Preliminary Technical Information Report

Fortress- Puyallup

240 15th Street SE
Puyallup, Washington 98372

Prepared for:
CREF3 Puyallup, LLC
11611 San Vicente Blvd, 10th Floor
Los Angeles, CA 90049

8/31/2023

Revised August 31, 2023
Revised May 24, 2023
October 24, 2022
Our Job No. 22085

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Tab 1.0

1.0 PROJECT OVERVIEW

The proposed Fortress - Puyallup project is located on a 7.84-acre site located in the City of Puyallup, Washington. The project address is 240 15th Street SE, Puyallup, WA 98372 with the parcel numbers being 0420274126, 7845000161, and 7845000170. The site is located northwest of the intersection of 15th Street SE and East Pioneer Way. The current zoning of the project site is Limited Manufacturing (ML). Please see the enclosed Figure 1 - Vicinity Map for additional location information.

The existing site contains a cold storage warehouse that is in the process of demolition, a separate industrial building, and an office building. The majority of the site has been developed with buildings and pavement, though a small portion of the site is an undeveloped field. The property is not currently being used other than for demolition activity. There are three driveways serving the site off of 15th Street SE. The site is relatively flat and does not contain any steep slopes. The developed portion of the site drains to existing stormwater catch basins and piping, which discharge into the public stormwater systems in East Main Street and 15th Street SE, ultimately discharging to Deer Creek near the Puyallup River. See Figure 2 for a map of existing site conditions.

The site is not within a flood zone. See Figure 4 for a FEMA flood map. According to Puyallup GIS mapping, the project does not contain any wetlands or potential landslide hazards. The public stormwater system in 15th Street SE discharges to a wetland. See Figure 3 for a critical areas map.

The proposal for this development is to construct one warehouse building, new pavement, associate utilities, and landscaping. The developed runoff from the west portion of the site will be collected and conveyed to both water quality and detention vaults prior to discharge into the public stormwater system draining to East Main Street. The east part of the site will be collected and discharged through a water quality vault to the 15th Street SE system that drains to a wetland. This basin has been sized to match the existing conditions to match existing flows to the wetland. Stormwater treatment will be provided upstream of the detention vault by DOE-approved underground treatment vaults (Oldcastle Biopods).

This site has some incidental run-on from adjacent property that is accounted for by the proposed stormwater improvements.

Figure 1
Vicinity Map

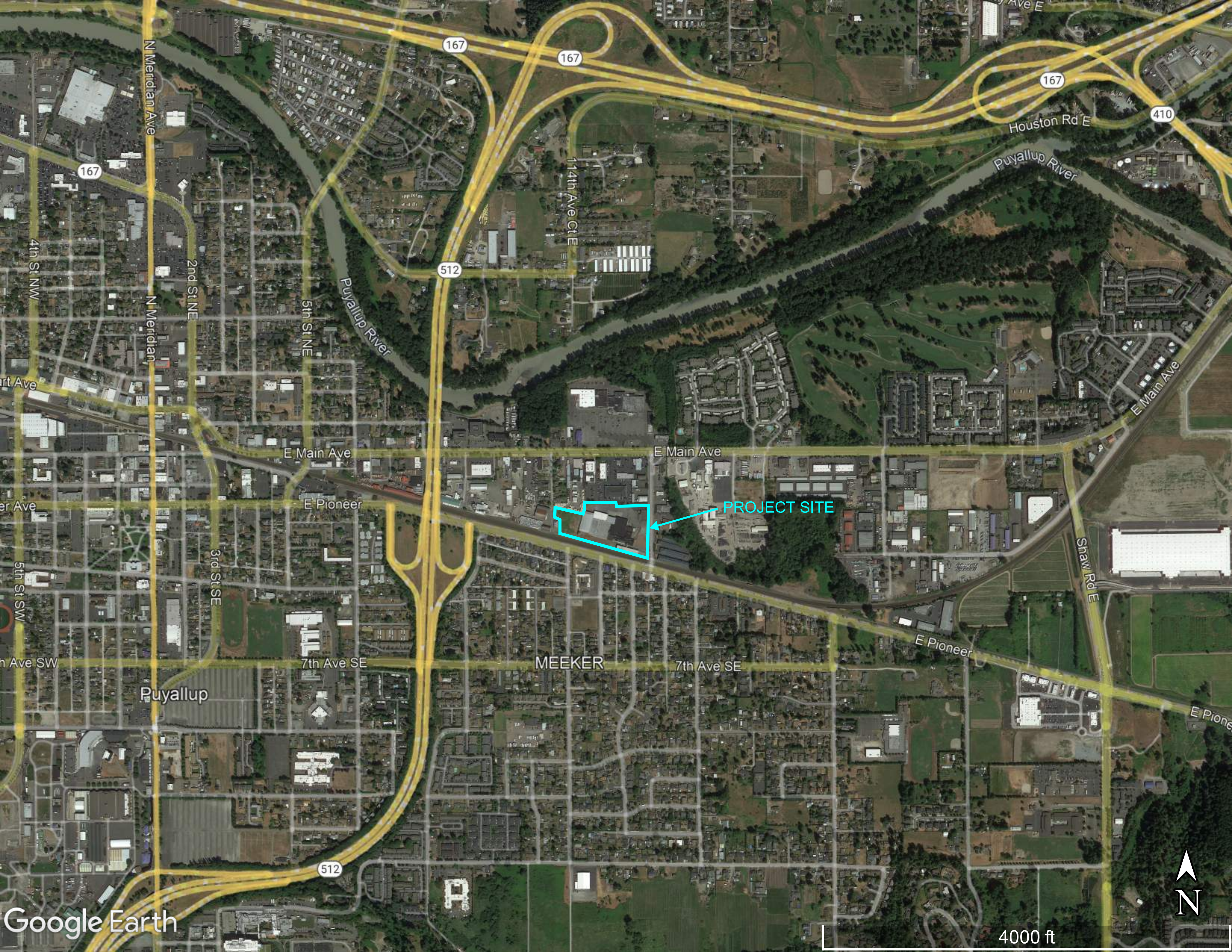
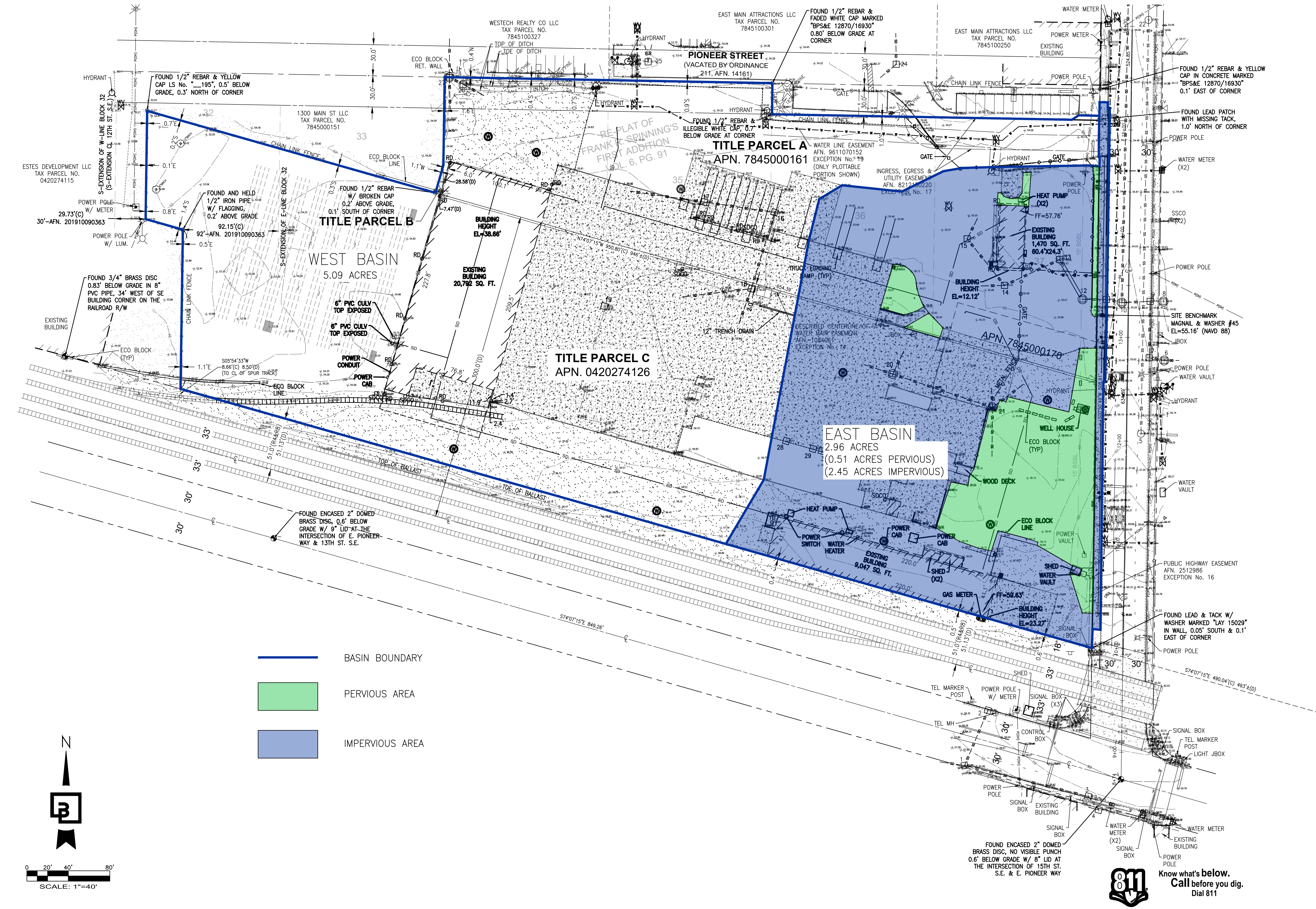

PROJECT SITE
167
410
512
Houston Rd E
Puyallup River
N Meridian Ave
N Meridian
4th St NW
2nd St NE
5th St NE
114th Ave Ct E
E Main Ave
E Pioneer
3rd St SE
5th St SW
7th Ave SE
MEEKER
Puyallup
Shaw Rd E
Google Earth
4000 ft
N

Figure 2
Existing Conditions Map

EXISTING CONDITION BASIN MAP EXHIBIT



Title: EXISTING CONDITION BASIN MAP EXHIBIT

FORTRESS - PUYALLUP

For: FORTRESS INVESTMENT GROUP
11611 SAN VICENTE BLVD
10TH FLOOR
LOS ANGELES, CA 90049

Scale: Horizontal 1"=40' Vertical N/A

Designed VMS
Drawn VMS
Checked KEH
Approved KEH
Date 10/04/22

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Sheet __ of __

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APPROXIMATE SITE BOUNDARY
EXISTING BUILDINGS UNDER DEMOLITION
15th St SE
E Pioneer
13th St SE
14th St SE
River
N
400 ft
Google Earth

Figure 3
Critical Areas Map

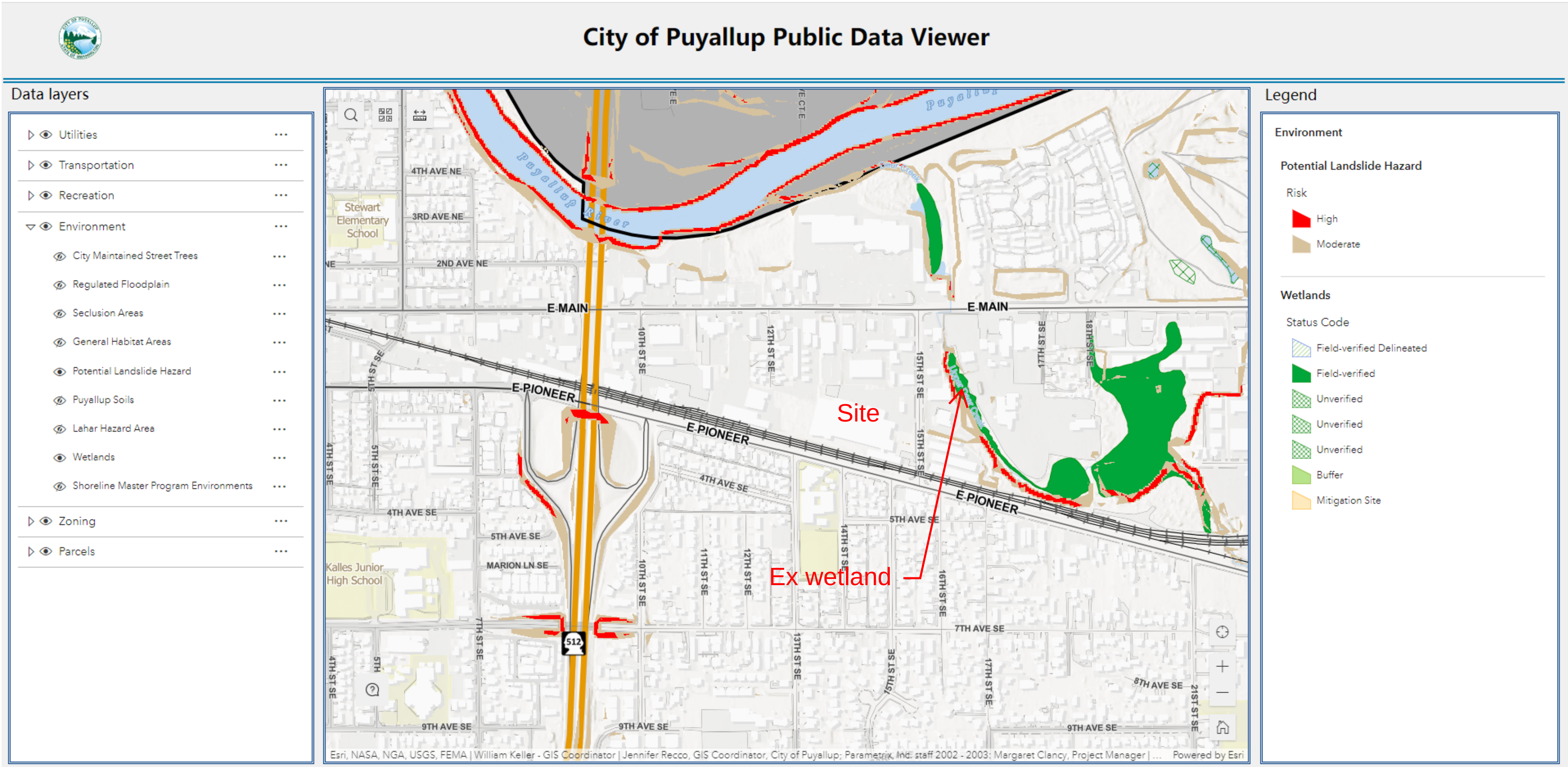

City of Puyallup Public Data Viewer
Data layers
Utilities
Transportation
Recreation
Environment
City Maintained Street Trees
Regulated Floodplain
Seclusion Areas
General Habitat Areas
Potential Landslide Hazard
Puyallup Soils
Lahar Hazard Area
Wetlands
Shoreline Master Program Environments
Zoning
Parcels
Legend
Environment
Potential Landslide Hazard
Risk
High
Moderate
Wetlands
Status Code
Field-verified Delineated
Field-verified
Unverified
Unverified
Unverified
Buffer
Mitigation Site
Site
Ex wetland
Puyallup River
E MAIN
E PIONEER
4TH AVE NE
3RD AVE NE
2ND AVE NE
4TH AVE SE
5TH AVE SE
7TH AVE SE
8TH AVE SE
9TH AVE SE
MARION LN SE
10TH ST SE
12TH ST SE
15TH ST SE
17TH ST SE
Stewart Elementary School
Kalles Junior High School
512
Esri, NASA, NGA, USGS, FEMA | William Keller - GIS Coordinator | Jennifer Recco, GIS Coordinator, City of Puyallup; Parametrix, Inc. staff 2002 - 2003: Margaret Clancy, Project Manager | ...
Powered by Esri

Figure 4
FEMA Flood Map

National Flood Hazard Layer FIRMette

FEMA

122°16'52"W 47°11'35"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

122°16'14"W 47°11'11"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/29/2022 at 5:18 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Tab 2.0

2.0 MINIMUM REQUIREMENTS SUMMARY

Per Figure 1-3.1 of the 2019 Department of Ecology Stormwater Management Manual for Western Washington (the Manual), minimum requirements #1 through #9 apply to this project. Minimum requirements (MRs) as listed in the Manual are listed in this section.

MR1 - Preparation of Stormwater Site Plans.

This report and the prepared construction drawings satisfy this requirement.

MR2 - Construction Stormwater Pollution Prevention Plan (SWPPP)

A SWPPP will be prepared and submitted to the City with the permit submittal plans.

MR3 - Source Control of Pollution

Source Control BMPs will be selected in accordance with Volume IV of the Manual once the property has been leased and actual commercial activities are able to be identified. Good housekeeping measures will be used to keep the site clean and to reduce the chance that stormwater will come into contact with pollutants.

MR4 - Preservation of Natural Drainage Systems and Outfalls

In the existing condition the site discharges into the public stormwater systems in East Main Street and 15th Street SE, ultimately discharging to Deer Creek and then to the Puyallup River. These discharge locations will be maintained.

MR5 - On-Site Stormwater Management

To satisfy this Minimum Requirement, the BMPs given by List #2 are evaluated for feasibility. In accordance with the geotechnical report prepared for this project, infiltration of stormwater on the project site is not feasible. Dispersion BMPs are also infeasible due to the absence of available dispersion areas on the project site. Therefore, the project proposes to manage stormwater by implementing BMP T5.13 to all landscape areas and by conveying onsite runoff from the western portion of the site to the proposed stormwater treatment and detention facilities.

MR6 - Runoff Treatment

The use of OldCastle Biopods is proposed. These are proprietary underground treatment vaults that have received a General Use Level Designation (GULD) approval from the DOE. Sizing is not provided with this preliminary report, but it will be provided with the final report included with the permit submittal.

MR7 - Flow Control

The project will meet the duration matching requirement. Flow control will be provided by the proposed detention vault. See Section 4.3 of this report for more information.

MR8 - Wetlands Protection

Some runoff from the project site enters the public stormwater system in 15th Street SE, which ultimately discharges to Deer Creek at a location where it is mapped as wetlands per City GIS. In order to protect this wetland, the flow to this discharge location will be maintained. The eastern portion of the site will continue to discharge to the wetland. This area is largely impervious in the existing condition so flows will be matched by discharging the eastern portion of the site without detention. See Figure 5 for the Flow Chart for Determining Wetland Protection Level Requirements, and see Section 4.5 for additional narrative.

MR9 - Operation and Maintenance

An operations and maintenance manual will be completed and submitted as a separate document with the permit construction plans.

Figure 5
Minimum Requirements Flowchart

Figure I-3.1: Flow Chart for Determining Requirements for New Development

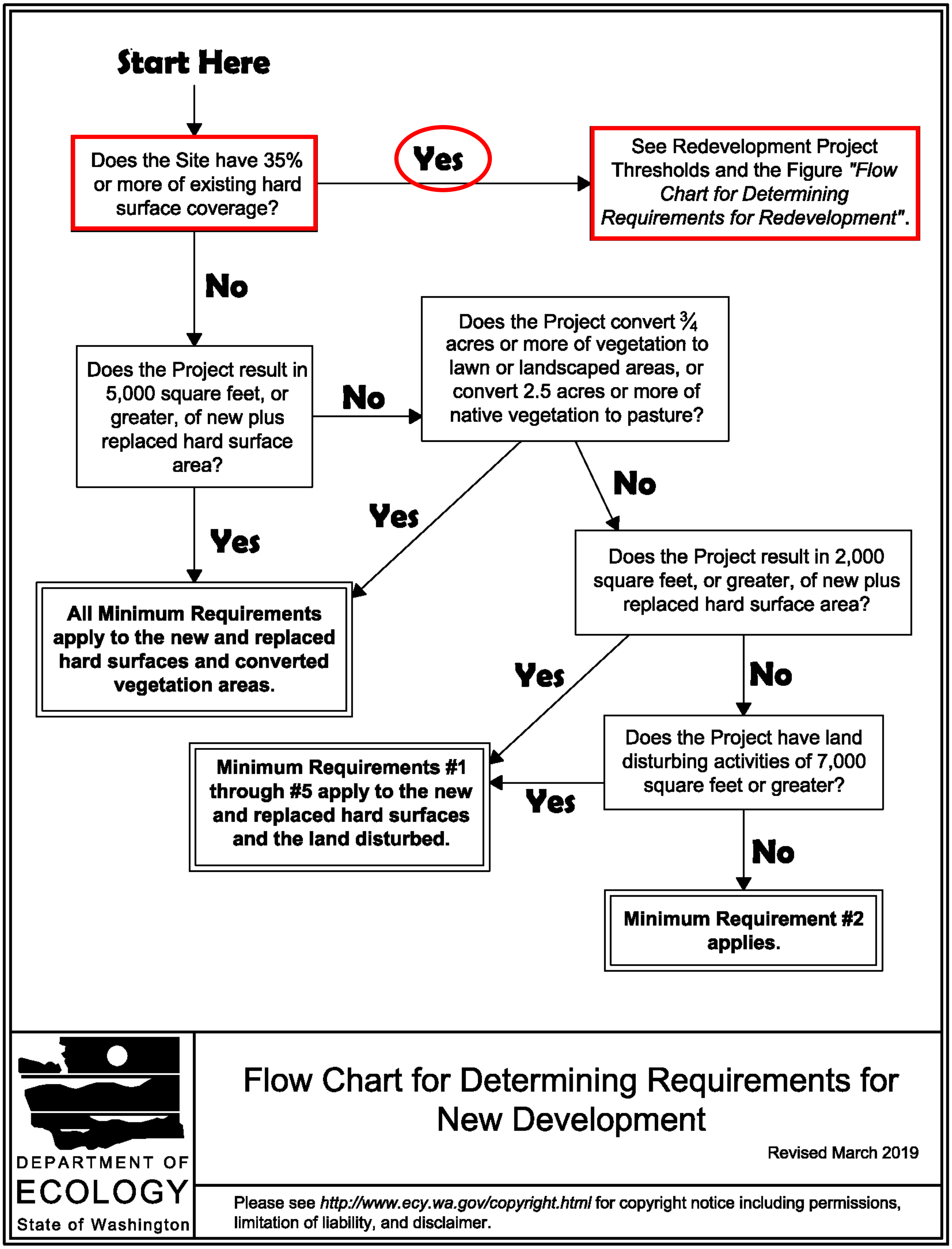


Figure I-3.2: Flow Chart for Determining Requirements for Redevelopment

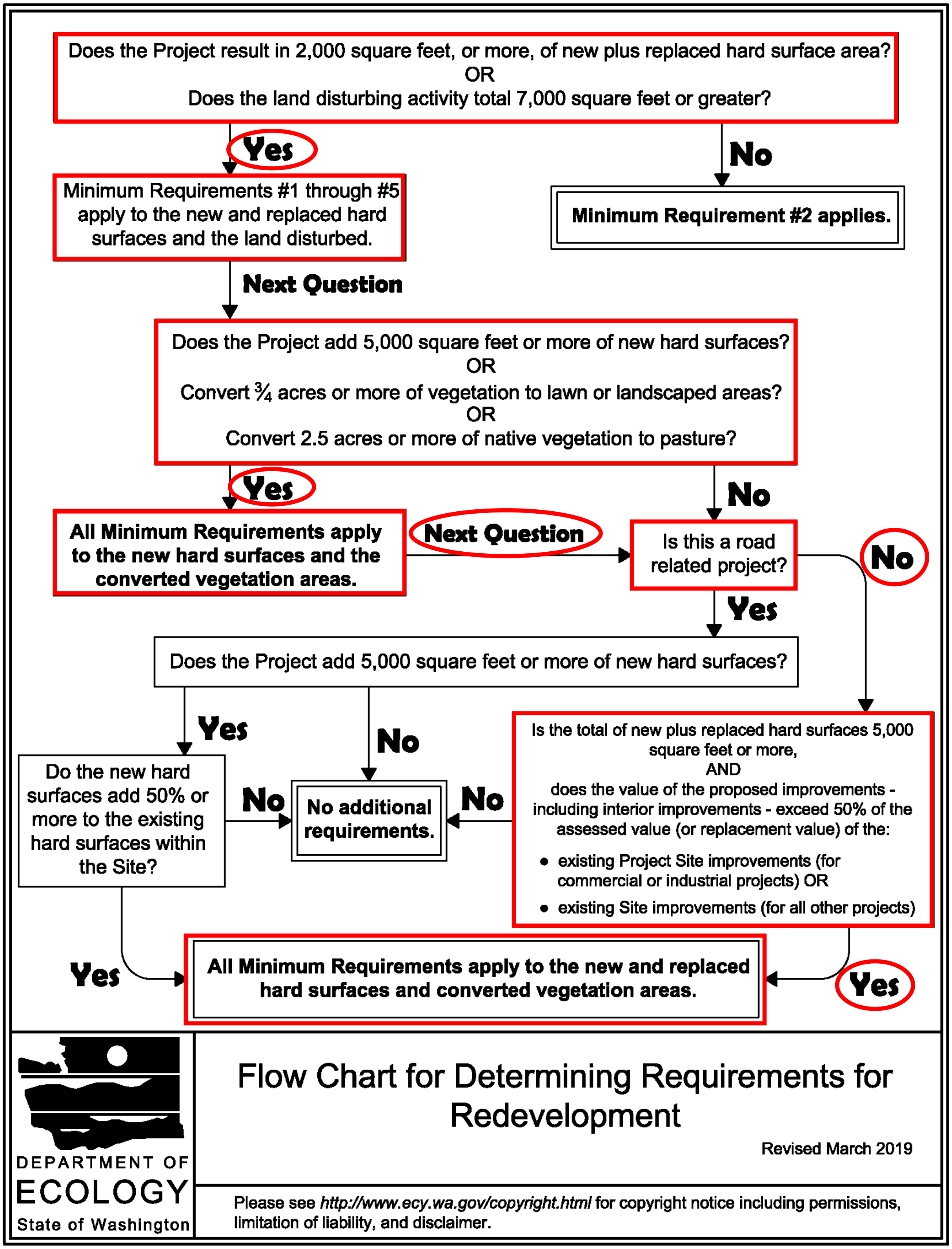


Figure III-1.1: Runoff Treatment BMP Selection Flow Chart

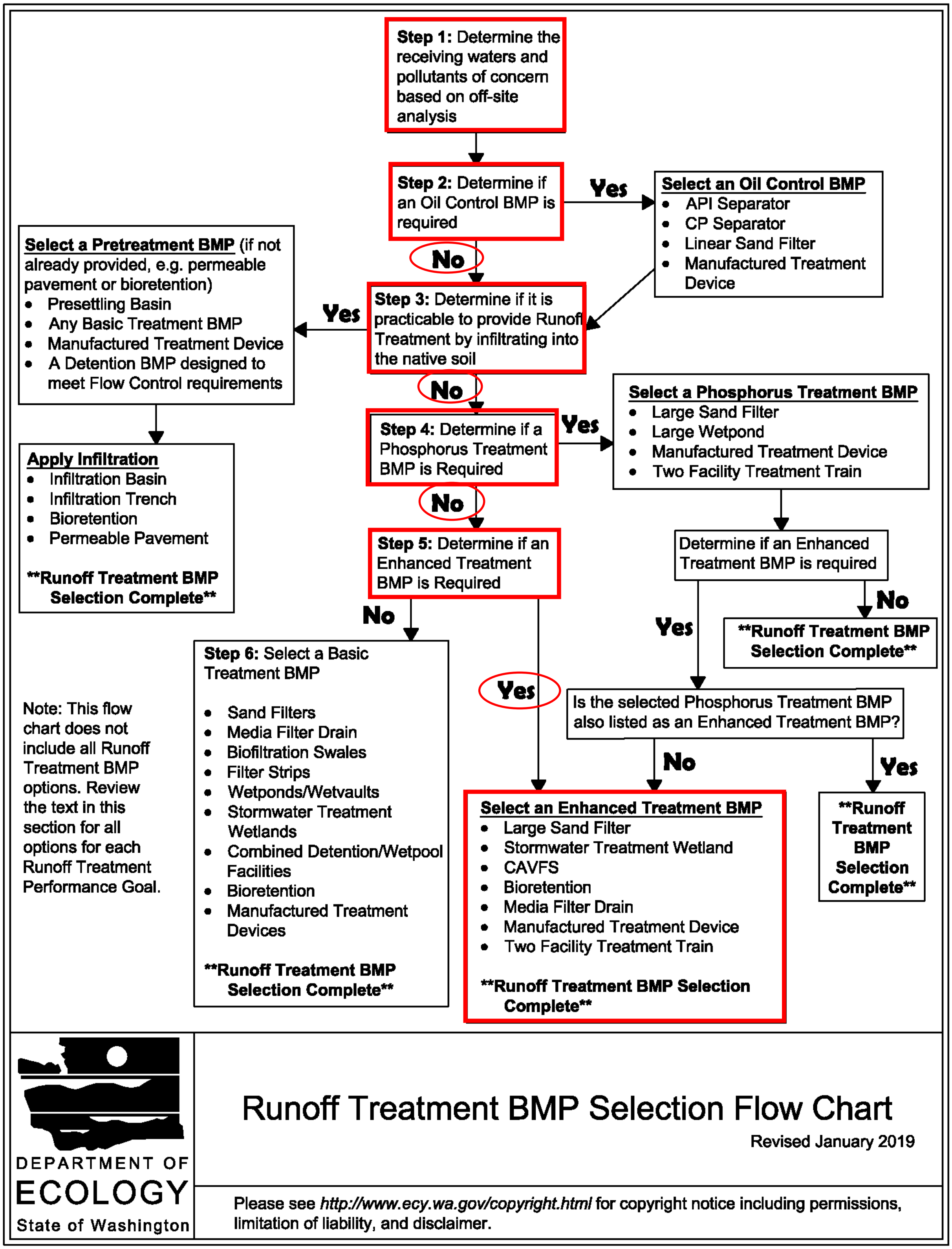
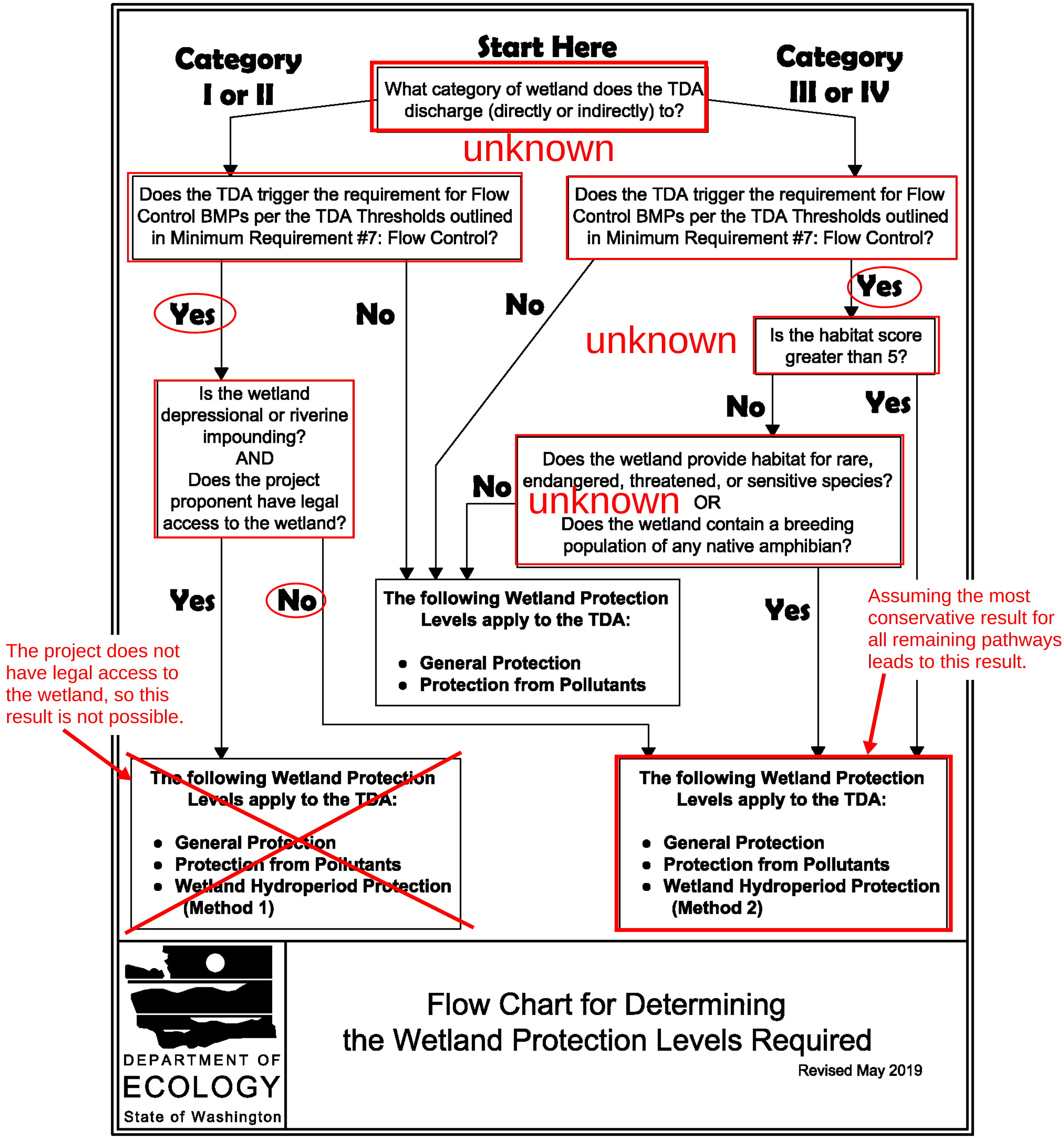


Figure I-3.5: Flow Chart for Determining Wetland Protection Level Requirements

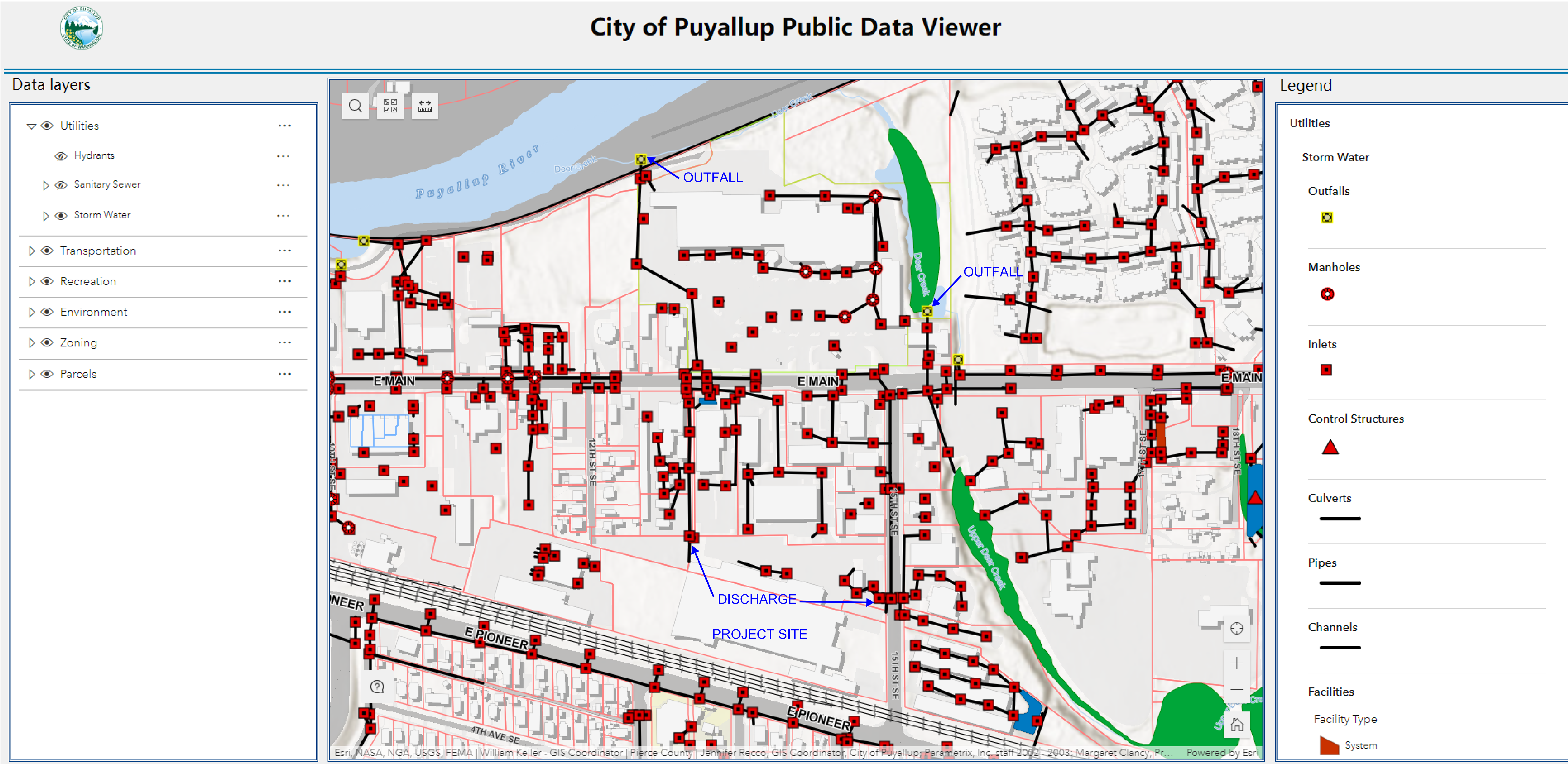


Tab 3.0

3.0 OFF-SITE ANALYSIS

The project site drains to existing stormwater catch basins and piping, which discharge into the public stormwater systems in East Main Street and 15th Street SE, ultimately discharging to Deer Creek near the Puyallup River. The outfall from the 15th Street SE system is location within an area classified as wetland per City of Puyallup GIS. See Figure 6. We are not aware of any known drainage issues with the existing downstream drainage systems.

Figure 6
Downstream
Drainage
Map


City of Puyallup Public Data Viewer
Data layers
Utilities
Hydrants
Sanitary Sewer
Storm Water
Transportation
Recreation
Environment
Zoning
Parcels
Puyallup River
Deer Creek
OUTFALL
OUTFALL
E MAIN
E MAIN
E MAIN
12TH ST SE
15TH ST SE
18TH ST SE
E PIONEER
E PIONEER
4TH AVE SE
Upper Deer Creek
DISCHARGE
PROJECT SITE
Esri, NASA, NGA, USGS, FEMA | William Keller - GIS Coordinator | Pierce County | Jennifer Recco, GIS Coordinator, City of Puyallup; Parametrix, Inc. staff 2002 - 2003; Margaret Clancy, Pr...
Powered by Esri
Legend
Utilities
Storm Water
Outfalls
Manholes
Inlets
Control Structures
Culverts
Pipes
Channels
Facilities
Facility Type
System

Tab 4.0

4.0 FLOW CONTROL AND WATER QUALITY FACILITY ANALYSIS AND DESIGN

4.1 Existing Site Hydrology

For the purpose of flow control modeling, the predeveloped site condition for the west portion of the site (5.09 acres) is assumed to be forested. To meet the wetland protection guidelines, the eastern portion of the site and offsite improvements (2.96 acres) is modeled as the current conditions which is mostly impervious. In accordance with soil characteristics described in the geotechnical report prepared for this project, existing site soils are modeled as Type C. The total area of the predeveloped basin is 8.05 acres. See Figure 7.

Basin ID	Existing Basin Area	
West Basin	5.09 ac	Forested
East Basin	2.96 acres	0.51 ac lawn 2.45 ac impervious

4.2 Developed Site Hydrology

The proposed development will convey runoff from the west portion of the site (5.31 acres) to the proposed detention vault using the proposed catch basins and gravity conveyance piping. The eastern portion of the site (2.52 acres) will discharge through a water quality unit prior to discharge. The pervious surface is modeled as pasture in accordance with BMP T5.13.

Basin ID	Basin Area	
West Basin	5.31 ac	4.59 ac impervious 0.72 ac pasture
East Basin	2.75 acres	2.25 ac impervious 0.50 ac pasture

4.3 Flow Control System

In accordance with the Manual the duration matching requirement that must be satisfied for flow control is: Stormwater discharges shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50% of the 2-year peak flow up to the full 50-year peak flow. The proposed detention vault has been modeled using WWHM, a DOE approved continuous rainfall runoff modeling program, to ensure that this requirement is met. See Figure 7 for modeling inputs and outputs. The discharge to the wetland requires flows to match existing/current conditions. Flow control is not necessary for the discharge to the wetland in order to match existing flows.

4.4 Water Quality System

For commercial development, enhanced water quality treatment is required. OldCastle Bipods are proposed to provide the required treatment. These units have received a General Use Level

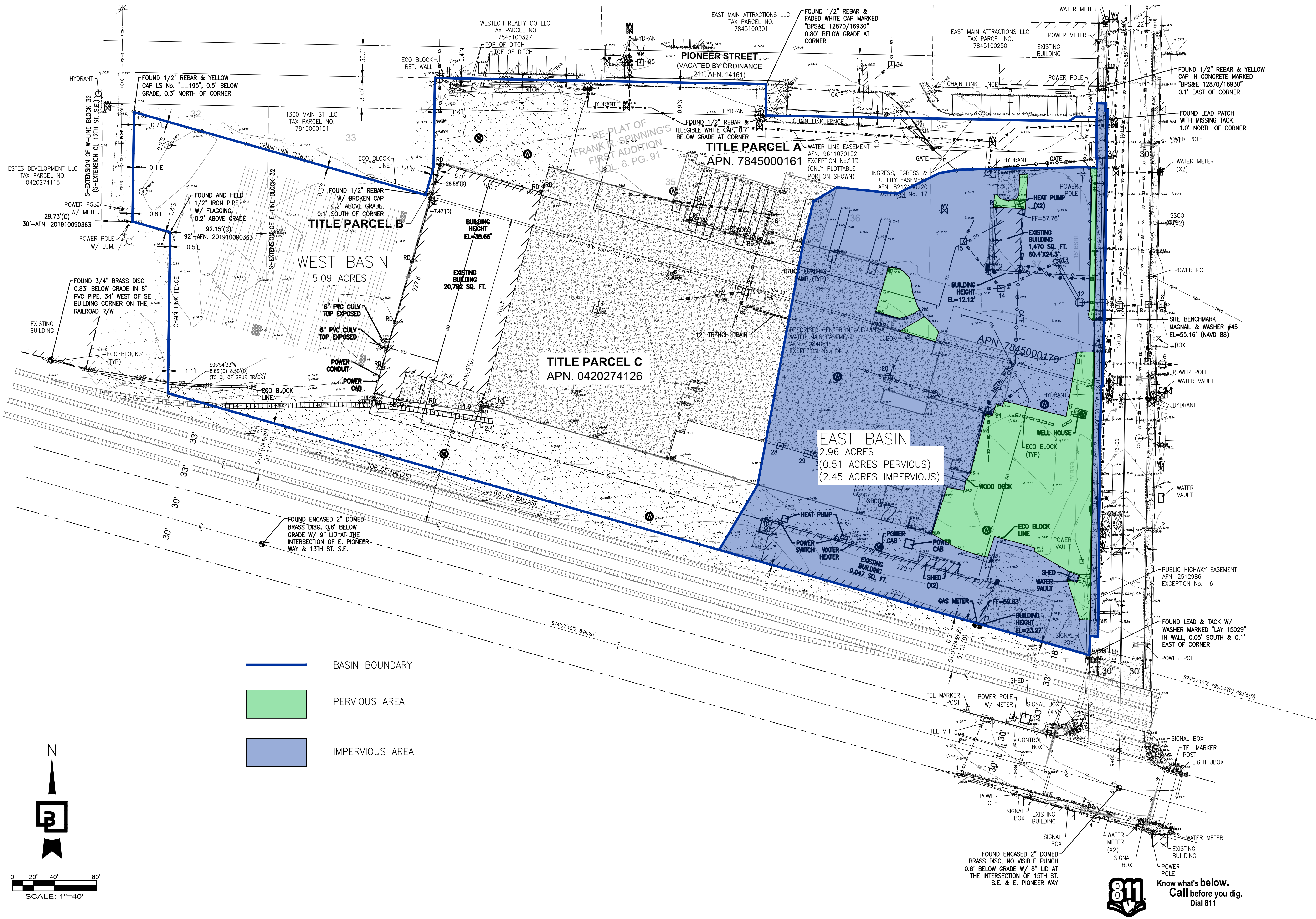
Designation (GULD) approval from the DOE. Sizing is not provided with this preliminary report, but it will be provided with the final report included with the permit submittal.

4.5 Wetland Protection

The discharge to Deer Creek for the eastern basin is shown as a wetland per the Puyallup critical areas map. It is assumed that the wetland requires General Protection, Protection from Pollutants and Wetland Hydroperiod Protection (Method 2). The discharge from the east basin will be discharged through an enhanced treatment water quality unit prior to discharge to protect the wetland from pollutants. The basin to the wetland was sized to match the existing conditions of the site, which is mostly impervious. Per I-3.4.8 MR8: Wetlands Protection from the DOE Stormwater Management Manual for Western Washington, when the flow control and wetlands protections requirements cannot bot be met, the wetlands protection is the overriding concern. In order to match current discharge conditions to the wetland, flow control matching forested conditions is not possible or flows to the wetland would be overly reduced. See East Basin - Wetland recharge in Figure 7 to see flow durations are being matched for the basin that flows to the wetland.

Figure 7
Flow Control Calculations

EXISTING CONDITION BASIN MAP EXHIBIT



Title: EXISTING CONDITION BASIN MAP EXHIBIT

FORTRESS - PUYALLUP

For: FORTRESS INVESTMENT GROUP
11611 SAN VICENTE BLVD
10TH FLOOR
LOS ANGELES, CA 90049

No.	Date	By	Ckd.	Appr.	Revision

Scale: Horizontal 1"=40' Vertical N/A

Designed VMS
Drawn VMS
Checked KEH
Approved KEH
Date 10/04/22

Barghausen Consulting Engineers, Inc.
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barghausen.com

Job Number 22085

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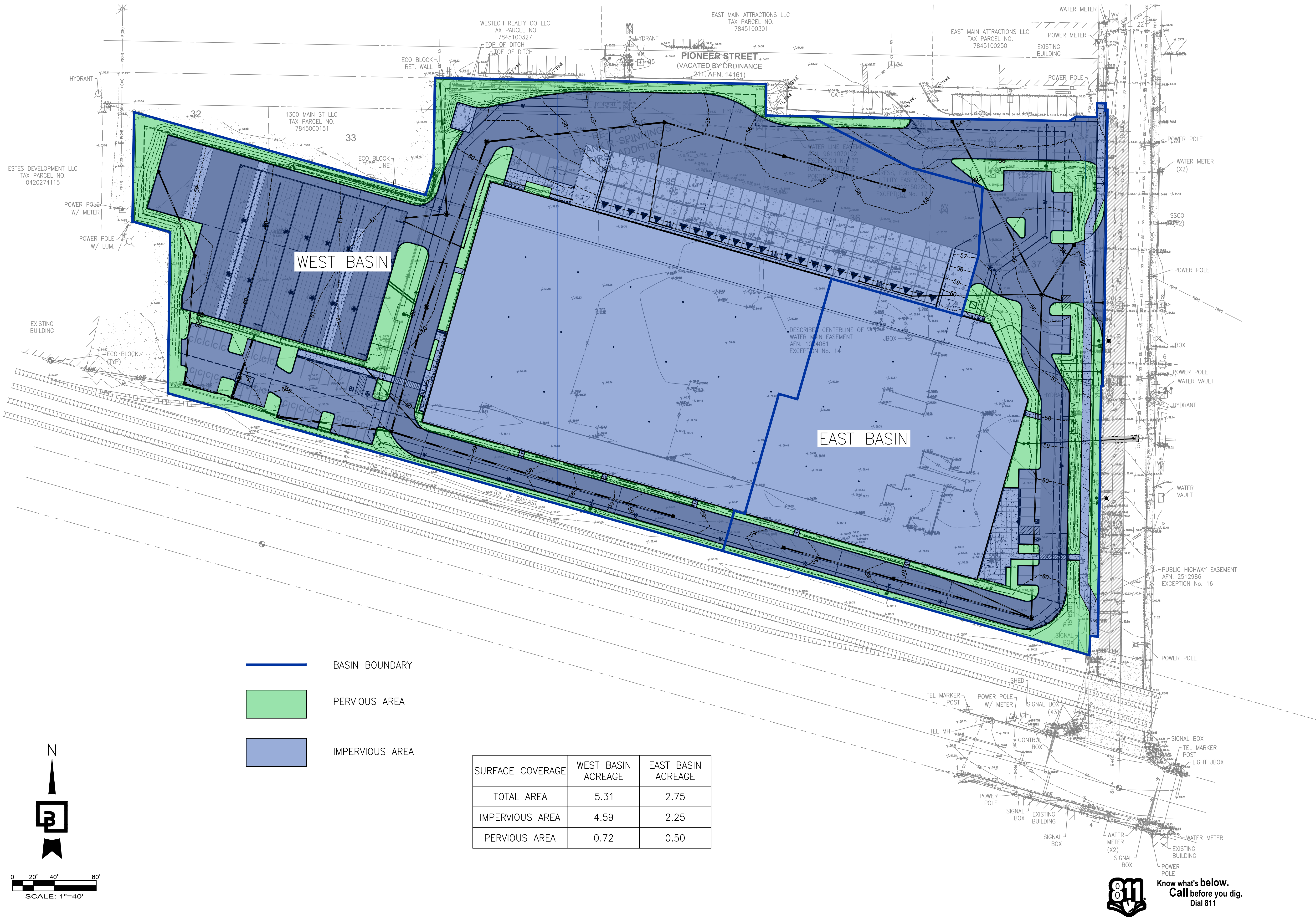
PROPOSED CONDITION BASIN MAP EXHIBIT



BASIN BOUNDARY

PERVIOUS AREA

IMPERVIOUS AREA

SURFACE COVERAGE	WEST BASIN ACREAGE	EAST BASIN ACREAGE
TOTAL AREA	5.31	2.75
IMPERVIOUS AREA	4.59	2.25
PERVIOUS AREA	0.72	0.50

Know what's below. Call before you dig. Dial 811

Title: PROPOSED CONDITION BASIN MAP EXHIBIT

FORTRESS - PUYALLUP

For: CREF3 PUYALLUP OWNER LLC
11611 SAN VICENTE BLVD
10TH FLOOR
LOS ANGELES, CA 90049

Scale: Horizontal 1"=40' Vertical N/A

Designed VMS Drawn VMS Checked KEH Approved KEH Date 10/04/22

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Kent, WA 98032
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barghausen.com

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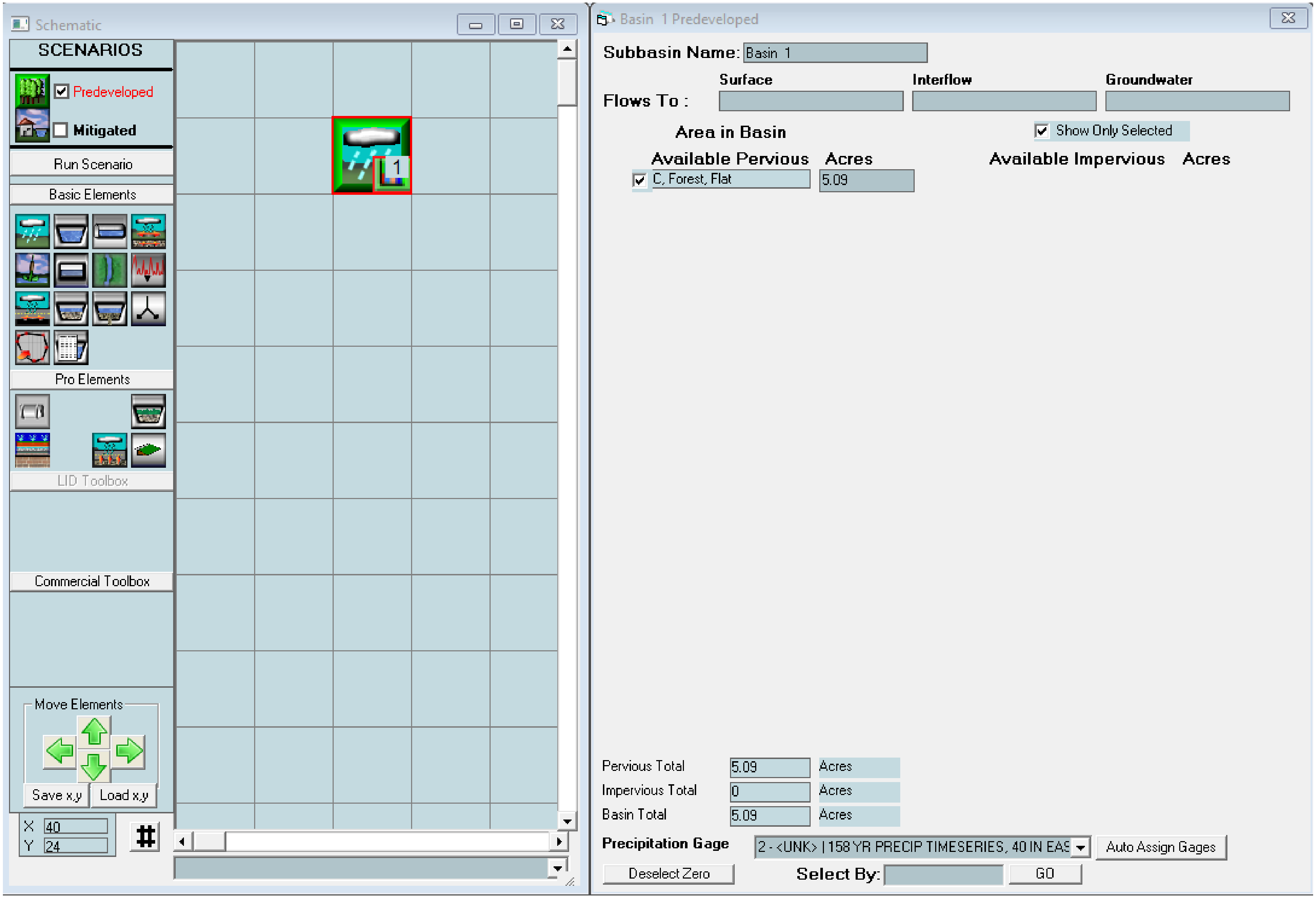
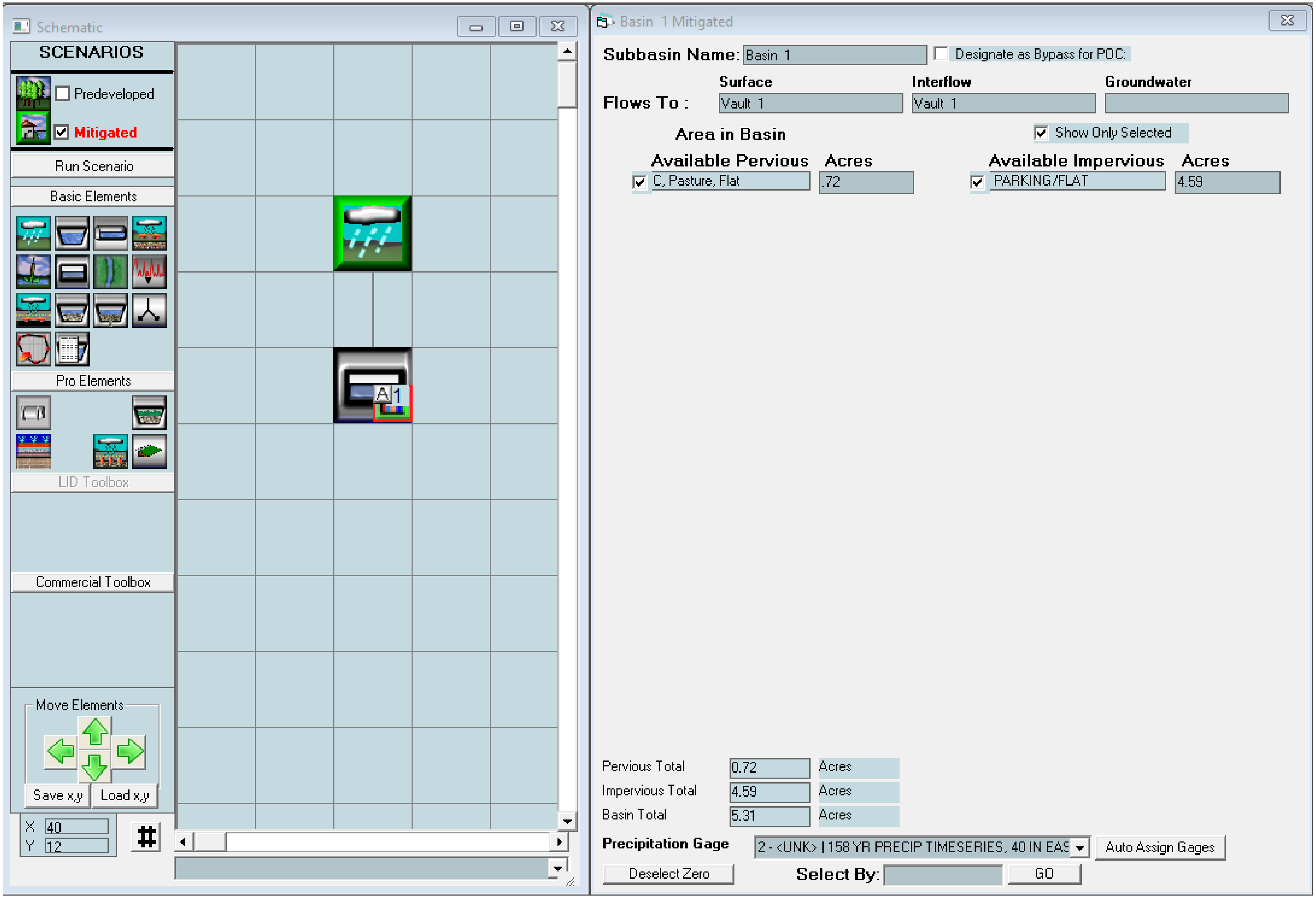
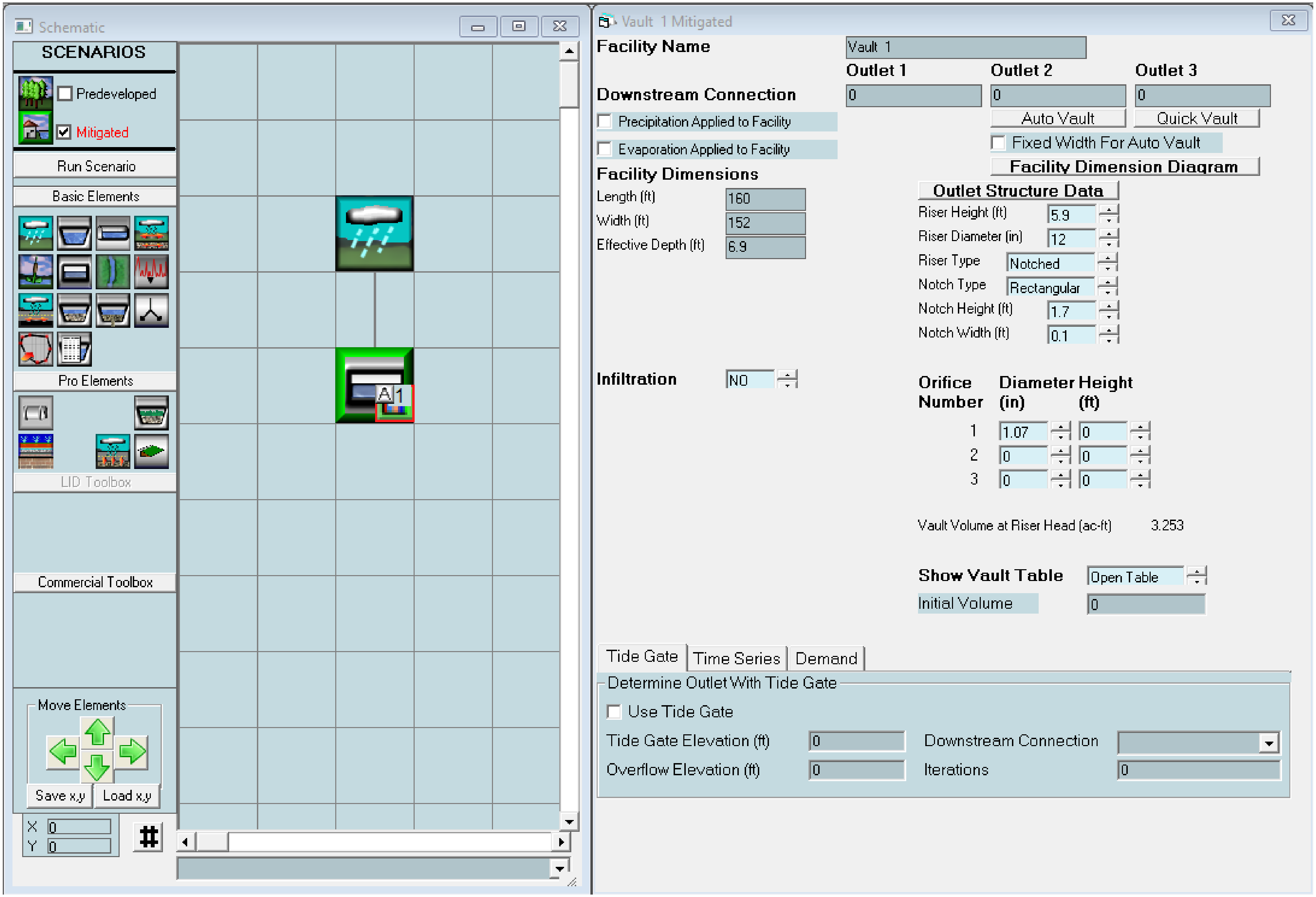
West Basin -Predeveloped Conditions



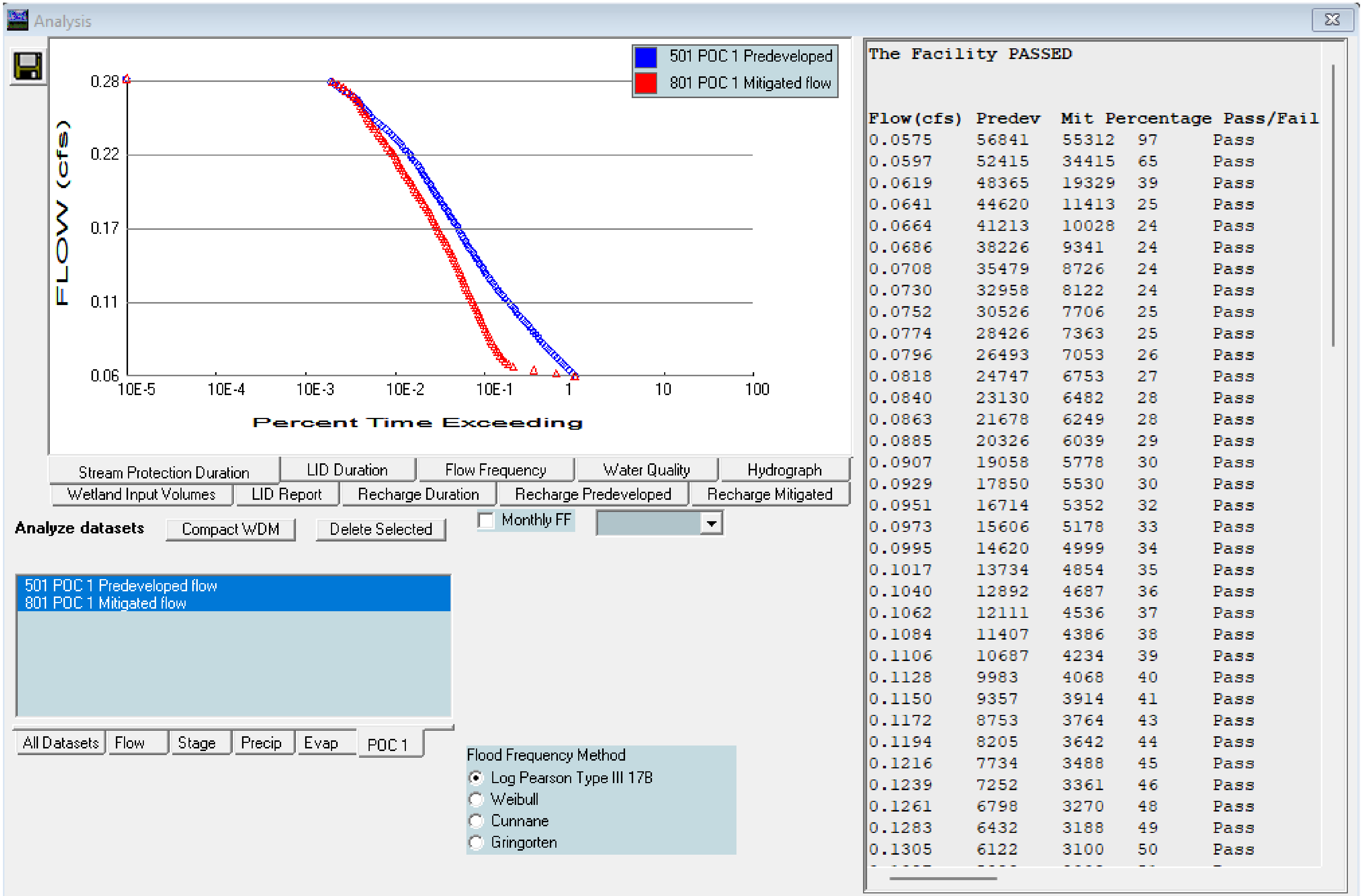
West Basin -Proposed Conditions



West Basin -Detention Vault

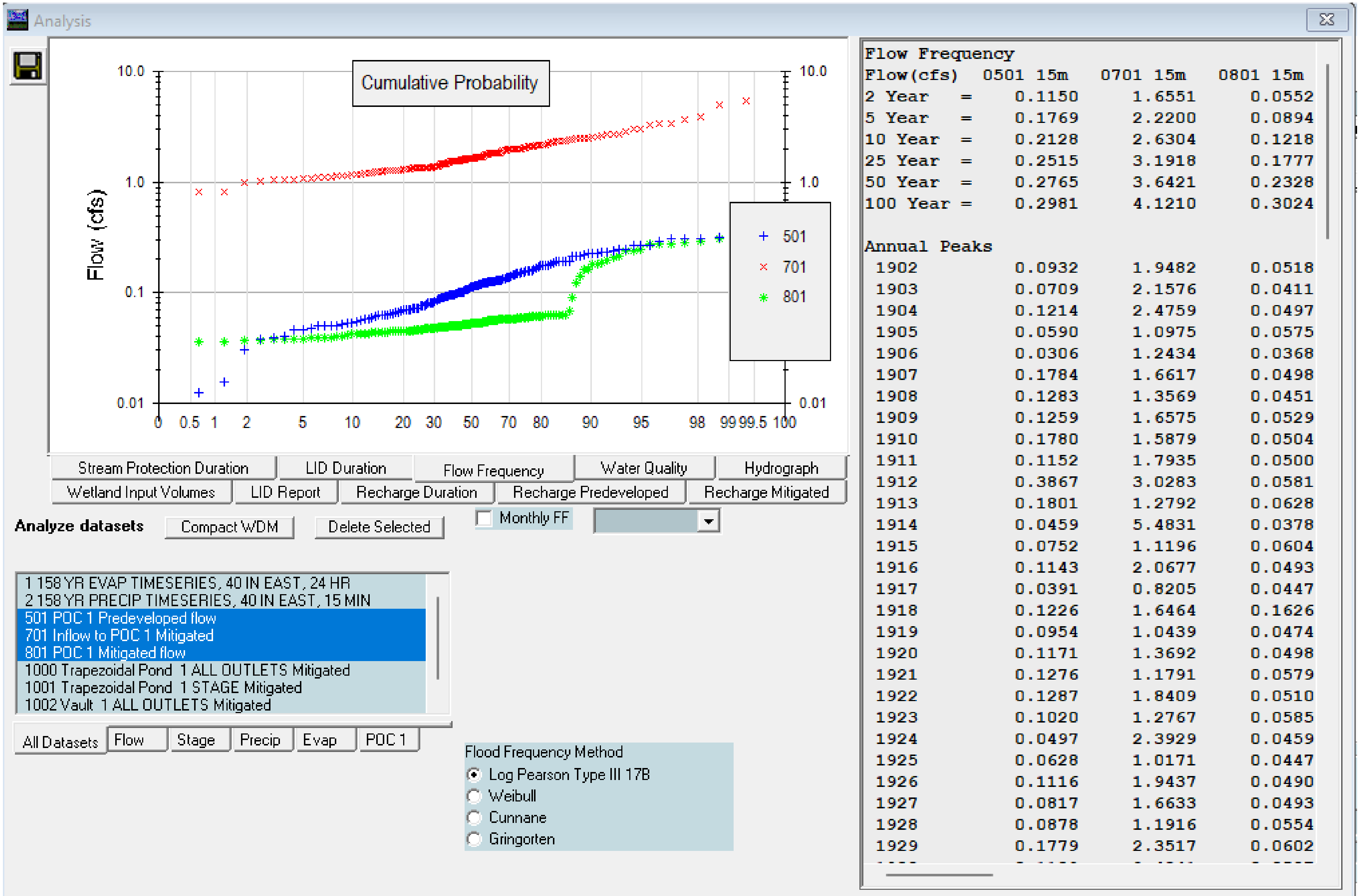


West Basin -Flow Duration

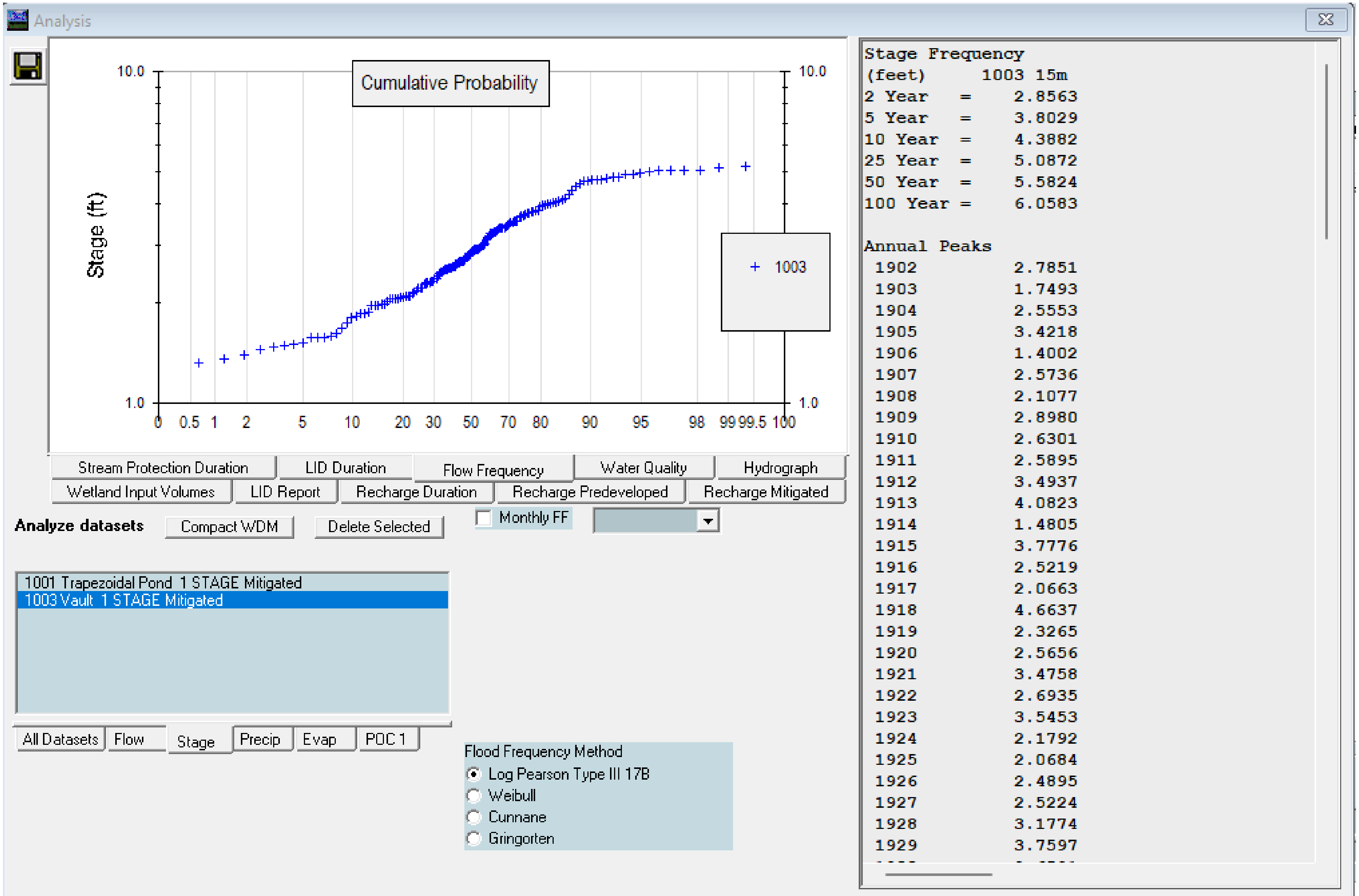


Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0575	56841	55312	97	Pass
0.0597	52415	34415	65	Pass
0.0619	48365	19329	39	Pass
0.0641	44620	11413	25	Pass
0.0664	41213	10028	24	Pass
0.0686	38226	9341	24	Pass
0.0708	35479	8726	24	Pass
0.0730	32958	8122	24	Pass
0.0752	30526	7706	25	Pass
0.0774	28426	7363	25	Pass
0.0796	26493	7053	26	Pass
0.0818	24747	6753	27	Pass
0.0840	23130	6482	28	Pass
0.0863	21678	6249	28	Pass
0.0885	20326	6039	29	Pass
0.0907	19058	5778	30	Pass
0.0929	17850	5530	30	Pass
0.0951	16714	5352	32	Pass
0.0973	15606	5178	33	Pass
0.0995	14620	4999	34	Pass
0.1017	13734	4854	35	Pass
0.1040	12892	4687	36	Pass
0.1062	12111	4536	37	Pass
0.1084	11407	4386	38	Pass
0.1106	10687	4234	39	Pass
0.1128	9983	4068	40	Pass
0.1150	9357	3914	41	Pass
0.1172	8753	3764	43	Pass
0.1194	8205	3642	44	Pass
0.1216	7734	3488	45	Pass
0.1239	7252	3361	46	Pass
0.1261	6798	3270	48	Pass
0.1283	6432	3188	49	Pass
0.1305	6122	3100	50	Pass

West Basin -Flows



West Basin -Detention Vault Stage



WWHM2012

PROJECT REPORT

General Model Information

Project Name:	22085-6 ft live
Site Name:	
Site Address:	
City:	
Report Date:	7/7/2023
Gage:	40 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	5.09
Pervious Total	5.09
Impervious Land Use	acre
Impervious Total	0
Basin Total	5.09

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.72
Pervious Total	0.72
Impervious Land Use	acre
PARKING FLAT	4.59
Impervious Total	4.59
Basin Total	5.31

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Routing Elements
Predeveloped Routing

Mitigated Routing

Vault 1

Width:	152 ft.
Length:	160 ft.
Depth:	6.9 ft.
Discharge Structure	
Riser Height:	5.9 ft.
Riser Diameter:	12 in.
Notch Type:	Rectangular
Notch Width:	0.100 ft.
Notch Height:	1.700 ft.
Orifice 1 Diameter:	1.07 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

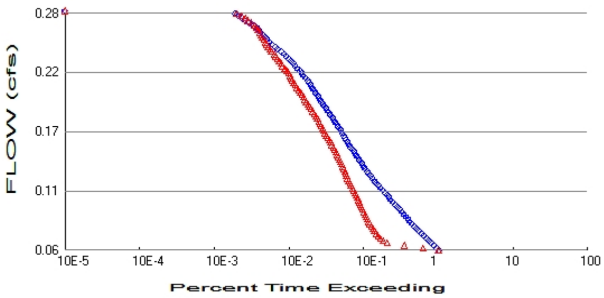
Vault Hydraulic Table

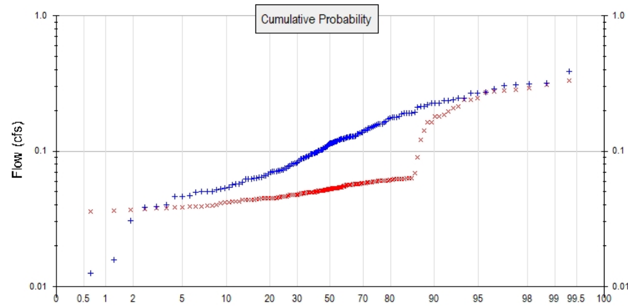
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.558	0.000	0.000	0.000
0.0767	0.558	0.042	0.008	0.000
0.1533	0.558	0.085	0.012	0.000
0.2300	0.558	0.128	0.014	0.000
0.3067	0.558	0.171	0.017	0.000
0.3833	0.558	0.214	0.019	0.000
0.4600	0.558	0.256	0.021	0.000
0.5367	0.558	0.299	0.022	0.000
0.6133	0.558	0.342	0.024	0.000
0.6900	0.558	0.385	0.025	0.000
0.7667	0.558	0.428	0.027	0.000
0.8433	0.558	0.470	0.028	0.000
0.9200	0.558	0.513	0.029	0.000
0.9967	0.558	0.556	0.031	0.000
1.0733	0.558	0.599	0.032	0.000
1.1500	0.558	0.642	0.033	0.000
1.2267	0.558	0.684	0.034	0.000
1.3033	0.558	0.727	0.035	0.000
1.3800	0.558	0.770	0.036	0.000
1.4567	0.558	0.813	0.037	0.000
1.5333	0.558	0.856	0.038	0.000
1.6100	0.558	0.898	0.039	0.000
1.6867	0.558	0.941	0.040	0.000
1.7633	0.558	0.984	0.041	0.000
1.8400	0.558	1.027	0.042	0.000
1.9167	0.558	1.070	0.043	0.000
1.9933	0.558	1.112	0.043	0.000
2.0700	0.558	1.155	0.044	0.000
2.1467	0.558	1.198	0.045	0.000
2.2233	0.558	1.241	0.046	0.000
2.3000	0.558	1.284	0.047	0.000
2.3767	0.558	1.326	0.047	0.000
2.4533	0.558	1.369	0.048	0.000
2.5300	0.558	1.412	0.049	0.000
2.6067	0.558	1.455	0.050	0.000
2.6833	0.558	1.498	0.050	0.000
2.7600	0.558	1.540	0.051	0.000

2.8367	0.558	1.583	0.052	0.000
2.9133	0.558	1.626	0.053	0.000
2.9900	0.558	1.669	0.053	0.000
3.0667	0.558	1.712	0.054	0.000
3.1433	0.558	1.755	0.055	0.000
3.2200	0.558	1.797	0.055	0.000
3.2967	0.558	1.840	0.056	0.000
3.3733	0.558	1.883	0.057	0.000
3.4500	0.558	1.926	0.057	0.000
3.5267	0.558	1.969	0.058	0.000
3.6033	0.558	2.011	0.059	0.000
3.6800	0.558	2.054	0.059	0.000
3.7567	0.558	2.097	0.060	0.000
3.8333	0.558	2.140	0.060	0.000
3.9100	0.558	2.183	0.061	0.000
3.9867	0.558	2.225	0.062	0.000
4.0633	0.558	2.268	0.062	0.000
4.1400	0.558	2.311	0.063	0.000
4.2167	0.558	2.354	0.064	0.000
4.2933	0.558	2.397	0.073	0.000
4.3700	0.558	2.439	0.087	0.000
4.4467	0.558	2.482	0.104	0.000
4.5233	0.558	2.525	0.123	0.000
4.6000	0.558	2.568	0.144	0.000
4.6767	0.558	2.611	0.166	0.000
4.7533	0.558	2.653	0.189	0.000
4.8300	0.558	2.696	0.213	0.000
4.9067	0.558	2.739	0.238	0.000
4.9833	0.558	2.782	0.264	0.000
5.0600	0.558	2.825	0.289	0.000
5.1367	0.558	2.867	0.315	0.000
5.2133	0.558	2.910	0.342	0.000
5.2900	0.558	2.953	0.374	0.000
5.3667	0.558	2.996	0.407	0.000
5.4433	0.558	3.039	0.441	0.000
5.5200	0.558	3.081	0.477	0.000
5.5967	0.558	3.124	0.513	0.000
5.6733	0.558	3.167	0.703	0.000
5.7500	0.558	3.210	0.753	0.000
5.8267	0.558	3.253	0.804	0.000
5.9033	0.558	3.295	0.857	0.000
5.9800	0.558	3.338	1.094	0.000
6.0567	0.558	3.381	1.499	0.000
6.1333	0.558	3.424	1.971	0.000
6.2100	0.558	3.467	2.420	0.000
6.2867	0.558	3.509	2.770	0.000
6.3633	0.558	3.552	2.989	0.000
6.4400	0.558	3.595	3.172	0.000
6.5167	0.558	3.638	3.332	0.000
6.5933	0.558	3.681	3.481	0.000
6.6700	0.558	3.723	3.623	0.000
6.7467	0.558	3.766	3.758	0.000
6.8233	0.558	3.809	3.887	0.000
6.9000	0.558	3.852	4.010	0.000
6.9767	0.558	3.387	4.129	0.000

Analysis Results

POC 1





\+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 5.09
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.72
Total Impervious Area: 4.59

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.115006
5 year	0.176949
10 year	0.212753
25 year	0.251534
50 year	0.276481
100 year	0.298127

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.0552
5 year	0.089355
10 year	0.121841
25 year	0.177703
50 year	0.232848
100 year	0.302375

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.093	0.052
1903	0.071	0.041
1904	0.121	0.050
1905	0.059	0.057
1906	0.031	0.037
1907	0.178	0.050
1908	0.128	0.045
1909	0.126	0.053
1910	0.178	0.050
1911	0.115	0.050

1912	0.387	0.058
1913	0.180	0.063
1914	0.046	0.038
1915	0.075	0.060
1916	0.114	0.049
1917	0.039	0.045
1918	0.123	0.163
1919	0.095	0.047
1920	0.117	0.050
1921	0.128	0.058
1922	0.129	0.051
1923	0.102	0.058
1924	0.050	0.046
1925	0.063	0.045
1926	0.112	0.049
1927	0.082	0.049
1928	0.088	0.055
1929	0.178	0.060
1930	0.114	0.051
1931	0.108	0.053
1932	0.083	0.057
1933	0.092	0.053
1934	0.234	0.330
1935	0.108	0.090
1936	0.097	0.057
1937	0.156	0.050
1938	0.096	0.051
1939	0.008	0.036
1940	0.105	0.058
1941	0.064	0.039
1942	0.158	0.197
1943	0.080	0.053
1944	0.165	0.060
1945	0.127	0.053
1946	0.075	0.043
1947	0.053	0.045
1948	0.245	0.052
1949	0.213	0.063
1950	0.062	0.046
1951	0.080	0.045
1952	0.317	0.062
1953	0.288	0.164
1954	0.102	0.055
1955	0.089	0.042
1956	0.047	0.042
1957	0.152	0.060
1958	0.306	0.311
1959	0.191	0.276
1960	0.056	0.039
1961	0.192	0.181
1962	0.104	0.056
1963	0.051	0.038
1964	0.053	0.045
1965	0.215	0.286
1966	0.063	0.047
1967	0.096	0.044
1968	0.101	0.056
1969	0.096	0.051

1970	0.148	0.052
1971	0.227	0.121
1972	0.149	0.055
1973	0.193	0.062
1974	0.106	0.050
1975	0.240	0.274
1976	0.129	0.054
1977	0.057	0.037
1978	0.211	0.214
1979	0.062	0.047
1980	0.123	0.051
1981	0.113	0.054
1982	0.054	0.039
1983	0.192	0.058
1984	0.087	0.047
1985	0.137	0.047
1986	0.115	0.056
1987	0.219	0.142
1988	0.137	0.062
1989	0.126	0.048
1990	0.144	0.051
1991	0.115	0.056
1992	0.150	0.180
1993	0.155	0.052
1994	0.227	0.055
1995	0.052	0.048
1996	0.248	0.241
1997	0.102	0.044
1998	0.123	0.049
1999	0.012	0.044
2000	0.091	0.057
2001	0.050	0.036
2002	0.164	0.052
2003	0.141	0.054
2004	0.125	0.053
2005	0.228	0.056
2006	0.073	0.049
2007	0.077	0.053
2008	0.122	0.051
2009	0.081	0.048
2010	0.071	0.058
2011	0.064	0.045
2012	0.096	0.049
2013	0.072	0.038
2014	0.050	0.039
2015	0.098	0.046
2016	0.040	0.045
2017	0.175	0.061
2018	0.312	0.291
2019	0.308	0.278
2020	0.097	0.045
2021	0.159	0.069
2022	0.066	0.045
2023	0.133	0.057
2024	0.267	0.051
2025	0.119	0.053
2026	0.190	0.061
2027	0.072	0.046

2028	0.062	0.038
2029	0.129	0.062
2030	0.236	0.060
2031	0.078	0.042
2032	0.046	0.040
2033	0.071	0.042
2034	0.069	0.046
2035	0.269	0.240
2036	0.143	0.057
2037	0.038	0.043
2038	0.118	0.060
2039	0.016	0.031
2040	0.067	0.047
2041	0.090	0.044
2042	0.271	0.186
2043	0.130	0.062
2044	0.173	0.062
2045	0.117	0.059
2046	0.136	0.246
2047	0.100	0.058
2048	0.133	0.050
2049	0.119	0.054
2050	0.085	0.049
2051	0.121	0.053
2052	0.072	0.053
2053	0.127	0.208
2054	0.158	0.061
2055	0.065	0.040
2056	0.057	0.044
2057	0.089	0.056
2058	0.106	0.059
2059	0.187	0.063

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3867	0.3301
2	0.3168	0.3106
3	0.3121	0.2905
4	0.3085	0.2856
5	0.3060	0.2782
6	0.2876	0.2758
7	0.2713	0.2736
8	0.2685	0.2459
9	0.2672	0.2410
10	0.2480	0.2402
11	0.2448	0.2143
12	0.2405	0.2078
13	0.2357	0.1971
14	0.2345	0.1859
15	0.2277	0.1810
16	0.2271	0.1802
17	0.2265	0.1638
18	0.2191	0.1626
19	0.2150	0.1419
20	0.2128	0.1211
21	0.2113	0.0900
22	0.1928	0.0688

23	0.1917	0.0632
24	0.1916	0.0628
25	0.1913	0.0628
26	0.1898	0.0625
27	0.1872	0.0623
28	0.1801	0.0621
29	0.1784	0.0621
30	0.1780	0.0619
31	0.1779	0.0617
32	0.1745	0.0614
33	0.1729	0.0607
34	0.1653	0.0607
35	0.1639	0.0604
36	0.1590	0.0604
37	0.1585	0.0602
38	0.1583	0.0601
39	0.1555	0.0598
40	0.1546	0.0597
41	0.1523	0.0594
42	0.1498	0.0592
43	0.1488	0.0585
44	0.1479	0.0584
45	0.1437	0.0584
46	0.1430	0.0581
47	0.1411	0.0581
48	0.1371	0.0579
49	0.1369	0.0577
50	0.1356	0.0575
51	0.1333	0.0572
52	0.1330	0.0572
53	0.1298	0.0571
54	0.1288	0.0571
55	0.1287	0.0569
56	0.1285	0.0565
57	0.1283	0.0563
58	0.1276	0.0562
59	0.1273	0.0561
60	0.1271	0.0561
61	0.1259	0.0560
62	0.1256	0.0555
63	0.1247	0.0554
64	0.1232	0.0551
65	0.1226	0.0546
66	0.1226	0.0541
67	0.1225	0.0538
68	0.1214	0.0538
69	0.1214	0.0538
70	0.1192	0.0534
71	0.1187	0.0533
72	0.1181	0.0530
73	0.1171	0.0529
74	0.1165	0.0529
75	0.1155	0.0529
76	0.1152	0.0529
77	0.1147	0.0527
78	0.1143	0.0526
79	0.1139	0.0526
80	0.1125	0.0524

81	0.1116	0.0521
82	0.1084	0.0518
83	0.1080	0.0518
84	0.1063	0.0516
85	0.1062	0.0514
86	0.1053	0.0511
87	0.1039	0.0510
88	0.1021	0.0509
89	0.1020	0.0509
90	0.1016	0.0508
91	0.1012	0.0507
92	0.1004	0.0507
93	0.0980	0.0504
94	0.0974	0.0504
95	0.0974	0.0500
96	0.0963	0.0499
97	0.0963	0.0498
98	0.0958	0.0498
99	0.0957	0.0497
100	0.0954	0.0496
101	0.0932	0.0495
102	0.0917	0.0493
103	0.0915	0.0493
104	0.0900	0.0491
105	0.0893	0.0490
106	0.0891	0.0489
107	0.0878	0.0487
108	0.0870	0.0482
109	0.0849	0.0479
110	0.0827	0.0477
111	0.0817	0.0474
112	0.0811	0.0474
113	0.0801	0.0473
114	0.0801	0.0473
115	0.0778	0.0472
116	0.0766	0.0470
117	0.0752	0.0464
118	0.0752	0.0463
119	0.0725	0.0462
120	0.0723	0.0459
121	0.0721	0.0456
122	0.0719	0.0455
123	0.0709	0.0451
124	0.0709	0.0451
125	0.0706	0.0450
126	0.0693	0.0449
127	0.0675	0.0448
128	0.0656	0.0447
129	0.0655	0.0447
130	0.0642	0.0446
131	0.0639	0.0445
132	0.0628	0.0442
133	0.0628	0.0438
134	0.0623	0.0438
135	0.0621	0.0437
136	0.0618	0.0437
137	0.0590	0.0435
138	0.0573	0.0427

139	0.0569	0.0424
140	0.0562	0.0423
141	0.0539	0.0420
142	0.0530	0.0419
143	0.0525	0.0411
144	0.0517	0.0403
145	0.0506	0.0396
146	0.0501	0.0393
147	0.0499	0.0391
148	0.0497	0.0390
149	0.0471	0.0389
150	0.0461	0.0382
151	0.0459	0.0382
152	0.0400	0.0379
153	0.0391	0.0378
154	0.0382	0.0374
155	0.0306	0.0368
156	0.0157	0.0363
157	0.0124	0.0357
158	0.0080	0.0313

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0575	56841	55312	97	Pass
0.0597	52415	34415	65	Pass
0.0619	48365	19329	39	Pass
0.0641	44620	11413	25	Pass
0.0664	41213	10028	24	Pass
0.0686	38226	9341	24	Pass
0.0708	35479	8726	24	Pass
0.0730	32958	8122	24	Pass
0.0752	30526	7706	25	Pass
0.0774	28426	7363	25	Pass
0.0796	26493	7053	26	Pass
0.0818	24747	6753	27	Pass
0.0840	23130	6482	28	Pass
0.0863	21678	6249	28	Pass
0.0885	20326	6039	29	Pass
0.0907	19058	5778	30	Pass
0.0929	17850	5530	30	Pass
0.0951	16714	5352	32	Pass
0.0973	15606	5178	33	Pass
0.0995	14620	4999	34	Pass
0.1017	13734	4854	35	Pass
0.1040	12892	4687	36	Pass
0.1062	12111	4536	37	Pass
0.1084	11407	4386	38	Pass
0.1106	10687	4234	39	Pass
0.1128	9983	4068	40	Pass
0.1150	9357	3914	41	Pass
0.1172	8753	3764	43	Pass
0.1194	8205	3642	44	Pass
0.1216	7734	3488	45	Pass
0.1239	7252	3361	46	Pass
0.1261	6798	3270	48	Pass
0.1283	6432	3188	49	Pass
0.1305	6122	3100	50	Pass
0.1327	5828	3009	51	Pass
0.1349	5557	2922	52	Pass
0.1371	5271	2824	53	Pass
0.1393	5009	2715	54	Pass
0.1416	4790	2624	54	Pass
0.1438	4536	2529	55	Pass
0.1460	4345	2441	56	Pass
0.1482	4166	2357	56	Pass
0.1504	3936	2269	57	Pass
0.1526	3713	2189	58	Pass
0.1548	3537	2090	59	Pass
0.1570	3366	2011	59	Pass
0.1593	3231	1923	59	Pass
0.1615	3091	1830	59	Pass
0.1637	2968	1748	58	Pass
0.1659	2853	1677	58	Pass
0.1681	2741	1624	59	Pass
0.1703	2599	1562	60	Pass
0.1725	2477	1499	60	Pass

0.1747	2359	1448	61	Pass
0.1769	2267	1386	61	Pass
0.1792	2160	1323	61	Pass
0.1814	2059	1262	61	Pass
0.1836	1950	1210	62	Pass
0.1858	1840	1150	62	Pass
0.1880	1748	1094	62	Pass
0.1902	1659	1042	62	Pass
0.1924	1579	992	62	Pass
0.1946	1510	945	62	Pass
0.1969	1445	903	62	Pass
0.1991	1368	866	63	Pass
0.2013	1298	830	63	Pass
0.2035	1243	793	63	Pass
0.2057	1182	750	63	Pass
0.2079	1129	696	61	Pass
0.2101	1079	671	62	Pass
0.2123	1026	640	62	Pass
0.2145	980	609	62	Pass
0.2168	925	591	63	Pass
0.2190	872	570	65	Pass
0.2212	819	550	67	Pass
0.2234	772	523	67	Pass
0.2256	717	486	67	Pass
0.2278	668	457	68	Pass
0.2300	629	435	69	Pass
0.2322	588	413	70	Pass
0.2345	549	389	70	Pass
0.2367	507	372	73	Pass
0.2389	475	354	74	Pass
0.2411	429	324	75	Pass
0.2433	392	308	78	Pass
0.2455	363	290	79	Pass
0.2477	329	278	84	Pass
0.2499	300	268	89	Pass
0.2522	281	255	90	Pass
0.2544	264	243	92	Pass
0.2566	248	233	93	Pass
0.2588	233	226	96	Pass
0.2610	219	212	96	Pass
0.2632	205	201	98	Pass
0.2654	186	189	101	Pass
0.2676	162	175	108	Pass
0.2698	143	157	109	Pass
0.2721	130	144	110	Pass
0.2743	117	128	109	Pass
0.2765	106	111	104	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

Model Default Modifications

Total of 0 changes have been made.

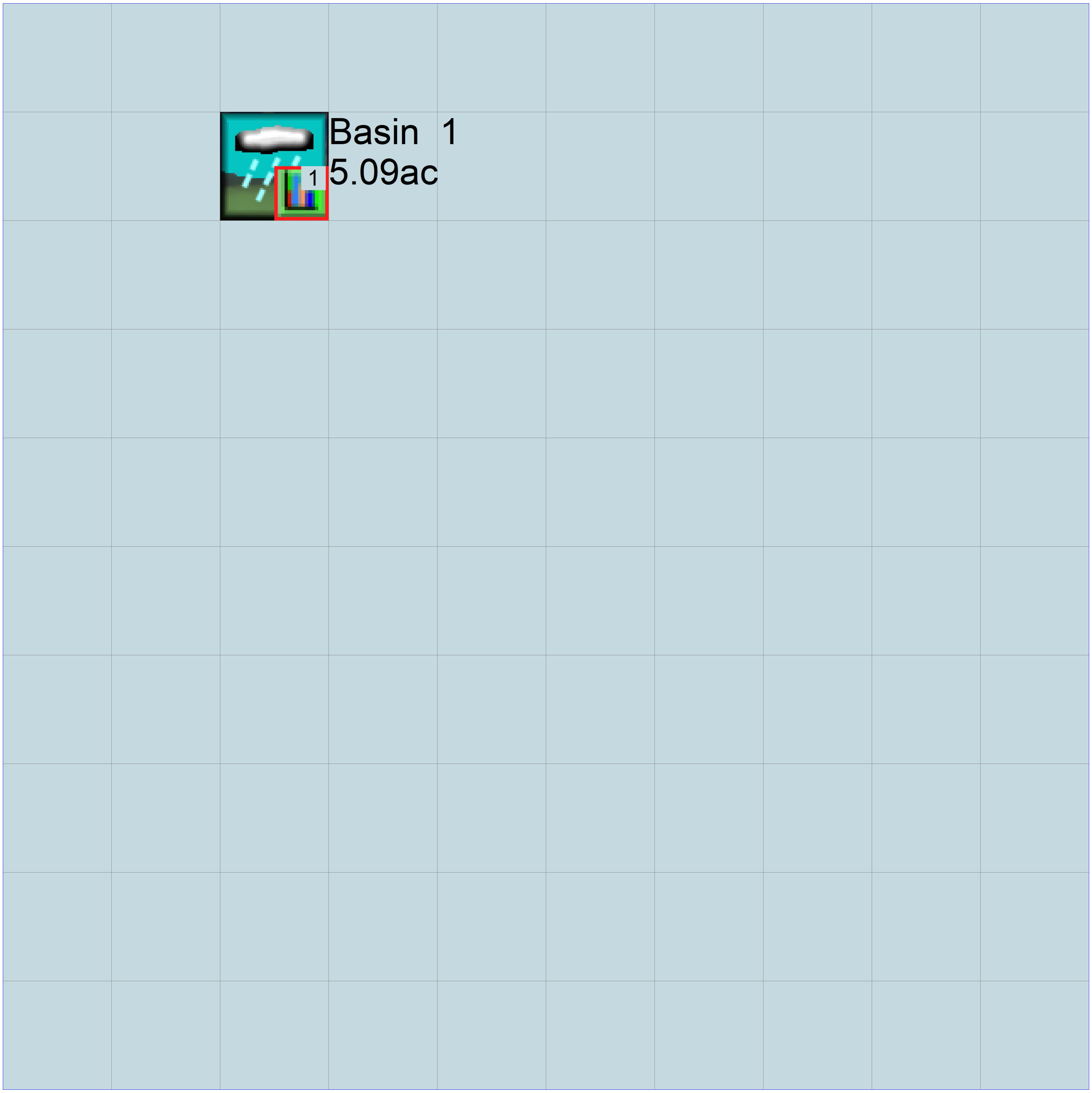
PERLND Changes

No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
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WDM        26   22085-6 ft live.wdm
MESSU      25   Pre22085-6 ft live.MES
           27   Pre22085-6 ft live.L61
           28   Pre22085-6 ft live.L62
           30   POC22085-6 ft live1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      10
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                    MAX                   1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                            in  out           ***
   10     C, Forest, Flat         1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   10         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   10         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   10         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   10              0       4.5      0.08       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   10              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   10            0.2       0.5      0.35         6       0.5       0.7
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   10              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                     in  out            ***
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
  END IWAT-STATE1
```

```
END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  10                        5.09     COPY   501     12
PERLND  10                        5.09     COPY   501     13

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *        *  *  *  *  *        ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
```

```
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   22085-6 ft live.wdm
MESSU      25   Mit22085-6 ft live.MES
           27   Mit22085-6 ft live.L61
           28   Mit22085-6 ft live.L62
           30   POC22085-6 ft live1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      13
      IMPLND      11
      RCHRES       1
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Vault  1                    MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out            ***
   13     C, Pasture, Flat        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   13         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
```

```
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   13             0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   13             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   13           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   13             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name-------->   Unit-systems   Printer ***
    # -  #                      User  t-series Engl Metr ***
                                        in  out          ***
   11      PARKING/FLAT            1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
   11           400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
```

```
    # -  # ***PETMAX    PETMIN
   11             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   11             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  13                        0.72     RCHRES   1      2
PERLND  13                        0.72     RCHRES   1      3
IMPLND  11                        4.59     RCHRES   1      5

******Routing******
PERLND  13                        0.72     COPY     1     12
IMPLND  11                        4.59     COPY     1     15
PERLND  13                        0.72     COPY     1     13
RCHRES   1                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                              in  out                        ***
    1     Vault  1               1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
```

```
    1              1      0.03       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                             ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1          0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.558310  0.000000  0.000000
  0.076667  0.558310  0.042804  0.008603
  0.153333  0.558310  0.085608  0.012166
  0.230000  0.558310  0.128411  0.014900
  0.306667  0.558310  0.171215  0.017205
  0.383333  0.558310  0.214019  0.019236
  0.460000  0.558310  0.256823  0.021072
  0.536667  0.558310  0.299627  0.022760
  0.613333  0.558310  0.342430  0.024332
  0.690000  0.558310  0.385234  0.025808
  0.766667  0.558310  0.428038  0.027204
  0.843333  0.558310  0.470842  0.028532
  0.920000  0.558310  0.513646  0.029800
  0.996667  0.558310  0.556449  0.031017
  1.073333  0.558310  0.599253  0.032188
  1.150000  0.558310  0.642057  0.033318
  1.226667  0.558310  0.684861  0.034410
  1.303333  0.558310  0.727665  0.035469
  1.380000  0.558310  0.770468  0.036498
  1.456667  0.558310  0.813272  0.037498
  1.533333  0.558310  0.856076  0.038472
  1.610000  0.558310  0.898880  0.039422
  1.686667  0.558310  0.941684  0.040350
  1.763333  0.558310  0.984487  0.041257
  1.840000  0.558310  1.027291  0.042144
  1.916667  0.558310  1.070095  0.043013
  1.993333  0.558310  1.112899  0.043865
  2.070000  0.558310  1.155702  0.044700
  2.146667  0.558310  1.198506  0.045521
  2.223333  0.558310  1.241310  0.046326
  2.300000  0.558310  1.284114  0.047118
  2.376667  0.558310  1.326918  0.047897
  2.453333  0.558310  1.369721  0.048664
  2.530000  0.558310  1.412525  0.049418
  2.606667  0.558310  1.455329  0.050161
  2.683333  0.558310  1.498133  0.050894
  2.760000  0.558310  1.540937  0.051616
  2.836667  0.558310  1.583740  0.052328
  2.913333  0.558310  1.626544  0.053030
  2.990000  0.558310  1.669348  0.053723
  3.066667  0.558310  1.712152  0.054408
  3.143333  0.558310  1.754956  0.055083
  3.220000  0.558310  1.797759  0.055751
  3.296667  0.558310  1.840563  0.056411
  3.373333  0.558310  1.883367  0.057063
  3.450000  0.558310  1.926171  0.057708
  3.526667  0.558310  1.968975  0.058346
  3.603333  0.558310  2.011778  0.058976
  3.680000  0.558310  2.054582  0.059601
  3.756667  0.558310  2.097386  0.060218
  3.833333  0.558310  2.140190  0.060830
  3.910000  0.558310  2.182994  0.061435
```

```
  3.986667  0.558310  2.225797  0.062034
  4.063333  0.558310  2.268601  0.062628
  4.140000  0.558310  2.311405  0.063216
  4.216667  0.558310  2.354209  0.064513
  4.293333  0.558310  2.397013  0.073694
  4.370000  0.558310  2.439816  0.087495
  4.446667  0.558310  2.482620  0.104298
  4.523333  0.558310  2.525424  0.123342
  4.600000  0.558310  2.568228  0.144139
  4.676667  0.558310  2.611032  0.166330
  4.753333  0.558310  2.653835  0.189633
  4.830000  0.558310  2.696639  0.213816
  4.906667  0.558310  2.739443  0.238681
  4.983333  0.558310  2.782247  0.264055
  5.060000  0.558310  2.825051  0.289786
  5.136667  0.558310  2.867854  0.315736
  5.213333  0.558310  2.910658  0.342685
  5.290000  0.558310  2.953462  0.374620
  5.366667  0.558310  2.996266  0.407677
  5.443333  0.558310  3.039069  0.441818
  5.520000  0.558310  3.081873  0.477008
  5.596667  0.558310  3.124677  0.513218
  5.673333  0.558310  3.167481  0.702981
  5.750000  0.558310  3.210285  0.753208
  5.826667  0.558310  3.253088  0.804676
  5.903333  0.558310  3.295892  0.857107
  5.980000  0.558310  3.338696  1.094825
  6.056667  0.558310  3.381500  1.499909
  6.133333  0.558310  3.424304  1.971555
  6.210000  0.558310  3.467107  2.420936
  6.286667  0.558310  3.509911  2.770446
  6.363333  0.558310  3.552715  2.989223
  6.440000  0.558310  3.595519  3.172915
  6.516667  0.558310  3.638323  3.332233
  6.593333  0.558310  3.681126  3.481944
  6.670000  0.558310  3.723930  3.623604
  6.746667  0.558310  3.766734  3.758391
  6.823333  0.558310  3.809538  3.887219
  6.900000  0.558310  3.852342  4.010817
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1             PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1             IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1             PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1             IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   1 HYDR   RO     1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   1 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
```

```
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1964/ 9/30 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-0.28075     0.00000  0.0000E+00     0.00000  -6.855E-10

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1966/ 8/31 24: 0

RCHRES :    1

RELERR       STORS        STOR       MATIN      MATDIF
-2.065E-01     0.00000  0.0000E+00     0.00000  -1.028E-09

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
```

DATE/TIME: 1989/ 8/31 24: 0

RCHRES : 1

RELERR	STORS	STOR	MATIN	MATDIF
-7.406E-03	0.00000	0.0000E+00	0.00000	-3.596E-08

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR is the storage of material in the processing unit (land-segment or reach/reservior) at the end of the present interval.
STORS is the storage of material in the pu at the start of the present printout reporting period.
MATIN is the total inflow of material to the pu during the present printout reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the present printout reporting period.

ERROR/WARNING ID: 238 1

The continuity error reported below is greater than 1 part in 1000 and is therefore considered high.

Did you specify any "special actions"? If so, they could account for it.

Relevant data are:
DATE/TIME: 1992/ 8/31 24: 0

RCHRES : 1

RELERR	STORS	STOR	MATIN	MATDIF
-1.094E-02	0.00000	0.0000E+00	0.00000	-2.427E-08

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR is the storage of material in the processing unit (land-segment or reach/reservior) at the end of the present interval.
STORS is the storage of material in the pu at the start of the present printout reporting period.
MATIN is the total inflow of material to the pu during the present printout reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the present printout reporting period.

ERROR/WARNING ID: 238 1

The continuity error reported below is greater than 1 part in 1000 and is therefore considered high.

Did you specify any "special actions"? If so, they could account for it.

Relevant data are:
DATE/TIME: 2010/ 8/31 24: 0

RCHRES : 1

RELERR	STORS	STOR	MATIN	MATDIF
-1.099E-03	0.00000	0.0000E+00	0.00000	-2.443E-07

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR is (STOR-STORS) - MATDIF.

REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or reach/reservior) at the end of the present interval.
STORS is the storage of material in the pu at the start of the present printout reporting period.
MATIN is the total inflow of material to the pu during the present printout reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the present printout reporting period.

The count for the WARNING printed above has reached its maximum.

If the condition is encountered again the message will not be repeated.

Disclaimer

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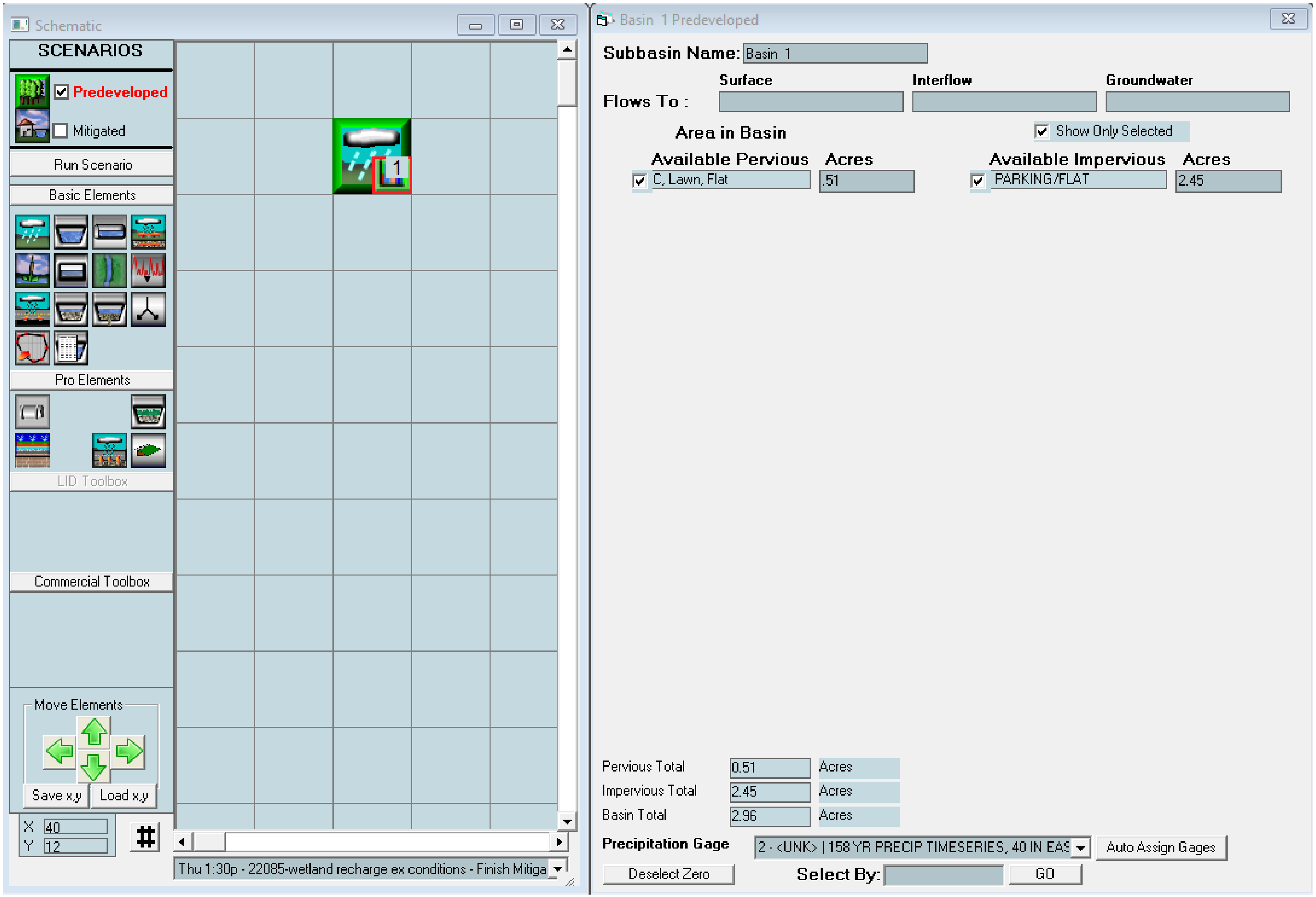
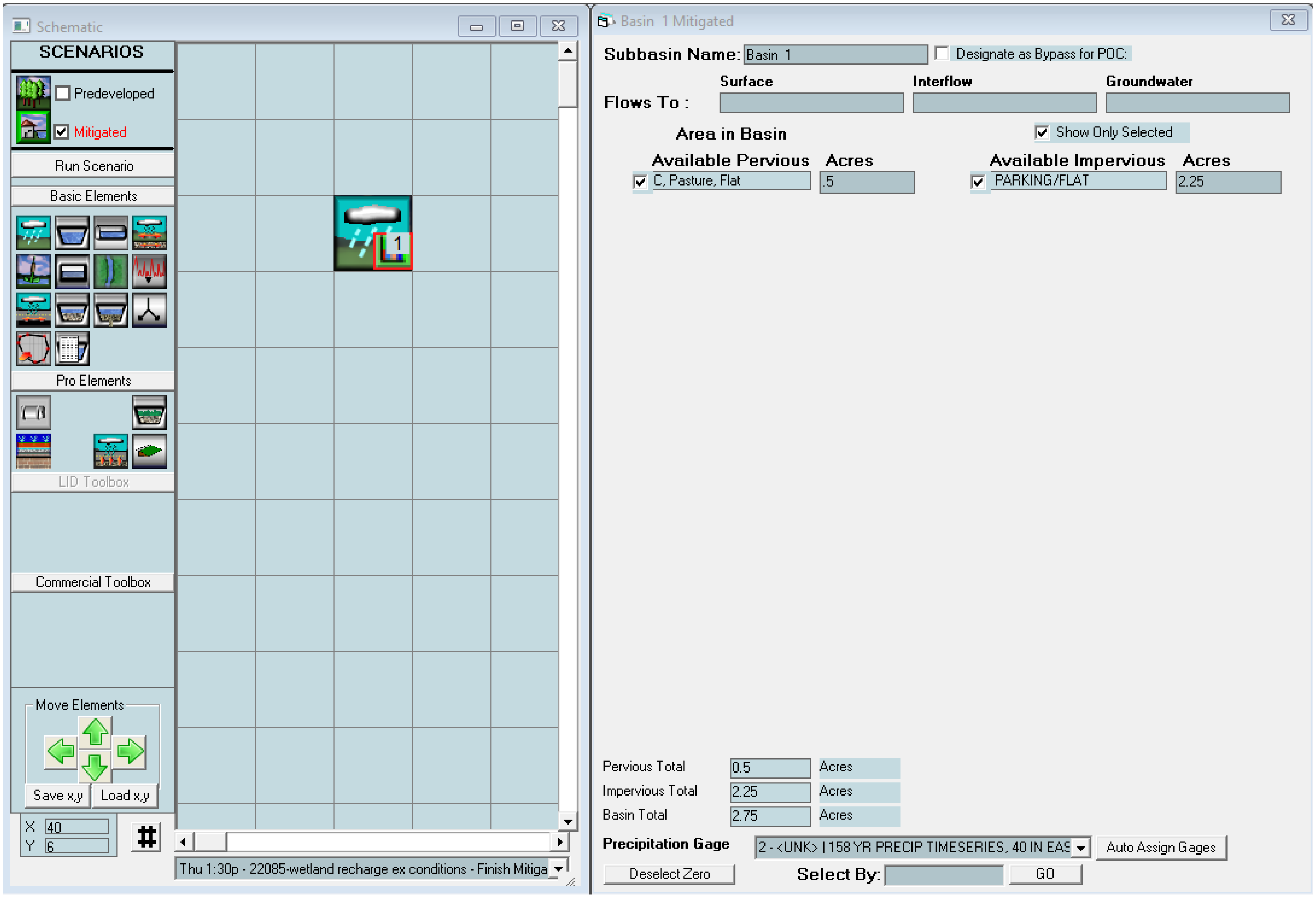
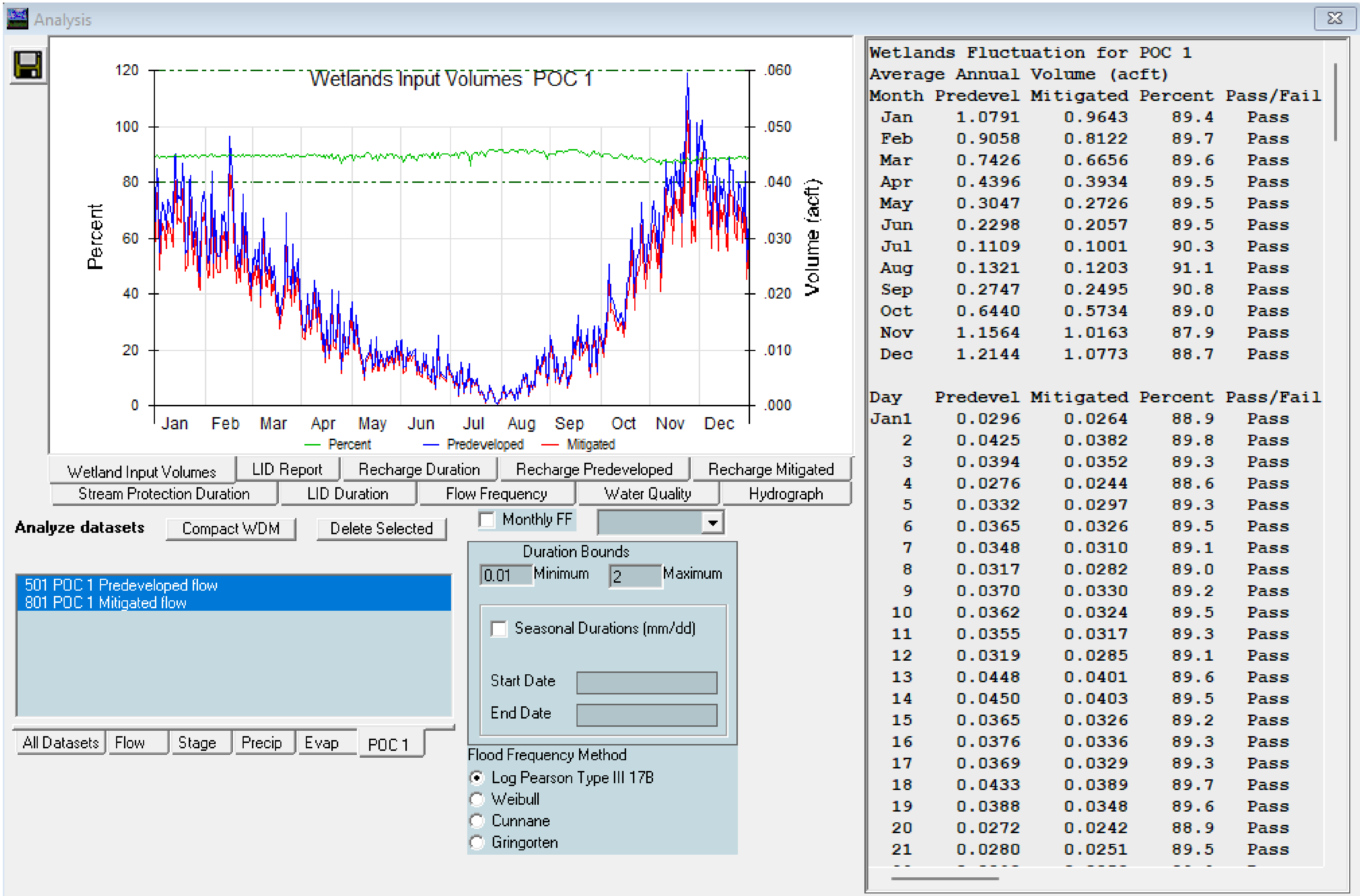
East Basin -Ex Conditions



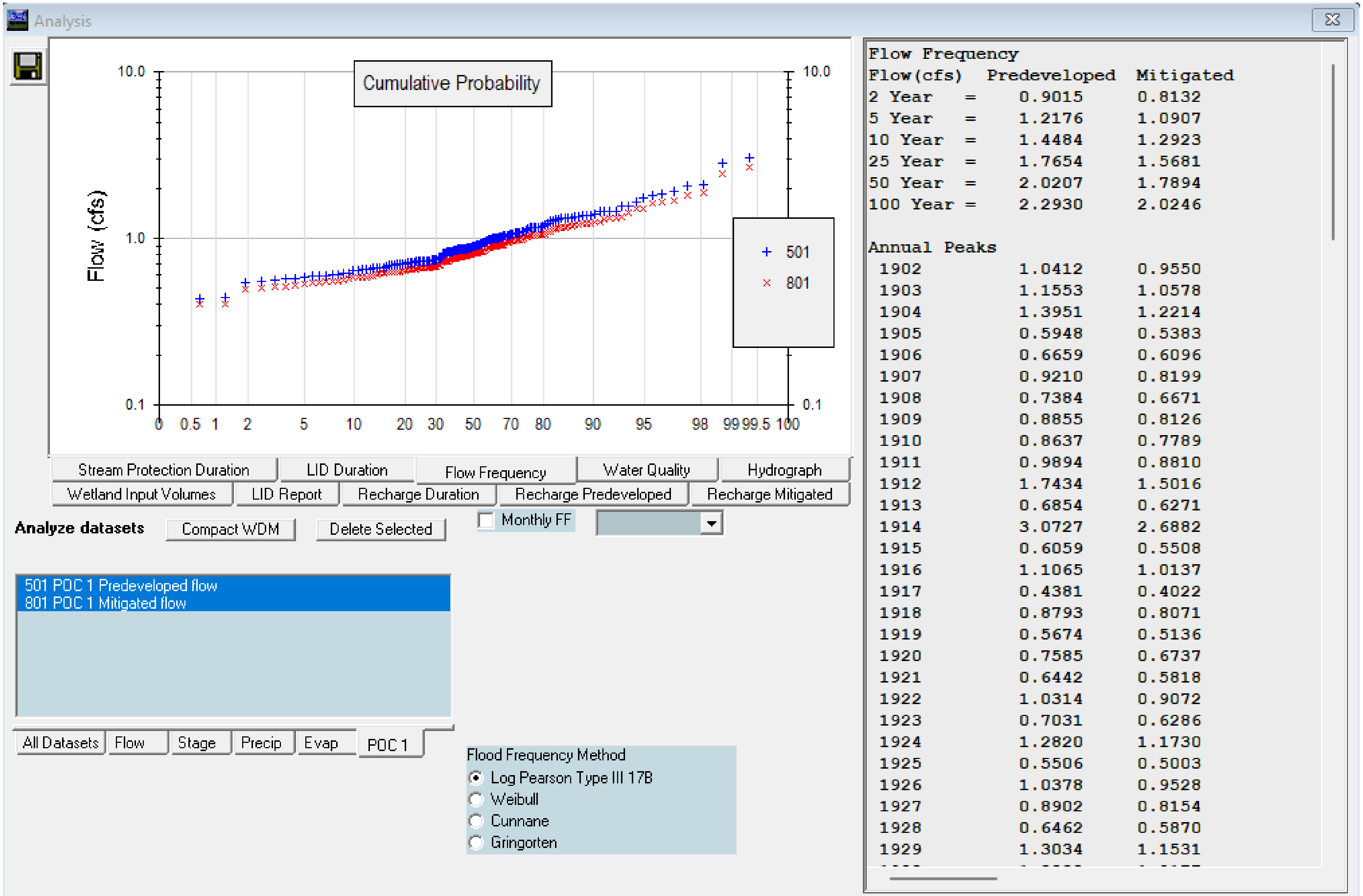
East Basin -Proposed Conditions



East Basin -Wetland recharge



East Basin -Flows



WWHM2012

PROJECT REPORT

General Model Information

Project Name:	22085-wetland recharge ex conditions
Site Name:	
Site Address:	
City:	
Report Date:	8/31/2023
Gage:	40 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.51
Pervious Total	0.51
Impervious Land Use	acre
PARKING FLAT	2.45
Impervious Total	2.45
Basin Total	2.96

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.5
Pervious Total	0.5
Impervious Land Use	acre
PARKING FLAT	2.25
Impervious Total	2.25
Basin Total	2.75

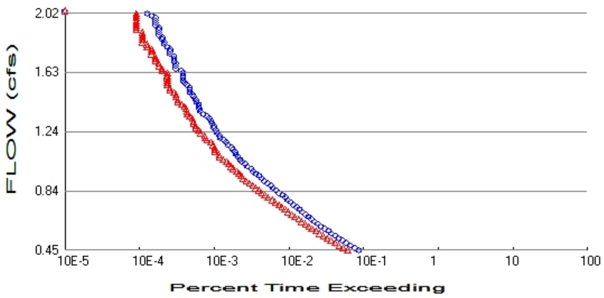
Element Flows To:

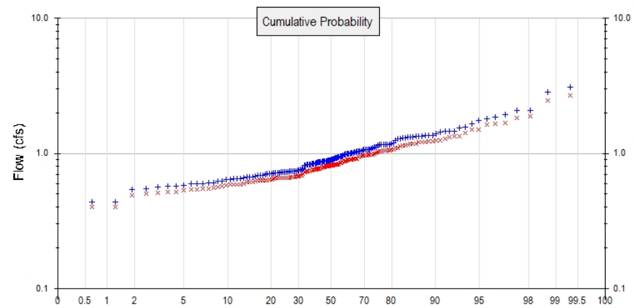
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.51
Total Impervious Area: 2.45

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.5
Total Impervious Area: 2.25

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.901539
5 year	1.217573
10 year	1.448354
25 year	1.765409
50 year	2.02072
100 year	2.292968

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.813181
5 year	1.090728
10 year	1.292333
25 year	1.568127
50 year	1.789378
100 year	2.024605

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	1.041	0.955
1903	1.155	1.058
1904	1.395	1.221
1905	0.595	0.538
1906	0.666	0.610
1907	0.921	0.820
1908	0.738	0.667
1909	0.885	0.813
1910	0.864	0.779
1911	0.989	0.881

1912	1.743	1.502
1913	0.685	0.627
1914	3.073	2.688
1915	0.606	0.551
1916	1.107	1.014
1917	0.438	0.402
1918	0.879	0.807
1919	0.567	0.514
1920	0.758	0.674
1921	0.644	0.582
1922	1.031	0.907
1923	0.703	0.629
1924	1.282	1.173
1925	0.551	0.500
1926	1.038	0.953
1927	0.890	0.815
1928	0.646	0.587
1929	1.303	1.153
1930	1.338	1.218
1931	0.653	0.590
1932	0.702	0.636
1933	0.690	0.628
1934	1.179	1.032
1935	0.600	0.551
1936	0.834	0.752
1937	1.066	0.979
1938	0.608	0.554
1939	0.740	0.677
1940	1.339	1.219
1941	1.455	1.333
1942	1.031	0.913
1943	0.995	0.896
1944	1.467	1.289
1945	1.072	0.969
1946	0.866	0.768
1947	0.647	0.588
1948	0.896	0.809
1949	1.362	1.246
1950	0.749	0.688
1951	1.158	1.064
1952	1.441	1.230
1953	1.316	1.135
1954	0.728	0.660
1955	0.670	0.614
1956	0.619	0.569
1957	0.721	0.655
1958	0.936	0.827
1959	0.940	0.828
1960	0.724	0.658
1961	2.067	1.829
1962	0.871	0.787
1963	0.636	0.584
1964	1.928	1.690
1965	0.904	0.790
1966	0.704	0.639
1967	1.028	0.905
1968	0.840	0.756
1969	0.758	0.684

1970	0.870	0.775
1971	0.861	0.760
1972	2.820	2.466
1973	1.552	1.422
1974	1.169	1.047
1975	1.282	1.098
1976	1.321	1.159
1977	0.541	0.491
1978	0.972	0.847
1979	1.015	0.899
1980	0.989	0.867
1981	0.906	0.820
1982	0.729	0.661
1983	1.011	0.902
1984	1.002	0.892
1985	1.169	1.022
1986	0.572	0.520
1987	0.996	0.914
1988	0.595	0.541
1989	0.579	0.532
1990	0.733	0.662
1991	1.110	0.982
1992	1.026	0.943
1993	1.138	1.044
1994	0.821	0.728
1995	0.619	0.562
1996	0.852	0.759
1997	0.746	0.675
1998	0.914	0.814
1999	1.000	0.915
2000	0.847	0.766
2001	0.678	0.623
2002	1.320	1.138
2003	0.719	0.652
2004	1.073	0.972
2005	2.089	1.893
2006	0.953	0.872
2007	1.094	0.979
2008	0.886	0.804
2009	0.666	0.612
2010	0.870	0.787
2011	0.889	0.816
2012	0.856	0.776
2013	0.826	0.730
2014	0.773	0.710
2015	1.363	1.177
2016	0.835	0.767
2017	1.305	1.181
2018	0.829	0.733
2019	1.239	1.093
2020	0.983	0.872
2021	0.815	0.735
2022	1.331	1.204
2023	1.648	1.509
2024	1.862	1.625
2025	0.863	0.792
2026	0.976	0.894
2027	1.064	0.973

2028	0.411	0.377
2029	0.701	0.631
2030	1.451	1.320
2031	0.436	0.399
2032	0.718	0.658
2033	0.907	0.833
2034	0.689	0.633
2035	0.930	0.828
2036	0.713	0.654
2037	0.955	0.877
2038	0.959	0.844
2039	1.813	1.663
2040	0.728	0.659
2041	0.925	0.831
2042	1.057	0.969
2043	1.160	1.063
2044	0.809	0.733
2045	0.661	0.597
2046	0.733	0.661
2047	0.879	0.807
2048	0.723	0.663
2049	1.072	0.983
2050	0.829	0.744
2051	1.196	1.052
2052	0.868	0.797
2053	0.734	0.672
2054	1.566	1.341
2055	0.840	0.761
2056	1.158	1.059
2057	0.562	0.511
2058	1.082	0.993
2059	1.365	1.253

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	3.0727	2.6882
2	2.8196	2.4655
3	2.0894	1.8933
4	2.0673	1.8295
5	1.9285	1.6903
6	1.8620	1.6629
7	1.8133	1.6249
8	1.7434	1.5091
9	1.6483	1.5016
10	1.5657	1.4218
11	1.5518	1.3414
12	1.4666	1.3332
13	1.4546	1.3199
14	1.4512	1.2890
15	1.4409	1.2527
16	1.3951	1.2458
17	1.3648	1.2301
18	1.3625	1.2214
19	1.3621	1.2189
20	1.3390	1.2177
21	1.3383	1.2039
22	1.3312	1.1806

23	1.3208	1.1767
24	1.3198	1.1730
25	1.3158	1.1587
26	1.3045	1.1531
27	1.3034	1.1375
28	1.2820	1.1346
29	1.2818	1.0978
30	1.2395	1.0927
31	1.1960	1.0636
32	1.1792	1.0630
33	1.1694	1.0593
34	1.1690	1.0578
35	1.1599	1.0515
36	1.1584	1.0472
37	1.1577	1.0439
38	1.1553	1.0316
39	1.1378	1.0219
40	1.1104	1.0137
41	1.1065	0.9931
42	1.0937	0.9830
43	1.0816	0.9819
44	1.0733	0.9792
45	1.0719	0.9789
46	1.0719	0.9728
47	1.0662	0.9717
48	1.0639	0.9690
49	1.0568	0.9687
50	1.0412	0.9550
51	1.0378	0.9528
52	1.0314	0.9428
53	1.0311	0.9151
54	1.0282	0.9142
55	1.0265	0.9126
56	1.0146	0.9072
57	1.0108	0.9054
58	1.0018	0.9015
59	0.9997	0.8986
60	0.9960	0.8960
61	0.9949	0.8939
62	0.9894	0.8924
63	0.9894	0.8810
64	0.9831	0.8769
65	0.9760	0.8721
66	0.9723	0.8720
67	0.9590	0.8673
68	0.9551	0.8467
69	0.9526	0.8444
70	0.9399	0.8333
71	0.9359	0.8314
72	0.9297	0.8281
73	0.9249	0.8279
74	0.9210	0.8270
75	0.9136	0.8203
76	0.9074	0.8199
77	0.9062	0.8163
78	0.9036	0.8154
79	0.8961	0.8145
80	0.8902	0.8126

81	0.8889	0.8087
82	0.8860	0.8074
83	0.8855	0.8071
84	0.8793	0.8044
85	0.8792	0.7973
86	0.8711	0.7923
87	0.8704	0.7896
88	0.8703	0.7870
89	0.8681	0.7870
90	0.8663	0.7789
91	0.8637	0.7757
92	0.8627	0.7746
93	0.8613	0.7676
94	0.8557	0.7665
95	0.8525	0.7659
96	0.8470	0.7609
97	0.8403	0.7604
98	0.8397	0.7586
99	0.8348	0.7557
100	0.8343	0.7518
101	0.8293	0.7440
102	0.8292	0.7355
103	0.8260	0.7333
104	0.8212	0.7330
105	0.8148	0.7300
106	0.8095	0.7278
107	0.7727	0.7096
108	0.7585	0.6881
109	0.7575	0.6842
110	0.7493	0.6770
111	0.7462	0.6748
112	0.7405	0.6737
113	0.7384	0.6722
114	0.7339	0.6671
115	0.7335	0.6631
116	0.7325	0.6620
117	0.7287	0.6606
118	0.7282	0.6606
119	0.7281	0.6599
120	0.7236	0.6593
121	0.7227	0.6583
122	0.7212	0.6582
123	0.7191	0.6545
124	0.7179	0.6539
125	0.7131	0.6517
126	0.7042	0.6394
127	0.7031	0.6358
128	0.7018	0.6326
129	0.7009	0.6312
130	0.6904	0.6286
131	0.6889	0.6279
132	0.6854	0.6271
133	0.6779	0.6227
134	0.6698	0.6142
135	0.6663	0.6116
136	0.6659	0.6096
137	0.6607	0.5973
138	0.6529	0.5900

139	0.6468	0.5880
140	0.6462	0.5870
141	0.6442	0.5837
142	0.6359	0.5818
143	0.6192	0.5685
144	0.6186	0.5619
145	0.6082	0.5544
146	0.6059	0.5508
147	0.5995	0.5505
148	0.5950	0.5409
149	0.5948	0.5383
150	0.5793	0.5320
151	0.5717	0.5199
152	0.5674	0.5136
153	0.5615	0.5113
154	0.5506	0.5003
155	0.5411	0.4910
156	0.4381	0.4022
157	0.4364	0.3987
158	0.4112	0.3774

Model Default Modifications

Total of 0 changes have been made.

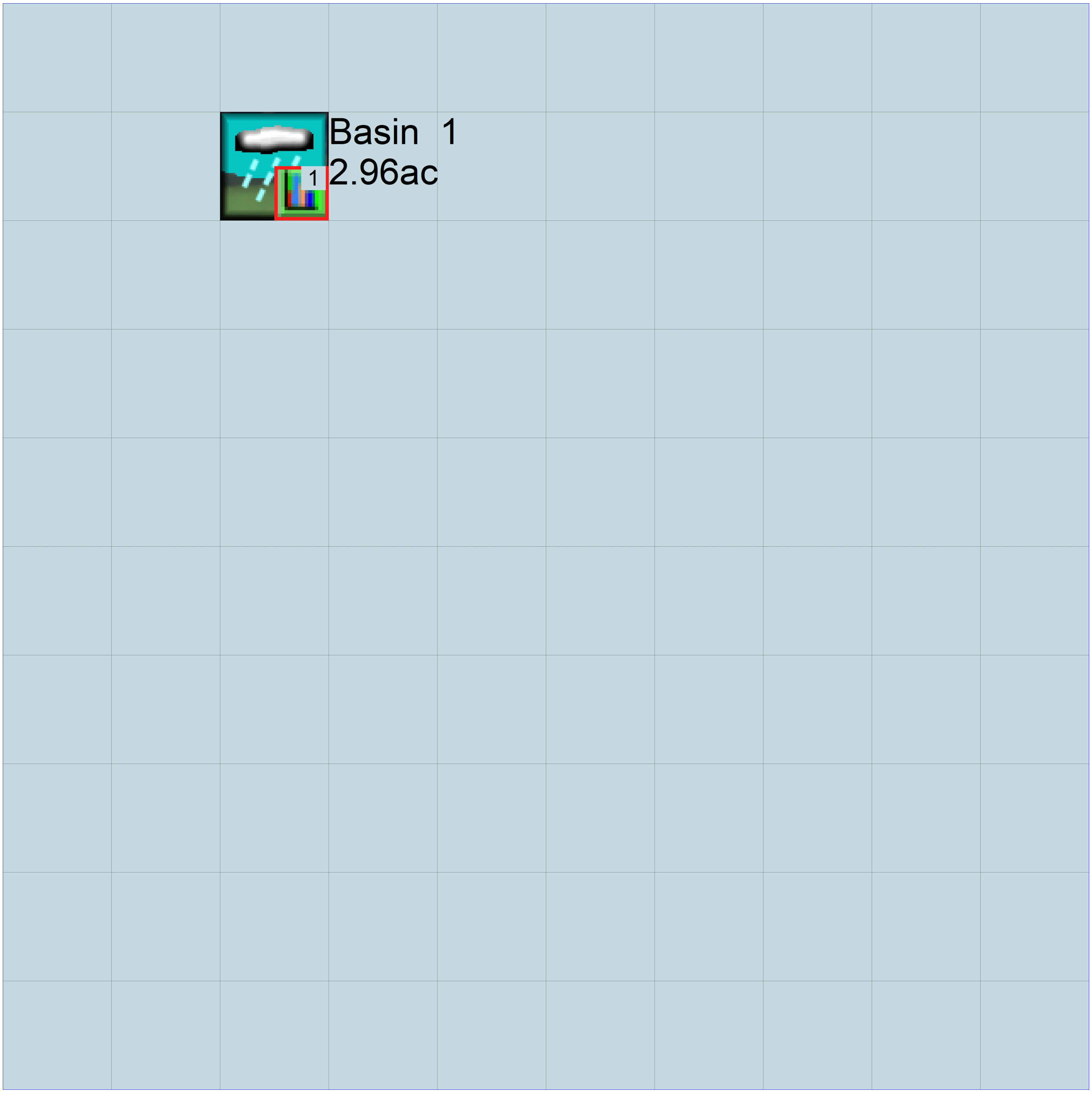
PERLND Changes

No PERLND changes have been made.

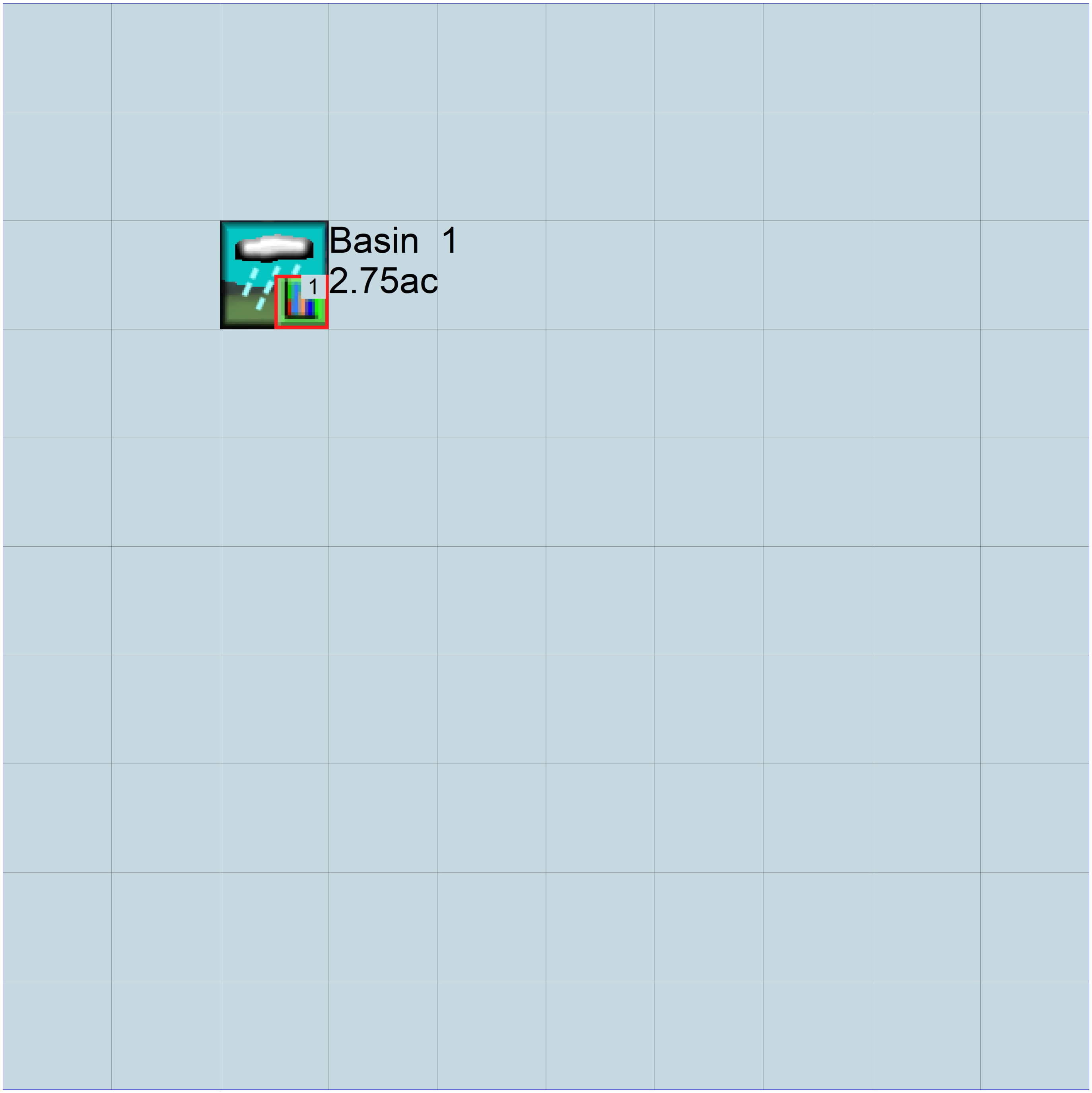
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   22085-wetland recharge ex conditions.wdm
MESSU      25   Pre22085-wetland recharge ex conditions.MES
           27   Pre22085-wetland recharge ex conditions.L61
           28   Pre22085-wetland recharge ex conditions.L62
           30   POC22085-wetland recharge ex conditions1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                             in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16              0       4.5      0.03       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out         ***
   11      PARKING/FLAT           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
   11              0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   11             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        0.51     COPY   501     12
PERLND  16                        0.51     COPY   501     13
IMPLND  11                        2.45     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   22085-wetland recharge ex conditions.wdm
MESSU      25   Mit22085-wetland recharge ex conditions.MES
           27   Mit22085-wetland recharge ex conditions.L61
           28   Mit22085-wetland recharge ex conditions.L62
           30   POC22085-wetland recharge ex conditions1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      13
      IMPLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  1                   MAX                      1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                            User  t-series Engl Metr ***
                                            in  out           ***
   13     C, Pasture, Flat        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   13         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
```

```
  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   13             0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   13             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   13           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
             ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   13             0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
   11      PARKING/FLAT           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
   11              400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
   11             0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   11             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  13                         0.5     COPY   501     12
PERLND  13                         0.5     COPY   501     13
IMPLND  11                        2.25     COPY   501     15

******Routing******
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                           in  out                          ***
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *     *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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Local (360)943-0304

www.clearcreeksolutions.com

Tab 5.0

5.0 CONVEYANCE SYSTEM ANALYSIS AND DESIGN

The conveyance system for this project will consist of a series of catch basins and storm drainage conveyance pipes. This system will convey the stormwater runoff from the developed site to the proposed detention vault located on the west side of the property. Pipe sizing calculations will be included with the permit submittal plans.

Tab 6.0

6.0 SPECIAL REPORTS AND STUDIES

The following special reports and studies are included in this section:

- *Geotechnical Report*

Figure 8 Geotechnical Report

GEOTECHNICAL REPORT

240 – 15th Street SE Industrial
240 – 15th Street Southeast
Puyallup, Washington

Project No. T-8661

Terra Associates, Inc.

Prepared for:

Cref3 Puyallup Owner, LLC
Los Angeles, California

January 12, 2022
Revised June 23, 2023

TERRA ASSOCIATES, Inc.
Consultants in Geotechnical Engineering, Geology
and
Environmental Earth Sciences

January 12, 2022
Revised June 23, 2023
Project No. T-8661

Mr. Michael Cohn
Cref3 Puyallup Owner, LLC
11611 San Vicente Boulevard, 10th Floor
Los Angeles, California 90049

Subject: Geotechnical Report
240 – 15th Street SE Industrial
240 – 15th Street Southeast
Puyallup, Washington

Dear Mr. Cohn:

As requested, we have conducted a geotechnical engineering study for the subject project. The attached report presents our findings and recommendations for the geotechnical aspects of project design and construction.

The native soils observed in the test borings are alluvial deposits generally consisting of loose to medium dense, wet, fine sand, silty fine sand, and silt with varying proportions of fine sand. The CPT data shows similar interbedded alluvial soils extending to a depth of about 80 feet. Groundwater levels at the site range between depths of about two and one-half feet and five feet. In our opinion, the soil and groundwater conditions observed at the site would not preclude the proposed development provided the recommendations contained herein are incorporated into design and construction.

We trust the information presented in this report is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,
TERRA ASSOCIATES, INC.

John C. Sadler, L.E.G., L.H.G.
Senior Engineering Geologist

CAROLYN S. DECKER
STATE OF WASHINGTON
47016
REGISTERED
PROFESSIONAL ENGINEER

6-23-2023

Carolyn S. Decker, P.E.
President

12220 113th Avenue NE, Ste. 130, Kirkland, Washington 98034
Phone (425) 821-7777

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Geotechnical Report
240 – 15th Street SE Industrial
240 – 15th Street Southeast
Puyallup, Washington

1.0 PROJECT DESCRIPTION

The proposed project is an industrial development consisting of a warehouse-style building and associated paved access, parking, and utility improvements. A conceptual site plan by Mackenzie, dated September 27, 2021, shows a 131,250 square-foot building in the central portion of the site. Truck and trailer parking is shown on the northern and western sides of the building, respectively. Passenger vehicle parking is shown on the eastern side of the building. Building plans are currently not available; however, we expect the building will be constructed using precast concrete tilt-up perimeter wall panels with interior columns spaced at 30 to 50 feet. Building floors will be constructed at grade with dock high access on the northern side of the building. Structural loading is expected to be light to moderate, with isolated columns carrying loads of 50 to 100 kips, and bearing walls carrying 4 to 8 kips per foot.

The recommendations in this report are based on our understanding of the design features outlined above. We should review design drawings as they become available to verify that our recommendations have been properly interpreted and to supplement them, if required.

2.0 SCOPE OF WORK

Our scope of work for this project included subsurface exploration, laboratory testing, office review, engineering analysis, and preparation of this report. Our subsurface exploration included ten test borings drilled to maximum depths of 6.5 feet and 31.5 feet with a limited access, track-mounted drill rig using hollow-stem auger drilling methods, one approximately 60-foot deep cone penetration test (CPTs), and one approximately 84-foot deep CPT.

Using the results of our subsurface explorations and laboratory testing, analyses were undertaken to develop geotechnical recommendations for project design and construction. Specifically, this report addresses the following:

- Soil and groundwater conditions.
- Geologic hazards per the City of Puyallup Municipal Code.
- Seismic Site Class.
- Site preparation and grading including recommendations for building preload or surcharge to mitigate floor and foundation settlement.

- Excavations.
- Foundations.
- Slab-on-grade floors.
- Lateral earth pressures for wall design.
- Subsurface drainage.
- Infiltration feasibility.
- Utilities.
- Pavement.

3.0 SITE CONDITIONS

3.1 Surface

The site is an approximately 8.74-acre assemblage of three parcels located northwest of and adjacent to the intersection of 15th Street Southeast and East Pioneer Avenue in Puyallup, Washington. The site location is shown on Figure 1.

Existing site improvements include a small office building in the northeastern portion of the site, a vacant industrial building in the southeast corner of the site, and the remains of a large cold-storage warehouse in the central portion of the site that was recently destroyed by fire. Areas around the buildings are typically surfaced with asphalt or concrete pavement or crushed gravel. An open area of the site located west of the cold storage building is an undeveloped grass field. Site topography is relatively flat.

3.2 Soils

The native soils observed in the test borings are alluvial deposits generally consisting of loose to medium dense, wet, fine sand, silty fine sand, and silt with varying proportions of fine sand and traces of fine organic particles. Fine-grained sand deposits encountered between depths of 20 and 21.5 feet in Borings B-1, B-2, B-6, and B-10 contained numerous fine pumice grains.

The upper approximately 3 to 4 feet of soil encountered in Borings B-7 through B-10 consists of loose to medium dense, silty fine sand that is interpreted to be fill. The fill materials observed in Borings B-7 and B-10 contain numerous wood shavings or fragments.

The CPT data shows interbedded alluvial soils extending the full 60-foot depth of CPT-2 and to a depth of about 80 feet in CPT-1. Soil behavior types determined from the CPT data generally consist of about 30 feet of sand to silty sand and silty sand to sandy silt with scattered clayey silt to silty clay interbeds underlain primarily by interbedded sandy silt to silty clay. A soil behavior type consistent with gravelly sand to sand was encountered below a depth of about 80 feet in CPT-1. In general, where cohesive silt and clay soils are indicated, correlated N_{60} values, indicate consistencies in the medium stiff to stiff range above a depth of about 72 feet and stiff to very stiff below that depth. Where cohesionless sand, silty sand, and silt soils are indicated, correlated N_{60} values indicate relative densities typically in the loose to medium dense range. The soil conditions determined from the CPTs are generally consistent with those observed in the test borings.

The *Geologic map of the Tacoma 1:100,000-scale quadrangle, Washington,* by J.E. Schuster (2015), shows surficial geology at the site mapped as Holocene alluvium (Qa). The soils observed in our subsurface explorations are consistent with this geologic map unit.

Detailed descriptions of the conditions observed in our subsurface explorations are given on the Boring Logs in Appendix A. The CPT data plots are also attached in Appendix A. The approximate test boring and CPT locations are shown on Figure 2.

3.3 Groundwater

Groundwater was encountered in all of the test borings with groundwater levels typically encountered below a depth of about 5 feet. Pore pressure dissipation testing performed in CPT-2 determined a hydrostatic level approximately 5 feet below ground surface as well. Borings B-3 through B-5 and Boring B-7 all encountered wet soils below depths of about 2.5 to 3 feet.

The depths to groundwater at the site will fluctuate on a seasonal basis with maximum levels occurring during the wet winter and spring months. Considering that our field work occurred during late November, we expect that the observed groundwater levels are approaching seasonal high levels.

3.4 Seismic Site Class

Soil conditions at the site, as discussed in the following section, will be subject to the soil liquefaction phenomenon. Because of this condition, per the current International Building Code (IBC), subsurface conditions would be assigned site class “F” which would require performing a site-specific seismic analysis to determine seismic forces for structural design. However, the IBC allows for using code derived seismic values for the soil conditions indicated if the building’s fundamental period is equal to or less than 0.5 seconds. We expect that the proposed industrial building will fall into this category. In this case, based on soil conditions encountered and our knowledge of the area geology, site class “D” can be used to determine seismic design forces.

3.5 Geologic Hazards

Chapter 21.06.1210(1) of the Puyallup Municipal Code (PMC) defines geologic hazard areas as "…areas susceptible to erosion, landsliding, earthquake, volcanic activity or other potentially hazardous geological processes." Site conditions do not meet the PMC criteria defining landslide hazard areas or erosion hazard areas. In our opinion, site conditions are susceptible to potential seismic and volcanic hazards as discussed below.

3.5.1 Seismic Hazards

Chapter 21.06.1210(3)(c) of the PMC defines seismic hazard areas as "…areas subject to severe risk of damage as a result of earthquake-induced ground shaking, slope failure, settlement or subsidence, soil liquefaction, or tsunamis. Settlement and soil liquefaction conditions occur in areas underlain by cohesionless, loose, or soft-saturated soils of low density, typically in association with a shallow ground water table."

The site conditions are not susceptible to seismically-induced slope failure and the site is not located within an area that is susceptible to tsunamis inundation. In our opinion, potential hazards associated with ground shaking would be adequately mitigated by designing with seismic forces determined by local building codes or site specific seismic analysis, if needed.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations. Liquefaction mainly affects geologically recent deposits of fine-grained sands underlying the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil's strength.

We completed a liquefaction analysis using the computer program LiquefyPro published by CivilTech Corporation. The analysis was completed using a site modified peak ground acceleration (PGA_M) of 0.60g representing the peak horizontal acceleration for the maximum considered earthquake (MCE) having a 2 percent probability of exceedance in 50 years. The value was obtained for Latitude 47.18978287°N and Longitude -122.27573704°W using the Structural Engineers Association of California (SEAOC) U.S. Seismic Design Maps website (https://seismicmaps.org/) accessed on December 27, 2021. The results of the liquefaction analysis are attached in Appendix B.

The results of our analysis indicate the site is a seismic hazard area with respect to soil liquefaction. Soil liquefaction could occur during the design earthquake event resulting in total settlements ranging between about four and one-half and seven inches with about one-half of this settlement likely being differential in nature. In our opinion, this amount of settlement has the potential to structurally impair the building. The structural engineer should review the estimated settlement to determine if additional mitigation measures are necessary. Additionally, cosmetic damage to the structure in the form of misaligned doors and windows, cracking, and floor settlement could occur. Some utility connections may also be impacted. If the owner is not willing to accept the risk of building damage requiring repair should liquefaction-induced settlements occur, foundations should be supported on ground improved using stone columns designed to mitigate soil liquefaction settlements below the building foundations.

3.5.2 Volcanic Hazards

Chapter 21.06.1210(3)(d) of the PMC defines volcanic hazard areas as "…areas subject to pyroclastic flows, lava flows, debris avalanche, inundation by debris flows, lahars, mudflows, or related flooding resulting from volcanic activity. Volcanic hazard areas shall be classified as Case I or Case II lahars per the definitions in PMC 21.06.210." The site is located in a potential Case II lahar inundation zone. Therefore, per the PMC, the site is considered a volcanic hazard area.

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 General

In our opinion, there are no geotechnical considerations that would preclude development of the site as planned. The fine-grained native soils observed at the site will consolidate under static dead loads imposed by the structure and by product loading on structure floor slabs. To mitigate the potential for post-construction settlement due to this consolidation, we recommend preloading the building location. Preloading will involve placing the structural fill required to achieve the finish floor elevation and allowing settlements to occur under this load before building construction is initiated. We expect that these settlements would occur in about two to four weeks following full application of the building fill.

The preloading program will adequately mitigate post-construction settlement under static loading but will not eliminate the risk of damage resulting from seismically-induced soil liquefaction. If the owner is not willing to accept the risk of building damage requiring repair should liquefaction-induced settlements occur, foundations should be supported on ground improved using stone columns designed to mitigate soil liquefaction settlements below the building foundations. The use of stone columns to improve the foundation subgrade would preclude the need for preloading.

After completing the preload, building construction can begin. The buildings can be supported on conventional spread footings bearing on a minimum of two feet of compacted structural fill. Overexcavation of native soils and replacement with structural fill will likely be required where deeper footing depths are required, such as below the perimeter foundations adjacent to the loading dock areas or where perimeter footings are deepened for seismic resistance. In our opinion, mitigation of the weak subgrade soils in paved areas will require cement amending or excavation and replacement with imported gravel base material.

The native soils encountered at the site contain a sufficient percentage of fines that will make it difficult to compact as structural fill when too wet. The ability to use soils from site excavations as structural fill will depend on the soil moisture content and the prevailing weather conditions at the time of construction. The contractor should be prepared to dry the native soils by aeration during the normally dry summer season to facilitate compaction as structural fill. Alternatively, stabilizing the moisture in the native soil with cement or lime can be considered. If grading activities will take place during the winter season, the contractor should be prepared to import clean granular material for use as structural fill and backfill.

The following sections provide detailed recommendations regarding the above issues and other geotechnical design considerations. These recommendations should be incorporated into the final design drawings and construction specifications.

4.2 Site Preparation and Grading

In general, it will not be necessary to strip the organic surface layer where structural fill thicknesses above existing grade are a minimum of 3 feet and 2 feet in building and pavement areas, respectively. However, existing surface vegetation, such as that in the western portion of the site, should be mowed close to the ground with the cut debris removed from the site. Clearing of trees should include removal of the entire tree root ball. Where structural fill thicknesses are less than the recommended minimums, both the organic surface soil and vegetation should be stripped from below building and pavement areas. In this case surface stripping depths of four to six inches should be expected. Topsoil will not be suitable for use as structural fill, but can be used in landscaped areas.

We recommend removing existing building foundations and slabs and abandoning underground septic systems and other buried utilities from the planned development area. Abandoned utility pipes that fall outside of new building areas can be left in place provided they are sealed to prevent intrusion of groundwater seepage and soil.

Prior to placing fill or constructing footings, all exposed bearing surfaces should be observed by a representative of Terra Associates, Inc. to verify that soil conditions are as expected and suitable for support of new fill or building elements. Our representative may request proofrolling the exposed subgrade for pavement and floor slab support with a loaded ten yard dump truck. If unstable soils are observed and cannot be stabilized in place by compaction, the affected soils should be excavated and removed to firm bearing and grade restored with new structural fill.

All building footings should obtain support on a minimum of two feet of granular structural fill. The fill should extend laterally from the edge of footing a minimum distance of one-foot. Based on planned grades, for normal perimeter footings bearing at the frost depth and interior footings immediately below the slab-on-grade floor, we expect that this requirement will be met over most of the building area with the fill depth required to achieve the design floor elevations. Deeper footings such as the perimeter footings adjacent the loading docks and for shear walls may require some overexcavation and grade restoration with structural fill.

Our study indicates that the native soils contain a sufficient percentage of fines (silt and clay size particles) that will make them difficult to compact as structural fill if they are too wet or too dry. Accordingly, the ability to use these native soils from site excavations as structural fill will depend upon their moisture content and the prevailing weather conditions when site grading activities take place. Native soils that are too wet to properly compact could be dried by aeration during dry weather conditions or mixed with an additive such as cement or lime to stabilize the soil and facilitate compaction. If an additive is used, additional Best Management Practices (BMPs) for its use will need to be incorporated into the Temporary Erosion and Sedimentation Control plan (TESC) for the project. If grading activities are planned during the wet winter months, and the onsite soils become too wet to achieve adequate compaction, the owner or contractor should be prepared to treat soils with lime, cement, or import wet weather structural fill.

For this purpose, we recommend importing a granular soil that meets the following grading requirements:

U.S. Sieve Size	Percent Passing
6 inches	100
No. 4	75 maximum
No. 200	5 maximum*

*Based on the 3/4-inch fraction

Prior to use, Terra Associates, Inc. should examine and test all materials to be imported to the site for use as structural fill. If building subgrades were constructed using native soils and will be exposed during wet weather, it would be advisable to place 12 inches of this granular structural fill on the building pad to prevent deterioration of the floor subgrade.

Structural fill should be placed in uniform loose layers not exceeding 12 inches and compacted to a minimum of 95 percent of the soil's maximum dry density, as determined by American Society for Testing and Materials (ASTM) Test Designation D-698 (Standard Proctor). The moisture content of the soil at the time of compaction should be within two percent of its optimum, as determined by this same ASTM standard. In nonstructural areas the degree of compaction can be reduced to 90 percent.

4.3 Preload

We recommend preloading the building areas to limit building and floor slab settlements to tolerable levels. For this procedure, we recommend placing structural fill in the building areas to the design floor elevation, and delaying building construction until settlement under this fill load has occurred. The preload fill should extend a minimum of five feet beyond the building perimeter. A minimum of three feet of fill should be placed. If this fill depth exceeds that required to achieve design floor grade, the surplus depth would be treated as a surcharge and removed following completion of settlement as indicated by survey readings at settlement markers as discussed below.

Total settlement under the building fill is estimated in the range of one to three inches. These settlements are expected to occur in about three to four weeks following full application of the building fill.

To verify the amount of settlement and the time rate of movement, the preload program should be monitored by installing settlement markers. The settlement markers should be installed on the existing grade prior to placing any building or preload fills. Once installed, elevations of both the fill height and marker should be taken daily until the full height of the preload is in place. Once fully preloaded, readings should continue weekly until the anticipated settlements have occurred. A typical settlement marker detail is provided as Figure 3.

It is critical that the grading contractor recognize the importance of the settlement marker installations. All efforts must be made to protect the markers from damage during fill placement. It is difficult, if not impossible, to evaluate the progress of the preload program if the markers are damaged or destroyed by construction equipment. As a result, it may be necessary to install new markers and extend the surcharging time period in order to ensure that settlements have ceased and building construction can begin.

Following the successful completion of the preload program, with foundations designed as recommended in Section 4.5 of this report, you should expect maximum total and differential post-construction static settlements of 0.5 inches for perimeter foundations and 1 inch for interior columns.

4.4 Excavations

All excavations at the site associated with confined spaces, such as lower building level retaining walls, must be completed in accordance with local, state, or federal requirements. Based on current Washington Industrial Safety and Health Act (WISHA) regulations, the site soils would be classified as a Type C soil.

For properly dewatered excavations in Type C soils that are greater than 4 feet and less than 20 feet in depth, the side slopes should be laid back at an inclination of 1.5:1 (Horizontal:Vertical) or flatter. If there is insufficient room to complete the excavations in this manner, or if excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations may need to be considered.

Based on our study, groundwater seepage should be anticipated within excavations extending below depths of about two and one-half to five feet. Excavations extending below these depths will likely encounter groundwater seepage with volumes and flow rates sufficient to require some level of dewatering. Shallow excavations that do not extend more than two feet below the groundwater table can likely be dewatered by conventional sump-pumping procedures along with a system of collection trenches. Deeper excavations will likely require dewatering by well points or isolated deep-pump wells. The utility subcontractor should be prepared to implement excavation dewatering by well point or deep-pump wells, as needed. This will be an especially critical consideration for any deep excavations such as stormwater detention vaults, lift stations, and sanitary sewer tie-ins.

This information is provided solely for the benefit of the owner and other design consultants and should not be construed to imply that Terra Associates, Inc. assumes responsibility for job site safety. It is understood that job site safety is the sole responsibility of the project contractor.

4.5 Foundations

In our opinion, following the completion of a successful preload program, the building may be supported on conventional spread footing foundations bearing on a minimum of 2 feet of structural fill placed and compacted as recommended in Section 4.2 of this report. Foundations exposed to the weather should bear at a minimum depth of one and one-half feet below adjacent grades for frost protection.

We recommend designing foundations for a net allowable bearing capacity of 2,500 pounds per square foot (psf). For short-term loads, such as wind and seismic, a one-third increase in this allowable capacity can be used. With the expected building loads and this bearing stress applied, in general, total and differential settlements should not exceed 0.5 inches for perimeter foundations and 1 inch for interior column supports.

For designing foundations to resist lateral loads, a base friction coefficient of 0.35 can be used. Passive earth pressures acting on the sides of the footings can also be considered. We recommend calculating this lateral resistance using an equivalent fluid weight of 300 pounds per cubic foot (pcf). We do not recommend including the upper 12 inches of soil in this computation because it can be affected by weather or disturbed by future grading activity. This value assumes the foundation will be constructed neat against competent native soil or backfilled with structural fill, as described in Section 4.2 of this report. The values recommended include a safety factor of 1.5.

4.6 Lateral Earth Pressures for Retaining Walls

The magnitude of earth pressure development on below-grade walls, such as basement or retaining walls, will partly depend upon the quality of the wall backfill. We recommend placing and compacting wall backfill as structural fill as described in Section 4.2 of this report. To guard against hydrostatic pressure development, drainage must be installed behind the wall. A typical wall drainage detail is shown on Figure 4.

With wall backfill placed and compacted as recommended and drainage properly installed, unrestrained walls can be designed for an active earth pressure equivalent to a fluid weighing 35 pcf. For restrained walls, an additional uniform lateral pressure of 100 psf should be included. For evaluating the walls under seismic loading, a uniform earth pressure equivalent to 8H psf, where H is the height of the retained earth in feet, can be used. These values assume a horizontal backfill condition and that no other surcharge loading, such as traffic, sloping embankments, or adjacent buildings, will act on the wall. If such conditions exist, then the imposed loading must be included in the wall design.

Friction at the base of the wall foundation and passive earth pressure will provide resistance to these lateral loads. Values for these parameters are provided in Section 4.5.

4.7 Slab-on-Grade Floors

Slab-on-grade floors may be supported on subgrades prepared as recommended in Section 4.2 of this report. Immediately below the floor slabs, we recommend placing a 4-inch thick capillary break layer of clean, free-draining, coarse sand or fine gravel that has less than 5 percent passing the No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slabs.

The capillary break layer will not prevent moisture intrusion through the slab caused by water vapor transmission. Where moisture by vapor transmission is undesirable, such as covered floor areas, a common practice is to place a durable plastic membrane on the capillary break layer and then cover the membrane with a layer of clean sand or fine gravel to protect it from damage during construction, and aid in uniform curing of the concrete slab.

It should be noted that if the sand or gravel layer overlying the membrane is saturated prior to pouring the slab, it will be ineffective in assisting in uniform curing of the slab and can actually serve as a water supply for moisture transmission through the slab and affecting floor coverings. Therefore, in our opinion, covering the membrane with a layer of sand or gravel should be avoided if floor slab construction occurs during the wet winter months and the layer cannot be effectively drained. We recommend floor designers and contractors refer to the American Concrete Institute (ACI) Manual of Concrete Practice for further information regarding vapor barrier installation below slab-on-grade floors.

For design of the floor slabs on grade, a subgrade modulus (k_s) of 100 pounds per cubic inch (pci) can be used.

4.8 Drainage

Surface

Final exterior grades should promote free and positive drainage away from the building at all times. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. We recommend providing positive gradient away from the building perimeter.

Subsurface

We expect that building floor elevations will be above existing surface grades and that permanent hard surfaces will extend to the building over most of its perimeter. With these conditions, it is our opinion that building foundation drains would not be required. However, footing drains associated with retaining wall drainage, such as loading dock walls should be installed. Foundation drains should also be installed where landscaping is adjacent to the building.

4.9 Infiltration Feasibility

Based on the shallow seasonal water table and the fine-grained nature of the soils observed across the site, it is our opinion that infiltration is not a feasible option for stormwater management.

4.10 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Associates (APWA) or local jurisdictional specifications. At a minimum, trench backfill should be placed and compacted as structural fill as described in Section 4.2 of this report. At the time of our study, soil moisture contents were generally above optimum; therefore, drying back or other means to condition the material will probably be necessary to facilitate proper compaction. If utility construction takes place during the winter, it may be necessary to import suitable wet weather fill for utility trench backfilling.

For any structure installed below a depth of approximately two and one-half feet, buoyancy effects must be considered. Buoyancy or uplift will be resisted by the weight of the structure and the weight of the soil overlying its foundation or cover. For backfill placed as structural fill, a soil unit weight of 110 pcf can be used.

Buoyancy, or an unbalanced hydrostatic head, will also impact the trench bottom stability. Where an unbalanced hydrostatic head exists in the trench excavation, the trench bottom can heave and, subsequently, become unstable causing installed utility pipes to settle when overburdened stresses from utility trench backfill are replaced.

Two methods for stabilizing the trench bottoms can be considered. The first involves using well point dewatering systems to lower the groundwater table adjacent to utility excavation and prevent development of an unbalanced hydrostatic head. Single-stage well point dewatering systems are typically effective for utility excavations occurring to depths of 15 to 20 feet.

The second method that can be used to mitigate heave or unstable soil conditions at the trench bottom involves overexcavation of the affected soils and replacement with additional free-draining bedding material. As a general rule, the depth of overexcavation below the pipe invert and replacement with free-draining bedding material would be equivalent to one foot for every two feet of unbalanced hydrostatic head.

4.11 Pavements

Pavements should be constructed on subgrades prepared as recommended in Section 4.2 of this report. Regardless of the degree of relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. Proofrolling the subgrade with heavy construction equipment should be completed to verify this condition.

The pavement design section is dependent upon the supporting capability of the subgrade soils and the traffic conditions to which it will be subjected. We expect traffic at the facility will consist of cars and light trucks, along with heavy traffic in the form of tractor-trailer-rigs. For design considerations, we have assumed traffic in parking and in car/light truck access pavement areas can be represented by an 18-kip Equivalent Single Axle Loading (ESAL) of 50,000 over a 20-year design life. For heavy traffic pavement areas, we have assumed an ESAL of 300,000 would be representative of the expected loading. These ESALs represent loading approximately equivalent to 3 and 18, loaded (80,000-pound GVW) tractor-trailer rigs traversing the pavement daily in each area, respectively.

With a stable subgrade prepared as recommended, for the design ESAL values, we recommend the following pavement sections:

Light Traffic/Car Access:

- 2 inches of hot mix asphalt (HMA) over 6 inches of crushed rock surfacing (CRS).
- 4 inches full depth HMA.

Heavy Traffic/Truck Access:

- 3 inches of HMA over 8 inches of CRS.
- 6 inches full depth HMA.

For exterior Portland cement concrete (PCC) pavement, we recommend the following:

- 6 inches of PCC over 2 inches of CRS.
    - 28-day compressive strength – 4,000 psi.
    - Control joints spaced at a maximum of 15 feet.

Soil cement stabilization or constructing a soil cement base for support of the pavement section can also be considered as an alternate to the above conventional pavement sections. Assuming a properly constructed soil cement base having a minimum thickness of 12 inches and a minimum 7-day compressive strength of 100 pounds per square inch (psi), the following pavement sections are recommended:

Light Traffic/Car Access:

- 2 inches of HMA over 12 inches of soil cement base (SCB).

Heavy Traffic/Truck Access:

- 3 inches of HMA over 12 inches of SCB.
- 6 inches of PCC over 12 inches of SCB.

The design of the soil cement base should be completed using samples of the subgrade exposed at the time of construction.

The paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for ½-inch class HMA and CRS.

Long-term pavement performance will depend upon surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability. For optimum pavement performance, we recommend surface drainage gradients of at least two percent. Some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

5.0 ADDITIONAL SERVICES

Terra Associates, Inc. should review the final design and specifications in order to verify that earthwork recommendations have been properly interpreted and incorporated into project design and construction. We should also provide geotechnical services during construction in order to observe compliance with the design concepts, specifications, and recommendations. This will allow for design changes if subsurface conditions differ from those anticipated prior to the start of construction.

6.0 LIMITATIONS

We prepared this report in accordance with generally accepted geotechnical engineering practices. This report is the property of Terra Associates, Inc. and is intended for specific application to the 240 – 15th Street SE Industrial project in Puyallup, Washington. This report is for the exclusive use of Fortress, LLC, and its authorized representatives.

The analyses and recommendations presented in this report are based upon data obtained from the subsurface explorations completed onsite. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, Terra Associates, Inc. should be requested to reevaluate the recommendations in this report prior to proceeding with construction.

REFERENCE: WSDOT GEOPORTAL

NOT TO SCALE

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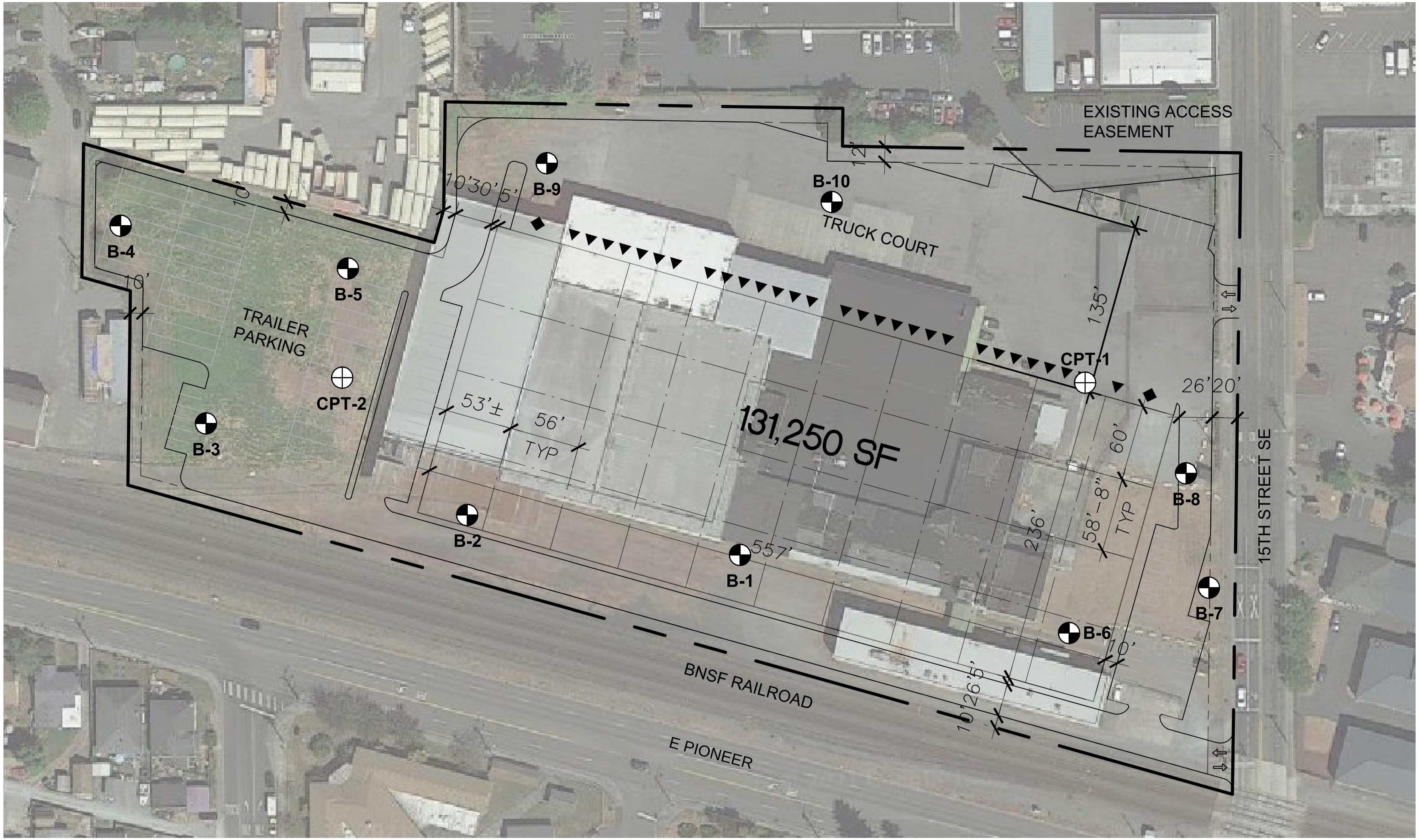
VICINITY MAP
240 - 15TH STREET SE INDUSTRIAL
PUYALLUP, WASHINGTON

Proj. No.T-8661	Date JUNE 2023	Figure 1



NOTE:

THIS SITE PLAN IS SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY AND SHOULD NOT BE USED FOR DESIGN OR CONSTRUCTION PURPOSES.

REFERENCE:

MACKENZIE

LEGEND:

APPROXIMATE BORING LOCATION

APPROXIMATE CPT LOCATION

0 80 160

APPROXIMATE SCALE IN FEET

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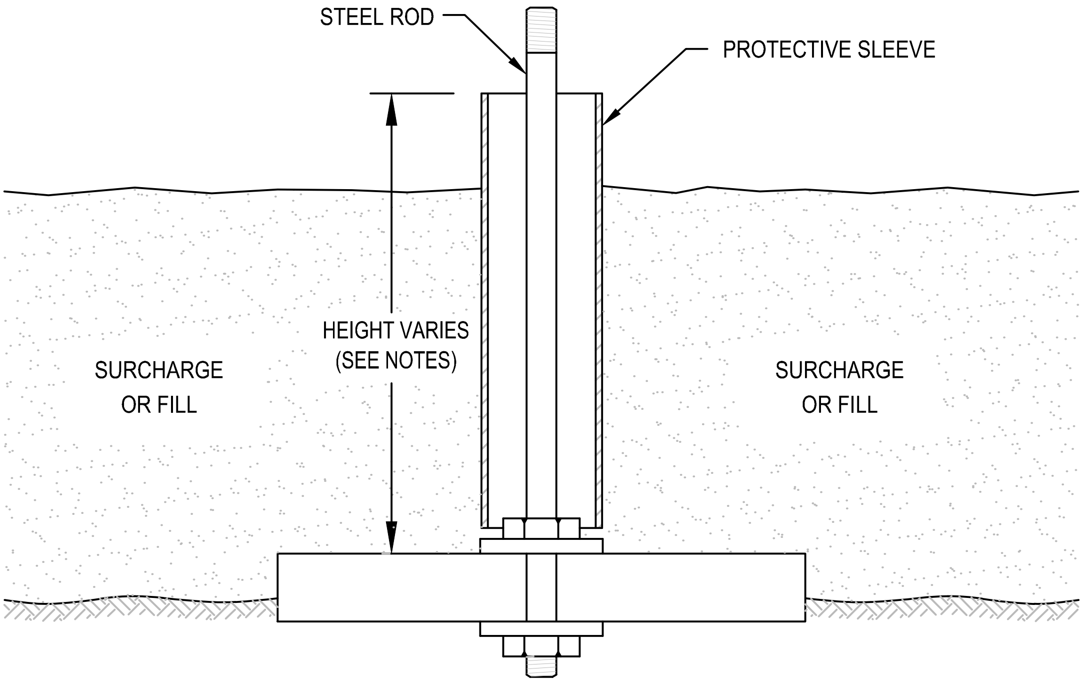
EXPLORATION LOCATION PLAN
240 - 15TH STREET SE INDUSTRIAL
PUYALLUP, WASHINGTON

Proj. No.T-8661	Date JUNE 2023	Figure 2



NOT TO SCALE

NOTES:

1. BASE CONSISTS OF 3/4" THICK, 2'x2' PLYWOOD WITH CENTER DRILLED 5/8" DIAMETER HOLE.
2. BEDDING MATERIAL, IF REQUIRED, SHOULD CONSIST OF CLEAN COARSE SAND.
3. MARKER ROD IS 1/2" DIAMETER STEEL ROD THREADED AT BOTH ENDS.
4. MARKER ROD IS ATTACHED TO BASE BY NUT AND WASHER ON EACH SIDE OF BASE.
5. PROTECTIVE SLEEVE SURROUNDING MARKER ROD SHOULD CONSIST OF 2" DIAMETER PLASTIC TUBING. SLEEVE IS NOT ATTACHED TO ROD OR BASE.
6. ADDITIONAL SECTIONS OF STEEL ROD CAN BE CONNECTED WITH THREADED COUPLINGS.
7. ADDITIONAL SECTIONS OF PLASTIC PROTECTIVE SLEEVE CAN BE CONNECTED WITH PRESS-FIT PLASTIC COUPLINGS.
8. STEEL MARKER ROD SHOULD EXTEND AT LEAST 6" ABOVE TOP OF PLASTIC PROTECTIVE SLEEVE.
9. PLASTIC PROTECTIVE SLEEVE SHOULD EXTEND AT LEAST 1" ABOVE TOP OF FILL SURFACE.

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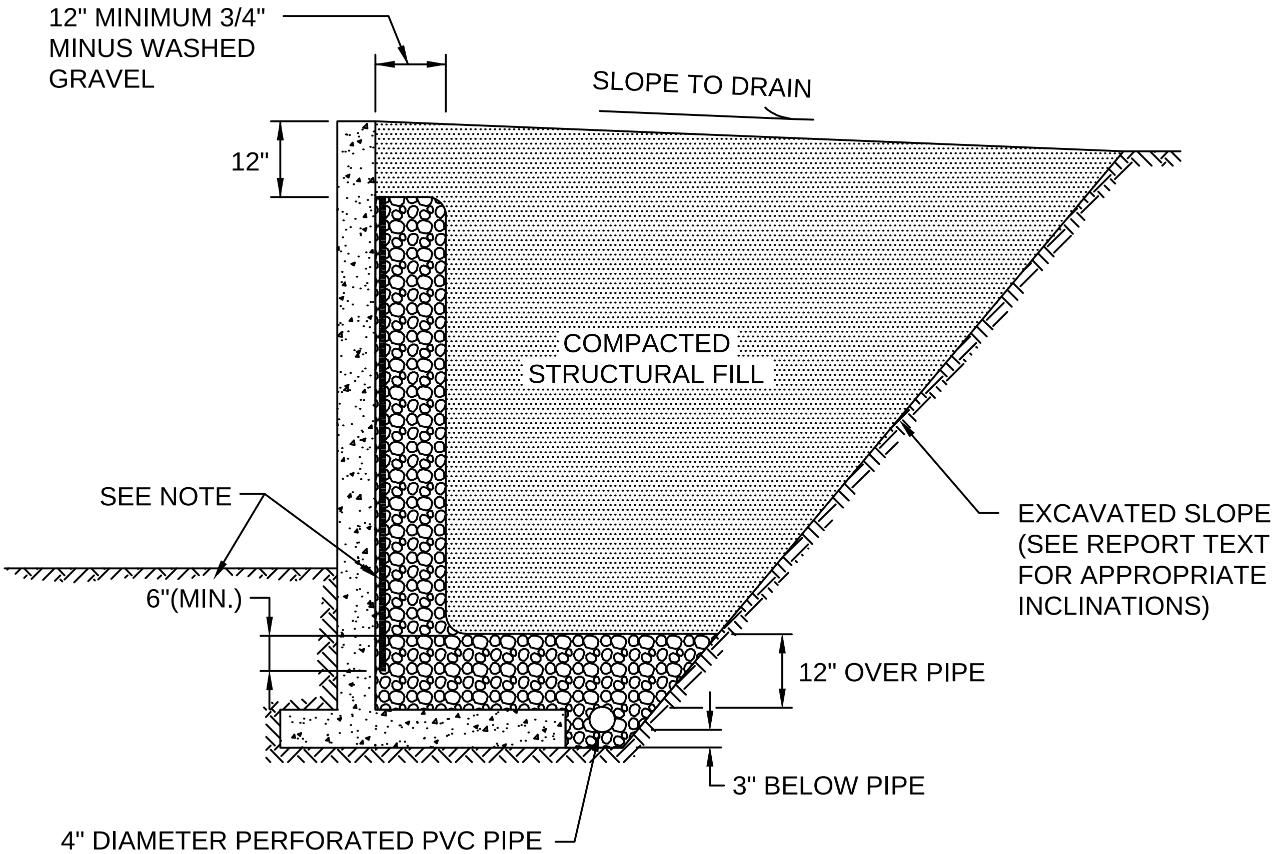
TYPICAL SETTLEMENT MARKER DETAIL
240 - 15TH STREET SE INDUSTRIAL
PUYALLUP, WASHINGTON

Proj. No.T-8661	Date JUNE 2023	Figure 3



NOT TO SCALE

NOTE:

MIRADRAIN G100N PREFABRICATED DRAINAGE PANELS OR SIMILAR PRODUCT CAN BE SUBSTITUTED FOR THE 12-INCH WIDE GRAVEL DRAIN BEHIND WALL. DRAINAGE PANELS SHOULD EXTEND A MINIMUM OF SIX INCHES INTO 12-INCH THICK DRAINAGE GRAVEL LAYER OVER PERFORATED DRAIN PIPE.

Terra Associates, Inc. Consultants in Geotechnical Engineering Geology and Environmental Earth Sciences	TYPICAL WALL DRAINAGE DETAIL 240 - 15TH STREET SE INDUSTRIAL PUYALLUP, WASHINGTON		
	Proj. No.T-8661	Date JUNE 2023	Figure 4

APPENDIX A

FIELD EXPLORATION AND LABORATORY TESTING

240 – 15th Street SE Industrial
Puyallup, Washington

We explored subsurface conditions at the site by drilling six 31.5-foot deep test borings and four 6.5-foot deep test borings with a track-mounted drill rig using hollow-stem auger drilling methods, and by conducting two cone penetration tests (CPTs) to maximum depths of about 60 feet and about 84 feet. The test boring and CPT locations were approximately determined in the field by pacing and sighting from existing site features. The test boring and CPT locations are shown on Figure 2. The Boring Logs are presented as Figures A-2 through A-11.

An engineering geologist from our office conducted the field exploration. Our representative classified the soil conditions encountered, maintained a log of each boring, obtained representative soil samples, and recorded groundwater levels observed during drilling. Soil samples were obtained during drilling in general accordance with ASTM Test Designation D-1586. Using this procedure, a 2-inch (outside diameter) split barrel sampler is driven into the ground 18 inches using a 140-pound hammer free falling a height of 30 inches the number of blows required to drive the sampler 12 inches after an initial 6-inch set is referred to as the Standard Penetration Resistance value or N value. This is an index related to the consistency of cohesive soils and relative density of cohesionless materials. N values obtained for each sampling interval are recorded on the Boring Logs. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described on Figure A-1.

Representative soil samples obtained from the test borings were placed in sealed plastic bags and taken to our laboratory for further examination and testing. The moisture content of each sample was measured and is reported on the Boring Logs. Grain size analyses were performed on eight soil samples. The results are shown on Figures A-12 through A-14.

In Situ Engineering, under subcontract to Terra Associates, Inc., performed the CPTs at locations selected by Terra Associates, Inc. The CPT consists of pushing an instrumented, approximately one and one-half inch diameter cone into the ground at a constant rate. During advancement, continuous measurements are made of the resistance to penetration of the cone and the friction of the outer surface of a sleeve. The cone is also equipped with a porous filter and a pressure transducer for measuring the generated groundwater or pore water pressure. Measurements of tip and sleeve frictional resistance, pore pressure, and interpreted soil conditions are summarized in graphical form on the attached CPT Logs.

MAJOR DIVISIONS				LETTER SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	More than 50% material larger than No. 200 sieve size	**GRAVELS** More than 50% of coarse fraction is larger than No. 4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines.
			Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS More than 50% of coarse fraction is smaller than No. 4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, sands with gravel, little or no fines.
				SP	Poorly-graded sands, sands with gravel, little or no fines.
			Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines.
				SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	More than 50% material smaller than No. 200 sieve size	**SILTS AND CLAYS** Liquid Limit is less than 50%		ML	Inorganic silts, rock flour, clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity. (Lean clay)
				OL	Organic silts and organic clays of low plasticity.
		SILTS AND CLAYS Liquid Limit is greater than 50%		MH	Inorganic silts, elastic.
				CH	Inorganic clays of high plasticity. (Fat clay)
				OH	Organic clays of high plasticity.
HIGHLY ORGANIC SOILS				PT	Peat.

DEFINITION OF TERMS AND SYMBOLS

COHESIONLESS

Density	Standard Penetration Resistance in Blows/Foot
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

COHESIVE

Consistancy	Standard Penetration Resistance in Blows/Foot
Very Soft	0-2
Soft	2-4
Medium Stiff	4-8
Stiff	8-16
Very Stiff	16-32
Hard	>32

Symbol	Definition
	2" OUTSIDE DIAMETER SPILT SPOON SAMPLER
	2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER
▼	WATER LEVEL (Date)
Tr	TORVANE READINGS, tsf
Pp	PENETROMETER READING, tsf
DD	DRY DENSITY, pounds per cubic foot
LL	LIQUID LIMIT, percent
PI	PLASTIC INDEX
N	STANDARD PENETRATION, blows per foot

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Environmental Earth Sciences

UNIFIED SOIL CLASSIFICATION SYSTEM
240 - 15TH STREET SE INDUSTRIAL
PUYALLUP, WASHINGTON

Proj. No.T-8661	Date JUNE 2023	Figure A-1

LOG OF BORING NO. 1

Figure No. A-2

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 5 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density
0–12	Dark brown to gray-brown SAND, fine grained, moist. (SP) - Becomes fine to medium grained and wet below 5 feet. - Trace of brown silt seams and gray silt pockets below 8.5 feet.	Medium Dense
12–15.5	Dark gray-brown silty SAND, fine grained, wet, trace of dark brown fine organic particles and wood fragments. (SM)	Medium Dense
15.5–18	Dark gray-brown sandy SILT, fine sand, wet. (ML)	Medium Dense
18–23	Dark gray-brown SAND, fine grained, wet, scattered layers containing numerous fine pumice fragments, trace of silt seams. (SP)	Medium Dense
23–25.5	Dark gray-brown silty SAND to sandy SILT, fine sand, wet. (SM/ML)	Medium Dense
25.5–28	Dark gray-brown SAND, fine to medium grained, wet. (SP)	Medium Dense
28–31.5	Dark gray-brown SAND with silt to silty SAND, fine sand, wet, scattered brown silt seams, trace of wood fragments and gray-brown silt pockets. (SP-SM/SM)	Loose
31.5	Boring terminated at 31.5 feet. Groundwater encountered below 5 feet.	

Sample Depth (ft)	SPT (N) Blows/foot	Moisture Content (%)
2.5	12	23.9
5	10	24.3
7.5	12	23.7
10	12	23.9
12.5	22	35.4
15	12	30.1
20	12	24.7
25	14	26.5
30	6	64.8

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. 2

Figure No. A-3

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 5 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot	Moisture Content (%)
0–13.5	Dark brown to dark gray-brown SAND, fine grained, moist, scattered silty fine sand seams and layers. (SP)	Loose	9	27.2
5	- Becomes wet below 5 feet.	Medium Dense	10	26.4
	- Numerous silty fine sand seams and trace of dark brown organic partings and seams below 8 feet.	Medium Dense	12	31.6
10		Medium Dense	13	25.7
		Medium Dense	27	29.1
13.5	Dark gray-brown silty SAND, fine grained, wet. (SM)	Medium Dense		
15	Interbedded dark gray-brown silty fine SAND to fine sandy SILT and fine to medium grained SAND, wet, trace of fine dark brown organic fragments. (SM/ML and SP)	Medium Dense	15	33.9
20	Dark gray-brown SAND, fine grained, wet, numerous fine pumice fragments. (SP)	Medium Dense	12	27.4
23	Dark gray SILT, wet, trace of fine black organic fragments. (ML)	Medium Dense	13	39.4 / 25.7
26	Dark gray-brown silty SAND, fine grained, wet. (SM)	Medium Dense		
28	Dark gray-brown SAND, fine grained, wet. (SP)	Loose	6	31.0
31.5	Dark gray-brown SILT, wet. (ML)			
	Boring terminated at 31.5 feet. Groundwater encountered below 5 feet.			

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LOG OF BORING NO. 3

Figure No. A-4

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 3 ft **Approx. Elev:** NA

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot (10 30 50)	Moisture Content (%)
0					
~2.5 (▼ groundwater at 3 ft)	I	Dark gray-brown SAND with silt, fine grained, moist (wet below 3 feet), trace of gray silty fine sand layers, mottled above 3 feet. (SP-SM)	Medium Dense	11	25.2
5	I	- Scattered iron-oxide stained pockets below 5 feet.	Loose	9	28.8
		Dark gray SILT, wet. (ML)			
		Boring terminated at 6.5 feet. Groundwater encountered below about 3 feet.			
10					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as indicative of other areas of the site

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LOG OF BORING NO. 4

Figure No. A-5

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 2.5 ft **Approx. Elev:** NA

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot (10 30 50)	Moisture Content (%)
0					
▼ (2.5)		Dark gray-brown SAND, fine to medium grained, wet. (SP)	Loose	8	25.5
5				5	
		Dark gray-brown SILT to sandy SILT, fine sand, wet, coarse wood fragment at 6.5 feet. (ML)			44.0
		Boring terminated at 6.5 feet. Groundwater encountered below about 2.5 feet.			
10					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. 5

Figure No. A-6

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 2.5 ft **Approx. Elev:** NA

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot (10 30 50)	Moisture Content (%)
0					
▼ 2.5	I	No recovery at 2.5 feet. Sampler wet.	Medium Dense	21	
5	I	Dark gray-brown SAND, fine to medium grained, wet. (SP)	Medium Dense	13	22.2
6.5		Boring terminated at 6.5 feet. Groundwater encountered below about 2.5 feet.			
10					

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. 6

Figure No. A-7

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 5 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot	Moisture Content (%)
0	Dark brown SAND, fine grained, moist. (SP)	Medium Dense		
			12	23.8
5 (▼)	Dark gray-brown SAND to SAND with silt, fine to medium grained, wet. (SP/SP-SM)		10	24.1
			10	23.2
10			10	21.6
			29	26.1
	Dark gray-brown silty SAND, fine grained, wet. (SM)			
15	Interbedded dark gray-brown fine to medium SAND and silty fine SAND, wet. (SP and SM)		10	23.4
				25.6
	Dark gray SILT, wet, wood fragments in tip of sampler. (ML)			
20	Dark gray SAND to SAND with silt, fine grained, wet, numerous fine pumice fragments. (SP/SP-SM)		22	27.6
25	Interbedded dark gray-brown fine SAND and gray SILT, wet, trace of wood fragments. (SP and ML)	Loose	7	31.6
30	Dark gray SAND, fine grained, wet. (SP)	Medium Dense	25	25.4
35	Boring terminated at 31.5 feet. Groundwater encountered below 5 feet.			
40				

SPT scale: 10, 30, 50

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LOG OF BORING NO. 7

Figure No. A-8

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 2.5 ft **Approx. Elev:** NA

Depth (ft)	Sample Interval	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot (10 30 50)	Moisture Content (%)
0					
▼ (2.5)	I	Fill: Dark brown silty SAND, fine grained, wet, numerous wood fragments. (SM)	Loose	9	
		Brown to gray-brown sandy SILT to silty SAND, fine grained, wet, mottled. (ML/SM)	Loose		30.8
5	I	Dark gray-brown SAND, fine grained, wet, scattered silty fine sand seams, trace of wood fragments. (SP)	Loose	8	25.2
		Boring terminated at 6.5 feet. Groundwater encountered below about 2.5 feet.			
10					

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LOG OF BORING NO. 8

Figure No. A-9

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** November 30, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 5 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows / foot	Moisture Content (%)
0–5	Gray-brown SAND with silt to silty SAND, fine grained, moist, mottled. (SP-SM/SM) (Possible fill)	Loose	6	21.1
5 (▼)	Dark brown SAND, fine grained, wet, numerous silty fine sand seams below 6 feet. (SP)	Loose	7	28.4
	Dark gray-brown to dark gray SAND, fine to medium grained, wet, trace of fine to coarse gravel above 9 feet. (SP)	Medium Dense	15	20.0
10		Medium Dense	11	27.8
	- Scattered brown silt pockets below 10 feet. - Scattered wood fragments at 13 feet.	Medium Dense	20	31.6
15	Interbedded dark gray-brown fine SAND and gray SILT, wet. (SP and ML)	Medium Dense	12	27.5
20	Gray sandy SILT, fine sand, moist to wet, trace of dark brown organic fragments. (ML)	Loose	9	38.2
	Dark gray-brown SAND, fine grained, wet. (SP)	Loose		
25	Gray to gray-brown sandy SILT, fine sand, wet, trace of dark brown organic fragments. (ML)	Loose	6	36.1
30	Dark gray SAND with silt to silty SAND, fine grained, wet, scattered gray silt seams. (SP-SM/SM)	Medium Dense	10	28.4
35	Boring terminated at 31.5 feet. Groundwater encountered below 5 feet. Installed 2-inch diameter monitoring well to 30 feet. DOE Well ID - BMR-595			
40				

Observ. Well

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. 9

Figure No. A-10

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** December 1, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 5 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows / foot	Moisture Content (%)
0–4	Brown silty SAND, fine grained, moist, scattered fine to coarse angular gravel. (SM) (Possible fill/disturbed)	Medium Dense	14	13.7
4–14.5	Brown to dark gray-brown SAND, fine grained, moist (wet below 5.5 feet), scattered brown silt to silty fine sand seams and layers above 9 feet. (SP)	Medium Dense	12	24.2
			13	22.5
	- Trace of organic partings and fine pumice graines between 10 and 11.5 feet.		10	29.4
	- Scattered brown silt seams below 12.5 feet.		28	28.4
14.5–18	Interbedded dark gray-brown SAND and gray silty SAND to sandy SILT, fine sand, wet. (SP and SM/ML)	Loose	8	30.8
18–26	Dark gray to green-gray SILT, wet, scattered dark gray-brown fine sand seams and layers. (ML)	Loose	9	33.9
		Medium Dense	13	35.9 / 30.7
26–31.5	Dark gray-brown SAND, fine grained, wet. (SP)			
	- Scattered clayey silt layers between 30 and 30.5 feet.	Loose	5	30.4

Boring terminated at 31.5 feet.
Groundwater encountered below 5 feet.
Installed 2-inch diameter monitoring well to 30 feet.
DOE Well ID - BMR-596

Observ. Well

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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LOG OF BORING NO. 10

Figure No. A-11

Project: 240 - 15th Street SE Industrial **Project No:** T-8661 **Date Drilled:** December 1, 2021

Client: Fortress, LLC **Driller:** Boretec1 **Logged By:** JCS

Location: Puyallup, Washington **Depth to Groundwater:** 5 ft **Approx. Elev:** NA

Depth (ft)	Soil Description	Consistency/ Relative Density	SPT (N) Blows/foot	Moisture Content (%)
0	Fill: Dark brown to tan silty SAND with gravel, fine sand, fine to coarse gravel, moist to wet, numerous wood shavings. (SM)	Medium Dense	11	16.0
5 (groundwater)	Gray-brown SAND, fine grained, moist, mottled. (SP)	Loose	8	25.7
	Dark gray-brown SAND, fine grained, wet, mottled. (SP)	Medium Dense	12	26.1
10	- 1-inch silt layer at 10.5 feet. - Trace of wood fragments below 10.5 feet		20	26.9
			11	27.6
15	Dark gray sandy SILT to silty SAND, fine sand, wet, trace of wood fragments. (ML/SM)		17	28.7
20	Gray-brown SAND, fine to medium grained, wet, scattered fine pumice grains. (SP)		12	21.6
25	Interbedded gray SILT to sandy SILT and dark gray-brown SAND, fine sand, wet, trace of wood fragments. (ML and SP)		10	26.2
30			10	28.1
35	Boring terminated at 31.5 feet. Groundwater encountered below 5 feet.			
40				

NOTE: This borehole log has been prepared for geotechnical purposes. This information pertains only to this boring location and should not be interpeted as being indicative of other areas of the site

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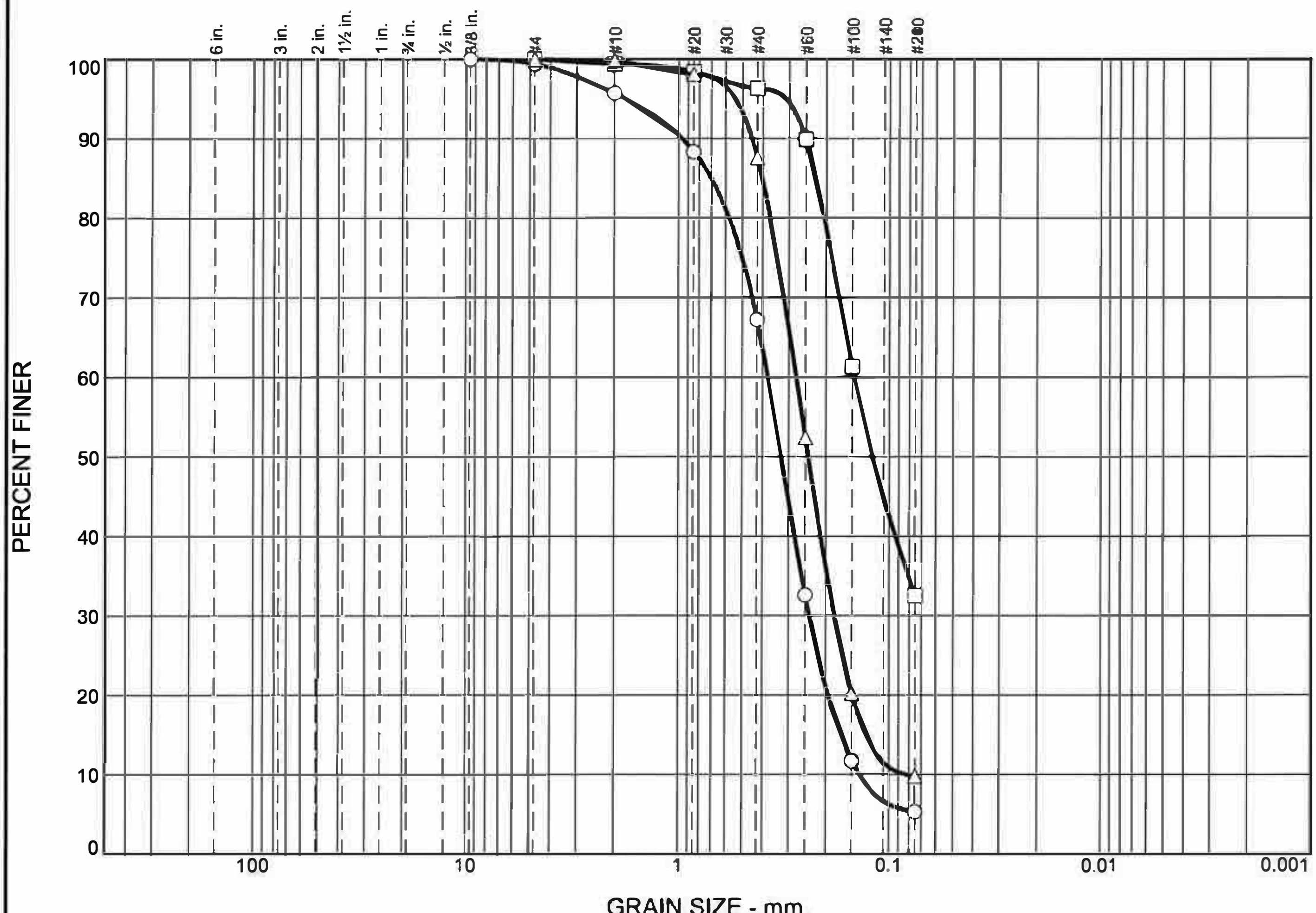
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.6	3.7	28.5	61.9	5.3	
□	0.0	0.0	0.0	0.6	3.1	63.8	32.5	
△	0.0	0.0	0.0	0.2	12.2	77.8	9.8	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.7016	0.3770	0.3250	0.2390	0.1692	0.1384	1.09	2.72
□			0.2237	0.1466	0.1198					
△			0.4026	0.2764	0.2421	0.1812	0.1285	0.0836	1.42	3.31

Material Description	USCS	AASHTO
○ SAND with silt	SP-SM	
□ silty SAND	SM	
△ SAND with silt	SP-SM	

Project No. T-8661 **Client:** Fortress,LLC

Project: 240 - 15 Street SE Industrial

○ **Location:** B-1 **Depth:** 5'

□ **Location:** B-1 **Depth:** 12.5'

△ **Location:** B-3 **Depth:** 2.5'

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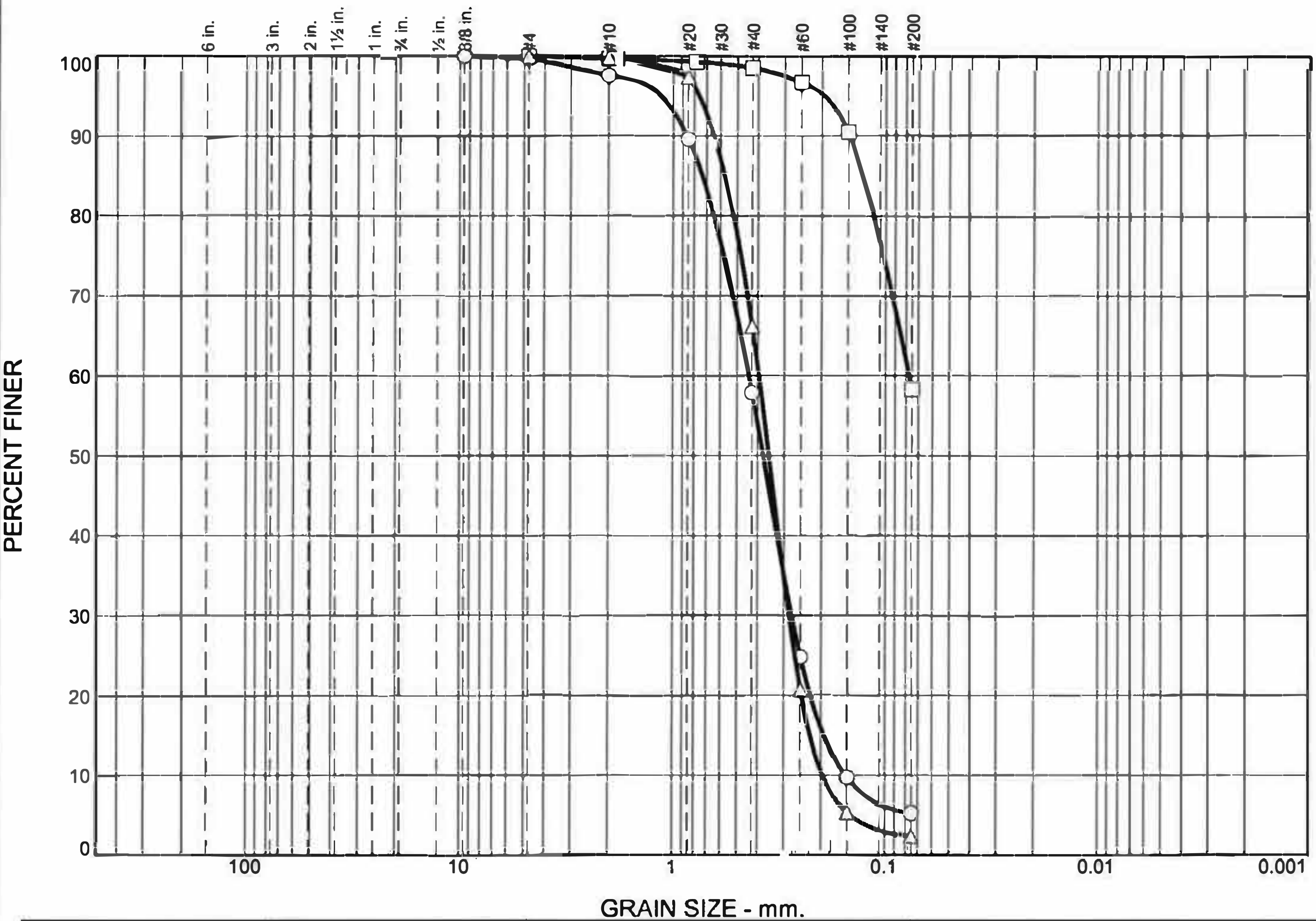
Kirkland, WA

Remarks:

Figure A-12

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.3	2.1	39.7	52.6	5.3	
□	0.0	0.0	0.0	0.3	1.2	40.2	58.3	
△	0.0	0.0	0.0	0.2	33.6	63.8	2.4	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.7323	0.4396	0.3765	0.2755	0.1932	0.1530	1.13	2.87
□			0.1275	0.0773						
△			0.5722	0.3949	0.3538	0.2835	0.2252	0.1964	1.04	2.01

Material Description	USCS	AASHTO
○ SAND with silt	SP-SM	
□ sandy SILT	ML	
△ SAND	SP	

Project No. T-8661 **Client:** Fortress,LLC

Project: 240 - 15 Street SE Industrial

○ **Location:** B-6 **Depth:** 7.5'

□ **Location:** B-7 **Depth:** 3'

△ **Location:** B-8 **Depth:** 10'

Remarks:

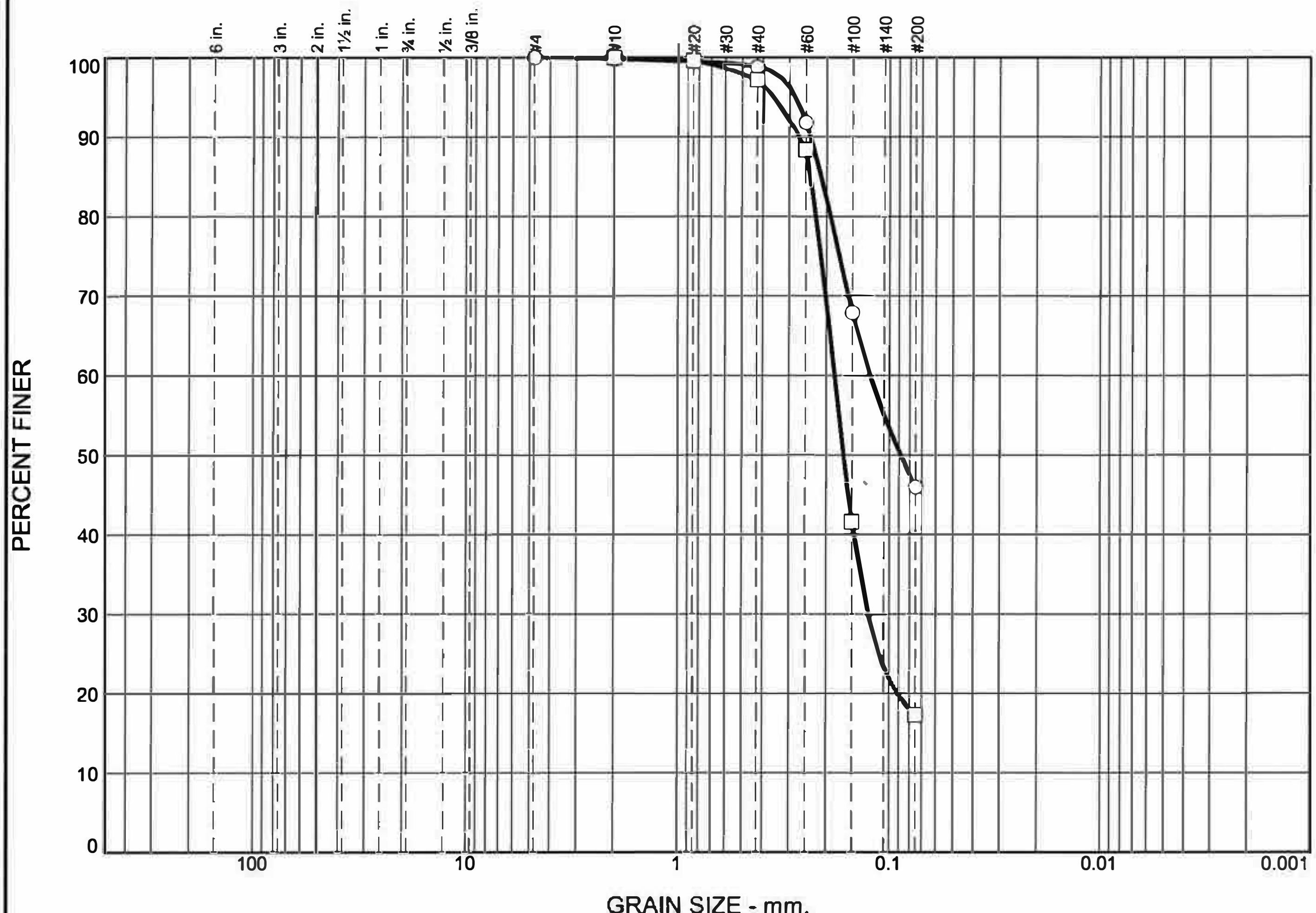
Terra Associates, Inc.

Kirkland, WA

Figure A-13

Tested By: FQ

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.2	1.0	52.8	46.0	
□	0.0	0.0	0.0	0.0	2.8	79.9	17.3	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2117	0.1233	0.0881					
□			0.2379	0.1822	0.1648	0.1254				

Material Description	USCS	AASHTO
○ silty SAND	SM	
□ silty SAND	SM	

Project No. T-8661 **Client:** Fortress,LLC

Project: 240 - 15 Street SE Industrial

○ **Location:** B-8 **Depth:** 30'

□ **Location:** B-9 **Depth:** 10'

Remarks:

Terra Associates, Inc.

Kirkland, WA

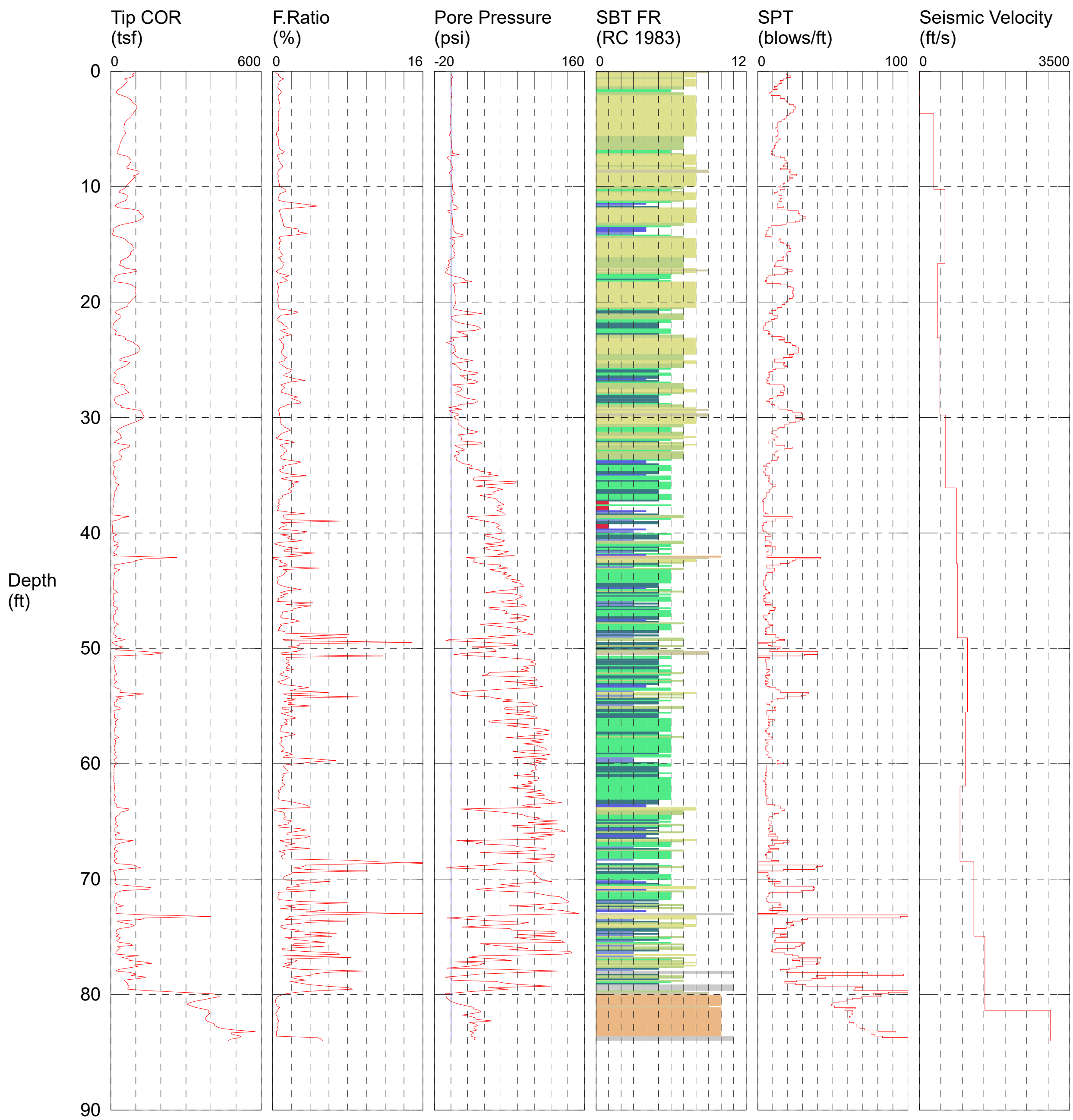
Figure A-14

Tested By: FQ

CPT- 01

CPT CONTRUCTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Puyallup
JOB NUMBER: T-8661
COMMENT: 240 - 15th St SE
COMMENT:

OPERATOR: Okbay
CONE ID: DDG1369
TEST DATE: 12/8/2021 9:38:13 AM
PREDRILL: 0 ft
BACK FILL: 20% Grout + Bentonite Chips
SURFACE PATCH: None



TOTAL DEPTH: 83.990 ft

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

HOLE NUMBER: CPT- 01

OPERATOR: Okbay

CUSTOMER: Terra Asso

LOCATION: Puyallup

JOB NUMBER: T-8661

CPT CONTRUCTOR: In Situ Engineering

CONE ID: DDG1369

TEST DATE: 12/8/2021 9:38:13 AM

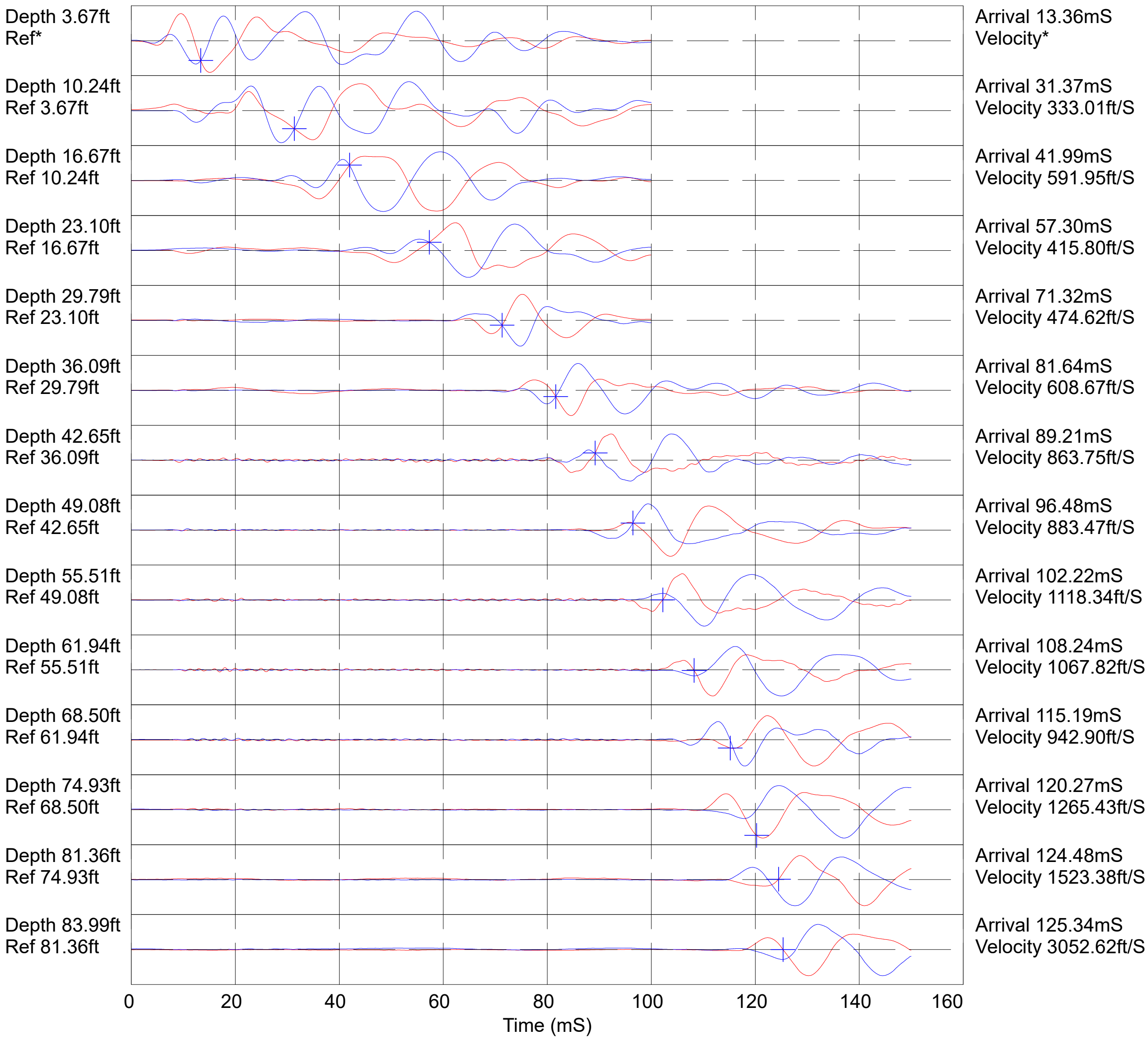
COMMENT: 240 - 15th St SE

PREDRILL0 ft

BACK FILL: 20% Grout + Bentonite Chips

SURFACE PATCH: none

HOLE NUMBER: CPT- 01



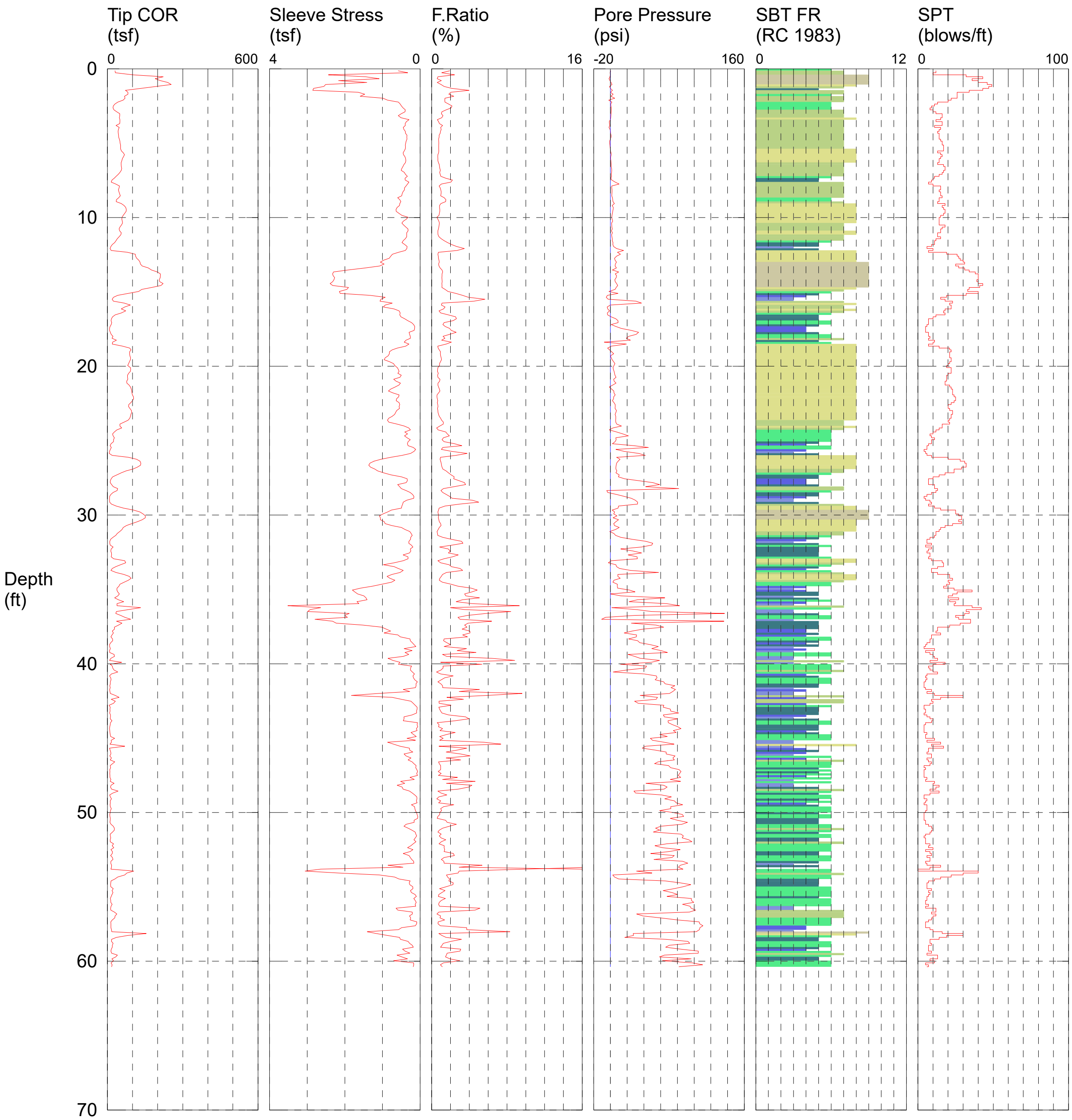
Hammer to Rod String Distance (ft): 2.79
* = Not Determined

COMMENT: 240 - 15th St SE

CPT- 02

CPT CONTRUCTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Puyallup
JOB NUMBER: T-8661
COMMENT: 240 - 15th St SE
COMMENT:

OPERATOR: Okbay
CONE ID: DDG1369
TEST DATE: 12/8/2021 12:37:48 PM
PREDRILL: 0 ft
BACK FILL: 20% Grout + Bentonite Chips
SURFACE PATCH: None



TOTAL DEPTH: 60.367 ft

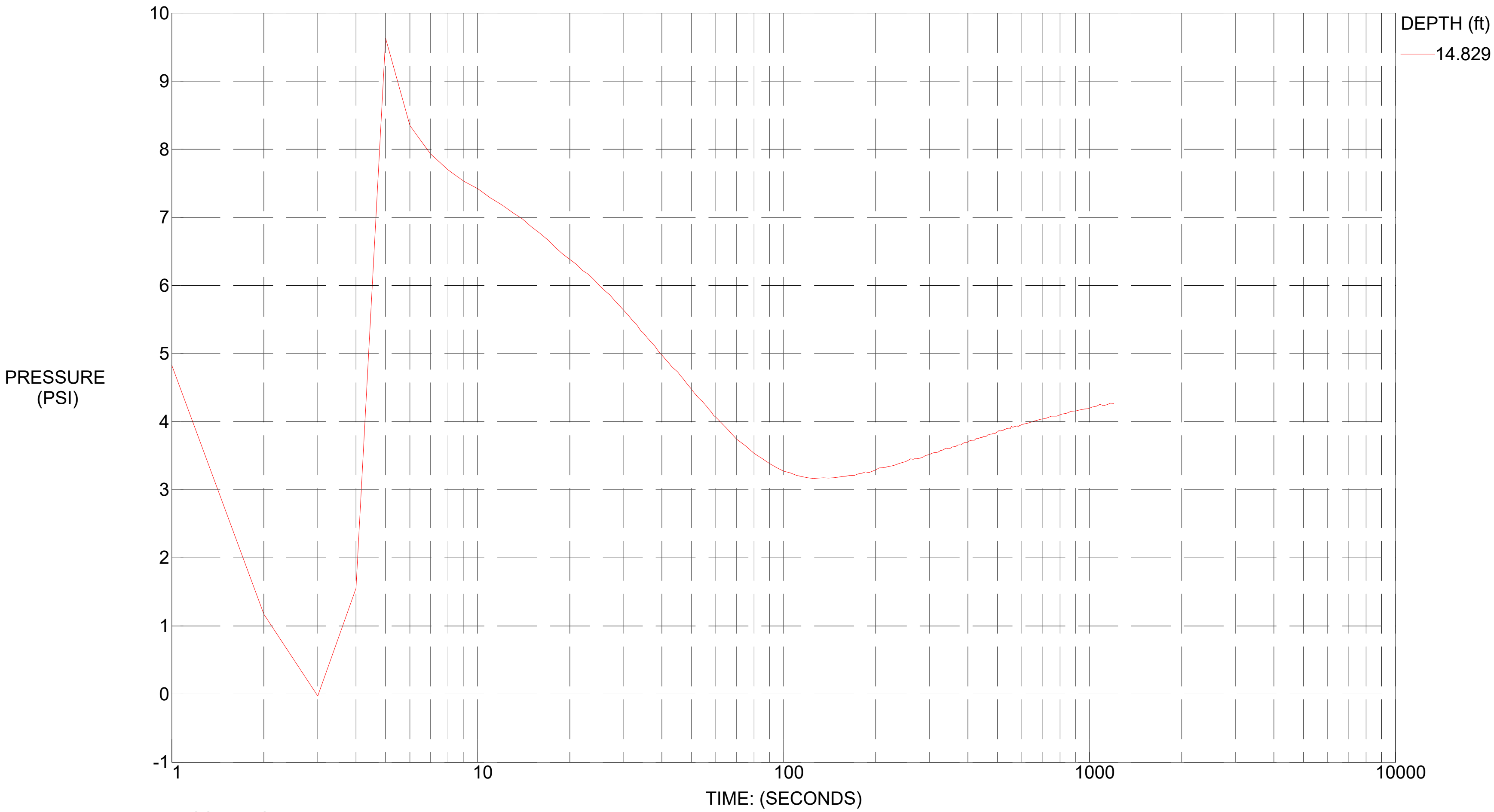
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

CPT- 02

CPT CONTRUCTOR: In Situ Engineering
CUSTOMER: Terra Asso
LOCATION: Puyallup
JOB NUMBER: T-8661

OPERATOR: Okbay
CONE ID: DDG1369
TEST DATE: 12/8/2021 12:37:48 PM
PREDRILL: 0 ft
BACK FILL: 20% Grout + Bentonite Chips
SURFACE PATCH: Cold Patch



DISSIPATION

APPENDIX B

LIQUEFACTION ANALYSES

LIQUEFACTION ANALYSIS

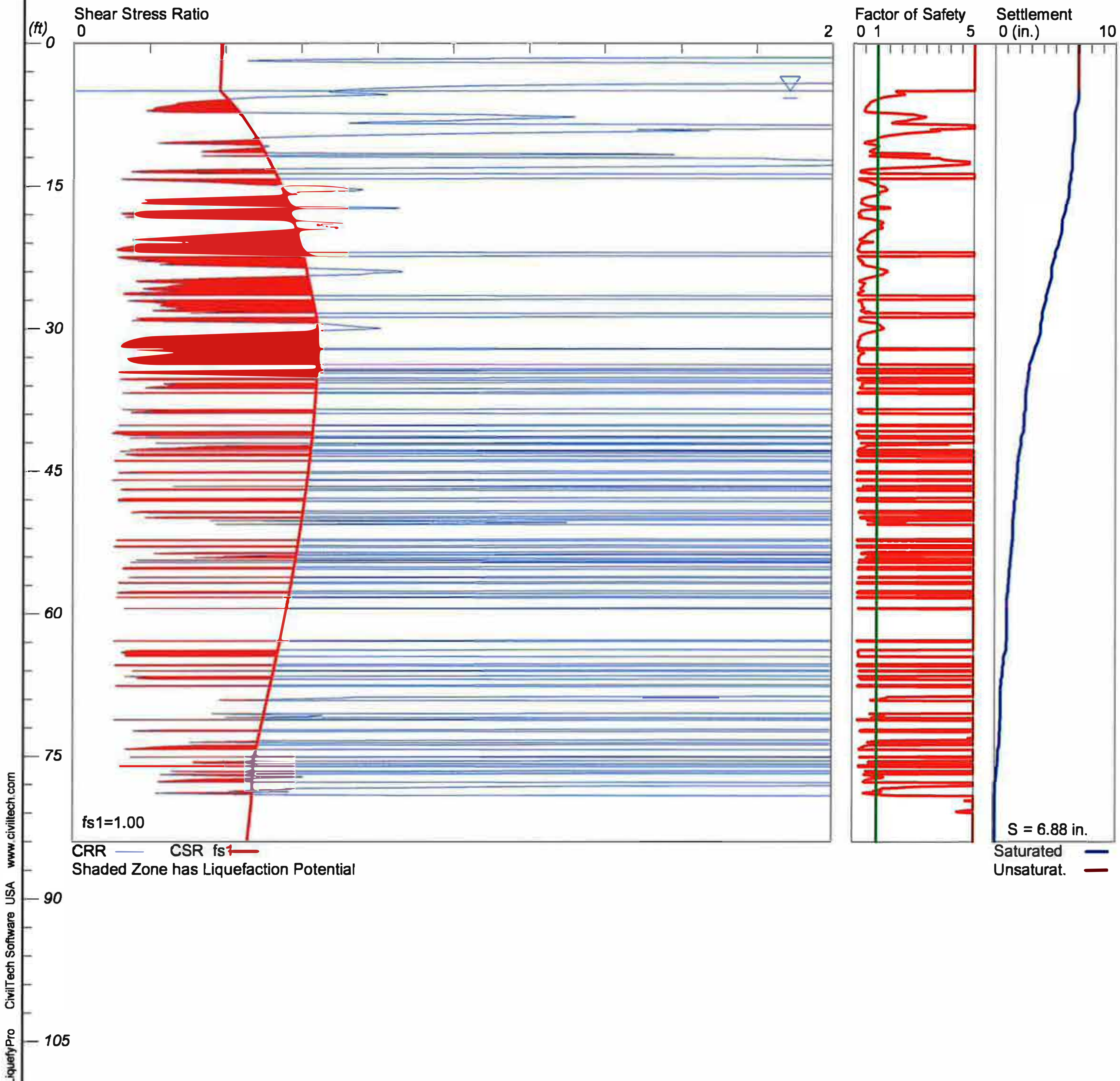
240 - 15th St SE Industrial

Hole No.=CPT-1 Water Depth=5.0 ft

Ground Improvement of Fill=3 ft

Magnitude=7

Acceleration=0.6g



LIQUEFACTION ANALYSIS

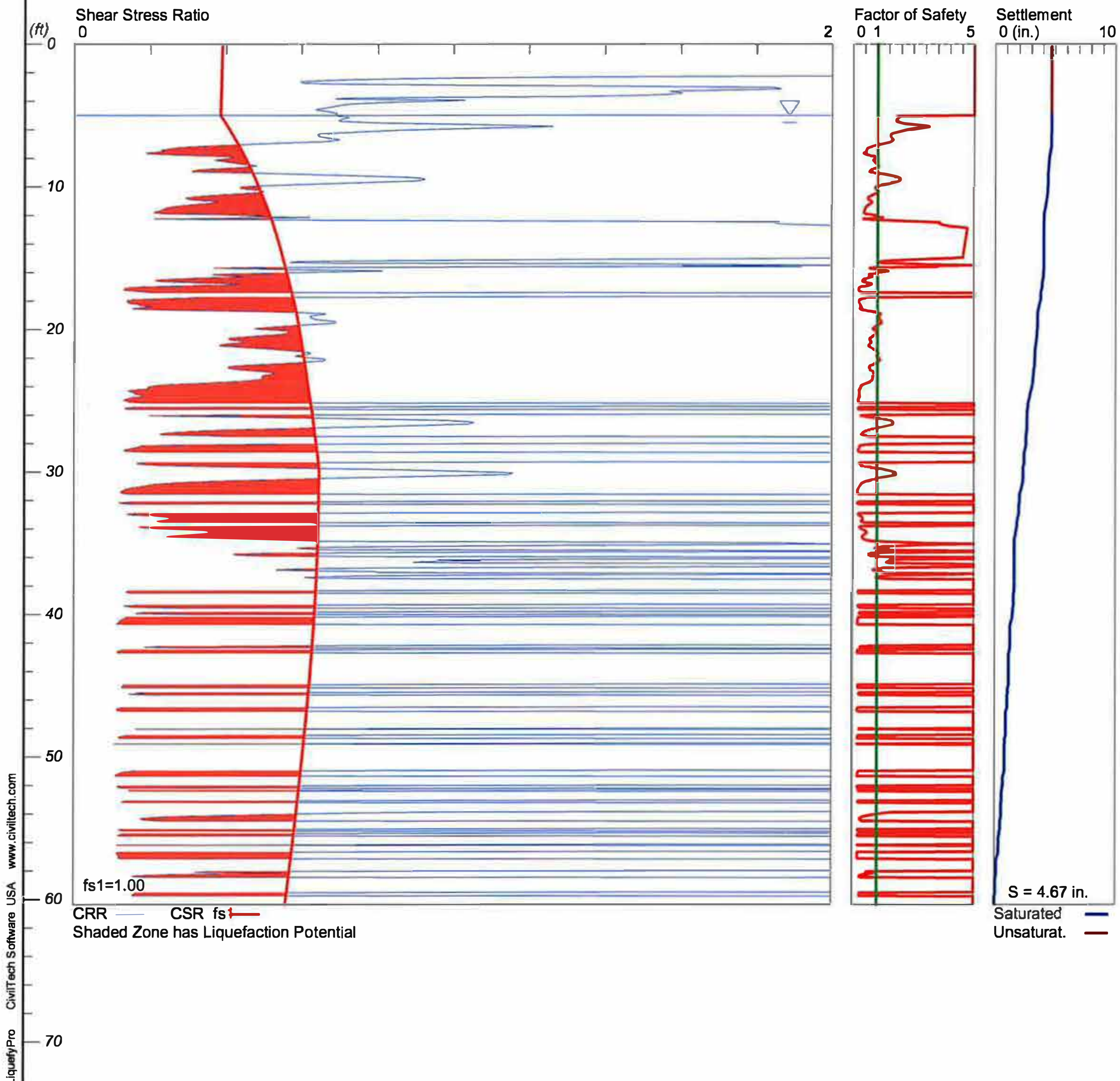
240 - 15th St SE Industrial

Hole No.=CPT-2 Water Depth=5.0 ft

Ground Improvement of Fill=3 ft

Magnitude=7

Acceleration=0.6g



Tab 7.0

7.0 OTHER PERMITS

Other permits that may be required for this project include:

- SEPA Environmental Checklist
- Civil Construction Permit
- Building Permits
- Construction Stormwater General Permit
- Fire Permit

Tab 8.0

8.0 ESC ANALYSIS AND DESIGN

An erosion and sediment control plan will be prepared as part of the civil construction plan set. These plans will follow the measures outlined in the Erosion and Sediment Control Standards. The measures outlined in the Manual are discussed below.

Clearing Limits: Prior to any site clearing or grading, the construction limits will be clearly marked with a combination of silt fencing and/or brightly colored survey tape.

Cover Measures: Temporary and permanent cover measures shall be provided when necessary to protect disturbed areas. Temporary cover shall be installed if an area is to remain unworked for more than seven days during the dry season (May 1 to September 30) or for more than two days during the wet season (October 1 to April 30), unless otherwise noted by the City. Any area to remain unworked for more than 30 days shall be seeded or sodded, unless the City determines that winter weather makes vegetation establishment unfeasible. During the wet season, slopes and stockpiles 3H:1V or steeper with more than 10 feet of vertical relief shall be covered if they are to remain unworked for more than 12 hours. The CESCL lead shall be responsible for determining what specific measures to implement to suit changing site conditions.

Perimeter Protection: Silt fence shall be installed along the property lines prior to any upstream grading to prevent and filter sediment sheet flow from adjacent areas.

Traffic Area Stabilization: A construction entrance will be installed to minimize erosion tracking of sediment offsite. Should there be parking areas used by construction traffic onsite they shall also require stabilization.

Sediment Retention: Surface water collected from disturbed areas of the site shall be routed through a sediment pond or trap prior to release from the site.

Surface Water Controls: Surface water controls shall be installed in the form of temporary "v" ditches with rock check dams to intercept and convey surface water from disturbed areas to the sediment trap.

Dust Control: Preventative measures to minimize the wind transport of soil shall be taken as necessary depending on site conditions. The most common method shall be to spray exposed soils until wet, but not so wet as to cause the soils to generate runoff from the spraying.

Tab 9.0

9.0 BOND QUANTITIES, FACILITY SUMMARIES, AND DECLARATION OF COVENANT

All required bonding and financial guarantees will be provided as required by the City of Puyallup.

Tab 10.0

10.0 OPERATIONS AND MAINTENANCE MANUAL

The proposed on-site facilities will be owned and maintained by the owner. An Operations and Maintenance Manual will be completed and submitted as a separate document with the permit construction plans.