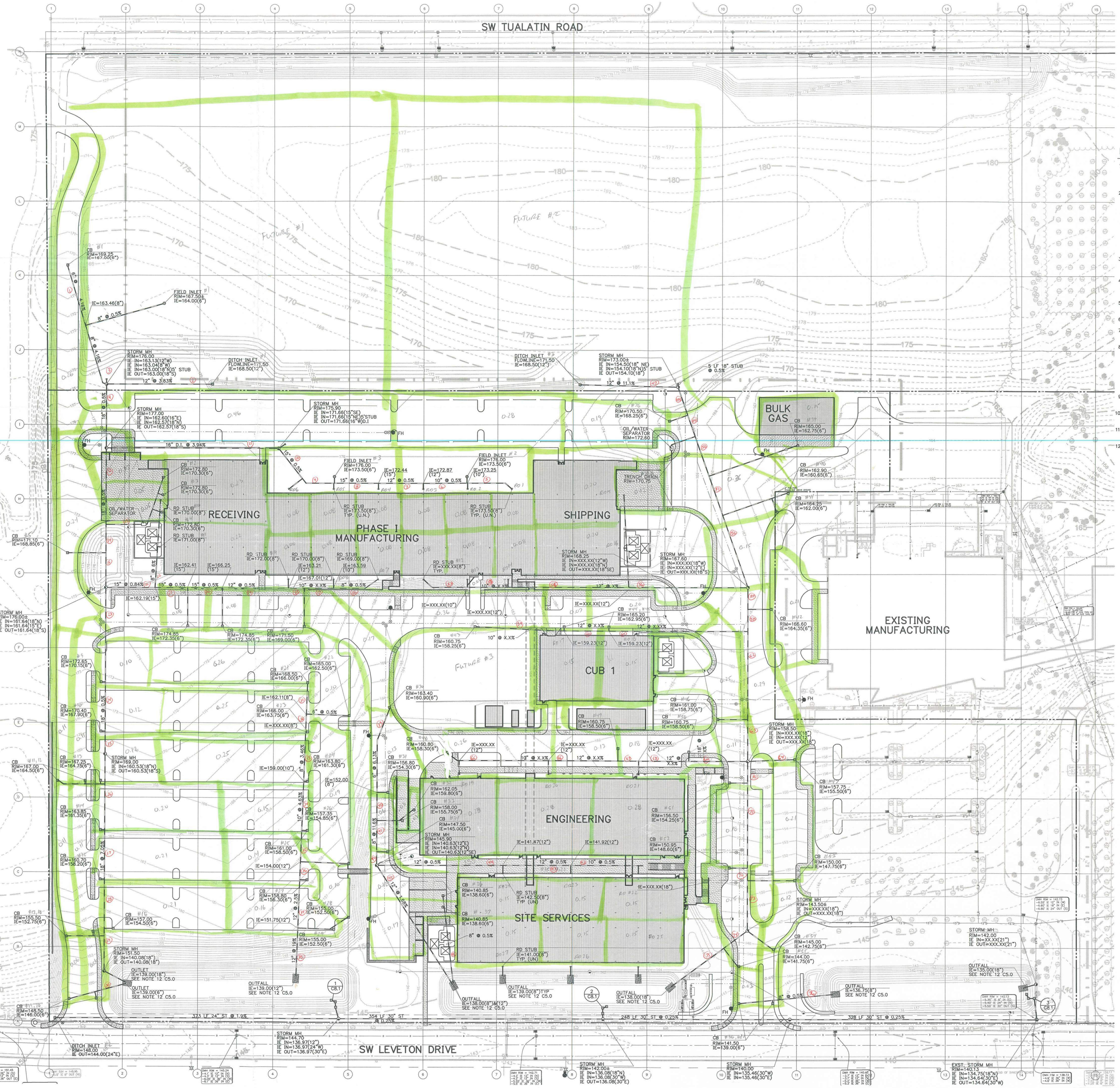
By: _____
Date: _____
Ck'd _____
Date: _____

SEWER LOCATION			TIME (Min)		In./Hr.	AREA (Acres)					SEWER DESIGN				PROFILE		
STREET	M.H. #	TO M.H. #	INCR. TIME	TOTAL TIME (To Upper End)	INTENSITY (I)	INCR. AREA	COEF. OF RUNOFF (c)	INCR. EQUIV. (c·A)	TOTAL EQUIV. AREA (Increm. Sum) cf	RUNOFF (C.F.S.) (I) W (c·A)	SLOPE (%)	DIAMETER (IN.)	CAPACITY (C.F.S.)	VELOCITY (F.P.S.), n = 0.012	LENGTH (Ft.)	GROUND ELEV. / INVERT ELEV. UPPER	GROUND ELEV. / INVERT ELEV. LOWER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
RO #12 (53)									0.07	0.07	2.0	6"	0.86				
RO #13 (54)									0.07	0.21	0.5	12"	2.73				
RO #14 (55)									0.07	0.21	0.5	12"	2.73				
RO # 15,16 (56)									0.32	0.53	0.5	12"	2.73				
(52) + (56) = (57)										4.36	2.65	18"	18.53				
CB #42 (58)									0.17	4.53	2.65	18"	18.53				
CB #43 FAT #3 (59)									0.58	0.58	0.75	10"	2.06				
CB # 41, RO # 17 (60)									0.18	0.76	0.75	10"	2.06				
CB # 45, RO #18 (61)									0.28	1.04	0.49	12"	2.70				
(58) + (61) = (62)										5.57	2.65	12"	6.28				
CB #46 (63)									0.20	5.77	2.65	12"	6.28				
CB # 47 (64)									0.24	0.24	2%	6"	0.86				

STORM SEWERS

By: _____
Date: _____
Ck'd _____
Date: _____

SEWER LOCATION			TIME (Min.)		In./Hr.	AREA (Acres)					SEWER DESIGN				PROFILE		
STREET	M.H. #	TO M.H. #	INCR. TIME	TOTAL TIME (To Upper End)	INTENSITY (I)	INCR. AREA	COEF. OF RUNOFF (C)	INCR. EQUIV. (C·A)	TOTAL EQUIV. AREA INCREM. ~~C·A~~ CA	RUNOFF (C.F.S.) ~~(I) × (CA)~~	SLOPE (%)	DIAMETER (IN.)	CAPACITY (C.F.S.)	VELOCITY (F.P.S.), n=0.012	LENGTH (FT.)	GROUND ELEV. / INVERT ELEV. UPPER	GROUND ELEV. / INVERT ELEV. LOWER
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
CB #48 RD # 19 (65)									0.44	0.44	0.5	10"	1.68				
RD #20 (66)									0.23	0.67	0.5	10"	1.68				
CB #49 (67)									0.11	0.77	0.5	12"	2.72				
RD #21 (68)									6.23	1.00	3.93	12"	7.65				
CB #50 (69)									0.15	1.15	3.93	12"	7.65				
										7.16	5.45	18"	26.5				
(63) + (64) + (69) = (70)									6.09	7.25	5.45	18"	26.5				
CB #51 (71)									0.15	7.40	5.45	18"	26.5				
CB # 52 (72)									0.17	7.57	5.45	18"	26.5				
CB # 53 (73)									0.10	7.67	0.5	18"	8.04				
CB # 54 (74)									0.12	7.79	0.5	18"	8.04				
CB #55 (75)																	
CB #56, 57 (76)																	



GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

UTILITY NOTES

1. ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF TUALATIN, THE UNIFIED SEWAGE AGENCY, AND THE CURRENT EDITION OF THE UNIFORM PLUMBING CODE AND THE UNIFORM BUILDING CODE. ALL WORK WITHIN THE PUBLIC R.O.W. REQUIRES A PUBLIC WORKS PERMIT.
2. THE WORKING DRAWINGS ARE GENERALLY DIAGRAMMATIC. THEY DO NOT SHOW EVERY OFFSET, BEND OR ELBOW REQUIRED FOR INSTALLATION IN THE SPACE PROVIDED. THEY DO NOT SHOW EVERY DIMENSION, COMPONENT PIECE, SECTION, JOINT OR FITTING REQUIRED TO COMPLETE THE PROJECT. ALL LOCATIONS FOR WORK SHALL BE CHECKED AND COORDINATED WITH EXISTING CONDITIONS IN THE FIELD BEFORE BEGINNING CONSTRUCTION. EXISTING UNDERGROUND UTILITIES LAYING WITHIN THE LIMITS OF EXCAVATION SHALL BE VERIFIED AS TO CONDITION, SIZE AND LOCATION BY UNCOVERING, PROVIDING SUCH IS PERMITTED BY LOCAL PUBLIC AUTHORITIES WITH JURISDICTION, BEFORE BEGINNING CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER IF THERE ARE ANY DISCREPANCIES.
3. PROVIDE CLEANOUTS AS REQUIRED IN THE CURRENT UNIFORM PLUMBING CODE CHAPTER 7, SECTIONS 707 AND 719, AND CHAPTER 11, SECTION 1103.04. NOTE: NOT ALL REQUIRED CLEANOUTS ARE SHOWN ON THE PLANS.
4. ALL STORM PIPING IS SIZED FOR A MANNING'S "N" VALUE = 0.013. ALL STORM PIPING IS DESIGNED USING CONCENTRIC PIPE TO PIPE AND WYE FITTINGS.
5. SEE MECHANICAL DRAWINGS FOR UTILITIES LOCATED WITHIN THE BUILDING AND TO 5' OUTSIDE THE BUILDING.
6. ALL ROOF DRAIN LEADERS TO BE 8" AT 2.0% MIN. UNLESS NOTED OTHERWISE.
7. VERIFY LOCATION, SIZE AND DEPTH OF EXISTING UTILITIES BY POTHOLING PRIOR TO CONSTRUCTION. NOTIFY ENGINEER OF DISCREPANCIES.
8. PROVIDE 2" PVC DRAIN LINE FROM DOMESTIC WATER METER VAULT AND BACKFLOW PREVENTER VAULT TO THE DOUBLE DETECTOR CHECK VALVE (FIRE) VAULT. PROVIDE 1/3 HP SUMP PUMP AT BASE OF FIRE VAULT AND INSTALL 2" PVC DRAIN LINE WITH BACKFLOW VALVE FROM SUMP PUMP TO DAYLIGHT AT NEAREST CURB. FURNISH ¾ INCH DIAMETER CONDUIT FROM BUILDING ELECTRICAL ROOM TO FIRE VAULT FOR SUMP PUMP ELECTRICAL SERVICE. NOTE: COORDINATE WITH FIRE PROTECTION CONTRACTOR FOR FLOW SENSOR INSTALLATION AND CONDUIT REQUIREMENTS.
9. THE SURVEY INFORMATION SHOWN AS A BACKGROUND SCREEN ON THIS SHEET IS BASED ON A SURVEY PREPARED BY HICKMAN AND ASSOCIATES.
10. CONTRACTOR TO PROVIDE POWER TO IRRIGATION CONTROLLER. SEE SPECIFICATIONS AND LANDSCAPE PLANS.
11. SEE BUILDING PLUMBING DRAWINGS FOR PIPING WITHIN THE BUILDING AND UP TO 5' OUTSIDE THE BUILDING, INCLUDING ANY FOUNDATION DRAINAGE PIPING.
12. PROVIDE MINIMUM 12'x8'x12" THICK TYPE II RIP-RAP AT 12" AND LARGER STORM OUTFALLS. PROVIDE MINIMUM 8'x6'x12" THICK TYPE II RIP-RAP AT 10" AND SMALLER OUTFALLS.

PROPOSED UTILITY LEGEND

STORM SEWER LINE	
SANITARY SEWER LINE	
FIRE WATER LINE	FW
WATER METER	
MANHOLE	
CATCH BASIN/DITCH INLET	
FIELD INLET	
FIRE HYDRANT ASSEMBLY	
UNLESS NOTED	U.N.

EXISTING UTILITY LEGEND

SITE BOUNDARY	
ADJOINING OR INTERIOR PROPERTY LINE	
RIGHT-OF-WAY CENTERLINE	
WATER LINE	W
GAS LINE	G
SANITARY SEWER LINE	S
UNDERGROUND TELEPHONE LINE (GTE)	UT
STORM DRAINAGE LINE	D
UNDERGROUND POWER LINE	UP
OVERHEAD POWER LINE	OP
FIRE HYDRANT	
WATER VALVE	
WATER METER	
GAS VALVE	
CATCH BASIN	
CURB LINE	
EDGE OF PAVEMENT	
STREET SIGN	
SANITARY SEWER MANHOLE	
EVERGREEN TREE WITH DIAMETER	
DECIDUOUS TREE WITH DIAMETER	
CHAIN LINK FENCE LINE	
LIGHT POLE	
6" BOLLARD	
ROOF DRAIN (SHOOT ON ROOF)	
GAS METER	
POWER TRANSFORMER	
CAMERA TOWER	
POWER POLE	
GUY ANCHOR	
SIDE INLET CATCH BASIN	
MAIL BOX	
STORM SEWER MANHOLE	

NOVELLUS

SWINERTON BUILDERS

Project
NOVELLUS TUALATIN FACILITY

Tualatin, Oregon

Architecture, Structural Engineer
Civil Engineer
Group Mackenzie
0690 SW Bancroft Street
Portland, Oregon 97201
Phone: (503)224-9560
FAX: (503)228-1285

Group Mackenzie Consultants

Landscape Architect
Greenworks PC
Phone: (503)222-5612
FAX: (503)222-2283

Safety & Health Consultant
Miller Safety
Phone: (503)243-1040
FAX: (503)243-1470

Design Builder
Swinerton Builders
3030 SW Moody Avenue
Suite 250
Portland, Oregon 97201
Phone: (503)222-2000
FAX: (503)478-2500

Swinerton Consultants

Mechanical Engineer
Southland Industries
Phone: (503)255-7118
FAX: (503)255-7955

Mechanical Consultant
Kinetics
Phone: (503)224-5200
FAX: (503)224-8521

Electrical Engineer
Oregon Electric
Phone: (503)234-9900
FAX: (503)231-3587

Electrical Consultant
Glumac International
Phone: (503)227-5280
FAX: (503)274-7674

REGISTERED PROFESSIONAL ENGINEER #19178 OREGON JULY 15, 1987 FORREST L FRENTRESS JR

EXPIRES: 12/31/01

© GROUP MACKENZIE 2000 ALL RIGHTS RESERVED
THESE DRAWINGS ARE THE PROPERTY OF GROUP MACKENZIE AND ARE NOT TO BE USED OR REPRODUCED IN ANY MANNER, WITHOUT PRIOR WRITTEN PERMISSION

REVISIONS:

REVISION EDITION	LAST REVISION THIS SHEET	REVISION EDITION CLOSING DATE

SHEET TITLE:
SITE STORM SEWER PLAN PHASE I

FIRST ISSUED:
LAST ISSUED:
DRAWN BY:
CHECKED BY:

SHEET **C5.0**
OF

GROUP MACKENZIE JOB NO. **000366**
CONSULTANT JOB NO.

UTILITY PERMIT REVIEW SUBMITTAL 2/14/01

02/13/01 17:20 1:1 C5.0-PLAN.DWG

APPENDIX F

GEOTECHNICAL REPORT

REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Lam Office Building
Lam Research Corporation Campus
11357 SW Leveton Drive
Tualatin, Oregon

For
Lam Research Corporation
c/o Mackenzie
June 22, 2022

Project: LamResCorp-7-01

NV5

June 22, 2022

Lam Research Corporation
c/o Mackenzie
River East Center
1515 SE Water Avenue, Suite 100
Portland, OR 97214

Attention: Brent Nielsen

Report of Geotechnical Engineering Services
Lam Office Building
Lam Research Corporation Campus
11357 SW Leveton Drive
Tualatin, Oregon
Project: LamResCorp-7-01

NV5 is pleased to present this report of geotechnical engineering services for the proposed office building at the Lam Research Corporation campus located at 11357 SW Leveton Drive in Tualatin, Oregon. Our services were provided in general conformance with our proposals dated March 24, 2022, and May 16, 2022.

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

Sincerely,

NV5

Najib A. Kalas, P.E.
Principal Engineer

Brett A. Shipton, P.E., G.E.
Principal Engineer

cc: Mike Rueter, Mackenzie (via email only)
David Linton, Mackenzie (via email only)

NAK:BAS:kt
Attachments
One copy submitted (via email only)
Document ID: LamResCorp-7-01-062222-geor.docx
© 2022 NV5. All rights reserved.

EXECUTIVE SUMMARY

- The proposed building can be supported on spread footings, provided the building can safely withstand the predicted foundation settlement.
- The foundations should be underlain by granular pads underlain by undisturbed native soil or new structural fill overlain by native soil. Topsoil and prior fill (if present) should be removed from under foundations.
- The site soil is slightly susceptible to liquefaction-induced ground settlement. A detailed discussion is provided in the report.
- The planned development will require demolition of structures and pavement. Demolition should include complete removal of the floor slabs and buried foundation elements to allow for evaluating subgrades. After evaluation, the excavations should be backfilled with compacted structural fill.
- The moisture content of the on-site soil generally varied from 10 to 37 percent at the time of our explorations, with an average of approximately 27 percent in the upper 5 feet. Moisture conditioning (drying) will be required to use the material as structural fill.
- The site soil is sensitive to moisture and is easily disturbed when at a moisture content that is above optimum. The subgrade should be protected from construction traffic. A granular working blanket consisting of imported granular material may be required to support construction activities. The contractor should select the thickness of the working blanket as they are in control of the type and frequency of construction traffic.
- Our explorations in vegetated portions of the site encountered a topsoil/tilled zone in the upper 14 to 22 inches, which includes an approximately 1- to 3-inch-thick root zone from past agricultural activities. The topsoil/tilled zone will provide poor support for foundations, floor slabs, and pavement. We recommend the topsoil/tilled zone be improved or stabilized.
- Infiltration rates were measured at between 1 inch and 6 inches per hour. Infiltration testing results and recommendations are discussed in the “Infiltration Systems” section.
- Groundwater was encountered in boring B-5 at a depth of 24.3 feet BGS during drilling and pore water pressure dissipation tests completed in the CPTs indicated groundwater was present at depths between approximately 19.4 and 21.6 feet BGS at the time of our explorations (May 2022). Perched groundwater is possible in the upper soil at the site during the wet winter to spring months.
- Foundation drains will not be required assuming cuts and fills will be less than a few feet each. NV5 should be contacted to review the final grading plans to verify our recommendations.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

1.0	INTRODUCTION		1
2.0	PROJECT UNDERSTANDING		1
3.0	BACKGROUND INFORMATION		1
4.0	PURPOSE AND SCOPE		1
5.0	SITE CONDITIONS		2
	5.1	Surface Conditions	2
	5.2	Subsurface Conditions	3
	5.3	Infiltration Testing	4
	5.4	Geologic Hazards	4
6.0	CONCLUSIONS AND RECOMMENDATIONS		5
7.0	DESIGN		5
	7.1	General	5
	7.2	Shallow Foundations	5
	7.3	Seismic Design Considerations	7
	7.4	Floor Slabs	7
	7.5	Retaining Structures	8
	7.6	Drainage	9
	7.7	Infiltration Systems	10
	7.8	Pavement	11
8.0	CONSTRUCTION		13
	8.1	Site Preparation	13
	8.2	Construction Considerations	14
	8.3	Permanent Slopes	15
	8.4	Excavation	15
	8.5	Materials	17
	8.6	Erosion Control	22
9.0	OBSERVATION OF CONSTRUCTION		22
10.0	LIMITATIONS		22

REFERENCES 24

FIGURES

Vicinity Map	Figure 1
Site Plan	Figure 2

TABLE OF CONTENTS

APPENDICES

Appendix A

Field Explorations	A-1
Laboratory Testing	A-2
Exploration Key	Table A-1
Soil Classification System	Table A-2
Boring Logs	Figures A-1 – A-5
Atterberg Limits Test Results	Figure A-6
Summary of Laboratory Data	Figure A-7

Appendix B

Cone Penetration Testing	B-1
CPT Results	

Appendix C

Previous Explorations	C-1
Site Plans, Exploration Logs, Laboratory Testing Results	

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACP	asphalt concrete pavement
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BGS	below ground surface
CPT	cone penetration test
ESAL	equivalent single-axle load
g	gravitational acceleration (32.2 feet/second^2)
GPR	ground penetrating radar
H:V	horizontal to vertical
MCE	maximum considered earthquake
MSL	mean sea level
OSHA	Occupational Safety and Health Administration
OSSC	2021 Oregon Standard Specifications for Construction
pcf	pounds per cubic foot
PG	performance grade
psf	pounds per square foot
psi	pounds per square inch
SPT	standard penetration test
µm	micrometer

1.0 INTRODUCTION

NV5 is pleased to submit this report of geotechnical engineering services for the proposed office building at the Lam Research Corporation campus located at 11357 SW Leveton Drive in Tualatin, Oregon. The site location is shown relative to surrounding features on Figure 1. Existing conditions and the proposed site layout (overlay) are shown on Figure 2. Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 PROJECT UNDERSTANDING

The proposed development is a four-story office building (Building G) with a footprint of 130,000 square feet located south of existing Building B; a basement is not planned. Other improvements include a paved parking lot in the eastern portion of the site and utilities. We understand on-site disposal of stormwater is under consideration. The site is occupied by structures, pavement, and landscaped areas that will be demolished.

Based on correspondence with Mackenzie, maximum interior column and perimeter column/tilt walls loads for the building will be 500 kips (250 kips dead load and 250 kips live load) and 300 kips (225 kips dead load and 75 kips live load), respectively. Maximum floor slab loading will be up to 100 psf. Mackenzie indicates maximum total allowable static settlement for the building is 1 inch. Differential building static settlement can be up to 0.5 inch.

A site survey was not available at the time of this report. Based on Google Earth information, the site grades down from an elevation of approximately 153 feet at the northwestern portion to approximately 147 feet at the southeastern portion of proposed Building G. A grading plan has not been developed at the time of this report. However, based on existing site grades, we anticipate mass cuts and fills will likely be less than a few feet each. NV5 should be contacted to review the final grading plan to verify our recommendations.

3.0 BACKGROUND INFORMATION

We conducted prior phases of work at the site, including four geotechnical studies for the existing facility (GeoDesign, Inc., 2001, 2014, 2015, and 2017) and provided two letters (GeoDesign, Inc., 2013 and 2018) with our recommendations for design of a proposed retaining wall and a generator pad addition, respectively. Mackenzie also provided us with a 1989 geotechnical report by L.R. Squier Associates, Inc. for the property when it was occupied by the OKI Oregon Plant (.R. Squier Associates, Inc., 1989). Our prior work included borings to depths between 6.5 and 71.5 feet BGS, test pits to depths between 12 and 15 feet BGS, and CPTs to depths between 41.7 and 99.4 feet BGS.

4.0 PURPOSE AND SCOPE

The purpose of our services was to provide geotechnical engineering recommendations for use in design and construction of the proposed development. We completed the following specific scope of services:

- Reviewed readily available, published geologic data and our in-house files for existing information on subsurface conditions in the site vicinity.
- Prepared site-specific Safety Incident Prevention Program.
- Coordinated and managed the field explorations, including private and public utility locates and scheduling subcontractors and NV5 staff.
- Conducted a geophysical site survey of the exploration locations as well as low voltage conduits using a GPR.
- Drilled five borings to depths between 6.5 and 30 feet BGS using solid-stem auger drilling methods.
- Conducted two CPTs to depths between approximately 51.7 and 51.8 feet BGS
- Collected geotechnical soil samples from the borings for laboratory testing and maintained a log of encountered soil and groundwater conditions in the borings. Results of the CPTs were provided by the CPT subcontractor.
- Performed two infiltration tests at the locations and depths requested by the design team.
- Conducted a laboratory testing program, including the following tests:
  - Sixteen moisture content determinations in general accordance with ASTM D2216
  - Five particle-size analyses in general accordance with ASTM D1140
  - One Atterberg limits test in general accordance with ASTM D4318
- Prepared this geotechnical engineering report that presents our findings, conclusions, and recommendations, including the following:
  - Soil and groundwater conditions at the site
  - Recommendations for site preparation and grading, including temporary and permanent slopes, fill placement criteria, suitability of on-site soil for fill, and subgrade preparation
  - Recommendations for wet weather construction
  - Discussion of geologic hazards and evaluation of liquefaction and lateral spreading at the site
  - Seismic design parameters in accordance with ASCE 7-16 and the 2019 SOSSC
  - Recommendations for foundation support for the proposed building
  - Recommendations for use in design of conventional retaining walls, including backfill and drainage requirements and lateral earth pressures
  - Recommendations for AC pavement design sections and pavement subgrade preparation
  - General recommendations for dewatering during construction and subsurface drainage
  - Results of field infiltration testing

5.0 SITE CONDITIONS

5.1 SURFACE CONDITIONS

The site is currently occupied by canopies, a paved parking lot, gravel-surfaced areas, and landscaped areas that will be demolished. Small piles of mulch/wood chips are present on the eastern portion of the site.

Based on Google Earth, the site grades down from an elevation of approximately 153 feet at the northwestern portion to approximately 147 feet at the southeastern portion of proposed Building G. Elevations at the proposed parking lots range between approximately 168 and 143 feet from north to south.

5.2 SUBSURFACE CONDITIONS

Subsurface conditions were explored by drilling five borings (B-1 through B-5) to depths between 6.5 and 30 feet BGS and conducting two CPTs (CPT-1 and CPT-2) to depths between approximately 51.7 and 51.8 feet BGS. The locations of the explorations are shown on Figure 2. Descriptions of our field explorations and laboratory testing program, logs of the borings, and results of our laboratory testing are presented in Appendix A. The results of the CPTs are presented in Appendix B.

The subsurface conditions encountered in our explorations were generally consistent with those encountered in our previous explorations. The relevant site plans, exploration logs, and laboratory test results from our previous explorations are presented in Appendix C.

Subsurface conditions encountered in our explorations generally consist of a topsoil/tilled zone or pavement, underlain by up to 7.5 feet of silt and clay, underlain by silty sand to sand with silt with interbeds of silt and clay to the depths explored. The following sections provide a detailed description of the geologic units encountered.

5.2.1 Pavement Section

A pavement section was encountered in boring B-5. The pavement section consists of 2 inches of AC underlain by 9 inches of aggregate base. Boring B-2 encountered 2 inches of crushed rock underlain by geotextile fabric.

5.2.2 Topsoil and Tilled Zone

The upper 14 to 22 inches of soil at the boring locations (in vegetated areas) generally consists of topsoil that has been tilled for agricultural purposes and includes an approximately 1- to 3-inch-thick root zone.

5.2.3 Native Soil

Underlying the pavement or topsoil is medium stiff to stiff silt and clay with minor to with sand. The silt and clay extend to depths between approximately 4.5 and 7.5 feet BGS in explorations B-2, B-3, B-4, and CPT-2. Interbeds of silt and clay were encountered within the sand unit in the CPTs. CPT-1 was completed in silt and clay at a depth of approximately 51.7 feet BGS. The silt and clay have low plasticity based on field classifications and laboratory test results. Laboratory testing indicates the moisture content of the silt and clay at the time of our explorations ranged between 27 and 37 percent.

Underlying the pavement, topsoil, or silt and clay is loose to medium dense, silty sand to sand with silt. In general, the sand becomes denser and contains less fines with depth. The sand extends to the maximum depth explored of approximately 51.8 feet BGS in CPT-2. Boring B-5 was terminated in sand at a depth of 30 feet BGS due to heaving of sand below groundwater. All explorations, except B-4, encountered sand. Laboratory testing of the sand indicates the moisture content ranged between 10 and 31 percent at the time of our explorations. Fines content analysis of select sand samples indicates a fines content of between 8 and 45 percent.

5.2.4 Groundwater

Groundwater was encountered in boring B-5 at a depth of 24.3 feet BGS during drilling and pore water pressure dissipation tests completed in the CPTs indicated groundwater was present at depths between approximately 19.4 and 21.6 feet BGS at the time of our explorations (May 2022).

Based on our experience with projects completed in the vicinity, groundwater levels were generally encountered at depths between approximately 20 to 40 feet BGS (approximate elevations of 125 to 145 feet above MSL based on ground surface elevation of 165 feet above MSL), as measured in a piezometer installed on site in the year 2000. Groundwater levels were generally encountered at approximately 15 to 18 feet BGS (approximate elevations of 127 to 130 feet above MSL based on ground surface elevation of 145 feet above MSL) at the sites on the south side of SW Leveton Drive. The depth to groundwater may fluctuate in response to seasonal changes, prolonged rainfall, changes in surface topography, and other factors not observed in this study. Perched groundwater zones are also likely in the upper soil at the site, particularly during extended periods of wet weather.

5.3 INFILTRATION TESTING

We understand stormwater infiltration systems are proposed for the development. The locations and configurations were preliminary at the time of this report. We conducted an infiltration test in borings B-1 and B-3 at a depth of 8 feet BGS, as requested by Mackenzie. The infiltration testing procedures are described in Appendix A, and the results of the infiltration testing are described in the "Infiltration Systems" section.

5.4 GEOLOGIC HAZARDS

5.4.1 Liquefaction

Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. The excessive buildup of pore water pressure results in the sudden loss of shear strength in a soil. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Low plasticity silty sand and silt may be moderately susceptible to liquefaction under relatively higher levels of ground shaking. Liquefaction can cause seismically induced densification of subsurface soil, which can result in settlement at the ground surface. If the ground surface is sloped or if there is an open face such as a ravine, the liquefied soil can also move horizontally in a process that is called lateral spreading.

We performed liquefaction analysis using the CPT results in accordance with Boulanger and Idriss (2014) employing the depth weighting methods from Cetin (2009). The CPTs provide continuous soil strength data for the full depth of penetration. The two strength parameters obtained are tip resistance and frictional resistance along the probe.

Our analysis indicates some of the silty sand to sandy silt and sand layers present below groundwater are susceptible to liquefaction under design levels of ground shaking. We estimate

total post-liquefaction settlement at the existing ground surface will be less than approximately 1.5 inches under a design-level seismic event. Differential settlement of up to 0. -inch over a 50-foot distance within the building should be assumed for design purposes.

Based on our correspondence with Mackenzie, we understand these settlements are within the acceptable structural tolerance.

5.4.2 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard. Areas subject to lateral spreading are typically gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Due to the low potential for liquefaction, the fact that there are no open faces in the site vicinity, and the Tualatin River is approximately 0.7 mile away from the site, the potential for lateral spreading at site is low.

5.4.3 Fault Surface Rupture

The closest mapped fault to the site is the Canby-Molalla fault, which is located approximately 1.8 miles northeast of the site. Consequently, it is our opinion that the probability of surface fault rupture beneath the site is low.

5.4.4 Other Geologic Hazards

Based on explorations and the topography at the site, the risk of damage from seiches, landslides, and subsidence is also low.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our understanding of the proposed development and the results of our explorations, laboratory testing, and analyses, it is our opinion the proposed development can be constructed at the site. The primary geotechnical considerations for the project are summarized in the "Executive Summary" section. Our specific recommendations are provided in the following sections.

7.0 DESIGN

7.1 GENERAL

The following sections provide our design recommendations for the project. All site preparation and structural fill should be prepared as recommended in the "Construction" section.

7.2 SHALLOW FOUNDATIONS

7.2.1 General

Based on the provided foundation loads as previously stated (column loads between 300 and 500 kips), assuming cut and fill will be less than a few feet each, and assuming the site is prepared as recommended in the "Construction" section, it is our opinion the proposed building can be supported on conventional spread footings founded on 24-inch-thick granular pads underlain by firm native soil or on structural fill overlying firm native soil. Foundation elements should not be supported on topsoil or undocumented fill material. If present, these materials should be removed and replaced with structural fill. The granular pads should extend 6 inches

beyond the margins of the footings for every foot excavated below the base grade of the footings. The granular pads should consist of imported granular material, as defined in the "Structural Fill" section. The imported granular material should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557, or until well keyed, as determined by one of our geotechnical staff. We recommend that a member of our geotechnical staff observe the prepared footing subgrade.

7.2.2 Bearing Capacity

Continuous wall and isolated spread footings should be at least 18 and 24 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 24-inch-thick granular pads over subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 3,000 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 may be increased by 50 percent for short-term loads such as those resulting from wind or seismic forces.

7.2.3 Resistance to Sliding

Lateral loads on footings can be resisted by passive earth pressure on the sides of structures and by friction on the base of footings. Our analysis indicates the available passive earth pressure for footings confined by native soil and structural fill is 350 pcf modeled as an equivalent fluid pressure. Adjacent floor slabs, pavement, or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance. In addition, in order to rely on passive resistance, a minimum of 10 feet of horizontal clearance must exist between the face of the footings and any adjacent down slopes. For footings that bear on granular pads as described above, a coefficient of friction equal to 0.45 may be used when calculating resistance to sliding; this should be reduced to 0.35 for footings bearing on native silt and sand.

7.2.4 Settlement

Total foundation settlement should be less than 1 inch with differential settlement between similarly loaded foundations of less than 0.5 inch under dead and long-term live loads.

As discussed in the "Geologic Hazards" section, the site soil is slightly susceptible to liquefaction-induced settlement. We estimate total post-liquefaction settlement at the existing ground surface will be less than approximately 1.5 inches during a design-level earthquake. We anticipate differential settlement of up to 0.5 inch over a 50-foot distance within the building. Based on our correspondence with Mackenzie, we understand these settlements are within acceptable structural tolerances.

7.2.5 Subgrade Observation

All footing and floor slab subgrades should be evaluated by a representative of NV5 to evaluate the bearing conditions. Observations should also confirm that all loose or soft material, organic

material, unsuitable fill, prior topsoil zones, and softened subgrades (if present) have been removed. Localized deepening of footing excavations may be required to penetrate deleterious material.

7.3 SEISMIC DESIGN CONSIDERATIONS

7.3.1 Seismic Design Parameters

Seismic design criteria for this project will be based on the 2019 SOSSC and ASCE 7-16. Based on the results of our subsurface explorations and shear wave velocity testing in CPT-1, the site is classified as Site Class D. Due to liquefaction potential, the site is classified as Site Class F according to ASCE 7-16. ASCE 7-16 indicates a site-specific response analysis is not required for structures with a fundamental period of vibration equal to or less than 0.5 second and the site class without liquefaction can be used for design. Based on our correspondence with Mackenzie, we understand the fundamental period of vibration for the structure has not been determined. ASCE 7-16 Section 11.4.8 requires a ground motion hazard study in accordance with Section 21.2 for structures on Site Class D sites with S_1 greater than or equal to 0.2 g (S_1 at the site is 0.390 g). Exception 2 of ASCE 7-16 Section 11.4.8 indicates a ground motion hazard study is not required for structures on Site Class D sites with S_1 greater to or equal 0.2 g, provided the value of the seismic response coefficient C_S is determined by Eq. (12.8-2) for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. (12.8-3) for $T_L \geq T > 1.5T_s$ or Eq. (12.8-4) for $T > T_L$. If Exception 2 is not applicable, a ground motion hazard analysis will be required. We recommend the structural engineer evaluate these requirements and exceptions to determine if the parameters for Site Class D provided in Table 1 can be used for design or if a site-specific seismic hazard evaluation is required.

Table 1. Seismic Design Parameters[1]

Seismic Design Parameter	Short Period (T_s)	1-Second Period (T_1)
MCE Spectral Acceleration	S_s = 0.839 g	S_1 = 0.390 g
Site Class	F[2]	
Site Coefficient	F_a = 1.164	F_v = 1.910
Adjusted Spectral Acceleration	S_{MS} = 0.977 g	S_{M1} = 0.745 g
Design Spectral Response Acceleration Parameters	S_{DS} = 0.651 g	S_{D1} = 0.497 g

1. The structural engineer should evaluate code requirements and exceptions to determine if these parameters can be used for design.
2. Site Class D can be assumed for the purpose of computing base shear forces, provided the building period is less than 0.5 second.

7.4 FLOOR SLABS

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 125 psi per inch. To aid as a capillary break, we recommend a 6-inch-

thick layer of floor slab base rock be placed and compacted over the prepared subgrade. The floor slab base rock should meet the requirements in the "Structural Fill" section and be compacted to at least 95 percent of ASTM D1557.

The near-surface native soil is primarily fine grained and will tend to maintain a high moisture content. In areas where moisture-sensitive floor slab and flooring will be installed, installation of a vapor barrier is warranted in order to reduce the potential for moisture transmission through and efflorescence growth on the slab and flooring. In addition, flooring manufacturers often require vapor barriers to protect flooring and flooring adhesives and will warrant their product only if a vapor barrier is installed according to their recommendations. Selection and design of an appropriate vapor barrier should be a collaborative effort with members of the design team.

7.5 RETAINING STRUCTURES

7.5.1 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 material; 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.

7.5.2 Lateral Earth Pressures

Permanent retaining structures free to rotate slightly around the base should be designed for active earth pressures using an equivalent fluid unit pressure of 35 pcf. If retaining walls are restrained against rotation during backfilling, they should be designed for an at-rest earth pressure of 55 pcf.

Seismic lateral forces can be calculated using a dynamic force equal to $7H^2$ pounds per linear foot of wall, where H is the wall height. The seismic force should be applied as a distributed load with the centroid located at 0.6H from the wall base. Footings for retaining walls should be designed as recommended for shallow foundations.

The design equivalent fluid pressure should be increased for walls that retain sloping soil. We recommend the above lateral earth pressures be increased using the factors presented in Table 2 when designing walls that retain sloping soil.

Table 2. Lateral Earth Pressure Increase Factors for Sloping Soil

Slope of Retained Soil (degrees)	Lateral Earth Pressure Increase Factor
0	1.00
5	1.06
10	1.12
20	1.33
25	1.52
30	2.27

If other surcharges (i.e., slopes steeper than 2H:1V, foundations, vehicles, etc.) are located within a horizontal distance of twice the height of the wall from the back of the wall, 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.

7.5.3 Wall Drainage and Backfill

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

Backfill material placed behind the walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of retaining wall select backfill placed and compacted in conformance with the "Structural Fill" section.

A minimum 6-inch-diameter, perforated collector pipe 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 that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of the finished grade. The drain rock and drainage geotextile fabric should meet specifications provided in the "Materials" section. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the drainage system of the wall.

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

7.6 DRAINAGE

7.6.1 Temporary

During mass 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 site, the contractor should keep all pads and subgrade free of ponding water.

7.6.2 Surface

Where possible, the finished ground surface around the building should be sloped away from the structure 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 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 (e.g., swales or catch basins).

7.6.3 Subsurface

Assuming the site grades around the building will be sloped as discussed previously, it is our opinion that perimeter footing drains will not be required around the proposed building. However, the use of these drains should be considered in areas where landscaping planters are placed proximate to the foundations or where surface grades cannot be completed as outlined above.

If installed, foundation drains should be constructed at a minimum slope of approximately ½ percent and pumped or drained by gravity to a suitable discharge. The perforated drainpipe should not be tied to a stormwater drainage system without backflow provisions. Foundation drains should consist of 4-inch-diameter, perforated drainpipe embedded in a minimum 2-foot-wide zone of crushed drain rock that extends to the ground surface. The invert elevation of the drainpipe should be installed at least 18 inches below the elevation of the floor slab.

The drain rock and geotextile should meet the requirements specified in the "Materials" section. The drain rock and geotextile should extend up the side of embedded walls to within a foot of the ground surface, geotextile wrapped over the top of the drain rock, as recommended in the "Retaining Structures" section.

7.7 INFILTRATION SYSTEMS

We understand stormwater infiltration systems are being considered for the proposed development. The locations and configurations were conceptual at the time of this report. The infiltration tests were performed to evaluate the infiltration potential for the proposed infiltration systems. The results of our field infiltration testing are presented in Table 3.

Table 3. Infiltration Testing Summary

Location	Depth (feet BGS)	Observed Infiltration Rate[1] (inches per hour)	Fines Content[2] (percent)	Soil Type at Test Depth
B-1	8	6	14	Silty sand
B-3	8	1	32	Silty sand

1. In-situ infiltration rate observed in the field
2. Fines content – material passing the U.S. Standard No. 200 sieve

The infiltration rates shown in Table 3 are short-term field rates and factors of safety have not been applied.

We recommend all infiltration systems be installed in the sand (below the upper silt and clay) and be at least 8 feet deep. Also, we recommend a minimum separation of 5 feet between the bottom of the infiltration systems and the groundwater encountered as shallow as 19.4 feet BGS. We recommend the following unfactored field infiltration rates:

- For infiltration systems in the silty sand at the southern portion of the site (near boring B-1), we recommend an unfactored field infiltration rate of 6 inches per hour.
- For infiltration systems in the silty sand at the northern portion of the site (near boring B-3), we recommend an unfactored field infiltration rate of 1 inch per hour.

We note that the high variability in the observed infiltration rates is due to high variability in fines content as presented in Table 3.

The recommended infiltration rates are measured rates and are unfactored. Correction factors should be applied to the recommended infiltration rates by the civil engineer during design to account for the degree of long-term maintenance and influent/pre-treatment control, as well as the potential for long-term clogging due to siltation and buildup of organic material, depending on the proposed length, location, and type of infiltration facility. We recommend a minimum factor of safety of at least 2 be applied to the recommended unfactored rates.

The actual depths and estimated infiltration rates can vary significantly from the values presented above. We recommend that the design infiltration values for the stormwater systems be confirmed by field testing completed during installation of the systems. The results of this field testing might necessitate that the stormwater system be enlarged to achieve the design infiltration rate.

7.8 PAVEMENT

Pavement should be installed on native subgrade or new engineered fills prepared in conformance with the "Site Preparation" and "Structural Fill" sections.

Our pavement recommendations are based on the assumption that the standard-duty traffic section will be subject to passenger cars and occasional maintenance and delivery trucks. We do not have specific information on the frequency and type of vehicles that will use the area; however, we have assumed that standard traffic conditions will consist of a maximum of 2 trucks per day and a maximum of 50 cars per day. We recommend that the heavy-duty pavement section be constructed in areas that will be subject to higher traffic volumes (such as entrances and areas subject to repeated delivery vehicles) or driveways that provide emergency fire truck access. The heavy-duty section assumes that traffic will consist of up to ten trucks per day.

Our pavement recommendations are based on the following assumptions:

- A resilient modulus of 20,000 psi was estimated for the aggregate base.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.45.
- Structural coefficients of 0.42 and 0.10 for the AC and aggregate base, respectively.
- No growth.
- A resilient modulus of 3,500 psi for site subgrades assuming the surface 18 inches of subgrade is scarified and compacted to at least 92 percent of the maximum dry density, as defined by ASTM D1557 (modified).

- The pavement section of access roadways associated with the fire access road will support an imposed fire apparatus load of 75,000 pounds on an infrequent basis.
- Design life of 20 years.
- No growth.

If any of these assumptions are incorrect, our office should be contacted with the appropriate information so that the pavement designs can be revised.

Our pavement design recommendations are provided in Table 4.

Table 4. 20-Year Standard Pavement Sections

Traffic Levels	Trucks per Day	ESALs	AC (inches)	Aggregate Base (inches)
Standard Duty	2	10,000	3	10
Heavy Duty	10	51,000	4	11

If the subgrade is cement amended to the thicknesses indicated below and the amended soil achieves a seven-day unconfined compressive strength of at least 100 psi, the pavement can be constructed as recommended in Table 5.

Table 5. 20-Year Pavement Sections with Cement Amendment

Traffic Levels	Trucks per Day	ESALs	AC (inches)	Aggregate Base (inches)	Cement Amendment[1] (inches)
Standard Duty	2	10,000	3	4	12
Heavy Duty	10	51,000	4	4	12

1. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

All thicknesses are intended to be the minimum acceptable. Design of the recommended pavement section is based on the assumption that construction will be completed during an extended period of dry weather. Wet weather construction could require an increased thickness of aggregate base. In addition, to prevent strength loss during curing, cement-amended soil should be allowed to cure for at least four days prior to construction traffic. Lastly, amended subgrade should be protected with a minimum of 4 inches of aggregate base prior to construction traffic access.

The AC, aggregate base, and cement amendment should meet the requirements outlined in the "Materials" section.

Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavement. 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. The aggregate base and cement amendment thicknesses (if installed) do not account for construction traffic, and haul roads and staging areas should be used as described in the "Construction" section.

8.0 CONSTRUCTION

8.1 SITE PREPARATION

8.1.1 Demolition

Demolition includes complete removal of the existing buildings, retaining walls, pavement, concrete curbs, abandoned utilities, and any subsurface elements within 5 feet of areas to receive new pavement, buildings, retaining walls, or engineered fills. Demolished material should be transported off site for disposal. In general, this material will not be suitable for re-use as engineered fill. However, concrete, pavement, and base rock material may be recycled in accordance with the requirements set forth by the project jurisdiction and the recommendations provided in the "Structural Fill" section.

Excavations remaining from removing basements, foundations, utilities, and other subsurface elements should be backfilled with structural fill where these are below planned site grades. The base of the excavations should be excavated to expose firm subgrade before filling. The sides of the excavations should be cut into firm material and sloped a minimum of 1.5H:1V. Utility lines abandoned under new structural components should be completely removed and backfilled with structural fill or grouted full if left in place. Soft or disturbed soil encountered during demolition should be removed and replaced with structural fill.

Considerable subgrade damage can occur during demolition activities and we recommend that the subgrade protection measures discussed in the "Construction Considerations" section be implemented.

8.1.2 Grubbing and Stripping

Trees and shrubs should be removed from fill areas. In addition, 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 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.

The existing topsoil zone should be stripped and removed from all fill areas. Based on our explorations in vegetated areas, the average depth of stripping will be approximately 2.5 inches, although greater stripping depths may be required to remove localized zones of loose or organic soil. Greater stripping depths (approaching 12 inches) may be anticipated in areas with thicker vegetation and shrubs, which should be expected in the tree and shrub areas 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 in accordance with the project Contaminated Media Management Plan.

8.1.3 Topsoil/Tilled Zone

An approximately 14- to 22-inch-deep agricultural topsoil/tilled zone was observed at the ground surface in our explorations in vegetated portions of the site. Reliable strength properties are extremely difficult to predict for the topsoil/tilled zone material. There is a high risk for poor performance of floor slabs and pavement established directly over topsoil/tilled zone soil. In order to reduce the risk of settlement, we recommend the topsoil/tilled zone be improved during site preparation in areas where planned cuts do not extend to the bottom of the topsoil/tilled zone (up to 22 inches). Prior to fill placement and construction, the topsoil/tilled zone should be improved by removing and replacing with structural fill or scarifying and re-compacting to structural fill requirements.

As discussed in the "Structural Fill" section, the native soil 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 soil for use as structural fill during periods of wet weather or when drying the soil is not an option.

8.1.4 Subgrade Evaluation

Upon completion of stripping and subgrade stabilization, and prior to the placement of fill or pavement, the exposed subgrade should be evaluated by proof rolling. The subgrade should be proof rolled with a fully loaded dump truck or similarly heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe proof rolling to evaluate yielding of the ground surface. During wet weather, subgrade evaluation should be performed by probing with a foundation probe rather than proof rolling. Areas that appear soft or loose should be improved in accordance with subsequent sections.

8.1.5 Compacting Prior Test Pit Excavations

The prior test pit excavations (see Appendix C) were backfilled using the relatively minimal compactive effort of the excavator's bucket; therefore, soft spots can be expected at these locations. We recommend this relatively uncompacted soil be removed from the test pits to a depth of 3 feet below finished subgrade. If a test pit is located within 10 feet of a footing, we recommend full-depth removal of the uncompacted soil. The resulting excavation should be brought back to grade with compacted structural fill.

8.2 CONSTRUCTION CONSIDERATIONS

The fine-grained soil present on this site is easily disturbed. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance.

If construction occurs during or extends into the wet season, or if the moisture content of the surficial soil is more than a couple percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Likewise, the use of granular haul roads and staging areas will be necessary for support of construction traffic during the rainy

season or when the moisture content of the surficial soil is more than a few percentage points above optimum. The base rock thickness for pavement areas is intended to support post-construction design traffic loads. This design base rock thickness will likely not support construction traffic or pavement construction. Moreover, if construction is planned for periods when the subgrade soil is wet, staging areas and haul roads with increased thicknesses of base rock will be required. The amount of staging areas and haul roads, as well as the required thickness of granular material, will vary with the contractor's sequencing of a project and type/frequency of construction equipment and should, therefore, be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material are generally required in staging areas and between 18 and 24 inches in haul roads areas. The contractor should also be responsible for selecting the type of material for construction of haul roads and staging areas. A geotextile fabric can be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic to help prevent silt migration into the base rock. The imported granular material, stabilization material, and geotextile fabric should meet the specifications in the "Materials" section.

As an alternative to thickened crushed rock sections, haul roads and utility work zones may be constructed using cement-amended subgrades overlain by a crushed rock wearing surface. If this approach is used, the thickness of granular material in staging areas and along haul roads can typically be reduced to between 6 and 9 inches. This recommendation is based on an assumed minimum unconfined compressive strength of 100 psi for subgrade amended to a depth of 12 to 16 inches. The actual thickness of the amended material and imported granular material will depend on the contractor's means and methods and should be the contractor's responsibility. Cement amendment is discussed in the "Materials" section.

8.3 PERMANENT SLOPES

Permanent cut and fill slopes should not exceed 2H:1V. Access roads and pavement 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. The 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.

8.4 EXCAVATION

8.4.1 Excavation and Shoring

The site soil should be readily excavatable with conventional grading equipment. If buried construction debris from prior on-site structures is encountered beneath the ground surface, this material will result in difficult trench excavations and may require additional effort or special equipment. If difficult excavations are encountered, trenches may also be wider than anticipated, increasing the amount of backfill material required.

Temporary excavation sidewalls should stand vertical to a depth of approximately 4 feet, provided groundwater seepage is not observed in the sidewalls and surcharge loads will not be present within H feet, where H is the depth of the trench. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1.5H:1V and groundwater seepage and surcharge loads are not

present. At this inclination, slopes with loose sand may ravel and require some ongoing repair. Excavations should be flattened to 2H:1V if excessive sloughing or raveling occurs. In lieu of large and open cuts, approved temporary shoring may be used for excavation support. Use of approved temporary shoring is recommended where the slopes cannot be cut back, within the influence area of structural elements, and for cuts below the water table. The influence area can be defined as a 1H:1V slope extending down from a 5-foot setback from the edge of a foundation element. A wide variety of shoring and dewatering systems are available. Consequently, we recommend the contractor be responsible for selecting the appropriate shoring and dewatering systems.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If excavations are left open for extended periods of time, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend 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.

8.4.2 Trench Dewatering

Groundwater was encountered in our explorations at depths between approximately 19.4 and 24.3 feet BGS at the time of exploration. Major dewatering is not anticipated for the project. If perched groundwater is present, dewatering may be required to maintain dry working conditions. Pumping from sumps located within the trench will likely be effective in removing water resulting from seepage.

If perched groundwater is encountered at the base of utility excavations, we recommend placing 1.5 to 2 feet of stabilization material at the base of the excavation. The use of a subgrade geotextile fabric may reduce the amount of stabilization material required. The actual thickness should be based on field observations during construction.

Trench stabilization material and the subgrade geotextile fabric should meet the requirements described in the “Materials” section. Trench stabilization material should be placed in one lift and compacted until well keyed. While we have described certain approaches to excavation dewatering, it is the contractor's responsibility to select the dewatering methods.

8.4.3 Safety

All excavations should be made in accordance with applicable OSHA requirements and regulations of the state, county, and local jurisdiction. While this report describes certain approaches to excavation and dewatering, the contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety, and providing shoring (as required) to protect personnel and adjacent structural elements.

8.5 MATERIALS

8.5.1 Structural Fill

8.5.1.1 General

Fill should be placed on subgrade that has been prepared in conformance with the "Site Preparation" section. A variety of material may be used as structural fill at the site. However, all material used as structural fill should be free of organic material or other unsuitable material. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill are provided below.

8.5.1.2 On-Site Soil

The material at the site should be suitable for use as general structural fill, provided it is properly moisture conditioned and free of debris, organic material, and particles over 6 inches in diameter. Moisture conditioning (drying) will likely be required to use on-site fine-grained soil for structural fill. Accordingly, extended dry weather will be required to adequately condition and place the soil as structural fill. It will be difficult, if not impossible, to adequately compact on-site soil during the rainy season or during prolonged periods of rainfall.

When used as structural fill, native soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557.

8.5.1.3 Imported Granular Material

Imported granular material used as structural fill should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand. The imported granular material should also be angular and fairly well graded between coarse and fine material, should have less than 5 percent fines by dry weight passing the U.S. Standard No. 200 sieve, and should have at least two mechanically fractured faces.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557. During the wet season or when wet subgrade conditions exists, 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.

8.5.1.4 Stabilization Material

Stabilization material used in staging or haul road areas or in trenches should consist of 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand. The material should have a maximum particle size of 6 inches, should have less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and should have at least two mechanically fractured faces. The material should be free of organic material and other deleterious material. Stabilization material should be placed in lifts between 12 and 24 inches thick and compacted to a firm condition.

8.5.1.5 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of durable, well-graded granular material with a maximum particle size

of 1½ inches, should have less than 7 percent fines by dry weight, and should have at least two mechanically fractured faces. The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

Within roadway alignments, the remainder of the trench backfill up to the subgrade elevation should consist of durable, well-graded granular material with a maximum particle size of 2½ inches, should have less than 7 percent fines by dry weight, and should have at least two mechanically fractured faces. This material should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department. The upper 3 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone may consist of general fill material that is free of organic material and material over 6 inches in diameter. This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

8.5.1.6 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches. The material should be free of roots, organic material, and other unsuitable material; should have less than 2 percent by dry weight passing the U.S. Standard No. 200 sieve (washed analysis); and should have at least two mechanically fractured faces. Drain rock should be compacted to a well-keyed, firm condition.

8.5.1.7 Aggregate Base Rock

Imported granular material used as base rock for building floor slabs and pavement should consist of ¾- or 1½-inch-minus material (depending on the application). In addition, the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve and have at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

8.5.1.8 Retaining Wall Select Backfill

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 imported granular material as described above and should have less than 7 percent fines by dry weight and have at least two mechanically fractured faces. We recommend the wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D1557. 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 D1557. 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 a jumping jack or vibratory plate compactor). If flatwork (sidewalks or pavement) will be placed atop the wall backfill, we recommend the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D1557.

8.5.1.9 Retaining Wall Leveling Pad

Imported granular material placed at the base of retaining wall footings should consist of select granular material. The granular material should be 1"-0 to ¾"-0 aggregate size and have at least two mechanically fractured faces. The leveling pad material should be placed in a 6- to 12-inch-thick lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

8.5.1.10 Existing Concrete and Crushed Rock

Concrete and crushed rock from the existing pavement areas and improvements can be used in general structural fill, provided particles greater than 3 inches are not present, it is thoroughly mixed and well graded so that there are no voids between the fragments, and the resulting mix is moisture conditioned for compaction. This material can be used as trench backfill if it meets the requirements for imported granular material, which would require a smaller maximum particle size. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

8.5.2 Geotextile Fabric

8.5.2.1 Subgrade Geotextile

Subgrade geotextile should conform to OSSC Table 02320-4 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles. All drainage aggregate and stabilization material should be underlain by a subgrade geotextile.

8.5.2.2 Drainage Geotextile

Drainage geotextile should conform to Type 2 material of OSSC Table 02320-1 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

8.5.3 Soil Amendment with Cement

8.5.3.1 General

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 soil with 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. The amount of cement used during amendment should be based on an assumed soil dry unit weight of 100 pcf.

In addition, the new Oregon Department of Environmental Quality requirements under 1200C permits include additional requirements for routing, testing, and (if necessary) treating runoff from sites where cement amendment is used.

8.5.3.2 Subbase Stabilization

Specific recommendations based on exposed site conditions for soil amendment can be provided if necessary. However, for preliminary design purposes, we recommend a target strength for cement-amended subgrade for building and pavement subbase (below aggregate base) soil of 100 psi. The amount of cement used to achieve this target generally varies with moisture content and soil type. It is difficult to predict field performance of soil to cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. In general, 6 percent cement by weight of dry soil can be used when the soil moisture content does not exceed approximately 20 percent. If the soil moisture content is in the range of 25 to 35 percent, 7 to 8 percent by weight of dry soil is recommended. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content.

We recommend assuming a minimum cement ratio of 6 percent by dry weight, with higher rates as discussed above. Because of the higher organic content and moisture of the topsoil, we recommend using a higher cement ratio when stabilizing topsoil zone, likely a minimum of 7 to 8 percent.

We recommend cement amendment equipment be equipped with balloon tires to reduce rutting and disturbance of the fine-grained soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction of the fine-grained soil without the use of vibratory action. A smooth-drum roller with a minimum applied linear force of 700 pounds per inch should be used for final compaction. The amended soil should be compacted to at least 92 percent of the achievable dry density at the moisture content of the material, as defined in ASTM D1557.

A minimum curing time of four days is required between amendment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-amended surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material.

Amendment depths for subgrade beneath buildings and pavement, haul roads, and staging areas are typically on the order of 12, 16, and 12 inches, respectively. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated traffic as well as the contractor's means and methods and should be the contractor's responsibility.

Cement amendment should not be attempted when the air temperature is below 40 degrees Fahrenheit or during moderate to heavy precipitation. Cement should not be placed when the ground surface is saturated or standing water exists.

8.5.3.3 Cement-Amended Structural Fill

On-site soil that would not otherwise be suitable for structural fill may be amended and placed as fill over a subgrade prepared in conformance with the "Site Preparation" section. The cement ratio for general cement-amended fill can generally be reduced by 1 percent (by dry weight). Typically, a minimum curing time of four days is required between amendment and construction traffic access. Consecutive lifts of fill may be amended immediately after the previous lift has been amended and compacted (e.g., the four-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, the four-day wait period is in effect.

8.5.3.4 Other Considerations

Portland cement-amended soil is hard and has low permeability. This soil does not drain well and it is not suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. Moreover, cement amendment of soil within building areas must be done carefully to avoid trapping water under floor slabs. We should be contacted if this approach is considered. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands. In general, cement amendment is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit) or during steady rainfall.

8.5.4 AC

8.5.4.1 ACP

The AC should be Level 2, ½-inch, dense ACP according to OSSC 00744 (Asphalt Concrete Pavement) and compacted to 91 percent of the theoretical maximum density of the mix, as determined by AASHTO T 209. The minimum and maximum lift thicknesses are 2 and 3 inches, respectively, for ½-inch ACP. Asphalt binder should be performance graded and conform to PG 64-22 or better. The binder grade should be adjusted depending on the aggregate gradation and amount of recycled asphalt pavement and/or recycled asphalt shingles in the contractor's mix design submittal.

8.5.4.2 Cold Weather Paving Considerations

In general, AC paving is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress.

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Oregon, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2 and 2.5 inches.

If paving activities must take place during cold-weather construction as defined above, the project team should be consulted and a site meeting should be held to discuss ways to lessen low compaction risks.

8.6 EROSION CONTROL

The site soil is susceptible to erosion; therefore, erosion control measures should be carefully planned and in place before construction begins. Surface water runoff should be collected and directed away from slopes to prevent water from running down the slope face. Erosion control measures (such as straw bales, sediment fences, and temporary detention and settling basins) should be used in accordance with local and state ordinances.

9.0 OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient observation 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 NV5 be retained to observe earthwork activities, including stripping, proof rolling of the subgrade and repair of soft areas, footing subgrade and granular pad preparation, final proof rolling of the pavement subgrade and base rock, and AC placement and compaction, and performing laboratory compaction and field moisture-density tests.

10.0 LIMITATIONS

We have prepared this report for use by Lam Research Corporation, Mackenzie, and members of the design and construction team for the proposed development. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Soil explorations 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, the conclusions and recommendations presented may not be applicable. If design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

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 this report for consideration in design.

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

NV5

Najib A. Kalas, P.E.
Principal Engineer

Brett A. Shipton, P.E., G.E.
Principal Engineer

REFERENCES

ASCE, 2016. *Minimum Design Loads and Associated Criteria for Buildings and Other Structures.* ASCE Standard ASCE/SEI 7-16.

Boulanger, R. W., and Idriss, I. M., 2014, "CPT and SPT based liquefaction triggering procedures." Report No. UCD/CGM-14/01, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, CA, 134 pp. Boulanger_Idriss_CPT_and_SPT_Liq_triggering_CGM-14-01_2014.

Boulanger, Ross W., Moug, Diane M., Munter, Sean K., Price, Adam B., and DeJong, Jason T., 2016, Evaluation Liquefaction and Lateral Spreading In Interbed Sand, Silt and Clay Deposits using the Cone Penetrometer, Australian Geomechanics, Volume 51: No. 4 December 2016.

Cetin, K, Bilge; H. Tolga; Wu, Jiaer; Kammerer, Annie, M; and Raymond Seed, 2009. *Probabilistic Model for the Assessment of Cyclically Induced Reconsolidation (Volumetric) Settlements.*

GeoDesign, Inc., 2001. *Report of Geotechnical Engineering Services; Novellus Systems Campus; SW Leveton Drive; Tualatin, Oregon,* dated January 10, 2001. GeoDesign Project: Novellus-4

GeoDesign, Inc., 2013. *Geotechnical Engineering Services; Lam Research Corporation Campus; SW Leveton Drive; Tualatin, Oregon*, dated June 17, 2013. GeoDesign Project: LamResCorp-1-01

GeoDesign, Inc., 2014. *Report of Geotechnical Engineering Services; Proposed Elevator Pit and Stairwell – Building F; Lam Research Corporation Campus; SW Leveton Drive; Tualatin, Oregon,* dated September 16, 2014. GeoDesign Project: LamResCorp-3-01

GeoDesign, Inc., 2015. *Report of Geotechnical Engineering Services; Building D Addition; Lam Research Corporation Campus; 11357 SW Leveton Drive; Tualatin, Oregon,* dated July 17, 2015. GeoDesign Project: LamResCorp-2-01

GeoDesign, Inc., 2017. *Report of Geotechnical Engineering Services; Gas Pad Expansion; Lam Research Corporation Campus; 11357 SW Leveton Drive; Tualatin, Oregon,* dated April 20, 2017. GeoDesign Project: LamResCorp-4-01

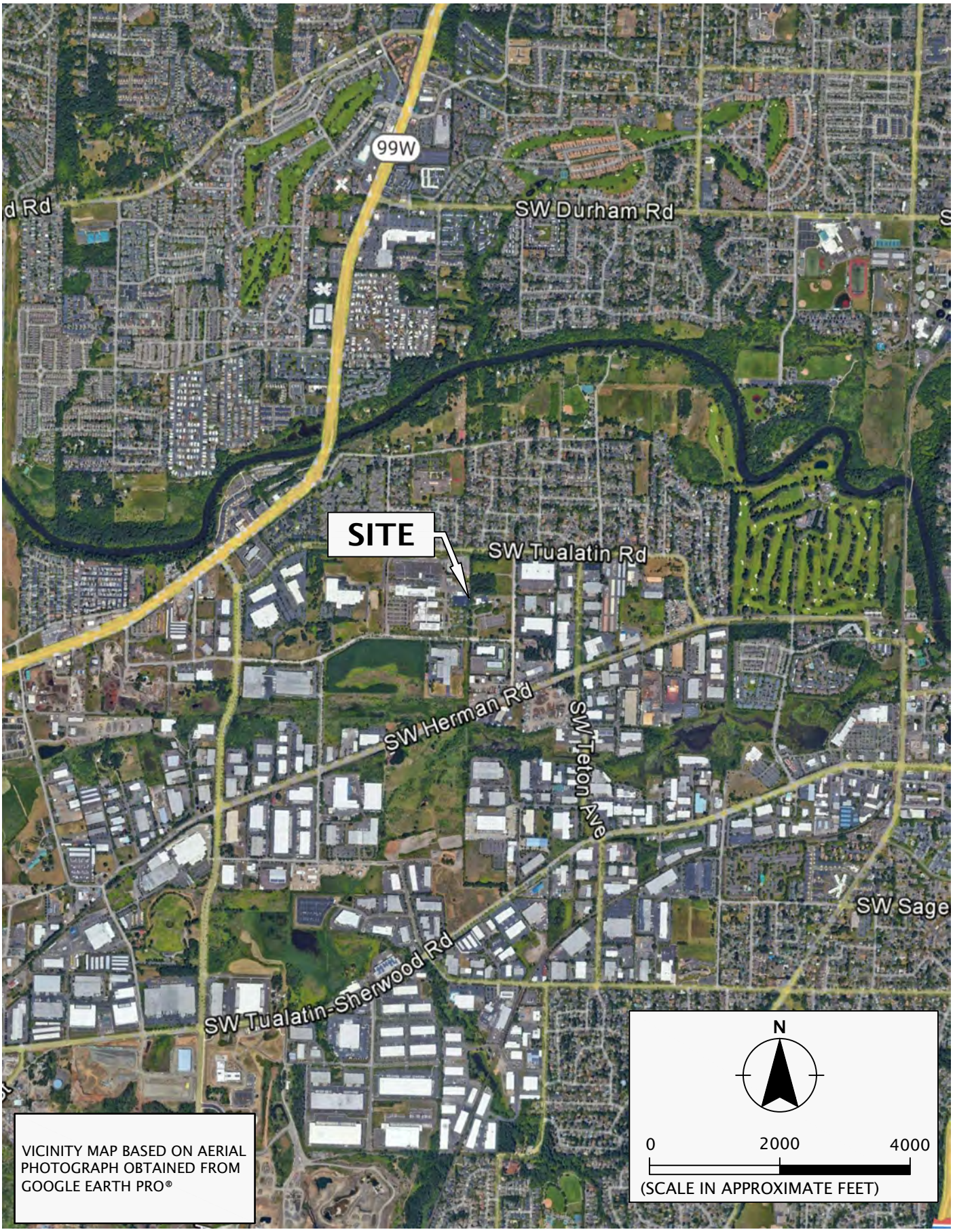
GeoDesign, Inc., 2018. *Generator Pad Design Recommendations; Generator Pad Addition; Lam Research Corporation Campus; 11357 SW Leveton Drive; Tualatin, Oregon*, dated January 8, 2018. GeoDesign Project: LamResCorp-5-01

L.R. Squier Associates, Inc., 1989. *Foundation Investigation; OKI Oregon Plant; Tualatin, Oregon*, dated August 3, 1989.

ODOT, 2021. *Oregon Standard Specifications for Construction,* Oregon Department of Transportation, 2021 Edition.

State of Oregon 2019 Structural Specialty Code.

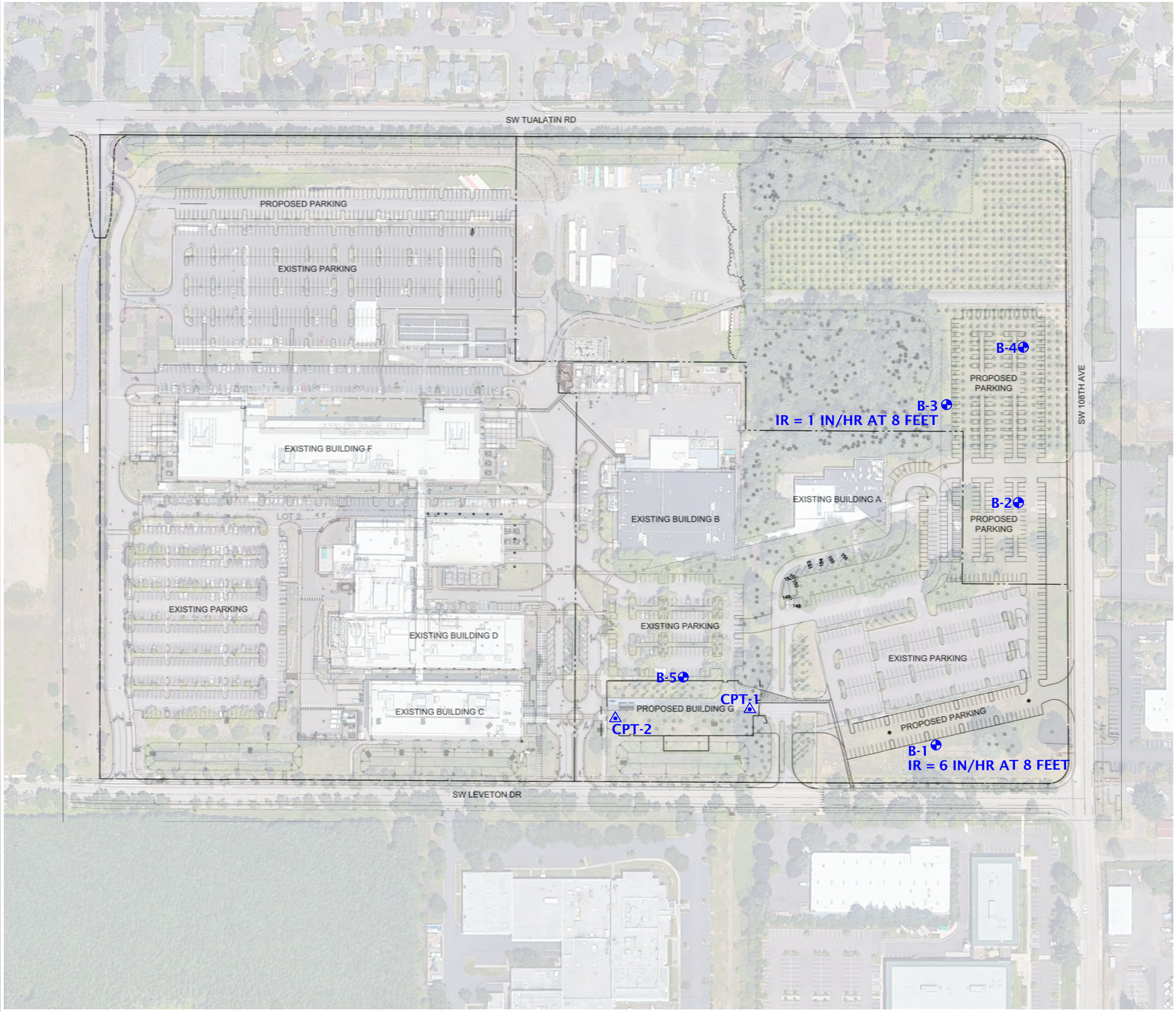
FIGURES



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

NV5	LAMRESCORP-7-01	**VICINITY MAP**
	JUNE 2022	LAM OFFICE BUILDING TUALATIN, OR
		FIGURE 1

Printed By: mmiller | Print Date: 6/10/2022 12:05:01 PM
File Name: J:\E-L\LamResCorp\LamResCorp-7\LamResCorp-7-01\Figures\CAD\LamResCorp-7-01-VM01.dwg | Layout: FIGURE 1



LEGEND:

B-1	BORING
CPT-1	CPT
IR = 6 IN/HR AT 8 FEET	UNFACTORED INFILTRATION RATE

N

0 200 400

(SCALE IN FEET)

NOTES:

1. SITE PLAN BASED ON IMAGE OF SHEET EX 1 OVERALL SITE PLAN PREPARED BY MACKENZIE.
2. AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO JUNE 10, 2022.

SITE PLAN

LAM OFFICE BUILDING
TUALATIN, OR

FIGURE 2

LAMRESCORP-7-01

JUNE 2022

NV5

Printed By: mmiller | Print Date: 6/10/2022 12:05:31 PM
File Name: J:\E-L\LamResCorp\LamResCorp-7\LamResCorp-7-01\Figures\CAD\LamResCorp-7-01-SP01.dwg | Layout: F

APPENDIX A

APPENDIX A

FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by drilling five borings (B-1 through B-5) to depths between 6.5 and 30 feet BGS and conducting two CPTs (CPT-1 and CPT-2) to depths between approximately 51.7 and 51.8 feet BGS.

Drilling services were provided by Dan J. Fischer Excavating, Inc. of Forest Grove, Oregon, on May 25, 2022, using a trailer-mounted drill rig with solid-stem auger methods. The CPTs were conducted by Oregon Geotechnical Explorations, Inc. of Salem, Oregon, on May 25, 2022. Logs of the borings are presented in this appendix, and results of the CPTs are presented in Appendix B.

The locations of the explorations are shown on Figure 2. The exploration locations were determined by pacing from existing site features and should be considered accurate to the degree implied by the methods used. A member of our geology staff observed the explorations.

SOIL SAMPLING

We collected representative samples of the various soils encountered during drilling for geotechnical laboratory testing. Samples were collected from the borings using 1½-inch-inside-diameter, split-spoon SPT samplers in general accordance with ASTM D1586. The samplers were driven into the soil with a 140-pound hammer free-falling 30 inches. The sampler was driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the exploration logs, unless otherwise noted. Sampling methods and intervals are shown on the exploration logs.

The hammer used to conduct the SPTs was lifted using a rope and cathead system. The hammer was raised using two wraps of the rope around the cathead to conduct the SPTs.

SOIL CLASSIFICATION

The soil samples were classified in the field in accordance with the "Exploration Key" (Table A-1) and "Soil Classification System" (Table A-2), which are presented in this appendix. The exploration logs indicate the depths at which the soil characteristics change, although the change could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

INFILTRATION TESTING

Infiltration testing was conducted borings B-1 and B-3 at a depth of 8 feet BGS. The infiltration rates were estimated by filling the pipe with water, allowing the area to saturate, and then measuring the drop in water with time. The tests were conducted under a hydrostatic head of generally between approximately 18 and 54 inches. Representative soil samples were collected from at or below the infiltration test locations for grain-size distribution analyses, as described in this appendix.

LABORATORY TESTING

We visually examined soil samples collected from the explorations to confirm field classifications. We also performed the following laboratory tests to evaluate the engineering properties of the soil.

MOISTURE CONTENT

We tested the natural moisture content of select soil samples in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to dry soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

PARTICLE-SIZE ANALYSIS

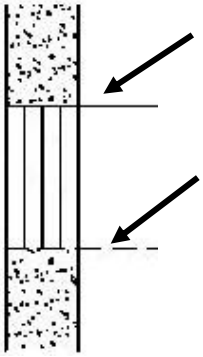
We completed grain-size testing on select soil samples in order to determine the distribution of soil particle sizes. The testing consisted of fines content determination completed in conformance with ASTM D1140. This test determines of the amount of material finer than a 75-µm expressed as a percentage of the dry weight of soil. The test results are presented in this appendix.

ATTERBERG LIMITS TESTING

Atterberg limits (plastic and liquid limits) testing was performed on a select soil sample in general accordance with ASTM D4318. The plastic limit is defined as the moisture content where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits. The test results are presented in this appendix.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample collected in general accordance with ASTM D1586 using Standard Penetration Test (SPT) with recovery
	Location of sample collected using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D1587 with recovery
	Location of sample collected using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample collected using Dames & Moore sampler and 140-pound hammer or pushed with recovery
	Location of sample collected using 3-inch-outside diameter California split-spoon sampler and 140-pound hammer 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

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

ENVIRONMENTAL TESTING EXPLANATIONS

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

RELATIVE DENSITY - COARSE-GRAINED SOIL

Relative Density	Standard Penetration Test (SPT) 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 SOIL

Consistency	Standard Penetration Test (SPT) 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

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SAND WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOIL			PT	PEAT

MOISTURE CLASSIFICATION		ADDITIONAL CONSTITUENTS					
		Secondary granular components or other materials such as organics, man-made debris, etc.					
			Silt and Clay In:			Sand and Gravel In:	
Term	Field Test	Percent	Fine-Grained Soil	Coarse-Grained Soil	Percent	Fine-Grained Soil	Coarse-Grained Soil
dry	very low moisture, dry to touch						
moist	damp, without visible moisture	< 5	trace	trace	< 5	trace	trace
		5 – 12	minor	with	5 – 15	minor	minor
wet	visible free water, usually saturated	> 12	some	silty/clayey	15 – 30	with	with
					> 30	sandy/gravelly	Indicate %

NV5

SOIL CLASSIFICATION SYSTEM

TABLE 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
0.0		Loose, dark brown, silty SAND (SM), trace organics (rootlets); moist, sand is fine to medium (14-inch-thick tilled zone, 2-inch-thick root zone).					
2.5						6 ▲ ●	
5.0		medium dense at 5.0 feet				11 ▲	
7.5				P200		11 ▲	Infiltration test at 8.0 feet. P200 = 14%
10.0						11 ▲	
11.5		Exploration completed at a depth of 11.5 feet. SPT completed using two wraps with a cathead.	11.5				Surface elevation was not measured at the time of exploration.
12.5							
15.0							
17.5							
20.0							

DRILLED BY: Dan J. Fischer Excavating, Inc. | LOGGED BY: L. Gose | COMPLETED: 05/25/22

BORING METHOD: solid-stem auger (see document text) | BORING BIT DIAMETER: 6 1/4 inches

N|V|5

LAMRESCORP-7-01

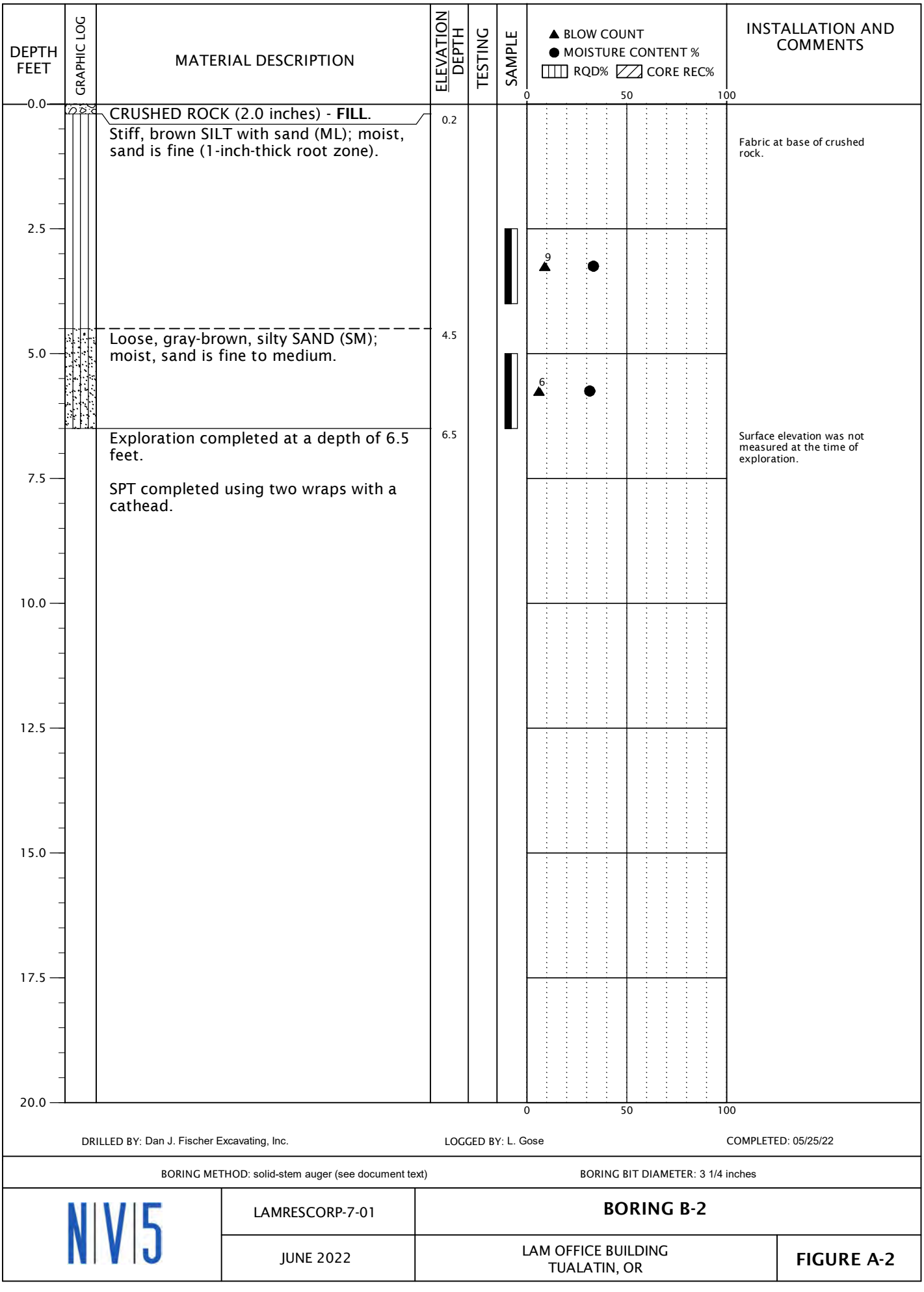
BORING B-1

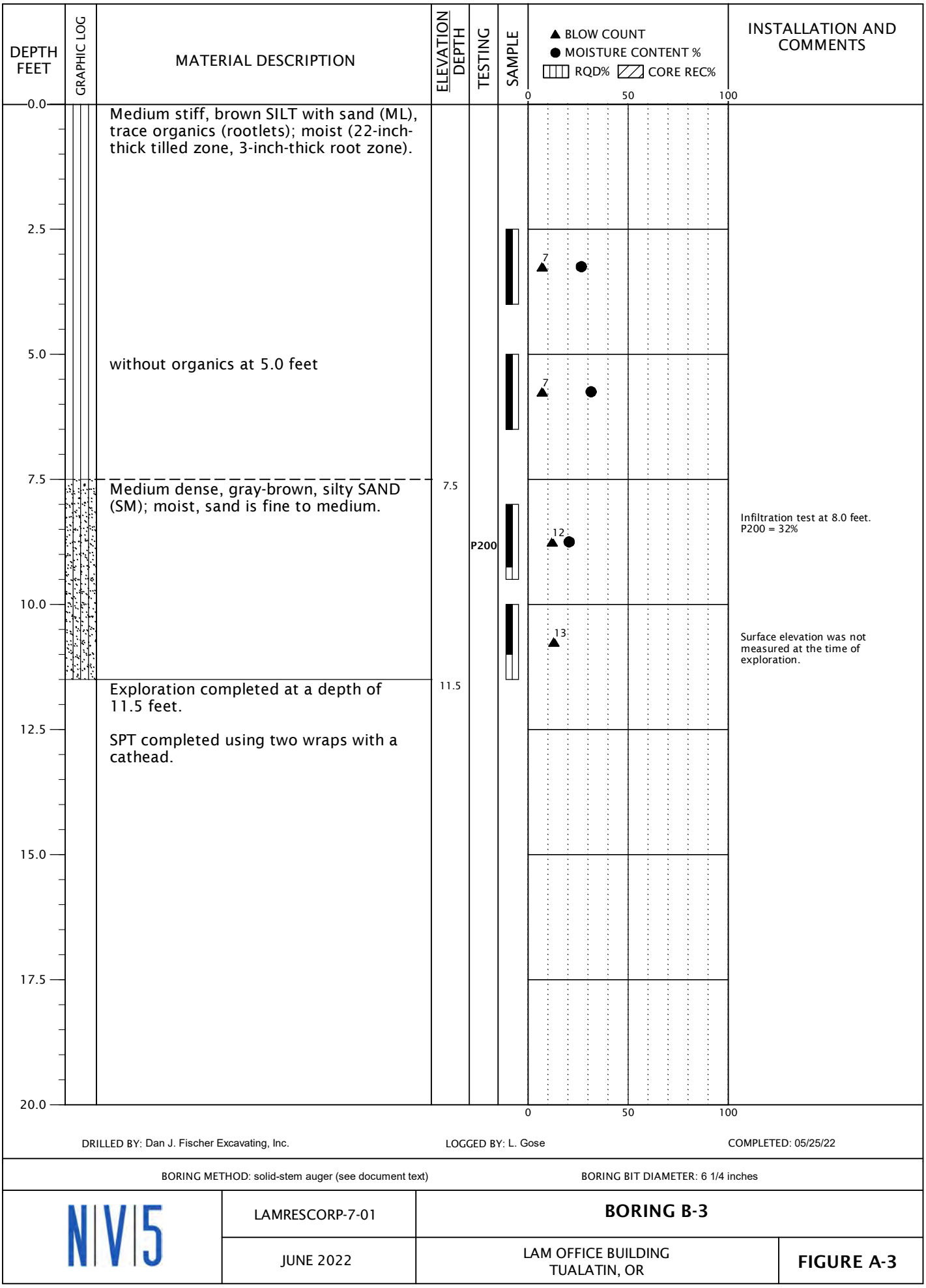
JUNE 2022

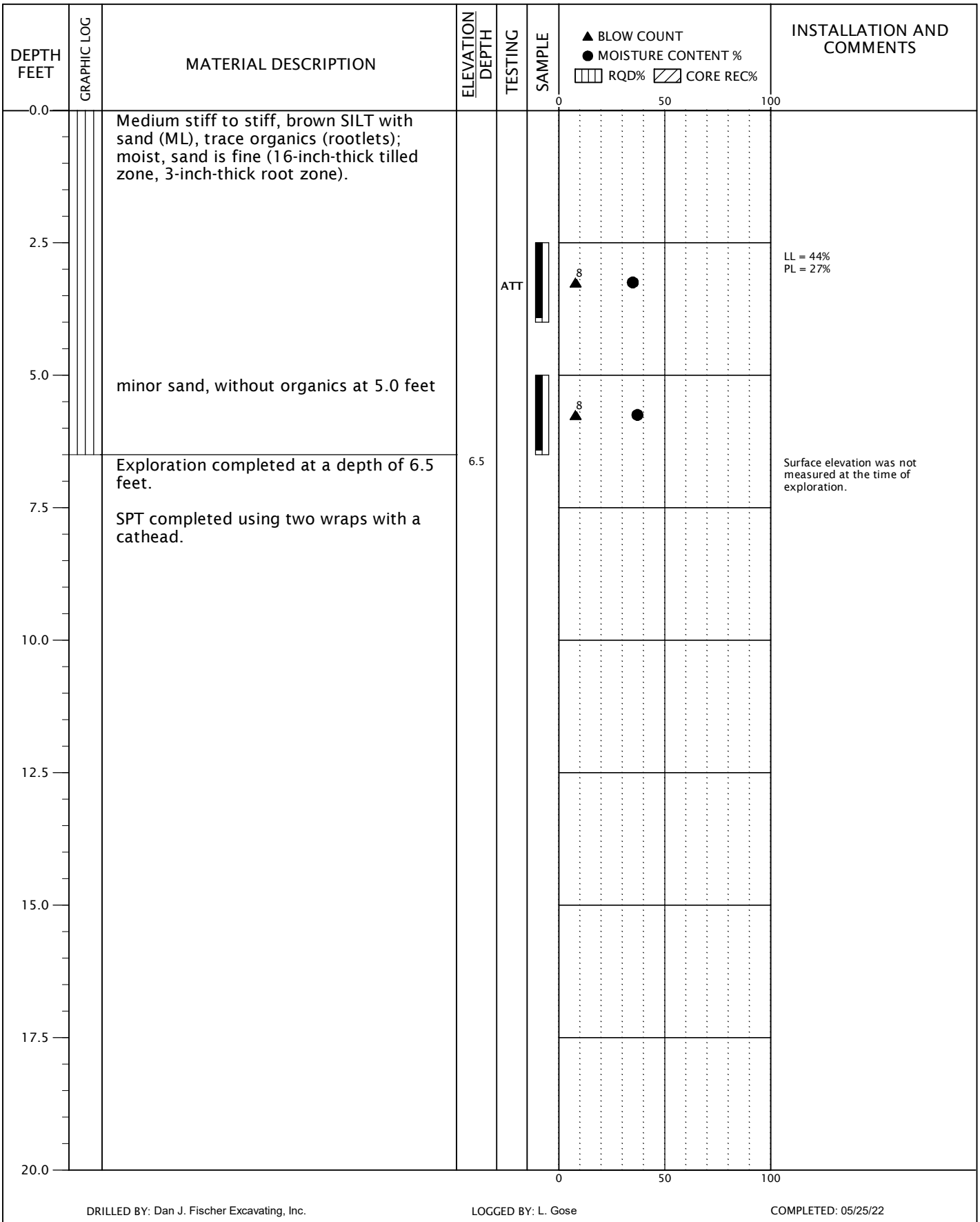
LAM OFFICE BUILDING
TUALATIN, OR

FIGURE A-1

BORING LOG - NV5 - 1 PER PAGE LAMRESCORP-7-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 6/7/22:SN


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
INSTALLATION AND COMMENTS
0
50
100
0.0
CRUSHED ROCK (2.0 inches) - FILL.
0.2
Stiff, brown SILT with sand (ML); moist, sand is fine (1-inch-thick root zone).
Fabric at base of crushed rock.
2.5
9
4.5
Loose, gray-brown, silty SAND (SM); moist, sand is fine to medium.
5.0
6
6.5
Exploration completed at a depth of 6.5 feet.
Surface elevation was not measured at the time of exploration.
SPT completed using two wraps with a cathead.
7.5
10.0
12.5
15.0
17.5
20.0
0
50
100
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: L. Gose
COMPLETED: 05/25/22
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 3 1/4 inches
N|V|5
LAMRESCORP-7-01
BORING B-2
JUNE 2022
LAM OFFICE BUILDING
TUALATIN, OR
FIGURE A-2
BORING LOG - NV5 - 1 PER PAGE LAMRESCORP-7-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 6/7/22:SN


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
BLOW COUNT
MOISTURE CONTENT %
RQD%
CORE REC%
INSTALLATION AND COMMENTS
0
50
100
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Medium stiff, brown SILT with sand (ML), trace organics (rootlets); moist (22-inch-thick tilled zone, 3-inch-thick root zone).
without organics at 5.0 feet
Medium dense, gray-brown, silty SAND (SM); moist, sand is fine to medium.
7.5
11.5
Exploration completed at a depth of 11.5 feet.
SPT completed using two wraps with a cathead.
7
7
12
13
P200
Infiltration test at 8.0 feet.
P200 = 32%
Surface elevation was not measured at the time of exploration.
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: L. Gose
COMPLETED: 05/25/22
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 6 1/4 inches
N|V|5
LAMRESCORP-7-01
BORING B-3
JUNE 2022
LAM OFFICE BUILDING
TUALATIN, OR
FIGURE A-3
BORING LOG - NV5 - 1 PER PAGE LAMRESCORP-7-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 6/7/22:SN



DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: L. Gose

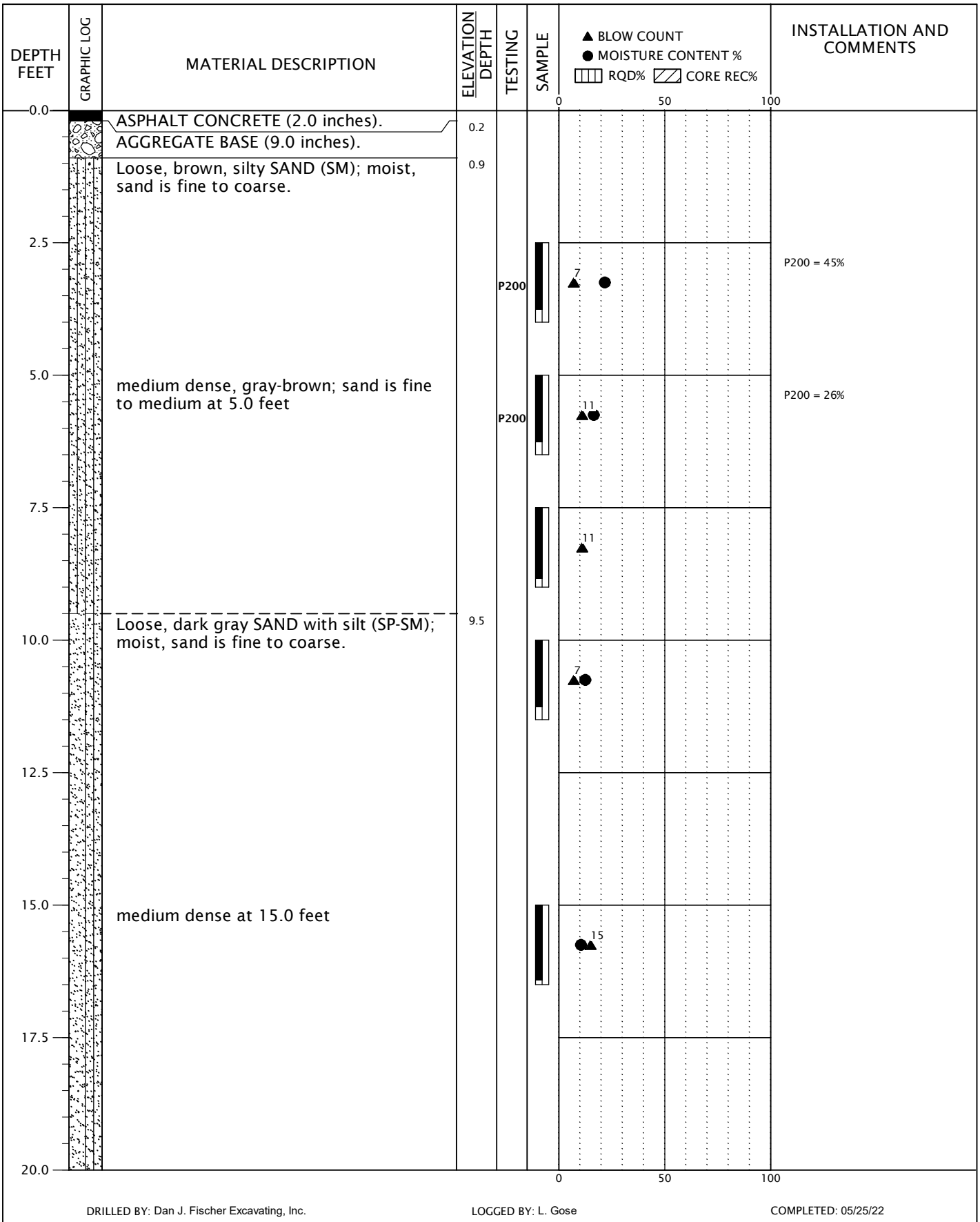
COMPLETED: 05/25/22

BORING METHOD: solid-stem auger (see document text)

BORING BIT DIAMETER: 3 1/4 inches

N|V|5	LAMRESCORP-7-01	**BORING B-4**
	JUNE 2022	LAM OFFICE BUILDING TUALATIN, OR
		FIGURE A-4

BORING LOG - NV5 - 1 PER PAGE LAMRESCORP-7-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 6/7/22:SN



DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: L. Gose

COMPLETED: 05/25/22

BORING METHOD: solid-stem auger (see document text)

BORING BIT DIAMETER: 3 1/4 inches

N|V|5

LAMRESCORP-7-01

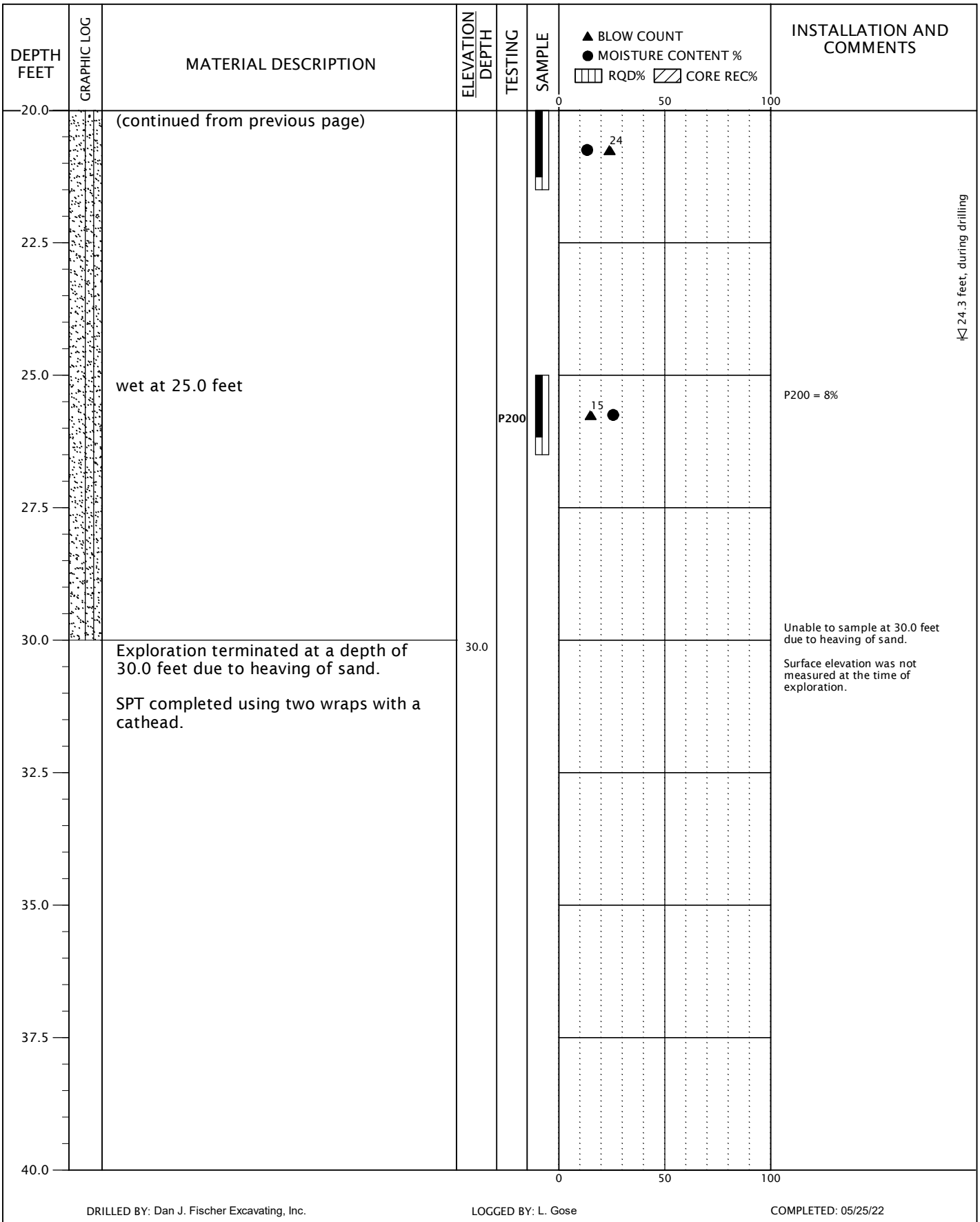
BORING B-5

JUNE 2022

LAM OFFICE BUILDING
TUALATIN, OR

FIGURE A-5

BORING LOG - NV5 - 1 PER PAGE LAMRESCORP-7-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 6/7/22:SN



DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: L. Gose

COMPLETED: 05/25/22

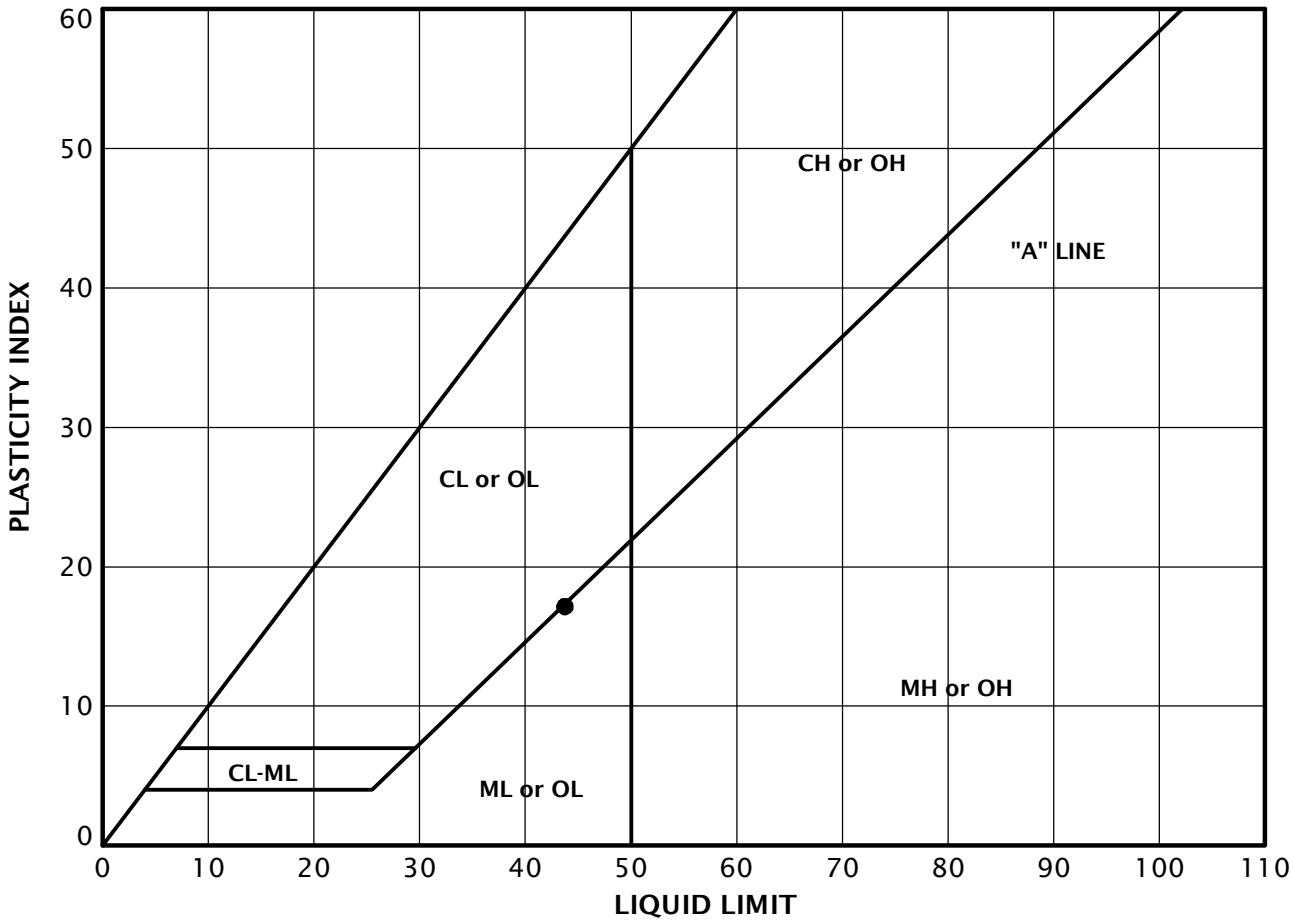
BORING METHOD: solid-stem auger (see document text)

BORING BIT DIAMETER: 3 1/4 inches

N|V|5	LAMRESCORP-7-01	**BORING B-5** (continued)
	JUNE 2022	LAM OFFICE BUILDING TUALATIN, OR

FIGURE A-5

BORING LOG - NV5 - 1 PER PAGE LAMRESCORP-7-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 6/7/22:SN



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-4	2.5	35	44	27	17

N|V|5	LAMRESCORP-7-01	ATTERBERG LIMITS TEST RESULTS	
	JUNE 2022	LAM OFFICE BUILDING TUALATIN, OR	FIGURE A-6

_ATTERBERG_LIMITS 7 LAMRESCORP-7-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 6/6/22:SN

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	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		17							
B-1	5.0		15							
B-1	8.0		15				14			
B-2	2.5		33							
B-2	5.0		31							
B-3	2.5		27							
B-3	5.0		31							
B-3	8.0		20				32			
B-4	2.5		35					44	27	17
B-4	5.0		37							
B-5	2.5		22				45			
B-5	5.0		16				26			
B-5	10.0		12							
B-5	15.0		10							
B-5	20.0		13							
B-5	25.0		26				8			

LAB SUMMARY - GDI-NV5 LAMRESCORP-7-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 6/6/22:SN

NV5	LAMRESCORP-7-01	**SUMMARY OF LABORATORY DATA**	
	JUNE 2022	LAM OFFICE BUILDING TUALATIN, OR	**FIGURE A-7**

APPENDIX B

APPENDIX B

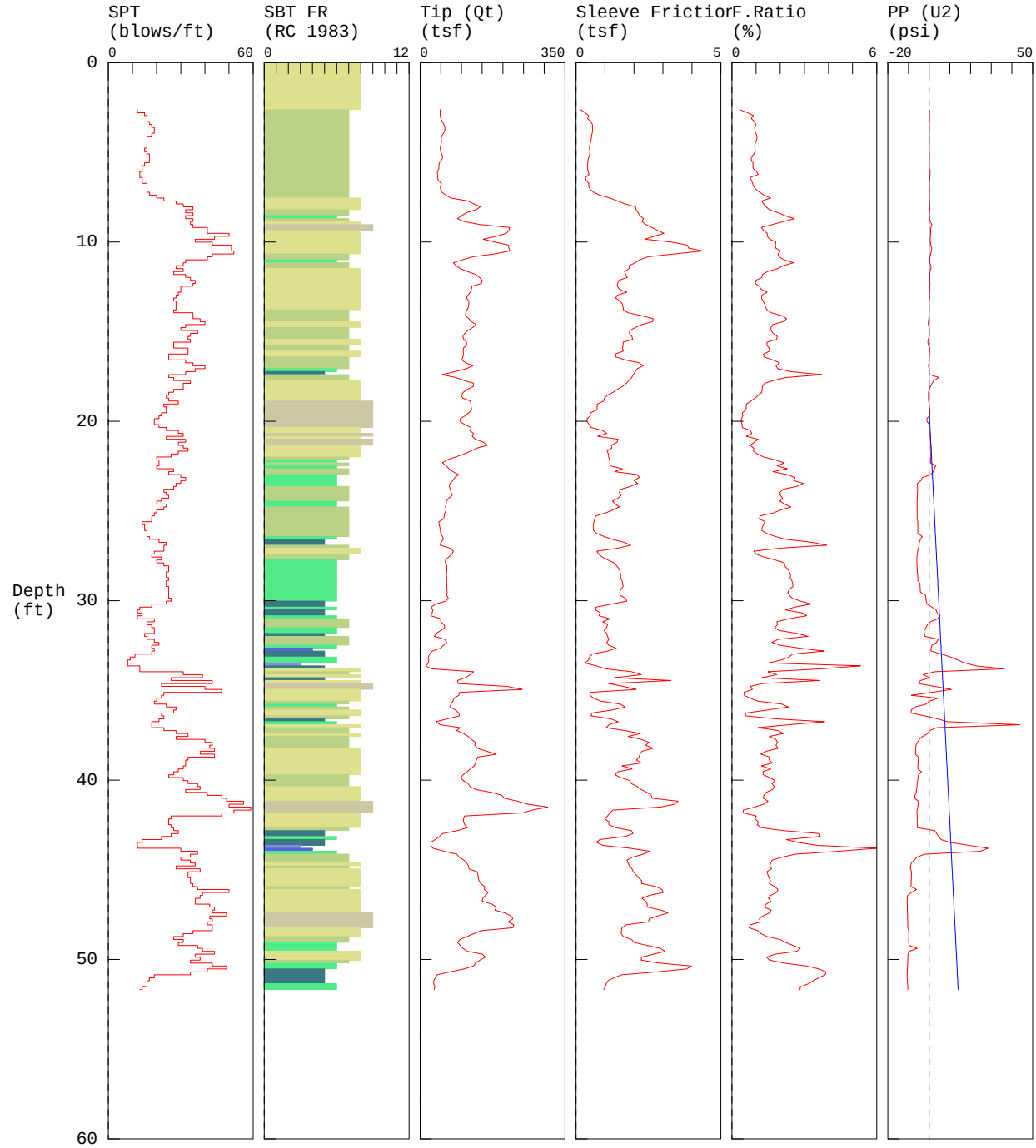
CONE PENETRATION TESTING

Our subsurface exploration program included two CPTs (CPT-1 and CPT-2) to depths between approximately 51.7 and 51.8 feet BGS. Figure 2 shows the locations of the CPTs. The CPTs were conducted in general accordance with ASTM D5778 by Oregon Geotechnical Explorations, Inc. of Salem, Oregon, on May 25, 2022. The results of the CPTs are presented in this appendix.

The CPT is an in-situ test that provides characterizes subsurface stratigraphy. The testing includes advancing a 35.6-millimeter-diameter cone equipped with a load cell and a friction sleeve through the soil profile. The cone is advanced at a rate of approximately 2 centimeters per second. Tip resistance, sleeve friction, and pore pressure at are typically recorded at 0.1-meter intervals. At selected depths, the CPT advancement can be suspended and pore water dissipation rates can be measured. Shear wave velocity of the subsurface soil can be measured, typically on increments of 1 meter to 2 meters.

NV5 / CPT-1 / 11357 SW Leveton Drive Tualatin

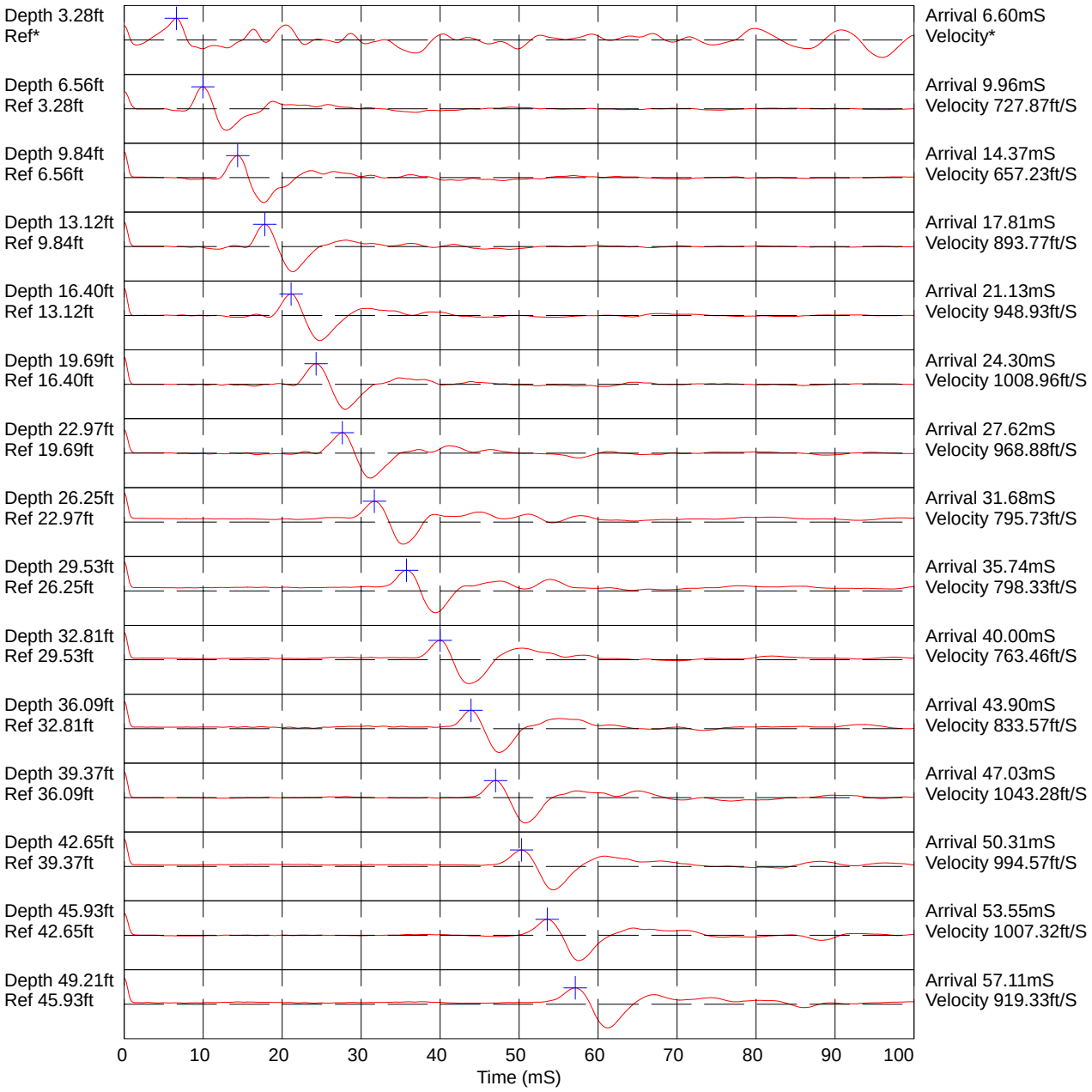
OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-1
TEST DATE: 5/25/2022 10:56:32 AM
TOTAL DEPTH: 51.673 ft



1 sensitive fine gra
2 organic materia
3 clay
4 silty clay to cl
5 clayey silt to silt
6 sandy silt to claye
7 silty sand to sandy
8 sand to silty sa
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

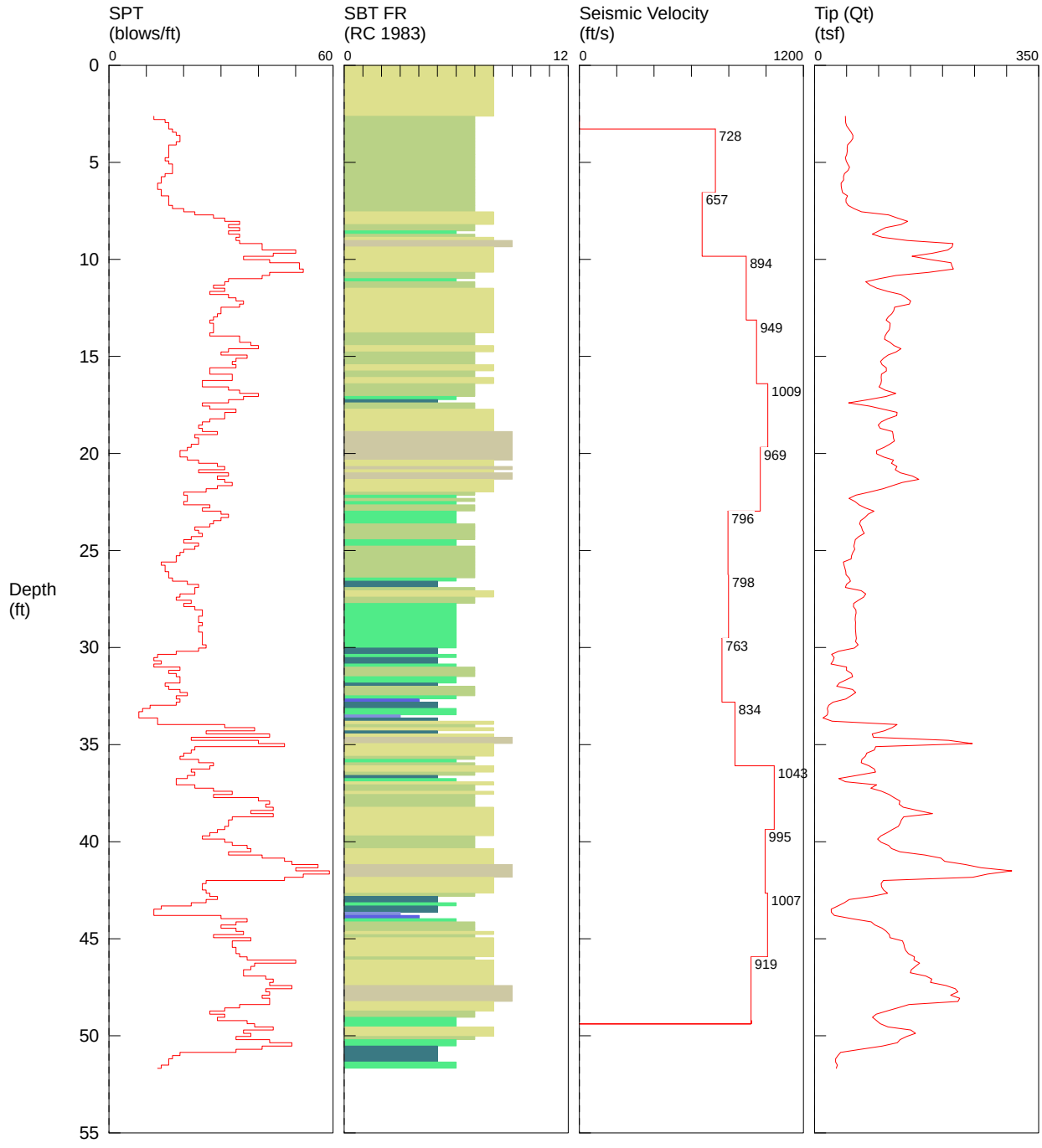
COMMENT: NV5 / CPT-1 / 11357 SW Leveton Drive Tualatin



Hammer to Rod String Distance (ft): 4.27
* = Not Determined

NV5 / CPT-1 / 11357 SW Leveton Drive Tualatin

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-1
TEST DATE: 5/25/2022 10:56:32 AM
TOTAL DEPTH: 51.673 ft

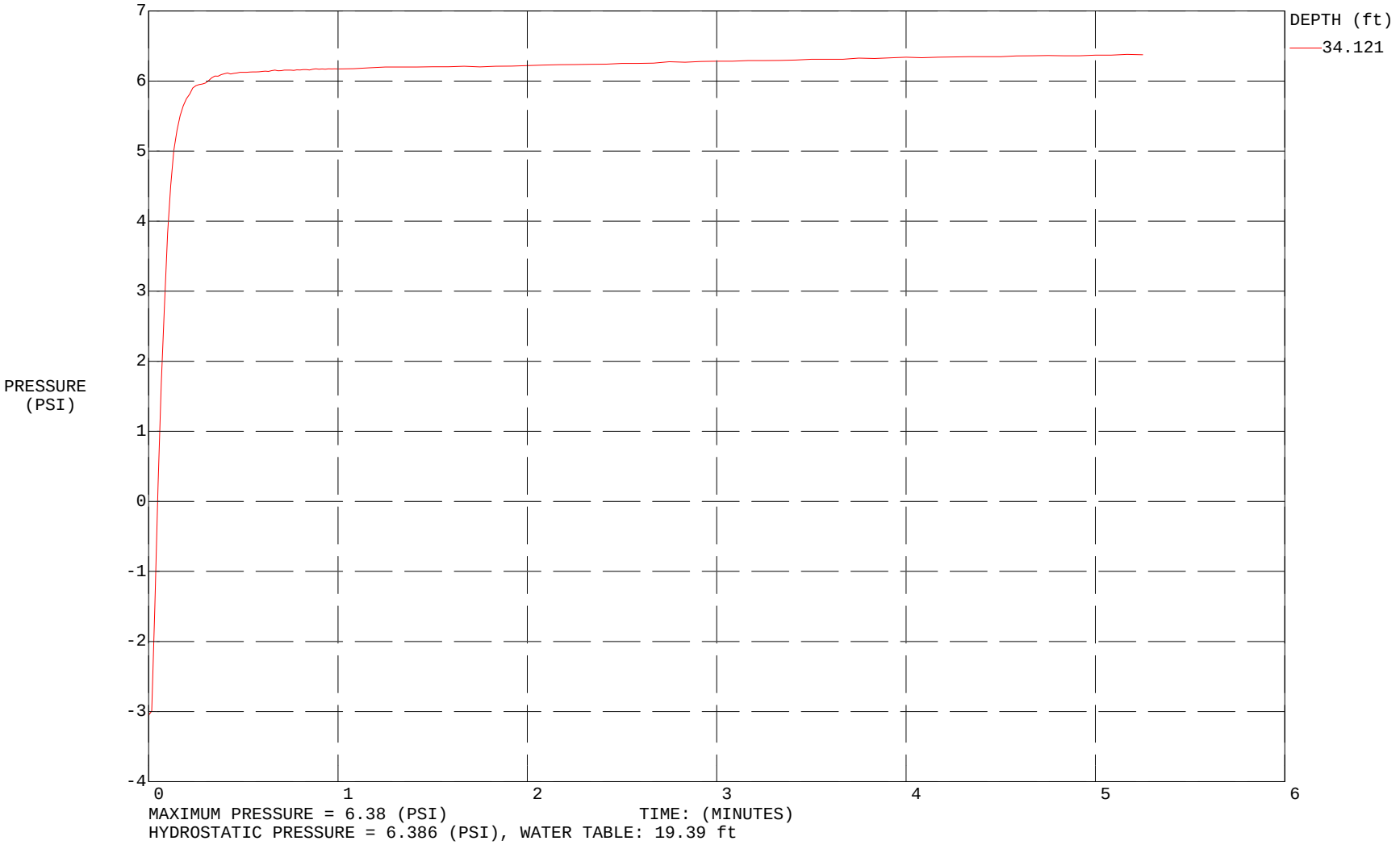


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: NV5 / CPT-1 / 11357 SW Leveton Drive Tualatin

TEST DATE: 5/25/2022 10:56:32 AM



NV5 / CPT-1 / 11357 SW Leveton Drive Tualatin

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-1
TEST DATE: 5/25/2022 10:56:32 AM
TOTAL DEPTH: 51.673 ft

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
2.625	48.18	0.1581	0.328	0.050	12	8	sand to silty sand
2.789	48.29	0.3114	0.645	0.053	15	7	silty sand to sandy silt
2.953	48.59	0.4316	0.888	0.031	16	7	silty sand to sandy silt
3.117	49.92	0.3972	0.796	0.070	16	7	silty sand to sandy silt
3.281	53.50	0.5007	0.936	0.095	17	7	silty sand to sandy silt
3.445	57.07	0.5649	0.990	-0.045	18	7	silty sand to sandy silt
3.609	59.83	0.5634	0.942	-0.014	19	7	silty sand to sandy silt
3.773	59.69	0.5669	0.950	-0.061	19	7	silty sand to sandy silt
3.937	56.11	0.5552	0.989	-0.047	18	7	silty sand to sandy silt
4.101	51.53	0.5325	1.033	-0.045	16	7	silty sand to sandy silt
4.265	50.73	0.5225	1.030	-0.006	16	7	silty sand to sandy silt
4.429	50.98	0.4974	0.976	-0.053	16	7	silty sand to sandy silt
4.593	50.02	0.4716	0.943	-0.070	16	7	silty sand to sandy silt
4.757	48.14	0.4573	0.950	-0.056	15	7	silty sand to sandy silt
4.921	49.44	0.4744	0.959	-0.039	16	7	silty sand to sandy silt
5.085	51.73	0.4733	0.915	0.006	17	7	silty sand to sandy silt
5.249	54.60	0.4407	0.807	0.020	17	7	silty sand to sandy silt
5.413	52.20	0.4145	0.794	0.006	17	7	silty sand to sandy silt
5.577	46.56	0.4069	0.874	-0.003	15	7	silty sand to sandy silt
5.741	45.21	0.3905	0.864	-0.017	14	7	silty sand to sandy silt
5.906	45.38	0.3968	0.875	-0.020	14	7	silty sand to sandy silt
6.070	41.31	0.4184	1.013	0.468	13	7	silty sand to sandy silt
6.234	41.55	0.4505	1.084	0.404	13	7	silty sand to sandy silt
6.398	42.48	0.3144	0.740	0.267	14	7	silty sand to sandy silt
6.562	43.59	0.3504	0.804	0.209	14	7	silty sand to sandy silt
6.726	51.53	0.4395	0.853	-0.011	16	7	silty sand to sandy silt
6.890	48.88	0.4367	0.893	0.064	16	7	silty sand to sandy silt
7.054	49.02	0.4835	0.986	0.075	16	7	silty sand to sandy silt
7.218	52.46	0.5965	1.137	0.017	17	7	silty sand to sandy silt
7.382	61.39	0.8112	1.321	0.006	20	7	silty sand to sandy silt
7.546	73.54	1.1727	1.595	0.056	23	7	silty sand to sandy silt
7.710	115.53	1.4263	1.235	0.092	28	8	sand to silty sand
7.874	129.70	1.6922	1.305	0.064	31	8	sand to silty sand
8.038	145.36	2.0506	1.411	0.212	35	8	sand to silty sand
8.202	134.81	2.0771	1.541	0.170	32	8	sand to silty sand
8.366	110.96	2.1435	1.932	0.070	35	7	silty sand to sandy silt
8.530	100.69	2.2064	2.191	0.070	32	7	silty sand to sandy silt
8.694	90.26	2.3300	2.581	0.167	35	6	sandy silt to clayey silt
8.858	105.55	2.2705	2.151	0.454	34	7	silty sand to sandy silt
9.022	144.80	2.4107	1.665	1.335	35	8	sand to silty sand
9.186	216.11	2.6139	1.210	0.772	41	9	sand
9.350	214.69	2.8134	1.310	0.688	41	9	sand
9.514	207.95	3.0319	1.458	0.710	50	8	sand to silty sand
9.678	184.18	2.6968	1.464	0.624	44	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
9.843	152.06	2.3817	1.566	0.396	36	8	sand to silty sand
10.007	181.47	3.3079	1.823	0.535	43	8	sand to silty sand
10.171	213.08	3.8328	1.799	0.722	51	8	sand to silty sand
10.335	214.39	3.8873	1.813	1.254	51	8	sand to silty sand
10.499	216.86	4.3675	2.014	1.050	52	8	sand to silty sand
10.663	177.86	3.3836	1.902	0.708	43	8	sand to silty sand
10.827	127.27	2.4812	1.950	0.320	41	7	silty sand to sandy silt
10.991	101.13	2.1887	2.164	0.273	32	7	silty sand to sandy silt
11.155	79.92	2.0372	2.549	0.312	31	6	sandy silt to clayey silt
11.319	86.64	1.8356	2.119	0.800	28	7	silty sand to sandy silt
11.483	96.95	1.8295	1.887	0.825	31	7	silty sand to sandy silt
11.647	114.01	1.6714	1.466	0.332	27	8	sand to silty sand
11.811	134.72	1.7105	1.270	0.184	32	8	sand to silty sand
11.975	143.15	1.7717	1.238	0.267	34	8	sand to silty sand
12.139	150.01	1.4768	0.984	0.312	36	8	sand to silty sand
12.303	148.01	1.4287	0.965	0.412	35	8	sand to silty sand
12.467	124.87	1.4188	1.136	0.237	30	8	sand to silty sand
12.631	123.78	1.4925	1.206	0.187	30	8	sand to silty sand
12.795	120.53	1.7455	1.448	0.167	29	8	sand to silty sand
12.959	115.09	1.4191	1.233	0.061	28	8	sand to silty sand
13.123	111.75	1.3685	1.225	0.159	27	8	sand to silty sand
13.287	117.89	1.5139	1.284	-0.089	28	8	sand to silty sand
13.451	117.60	1.6036	1.364	-0.128	28	8	sand to silty sand
13.615	116.78	1.6167	1.384	-0.131	28	8	sand to silty sand
13.780	113.00	1.6381	1.450	-0.164	27	8	sand to silty sand
13.944	110.09	1.7928	1.628	-0.162	35	7	silty sand to sandy silt
14.108	109.18	2.2737	2.083	-0.072	35	7	silty sand to sandy silt
14.272	117.75	2.6660	2.264	-0.251	38	7	silty sand to sandy silt
14.436	123.88	2.6377	2.129	-0.482	40	7	silty sand to sandy silt
14.600	134.94	2.2691	1.682	-0.474	32	8	sand to silty sand
14.764	127.13	2.0489	1.612	-0.031	30	8	sand to silty sand
14.928	114.89	1.8542	1.614	-0.098	37	7	silty sand to sandy silt
15.092	107.86	1.8370	1.703	-0.106	34	7	silty sand to sandy silt
15.256	102.89	1.9264	1.872	-0.031	33	7	silty sand to sandy silt
15.420	105.38	1.9562	1.856	-0.457	34	7	silty sand to sandy silt
15.584	111.98	1.6249	1.451	-0.733	27	8	sand to silty sand
15.748	112.23	1.6209	1.444	-0.371	27	8	sand to silty sand
15.912	104.33	1.6028	1.536	0.173	33	7	silty sand to sandy silt
16.076	103.92	1.6349	1.573	0.184	33	7	silty sand to sandy silt
16.240	104.29	1.3551	1.299	0.050	25	8	sand to silty sand
16.404	103.47	1.3737	1.328	-0.067	25	8	sand to silty sand
16.568	100.66	1.6961	1.685	-0.178	32	7	silty sand to sandy silt
16.732	110.05	2.1745	1.976	-0.159	35	7	silty sand to sandy silt
16.896	126.81	2.3145	1.825	-0.351	40	7	silty sand to sandy silt
17.060	111.60	2.1118	1.892	-0.123	36	7	silty sand to sandy silt
17.224	83.93	2.0413	2.432	-0.206	32	6	sandy silt to clayey silt
17.388	53.11	1.9786	3.725	0.117	25	5	clayey silt to silty clay
17.552	85.56	1.9200	2.244	4.675	27	7	silty sand to sandy silt
17.717	106.91	1.8221	1.704	2.209	34	7	silty sand to sandy silt
17.881	128.98	1.7381	1.348	1.365	31	8	sand to silty sand
18.045	128.26	1.6088	1.254	0.652	31	8	sand to silty sand
18.209	114.11	1.4273	1.251	-0.003	27	8	sand to silty sand
18.373	104.08	1.2816	1.231	-0.340	25	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
18.537	99.21	1.0759	1.084	-0.421	24	8	sand to silty sand
18.701	102.46	0.9791	0.956	-0.379	25	8	sand to silty sand
18.865	121.56	0.9493	0.781	-0.309	29	8	sand to silty sand
19.029	122.59	0.7314	0.597	-0.089	23	9	sand
19.193	122.95	0.7260	0.591	-0.045	24	9	sand
19.357	124.67	0.7201	0.578	0.443	24	9	sand
19.521	117.28	0.4987	0.425	0.237	22	9	sand
19.685	108.53	0.4879	0.450	0.148	21	9	sand
19.849	96.90	0.3779	0.390	-1.223	19	9	sand
20.013	96.83	0.3788	0.391	-0.922	19	9	sand
20.177	107.70	0.4524	0.420	0.008	21	9	sand
20.341	123.17	0.5296	0.430	-0.036	24	9	sand
20.505	119.96	0.9123	0.761	0.011	29	8	sand to silty sand
20.669	128.82	1.0544	0.819	0.109	31	8	sand to silty sand
20.833	125.97	0.7485	0.594	0.496	24	9	sand
20.997	134.06	1.4543	1.085	0.507	32	8	sand to silty sand
21.161	152.67	1.4137	0.926	0.574	29	9	sand
21.325	162.87	1.2170	0.747	0.577	31	9	sand
21.490	137.09	1.2340	0.900	1.011	33	8	sand to silty sand
21.654	121.68	1.0708	0.880	0.866	29	8	sand to silty sand
21.818	106.94	1.1160	1.044	0.736	26	8	sand to silty sand
21.982	85.55	1.1225	1.312	0.797	20	8	sand to silty sand
22.146	64.46	1.1603	1.800	0.607	21	7	silty sand to sandy silt
22.310	53.70	1.1665	2.172	0.644	21	6	sandy silt to clayey silt
22.474	62.94	1.1724	1.863	3.126	20	7	silty sand to sandy silt
22.638	69.48	1.5909	2.290	2.538	27	6	sandy silt to clayey silt
22.802	79.05	1.3378	1.692	1.975	25	7	silty sand to sandy silt
22.966	92.66	2.1184	2.286	0.761	30	7	silty sand to sandy silt
23.130	83.82	2.1871	2.609	-3.363	32	6	sandy silt to clayey silt
23.294	78.52	2.0033	2.551	-4.034	30	6	sandy silt to clayey silt
23.458	71.90	2.1243	2.955	-5.748	28	6	sandy silt to clayey silt
23.622	70.34	1.8801	2.673	-5.723	27	6	sandy silt to clayey silt
23.786	73.07	1.5488	2.119	-5.636	23	7	silty sand to sandy silt
23.950	74.73	1.4883	1.992	-5.725	24	7	silty sand to sandy silt
24.114	77.57	1.5518	2.000	-5.734	25	7	silty sand to sandy silt
24.278	69.16	1.4492	2.095	-5.781	22	7	silty sand to sandy silt
24.442	63.44	1.2575	1.982	-5.901	20	7	silty sand to sandy silt
24.606	62.51	1.3588	2.174	-5.834	24	6	sandy silt to clayey silt
24.770	61.30	1.4946	2.438	-5.831	23	6	sandy silt to clayey silt
24.934	62.68	1.2693	2.025	-5.831	20	7	silty sand to sandy silt
25.098	59.80	1.0339	1.729	-5.890	19	7	silty sand to sandy silt
25.262	57.81	0.6788	1.174	-5.873	18	7	silty sand to sandy silt
25.427	57.11	0.6469	1.133	-5.923	18	7	silty sand to sandy silt
25.591	45.09	0.6187	1.372	-5.483	14	7	silty sand to sandy silt
25.755	45.99	0.5980	1.300	-5.500	15	7	silty sand to sandy silt
25.919	47.41	0.5908	1.246	-5.516	15	7	silty sand to sandy silt
26.083	48.74	0.6002	1.232	-5.525	16	7	silty sand to sandy silt
26.247	49.26	0.7138	1.449	-5.533	16	7	silty sand to sandy silt
26.411	53.93	0.9693	1.797	-3.388	17	7	silty sand to sandy silt
26.575	56.09	1.2550	2.237	-4.277	21	6	sandy silt to clayey silt
26.739	49.72	1.6645	3.348	-4.786	24	5	clayey silt to silty clay
26.903	48.15	1.8866	3.918	-4.959	23	5	clayey silt to silty clay
27.067	72.74	1.4272	1.962	-5.174	23	7	silty sand to sandy silt

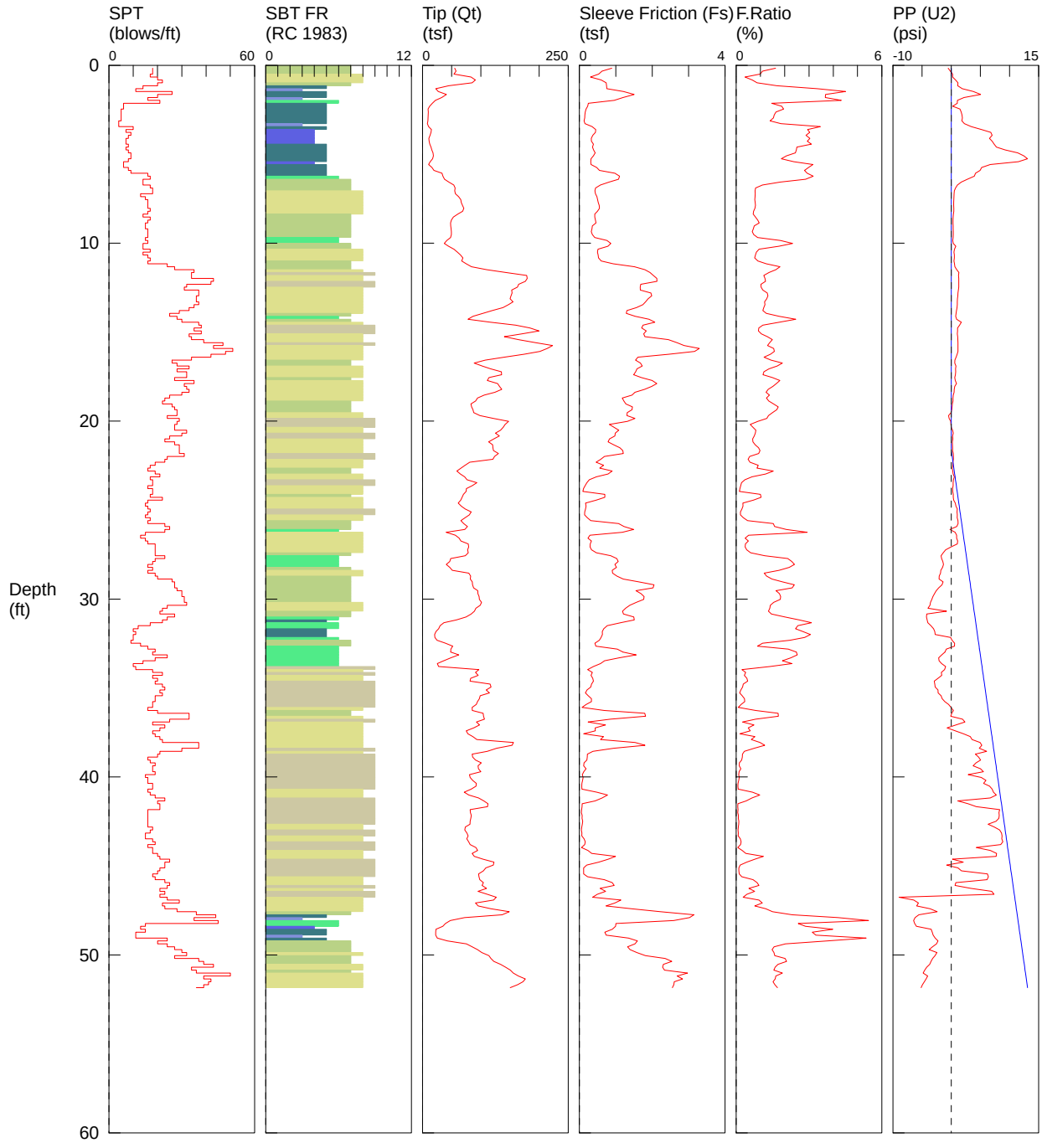
Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
27.231	79.90	0.7221	0.904	-5.600	19	8	sand to silty sand
27.395	76.66	0.7737	1.009	-5.781	18	8	sand to silty sand
27.559	68.62	0.9033	1.316	-5.971	22	7	silty sand to sandy silt
27.723	61.11	1.0945	1.791	-6.004	20	7	silty sand to sandy silt
27.887	60.66	1.3170	2.171	-5.979	23	6	sandy silt to clayey silt
28.051	64.35	1.4048	2.183	-5.912	25	6	sandy silt to clayey silt
28.215	64.73	1.4852	2.294	-5.809	25	6	sandy silt to clayey silt
28.379	63.91	1.5217	2.381	-5.714	24	6	sandy silt to clayey silt
28.543	63.42	1.5411	2.430	-5.611	24	6	sandy silt to clayey silt
28.707	63.99	1.5429	2.411	-5.536	25	6	sandy silt to clayey silt
28.871	63.87	1.5817	2.476	-5.511	24	6	sandy silt to clayey silt
29.035	63.89	1.6123	2.524	-4.491	24	6	sandy silt to clayey silt
29.199	64.24	1.6214	2.524	-4.455	25	6	sandy silt to clayey silt
29.364	64.62	1.5410	2.385	-4.405	25	6	sandy silt to clayey silt
29.528	65.25	1.5087	2.312	-4.268	25	6	sandy silt to clayey silt
29.692	64.00	1.5197	2.375	-1.819	25	6	sandy silt to clayey silt
29.856	67.93	1.6977	2.499	-1.691	26	6	sandy silt to clayey silt
30.020	62.04	1.7570	2.832	-1.491	24	6	sandy silt to clayey silt
30.184	37.47	1.2339	3.293	-1.156	18	5	clayey silt to silty clay
30.348	26.59	0.6905	2.597	1.326	13	5	clayey silt to silty clay
30.512	30.48	0.6748	2.214	3.318	12	6	sandy silt to clayey silt
30.676	28.82	0.8403	2.916	3.764	14	5	clayey silt to silty clay
30.840	25.54	0.7895	3.092	5.224	12	5	clayey silt to silty clay
31.004	49.84	1.1648	2.337	3.998	19	6	sandy silt to clayey silt
31.168	49.70	0.9234	1.858	0.596	16	7	silty sand to sandy silt
31.332	57.73	1.0909	1.890	-0.900	18	7	silty sand to sandy silt
31.496	59.40	1.0501	1.768	-1.588	19	7	silty sand to sandy silt
31.660	49.44	0.9692	1.960	-2.482	19	6	sandy silt to clayey silt
31.824	38.74	1.0535	2.720	-2.455	15	6	sandy silt to clayey silt
31.988	34.38	1.0834	3.151	-2.090	16	5	clayey silt to silty clay
32.152	59.07	1.1337	1.919	4.466	19	7	silty sand to sandy silt
32.316	64.25	1.0573	1.646	3.460	21	7	silty sand to sandy silt
32.480	56.74	1.1266	1.986	1.351	18	7	silty sand to sandy silt
32.644	48.83	1.3894	2.845	0.805	19	6	sandy silt to clayey silt
32.808	28.76	1.0914	3.794	0.841	18	4	silty clay to clay
32.972	22.21	0.5574	2.509	5.968	11	5	clayey silt to silty clay
33.136	19.77	0.4646	2.351	10.384	9	5	clayey silt to silty clay
33.301	20.92	0.4295	2.053	13.772	8	6	sandy silt to clayey silt
33.465	19.75	0.3018	1.528	17.157	8	6	sandy silt to clayey silt
33.629	13.12	0.6988	5.328	22.537	13	3	clay
33.793	27.37	1.0181	3.719	36.275	13	5	clayey silt to silty clay
33.957	128.88	1.9206	1.490	2.655	31	8	sand to silty sand
34.121	121.17	2.2492	1.856	-3.020	39	7	silty sand to sandy silt
34.285	108.82	1.3482	1.239	0.134	26	8	sand to silty sand
34.449	89.94	3.2797	3.647	-4.285	43	5	clayey silt to silty clay
34.613	91.72	1.1320	1.234	-5.260	22	8	sand to silty sand
34.777	209.47	1.6223	0.774	2.641	40	9	sand
34.941	246.31	2.0735	0.842	10.618	47	9	sand
35.105	95.38	0.4779	0.501	1.276	23	8	sand to silty sand
35.269	93.26	0.4745	0.509	-8.626	22	8	sand to silty sand
35.433	81.55	0.6151	0.754	4.207	20	8	sand to silty sand
35.597	79.18	0.8522	1.076	0.008	19	8	sand to silty sand
35.761	73.73	1.5235	2.066	-1.552	24	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
35.925	72.80	1.6970	2.331	-6.837	28	6	sandy silt to clayey silt
36.089	84.89	1.2538	1.477	-8.681	27	7	silty sand to sandy silt
36.253	93.32	0.5455	0.585	-8.723	22	8	sand to silty sand
36.417	95.25	0.5149	0.541	-2.471	23	8	sand to silty sand
36.581	65.56	1.1939	1.821	4.026	21	7	silty sand to sandy silt
36.745	37.78	1.4522	3.844	8.787	18	5	clayey silt to silty clay
36.909	48.16	1.1335	2.353	43.728	18	6	sandy silt to clayey silt
37.073	96.75	1.0413	1.076	3.686	23	8	sand to silty sand
37.238	87.68	1.6833	1.920	0.114	28	7	silty sand to sandy silt
37.402	104.61	2.2241	2.126	-0.783	33	7	silty sand to sandy silt
37.566	116.31	1.8040	1.551	-3.215	28	8	sand to silty sand
37.730	123.96	2.2457	1.812	-4.842	40	7	silty sand to sandy silt
37.894	133.31	2.5149	1.886	-5.664	43	7	silty sand to sandy silt
38.058	132.13	2.4094	1.823	-6.427	42	7	silty sand to sandy silt
38.222	138.44	2.6526	1.916	-6.547	44	7	silty sand to sandy silt
38.386	160.63	2.2735	1.415	-6.625	38	8	sand to silty sand
38.550	184.02	2.2029	1.197	-6.678	44	8	sand to silty sand
38.714	139.16	2.1756	1.563	-5.241	33	8	sand to silty sand
38.878	135.60	2.0857	1.538	-5.324	32	8	sand to silty sand
39.042	133.61	2.2460	1.681	-5.402	32	8	sand to silty sand
39.206	130.67	1.5928	1.219	-5.461	31	8	sand to silty sand
39.370	121.37	1.9375	1.596	-5.550	29	8	sand to silty sand
39.534	113.40	1.4506	1.279	-3.781	27	8	sand to silty sand
39.698	103.63	1.3497	1.302	-5.163	25	8	sand to silty sand
39.862	98.27	1.5395	1.567	-5.458	31	7	silty sand to sandy silt
40.026	104.05	1.8561	1.784	-5.633	33	7	silty sand to sandy silt
40.190	115.45	1.9111	1.655	-5.815	37	7	silty sand to sandy silt
40.354	120.18	2.1060	1.752	-5.962	38	7	silty sand to sandy silt
40.518	133.56	2.2418	1.678	-6.146	32	8	sand to silty sand
40.682	172.34	2.4462	1.419	-6.294	41	8	sand to silty sand
40.846	197.26	2.6014	1.319	-6.951	47	8	sand to silty sand
41.011	203.22	2.6273	1.293	-7.057	49	8	sand to silty sand
41.175	235.35	3.5213	1.496	-5.210	56	8	sand to silty sand
41.339	260.34	3.4033	1.307	-5.394	50	9	sand
41.503	308.10	2.9156	0.946	-5.539	59	9	sand
41.667	270.49	1.2611	0.466	-5.876	52	9	sand
41.831	247.07	1.1697	0.473	-5.990	47	9	sand
41.995	107.36	1.0840	1.010	-5.773	26	8	sand to silty sand
42.159	104.05	0.9883	0.950	-5.834	25	8	sand to silty sand
42.323	104.59	1.1396	1.090	-5.840	25	8	sand to silty sand
42.487	107.63	1.1312	1.051	-5.795	26	8	sand to silty sand
42.651	114.14	1.3811	1.210	-5.742	27	8	sand to silty sand
42.815	89.38	1.9169	2.145	2.580	29	7	silty sand to sandy silt
42.979	54.12	1.9640	3.629	3.614	26	5	clayey silt to silty clay
43.143	46.38	1.6955	3.656	4.413	22	5	clayey silt to silty clay
43.307	36.37	0.8177	2.248	5.723	14	6	sandy silt to clayey silt
43.471	25.85	0.7020	2.716	9.857	12	5	clayey silt to silty clay
43.635	25.98	0.9238	3.556	19.369	12	5	clayey silt to silty clay
43.799	30.94	1.8546	5.993	28.360	30	3	clay
43.963	57.95	2.5586	4.415	24.743	37	4	silty clay to clay
44.127	88.54	2.3150	2.615	-2.273	34	6	sandy silt to clayey silt
44.291	93.97	1.9563	2.082	-5.932	30	7	silty sand to sandy silt
44.455	105.43	1.7571	1.667	-7.302	34	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
44.619	112.20	1.7912	1.596	-8.623	36	7	silty sand to sandy silt
44.783	116.75	1.8353	1.572	-9.032	28	8	sand to silty sand
44.948	117.71	1.9279	1.638	-9.166	38	7	silty sand to sandy silt
45.112	137.34	1.9749	1.438	-8.570	33	8	sand to silty sand
45.276	139.34	2.0709	1.486	-8.615	33	8	sand to silty sand
45.440	140.47	2.1549	1.534	-8.642	34	8	sand to silty sand
45.604	142.17	2.2649	1.593	-8.715	34	8	sand to silty sand
45.768	146.53	2.2586	1.541	-8.787	35	8	sand to silty sand
45.932	155.73	2.7586	1.771	-8.879	37	8	sand to silty sand
46.096	155.08	2.9630	1.911	-6.102	50	7	silty sand to sandy silt
46.260	163.94	3.0154	1.839	-8.642	39	8	sand to silty sand
46.424	157.58	2.5291	1.605	-10.453	38	8	sand to silty sand
46.588	151.15	2.2791	1.508	-10.604	36	8	sand to silty sand
46.752	149.54	2.4050	1.608	-10.665	36	8	sand to silty sand
46.916	173.68	2.4614	1.417	-10.671	42	8	sand to silty sand
47.080	183.21	2.4483	1.336	-10.545	44	8	sand to silty sand
47.244	181.02	2.9451	1.627	-10.593	43	8	sand to silty sand
47.408	205.06	3.1749	1.548	-10.568	49	8	sand to silty sand
47.572	219.73	2.8153	1.281	-10.470	42	9	sand
47.736	224.06	2.5262	1.127	-10.492	43	9	sand
47.900	212.33	2.5014	1.178	-10.348	41	9	sand
48.064	226.60	1.7230	0.760	-10.328	43	9	sand
48.228	223.77	1.5844	0.708	-10.414	43	9	sand
48.392	147.19	1.5689	1.066	-9.913	35	8	sand to silty sand
48.556	129.69	1.5567	1.200	-9.891	31	8	sand to silty sand
48.720	113.12	1.6353	1.446	-9.866	27	8	sand to silty sand
48.885	96.13	1.9158	1.993	-9.946	31	7	silty sand to sandy silt
49.049	90.38	2.0046	2.218	-9.882	29	7	silty sand to sandy silt
49.213	96.88	2.4593	2.538	-9.704	37	6	sandy silt to clayey silt
49.377	102.67	2.9050	2.829	-5.826	39	6	sandy silt to clayey silt
49.541	114.58	3.0703	2.680	-9.657	44	6	sandy silt to clayey silt
49.705	150.24	2.6807	1.784	-10.253	36	8	sand to silty sand
49.869	157.56	2.2637	1.437	-10.367	38	8	sand to silty sand
50.033	144.01	2.2455	1.559	-10.375	34	8	sand to silty sand
50.197	133.54	2.8754	2.153	-10.434	43	7	silty sand to sandy silt
50.361	129.17	3.9855	3.086	-10.517	49	6	sandy silt to clayey silt
50.525	105.81	3.8151	3.606	-10.598	41	6	sandy silt to clayey silt
50.689	71.88	2.7983	3.893	-10.629	34	5	clayey silt to silty clay
50.853	40.69	1.5715	3.862	-10.712	19	5	clayey silt to silty clay
51.017	36.33	1.3024	3.584	-10.699	17	5	clayey silt to silty clay
51.181	32.76	1.1034	3.368	-10.573	16	5	clayey silt to silty clay
51.345	32.80	1.0392	3.168	-10.473	16	5	clayey silt to silty clay
51.509	35.56	1.0103	2.841	-10.392	14	6	sandy silt to clayey silt
51.673	33.78	0.9503	2.813	-10.325	13	6	sandy silt to clayey silt

NV5 / CPT-2 / 11357 SW Leveton Drive Tualatin

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-2
TEST DATE: 5/25/2022 8:28:59 AM
TOTAL DEPTH: 51.837 ft

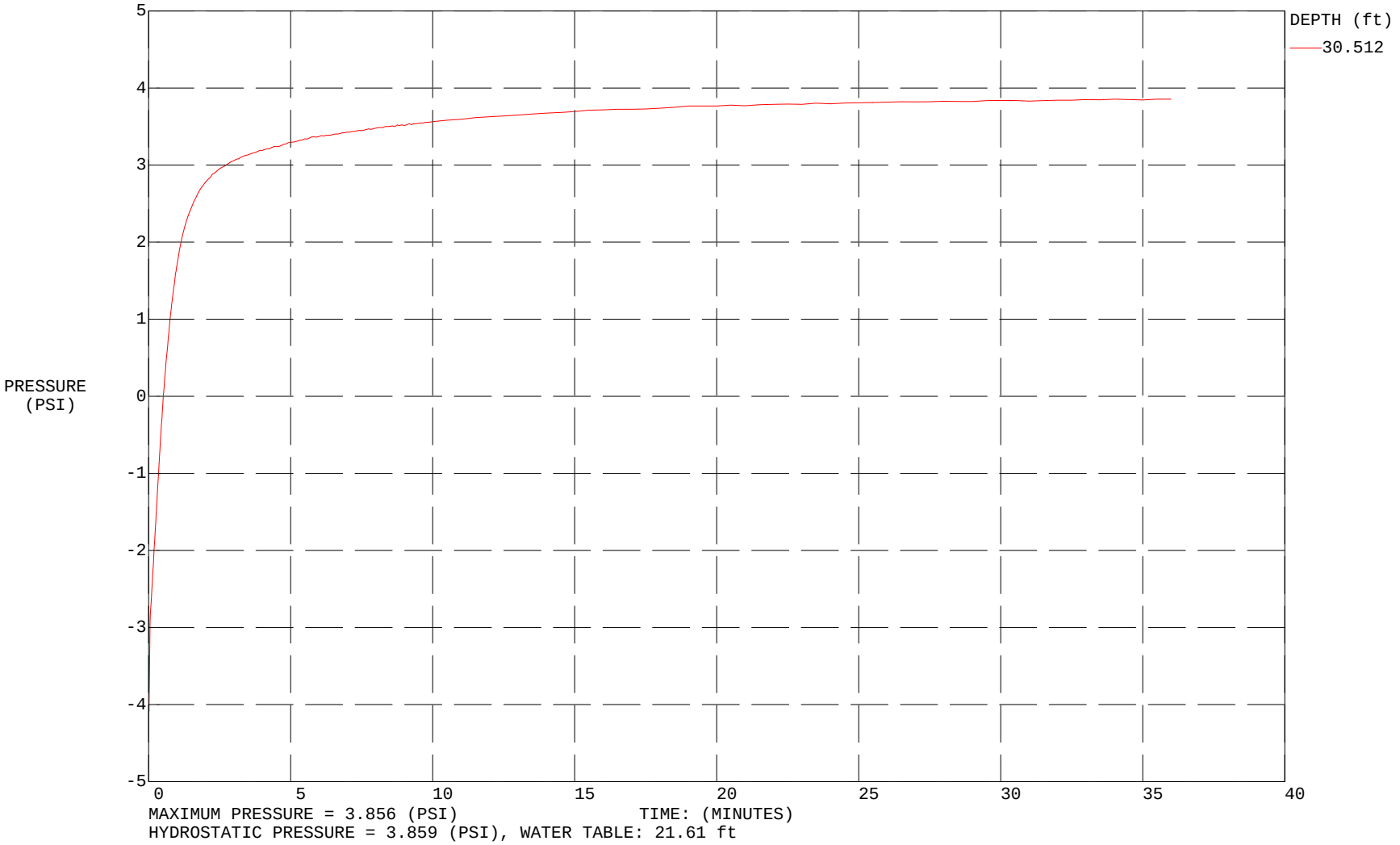


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: NV5 / CPT-2 / 11357 SW Leveton Drive Tualatin

TEST DATE: 5/25/2022 8:28:59 AM



NV5 / CPT-2 / 11357 SW Leveton Drive Tualatin

OPERATOR: OGE BAK
CONE ID: DDG1296
HOLE NUMBER: CPT-2
TEST DATE: 5/25/2022 8:28:59 AM
TOTAL DEPTH: 51.837 ft

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
0.164	55.00	0.8905	1.619	-0.538	18	7	silty sand to sandy silt
0.328	57.29	0.6209	1.084	-0.164	18	7	silty sand to sandy silt
0.492	53.74	0.5283	0.983	0.215	17	7	silty sand to sandy silt
0.656	83.27	0.3044	0.366	0.231	20	8	sand to silty sand
0.820	90.45	0.5991	0.662	0.730	22	8	sand to silty sand
0.984	85.21	0.7346	0.862	1.145	20	8	sand to silty sand
1.148	44.63	0.7469	1.673	1.109	14	7	silty sand to sandy silt
1.312	22.60	0.7540	3.337	1.883	11	5	clayey silt to silty clay
1.476	26.85	1.2101	4.507	3.811	26	3	clay
1.640	40.81	1.5016	3.679	5.040	20	5	clayey silt to silty clay
1.804	32.71	1.1993	3.666	2.182	16	5	clayey silt to silty clay
1.969	22.10	0.9561	4.327	1.059	21	3	clay
2.133	16.77	0.2451	1.462	1.039	6	6	sandy silt to clayey silt
2.297	12.16	0.2276	1.871	0.259	6	5	clayey silt to silty clay
2.461	9.40	0.1835	1.952	1.502	5	5	clayey silt to silty clay
2.625	9.79	0.1606	1.640	1.691	5	5	clayey silt to silty clay
2.789	9.61	0.1502	1.563	1.836	5	5	clayey silt to silty clay
2.953	9.41	0.1440	1.530	1.897	5	5	clayey silt to silty clay
3.117	9.29	0.1295	1.394	1.814	4	5	clayey silt to silty clay
3.281	8.31	0.1531	1.841	2.251	4	5	clayey silt to silty clay
3.445	10.12	0.3507	3.466	3.424	10	3	clay
3.609	15.22	0.4474	2.940	5.199	7	5	clayey silt to silty clay
3.773	14.46	0.4375	3.026	6.770	9	4	silty clay to clay
3.937	12.81	0.3683	2.875	7.026	8	4	silty clay to clay
4.101	10.71	0.3250	3.035	6.550	7	4	silty clay to clay
4.265	11.17	0.3275	2.931	7.032	7	4	silty clay to clay
4.429	12.33	0.3819	3.096	7.352	8	4	silty clay to clay
4.593	14.30	0.3577	2.501	7.759	7	5	clayey silt to silty clay
4.757	15.78	0.3905	2.474	9.244	8	5	clayey silt to silty clay
4.921	17.77	0.4337	2.441	11.420	9	5	clayey silt to silty clay
5.085	18.64	0.3868	2.075	12.457	9	5	clayey silt to silty clay
5.249	17.22	0.3197	1.857	13.086	8	5	clayey silt to silty clay
5.413	13.07	0.3101	2.373	11.526	6	5	clayey silt to silty clay
5.577	10.07	0.3185	3.162	6.701	6	4	silty clay to clay
5.741	15.83	0.4713	2.978	5.227	8	5	clayey silt to silty clay
5.906	19.62	0.5517	2.812	4.956	9	5	clayey silt to silty clay
6.070	33.29	0.9739	2.926	4.165	16	5	clayey silt to silty clay
6.234	34.80	1.1041	3.172	3.965	17	5	clayey silt to silty clay
6.398	37.59	1.0734	2.855	2.753	14	6	sandy silt to clayey silt
6.562	45.09	0.8169	1.812	1.730	14	7	silty sand to sandy silt
6.726	53.46	0.5781	1.081	1.067	17	7	silty sand to sandy silt
6.890	55.87	0.4454	0.797	0.733	18	7	silty sand to sandy silt
7.054	55.09	0.4272	0.775	0.518	18	7	silty sand to sandy silt
7.218	56.35	0.4417	0.784	0.493	13	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
7.382	61.74	0.4801	0.778	0.449	15	8	sand to silty sand
7.546	65.61	0.5014	0.764	0.432	16	8	sand to silty sand
7.710	66.34	0.5195	0.783	0.418	16	8	sand to silty sand
7.874	68.50	0.5428	0.792	0.418	16	8	sand to silty sand
8.038	70.81	0.5481	0.774	0.432	17	8	sand to silty sand
8.202	68.72	0.4930	0.717	0.429	16	8	sand to silty sand
8.366	60.42	0.4233	0.700	0.371	14	8	sand to silty sand
8.530	52.87	0.4189	0.792	0.312	17	7	silty sand to sandy silt
8.694	49.42	0.4393	0.889	0.298	16	7	silty sand to sandy silt
8.858	47.98	0.4547	0.948	0.301	15	7	silty sand to sandy silt
9.022	48.34	0.3570	0.739	0.315	15	7	silty sand to sandy silt
9.186	48.86	0.3447	0.705	0.318	16	7	silty sand to sandy silt
9.350	49.47	0.3266	0.660	0.345	16	7	silty sand to sandy silt
9.514	49.53	0.3569	0.721	0.332	16	7	silty sand to sandy silt
9.678	47.90	0.4231	0.883	0.323	15	7	silty sand to sandy silt
9.843	41.61	0.7567	1.818	0.265	16	6	sandy silt to clayey silt
10.007	37.12	0.8621	2.323	0.354	14	6	sandy silt to clayey silt
10.171	44.57	0.7830	1.757	0.766	14	7	silty sand to sandy silt
10.335	53.77	0.5079	0.945	0.543	17	7	silty sand to sandy silt
10.499	59.75	0.4976	0.833	0.462	14	8	sand to silty sand
10.663	65.07	0.5146	0.791	0.521	16	8	sand to silty sand
10.827	69.29	0.5249	0.758	0.524	17	8	sand to silty sand
10.991	67.02	0.5983	0.893	0.476	16	8	sand to silty sand
11.155	75.01	0.9288	1.238	0.535	24	7	silty sand to sandy silt
11.319	83.83	1.5121	1.804	0.613	27	7	silty sand to sandy silt
11.483	110.00	1.7986	1.635	0.942	35	7	silty sand to sandy silt
11.647	143.06	1.9385	1.355	1.318	34	8	sand to silty sand
11.811	178.75	2.0298	1.136	1.243	34	9	sand
11.975	179.61	2.1255	1.183	1.284	43	8	sand to silty sand
12.139	176.29	2.1274	1.207	1.296	42	8	sand to silty sand
12.303	164.79	1.6850	1.023	1.301	32	9	sand
12.467	162.75	1.6678	1.025	1.287	31	9	sand
12.631	152.87	1.6736	1.095	1.218	37	8	sand to silty sand
12.795	153.50	1.9646	1.280	1.148	37	8	sand to silty sand
12.959	151.93	1.9840	1.306	1.128	36	8	sand to silty sand
13.123	150.08	1.8871	1.257	1.064	36	8	sand to silty sand
13.287	155.31	1.8154	1.169	1.045	37	8	sand to silty sand
13.451	147.49	1.7435	1.182	1.039	35	8	sand to silty sand
13.615	137.87	1.5669	1.137	0.989	33	8	sand to silty sand
13.780	119.41	1.3061	1.094	0.892	29	8	sand to silty sand
13.944	103.57	1.2886	1.244	0.830	25	8	sand to silty sand
14.108	86.47	1.5329	1.773	0.752	28	7	silty sand to sandy silt
14.272	77.89	1.9151	2.459	0.928	30	6	sandy silt to clayey silt
14.436	116.41	2.0692	1.778	1.708	37	7	silty sand to sandy silt
14.600	159.77	1.7470	1.093	1.432	38	8	sand to silty sand
14.764	184.26	1.7124	0.929	1.084	35	9	sand
14.928	199.80	1.8339	0.918	1.081	38	9	sand
15.092	170.39	1.7624	1.034	1.022	33	9	sand
15.256	140.17	1.7977	1.283	1.095	34	8	sand to silty sand
15.420	164.40	2.4427	1.486	1.112	39	8	sand to silty sand
15.584	194.48	2.6797	1.378	1.151	47	8	sand to silty sand
15.748	223.10	2.8737	1.288	1.167	43	9	sand
15.912	213.78	3.2920	1.540	1.165	51	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
16.076	201.59	3.1651	1.570	1.145	48	8	sand to silty sand
16.240	174.31	2.4603	1.411	1.009	42	8	sand to silty sand
16.404	140.41	1.6069	1.144	0.830	34	8	sand to silty sand
16.568	107.62	1.5406	1.432	0.619	26	8	sand to silty sand
16.732	88.36	1.6791	1.900	0.605	28	7	silty sand to sandy silt
16.896	102.11	1.7247	1.689	0.797	33	7	silty sand to sandy silt
17.060	116.75	1.5797	1.353	0.727	28	8	sand to silty sand
17.224	135.23	1.5432	1.141	0.749	32	8	sand to silty sand
17.388	135.65	1.4908	1.099	0.708	32	8	sand to silty sand
17.552	114.11	1.6980	1.488	0.599	27	8	sand to silty sand
17.717	111.06	1.9970	1.798	0.688	35	7	silty sand to sandy silt
17.881	128.70	2.1246	1.651	0.883	31	8	sand to silty sand
18.045	131.81	1.9882	1.508	0.599	32	8	sand to silty sand
18.209	136.01	1.7907	1.317	0.504	33	8	sand to silty sand
18.373	124.18	1.5263	1.229	0.485	30	8	sand to silty sand
18.537	105.56	1.4446	1.369	0.343	25	8	sand to silty sand
18.701	94.39	1.1754	1.245	0.301	23	8	sand to silty sand
18.865	91.13	1.2197	1.338	0.298	22	8	sand to silty sand
19.029	83.01	1.2755	1.537	0.187	26	7	silty sand to sandy silt
19.193	84.17	1.4559	1.730	0.139	27	7	silty sand to sandy silt
19.357	86.42	1.4443	1.671	0.078	28	7	silty sand to sandy silt
19.521	87.74	1.3118	1.495	-0.050	28	7	silty sand to sandy silt
19.685	98.31	1.3054	1.328	-0.451	24	8	sand to silty sand
19.849	121.43	1.5281	1.258	-0.368	29	8	sand to silty sand
20.013	147.59	1.3186	0.893	-0.098	28	9	sand
20.177	141.66	0.8207	0.579	-0.078	27	9	sand
20.341	138.43	0.9488	0.685	-0.017	27	9	sand
20.505	133.79	1.0805	0.808	0.226	32	8	sand to silty sand
20.669	124.99	0.9836	0.787	0.357	30	8	sand to silty sand
20.833	131.66	0.9755	0.741	0.228	25	9	sand
20.997	122.40	0.8275	0.676	0.276	23	9	sand
21.161	113.27	0.7842	0.692	0.178	27	8	sand to silty sand
21.325	120.30	0.9426	0.784	0.198	29	8	sand to silty sand
21.490	120.78	1.1092	0.918	0.240	29	8	sand to silty sand
21.654	121.58	1.1891	0.978	0.226	29	8	sand to silty sand
21.818	130.11	1.2053	0.926	0.362	31	8	sand to silty sand
21.982	123.42	0.6864	0.556	0.379	24	9	sand
22.146	120.52	0.5878	0.488	0.376	23	9	sand
22.310	80.88	0.4569	0.565	0.281	19	8	sand to silty sand
22.474	72.77	0.6642	0.913	0.270	17	8	sand to silty sand
22.638	65.88	0.5597	0.850	0.167	16	8	sand to silty sand
22.802	58.86	0.8999	1.529	0.251	19	7	silty sand to sandy silt
22.966	64.87	0.7853	1.211	0.320	21	7	silty sand to sandy silt
23.130	72.02	0.4673	0.649	0.529	17	8	sand to silty sand
23.294	76.27	0.2690	0.353	0.376	18	8	sand to silty sand
23.458	92.93	0.2063	0.222	0.309	18	9	sand
23.622	85.28	0.1553	0.182	0.318	16	9	sand
23.786	75.14	0.1137	0.151	0.231	18	8	sand to silty sand
23.950	74.65	0.0954	0.128	0.254	18	8	sand to silty sand
24.114	69.99	0.6979	0.997	0.334	17	8	sand to silty sand
24.278	67.67	0.6955	1.028	0.326	22	7	silty sand to sandy silt
24.442	65.39	0.4632	0.708	0.401	16	8	sand to silty sand
24.606	61.15	0.1674	0.274	0.683	15	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
24.770	66.35	0.1848	0.279	0.819	16	8	sand to silty sand
24.934	72.95	0.1701	0.233	1.042	17	8	sand to silty sand
25.098	83.37	0.1461	0.175	0.989	16	9	sand
25.262	80.09	0.1402	0.175	1.045	15	9	sand
25.427	73.09	0.2133	0.292	1.009	17	8	sand to silty sand
25.591	65.79	0.3097	0.471	1.131	16	8	sand to silty sand
25.755	70.58	1.0777	1.527	1.179	23	7	silty sand to sandy silt
25.919	77.14	1.2226	1.585	0.947	25	7	silty sand to sandy silt
26.083	72.18	1.4871	2.060	-0.220	23	7	silty sand to sandy silt
26.247	40.40	1.1802	2.921	0.666	15	6	sandy silt to clayey silt
26.411	56.22	0.2881	0.512	0.928	13	8	sand to silty sand
26.575	62.73	0.2316	0.369	0.905	15	8	sand to silty sand
26.739	65.73	0.3300	0.502	1.095	16	8	sand to silty sand
26.903	78.38	0.2971	0.379	1.042	19	8	sand to silty sand
27.067	78.95	0.2903	0.368	-0.075	19	8	sand to silty sand
27.231	77.29	0.3356	0.434	-0.970	19	8	sand to silty sand
27.395	78.44	0.4652	0.593	-1.379	19	8	sand to silty sand
27.559	73.30	0.8597	1.173	-1.755	23	7	silty sand to sandy silt
27.723	48.40	1.0257	2.119	-1.666	19	6	sandy silt to clayey silt
27.887	46.49	1.0661	2.293	-1.457	18	6	sandy silt to clayey silt
28.051	40.65	0.9757	2.400	-1.332	16	6	sandy silt to clayey silt
28.215	46.62	1.0181	2.184	-1.479	18	6	sandy silt to clayey silt
28.379	50.97	0.8991	1.764	-1.800	16	7	silty sand to sandy silt
28.543	79.12	0.9097	1.150	-1.833	19	8	sand to silty sand
28.707	82.37	1.0295	1.250	-2.064	20	8	sand to silty sand
28.871	81.78	1.2039	1.472	-2.106	26	7	silty sand to sandy silt
29.035	85.36	1.6274	1.906	-1.410	27	7	silty sand to sandy silt
29.199	85.71	2.0494	2.391	-1.574	27	7	silty sand to sandy silt
29.364	87.65	2.0221	2.307	-2.151	28	7	silty sand to sandy silt
29.528	94.77	1.5525	1.638	-2.583	30	7	silty sand to sandy silt
29.692	94.81	1.6895	1.782	-2.886	30	7	silty sand to sandy silt
29.856	96.95	1.7776	1.833	-3.159	31	7	silty sand to sandy silt
30.020	97.35	1.7643	1.812	-3.329	31	7	silty sand to sandy silt
30.184	101.29	1.5598	1.540	-3.561	32	7	silty sand to sandy silt
30.348	98.71	1.3843	1.402	-3.661	24	8	sand to silty sand
30.512	91.38	1.2673	1.387	-4.004	22	8	sand to silty sand
30.676	88.89	1.1834	1.331	-0.788	21	8	sand to silty sand
30.840	83.41	1.2092	1.450	-4.204	27	7	silty sand to sandy silt
31.004	74.50	1.4925	2.003	-4.268	24	7	silty sand to sandy silt
31.168	58.10	1.5055	2.591	-4.135	22	6	sandy silt to clayey silt
31.332	36.45	1.1312	3.103	-4.031	17	5	clayey silt to silty clay
31.496	30.08	0.7632	2.537	-3.499	12	6	sandy silt to clayey silt
31.660	27.39	0.6689	2.442	-3.034	10	6	sandy silt to clayey silt
31.824	22.93	0.6296	2.745	-2.833	11	5	clayey silt to silty clay
31.988	20.71	0.6332	3.057	-2.758	10	5	clayey silt to silty clay
32.152	21.08	0.5941	2.819	-0.109	10	5	clayey silt to silty clay
32.316	24.68	0.5466	2.215	0.137	9	6	sandy silt to clayey silt
32.480	39.30	0.4267	1.086	0.563	13	7	silty sand to sandy silt
32.644	51.60	0.4512	0.874	0.543	16	7	silty sand to sandy silt
32.808	48.43	1.0390	2.145	-0.858	19	6	sandy silt to clayey silt
32.972	48.28	1.1951	2.475	-1.089	18	6	sandy silt to clayey silt
33.136	61.83	1.5574	2.519	-1.635	24	6	sandy silt to clayey silt
33.301	48.48	1.0910	2.250	-2.165	19	6	sandy silt to clayey silt

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
33.465	36.22	0.6907	1.907	-2.092	14	6	sandy silt to clayey silt
33.629	25.29	0.5809	2.297	-1.658	10	6	sandy silt to clayey silt
33.793	27.64	0.3841	1.390	-0.978	11	6	sandy silt to clayey silt
33.957	96.59	0.2282	0.236	-1.151	18	9	sand
34.121	90.60	0.3552	0.392	-1.702	22	8	sand to silty sand
34.285	95.21	0.3180	0.334	-1.633	18	9	sand
34.449	82.52	0.3638	0.441	-2.268	20	8	sand to silty sand
34.613	81.34	0.3844	0.473	-2.917	19	8	sand to silty sand
34.777	115.82	0.3337	0.288	-2.839	22	9	sand
34.941	117.52	0.3103	0.264	-2.778	23	9	sand
35.105	109.20	0.2095	0.192	-2.271	21	9	sand
35.269	114.68	0.1635	0.143	-2.262	22	9	sand
35.433	98.90	0.2425	0.245	-1.764	19	9	sand
35.597	97.45	0.3317	0.340	-1.560	19	9	sand
35.761	94.32	0.3306	0.351	-1.112	18	9	sand
35.925	92.22	0.1870	0.203	-0.454	18	9	sand
36.089	84.98	0.0733	0.086	-0.053	16	9	sand
36.253	85.37	0.6801	0.797	0.368	20	8	sand to silty sand
36.417	104.00	1.7947	1.726	0.081	33	7	silty sand to sandy silt
36.581	104.67	1.8168	1.736	-0.089	33	7	silty sand to sandy silt
36.745	106.14	0.8497	0.801	1.920	25	8	sand to silty sand
36.909	92.33	0.2403	0.260	2.351	18	9	sand
37.073	97.87	0.7145	0.730	0.786	23	8	sand to silty sand
37.238	87.88	0.4338	0.494	-0.722	21	8	sand to silty sand
37.402	74.96	0.4354	0.581	0.683	18	8	sand to silty sand
37.566	77.64	0.1169	0.151	2.098	19	8	sand to silty sand
37.730	86.06	0.6609	0.768	3.260	21	8	sand to silty sand
37.894	93.13	0.5788	0.621	3.580	22	8	sand to silty sand
38.058	155.80	1.5300	0.982	4.931	37	8	sand to silty sand
38.222	153.49	1.8011	1.173	5.249	37	8	sand to silty sand
38.386	127.17	0.9434	0.742	4.800	30	8	sand to silty sand
38.550	110.94	0.3709	0.334	6.071	21	9	sand
38.714	84.85	0.2176	0.256	4.143	20	8	sand to silty sand
38.878	85.95	0.2156	0.251	4.678	16	9	sand
39.042	90.69	0.2057	0.227	5.037	17	9	sand
39.206	100.63	0.1293	0.128	4.265	19	9	sand
39.370	95.18	0.1167	0.123	3.753	18	9	sand
39.534	95.90	0.1810	0.189	5.007	18	9	sand
39.698	99.91	0.1201	0.120	5.514	19	9	sand
39.862	80.30	0.0806	0.100	2.911	15	9	sand
40.026	81.42	0.1022	0.125	5.151	16	9	sand
40.190	85.90	0.0873	0.102	5.957	16	9	sand
40.354	92.19	0.0684	0.074	5.542	18	9	sand
40.518	91.66	0.0649	0.071	6.584	18	9	sand
40.682	83.33	0.0672	0.081	7.018	16	9	sand
40.846	71.50	0.4788	0.670	7.227	17	8	sand to silty sand
41.011	79.22	0.7697	0.972	7.729	19	8	sand to silty sand
41.175	96.11	0.6221	0.647	6.689	23	8	sand to silty sand
41.339	104.97	0.4338	0.413	1.123	20	9	sand
41.503	112.08	0.0778	0.069	2.875	21	9	sand
41.667	111.31	0.0711	0.064	4.302	21	9	sand
41.831	81.53	0.0618	0.076	8.300	16	9	sand
41.995	82.10	0.0546	0.067	8.191	16	9	sand

Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
42.159	83.61	0.0758	0.091	8.225	16	9	sand
42.323	82.81	0.0722	0.087	8.155	16	9	sand
42.487	81.42	0.0916	0.112	7.670	16	9	sand
42.651	81.22	0.0806	0.099	6.338	16	9	sand
42.815	73.20	0.0640	0.087	7.389	18	8	sand to silty sand
42.979	72.23	0.0531	0.074	8.308	17	8	sand to silty sand
43.143	76.05	0.0676	0.089	8.642	15	9	sand
43.307	78.15	0.0652	0.083	8.706	15	9	sand
43.471	75.89	0.1277	0.168	8.673	18	8	sand to silty sand
43.635	79.07	0.1609	0.203	8.863	19	8	sand to silty sand
43.799	81.54	0.1466	0.180	8.481	16	9	sand
43.963	91.46	0.0572	0.062	4.293	18	9	sand
44.127	94.61	0.2335	0.247	6.717	18	9	sand
44.291	85.13	0.3365	0.395	7.770	20	8	sand to silty sand
44.455	88.84	0.9939	1.119	7.690	21	8	sand to silty sand
44.619	103.69	0.7948	0.766	0.203	25	8	sand to silty sand
44.783	122.42	0.5293	0.432	2.051	23	9	sand
44.948	121.30	0.1997	0.165	-0.783	23	9	sand
45.112	108.42	0.1153	0.106	1.167	21	9	sand
45.276	104.24	0.1166	0.112	1.758	20	9	sand
45.440	96.00	0.1179	0.123	6.213	18	9	sand
45.604	96.90	0.2236	0.231	6.366	19	9	sand
45.768	98.10	0.6828	0.696	6.143	23	8	sand to silty sand
45.932	104.31	0.8999	0.863	0.777	25	8	sand to silty sand
46.096	102.05	0.9577	0.938	0.649	24	8	sand to silty sand
46.260	109.71	0.5688	0.518	3.382	21	9	sand
46.424	95.11	0.7209	0.758	6.946	23	8	sand to silty sand
46.588	110.91	0.4905	0.442	7.339	21	9	sand
46.752	126.47	0.3616	0.286	-8.971	24	9	sand
46.916	121.81	1.1424	0.938	-6.447	29	8	sand to silty sand
47.080	90.66	0.9739	1.074	-5.647	22	8	sand to silty sand
47.244	95.44	0.7299	0.765	-5.934	23	8	sand to silty sand
47.408	117.25	1.4283	1.218	-3.636	28	8	sand to silty sand
47.572	148.74	2.2271	1.497	-2.404	36	8	sand to silty sand
47.736	136.42	3.1428	2.304	-5.575	44	7	silty sand to sandy silt
47.900	72.16	3.0241	4.191	-6.224	35	5	clayey silt to silty clay
48.064	47.49	2.5903	5.455	-6.464	45	3	clay
48.228	39.31	1.0044	2.555	-6.274	15	6	sandy silt to clayey silt
48.392	34.71	0.9902	2.853	-5.998	13	6	sandy silt to clayey silt
48.556	22.75	0.9056	3.980	-3.452	15	4	silty clay to clay
48.720	22.37	0.7005	3.132	-3.262	11	5	clayey silt to silty clay
48.885	22.37	0.7338	3.281	-3.093	11	5	clayey silt to silty clay
49.049	25.23	1.3511	5.355	-2.747	24	3	clay
49.213	42.35	1.5927	3.761	-2.265	20	5	clayey silt to silty clay
49.377	75.22	1.5256	2.028	-2.538	24	7	silty sand to sandy silt
49.541	84.96	1.3257	1.560	-3.240	27	7	silty sand to sandy silt
49.705	94.07	1.3901	1.478	-3.783	30	7	silty sand to sandy silt
49.869	101.58	1.5775	1.553	-2.471	32	7	silty sand to sandy silt
50.033	113.97	1.8116	1.590	-2.783	27	8	sand to silty sand
50.197	117.06	2.3552	2.012	-3.201	37	7	silty sand to sandy silt
50.361	122.40	2.5409	2.076	-3.485	39	7	silty sand to sandy silt
50.525	133.81	2.3056	1.723	-3.719	43	7	silty sand to sandy silt
50.689	142.30	2.2855	1.606	-4.218	34	8	sand to silty sand

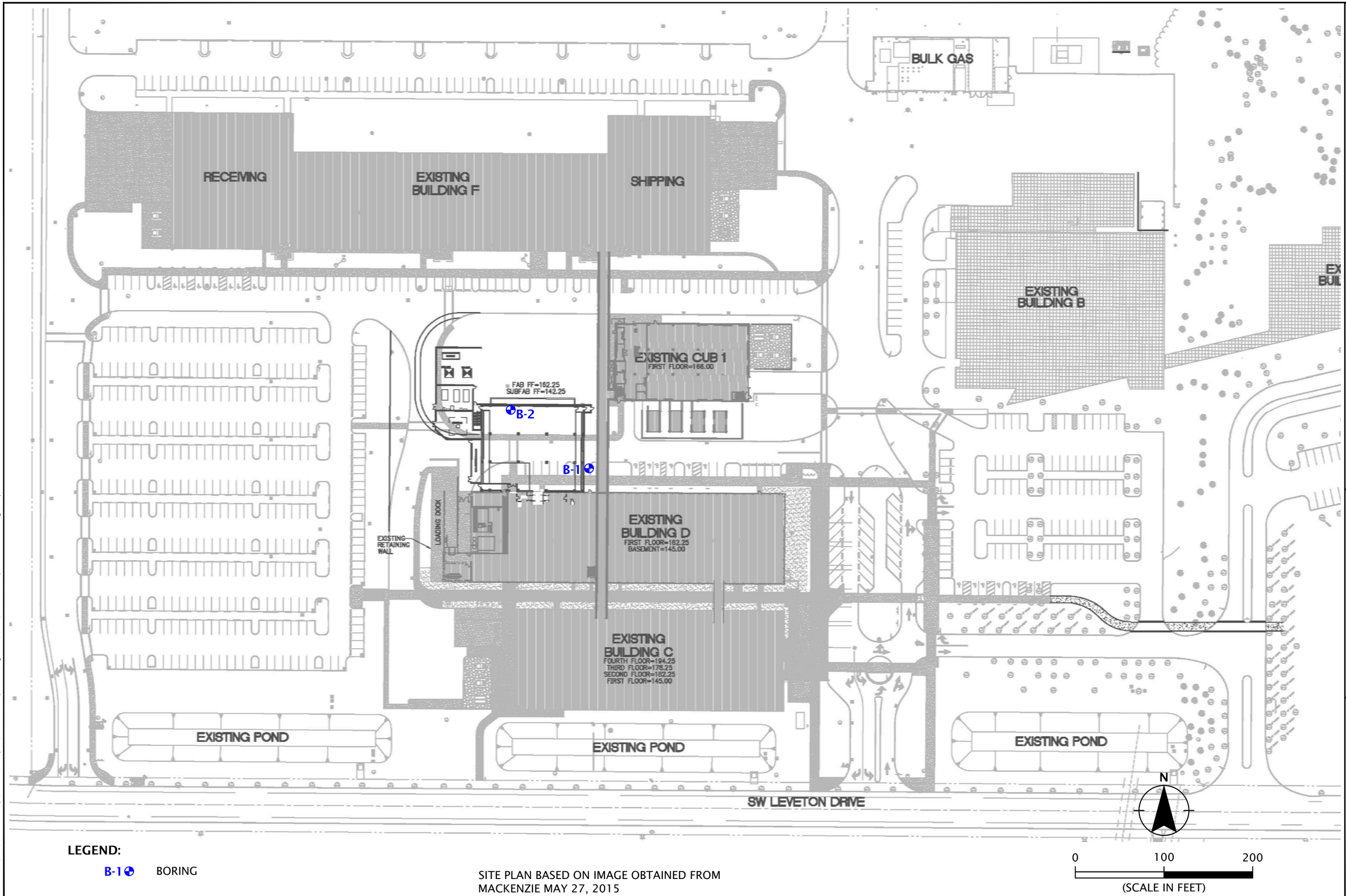
Depth ft	Tip (Qt) (tsf)	Sleeve Friction (Fs) (tsf)	F.Ratio (%)	PP (U2) (psi)	SPT (blows/ft)	Zone	Soil Behavior Type UBC-1983
50.853	150.51	2.3371	1.553	-4.547	36	8	sand to silty sand
51.017	155.69	2.9681	1.906	-4.817	50	7	silty sand to sandy silt
51.181	164.56	2.6844	1.631	-4.054	39	8	sand to silty sand
51.345	176.32	2.8310	1.606	-4.332	42	8	sand to silty sand
51.509	172.12	2.6038	1.513	-4.625	41	8	sand to silty sand
51.673	162.92	2.5907	1.590	-4.959	39	8	sand to silty sand
51.837	150.33	2.5507	1.697	-5.165	36	8	sand to silty sand

APPENDIX C

APPENDIX C

PREVIOUS EXPLORATIONS

This appendix contains copies of the prior relevant site plans. explorations logs, and laboratory test results that were completed by NV5 (formerly GeoDesign).



LEGEND:

B-1 BORING

SITE PLAN BASED ON IMAGE OBTAINED FROM MACKENZIE MAY 27, 2015

SITE PLAN

BUILDING D ADDITION
TUALATIN, OR

FIGURE 2

LAMRESCORP-2-01

JULY 2015

GeoDesign
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

Printed By: mmiller | Print Date: 7/17/2015 2:21:17 PM
File Name: J:\E-L\LamResCorp\LamResCorp-2\LamResCorp-2-01\Figures\CAD\LamResCorp-2-01-SP02.dwg | Layout: FIGURE 2

APPENDIX A

FIELD EXPLORATIONS

GENERAL

Subsurface conditions at the site were explored by drilling two borings (B-1 and B-2) to a maximum depth of 51.5 feet BGS. Figure 2 shows the approximate locations of our boring explorations. The borings were drilled on June 22, 2015 by Western States Soil Conservation, Inc., of Hubbard, Oregon, using mud rotary drilling techniques. The exploration was observed by a member of our geotechnical staff. We obtained representative samples of the various soil encountered in the exploration for geotechnical laboratory testing. Classifications and sampling depths are presented on the exploration log included in this appendix.

The locations of our explorations were chosen based on a site plan provided to our office by Mackenzie. This information should be considered accurate to the degree implied by the methods used.

SOIL SAMPLING

Samples were obtained from the boring explorations using 1½-inch-inner diameter, split-spoon samplers in general accordance with ASTM D 1586. The SPT sampler was driven into the soil with a 140-pound hammer free-falling 30 inches. The SPT sampler was driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the exploration logs, unless otherwise noted. Soil classifications, sampler type, and sampling intervals are presented on the exploration logs included in this appendix.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Exploration Key" (Table A-1) and "Soil Classification System" (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. If the change occurred between sample locations, the depth was interpreted. Classifications and sampling intervals are presented on the exploration logs included in this appendix.

The average efficiency of the automatic SPT hammer used by Western States Soil Conservation, Inc. was 92.6 percent. A copy of the calibration testing is presented at the end of 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

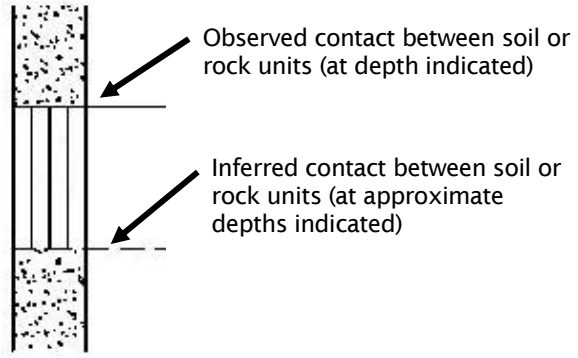
The natural moisture content of selected soil samples was determined in general accordance with ASTM D 2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

GRAIN-SIZE TESTING

Grain-size testing was performed on selected soil samples to determine the distribution of soil particle sizes. The testing consisted of percent fines determinations (percent passing the U.S. Standard No. 200 Sieve) completed in general accordance with ASTM C 117 and ASTM D 1140 (P200). Test results are presented 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 and 140-pound hammer or pushed with recovery
	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
	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

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

ENVIRONMENTAL TESTING EXPLANATIONS

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

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

EXPLORATION KEY

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

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVELS (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVELS WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SANDS (<5% fines)	SW or SP	SAND
		SANDS WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SANDS WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	PEAT

MOISTURE CLASSIFICATION

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

ADDITIONAL CONSTITUENTS

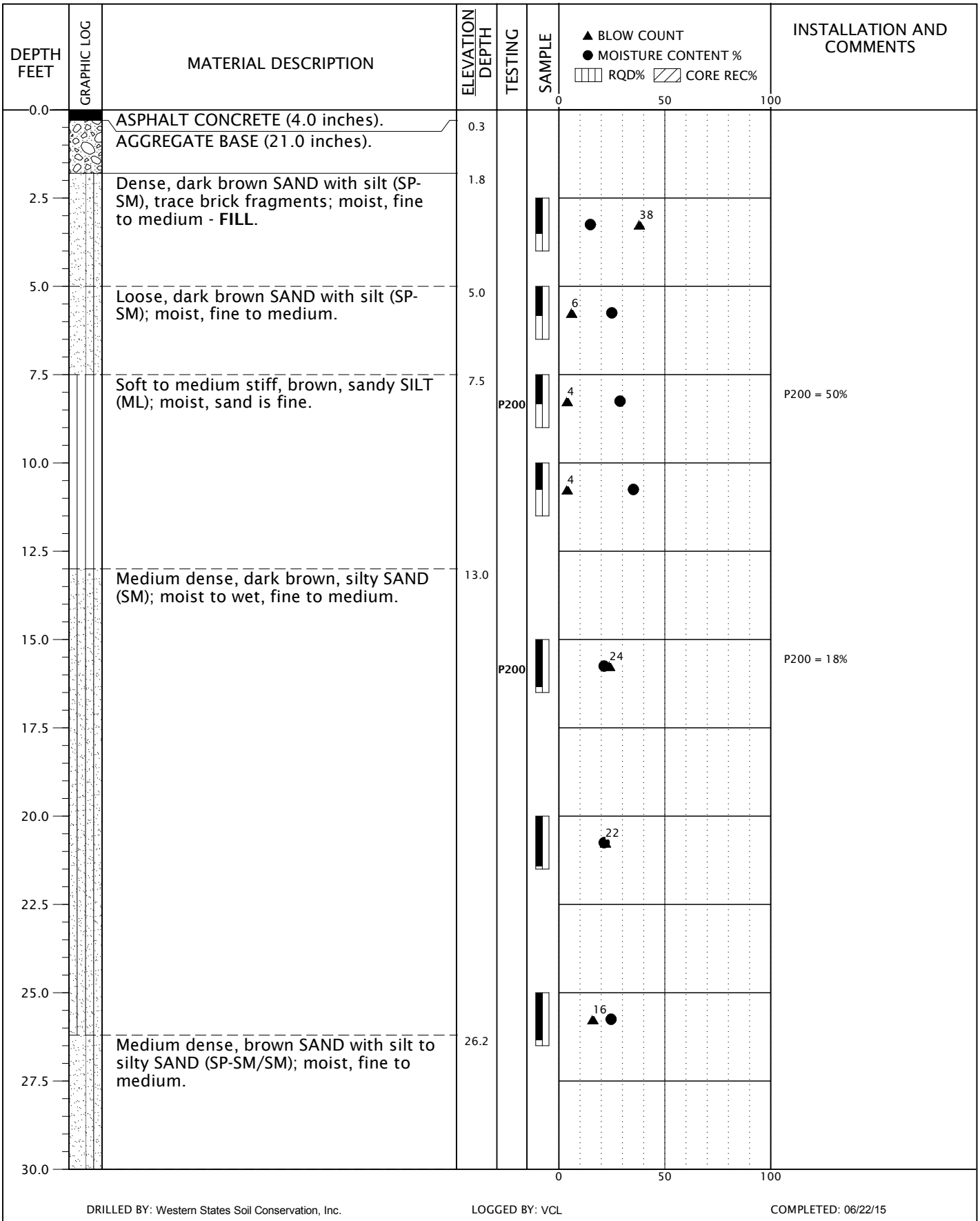
Secondary granular components or other materials such as organics, man-made debris, etc.

Percent	Silt and Clay In: Fine-Grained Soils	Silt and Clay In: Coarse-Grained Soils	Percent	Sand and Gravel In: Fine-Grained Soils	Sand and Gravel In: Coarse-Grained Soils
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	Indicate %

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

SOIL CLASSIFICATION SYSTEM

TABLE A-2



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: VCL

COMPLETED: 06/22/15

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 7/8 inches

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

LAMRESCORP-2-01

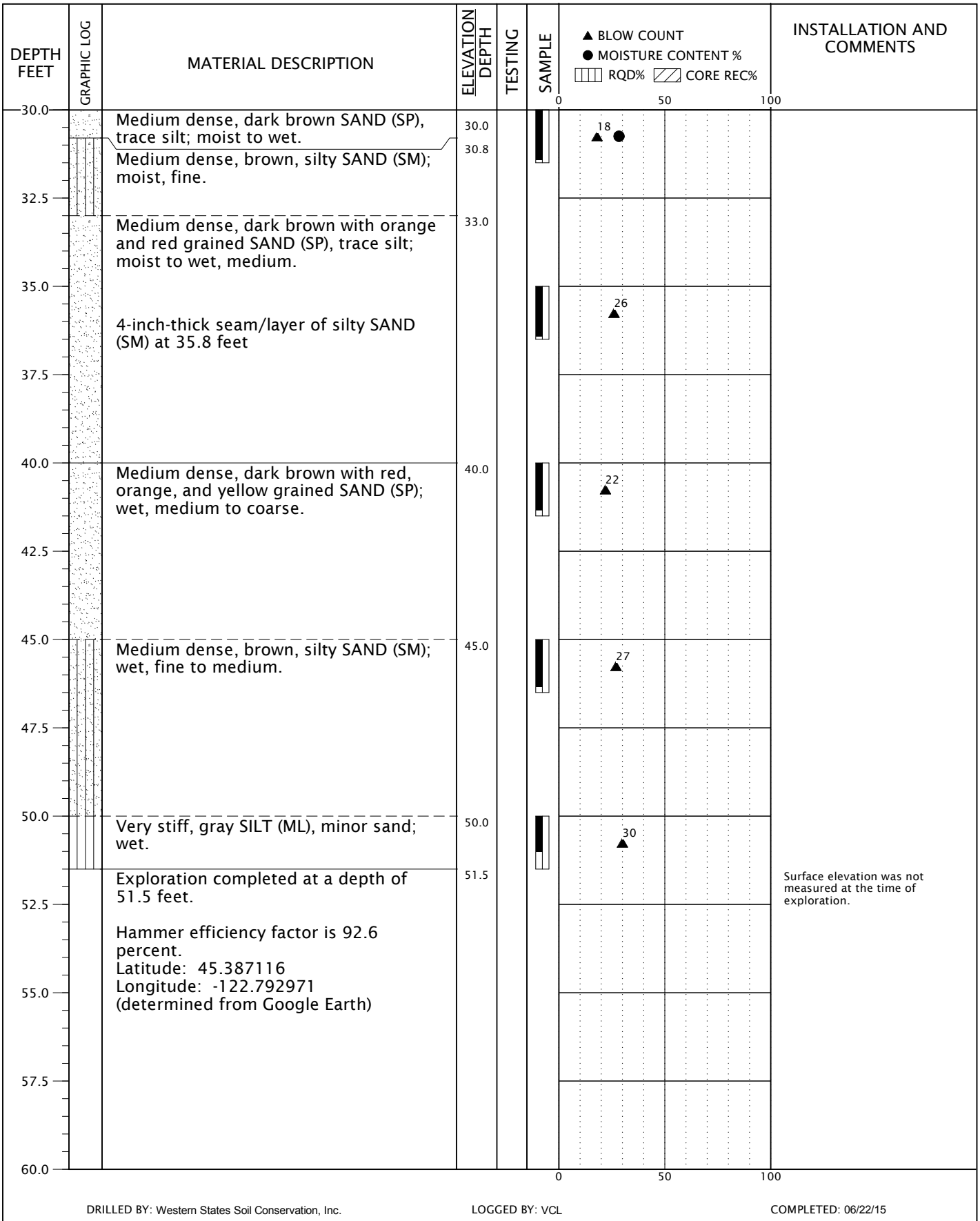
BORING B-1

JULY 2015

BUILDING D ADDITION
TUALATIN, OR

FIGURE A-1

BORING LOG LAMRESCORP-2-01-B1_2.GPJ GEODESIGN.GDT PRINT DATE: 7/17/15:KT



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: VCL

COMPLETED: 06/22/15

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 7/8 inches

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

LAMRESCORP-2-01

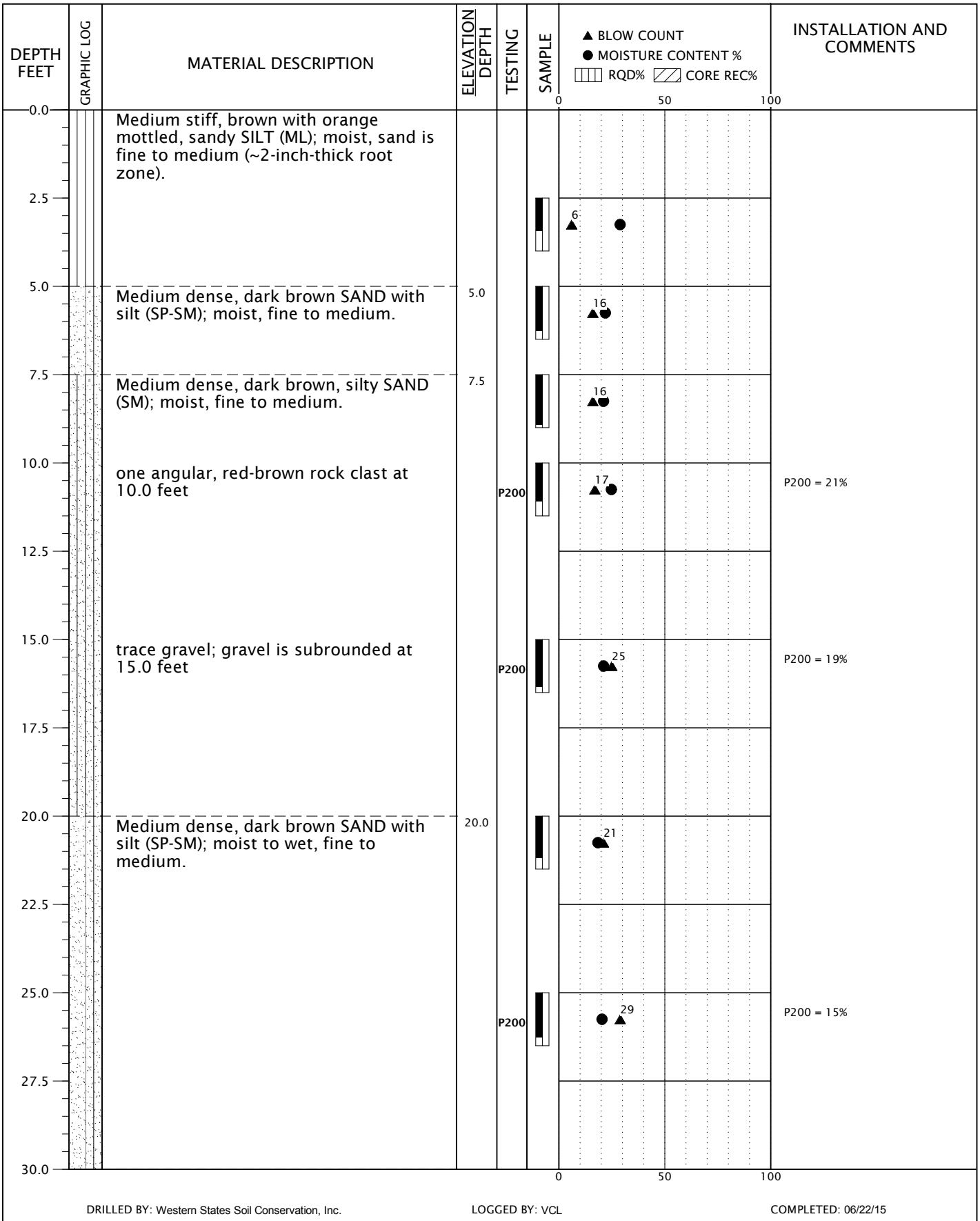
BORING B-1
(continued)

JULY 2015

BUILDING D ADDITION
TUALATIN, OR

FIGURE A-1

BORING LOG LAMRESCORP-2-01-B1_2.GPJ GEODESIGN.GDT PRINT DATE: 7/17/15:KT



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: VCL

COMPLETED: 06/22/15

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 7/8 inches

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

LAMRESCORP-2-01

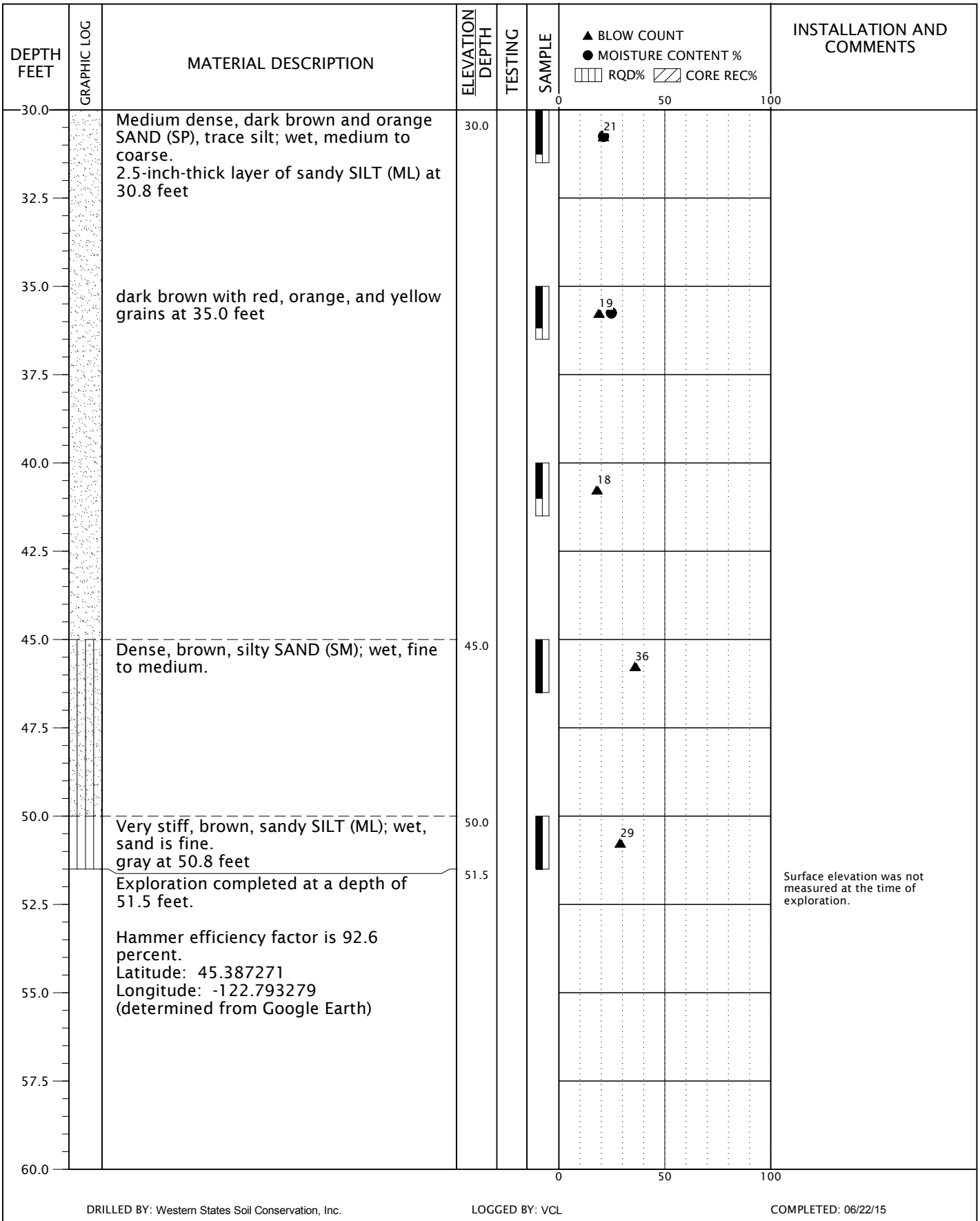
JULY 2015

BORING B-2

BUILDING D ADDITION
TUALATIN, OR

FIGURE A-2

BORING LOG LAMRESCORP-2-01-B1_2.GPJ GEODESIGN.GDT PRINT DATE: 7/17/15:KT



BORING LOG LAMRESCORP-2-01-B1_2.GPJ GEODESIGN.GDT PRINT DATE: 7/17/15:KT

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

LAMRESCORP-2-01

BORING B-2
(continued)

JULY 2015

BUILDING D ADDITION
TUALATIN, OR

FIGURE A-2

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	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		15							
B-1	5.0		25							
B-1	7.5		29				50			
B-1	10.0		35							
B-1	15.0		21				18			
B-1	20.0		21							
B-1	25.0		25							
B-1	30.0		28							
B-2	2.5		29							
B-2	5.0		22							
B-2	7.5		21							
B-2	10.0		25				21			
B-2	15.0		21				19			
B-2	20.0		18							
B-2	25.0		20				15			
B-2	30.0		21							
B-2	35.0		25							

GEODESIGN INC
15575 SW Sequoia Parkway - Suite 100
Portland OR 97224
Off 503.968.8787 Fax 503.968.3068

LAMRESCORP-2-01

SUMMARY OF LABORATORY DATA

JULY 2015

BUILDING D ADDITION
TUALATIN, OR

FIGURE A-3

LAB SUMMARY LAMRESCORP-2-01-B1_2.GPJ GEODESIGN.GDT PRINT DATE: 7/17/15:KT

WSSC-7-01 - TEST BORING B-3 25FT
OP: WMN

TRUCK NO. 1
Date: 30-May-2015

AR: 1.41 in²
LE: 28.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft³
EM: 30,000 ksi
JC: 0.00 []

ETR: Energy Transfer Ratio
EMX: Max Transferred Energy
CSB: Compression Stress at Bottom
BPM: Blows per Minute
FFS: Force Full Scale

DMX: Maximum Displacement
SFR: Skin friction w/ damping correction
MEX: Maximum Strain
VMX: Maximum Velocity

BL#	depth ft	BLC bl/ft	ETR (%)	EMX k-ft	CSB ksi	BPM bpm	FFS kips	DMX in	SFR kips	MEX µE	VMX f/s
9	25.17	6	85.3	0.3	0.0	50.1	60	1.46	0	953	17.2
11	25.52	6	92.8	0.3	0.0	49.9	60	1.08	0	1,035	18.8
13	25.86	6	94.7	0.3	0.0	50.0	60	1.15	0	1,037	19.3
15	26.21	6	93.5	0.3	0.0	50.1	60	0.82	0	1,044	18.7
17	26.55	6	92.7	0.3	0.0	50.2	60	0.75	0	1,034	18.3
19	26.90	6	90.2	0.3	0.0	19.6	60	0.77	0	1,026	17.1
21	27.24	6	89.3	0.3	0.0	50.1	60	1.62	0	1,035	16.4
23	27.59	6	91.6	0.3	0.0	50.0	60	0.95	0	1,089	17.3
25	27.93	6	95.1	0.3	0.0	50.0	60	0.82	0	1,082	17.6
27	28.28	6	92.3	0.3	0.0	50.2	60	1.30	0	1,046	17.2
37	30.00	6	90.8	0.3	0.0	51.9	60	1.30	0	998	17.5
39	30.26	8	93.8	0.3	0.0	51.9	60	1.25	0	1,021	18.0
41	30.53	8	92.9	0.3	0.0	52.0	60	1.05	0	1,018	17.8
43	30.79	8	92.9	0.3	0.0	52.0	60	0.94	0	1,037	17.6
45	31.05	8	90.4	0.3	0.0	51.9	60	0.65	0	1,004	16.9
47	31.32	8	92.0	0.3	0.0	52.0	60	1.22	0	995	17.5
49	31.58	8	93.4	0.3	0.0	52.0	60	1.02	0	1,004	18.2
51	31.84	8	93.0	0.3	0.0	51.9	60	0.93	0	1,015	17.4
53	32.11	8	92.6	0.3	0.0	51.9	60	0.86	0	992	17.0
55	32.37	8	92.0	0.3	0.0	52.0	60	0.70	0	1,024	16.9
57	32.63	8	92.3	0.3	0.0	51.9	60	0.74	0	1,004	17.2
59	32.89	8	95.9	0.3	0.0	52.0	60	1.20	0	1,024	17.7
61	33.16	8	92.3	0.3	0.0	52.0	60	0.73	0	1,006	17.0
63	33.42	8	94.6	0.3	0.0	51.9	60	1.37	0	993	17.4
75	35.00	8	94.0	0.3	0.0	54.3	60	0.65	0	986	15.7
77	35.29	7	94.8	0.3	0.0	54.3	60	0.73	0	996	15.6
79	35.57	7	94.5	0.3	0.0	54.4	60	0.68	0	994	16.2
81	35.86	7	94.2	0.3	0.0	54.2	60	0.65	0	996	15.5
83	36.14	7	95.7	0.3	0.0	54.4	60	0.79	0	997	16.7
85	36.43	7	95.0	0.3	0.0	54.3	60	0.80	0	1,004	15.7
87	36.71	7	95.4	0.3	0.0	54.2	60	0.65	0	997	16.7
89	37.00	7	99.5	0.3	0.0	54.4	60	1.51	0	1,009	16.4
91	37.29	7	95.8	0.3	0.0	54.2	60	0.61	0	1,021	16.9
93	37.57	7	95.7	0.3	0.0	54.3	60	0.42	0	1,039	16.3
95	37.86	7	94.5	0.3	0.0	54.2	60	0.73	0	981	16.4
97	38.14	7	93.8	0.3	0.0	54.2	60	0.48	0	973	16.1
99	38.43	7	98.3	0.3	0.0	54.2	60	0.60	0	1,049	16.5
101	38.71	7	94.8	0.3	0.0	54.3	60	0.40	0	975	16.0
103	39.00	7	95.4	0.3	0.0	54.4	60	0.53	0	1,013	15.8
105	39.29	7	10.5	0.0	0.0	49.3	60	0.08	0	339	5.2
111	40.14	7	93.9	0.3	0.0	54.0	60	0.98	0	909	16.7
113	40.43	7	97.3	0.3	0.0	53.9	60	1.10	0	981	16.6
115	40.71	7	98.9	0.3	0.0	54.1	60	1.31	0	962	17.1
117	41.00	7	94.8	0.3	0.0	54.0	60	0.73	0	940	16.1
119	41.29	7	96.5	0.3	0.0	54.1	60	1.23	0	962	16.7

WSSC-7-01 - TEST BORING B-3 25FT
OP: WMN

TRUCK NO. 1
Date: 30-May-2015

BL#	depth ft	BLC bl/ft	ETR (%)	EMX k-ft	CSB ksi	BPM bpm	FFS kips	DMX in	SFR kips	MEX µE	VMX f/s
121	41.57	7	95.7	0.3	0.0	54.2	60	1.25	0	965	16.7
123	41.86	7	96.9	0.3	0.0	54.0	60	1.11	0	948	16.7
125	42.14	7	95.9	0.3	0.0	54.1	60	1.07	0	966	16.6
127	42.43	7	95.0	0.3	0.0	54.1	60	1.15	0	967	16.3
129	42.71	7	102.1	0.4	0.0	54.0	60	1.58	0	974	16.9
		Average	92.6	0.3	0.0	52.4	60	0.99	0	986	16.7
		Std. Dev.	12.2	0.0	0.0	3.7	0	0.36	0	99	1.9

Total number of blows analyzed: 101

BL# Sensors

8-130 F3: [SPT B1] 217.8 (1.00); F4: [SPT B2] 218.9 (1.00); A3: [K0232] 290.0 (1.00); A4: [K0231] 325.0 (1.00)

BL# Comments

28 N 6, 9, 12
37 LE = 33.60 ft; WC = 16,775.9 f/s
64 N: 7,11,17
75 LE = 38.60 ft; WC = 16,777.3 f/s
105 N:9,13,17
110 LE = 43.60 ft; WC = 16,769.2 f/s
130 N: 3,9,12

Time Summary

Drive	25 seconds	10:45 AM - 10:45 AM (5/30/2015) BN 8 - 28
Stop	20 minutes 45 seconds	10:45 AM - 11:06 AM
Drive	31 seconds	11:06 AM - 11:06 AM BN 37 - 64
Stop	14 minutes 57 seconds	11:06 AM - 11:21 AM
Drive	33 seconds	11:21 AM - 11:22 AM BN 75 - 105
Stop	20 minutes 41 seconds	11:22 AM - 11:43 AM
Drive	22 seconds	11:43 AM - 11:43 AM BN 110 - 130

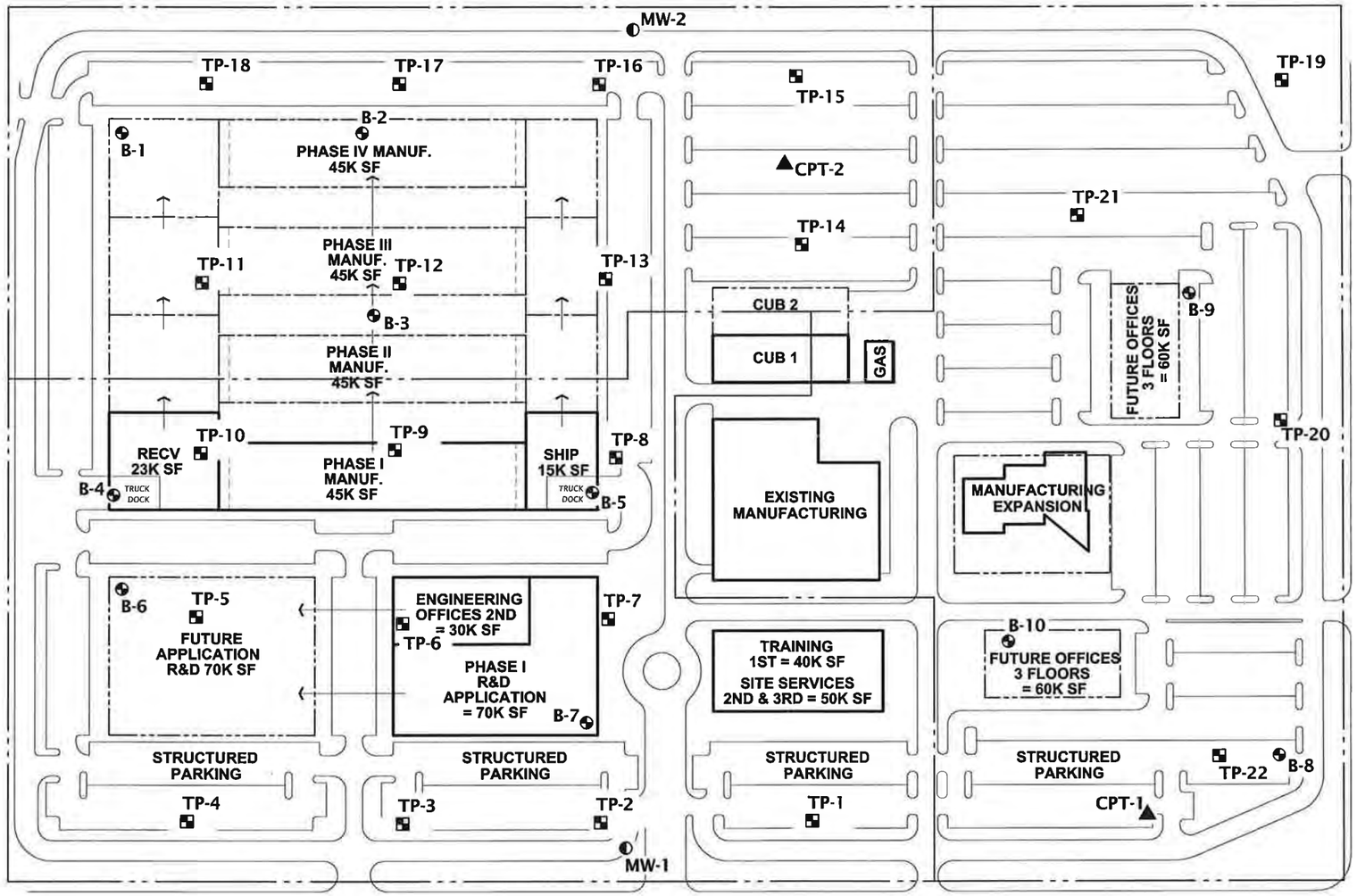
Total time [00:58:16] = (Driving [00:01:52] + Stop [00:56:23])

APPENDIX B

PREVIOUS EXPLORATIONS BY GEODESIGN

This appendix contains copies of the explorations logs that were completed by GeoDesign in December 2000. The locations of these explorations are shown on Figure 2 of the previous report, which is included in this appendix.

SITE PLAN



EXPLANATION:

- B-1 BORING
- MW-1 MONITORING WELL
- TP-1 TEST PIT
- CPT-1 CONE PENETROMETER

N

0 200 400 FT

SITE PLAN FROM DRAWING PROVIDED BY GROUP MACKENZIE.

FIGURE 2

DECEMBER 2000

NOVELLUS-4

GEODESIGN INC

KEY TO TEST PIT AND BORING LOG SYMBOLS

SYMBOL	SOIL DESCRIPTION
	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test
	Location of SPT sampling attempt with no sample recovery
	Location of sample obtained using thin wall, shelby tube, or Geoprobe® sampler in general accordance with ASTM D 1587
	Location of thin wall, shelby tube, or Geoprobe® sampling attempt with no sample recovery
	Location of sample obtained using Dames and Moore sampler and 300 pound hammer or pushed
	Location of Dames and Moore sampling attempt (300 pound hammer or pushed) with no sample recovery
	Location of grab sample
	Rock Coring Interval
	Water level

GEOTECHNICAL TESTING EXPLANATIONS

PP	Pocket Penetrometer	LL	Liquid Limit
TOR	Torvane	PI	Plasticity Index
CONSOL	Consolidation	PCF	Pounds Per Cubic Foot
DS	Direct Shear	PSF	Pounds Per Square Foot
P200	Percent Passing U.S. No. 200 Sieve	TSF	Tons Per Square Foot
W	Moisture Content	P	Pushed Sample
DD	Dry Density	OC	Organic Content

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
PID	Photoionization Detector Headspace Analysis	NS	No Visible Sheen
		SS	Slight Sheen
PPM	Parts Per Million	MS	Moderate Sheen
MG/KG	Milligrams Per Kilogram	HS	Heavy Sheen
P	Pushed Sample		

GEODESIGN INC

KEY TO TEST PIT AND BORING LOG SYMBOLS

TABLE A-1

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOL	NAME
Coarse Grained Soils More than 50% retained on No. 200 Sieve	Gravel More than 50% of coarse fraction retained on No. 4 Sieve	Clean Gravel	GW	Well graded, fine to coarse gravel
			GP	Poorly graded gravel
		Gravel with Fines	GM	Silty gravel
			GC	Clayey gravel
	Sand More than 50% of coarse fraction passes No. 4 Sieve	Clean Sand	SW	Well graded, fine to coarse sand
			SP	Poorly graded sand
		Sand with Fines	SM	Silty sand
			SC	Clayey sand
Fine Grained Soils More than 50% passes No. 200 Sieve	Silt and Clay Liquid Limit less than 50%	Inorganic	ML	Low plasticity silt
			CL	Low plasticity clay
		Organic	OL	Organic silt, organic clay
	Silt and Clay Liquid Limit greater than 50%	Inorganic	MH	High plasticity silt
			CH	High plasticity clay, fat clay
		Organic	OH	Organic clay, organic silt
Highly Organic Soils			PT	Peat

SOIL CLASSIFICATION GUIDELINES

GRANULAR SOILS		COHESIVE SOILS		
Relative Density	**Standard Penetration Resistance**	**Consistency**	**Standard Penetration Resistance**	**Unconfined Compressive Strength (tsf)**
Very Loose	0 – 4	Very Soft	Less than 2	Less than 0.25
Loose	4 – 10	Soft	2 - 4	0.25 - 0.50
Medium Dense	10 – 30	Medium Stiff	4 - 8	0.50 - 1.0
Dense	30 – 50	Stiff	8 - 15	1.0 - 2.0
Very Dense	More than 50	Very Stiff	15 - 30	2.0 - 4.0
		Hard	More than 30	More than 4.0

GRAIN SIZE CLASSIFICATION

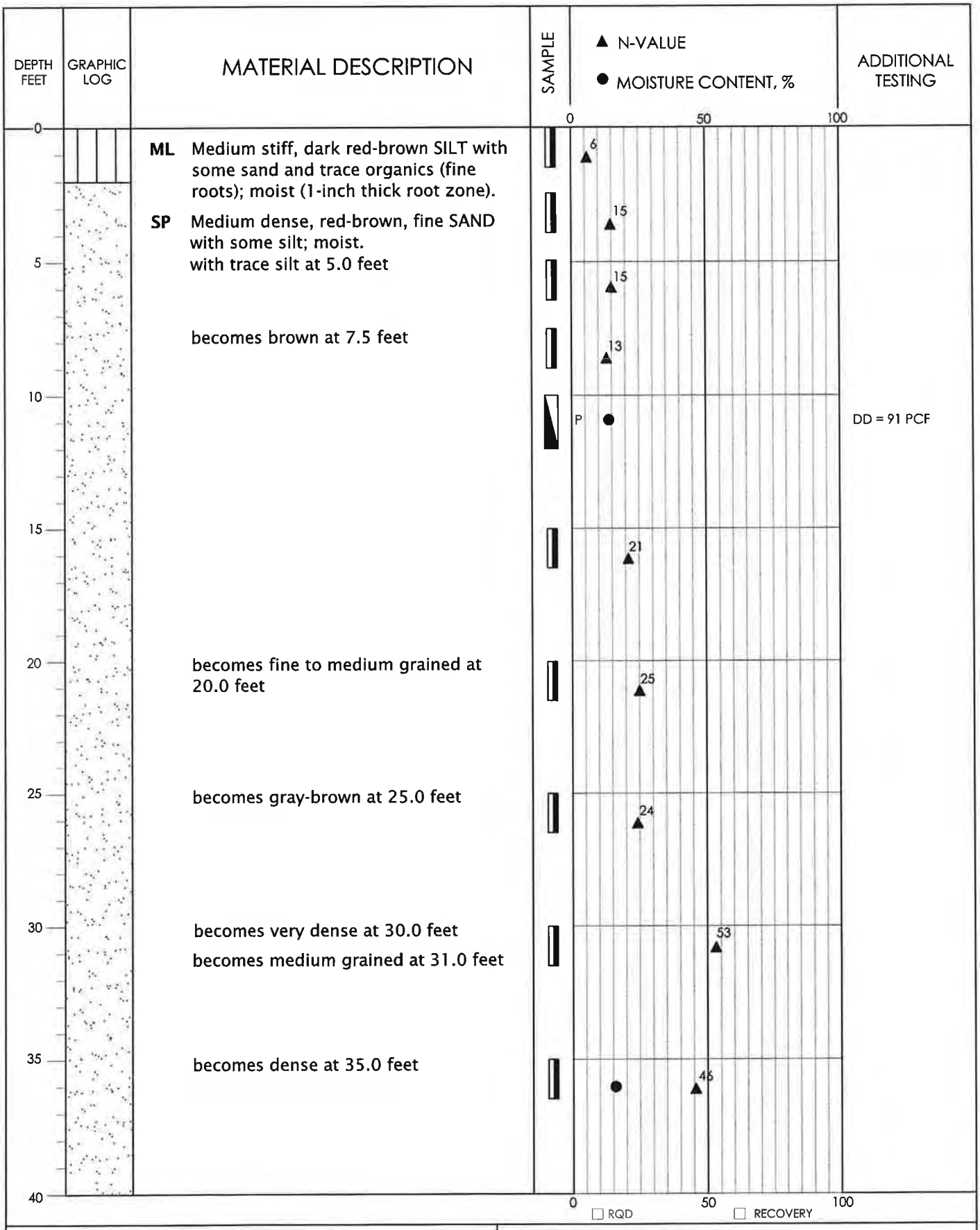
		Subclassifications	
Boulders	12 - 36 inches		
Cobbles	3 - 12 inches	Percentage of other material in sample	
Gravel	¾ - 3 inches (coarse) ¼ - ¾ inches (fine)	Clean	0 – 2
		Trace	2 – 10
Sand	No. 10 - No. 4 Sieve (coarse) No. 10 - No. 40 Sieve (medium) No. 40 - No. 200 Sieve (fine)	Some	10 - 30
		Sandy, Silty, Clayey, etc.	30 - 50

Dry = very low moisture, dry to the touch; Moist = damp, without visible moisture; Wet = saturated, with visible free water.

GEODESIGN INC

SOIL CLASSIFICATION SYSTEM AND GUIDELINES

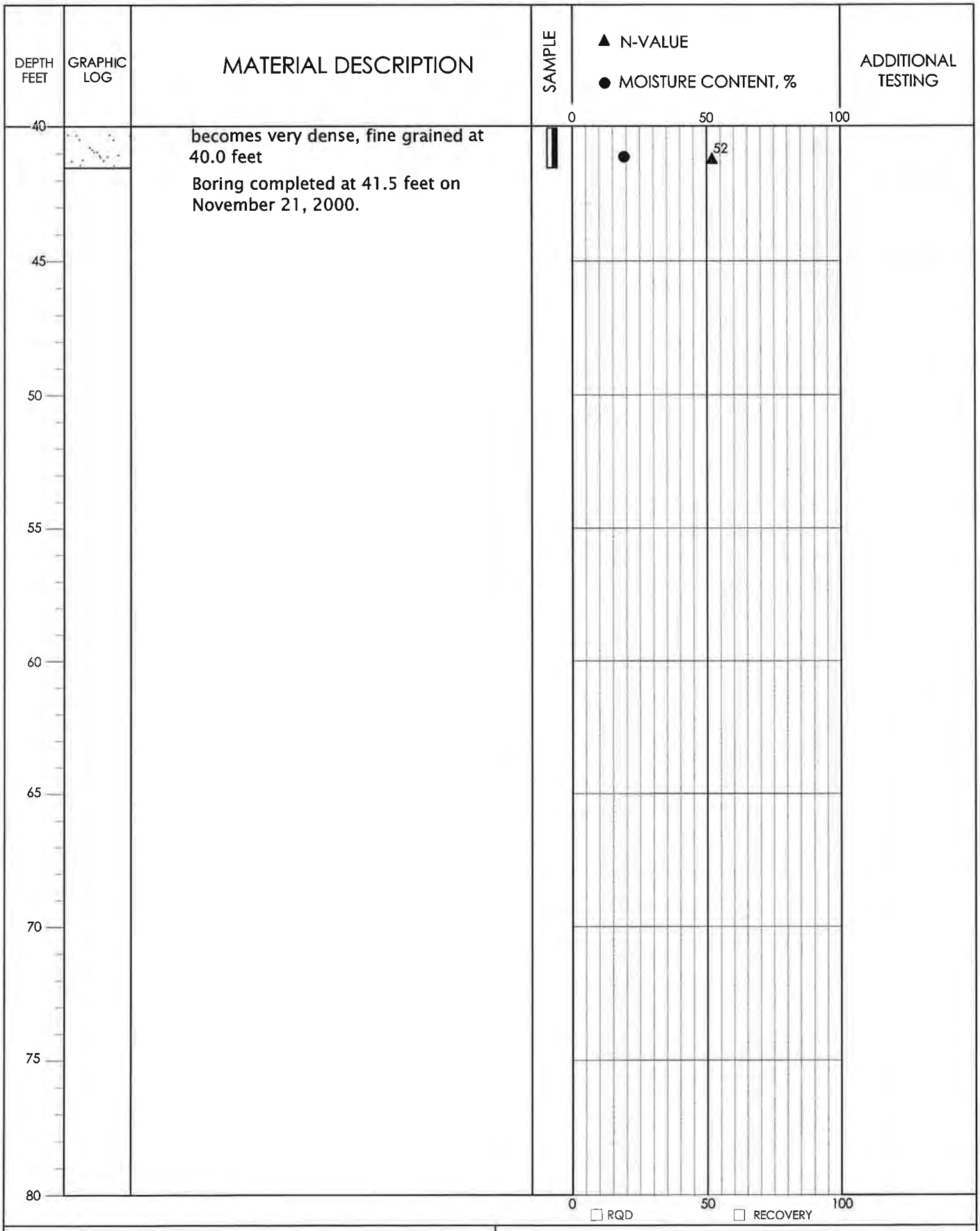
TABLE A-2



GEODESIGN INC

BORING B-1

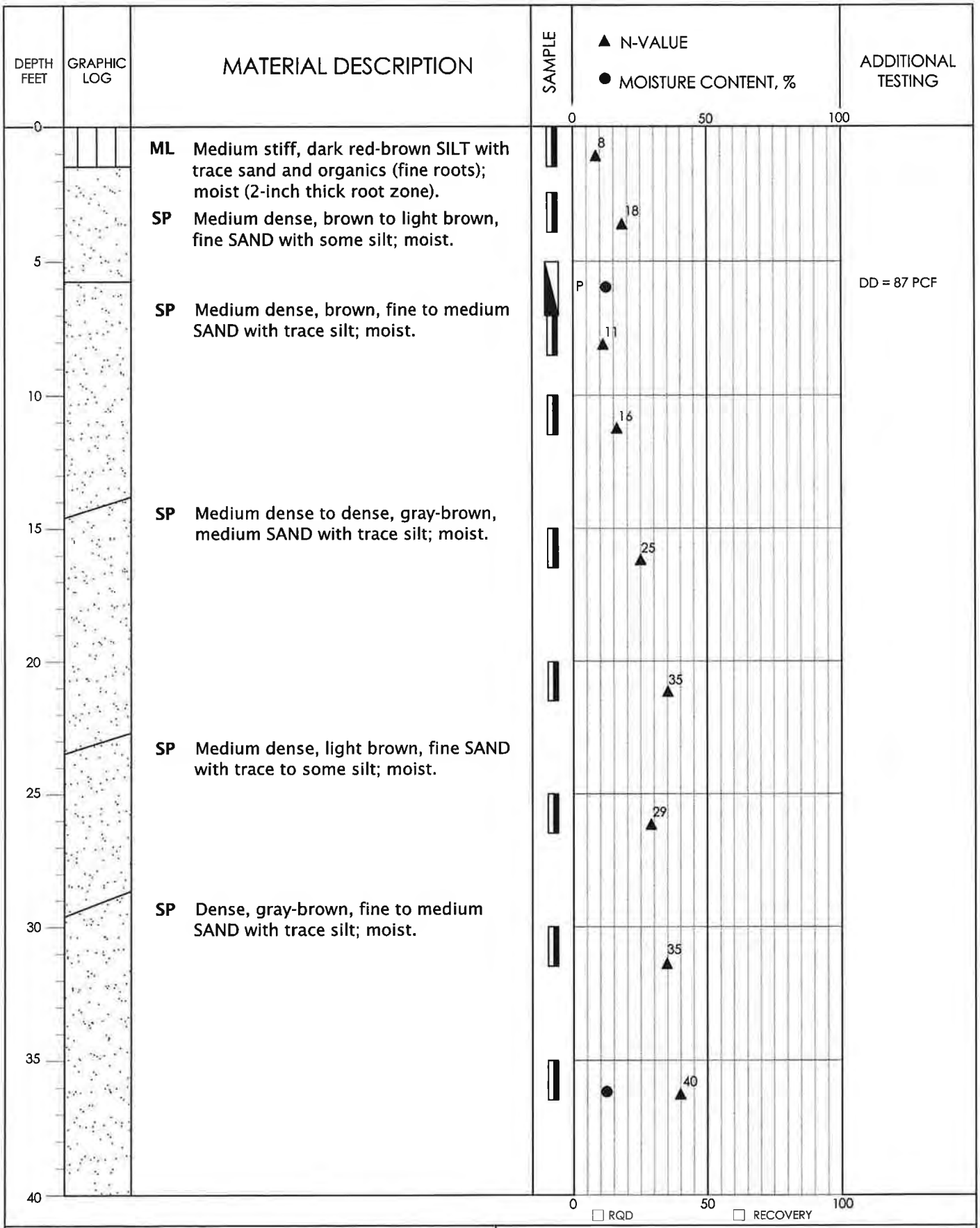
NOVELLUS-4	DECEMBER 2000	FIGURE A-1



GEODESIGN INC

BORING B-1 (CONT.)

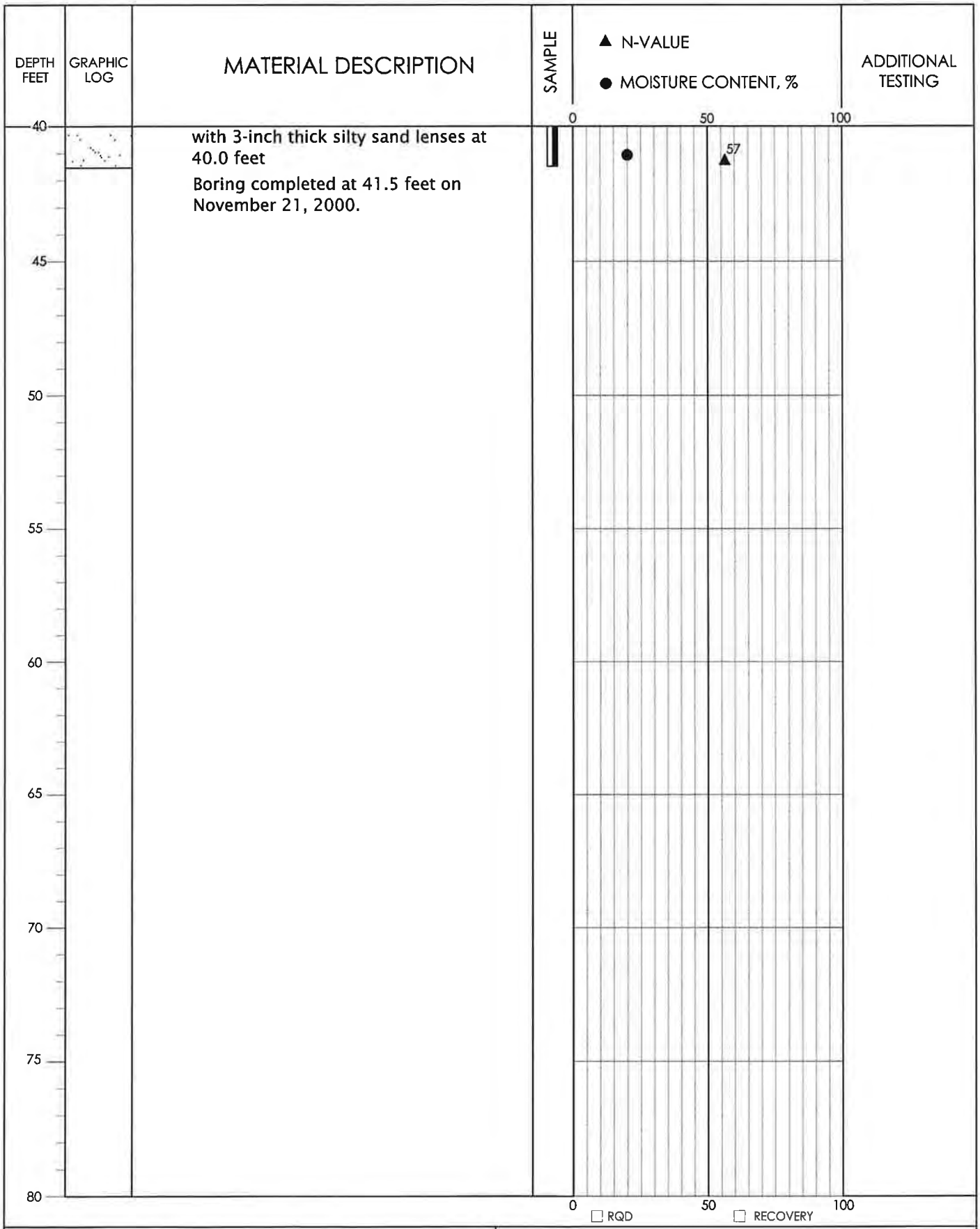
NOVELLUS-4	DECEMBER 2000	FIGURE A-1



GEODESIGN INC

BORING B-2

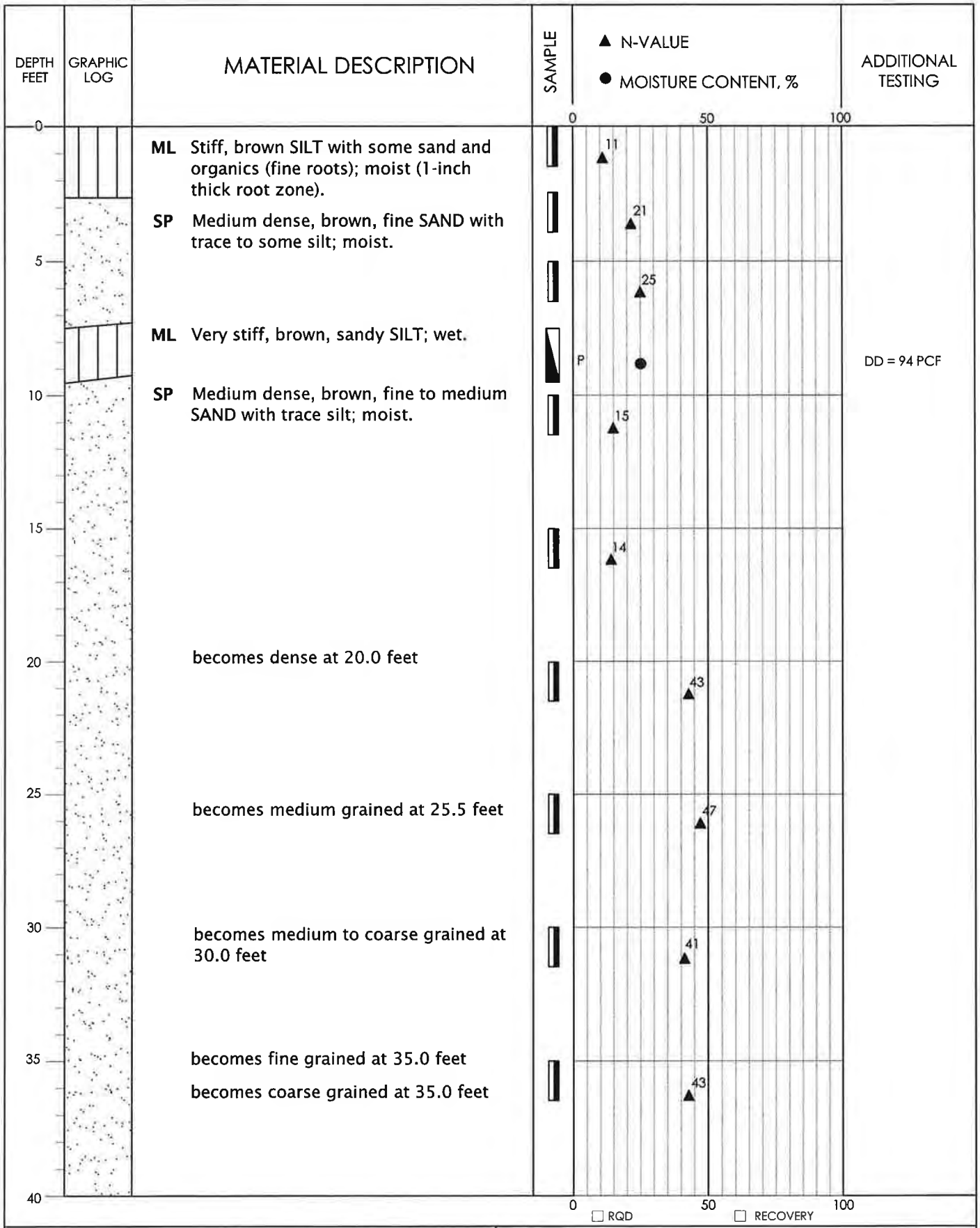
NOVELLUS-4	DECEMBER 2000	FIGURE A-2



GEODESIGN INC

BORING B-2 (CONT.)

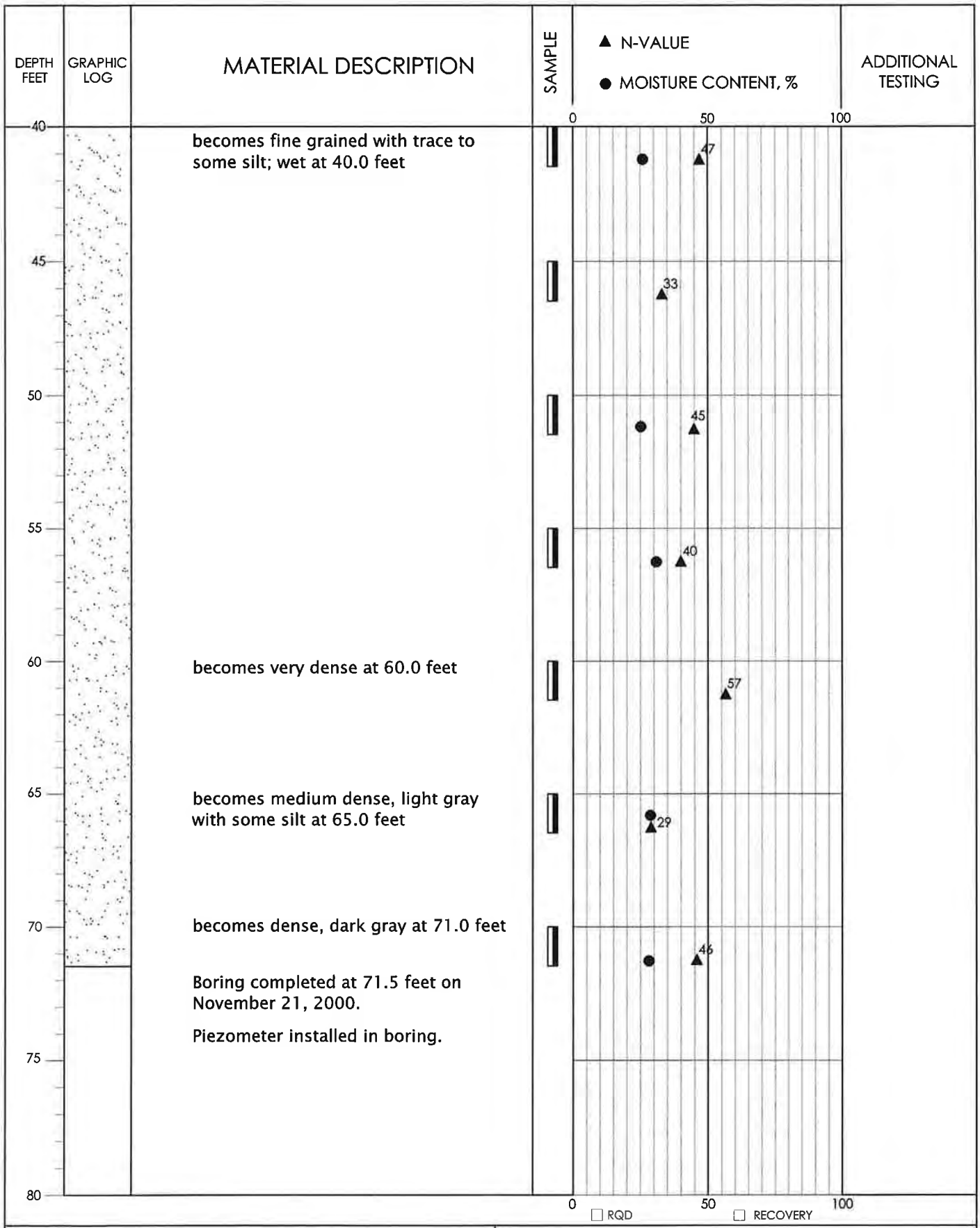
NOVELLUS-4	DECEMBER 2000	FIGURE A-2



GEODESIGN INC

BORING B-3

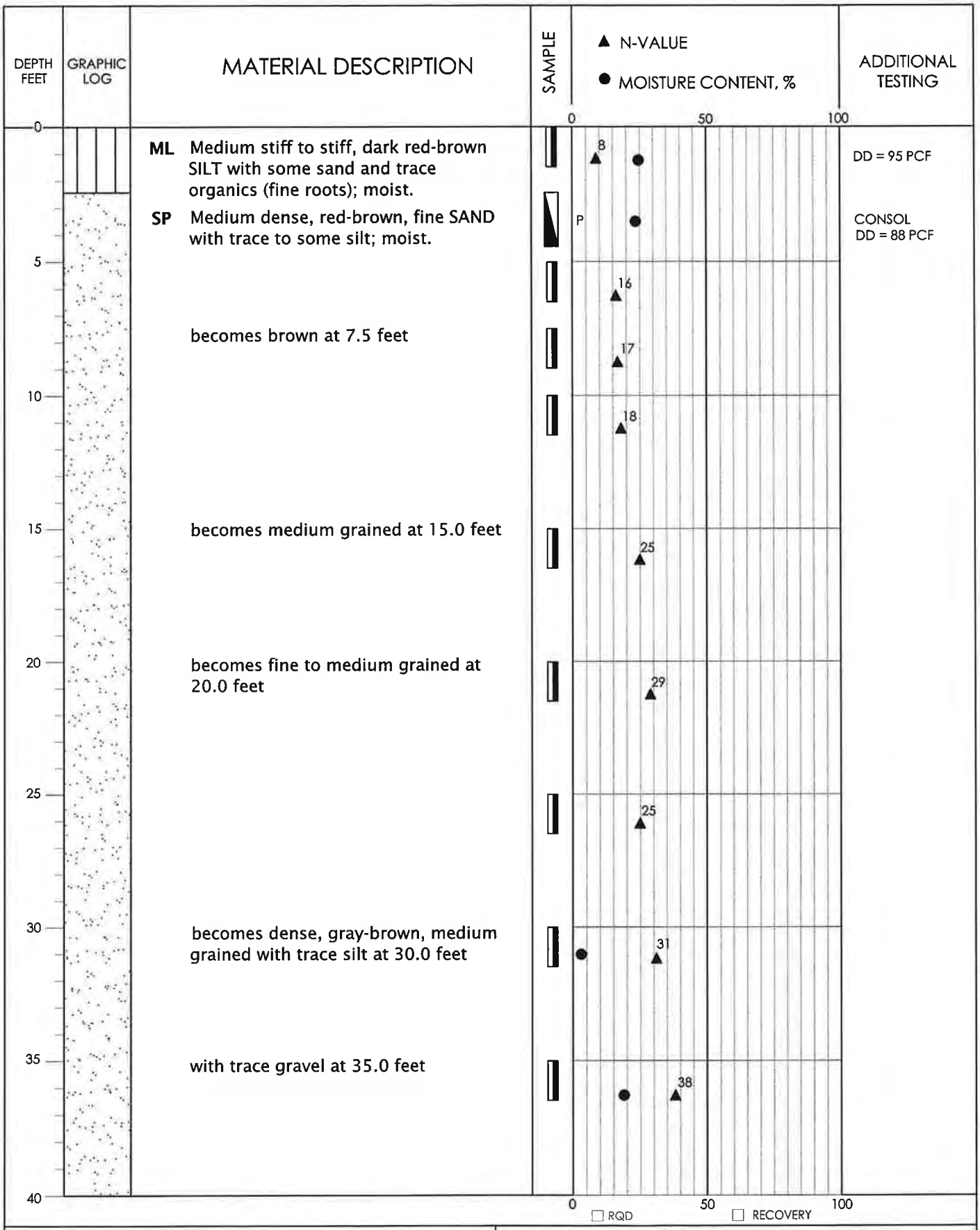
NOVELLUS-4	DECEMBER 2000	FIGURE A-3



GEODESIGN INC

BORING B-3 (CONT.)

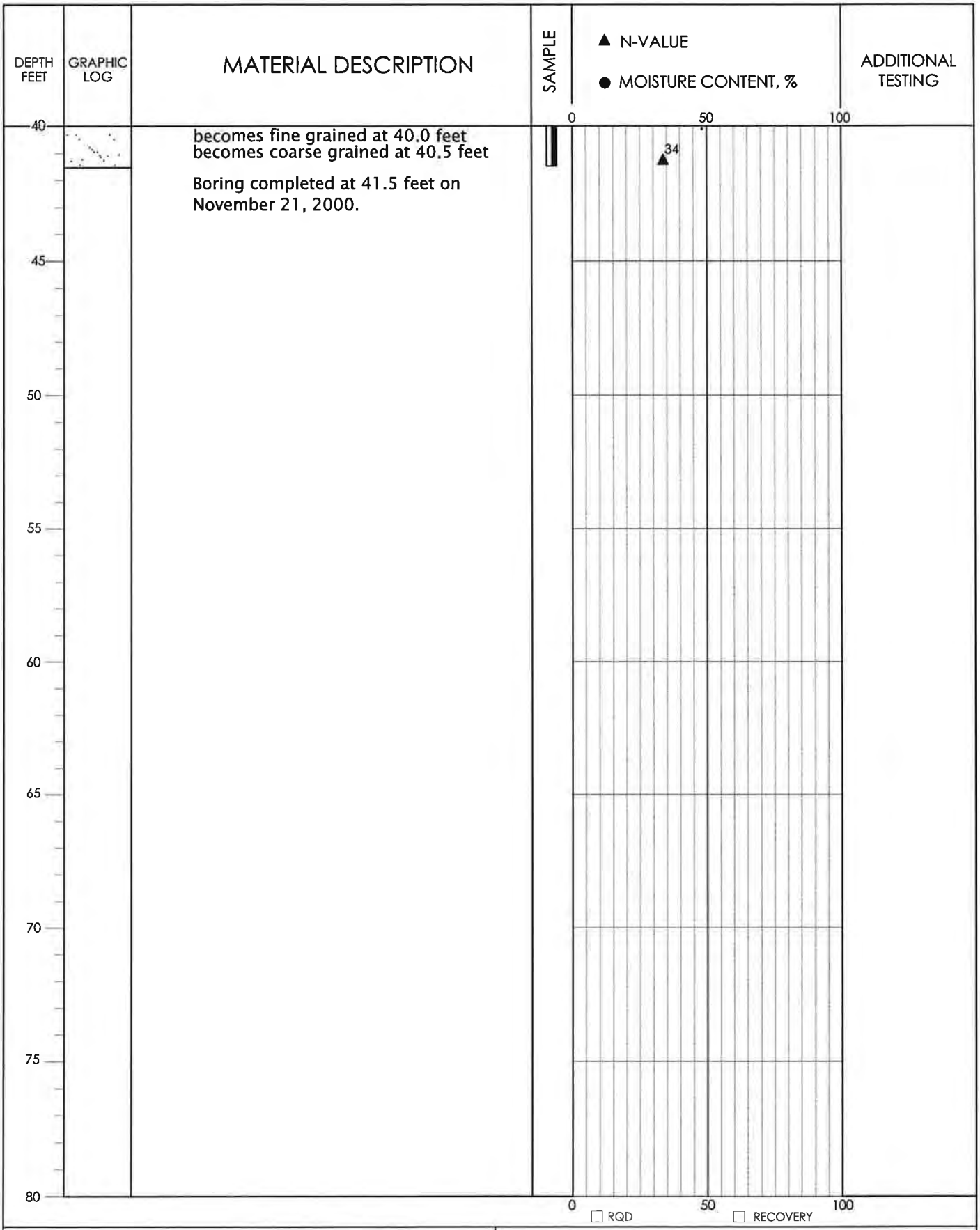
NOVELLUS-4	DECEMBER 2000	FIGURE A-3



GEODESIGN INC

BORING B-4

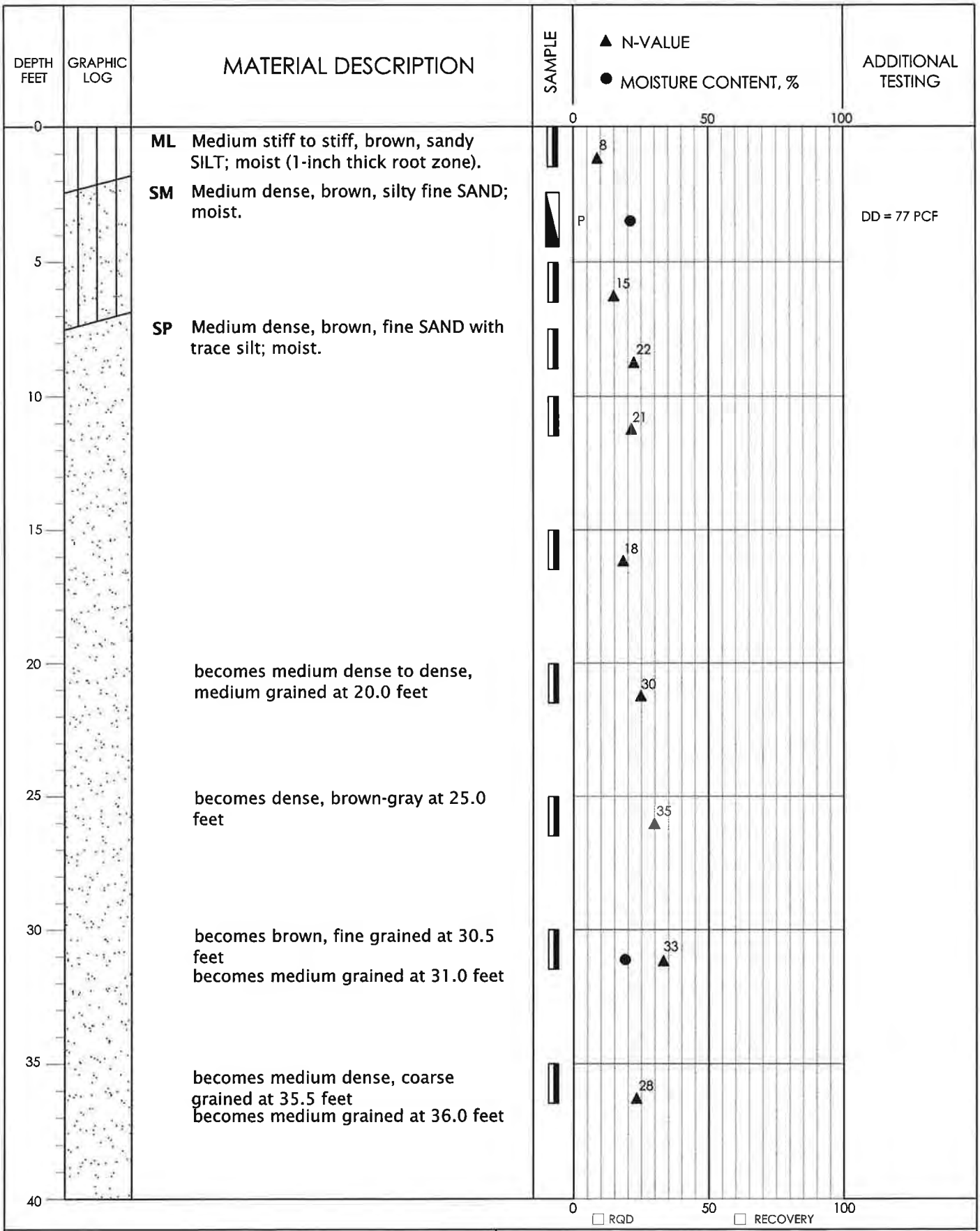
NOVELLUS-4	DECEMBER 2000	FIGURE A-4



GEODESIGN INC

BORING B-4 (CONT.)

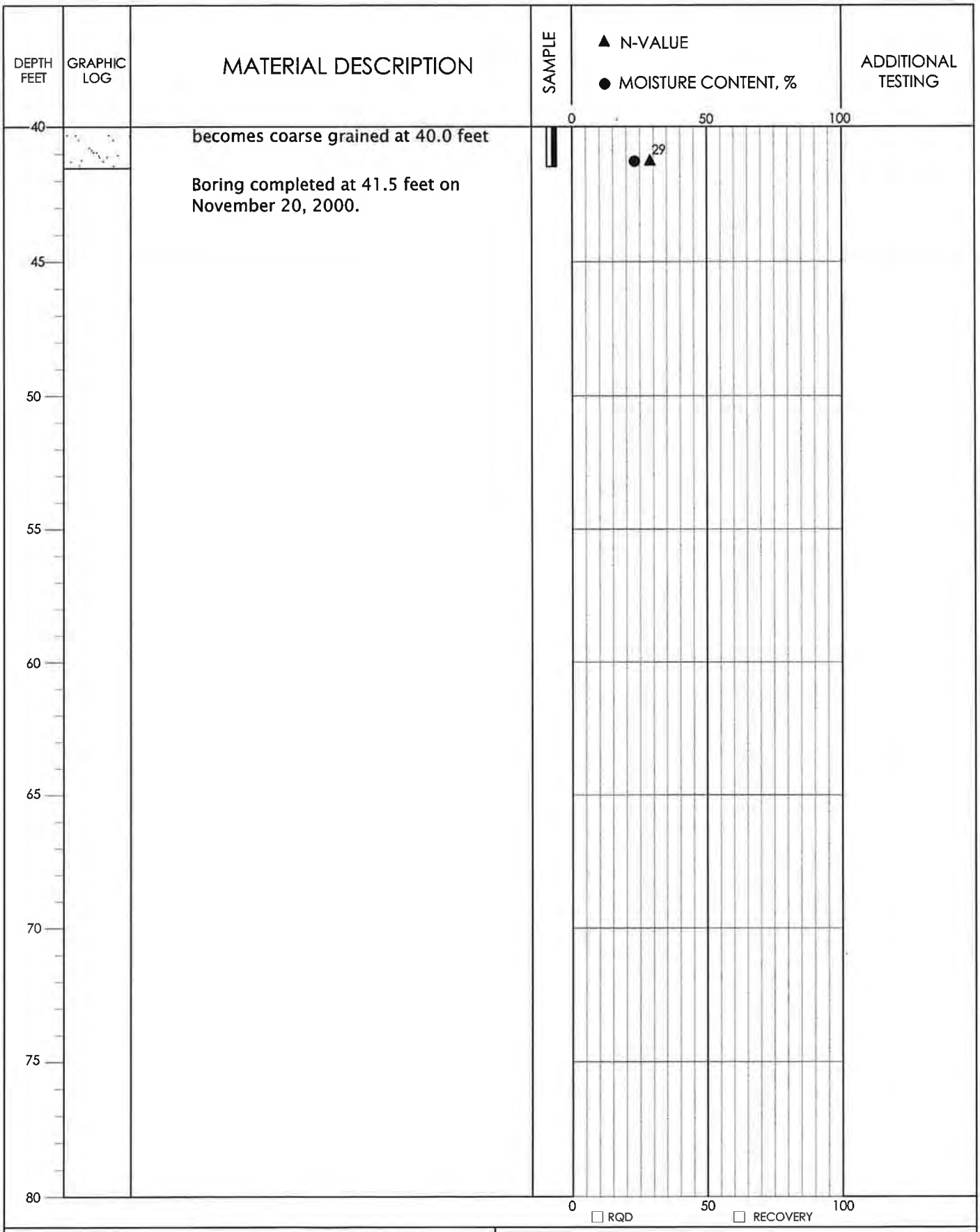
NOVELLUS-4	DECEMBER 2000	FIGURE A-4



GEODESIGN INC

BORING B-5

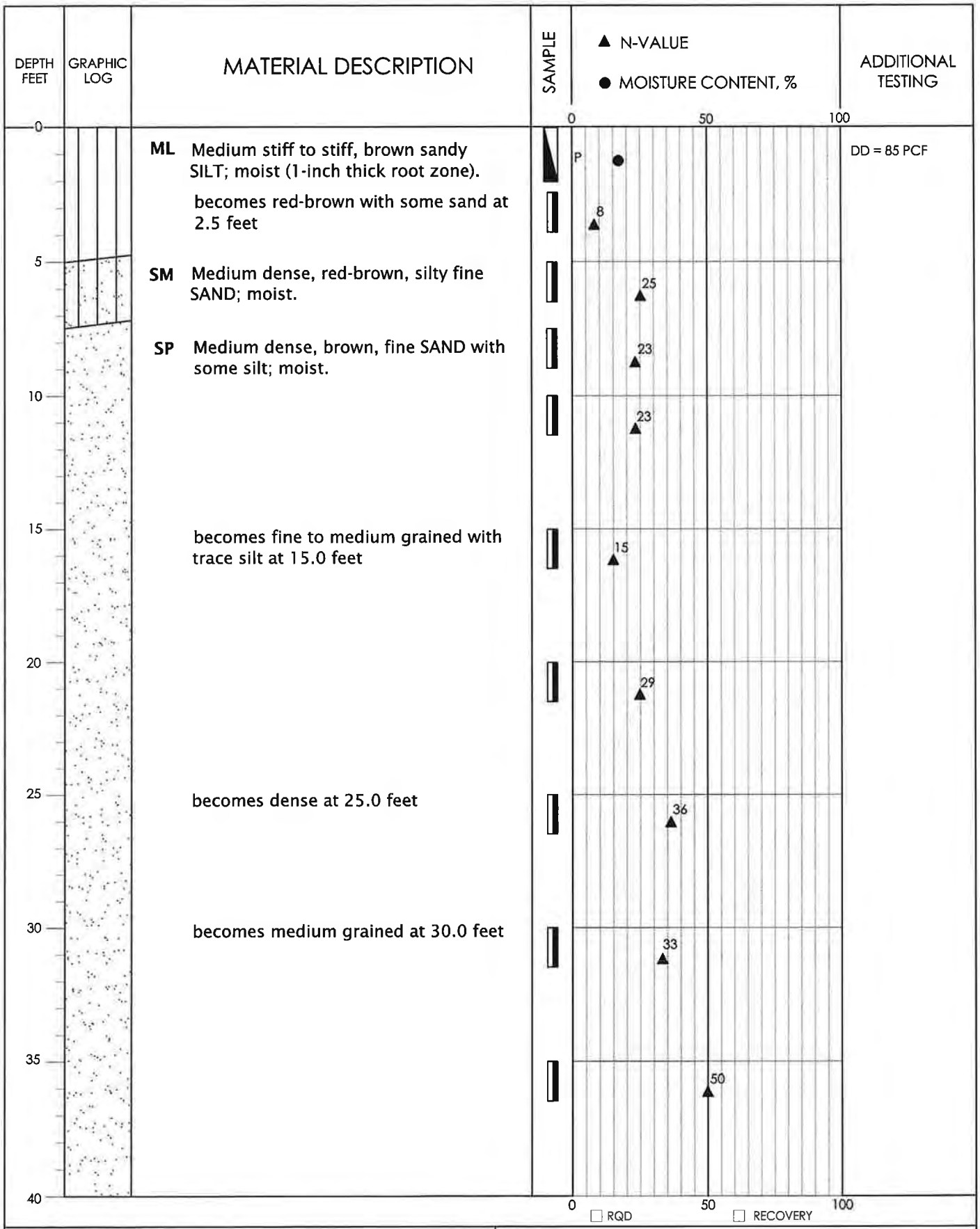
NOVELLUS-4	DECEMBER 2000	FIGURE A-5



GEODESIGN INC

BORING B-5 (CONT.)

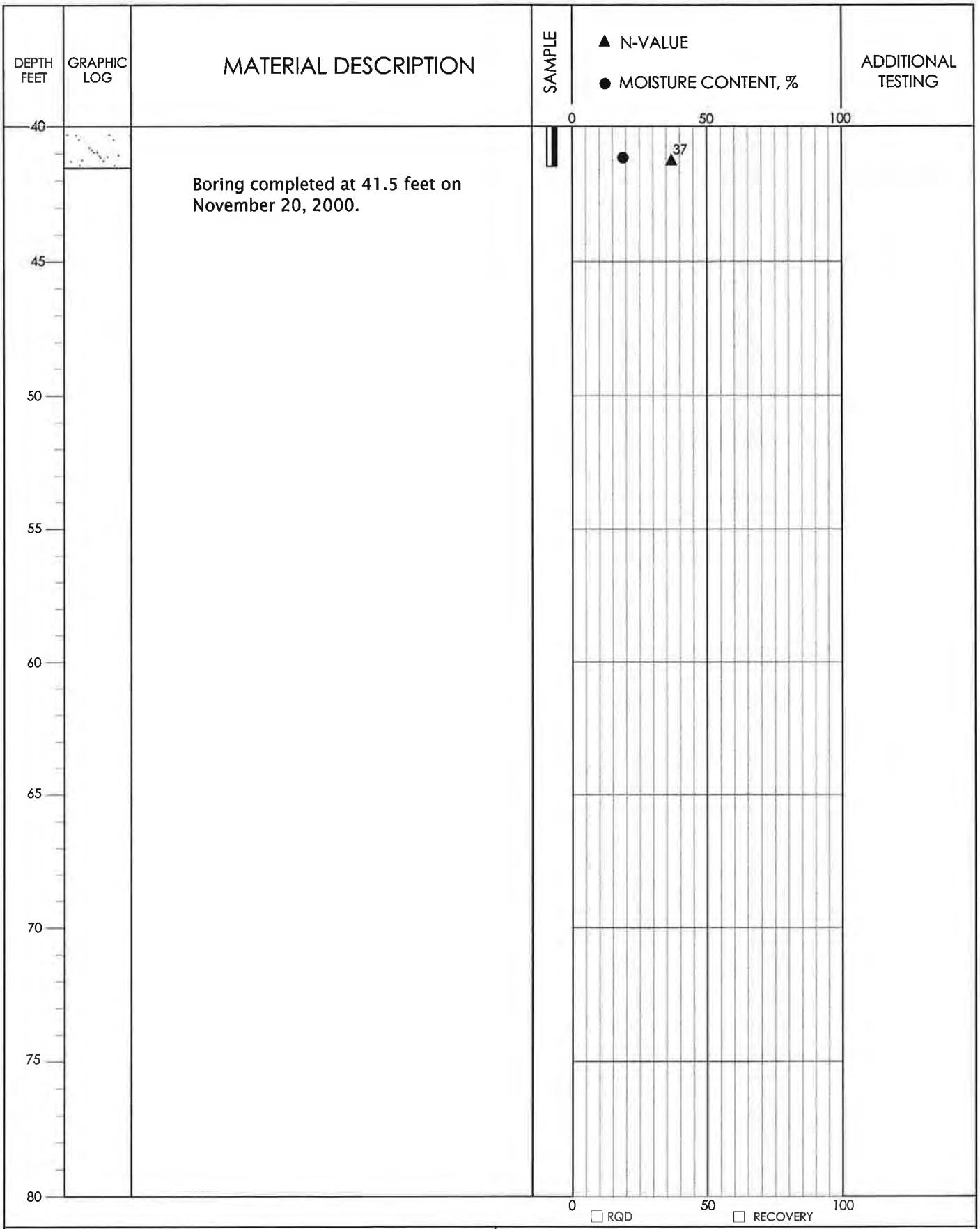
NOVELLUS-4	DECEMBER 2000	FIGURE A-5



GEODESIGN INC

BORING B-6

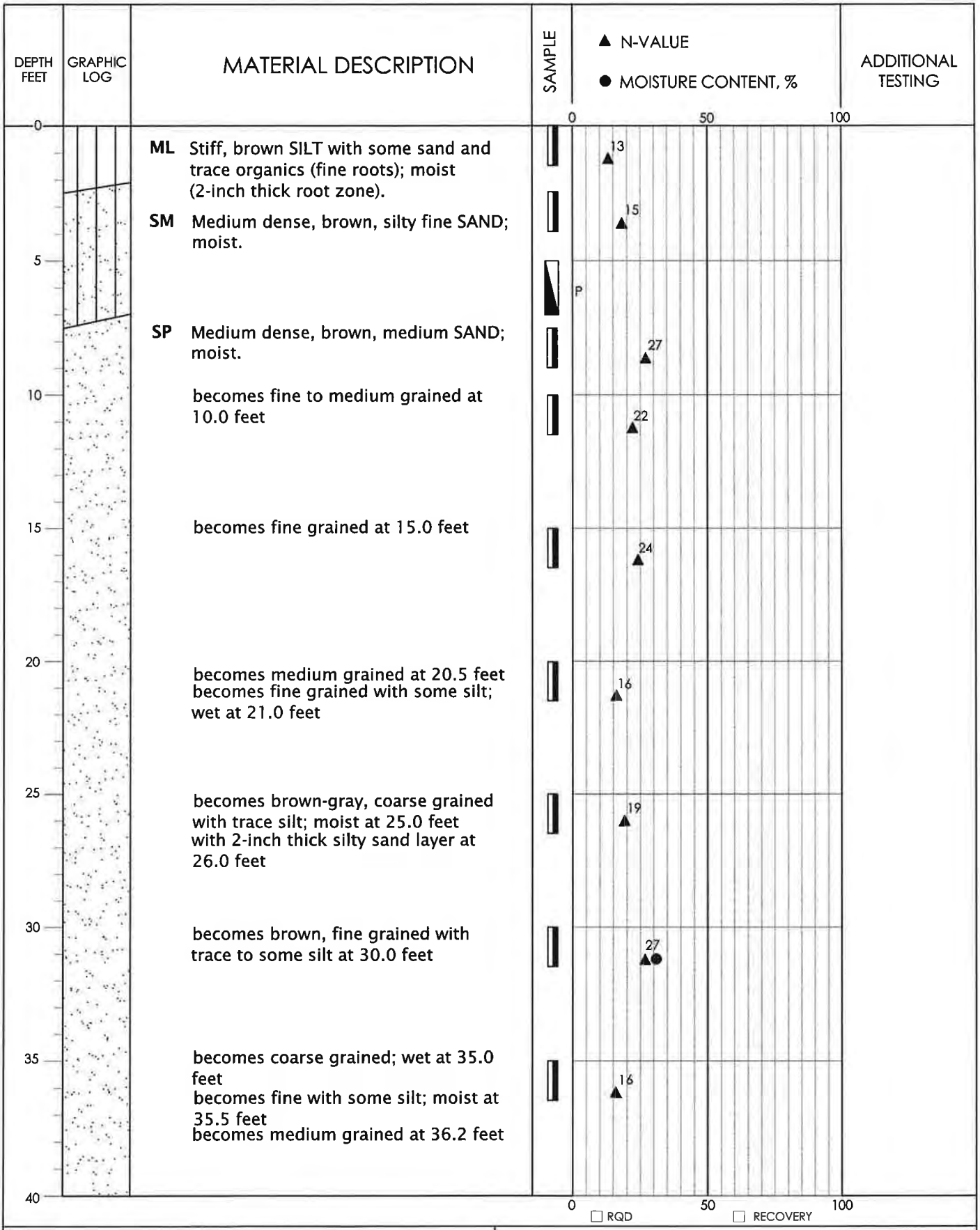
NOVELLUS-4	DECEMBER 2000	FIGURE A-6



GEODESIGN INC

BORING B-6 (CONT.)

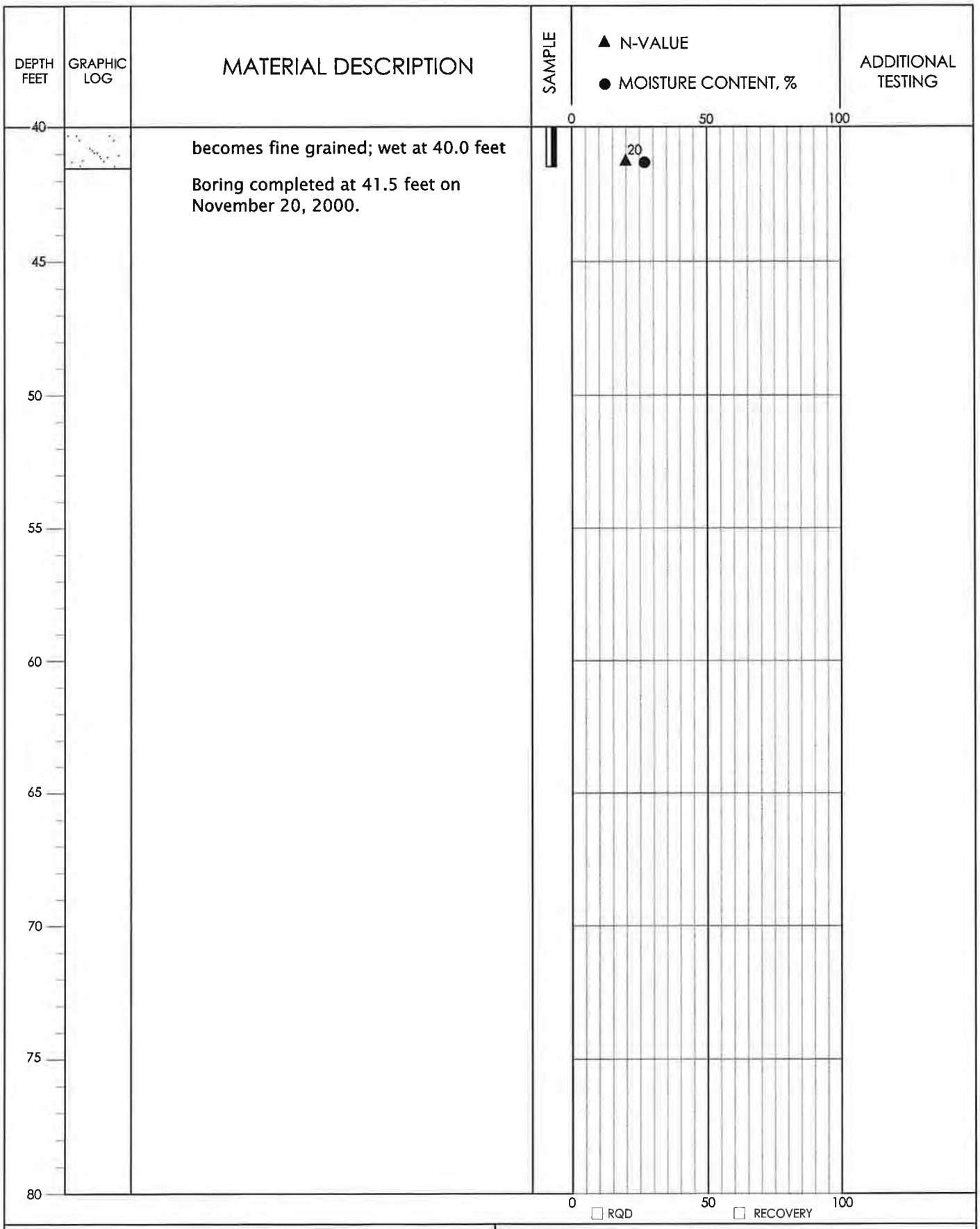
NOVELLUS-4	DECEMBER 2000	FIGURE A-6



GEODESIGN INC

BORING B-7

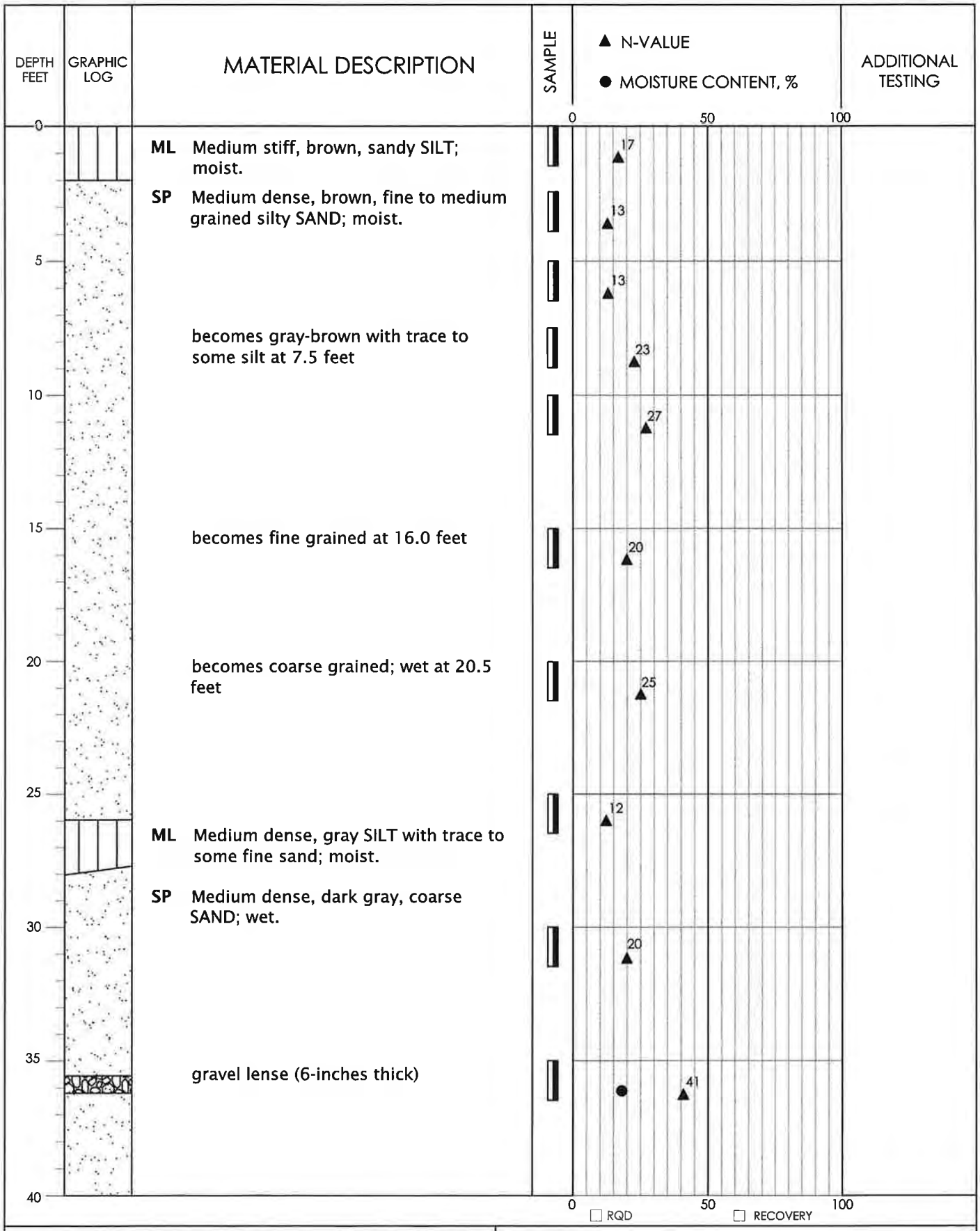
NOVELLUS-4	DECEMBER 2000	FIGURE A-7



GEODESIGN INC

BORING B-7 (CONT.)

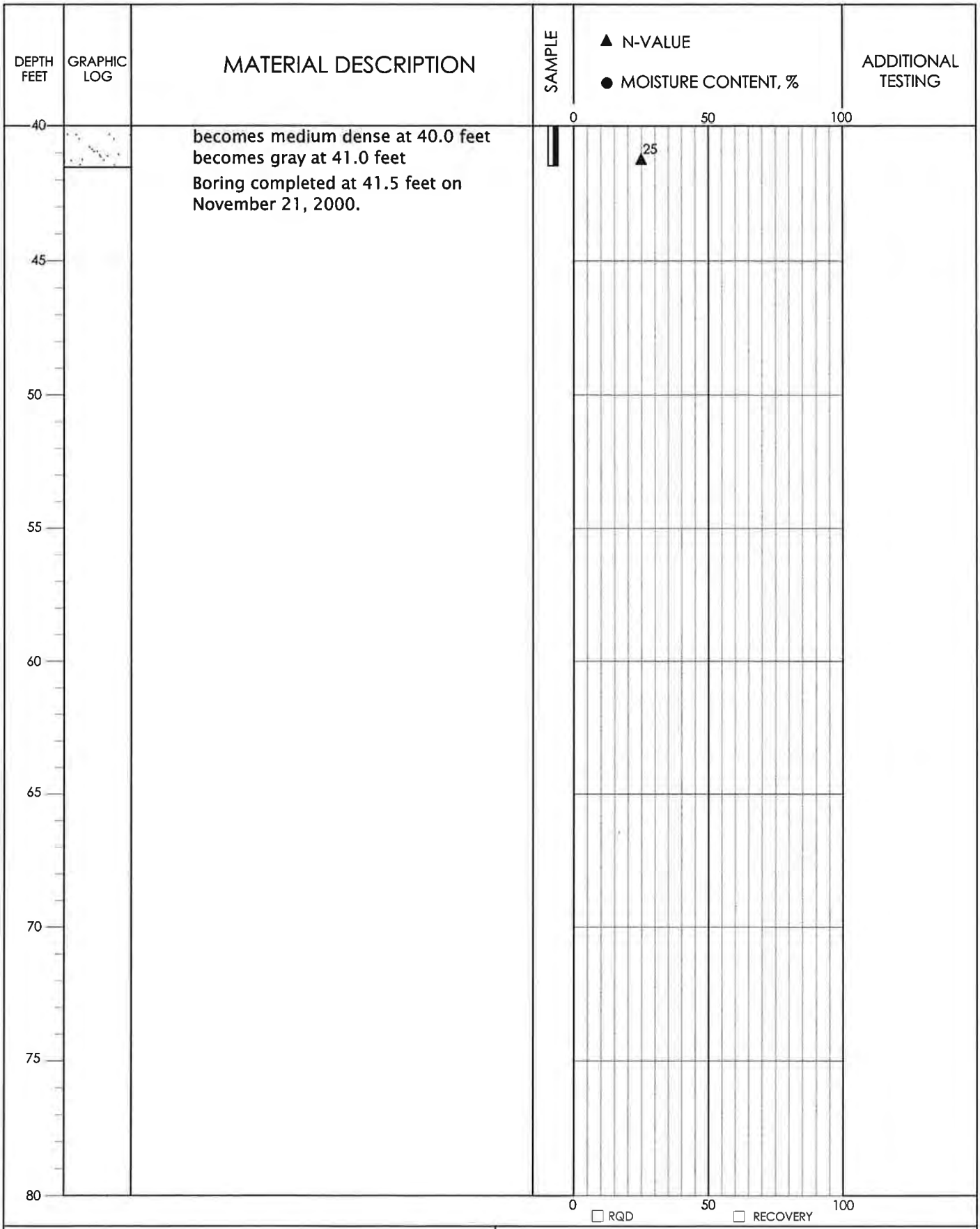
NOVELLUS-4	DECEMBER 2000	FIGURE A-7



GEODESIGN INC

BORING B-8

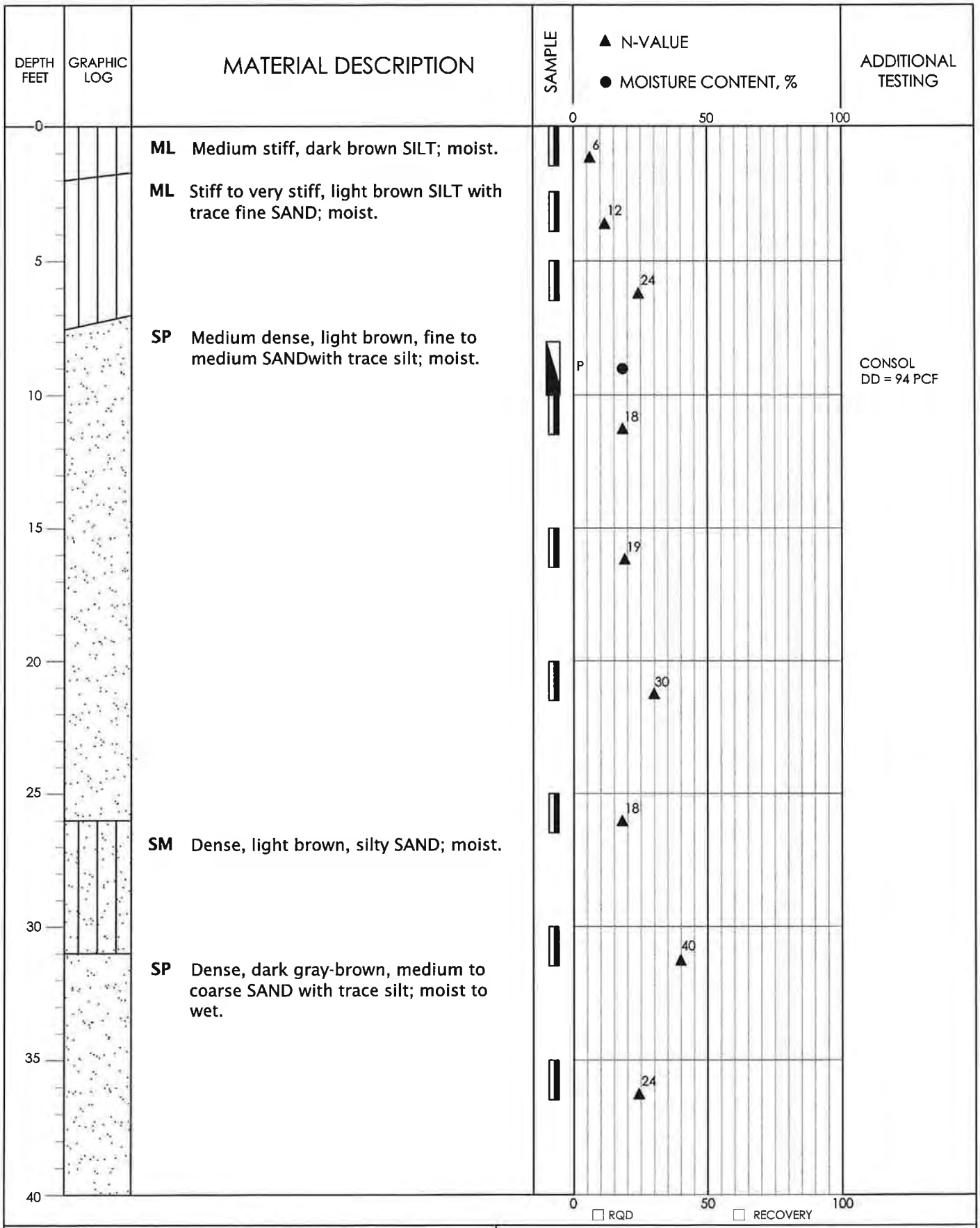
NOVELLUS-4 | DECEMBER 2000 | FIGURE A-8



GEODESIGN INC

BORING B-8 (CONT.)

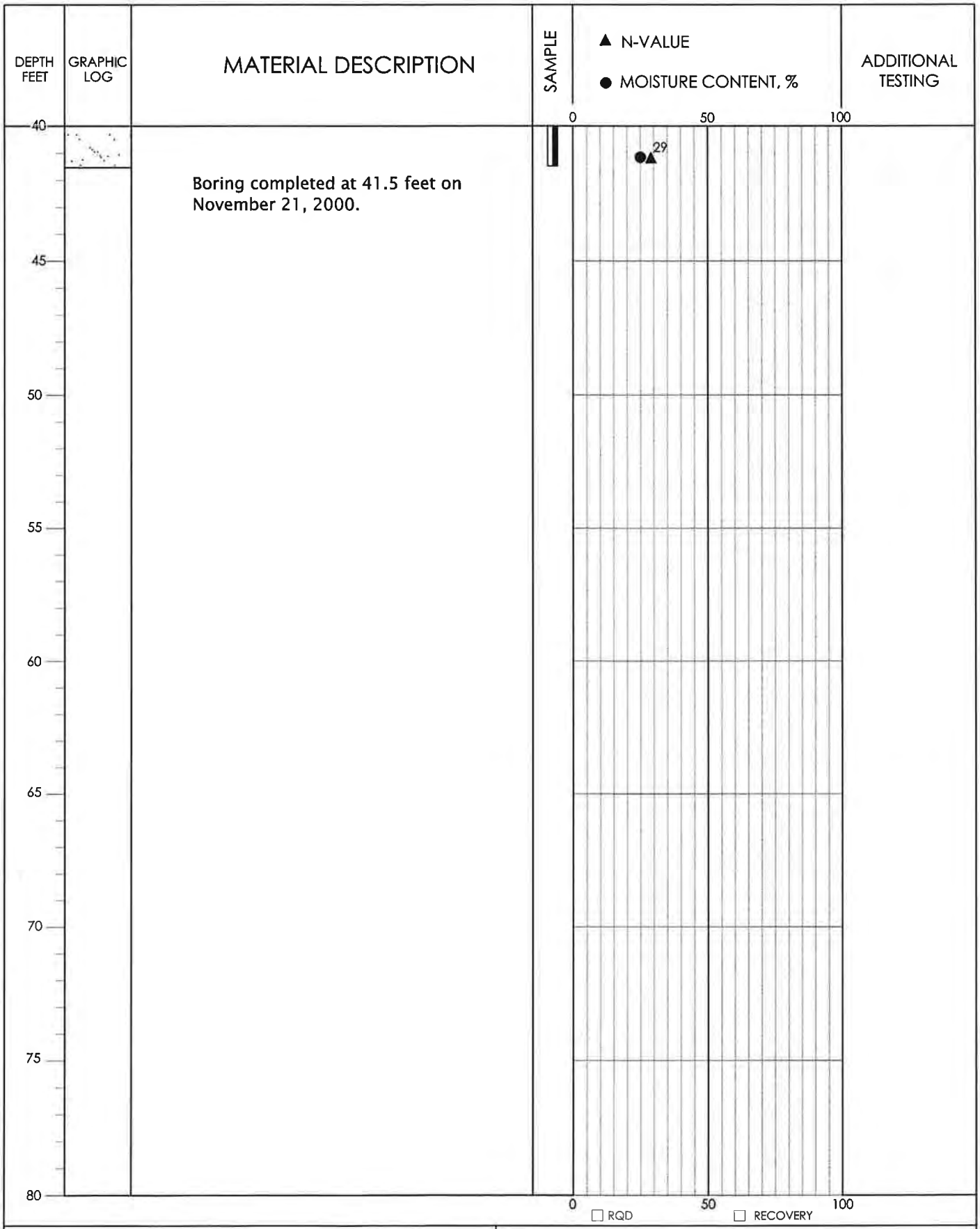
NOVELLUS-4	DECEMBER 2000	FIGURE A-8



GEODESIGN INC

BORING B-9

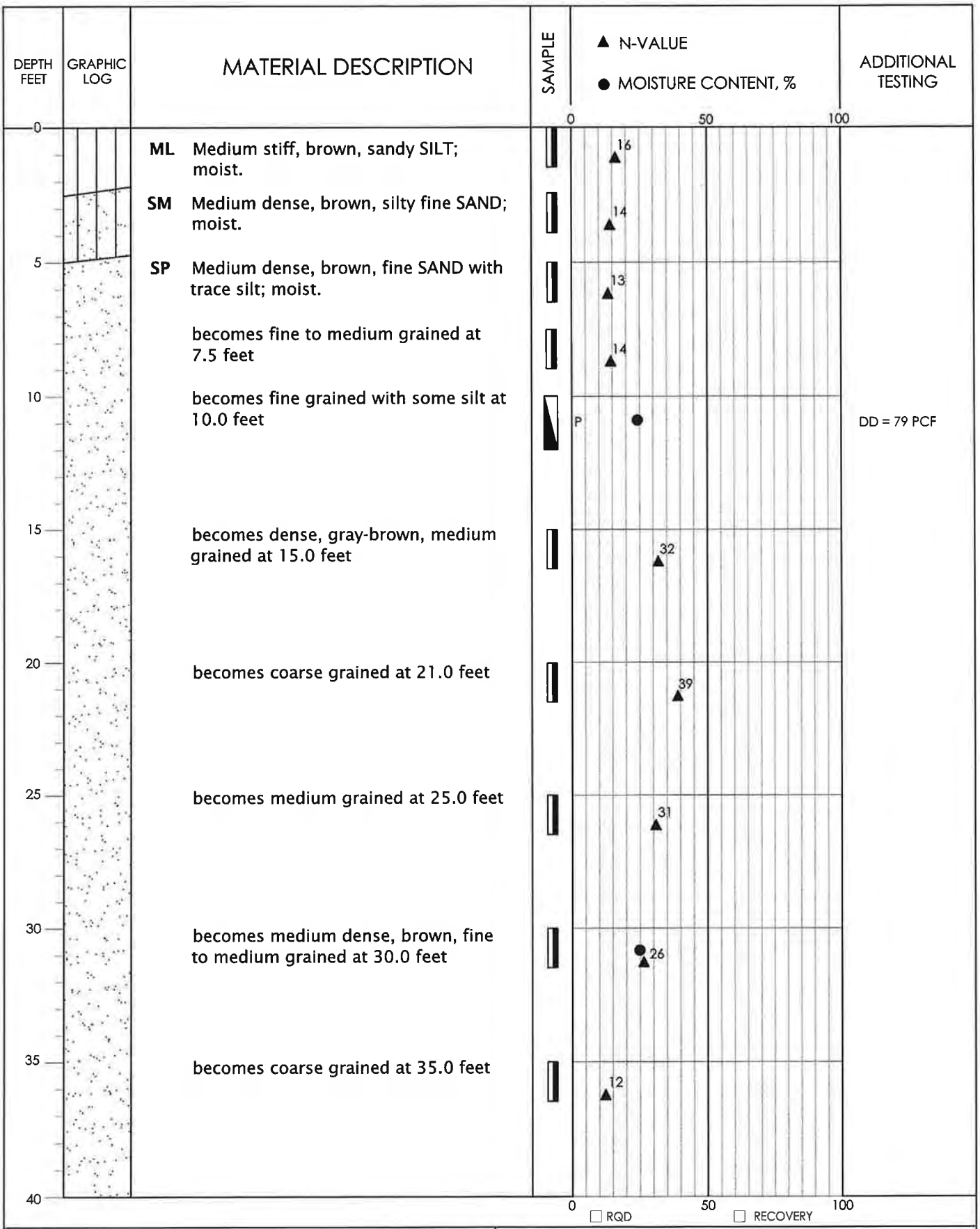
NOVELLUS-4	DECEMBER 2000	FIGURE A-9



GEODESIGN INC

BORING B-9 (CONT.)

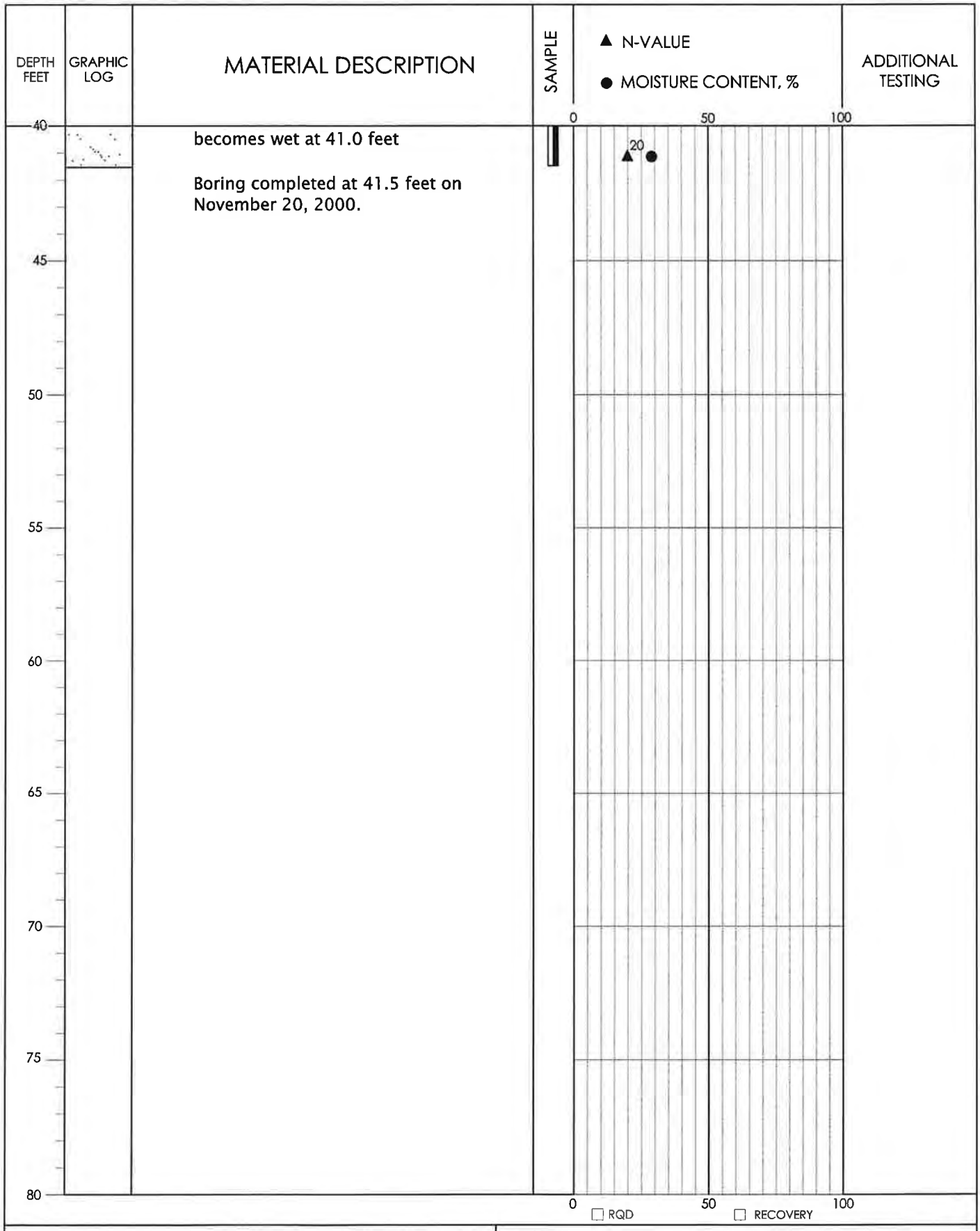
NOVELLUS-4	DECEMBER 2000	FIGURE A-9



GEODESIGN INC

BORING B-10

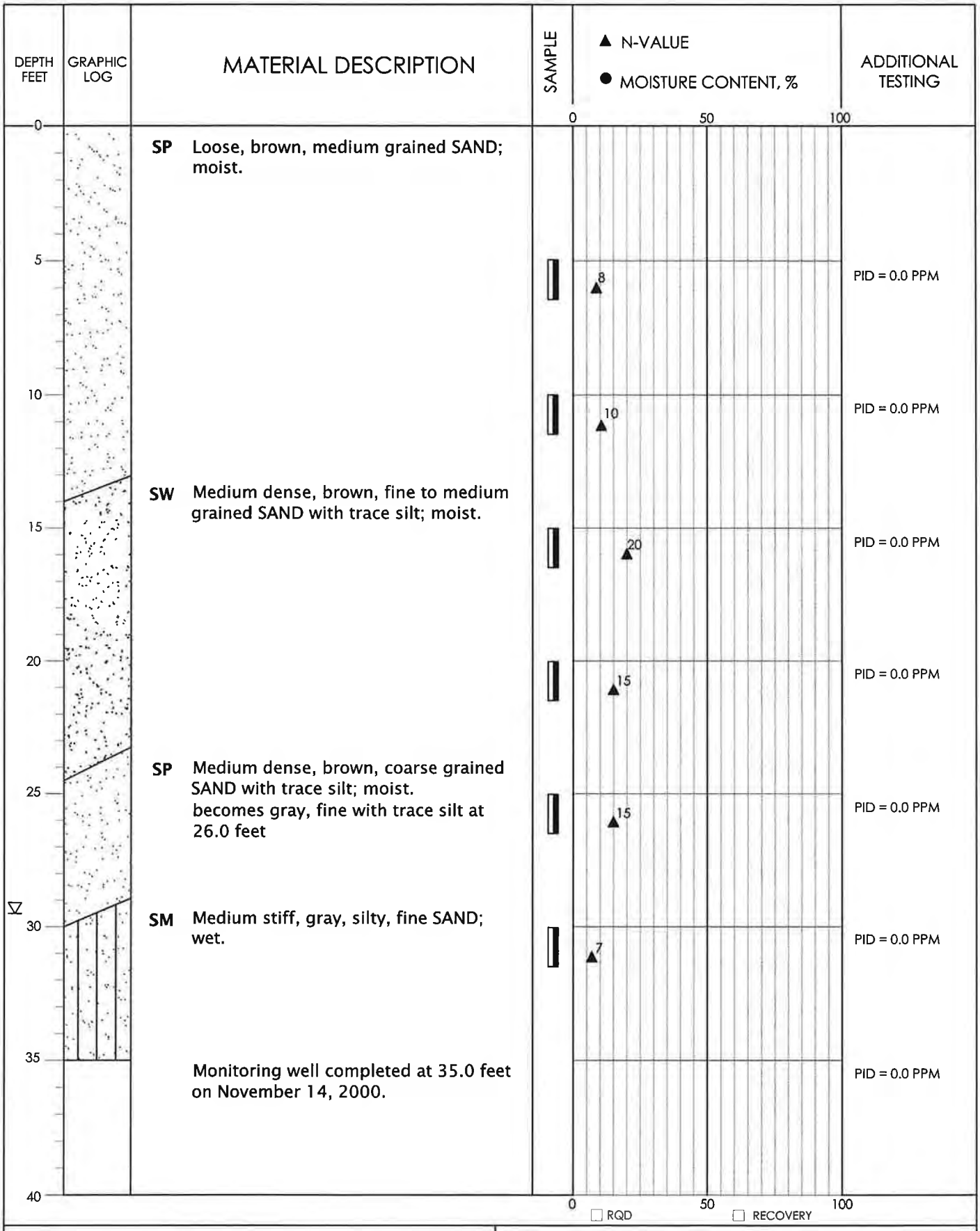
NOVELLUS-4	DECEMBER 2000	FIGURE A-10



GEODESIGN INC

BORING B-10 (CONT.)

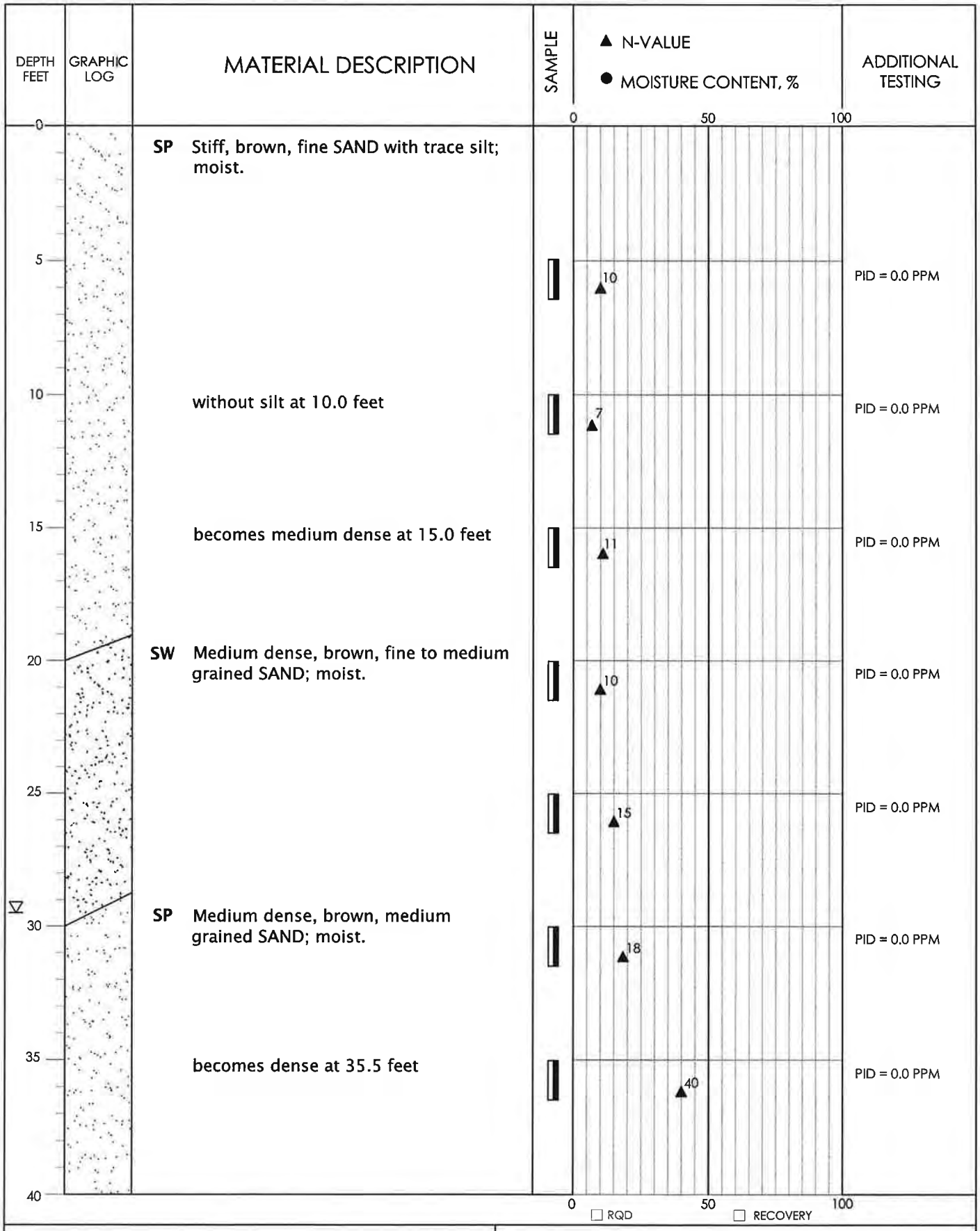
NOVELLUS-4	DECEMBER 2000	FIGURE A-10



GEODESIGN INC

MONITORING WELL MW-1

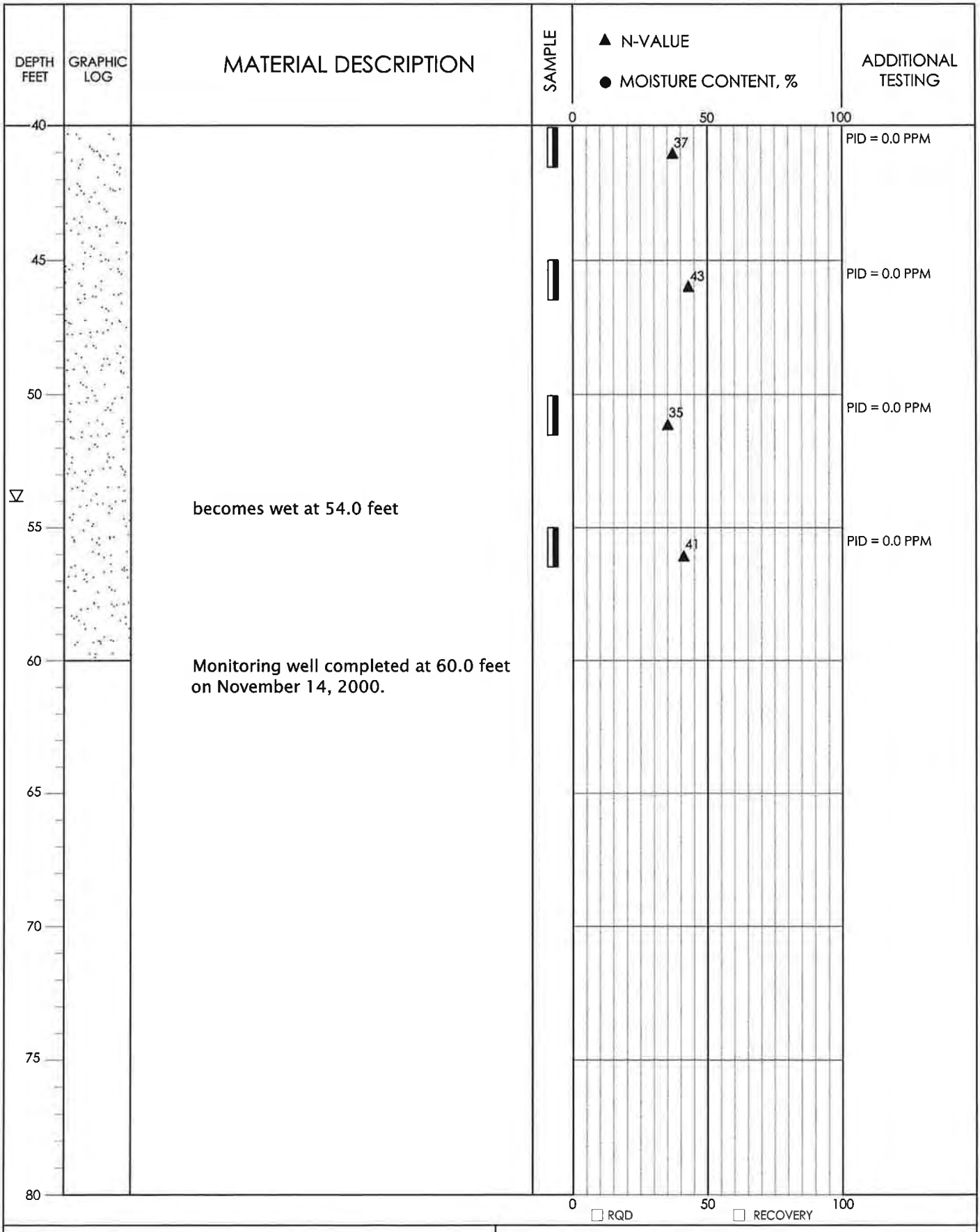
NOVELLUS-4	DECEMBER 2000	FIGURE A-11



GEODESIGN INC

MONITORING WELL MW-2

NOVELLUS-4	DECEMBER 2000	FIGURE A-12



GEODESIGN INC

MONITORING WELL MW-2 (CONT.)

NOVELLUS-4	DECEMBER 2000	FIGURE A-12

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-1

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	SP	Medium dense, dark brown SAND with some silt moist (2-inch thick root zone, 2-inch thick topsoil layer).	
1			
2		becomes dense, brown without silt at 2.0 feet	W = 10%
3			
4			W = 9%
5			
6		becomes medium dense at 6.0 feet	
7			
8			
9			
10			
11			
12		Test pit completed at 12.0 feet on November 9, 2000.	
13		Disturbed samples obtained at 2.0, 4.0, 6.0, 8.0, 10.0 and 12.0 feet.	
14		No groundwater seepage observed to the depth explored.	
15		No caving observed to the depth explored.	

TP-2

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	SM	Medium dense, dark brown silty SAND; moist (2-inch thick rooted zone, 12-inch thick topsoil layer).	W = 21%
1			
2	SP	Dense, brown SAND with some silt; moist.	
3		becomes dense to very dense at 3.0 feet	
4		grades to without silt at 4.0 feet	
5			
6			
7			
8			
9			
10			
11			
12		Test pit completed at 12.0 feet on November 9, 2000.	
13		Disturbed samples obtained at 1.0, 3.0, 5.0, 7.0, 9.0 and 11.0 feet.	
14		No groundwater seepage observed to the depth explored.	
15		Minor caving observed from 6.0 to 12.0 feet.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-13

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-3

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	SM	Medium dense, dark brown, silty SAND with trace organics; moist (2.5-inch thick root zone, 12-inch thick topsoil layer).	
1		becomes very dense, light brown, cemented at 1.8 feet	
2			
3			
4	SP	Medium dense, dark brown SAND with trace to some silt; moist.	
5		becomes dense to very dense, brown with occasional gravel at 5.0 feet	
6			
7			
8			
9			
10			
11			
12			
13		Test pit completed at 12.5 feet on November 9, 2000. Disturbed samples obtained at 2.0, 4.0, 8.0 and 12.0 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.	
14			
15			

TP-4

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Medium stiff, dark brown, sandy SILT; moist (2.5-inch thick root zone, 12-inch thick topsoil layer).	W = 24%
1			
2		grades to hard, light brown with some sand at 2.0 feet	
3			W = 20%
4			
5			
6	SP	Very dense, orange and brown, cemented, medium grained SAND; moist.	
7			
8			
9		becomes brown and not cemented at 9.0 feet	
10			
11			
12		Test pit completed at 12.0 feet on November 9, 2000. Disturbed samples obtained at 0.5, 3.0, 7.0 and 12.0 feet. No groundwater seepage observed to the depth explored. Minor caving observed from 10.0 to 12.0 feet.	
13			
14			
15			

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-14

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-5

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 2	ML	Very stiff, dark brown SILT with trace fine sand and organics (2-inch thick root zone, 12-inch thick topsoil layer). becomes very dense, light brown, cemented at 1.8 feet	PP = 2.0 TSF PP = 3.5 TSF PP = 2.75 TSF
3 - 6	SM	Dense to very dense, light brown, fine silty SAND; moist.	W = 14%
7 - 12	SP	Dense, brown, medium grained SAND; moist. becomes dark brown at 9.0 feet	
13 - 15		Test pit completed at 12.5 feet on November 9, 2000. Disturbed samples obtained at 2.5, 4.0, 7.0 and 9.0 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.	

TP-6

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 1	ML	Stiff, dark brown SILT with trace sand and organics (roots) and occasional gravel; moist (2-inch thick heavily root zone, 16-inch thick topsoil layer).	PP = 1.75 TSF W = 23%
2 - 4	SM	Dense, light brown, silty fine SAND; moist. becomes very dense at 2.5 feet	W = 16%
5 - 12	SP	Dense to very dense, light brown, fine SAND; moist. grades to trace silt at 11.0 feet	
13 - 15		Test pit completed at 12.5 feet on November 9, 2000. Disturbed samples obtained at 0.5, 3.0, 6.0 and 11.0 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-15

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-7

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Medium stiff to stiff, dark brown SILT with trace organics; moist (2-inch thick heavily root zone, 12-inch thick topsoil layer).	
1		becomes light brown with trace sand at 1.5 feet	
2			
3	SM	Dense to very dense, light brown, silty fine SAND; moist.	
4			
5	SP	Dense to very dense, light brown, fine SAND with trace silt; moist.	W = 11%
6			
7		becomes brown, fine to medium grained and cemented at 70 feet	
8			
9			
10		not cemented at 10.0 feet	
11			
12			
13		Test pit completed at 12.5 feet on November 9, 2000.	
14		Disturbed samples obtained at 2.0, 5.0, 7.0 and 12.0 feet.	
15		No groundwater seepage observed to the depth explored.	
		No caving observed to the depth explored.	

TP-8

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Stiff to very stiff, dark brown SILT with trace sand and organics; moist (2.5-inch thick root zone, 16-inch thick topsoil layer).	
1			
2			W = 18%
3	SM	Dense to very dense, light brown silty SAND; moist.	
4	SP	Dense to very dense, light brown, fine SAND with trace silt; moist.	
5		becomes gray-brown, medium grained without silt at 5.5 feet	
6			
7			
8			
9			
10			
11			
12			
13		becomes light brown, fine with trace silt at 13.0 feet	
14		Test pit completed at 15.0 feet on November 9, 2000.	
15		Relatively undisturbed sample obtained from 2.25 to 4.25 feet.	
		Disturbed samples obtained at 2.0, 4.0, 11.5, 13.0 and 15.0 feet.	
		No groundwater seepage or caving observed to the depth explored.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-16

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-9

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 3	ML	Stiff to very stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 12-inch thick topsoil layer). becomes light brown at 1.5 feet becomes hard at 2.0 feet	PP = 3.0 TSF W = 22% PP >4.0 TSF
4 - 14	SP	Dense to very dense, light brown, fine SAND with trace silt; moist. becomes medium grained without silt at 7.0 feet becomes brown at 10.0 feet	
15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 1.0, 4.0 and 12.0 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.	

TP-10

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 4	ML	Stiff to very stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 12-inch thick topsoil layer). becomes light brown at 1.5 feet	
5 - 14	SP	Dense to very dense, light brown, fine SAND with trace silt; moist. becomes medium grained without silt at 12.0 feet becomes brown at 12.0 feet	
15		Test pit completed at 15.0 feet on November 10, 2000. Relatively undisturbed sample obtained from 0.5 to 2.5 feet. Disturbed sample obtained at 7.0 feet. No groundwater seepage or caving observed to the depth explored.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-17

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-11

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Stiff to very stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone).	
1			PP = 2.0 TSF
2		grades to light brown with trace to some fine sand and without organics at 2.0 feet	W = 16%
3			
4	SP	Very dense, light brown, fine SAND with trace to some silt; moist.	PP >4.0 TSF
5		grades to trace silt at 5.0 feet	W = 17%
6			
7		becomes light orange-brown, cemented with interbedded silt layers at 7.0 feet	
8			
9			
10		becomes light brown, fine to medium grained without silt and not cemented at 10.0 feet	
11			
12		becomes medium grained at 12.5 feet	
13		becomes gray-brown at 13.5 feet	
14			
15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 5.0, 7.0 and 10.0 feet. No groundwater seepage or caving observed to the depth explored.	

TP-12

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Very stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 10-inch thick topsoil layer).	PP = 2.5 TSF
1		becomes hard, light brown at 1.5 feet	PP >4.0 TSF
2	SM	Very dense, light brown, silty SAND; moist.	
3			W = 17%
4			
5	SP	Dense to very dense, light brown, fine SAND with trace to some silt; moist.	
6		becomes cemented at 6.0 feet	
7			
8		becomes brown, medium grained at 8.0 feet	
9			
10		not cemented and without silt at 10.0 feet	
11			
12			
13			
14			
15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 3.0, 8.0 and 12.0 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-18

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-13

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Very stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 10-inch thick topsoil layer).	PP = 2.0 TSF
1			PP = 3.5 TSF
2		becomes light brown with out organics at 2.0 feet	
3	SM	Very dense, light brown, silty fine SAND; moist.	W = 13%
4			
5	SP	Very dense, light brown, fine SAND with trace to some silt; moist.	W = 24%
6			
7		becomes orange-brown, cemented, medium grained at 7.0 feet	
8			
9			
10		becomes brown at 10.0 feet	
11			
12			
13			
14			
15		Test pit completed at 15.0 feet on November 10, 2000. Relatively undisturbed sample obtained from 6.0 to 8.0 feet. Disturbed samples obtained at 3.0, 5.0, 7.5 and 15.0 feet. No groundwater seepage or caving observed to the depth explored.	

TP-14

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 18-inch thick topsoil layer).	PP = 1.25 TSF
1			
2		becomes light brown with trace to some sand and without organics at 2.0 feet	
3			
4	SP	Dense to very dense, light brown, fine SAND with some silt; moist.	W = 18%
5			
6			
7		becomes cemented with trace to some silt at 7.0 feet	
8		becomes dense, brown-gray and not cemented at 8.0 feet	
9			
10			
11			
12		becomes medium grained at 12.5 feet	
13			
14		becomes gray fine to medium grained at 14.5 feet	
15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 4.0, 8.0 and 15.0 feet. No groundwater seepage or caving observed to the depth explored.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-19

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-15

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 1	ML	Stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 18-inch thick topsoil layer).	PP = 1.25 TSF
1 - 2		becomes very stiff at 1.0 foot	PP = 2.5 TSF
2 - 3	SM	Very dense , light brown, silty SAND; moist.	W = 14%
3 - 4		trace roots (15-inch diameter) at 2.5 feet	
4 - 5	SP	Dense to very dense, light brown, fine SAND with trace silt; moist.	W = 14%
5 - 6			
6 - 7			
7 - 8		becomes light brown-gray and cemented at 7.0 feet	
8 - 9			
9 - 10			
10 - 11		becomes without silt and not cemented at 10.0 feet	
11 - 12			
12 - 13			
13 - 14		becomes fine to medium grained at 13.5 feet	
14 - 15			
15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 4.5, 7.0 and 10.5 feet. No groundwater seepage or caving observed to the depth explored.	

TP-16

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 1	ML	Stiff, dark brown SILT with trace sand and organics; moist (3-inch thick root zone, 12-inch thick topsoil layer).	PP = 1.5 TSF W = 24%
1 - 2			
2 - 3	SM	Dense to very dense, light brown, fine silty SAND with trace silt; moist.	W = 15%
3 - 4			
4 - 5	SP	Dense to very dense, light brown, cemented SAND with trace silt; moist.	
5 - 6			
6 - 7			
7 - 8			
8 - 9		becomes gray- brown, fine to medium grained without silt and not cemented at 10.0 feet	
9 - 10			
10 - 11			
11 - 12			
12 - 13			
13 - 14			
14 - 15		becomes medium grained at 15.0 feet Test pit completed at 15.0 feet on November 10, 2000. Relatively undisturbed sample obtained from 4.0 to 6.0 feet. Disturbed samples obtained at 1.0, 3.0, 5.0 and 11.0 feet. No groundwater seepage or caving observed to the depth explored.	

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-17

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 3	ML	Stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 12-inch thick topsoil layer). becomes red-brown from 1.0 to 2.0 feet becomes stiff, dark brown, sandy at 2.0 feet	PP = 1.5 TSF W = 18%
4 - 14	SP	Dense to very dense, light brown, fine SAND with some silt; moist. becomes cemented at 7.5 feet becomes brown-gray without silt and not cemented at 10.0 feet becomes medium grained at 12.5 feet	W = 16%
15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 1.5, 4.0, 8.0 and 12.5 feet. No groundwater seepage or caving observed to the depth explored.	

TP-18

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 1	ML	Very stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 14-inch thick topsoil layer).	PP = 3.0 TSF
2 - 3	SM	Very dense, light brown, silty fine SAND; moist.	
4 - 14	SP	Very dense, light brown, fine SAND with trace to some silt; moist. becomes cemented at 6.0 feet without silt and not cemented at 9.0 feet becomes brown-gray at 10.0 feet becomes medium grained at 10.5 feet	
15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 4.0, 9.0 and 15.0 feet. No groundwater seepage or caving observed to the depth explored.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-21

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-19

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Stiff, dark brown SILT with trace sand and organics; moist (12-inch thick topsoil layer).	PP = 1.5 TSF
1			
2		becomes hard, brown with trace to some fine sand at 2.0 feet	W = 19%
3	SM	Dense to very dense, brown, silty fine SAND; moist.	
4			W = 21%
5			
6	SP	Dense to very dense, light brown, fine SAND with some silt and interbedded silt lenses; moist.	
7			
8		becomes gray-brown and without silt at 8.0 feet	
9			
10			
11			
12			
13			
14		Test pit completed at 14.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 4.0 and 8.0 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.	
15			

TP-20

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0	ML	Very stiff, dark brown SILT with trace sand and organics; moist (2-inch thick root zone, 12-inch thick topsoil layer).	PP = 2.5 TSF
1			
2		becomes hard, brown with trace to some sand at 2.0 feet	
3	SM	Dense to very dense, brown, silty SAND; moist.	
4			
5	SP	Dense to very dense, brown, fine SAND with trace silt; moist. becomes cemented at 6.0 feet	
6			
7		without silt at 8.0 feet	
8		not cemented at 10.0 feet	
9			
10			
11		becomes fine to medium grained at 12.0 feet	
12			
13			
14		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 5.0 and 12.0 feet. No groundwater seepage or caving observed to the depth explored.	
15			

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-22

DEPTH/FT	MATERIAL DESCRIPTION	TESTING

TP-21

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 2	ML	Very stiff, dark brown SILT with trace sand and organics; moist (12-inch topsoil layer).	PP = 2.5 TSF W = 17%
3 - 5	SM	Dense to very dense, brown, silty SAND; moist.	W = 17%
6 - 14	SP	Dense to very dense, light brown, cemented fine SAND with trace to some silt; moist. becomes brown-gray without silt and not cemented at 9.0 feet grades to trace silt at 11.0 feet grades to fine to medium grained without silt at 13.0 feet	
14 - 15		Test pit completed at 14.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 5.0, 6.0 and 14.0 feet. No groundwater seepage observed to the depth explored. No caving observed to the depth explored.	

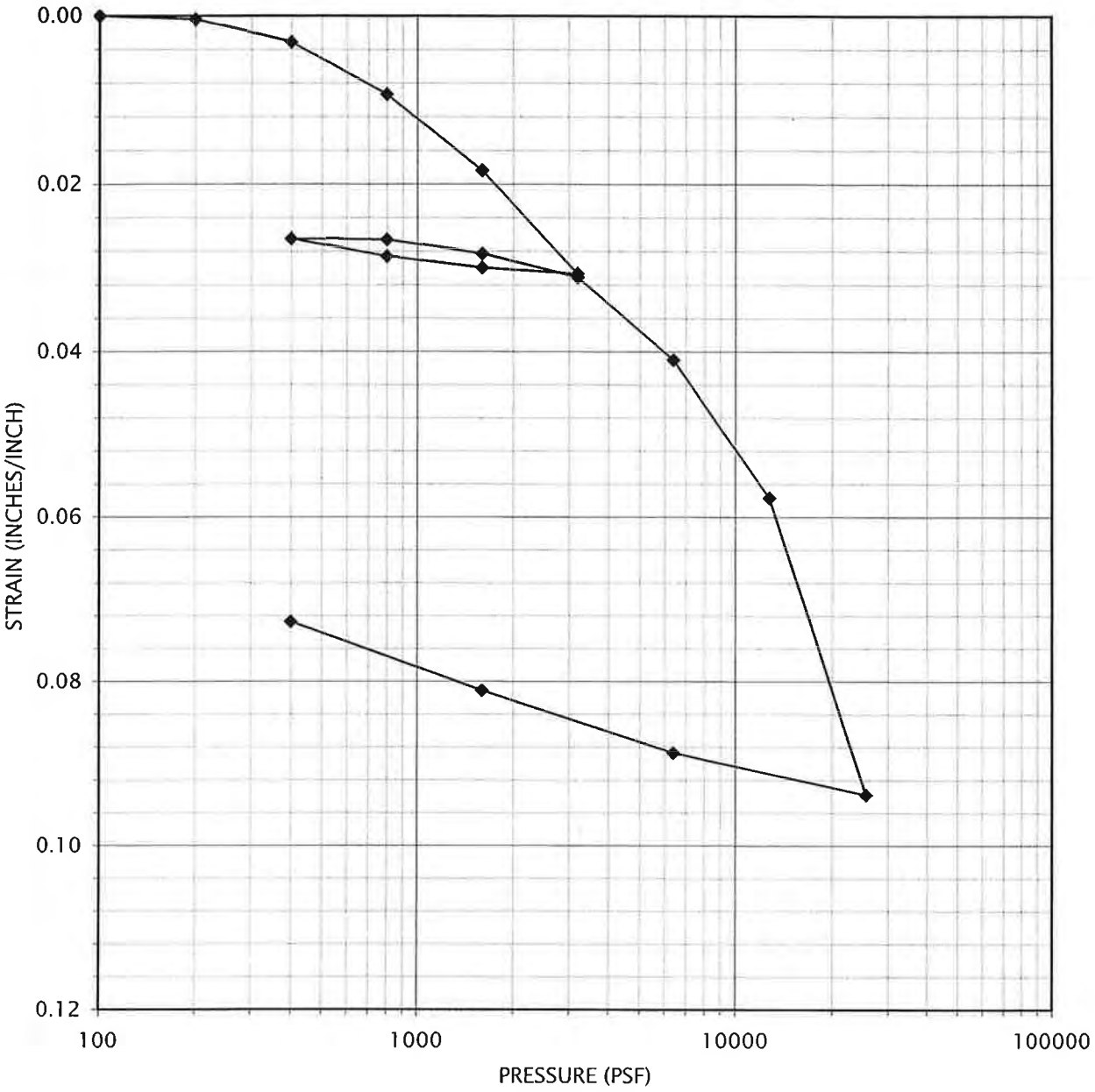
TP-22

DEPTH/FT		MATERIAL DESCRIPTION	TESTING
0 - 3	ML	Very stiff, dark brown SILT with trace sand and organics and occasional gravel; moist (2-inch thick root zone, 14-inch thick topsoil layer). becomes brown at 1.5 feet grades to trace to some sand at 2.0 feet	PP = 2.5 TSF W = 12%
4 - 14	SP	Dense to very dense, brown, fine SAND with trace silt; moist. becomes medium grained at 6.0 feet	W = 15%
14 - 15		Test pit completed at 15.0 feet on November 10, 2000. Disturbed samples obtained at 2.0, 4.5 and 6.0 feet. No groundwater seepage observed to the depth explored. Minor caving observed from 8.0 to 15.0 feet.	

GEODESIGN INC

TEST PIT LOGS

NOVELLUS-4	DECEMBER 2000	FIGURE A-23

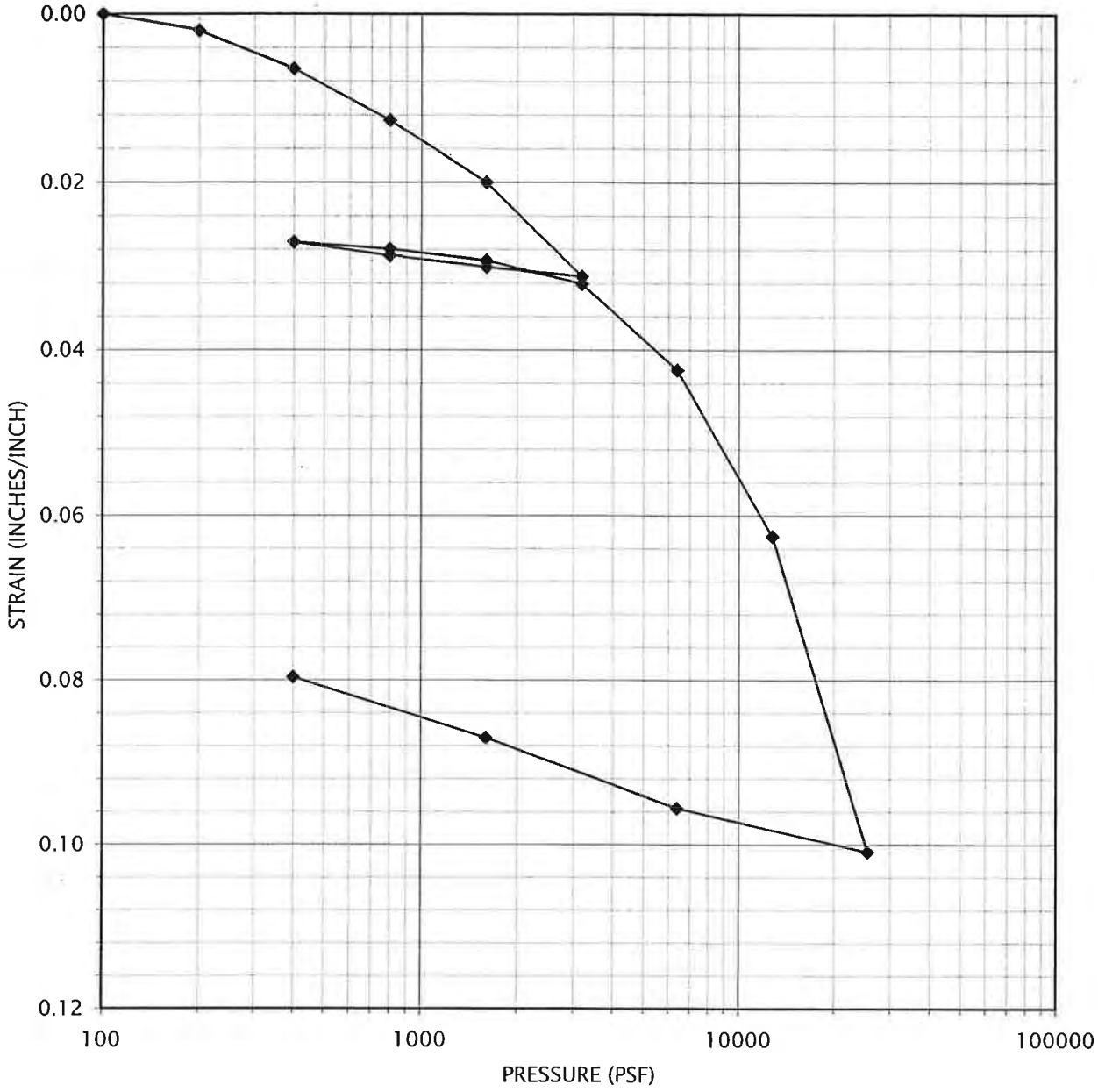


KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SOIL DESCRIPTION
—◆—	B-4	4.5	24	88	Medium dense, red-brown, fine SAND with trace to some silt; moist. (SP)

GEODESIGN INC

CONSOLIDATION TEST RESULTS

NOVELLUS-4	DECEMBER 2000	FIGURE A-24



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	SOIL DESCRIPTION
—◆—	B-9	8.5	19	94	Medium dense, light brown, fine to medium SAND with trace silt; moist. (SP)

GEODESIGN INC

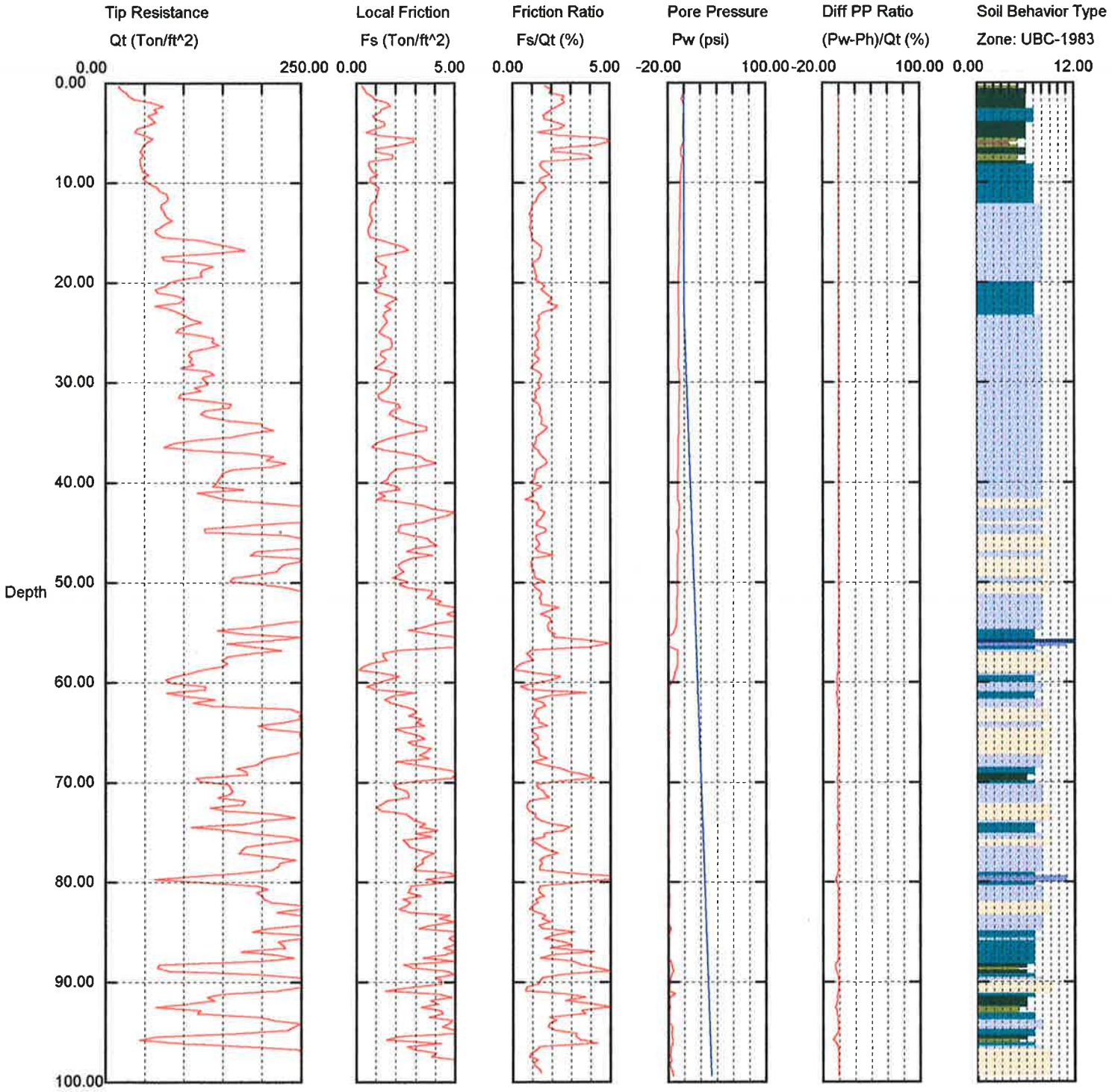
CONSOLIDATION TEST RESULTS

NOVELLUS-4	DECEMBER 2000	FIGURE A-25

Subsurface Technologies

Operator: W.MCC / A.MEE
Sounding: SND202
Cone Used: 442 TC

CPT Date/Time: 11-15-00 10:03
Location: CPT-2 TUALITAIN
Job Number: NOVELLUS-3



Maximum Depth = 99.41 feet

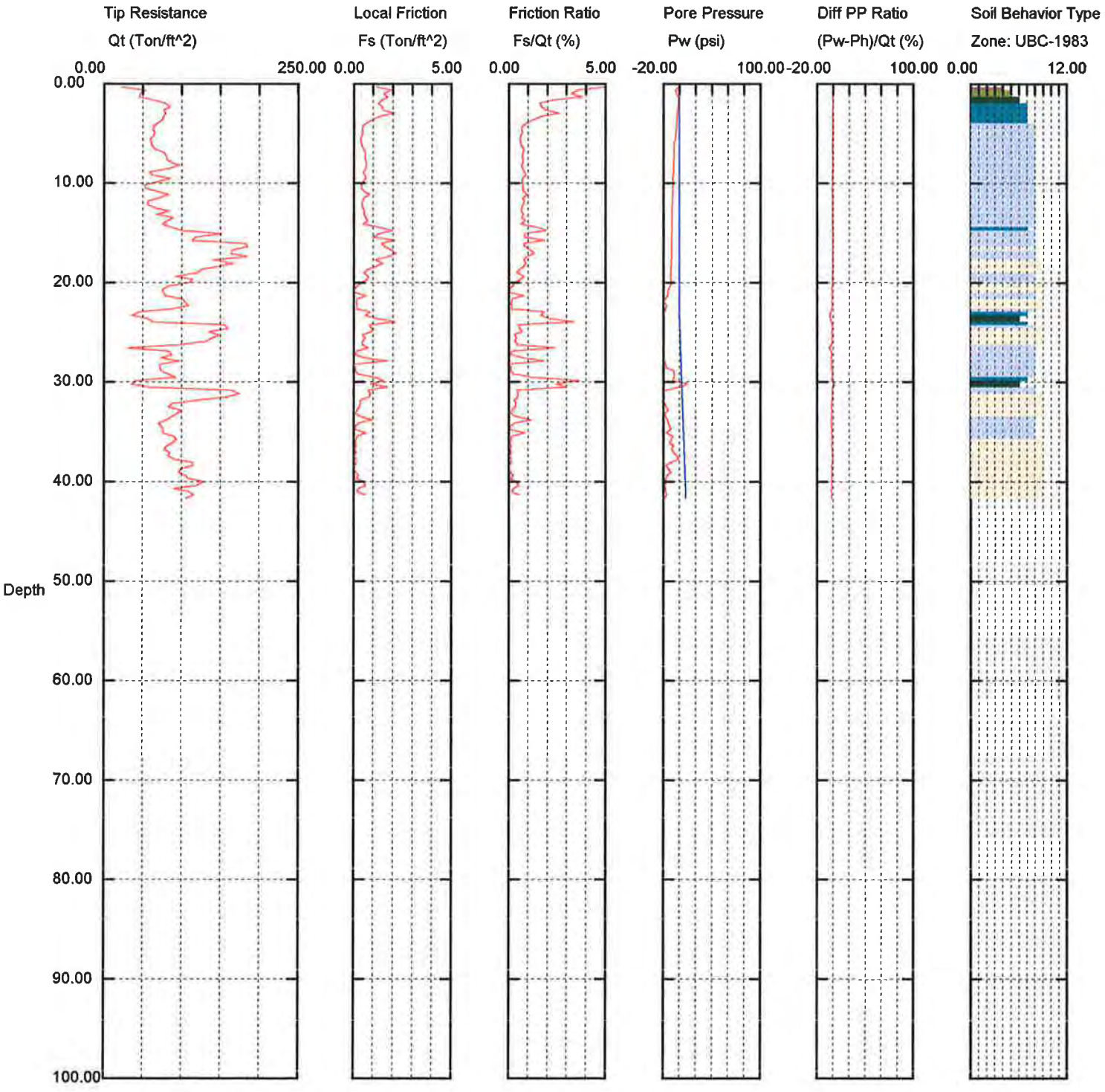
Depth Increment = 0.16 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

Subsurface Technologies

Operator: W.MCC / A.MEE
Sounding: SND201
Cone Used: 442 TC

CPT Date/Time: 11-15-00 08:32
Location: CPT-1 TUALITAIN
Job Number: NOVELLUS-3



Maximum Depth = 41.67 feet

Depth Increment = 0.16 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

STUART GREENBERGER ENGINEERING, INC.
P.O. BOX 1911, PORTLAND, OREGON 97207
TELEPHONE (503) 635-6516

To: GeoDesign, Inc., Brad Hupy
From: Stuart Greenberger, P.E.
Date: November 16, 2000
Subject: Soil Resistivity Test for Novellus

Attached are the soil resistivity measurements and interval calculations. Based on log probability distribution, the expected soil resistivities at 50% and 95% probabilities are as follows; however, note that the interval resistivities indicate distorted soil layers.

Soil Layer	**Resistivity (ohm-cm)**	
Interval (ft)	50% probability	95% probability
0-2½	525,000	1,100,000 or less
2½-5	20,000	35,000 or less[1]
5-7½	6,500	17,000 or less
7½-10	30,000	250,000 or less
10-15	15,000	40,000 or less
15-50	30,000	250,000 or less
0-5	35,000	80,000 or less
0-7½	14,000	30,000 or less

[1] Outliers at ranked percentiles of 90% and 95% are 90,000 ohm-cm and 225,000 ohm-cm, respectively.

EXPIRES 6/02

Novellus, Tualatin

4-Pin Resistivity Measurements (ohm-cm)[1]

Surface-to-Depth Resistivity

NORTH LINE

Depth (ft)	WEST				EAST
0-2½	550,000	425,000	950,000	520,000	260,000
0-5	25,000	32,000	29,000	27,000	26,000
0-7½	9,900	15,000	11,000	12,500	9,500
0-10	13,000	20,000	14,600	14,400	13,000
0-15	12,600	21,000	14,700	21,000	11,100
0-50	13,000	41,000	NR[2]	9,600	33,000

NORTH CENTER LINE

Depth (ft)	WEST			EAST
0-2½	650,000	370,000	445,000	335,000
0-5	48,000	35,000	30,000	34,000
0-7½	11,100	9,300	8,700	12,450
0-10	11,000	10,600	10,000	18,200
0-15	12,900	9,900	9,300	15,000
0-50	14,000	20,000	25,000	27,000

SOUTH CENTER LINE

Depth (ft)	WEST		EAST
0-2½	600,000	375,000	470,000
0-5	34,000	22,000	39,000
0-7½	12,800	13,400	10,100
0-10	13,800	16,000	12,600
0-15	12,000	19,800	15,600
0-50	62,000	NR[2]	39,000

SOUTH LINE

Depth (ft)	WEST				EAST
0-2½	435,000	750,000	650,000	900,000	1,000,000
0-5	25,000	50,000	54,000	90,000	43,000
0-7½	9,200	24,000	28,500	37,500	24,000
0-10	13,000	26,000	32,000	44,000	28,000
0-15	13,500	25,200	24,000	33,000	21,900
0-50	13,000	16,000	13,000	44,000	NR[2]

[1] Nilsson 400 AC soil resistivity meter

[2] NR - not reported, erratic interference

4-Pin Resistivity Measurements (ohm-cm)[1]

Interval Resistivity, Barnes Procedure

NORTH LINE

Depth (ft)	WEST				EAST
0-2½	550,000	425,000	950,000	520,000	260,000
2½-5	12,800	16,529	14,700	13,900	13,700
5-7½	4,500	7,143	4,900	6,000	4,200
7½-10	166,600	NR[3]	NR[3]	28,500	NR[3]
10-15	11,900	NR[3]	NR[3]	7,700	NR[3]
15-50	13,200	NR[3]	NR[3]	7,800	NR[3]

NORTH CENTER LINE

Depth (ft)	WEST			
0-2½	650,000	370,000	445,000	335,000
2½-5	25,000	18,400	227,300	17,900
5-7½	4,400	3,800	3,000	5,500
7½-10	63,500	18,100	2,700	NR[3]
10-15	11,500	8,800	8,200	NR[3]
15-50	14,500	41,200	87,500	NR[3]

SOUTH CENTER LINE

Depth (ft)	WEST		
0-2½	600,000	375,000	470,000
2½-5	17,200	11,300	20,500
5-7½	5,600	7,400	4,100
7½-10	18,600	41,700	3,500
10-15	9,500	37,700	5,700
15-50	NR[3]	NR[2]	108,700

SOUTH LINE

Depth (ft)	WEST				EAST
0-2½	435,000	750,000	650,000	900,000	1,000,000
2½-5	12,900	25,900	28,200	89,100	22,000
5-7½	4,000	11,800	14,700	17,300	12,700
7½-10	NR[3]	34,700	47,600	91,700	56,000
10-15	NR[3]	23,700	16,000	21,800	15,200
15-50	NR[3]	13,800	10,900	51,000	NR[2]

[1] Nilsson 400 AC soil resistivity meter

[2] NR - not reported, erratic interference

[3] NR - not reported, increased resistance within an incremental series

LEGEND:

B-1 BORING

N

0 50 100

(SCALE IN FEET)

SITE PLAN BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®, MARCH 14, 2017

SITE PLAN

GAS PAD EXPANSION
TUALATIN, OR

FIGURE 2

LAMRESCORP-4-01

APRIL 2017

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

Printed By: aday | Print Date: 4/18/2017 3:47:48 PM
File Name: J:\E-L\LamResCorp\LamResCorp-4\LamResCorp-4-01\Figures\CAD\LamResCorp-4-01-SP01.dwg | Layout: FIGURE 2

APPENDIX

FIELD EXPLORATIONS

GENERAL

Subsurface conditions at the site were explored by drilling three borings (B-1 through B-3) to depths ranging between 6.5 and 51.5 feet BGS. Figure 2 shows the approximate locations of our explorations. The borings were drilled on March 10, 2017 by Western States Soil Conservation, Inc. of Hubbard, Oregon, using hollow-stem auger drilling techniques. The explorations were observed by a member of our geology staff. Representative samples of the various soils encountered in the explorations were collected for geotechnical laboratory testing.

The locations of our explorations were chosen based on a site plan provided to our office by Mackenzie. This information should be considered accurate to the degree implied by the methods used.

SOIL SAMPLING

Samples were collected from the borings using 1½-inch-inner diameter, split-spoon samplers in general accordance with ASTM D 1586. The SPT sampler was driven into the soil with a 140-pound hammer free-falling 30 inches. The SPT sampler was driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the exploration logs, unless otherwise noted. Sampling methods and intervals are shown on the exploration logs.

The calibration factor for the SPT hammer used by Western States Soil Conservation was 88.3 percent. The calibration testing results are presented at the end of this appendix.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Exploration Key" (Table A-1) and "Soil Classification System" (Table A-2), which are presented in this appendix. The exploration logs indicate the depths at which the soils or their characteristics change, although the change could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

LABORATORY TESTING

CLASSIFICATION

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

MOISTURE CONTENT

The natural moisture content of selected soil samples was determined 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 test results are presented in this appendix.

PARTICLE-SIZE TESTING

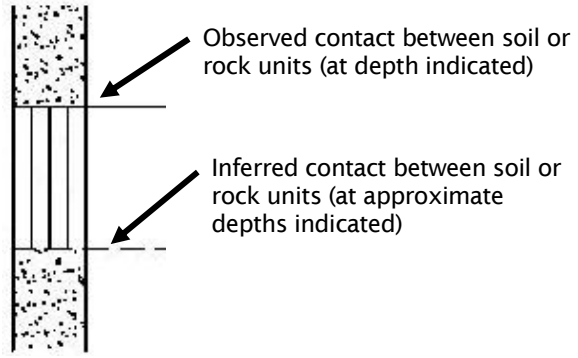
Particle-size testing was performed on selected soil samples to determine the distribution of soil particle sizes. The testing consisted of percent fines determinations (percent passing the U.S. Standard No. 200 sieve) completed in general accordance with ASTM D 1140. Test results are presented in this appendix.

ATTERBERG LIMITS

The plastic limit and liquid limit (Atterberg limits) of a selected soil sample were determined in accordance with ASTM D 4318. The Atterberg limits and the plasticity index were completed to aid in the classification of the soil. The test results are presented 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 and 140-pound hammer or pushed with recovery
	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
	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

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

ENVIRONMENTAL TESTING EXPLANATIONS

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

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

EXPLORATION KEY

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

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVELS (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVELS WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SANDS (<5% fines)	SW or SP	SAND
		SANDS WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SANDS WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	PEAT

MOISTURE CLASSIFICATION

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

ADDITIONAL CONSTITUENTS

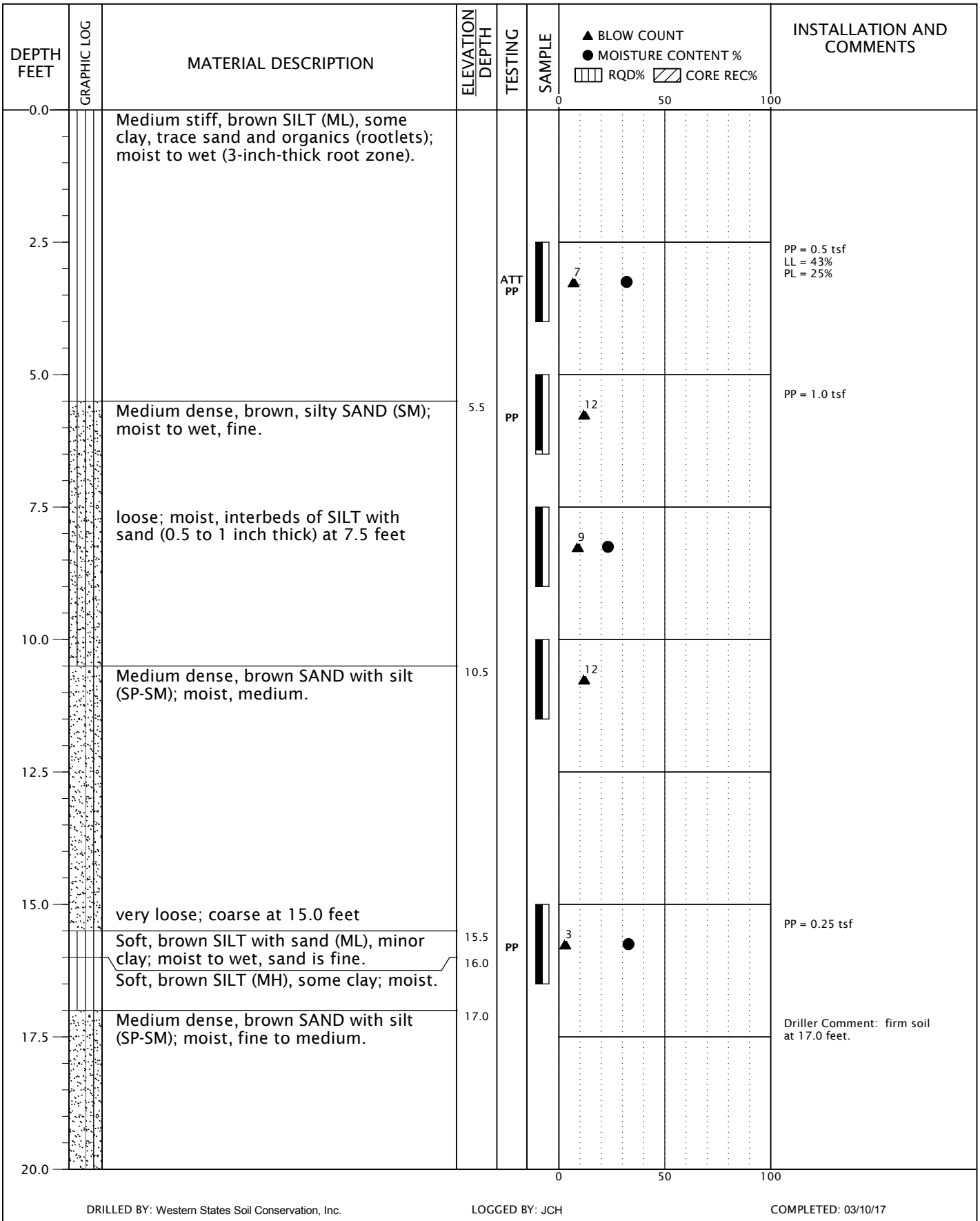
Secondary granular components or other materials such as organics, man-made debris, etc.

Percent	Silt and Clay In: Fine-Grained Soils	Silt and Clay In: Coarse-Grained Soils	Percent	Sand and Gravel In: Fine-Grained Soils	Sand and Gravel In: Coarse-Grained Soils
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	Indicate %

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

SOIL CLASSIFICATION SYSTEM

TABLE A-2



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: JCH COMPLETED: 03/10/17

BORING METHOD: hollow-stem auger (see document text) BORING BIT DIAMETER: 8 1/4 inches

BORING LOG LAMRESCORP-4-01-B1_3.GPJ GEODESIGN.GDT PRINT DATE: 4/18/17:RC

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

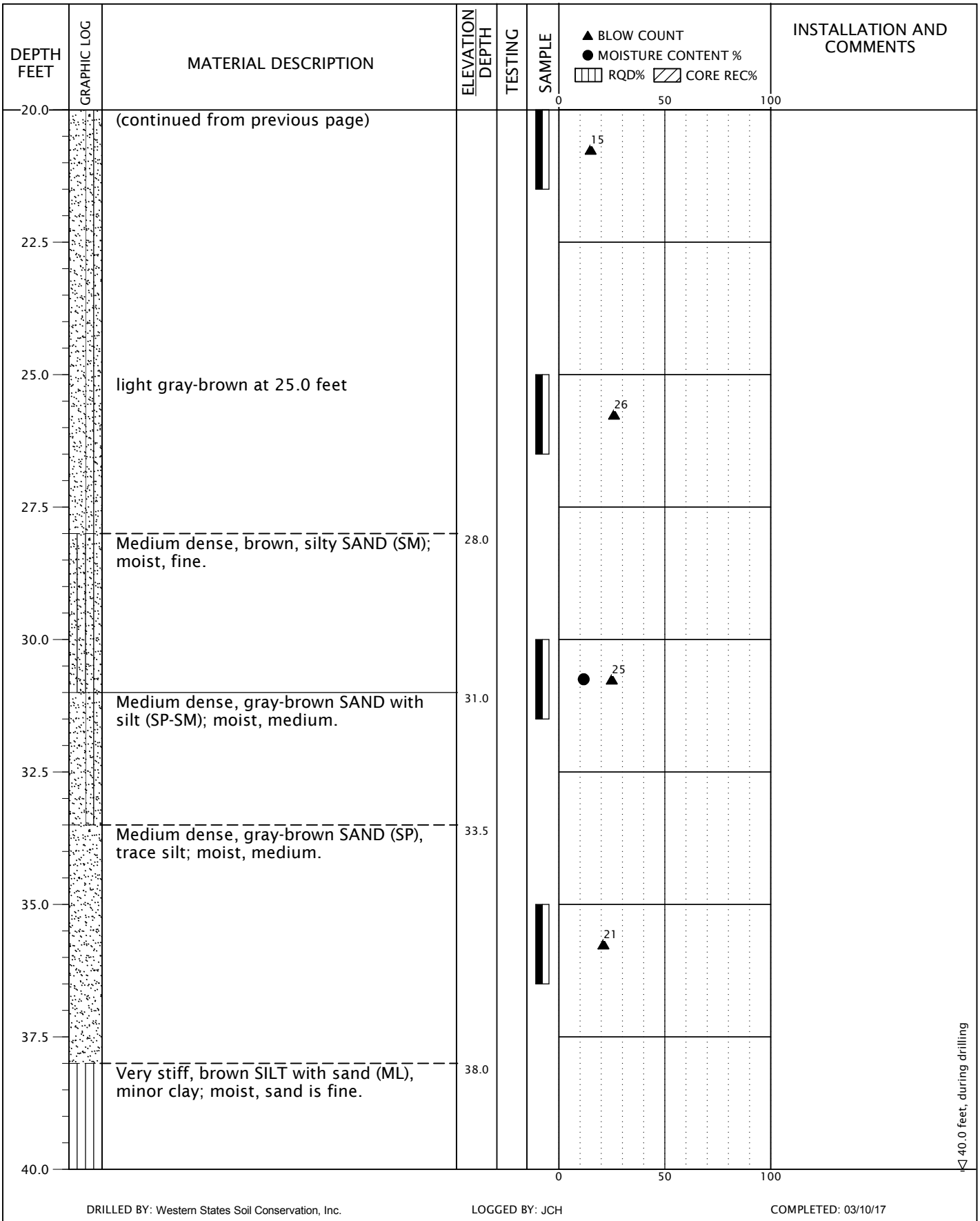
LAMRESCORP-4-01

BORING B-1

APRIL 2017

GAS PAD EXPANSION
TUALATIN, OR

FIGURE A-1



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: JCH

COMPLETED: 03/10/17

BORING METHOD: hollow-stem auger (see document text)

BORING BIT DIAMETER: 8 1/4 inches

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

LAMRESCORP-4-01

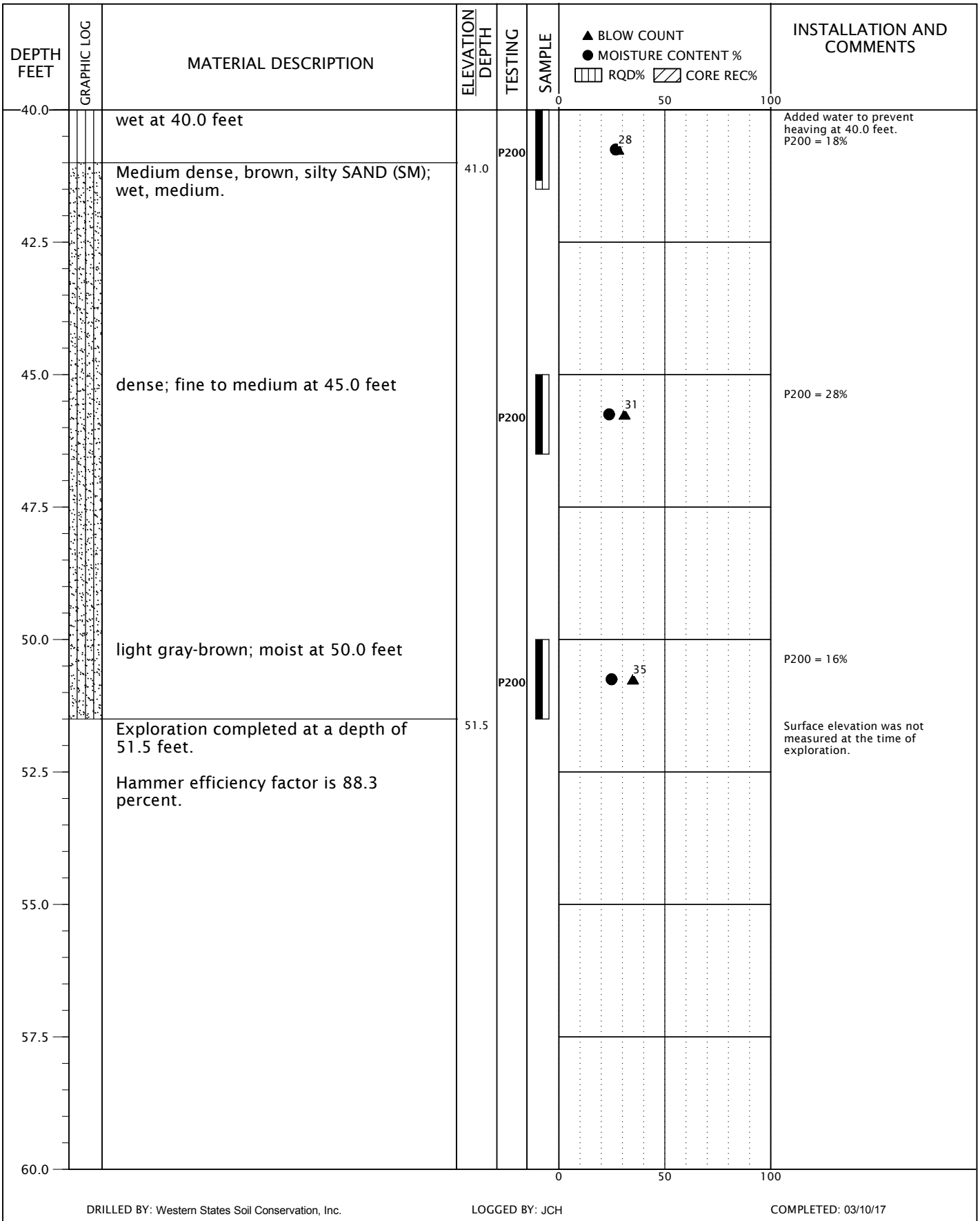
BORING B-1
(continued)

APRIL 2017

GAS PAD EXPANSION
TUALATIN, OR

FIGURE A-1

BORING LOG LAMRESCORP-4-01-B1_3.GPJ GEODESIGN.GDT PRINT DATE: 4/18/17:RC



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: JCH COMPLETED: 03/10/17

BORING METHOD: hollow-stem auger (see document text) BORING BIT DIAMETER: 8 1/4 inches

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

LAMRESCORP-4-01

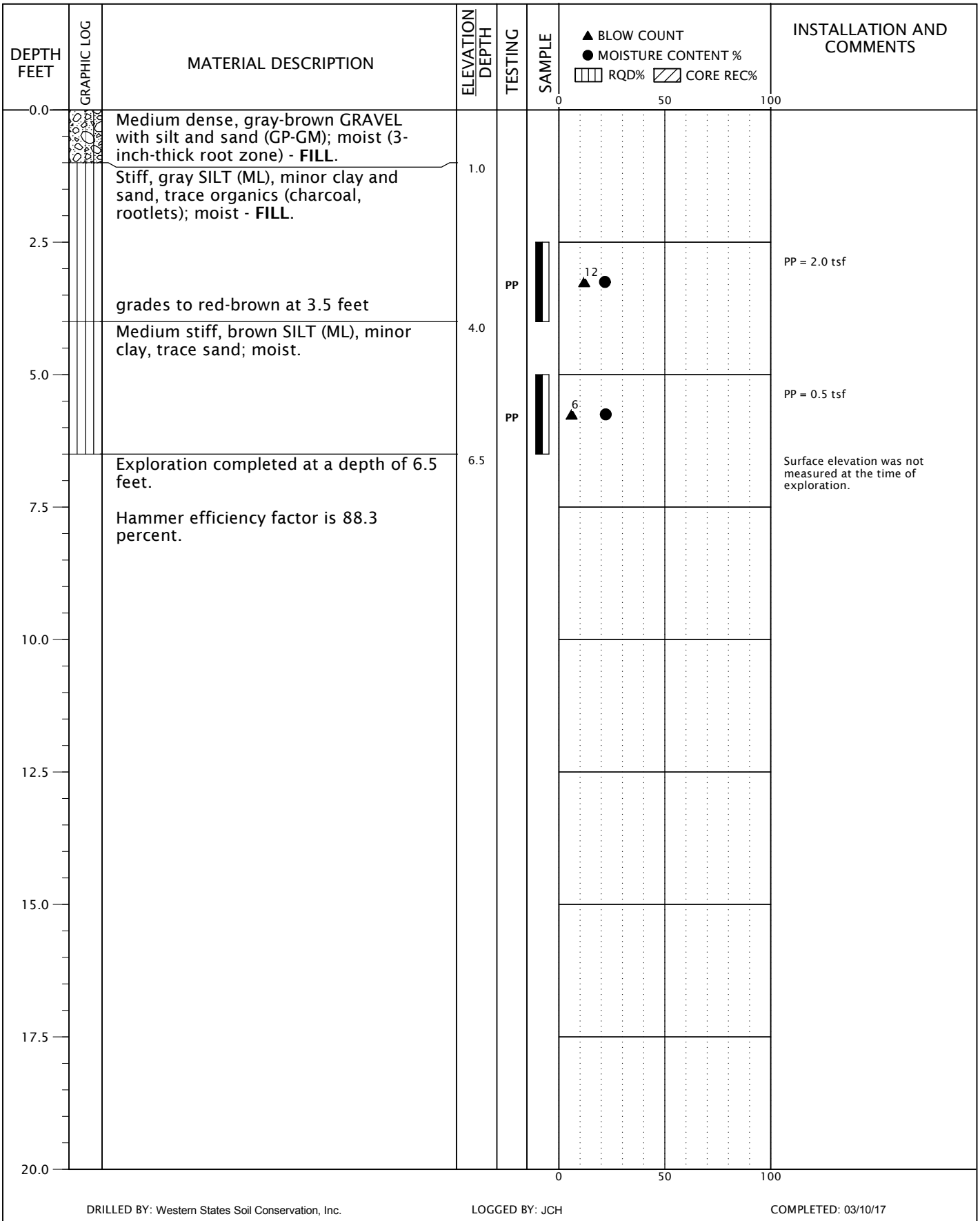
BORING B-1
(continued)

APRIL 2017

GAS PAD EXPANSION
TUALATIN, OR

FIGURE A-1

BORING LOG LAMRESCORP-4-01-B1_3.GPJ GEODESIGN.GDT PRINT DATE: 4/18/17:RC



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: JCH

COMPLETED: 03/10/17

BORING METHOD: hollow-stem auger (see document text)

BORING BIT DIAMETER: 8 1/4 inches

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

LAMRESCORP-4-01

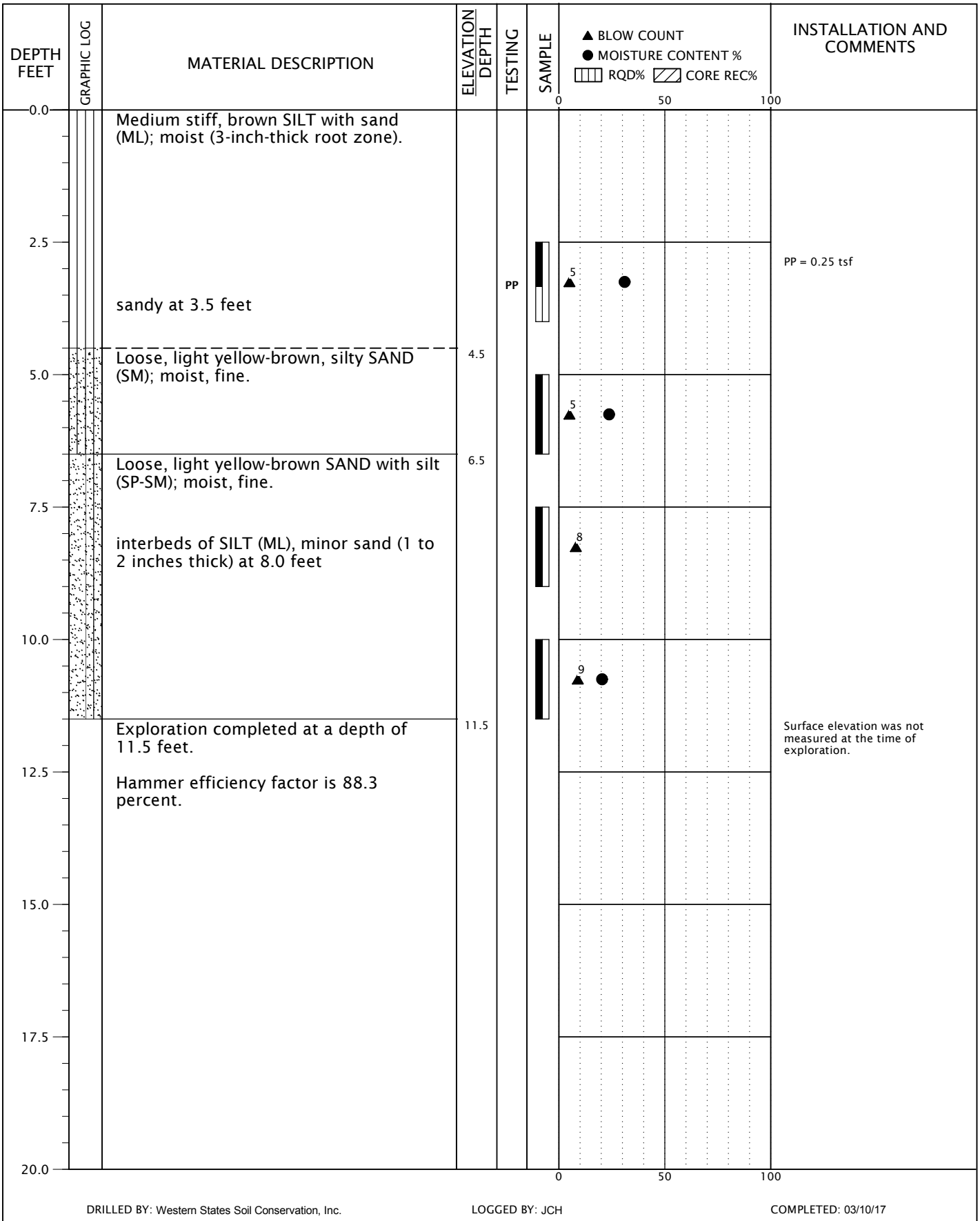
BORING B-2

APRIL 2017

GAS PAD EXPANSION
TUALATIN, OR

FIGURE A-2

BORING LOG LAMRESCORP-4-01-B1_3.GPJ GEODESIGN.GDT PRINT DATE: 4/18/17:RC



DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: JCH COMPLETED: 03/10/17

BORING METHOD: hollow-stem auger (see document text) BORING BIT DIAMETER: 8 1/4 inches

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

LAMRESCORP-4-01

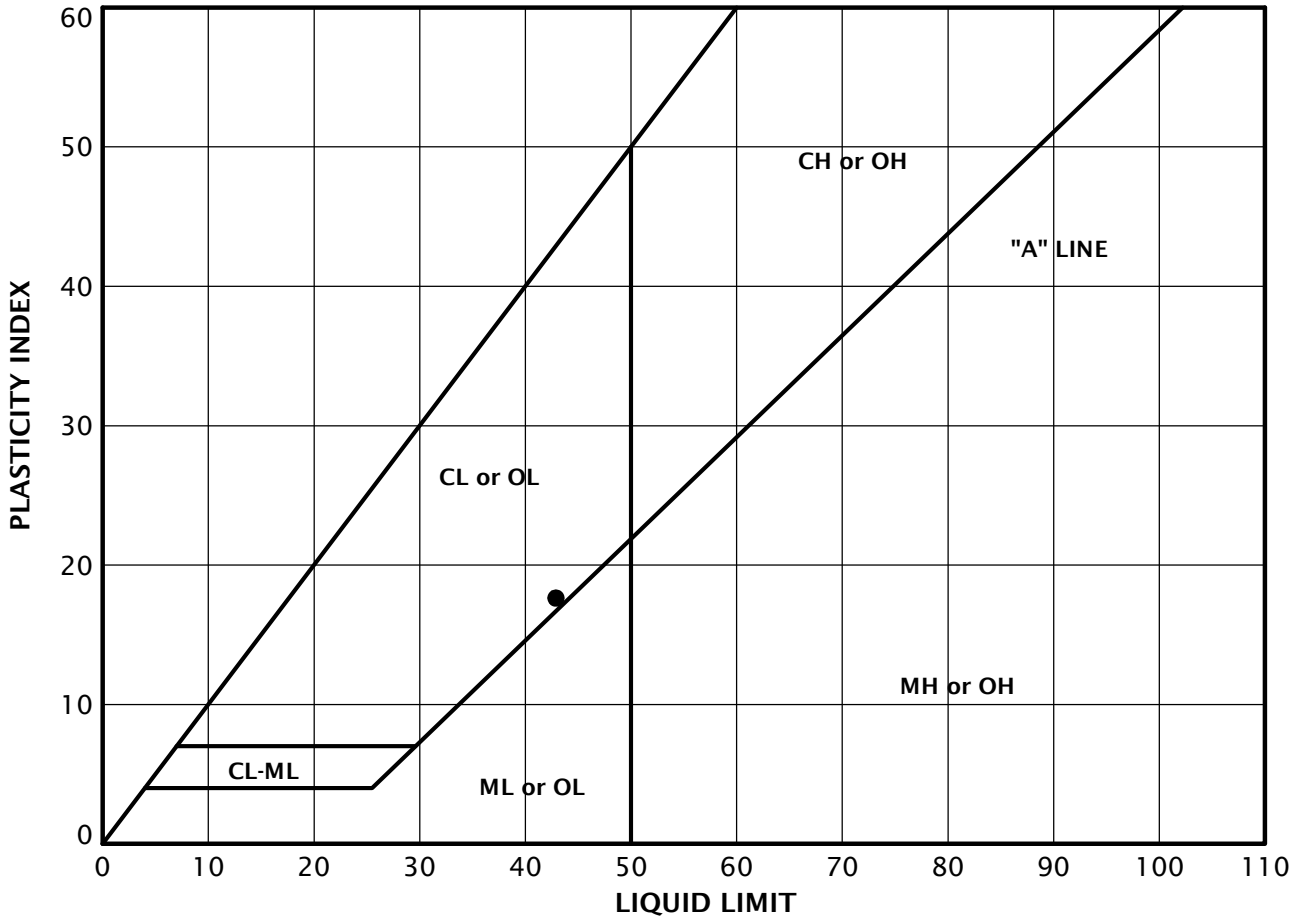
BORING B-3

APRIL 2017

GAS PAD EXPANSION
TUALATIN, OR

FIGURE A-3

BORING LOG LAMRESCORP-4-01-B1_3.GPJ GEODESIGN.GDT PRINT DATE: 4/18/17:RC



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-1	2.5	32	43	25	18

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

LAMRESCORP-4-01	**ATTERBERG LIMITS TEST RESULTS**	
APRIL 2017	GAS PAD EXPANSION TUALATIN, OR	**FIGURE A-4**

ATTERBERG_LIMITS 7 LAMRESCORP-4-01-B1_3.GPJ GEODESIGN.GDT PRINT DATE: 4/3/17:RC

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	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		32					43	25	18
B-1	7.5		23							
B-1	15.0		33							
B-1	30.0		12							
B-1	40.0		27				18			
B-1	45.0		24				28			
B-1	50.0		25				16			
B-2	2.5		22							
B-2	5.0		22							
B-3	2.5		31							
B-3	5.0		24							
B-3	10.0		20							

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

LAMRESCORP-4-01

APRIL 2017

SUMMARY OF LABORATORY DATA

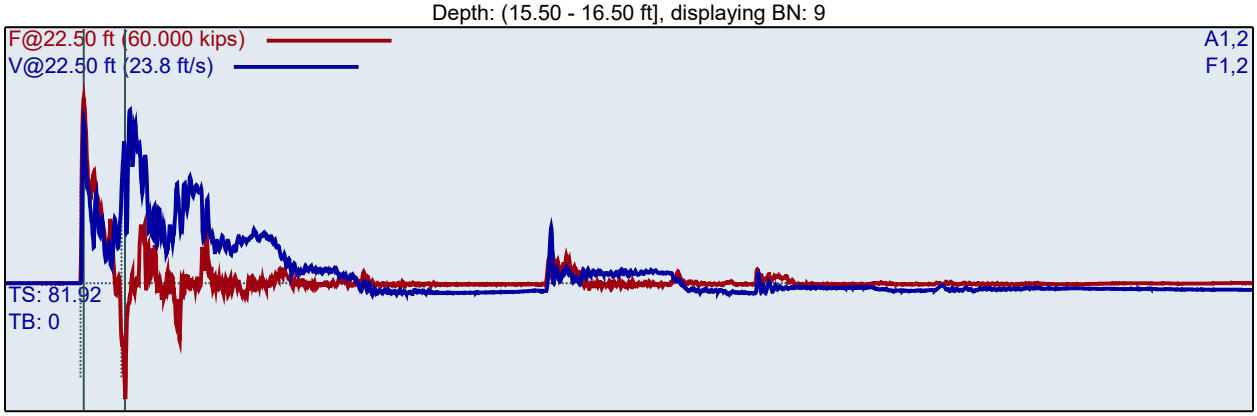
GAS PAD EXPANSION
TUALATIN, OR

FIGURE A-5

WSSC-8-01
JDT
AR: 1.41 in^2
LE: 22.50 ft
WS: 16807.9 ft/s

RIG 7 - SERIAL NO. 383942
Test date: 12/28/2016
SP: 0.492 k/ft3
EM: 30000 ksi

Depth: (15.50 - 16.50 ft], displaying BN: 9



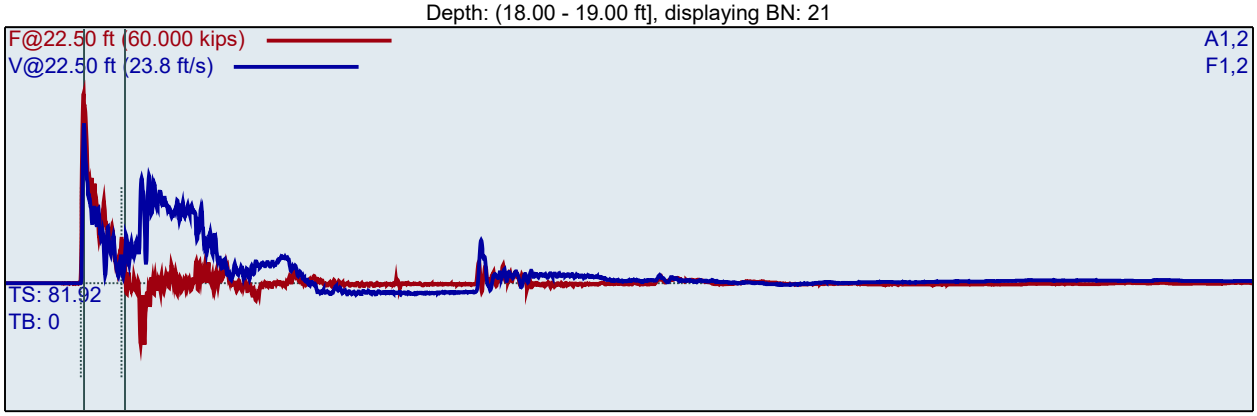
LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated

BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EMX ft-lb	ETR (%)
1	3	15.67	44.305	15.6	1.9	313.0	89.4
2	3	15.83	44.589	17.0	55.3	316.3	90.4
3	3	16.00	44.472	16.5	55.2	307.7	87.9
4	8	16.06	44.492	16.8	54.7	311.3	88.9
5	8	16.13	42.703	16.4	54.9	309.6	88.5
6	8	16.19	44.398	16.9	54.6	310.9	88.8
7	8	16.25	43.695	16.3	54.8	312.9	89.4
8	8	16.31	43.700	16.1	54.9	311.4	89.0
9	8	16.38	43.409	16.1	55.0	310.4	88.7
10	8	16.44	43.247	15.3	54.8	307.0	87.7
11	8	16.50	19.792	6.7	80.3	59.1	16.9
Average		16.16	41.709	15.4	52.4	288.2	82.3
Std Dev		0.24	6.955	2.8	17.5	72.5	20.7
Maximum		16.50	44.589	17.0	80.3	316.3	90.4
Minimum		15.67	19.792	6.7	1.9	59.1	16.9

N-value: 11

Sample Interval Time: 10.56 seconds.

Depth: (18.00 - 19.00 ft], displaying BN: 21

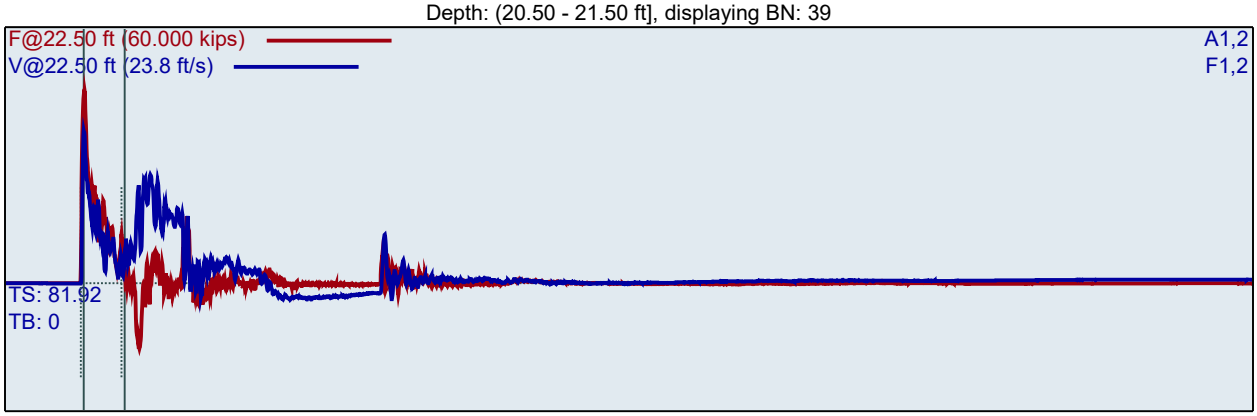


BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EMX ft-lb	ETR (%)
12	4	18.13	43.583	14.3	54.5	310.6	88.8
13	4	18.25	43.570	14.1	54.5	312.4	89.3
14	4	18.38	43.975	14.3	54.2	310.8	88.8
15	4	18.50	42.792	15.5	54.6	312.5	89.3
16	8	18.56	43.422	15.0	54.5	317.1	90.6
17	8	18.63	43.768	14.6	54.1	316.0	90.3
18	8	18.69	43.318	14.5	54.4	315.8	90.2
19	8	18.75	42.657	14.0	54.4	312.9	89.4
20	8	18.81	44.231	14.8	54.3	314.4	89.8
21	8	18.88	44.488	14.9	54.3	316.3	90.4
22	8	18.94	44.711	15.0	54.4	313.9	89.7
23	8	19.00	43.832	14.4	54.4	311.8	89.1
Average		18.63	43.696	14.6	54.4	313.7	89.6
Std Dev		0.26	0.591	0.4	0.1	2.1	0.6
Maximum		19.00	44.711	15.5	54.6	317.1	90.6
Minimum		18.13	42.657	14.0	54.1	310.6	88.8

N-value: 12

Sample Interval Time: 12.12 seconds.

Depth: (20.50 - 21.50 ft], displaying BN: 39

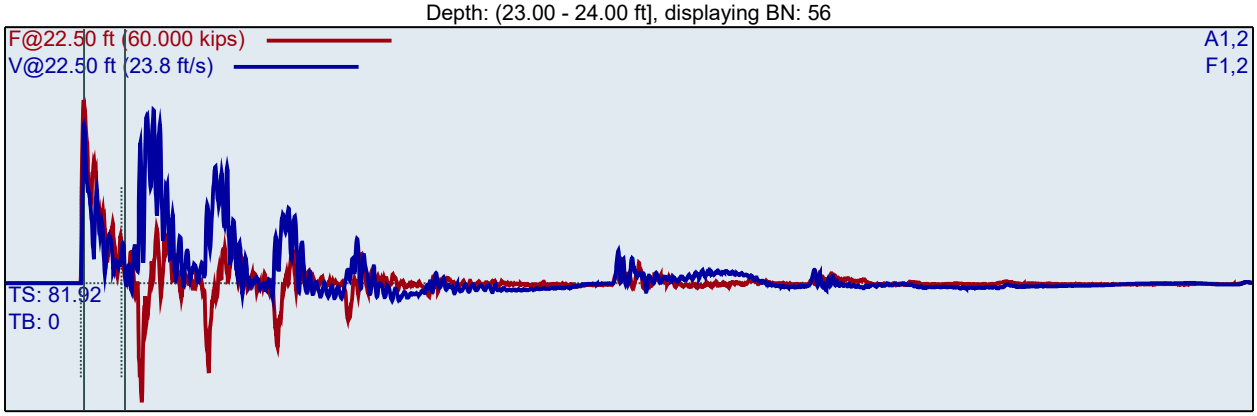


BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EMX ft-lb	ETR (%)
24	8	20.56	44.057	14.8	54.5	317.7	90.8
25	8	20.63	43.219	16.8	54.2	306.1	87.5
26	8	20.69	44.090	14.1	54.2	313.8	89.7
27	8	20.75	44.898	14.9	54.4	316.2	90.3
28	8	20.81	44.836	16.6	54.2	311.3	88.9
29	8	20.88	44.302	16.5	54.4	314.1	89.8
30	8	20.94	44.345	15.1	54.3	314.5	89.8
31	8	21.00	45.057	15.8	54.5	311.2	88.9
32	10	21.05	44.132	15.3	54.2	311.7	89.1
33	10	21.10	43.899	17.1	54.3	309.6	88.5
34	10	21.15	45.254	14.7	54.1	313.8	89.7
35	10	21.20	45.251	14.4	54.5	317.2	90.6
36	10	21.25	43.714	15.5	54.0	311.9	89.1
37	10	21.30	42.554	17.2	54.3	312.7	89.4
38	10	21.35	42.369	16.6	54.2	310.0	88.6
39	10	21.40	45.048	14.2	54.1	314.9	90.0
40	10	21.45	42.990	16.5	54.3	309.4	88.4
41	10	21.50	44.257	15.9	54.2	317.1	90.6
	Average	21.06	44.126	15.7	54.3	313.0	89.4
	Std Dev	0.28	0.861	1.0	0.1	3.0	0.9
	Maximum	21.50	45.254	17.2	54.5	317.7	90.8
	Minimum	20.56	42.369	14.1	54.0	306.1	87.5

N-value: 18

Sample Interval Time: 18.77 seconds.

Depth: (23.00 - 24.00 ft], displaying BN: 56



BL#	BC /6"	LP ft	FMX kips	VMX ft/s	BPM bpm	EMX ft-lb	ETR (%)
42	8	23.06	42.016	15.5	54.7	315.2	90.0
43	8	23.13	42.207	15.6	54.8	313.2	89.5
44	8	23.19	42.444	15.6	54.7	319.6	91.3
45	8	23.25	42.717	15.5	55.1	316.9	90.5
46	8	23.31	42.337	15.5	54.3	317.4	90.7
47	8	23.38	42.016	15.4	54.9	315.0	90.0
48	8	23.44	42.802	15.9	54.8	317.9	90.8
49	8	23.50	41.630	15.5	54.7	314.4	89.8
50	9	23.56	42.341	15.8	54.6	316.4	90.4
51	9	23.61	41.710	15.9	54.7	316.5	90.4
52	9	23.67	42.185	16.0	54.7	319.2	91.2
53	9	23.72	41.073	15.5	54.6	309.2	88.3
54	9	23.78	41.662	15.5	54.6	313.4	89.6
55	9	23.83	40.943	15.4	54.7	311.3	88.9
56	9	23.89	42.559	16.1	54.4	317.5	90.7
57	9	23.94	41.035	15.5	54.4	311.8	89.1
58	9	24.00	41.007	14.8	54.7	309.5	88.4
	Average	23.54	41.923	15.6	54.7	315.0	90.0
	Std Dev	0.29	0.599	0.3	0.2	3.1	0.9
	Maximum	24.00	42.802	16.1	55.1	319.6	91.3
	Minimum	23.06	40.943	14.8	54.3	309.2	88.3
			N-value: 17				

Sample Interval Time: 17.54 seconds.

Summary of SPT Test Results

Project: WSSC-8-01, Test Date: 12/28/2016

LP: Length of Penetration
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows/Minute
EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	N Value	N60 Value	Average LP ft	Average FMX kips	Average VMX ft/s	Average BPM bpm	Average EMX ft-lb	Average ETR (%)
22.50	**3-8**	**8**	**11**	16.16	41.709	15.4	52.4	288.2	82.3
22.50	**4-8**	**8**	**11**	18.63	43.696	14.6	54.4	313.7	89.6
22.50	**8-10**	**10**	**14**	21.06	44.126	15.7	54.3	313.0	89.4
22.50	**8-9**	**9**	**13**	23.54	41.923	15.6	54.7	315.0	90.0
		Overall Average Values:		20.35	42.933	15.4	54.1	309.0	88.3 ←
		Standard Deviation:		2.68	3.275	1.4	7.7	33.2	9.5
		Overall Maximum Value:		24.00	45.254	17.2	80.3	319.6	91.3
		Overall Minimum Value:		15.67	19.792	6.7	1.9	59.1	16.9

Average Energy Transfer Ratio = 88.3%
Energy Correction Factor = 1.47

NV5

Delivering Solutions
Improving Lives