ENGINEERING REPORT
Bellingham Shipping Terminal

Prepared for: Port of Bellingham

Permit No. WAR305536 • May 15, 2024 FINAL
Project No. AS190345A-002-047

Aspect
A Geosyntec Company

earth + water

ENGINEERING REPORT
Bellingham Shipping Terminal

Prepared for: Port of Bellingham

Permit No. WAR305536 • May 15, 2024 FINAL
Project No. AS190345A-002-047

Aspect Consulting

05/15/2024

Owen G. Reese, PE
Principal Water Resources Engineer
owen.reese@aspectconsulting.com

V:\190345 Prt of Bellingham NPDES SW Permit Support\Deliverables\BST 2024 Engineering Report\BST ER Final_2024.05.15.docx

Contents

List of Tables

List of Figures

List of Appendices

Acronyms

Aspect	Aspect Consulting
BMPs	best management practices
BST	Bellingham Shipping Terminal
CBI	catch basin insert
CESF	chitosan enhanced sand filtration
cfs	cubic feet per second
Contech	Contech Engineered Solutions
EC	electrocoagulation
Ecology	Washington State Department of Ecology
Facility	BST at 629 Cornwall Avenue, Bellingham, Washington
gpm	gallons per minute
GULD	General Use Level Designation
IBC	intermediate bulk container
ISGP	Industrial Stormwater General Permit
MFD	media filter drains
MFU	media filtration units
mg/L	milligrams per liter
µg/L	micrograms per liter
µm	micron
MWL	Modular Wetland® Linear
NAICS	North American Industrial Classification System
NTU	nephelometric turbidity unit
O&M	operation and maintenance
Port	Port of Bellingham
SEPA	State Environmental Policy Act
sf	square feet
SWMMWW	Stormwater Management Manual for Western Washington

SWPPP	Stormwater Pollution Prevention Plan
TAPE	Technology Assessment Protocol – Ecology
TMDL	total maximum daily load
TSS	total suspended solids
WAC	Washington Administrative Code

1 Introduction

This Engineering Report (Report) was prepared by Aspect Consulting, a Geosyntec company (Aspect), on behalf of the Port of Bellingham (Port), which owns the Bellingham Shipping Terminal (BST) at 629 Cornwall Avenue in Bellingham, Washington (Facility); see Figure 1) and leases it for industrial activity to a variety of tenants. Stormwater discharges from BST are authorized under Industrial Stormwater General Permit (ISGP) No. WAR-305536.

During 2023, stormwater monitoring results from the Facility exceeded the ISGP benchmarks for turbidity, total suspended solids (TSS), total copper, and total zinc at one or more monitoring locations in three calendar quarters, triggering a Level 3 Corrective Action under the ISGP for these parameters. In addition, a Level 2 Corrective Action was triggered for total lead exceeding the ISGP benchmark in two calendar quarters.

Prior to triggering the Level 3, the Port was already underway on design, permitting, and contracting of the Wharf Rehabilitation project, a major construction project to replace a significant portion of the pier at BST. To address stormwater management requirements for replaced impervious surfaces, the project includes stormwater treatment improvements appropriate for industrial facilities in the drainage areas for outfalls B1D and B2A (Figure 2).

The Level 3 also includes other outfalls (B1C, B3A-C, B4A, W1A and W1B; Figure 2) that will not be affected by the Wharf Rehabilitation project and are proposed for additional treatment improvements.

This Report has been prepared to meet the requirements specified in the 2020 ISGP, including providing the following:

- A brief summary of the treatment alternatives considered and why the proposed option was selected. Include cost estimates of ongoing operation and maintenance, including disposal of any spent media.
- The basic design data, including characterization of stormwater influent, and sizing calculations of the treatment units.
- A description of the treatment process and operation, including a flow diagram.
- The amount and kind of chemicals used in the treatment process, if any.
- Results to be expected from the treatment process, including the predicted stormwater discharge characteristics.
- A statement expressing sound engineering justification using pilot plant data, results from similar installations, and/or scientific evidence that the proposed treatment is reasonably expected to meet the permit benchmarks.
- Certification by a licensed professional engineer.

This Report was also prepared in accordance with the requirements for Engineering Reports in Chapter 173-240-130 of the Washington Administrative Code (WAC) and the *Guidelines for the Preparation of Industrial Stormwater General Permit Engineering Reports* (Ecology, 2013). A crosswalk of the WAC 173-240-130 requirements and where they are addressed in this report is provided in Appendix A.

2 Facility Information

2.1 Facility Location and Contact Information

BST is a 14.4-acre facility located on Bellingham Bay at 629 Cornwall Avenue in Bellingham, Washington. A vicinity map for the Facility is shown in Figure 1.

The Stormwater Pollution Prevention Plan (SWPPP) contact for the facility is:

Alice Cords
Environmental Specialist
Port of Bellingham
P.O Box 1677
Bellingham, WA 98227
360.676.2500, ext. 381

2.2 Facility Layout

Materials are transported over land in and out of BST by truck on Cornwall Avenue at the east side of the facility (Figure 1).

Cargo is transferred to and from ships and barges in the loading area at the central portion of the pier. Vessels moor at the north and south ends of the pier, but only limited cargo loading currently occurs due to structural limitations of the pier. A stub pier on the southern side of BST is very seldom used for loading certain cargo.

Cargo may also be transferred into BST from the adjacent parcel to the northeast. Truck access to this area is through BST. When industrial activity occurs on this parcel, the tenant is required to seek their own ISGP coverage, and the parcel is not included within the ISGP coverage for BST.

Most of the facility's permitted areal extent is comprised of impervious surfaces consisting of roofs, pavement, and piers. The remainder is generally gravel or compacted earth. Rip rap, gravel, and vegetation are located outside industrial activity areas along the shoreline.

2.3 Tenant Operations

Tenant operations at the Facility vary over time as different tenants lease the facility or cargos change.

Current tenants at BST include ABC Recycling for shipment of scrap metal, JE McAmis for storage and shipment of ballast rock, Bellingham Yachts for use of Warehouse 2 for storage of recreational boats, Foss for berthing of assist tugboats at Berth 3, and PTSC, a stevedore contracted to work with ABC Recycling during shiploading. On March 25, 2024, the Port Commissioners voted to terminate the lease of ABC Recycling (Port of Bellingham, 2024). By June 30, 2024, ABC Recycling will remove all scrap metal from BST and their adjacent leasehold.

Generally, industrial activities conducted at the Facility fall under the following North American Industrial Classification System (NAICS) codes:

488310 – Port and Harbor Operations

488320 – Marine Cargo Handling

493110 – General Warehousing and Storage

488999 – All Other Support Activities for Transportation

493130 – Farm Product Warehousing and Storage

493190 -- Other Warehousing and Storage

483211 – Inland Water Freight Transportation

332312 – Fabricated Structural Metal Manufacturing

Vehicle and equipment maintenance is not generally performed on-site. Emergency repairs of equipment may occasionally be necessary in areas with industrial activity. Vehicle and equipment washing is not conducted on-site.

Mobile fueling trucks may periodically fuel ships or equipment onsite. Fueling is conducted by commercial vendors; therefore, fuel trucks are not stored onsite when not fueling. The Port maintains a list of approved mobile fueling contractors for tenants to use for overwater fueling and provides a list of required Best Management Practices (BMPs) to approved mobile fueling contractors.

2.4 Potential Stormwater Pollutants

The potential stormwater pollutants at BST are primarily related to the marine cargo being handled and the truck traffic that transports it to the loading area. The nature and type of pollutants will vary based on the type of cargo handled. Currently the primary cargoes handled at BST are scrap metal and armor rock (large boulders).

Potential pollutants associated with the industrial activities conducted at BST are summarized in Table 1.

Table 1. Industrial Activities and Associated Pollutants

Industrial Activity / Exposed Materials	Associated Pollutants
Marine cargo handling	
Scrap metal	Metals, sediment, oil, and grease, TSS
Armor rock	TSS, turbidity
Truck traffic	Oil and grease, metals, TSS, turbidity
Mobile fueling	Petroleum products
Parking – equipment and employee vehicles	Oil and grease, metals, sediment
Galvanized materials (roof vents, downspouts, certain paints, fencing)	Zinc

2.5 Existing Stormwater Management System

BST's stormwater system consists of four drainage basins (Basins 1 through 4) and two roof areas (a portion of Warehouse 1 and the Block House) that discharge separately. The existing drainage systems in each of these areas are described below and are shown on Figure 2.

2.5.1 Basin 1

Basin 1 includes the pier along the northwest edge of BST. The pier has been divided into three areas: south pier, middle wharf, and the north wharf, based on uses. Runoff from the south pier sheet flows to the east and west before discharging into Bellingham Bay; no marine cargo handling or other industrial activity occurs in the south pier area; this area is used for berthing vessels. Runoff from the middle wharf area generally flows northwest as sheet flow before being treated in media filter baskets installed along the edge of the wharf. The media filter baskets discharge directly to Whatcom Waterway. Sample point B1D represents the discharge from the media filter baskets.

Runoff from the north wharf area sheet flows to the edge of the wharf then into Whatcom Waterway. Sample point B1C represents sheet flow that discharges from the wharf where treatment units are not installed.

2.5.2 Basin 2

Basin 2 includes a paved area to the northwest of Warehouse 2, the Warehouse 2 roof, and a southwestern portion of the Warehouse 1 roof. Roof runoff drains through downspout treatment media filtration units (MFUs). Treated roof runoff is then conveyed via closed conduit or overland flow to a stormwater drainage system that discharges to Outfall B2A. Outfall B2A has a total drainage area of approximately 1.9 acres.

The drainage system includes catch basins to collect sheet flow from nonroof areas of Basin 2. Two additional catch-basin vaults contain Contech StormFilter treatment systems. The downspout at the southwestern side of Warehouse 1 also drains through downspout treatment MFUs to this drainage network via overland flow. The actual outfall is located under the wharf and discharges to Whatcom Waterway. Sample point B2A is the monitoring location for Basin 2 and is in the maintenance hole immediately upstream of the outfall.

2.5.3 Basin 3

Basin 3 has a total drainage area of approximately 5 acres and is divided into 6 subbasins (Basins 3A through 3F) that each have their own outfall to Bellingham Bay. The western portion of the basin (Basins 3A to 3C) is paved, and the eastern portion (Basins 3D through 3F) is an unpaved gravel area.

Runoff in each subbasin sheet flows to the southwest and is collected by trench drains or swales and then conveyed to one of six media filter drains (MFD). Runoff flows vertically through the MFD media to underdrain pipes that convey it to the outfall pipes. The Port plugged the inlets to the MFDs in Basins 3D, 3E, and 3F so that stormwater infiltrates in the unpaved area. Since plugging the inlets there has been no discharge through Outfalls 3D, 3E, and 3F.

Outfalls B3A through B3C have been considered substantially identical to sample point B4A because they have paved drainage basins subject to truck traffic as the primary activity and receive treatment through MFDs. Based on feedback from Ecology in May 2024, the Port will begin sampling either B3A, B3B, or B3C as described in Section 4.8. The change in sampling location does not affect implementation of the Level 3 Corrective Action described in this Engineering Report since these outfalls are included in Level 3 and proposed for additional treatment.

Sampling point B3F is the monitoring location for substantially identical outfalls B3D and B3E. These three subbasins are unpaved, have the same industrial activities (marine cargo handling and truck traffic), and have MFDs for treatment. However, no discharges have occurred in any of the three basins since the inlets to the MFDs were plugged and stormwater allowed to infiltrate.

2.5.4 Basin 4

Basin 4 has a drainage area of approximately 4.2 acres, consisting of the paved area located north and east of Warehouses 1 and 2 and the southeastern and eastern portion of the Warehouse 1 roof.

Stormwater runoff from the paved areas of Basin 4 flows as sheet flow to a single MFD for treatment prior to discharge at Outfall B4A into Whatcom Waterway. Runoff from the portions of Warehouse 1 roof is treated in downspout treatment MFUs and then piped into the MFD. Treated water from the MFD comingles with runoff from Port property outside of the ISGP-permitted area prior to discharge to Outfall B4A. The sample point (B4A) is located upstream of the commingling.

2.5.5 Warehouse 1 and Block House Roofs

Portions of Warehouse 1 and the Block House roofs discharge to outfalls other than those from Basins 1 through 4.

Stormwater from downspouts on the northeastern and northwestern parts of the Warehouse 1 roof is treated in downspout MFUs located around the building. Downspouts installed along the northwestern and northeastern side of the building convey runoff into an underground pipe network that drain to outfalls W1A and W1B located under the wharf. Sample point W1C is located at the outlet of the one of the MFUs and is the monitoring point for these substantially identical outfalls, as the outfalls themselves are inaccessible.

Stormwater from the Block House roof is routed to underground piping and discharges directly to Whatcom Waterway through Outfall B4A. No industrial activity occurs in the Block House or on its roof.

2.6 Water Quality Monitoring Data

This section summarizes the results of water quality monitoring program conducted at the Facility in 2023. Under the Sampling Plan in the Facility's SWPPP, stormwater samples are collected quarterly from six sampling points, each named after its tributary drainage basin: B1C, B1D, B2A, B4A, W1C, and B3F. As described in Section 2.5, there was no discharge from B3F in 2023, as the inlet to the MFD was blocked to encourage stormwater to infiltrate.

Monitoring results from 2023 for the six monitoring locations are summarized in Table 2.

Table 2. Summary of 2023 Monitoring Results

Monitoring Point	Qtr	Quarterly Average Concentration						
		Turbidity in NTU	pH in s.u.	Copper in µg/L	Lead in µg/L	Zinc in µg/L	Diesel-range Total Petroleum Hydrocarbons (NWTPH-Dx) in mg/L	TSS in mg/L
Benchmark		25	5 to 9	14	64.6	117	10	30
B1C	1	6.58	7.5	13.2	1.1	32.4	0	0.77
	2	21.1	6	**35.7**	10.1	**120**	0.96	**42.7**
	3	**42.6**	6	**63.7**	19.4	**163**	0.88	**42.3**
	4	3.06	6.5	**18.2**	1.1	22.5	0.25	2.3
B1D	1	**44.8**	6	**27.45**	41.5	**463**	0.62	**85.85**
	2	**185**	6.5	**77.1**	**103**	**899**	1.33	**113**
	3	**313**	6.5	**33.3**	18	**243**	0	**136**
	4	**149**	6.5	**24.4**	17.9	**179**	0.31	23
B2A	1	**93.7**	6	8.9	16.3	**199.5**	1.12	27.65
	2	19.9	6	10.9	7.1	**138**	0.57	9.8
	3	**479**	6.5	**231**	**457**	**1970**	9.13	**554**
	4	**89.5**	6.5	**39.2**	29.5	**248**	0.76	**54.3**
B4A	1	1.47	6.5	2.3	0.82	9.5	0.37	3
	2	2.09	6.5	**30.3**	0.4	21.6	0.22	1
	3	**847**	6.5	**162**	**301**	**1220**	8.9	**502**
	4	19.8	6.5	**86.1**	7.8	58.7	0.26	16.5
W1C	1	3.19	6.5	4.1	0.29	45.2	0.12	3
	2	3.84	6	13.6	2.3	**273**	0.25	8.3
	3	**35.7**	5.5	10.1	2.13	117	0	26.7
	4	2.9	6	9.3	3	**136**	0.28	7.7
B3F	1	No Discharge						
	2	No Discharge						
	3	No Discharge						
	4	No Discharge						
Number of Quarters with Exceedances		4	0	4	2	4	0	3
Response Triggered		Level 3	None	Level 3	Level 2	Level 3	None	Level 3

Notes:
Qtr = quarter; NTU = Nephelometric Turbidity Unit, s.u. = standard units, µg/L = micrograms per liter; mg/L = milligrams per liter.

Based on these monitoring results, a Level 3 Corrective Action was triggered for turbidity, copper, zinc, and TSS in 2023 as each parameter had benchmark exceedances during three or more quarters. A Level 2 Corrective Action was triggered for lead in 2023 based on two quarters with exceedances. There were no exceedances of the pH or diesel-range total petroleum hydrocarbon (NWTPH-Dx) benchmarks.

The pollutant concentrations experienced in 2023 were significantly higher than in prior years. ABC Recycling's lease of a parcel adjacent to BST was approved on June 21, 2022, and significant operations on the adjacent area began in the third quarter of 2022. The first load of scrap metal was shipped out of BST in October 2022. Storage and loading of armor rock at BST had been occurring at BST for many years.

Prior to 2022, the Facility had achieved consistent attainment of benchmarks for many parameters and monitoring locations. Samples collected in the fourth quarter of 2022 generally exceeded benchmarks and required a return to monthly sampling. Concentrations remained elevated, with several benchmark exceedances each quarter.

Figures 3 and 4 illustrate the change in pollutant concentrations over time for the parameters and monitoring locations that triggered Level 3 corrective actions in 2023. The figures clearly show the increase of both solids and metals concentrations after ABC Recycling operations began.

2.7 Receiving Water

Stormwater from the Facility discharges to the marine waters of Bellingham Bay and the Whatcom Waterway (also known as the Whatcom Creek Waterway in some references). According to Washington State Department of Ecology's (Ecology) Water Quality Atlas, there are two waterbody segments that receive discharges from the Facility (Figure 2).

These waterbody segments are not on the list of impaired waterbodies (i.e., the 303(d) list) for any pollutants in water, but they are listed in Category 4B for 4 to 24 pollutants in sediment depending on the waterbody segment. Category 4B indicates that a pollution control program is in place and is expected to resolve the impairment. For these waterbody segments, the applicable pollution control programs are the RG Haley International (Facility ID: 2870) and Whatcom Waterway (Facility ID: 2899) Model Toxics Control Act (MTCA) Cleanup Action Plans and the Inner Bellingham Bay Contaminated Sediments Total Maximum Daily Load (TMDL; Ecology 2003).

The Facility discharges to a Puget Sound Sediment Cleanup Site, as defined in the ISGP, and has a benchmark and required monitoring for TSS and requirement to remove accumulated solids for storm drain lines once per permit cycle.

2.8 SEPA Compliance

The City of Bellingham completed an environmental review of the Port's BST Wharf Rehabilitation project, which includes the pier area stormwater conveyance and treatment improvements, under the State Environmental Policy Act (SEPA) and issued a Determination of Non-Significance on January 31, 2023. The proposed additional stormwater BMPs described in this Report that are not a component of the BST Wharf Rehabilitation project do not trigger reevaluation under SEPA.

3 Stormwater Treatment Alternative Evaluation and Selection

3.1 Target Treatment System Performance

Target treatment performance was evaluated based on monitoring data collected from fourth quarter 2022 to fourth quarter 2023, which represents all data available for the period where scrap metal cargo has been handled at BST. The target treatment system performance was calculated by comparing the median and maximum pollutant concentrations observed at each monitoring location with the benchmark.

Target treatment system performance is summarized in Table 3 and calculations are provided in Appendix B.

Table 3. Targets for Treatment System Performance

Mon. Pt	Summary Statistics	Turbidity in NTU	Copper in µg/L	Lead in µg/L	Zinc in µg/L	TSS in mg/L
	Benchmark	25	14	64.6	117	30
B1C	Median Concentration	21.1	**18.2**	9.1	**120**	2.3
	Maximum Concentration	**42.6**	**65.5**	19.4	**209**	**42.7**
	Target Removal Range	0-41%	23-79%		3-44%	0-30%
B1D	Median Concentration	**65.35**	**28**	28.2	**414**	**64.5**
	Maximum Concentration	**313**	**77.1**	**103**	**899**	**136**
	Target Removal Range	62-92%	50-82%	0-37%	72-87%	53-78%
B2A	Median Concentration	**107.4**	**20.3**	29.5	**247.5**	21.5
	Maximum Concentration	**479**	**231**	**457**	**1970**	**554**
	Target Removal Range	77-95%	31-94%	0-86%	53-94%	0-95%
B4A	Median Concentration	4.94	**30.3**	1	21.6	3
	Maximum Concentration	**847**	**162**	**301**	**1220**	**502**
	Target Removal Range	0-97%	54-91%	0-79%	0-90%	0-94%
W1C	Median Concentration	3.84	8.5	2.13	**136**	7.7
	Maximum Concentration	**35.7**	**45.2**	3	**818**	26.7
	Target Removal Range	**0-83%**	**0-89%**		**14-99%**	**0-81%**

Notes:
Bold indicates concentration is above the benchmark.
Median and maximum concentrations are from October 1, 2022 through December 31, 2023.

The highest target treatment performance is needed in the middle wharf of Basin 1 (represented by sampling point B1D) and Basin B2 (represented by sampling point B2A), where 50 to 95 percent removal of solids and metals is needed to reliably meet benchmark. Lower levels of treatment are needed at B4A and the north wharf of Basin 1 (represented by sampling point B1C), where one particularly poor monitoring event during first fall flush in 2023 dominates the results, but concentrations otherwise generally have met benchmark.

At W1C, concentrations generally meet benchmark, but there have been one or more elevated monitoring resulting in the need for around 80 percent removal of solids, up to 90 percent removal of copper, and 99 percent removal of zinc.

3.2 Hydrologic Analyses

Hydrologic analyses were performed as a component of the design of the BST Wharf Rehabilitation project. Wilson Engineering, the stormwater design lead, used the Western Washington Hydrology Model (WWHM), version 4.2.18 to model stormwater flows from a 3.9-acre tributary area that represents all of Basin 2 and portions of the north wharf of Basin 1.

Wilson subdivided the 3.9-acre tributary into two project-specific subbasins[1]:

- The subbasin directly affected by the BST Wharf Rehabilitation project, which includes all of Warehouse 2, the heavy lift paving area in Basins 1 and 2, and a small portion of Warehouse 1 roof on the southwest. This area is 2.46 acres, all impervious.
- Future capacity to treat the remainder of Warehouse 1 roof and future repaving in the north wharf area of Basin 1. This area is 1.44 acres, all impervious.

Wilson calculated a total water quality design flow rate from the tributary areas of 0.3121 cubic feet per second (cfs) or 140 gallons per minute (gpm).

Peak flows for use in design of conveyance system improvements are shown in Table 4. Peak flows were calculated by Wilson Engineering using the rational method in accordance with Section 2.5 of the Washington State Department of Transportation (WSDOT) *Hydraulics Manual* (2019). Calculations are provided in Appendix C.

Table 4. Peak Flows for Conveyance Design

Storm Event		Peak flow in cfs	
Recurrence Interval	Annual Exceedance Probability	Wharf Rehab Project Basin	Warehouse 1 and Future Paving
25-year	0.5	7.5	4.4
100-year	0.2	9.3	5.4

Hydrologic analyses were not performed for other basins of BST, because the treatment alternatives selected are not dependent on the flow rate for appropriate sizing and installation.

[1] These subbasins were labelled by Wilson Engineering as Basin 1 and Basin 2, respectively, in the project documentation included in Appendix C. That labelling is not used in this report to avoid confusion with the site-wide basin designations shown on Figure 2.

3.3 Structural Source Control and Treatment Alternatives

The following structural source control and treatment BMPs were identified as potentially applicable at the Facility:

Structural Source Controls:

- Ceasing Certain Industrial Activities
- Coating Roof Vents

Treatment Technologies:

- Catch Basin Inserts
- Biochar Wattles
- Aboveground Storage and Settling
- Contech Engineered Solutions Modular Wetland® Linear
- Newterra Aquip® Media Filtration System
- Pressurized Media Filtration Newterra
- Chitosan Enhanced Sand Filtration (CESF)
- Electrocoagulation (EC)

Descriptions of these technologies and how they might be applied as part of the Level 2/Level 3 Corrective Actions at BST are provided in the following sections.

3.3.1 Structural Source Control Alternatives

Ceasing of Existing Scrap Metal Cargo Handling Operation

The elevated concentrations of metals and solids that triggered the Level 3 Corrective Actions are clearly related to the onset of shipping scrap metal at BST. The Port identified environmental concerns associated with the manner in which this cargo was being handled by the tenant and developed a lease termination agreement with ABC Recycling. On March 25, 2024, the Port Commission approved the lease termination agreement (Port of Bellingham, 2024). The termination agreement requires that all scrap metal be removed from the waterfront by June 30, 2024. Remaining scrap from ABC Recycling's operation will be loaded onto two more cargo vessels at BST on or prior to June 30, 2024.

Cessation of existing scrap metal cargo handling at BST is expected to return stormwater concentrations at all outfalls to levels experienced prior to the third quarter of 2022. During that period there were rare exceedances for copper and zinc at some monitoring locations, but the facility generally met benchmark and achieved consistent attainment for most parameters and locations.

Cessation of existing scrap metal cargo handling is anticipated to reduce pollutant concentrations by 60 to 88 percent for copper, 95 to 99 percent for lead, 73 to 96 percent for zinc, and 73 to 98 percent for turbidity and solids at monitoring locations where concentrations exceed benchmarks since third quarter 2022. Thus, cessation of existing scrap metal cargo handling should be sufficient to consistently meet benchmarks; however, the Port already has some treatment improvements underway and can implement others to further ensure that benchmarks are met.

Coating Roof Vents of Warehouse 1

The vents on the top of the Warehouse 1 roof are suspected of being a source of zinc in stormwater. Approximately 18 vents are located on the portion of the Warehouse 1 roof that drains to Basin W1. The Port will apply a nonzinc-containing coating to these vents to eliminate them as a potential source of zinc.

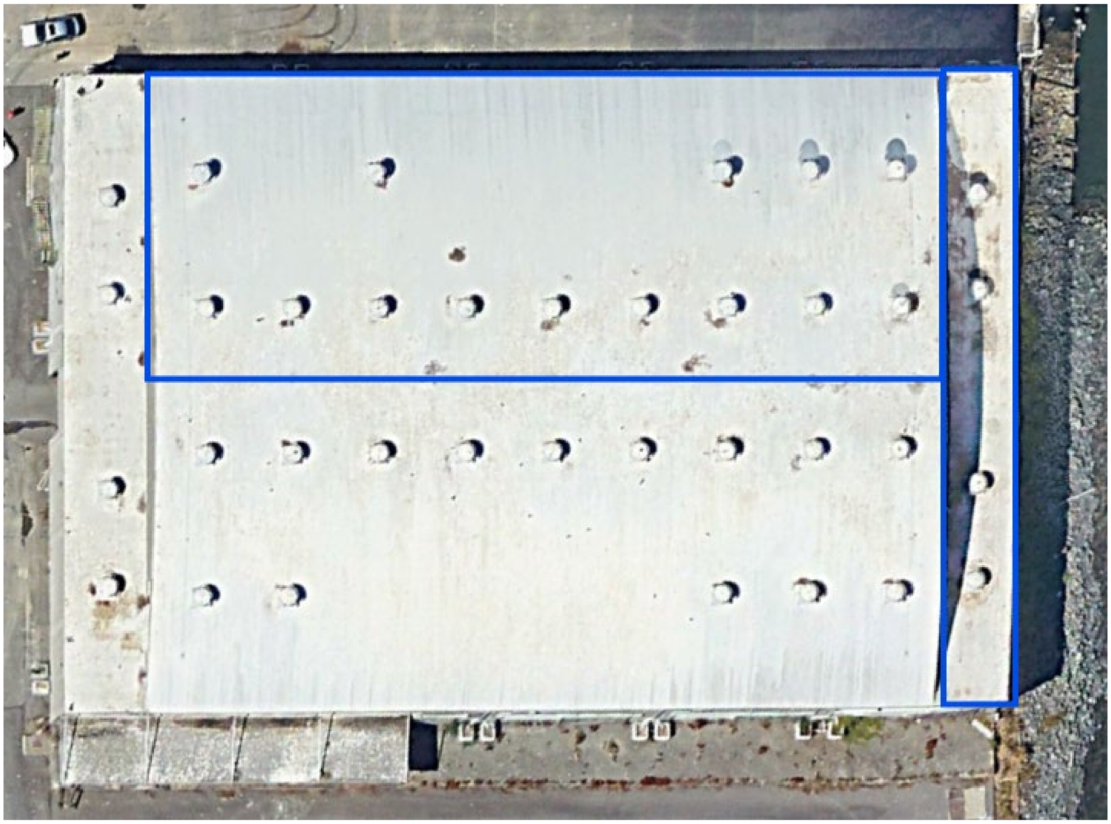


Image 1. Roof vents on Warehouse 1. *Area draining to Basin W1C is shown in blue.*

3.3.2 Treatment Technology Alternatives

Catch Basin Inserts

Catch basin inserts (CBIs) are treatment devices that fit within an existing catch basin. They typically hang from the catch basin grate and interior lip and treat stormwater as it enters the catch basin and flows through the CBI. Many different CBIs are available ranging from geotextile-based inserts focused on sediment and debris removal to plastic or metal structures containing treatment media that can target hydrocarbons and metals.

If selected for implementation, CBIs could be implemented at the site by installing them in any existing or new catch basins in areas of industrial activity. The majority of existing catch basins are in Basin 2 and almost all of them will be replaced as part of the Wharf Rehabilitation project. There is also one catch basin in an area of limited industrial activity on the east of Warehouse 1 that drains to MFD B4A.

Biochar Filter Socks

Biochar filter socks consist of biochar treatment media contained in a flexible, porous sock several feet long and about 8 inches in diameter. Biochar is a treatment media formed by pyrolysis (the breakdown of organic material at elevated temperature in the absence of oxygen) of an organic feedstock to form a carbon-rich char that is effective at absorbing some pollutants from stormwater.

Biochar filter socks can be laid on the ground to treat sheet flow, installed in ponds or stormwater vaults, or added as pretreatment to media filters. StormwaterBiochar produces standard biochar socks in 3- and 10-foot lengths, but custom lengths and diameters can be produced.

According to limited data presented on the manufacturer's website (StormwaterBiochar.com, 2024), biochar filter socks are capable of removing 60 to 75 percent of zinc and copper and over 80 percent of lead.

Biochar Filter Socks could be used at BST as pretreatment before the media filter baskets at the edge of the wharf, or as pretreatment before the MFDs by installing them in or on top of the concrete trench drains at the inlet to the MFD.

Roof Downspout Treatment Enhancement

The Port currently uses roof downspout MFUs on the downspouts from Warehouse 1 and 2. The MFUs consist of bioretention soil mix installed in an intermediate bulk container (IBC) tote. They are installed in pairs at the downspouts. Roof downspout treatment units have been shown to be effective at reducing metals and solids concentrations, but can become blinded by sediment loading. The MFUs at BST generally performed well, but had some benchmark exceedances in 2023.

The MFUs at Warehouse 1 could be enhanced by adding oyster shells on top of the existing treatment media. The oyster shells would serve two purposes: (1) provide a three-dimensional surface to enhance solids removal and prevent blinding of the treatment media, and (2) slightly increase the pH, resulting in increased precipitation and easier removal of metals (particularly copper).

Aboveground Storage and Settling

Construction of an aboveground pond or installation of above ground tanks was evaluated to allow for additional gravity settling. The pond would be constructed of concrete blocks to create a lined pond with a volume of approximately 100,000 gallons. The aboveground tanks option would include approximately five 18,000-gallon tanks to allow for additional gravity settling. Both options were determined not to be feasible because they would occupy too much operating space and may not significantly lower metals concentrations enough to achieve ISGP benchmarks.

Modular Wetland

Contech Engineered Solutions' (Contech) Modular Wetland® Linear (MWL) is a media filtration system using horizontal flow to maximize the surface area exposed to stormwater flow, which reduces the footprint required. MWL uses pretreatment chamber followed by a main chamber. The pretreatment chamber uses prefiltration cartridges filled with a proprietary media to remove sediment and hydrocarbons through separation, settling, and filtration, extending the life of the primary media. The main chamber is filled with a proprietary biofiltration media. Flow rate through a MWL is controlled by an orifice at the outlet. MWLs can be configured with, or without, an internal high flow bypass weir to provide flow splitting. Plants are not necessary for treatment system performance, so MWLs can be installed below grade where needed. Ecology has approved MWL as a General Use Level Designation (GULD) technology for Metals and Phosphorus Treatment (Ecology, 2024a). It is anticipated that an MWL would result in consistent achievement of ISGP benchmarks. Given the treatment performance, hydraulic feasibility, and relative low cost, a MWL is a viable treatment alternative at the Facility. The Port approached Contech regarding using MWLs for the Wharf Rehabilitation project and Contech was not willing to offer the MWL for use at this facility.

Newterra Aquip

Newterra's Aquip technology is a patented, enhanced media filtration system that can remove both fine particulates and dissolved pollutants. The Aquip has a demonstrated track record of successfully achieving benchmarks at industrial facilities subject to the ISGP, but is most typically used on largely paved facilities with lower turbidity and sediment concentrations. The Aquip technology was originally developed by StormwateRx, who was subsequently purchased by Newterra in 2019.

Aquips are typically installed aboveground and usually require pumping of stormwater to the system. From there, the system is passive and does not include a backwash or automated sediment management. It also typically does not include real-time monitoring of system performance, but sensors and control systems can be added.

Routine maintenance typically involves inspection and raking, or removal, of the top layer of media to maintain desired treatment flow rates. Periodic replacement of the media bed is required. The type of media used in the Aquip can be customized for the specific pollutants and concentrations present at a facility.

Ecology has approved the Aquip as a GULD technology for Basic, Metals, and Phosphorus treatment (Ecology, 2024b), and includes the following findings about treatment system performance based on real-world installations:

- Median TSS removal of 98 percent.
- Median dissolved copper removal of 73 percent for influent concentrations in the 3 to 20 micrograms per liter (µg/L) range. Median removal was 93 percent for higher concentrations.
- Median dissolved zinc removal was 59 percent for influent concentrations in the 20 to 300 µg/L range. Median removal was 94 percent for higher concentrations.

Implementing Newterra's Aquip technology at the site would involve the following components: a pump station and influent piping, aboveground media filter, discharge piping to an existing outfall. An Aquip system is being procured as part of the Wharf Rehabilitation project.

Pressurized Media Filtration

Pressurized media filtration is an active treatment technology that uses inert filtration media in pressurized beds to remove particulates from stormwater. Media can include sand, gravel, garnet, and/or anthracite, and most commonly include more than one media. The effective filter size can be as low as 5 µm, but 15 to 20 µm is more common.

Pressurized media filtration systems use an automatic backwash system to remove solids from the filter beds. The control system continuously monitors the pressure loss across the filter bed and when the pressure loss reaches a set point, triggers the backwash process. During backwash, the flow through the filter chamber is reversed and a high flow of pressurized water enters the bottom of the chamber, flowing up through the media and carrying away settled solids. Backwash only occurs for one vessel at a time, so the treatment system can continue to operate continuously with no interruptions during backwash. Backwash is directed to a separate settling tank, where solids accumulate, and the water is recycled through the treatment process.

Pressurized media filtration is often combined with a coagulation pretreatment, either using chemical addition (such as chitosan) or electrocoagulation, to increase particle size prior to and improve the removal efficiency of the filtration step.

Performance of pressurized media filtration has not been evaluated through Ecology's Technology Assessment Protocol – Ecology (TAPE) process, but is often a component of bench- and pilot-scale treatability testing for CESF and other coagulation-filtration treatment technologies. In other words, filtration alone is evaluated to determine the benefit of adding coagulation.

Performance of pressurized media filtration is dependent on the particle-size distribution of the influent stormwater. It is most effective with large particles and less effective with small particles, particularly at particles sizes below 5 microns (µm).

Chitosan Enhanced Sand Filtration

CESF is an active treatment technology that relies on chemical and physical processes to coagulate fine solids (and associated particulate metals or other contaminants sorbed to the solids), then physically remove them through filtration. Through coagulation, the particles stick together forming larger floc, which is easier to remove through settling or filtration. CESF uses liquid chitosan acetate, a biopolymer made from recycled crustacean shells, as the coagulant. Chitosan acetate is available in a variety of formulations (e.g., FlocClear, 1.0% Chitovan, etc.) that have been reviewed and approved for general use by Ecology (e.g., Ecology, 2017). In some applications, a supplemental polymer, BHR-P50, is added to enhance treatment performance. BHR-P50 has also been reviewed and approved by Ecology (Ecology, 2014). Chitosan acetate (and BHR-P50, if used) is injected at controlled dosing rates depending on the turbidity of the influent water. The dosing rate is typically determined through initial testing and can be adjusted over time to optimize treatment system performance.

CESF systems are installed aboveground and the key components, such as the control module, chemical storage, and sand filters, are containerized or skid mounted. Stormwater is pumped to the system and transferred within the system using pumps.

Unlike other active treatment systems, CESF has been incorporated into the *2019 Stormwater Management Manual for Western Washington* (SWMMWW; Ecology, 2019) as BMPs C250 and C251, reflecting its widespread use in treatment of construction stormwater.

Depending on the solids volume requiring management, supplemental solids dewatering steps may be necessary. For application at the site, the annual solids volume is anticipated to be high enough to warrant a basic sludge dewatering system, such as a phase separation box. This would reduce the liquid content of the sludge by allowing water to drain from the sludge in a contained environment. It would also allow for sludge management without requiring vactor trucks.

Ecology has approved CESF as a GULD technology for Erosion and Sediment Control. Ecology found that CESF systems resulted in an average reduction in turbidity on construction sites of 97.44 percent when operated at a hydraulic loading rate of 15 gpm per square foot (gpm/sf) of sand filter surface area (Ecology, 2017).

Ecology (2017) also found a slow degradation in CESF performance with turbidity levels above 600 NTU. The GULD approval for CESF limits influent turbidity to 600 NTU without additional pretreatment.

Chitosan acetate is nontoxic to humans and aquatic mammals, but has been shown to be toxic to rainbow trout. Through the TAPE process, Ecology has developed and requires implementation of protective procedures for ensuring that chitosan acetate is not discharged to receiving waters at concentrations toxic to rainbow trout.

Although performance of CESF in removing total metals has not been evaluated by Ecology through the TAPE process, CESF systems have a track record of meeting ISGP benchmarks for total metals with claimed removal rates of up to 95 percent of particulate copper and zinc and 50 percent removal of dissolved copper and zinc.

A CESF system would consist of the following components: pump station and influent piping, containerized CESF control system (including chitosan storage, influent and effluent water quality monitoring, chitosan injection, and the control system), skid-mounted pressurized sand filter pods, settling/backwash tank, and discharge piping to an existing outfall. The overall footprint would be similar to two to three shipping containers.

Electrocoagulation

EC systems use an active treatment technology that generates a coagulation process by passing electrical current across sacrificial steel or aluminum electrodes. The electrical current destabilizes charged particles allowing them to coagulate more readily, liberates metal ions that can precipitate and form a large floc, and creates small hydrogen bubbles through hydrolysis that lift the floc through the water column. In addition, the process can electrochemically oxidize metals and organics. The coagulated solids are subsequently settled then filtered in pressurized inert media filters. EC systems are automated and include continuous monitoring of discharge water quality for pH and turbidity.

Solids accumulate in the settling tanks and backwash tank. As with the other active treatment systems, supplemental solids management system would likely be a worthwhile component of an EC system.

Ecology has approved WaterTectonics' WaveIonics Electrocoagulation Subtractive Technology as a GULD technology for Erosion and Sediment Control. Ecology (2023) found that the WaveIonics technology reliably reduced turbidity below 10 NTU and frequently below 5 NTU. Although not evaluated through Ecology's TAPE program for metals removal, vendor-provided case studies indicate that EC systems can reduce high influent zinc (>1 milligram per liter [mg/L]) and copper (> 0.2 mg/L) concentrations to below ISGP benchmarks (WaterTectonics, 2019).

Implementing an EC system would consist of the following components: pump station and influent piping, containerized electrocoagulation system, settling tanks, filter pods, backwash tank, and discharge piping. The overall footprint would be similar to two to three shipping containers.

3.4 Evaluation of Treatment Alternatives

Treatment alternatives were evaluated based on their expected performance, feasibility, risks, flexibility, maintenance requirements, and relative cost. The results of the evaluation are summarized in Table 5.

Table 5. Treatment Alternatives Comparison Matrix

	Catch Basin Inserts	Biochar Wattles	Aboveground Storage and Settling	Contech Engineered Solutions Modular Wetland	Newterra Aquip	Pressurized Sand Filtration	Chitosan-Enhanced Sand Filtration	Electrocoagulation
Expected Water Quality Performance	• Could lower turbidity and metals concentrations, but unlikely to reliably meet benchmarks alone	• Could lower turbidity and metals concentrations, but unlikely to reliably meet benchmarks alone	• Could lower turbidity and metals concentrations, but unlikely to reliably meet benchmarks alone	• Expected to reliably meet benchmarks	• Expected to reliably meet benchmarks	• Expected to reliably meet benchmarks	• Expected to reliably meet benchmarks	• Expected to reliably meet benchmarks
Feasibility	• Feasible	• Feasible	• Infeasible – insufficient space	• Feasible	• Feasible	• Feasible	• Feasible	• Feasible
Advantages	• Passive operation •No construction or changes to infrastructure needed	• Passive operation • No construction or changes to infrastructure needed	• Simple, passive operation • Includes floatables control	• Generally passive operation • Proven for turbidity and metals in stormwater	• Generally passive operation • Relatively lower capital and O&M costs • Proven for turbidity and metals in stormwater • Polishing treatment can be added, if necessary	• Moderate footprint • Can adapt into CESF system, if necessary	• Proven performance for turbidity and metals • Flexible system, can handle range of influent quality • Can adapt into pressurized media filtration system if influent quality is good enough. • Supplemental treatment easily added, if necessary	• Generally unaffected by oils or heavy solids load • Proven for turbidity and metals in stormwater • Supplemental treatment easily added, if necessary
Risks	• May not reliably meet benchmarks. • Most CBs are within the Wharf Rehabilitation project area which will already receive superior treatment	• May increase sedimentation or partially obstruct MFD inlet trench drains	• Requires a lift station	• Requires a lift station • No backwash mechanism • Proprietary media	• Requires a lift station • Susceptible to oil and solids fouling • No backwash mechanism • Proprietary media	• Uncertain performance given small particle sizes in stormwater pond. • Moderate footprint • Active operation	• Larger footprint • Relatively active operator involvement • Risk of spills of chitosan, but relatively low toxicity	• Largest footprint for active system • Relatively active operator involvement
Maintenance	• Periodic solids and debris removal • Periodic replacement	• Periodic replacement.	• Solids removal and lift station maintenance	• Periodic replacement of pretreatment media, lift station maintenance	• Solids removal and raking surface • Periodic media replacement	• Solids removal and handling • Frequent operator visits	• Solids removal and handling • Frequent operator visits • Chitosan deliveries	• Solids removal and handling • Cell replacement • Periodic media replacement
Chemicals	• None	• None	• None	• None	• None	• None	• Chitosan acetate • Supplemental flocculants (e.g., BHR-P50)	• NaOH
Relative Capital Cost	• Very Low	• Very Low	• Moderate	• Moderate	• Moderate	• Moderate	• Moderate-High	• High
Additional Comments	• Not selected – not necessary given superior treatment for most CBs at facility	• Selected to enhance MFDs	• Not selected -	• Not selected - Manufacturer refused to sell for industrial site	• Selected for Wharf Rehabilitation project	• Not selected – more complex operation	• Not selected – higher cost and more complex operation	• Not selected – higher cost and more complex operation

4 Proposed Stormwater Treatment and Source Control Improvements

This section provides detailed information on the proposed stormwater treatment and source control improvements at BST.

4.1 Proposed Improvements and Site Layout

Based on the evaluation documented in Section 3, the following proposed structural source control and treatment improvements are proposed at the Facility:

- Site-wide: Cease existing scrap metal cargo handling activity.
- Basin 2 and Portion of Basin 1: Install aboveground Newterra Aquip media filter as component of Wharf Rehabilitation project.
- Remainder of Basin 1 with Industrial Activity: Reposition existing media filter baskets currently in Wharf Rehabilitation project area. Continue increased sweeping frequency added as Level 1 Corrective Action.
- Basin 4A and Substantially Identical Basins 3A, 3B, and 3C: Add biochar filter socks in or above the trench drains at the inlets to the existing MFDs.
- Basin W1:
    - Replaced galvanized downspouts on Warehouse 1 in August 2023.
    - Coat roof vents on portion of Warehouse 1
    - Add oyster shells to roof downspout MFUs in Basin W1

The layout of the proposed treatment improvements is shown on Figure 5. Notably, the Wharf Rehabilitation project would change the drainage basin boundary between Basin 1 (the wharf and pier) and Basin 2 (Warehouse 1 and nearby upland area). As part of that project, a portion of Basin 1 that currently drains to the edge of the wharf, and is represented by monitoring location B1D, would be sloped to drain back to the new stormwater conveyance system and would be treated by the Aquip media filter.

4.2 Treatment System Information

The following subsections provide detail on the proposed stormwater treatment improvements.

4.2.1 Basin 2 and Portion of Basin 1:

The Wharf Rehabilitation project will replace the stormwater collection and conveyance system and add stormwater treatment with a Newterra Aquip media filter to treat runoff from all of Basin 2 and a portion of Basin 1.

The Wharf Rehabilitation project will raise the grade at the western edge of 125 feet of the wharf (known as the "heavy lift area") by 18 inches and will slope that portion of the wharf to drain back to a replaced stormwater collection and conveyance system installed in the upland in Basin 2. The existing drainage system in Basin 2 will be largely demolished, except for the roof downspouts and related conveyance, and the outfall pipe. The existing roof downspout MFUs may be removed to reduce ongoing maintenance needs as the Aquip provides superior treatment.

The new collection and conveyance system is shown on Figure 5, and additional details are provided in stormwater-related excerpts from the engineering plans by Moffat and Nichol (2023) in Appendix D. A process flow diagram for the treatment system is shown on Figure 6. The new system will consist of the following components:

- Four 48-inch-diameter Type 2 catch basins with grated lids to collect stormwater.
- Two Type 2 catch basins of varying diameter with solid lids, located at junctions with the existing roof downspout conveyance pipes.
- A stormwater lift station in a 72-inch Type 3 manhole structure to lift stormwater for treatment. The lift station has a single sump pump (2 HP, 230V, 3-Phase Goulds Model WS2032D3) capable of conveying 160 gpm to the Aquip media filter.
- A 72-inch Type 2 junction manhole with solid lid that combines the treated discharge from the Aquip unit with any overflow from the lift station and conveys both to the outfall.
- A 48-inch Type 2 catch basin with solid lid to tie into the existing 24-inch outfall pipe.

The lift station discharges flow through a 4-inch ductile iron force main to a Newterra Aquip 160SBE media filter installed aboveground inside Warehouse 1. The lift station is designed to incorporate stormwater from a future wharf repaving project on the northwestern portion of Basin 1 and a portion of the Warehouse 1 roof, totaling 1.44 additional acres. These areas are incorporated to the design treatment flow rate of 140 gpm documented in Section 3.2. The capacity of the Aquip unit is 160 gpm, which exceeds the design treatment flow rate. Prior to the repaving project, the lift station and treatment system will function at 160 gpm, resulting in treatment of larger storm events than would be required for the 2.46-acre tributary area related to the Wharf Rehabilitation project.

The Aquip 160SBE unit is a passive adsorptive media filtration technology designed specifically for reduction of stormwater pollutants, such as suspended solids, turbidity, heavy metals, nutrients, and organics from industrial sites. The Aquip 160SBE is a skid-mounted rectangular steel open-topped tank that is approximately 8 feet wide by 25 feet long by 8 feet tall.

The Aquip technology uses a pretreatment chamber followed by a series of inert and adsorptive filtration media to effectively trap pollutants. Pollutant removal within the pretreatment chamber occurs by gravity settling; pollutant removal within the filtration chamber occurs through a combination of chemical complexing, coprecipitation, adsorption, absorption, microsedimentation, filtration, and biological degradation.

Aquip features and operation throughout the treatment system are described below:

1. **Inlet Piping**: Untreated stormwater will be pumped into the Aquip inlet pipe from the lift station. An inline electromagnetic flowmeter will monitor the flow into the system and record the total volume of water treated by the Aquip. The inlet piping will also include a flow control valve that will be used to calibrate the proper flow rate into the Aquip and inlet sample port.

2. **Pretreatment Chamber**: The pretreatment chamber is configured to settle coarse solids and condition the stormwater for dissolved metals removal. Aquip uses a passive pH buffering process. The buffered water helps positively charged metallic ions find negatively charged alkalinity compounds. Some of these positive and negative ions form insoluble complexes that are removed in the filtration chamber. Within the Aquip filtration treatment chamber some of the metals are removed as precipitates by microsedimentation. Because of the low alkalinity common to most stormwater, particularly those from facilities where most of the surface is paved, the pH buffering effect is temporary.

3. **Inlet Distributor**: Water from the pretreatment chamber will flow into the inlet distributor and will be dispersed in a perforated pipe along the full length of the filter media bed optimizing the contact area of stormwater with filtration media. Energy dissipation fabric beneath the distributor will prevent scouring of the media bed.

4. **Filtration Treatment**: Layers of inert and adsorptive media make up the media bed that filters out stormwater pollutants, such as metals and particulates. Within the filtration chamber, pollutant removal occurs through a combination of straining, filtration, complexing, adsorption, absorption, microsedimentation, and biological degradation, producing excellent water quality. Once filtered through the media bed, stormwater will flow into the underdrain located along the bottom of the media bed. The filter bed will drain down between storm events. Integrated ladders, filter maintenance tools and an external filter bed drain-down valve allow routine maintenance to be performed without the need for special equipment.

5. **Outlet Manifold**: Treated stormwater leaving the filter bed will pass through the adjustable head control. The adjustable head control sets the minimum hydraulic gradient through the filter bed to assure optimal water-filter media contact under a range of operating conditions.

6. **Emergency Overflow:** An upturned elbow will provide an emergency overflow to bypass stormwater if the media bed is not draining at a rate that keeps pace with the influent design flow rate of 160 gpm. A passive overflow indicator on the outside of the Aquip tank will visually indicate when an emergency overflow has occurred. After each overflow event, this feature will be reset by releasing the water stored inside the overflow indicator by turning the petcock valve at the bottom of the device.

7. **Outlet Sample Port**: Stormwater samples will be collected from the sample tap installed on the outlet manifold, which will provide safe and easy access to system effluent.

8. **Outlet**: Treated stormwater will discharge by gravity from the Aquip unit through aboveground 6-inch-diameter PVC piping that transitions to below-grade 6-inch diameter ductile iron piping. The discharge piping flows to the 72-inch junction manhole, where it joins any overflow from the lift station, then to another junction manhole and out existing outfall B2A.

4.2.2 Remainder of Basin 1 with Industrial Activity

Several media filter baskets (Image 2) are installed at the edge of wharf within the Wharf Rehabilitation project area. As the Wharf Rehabilitation project will change the slope of the wharf to drain away from the edge, those treatment baskets are no longer necessary in their current locations. Those media filter baskets would be relocated to other areas within Basin 1 to provide additional treatment.

Image 2. Media filter basket installed at edge of BST Wharf.

In addition, the frequency of vacuum sweeping within the remainder of Basin 1 was increased to weekly as part of a Level 1 Corrective Action in response to the exceedances in 2023 and will remain at weekly, even with the cessation of the existing scrap metal handling operation.

No treatment improvements are proposed for the south pier and the farthest north end of the wharf, where no marine cargo handling activity occurs. These areas are used for moorage/berthing of ships or are little used.

4.2.3 Basin 4 and Substantially Identical Basins 3A, 3B, and 3C

Biochar filter socks would be installed on top of or inside the trench drain trenches at the inlets to each of the MFDs in Basins 4, 3A, 3B, and 3C. A photo of the trench drain trench for the MFD in Basin 4 is shown in Image 3; similar trenches are present at the inlets to other MFDs.

Image 3. Trench drain at the inlet to the MFD in Basin 4. *Biochar filter socks would be installed either along the outside edge of the grate, or under the grate inside the concrete trough of the trench drain.*

Based on engineering plans by Kennedy Jenks (2016, 2018), the trench drains have the following lengths:

- Basin 4: 100 feet

- Basin 3A: 25 feet
- Basin 3B: 35 feet
- Basin 3C: 38 feet
- Total: 198 feet

Biochar filter socks cost approximately $13 per foot, so installing biochar filter socks the full length of each trench drain would cost approximately $2,500. Product information from StormwaterBiochar.com for biochar filter socks product information is included in Appendix E.

4.2.4 Basin W1

After replacement of galvanized downspouts and coating of the roof vents on the northwest side of Warehouse 1, oyster shells would be added to the existing roof downspouts MFUs to enhance settling and slightly raise the pH of influent stormwater. Approximately 3 inches of oyster shells would be added to the MFUs. The oyster shells would be added on top of the existing filtration media and mulch.

A diagram of the existing roof downspout MFUs from the engineering plans prepared by Kennedy Jenks (2016) is shown on Figure 7.

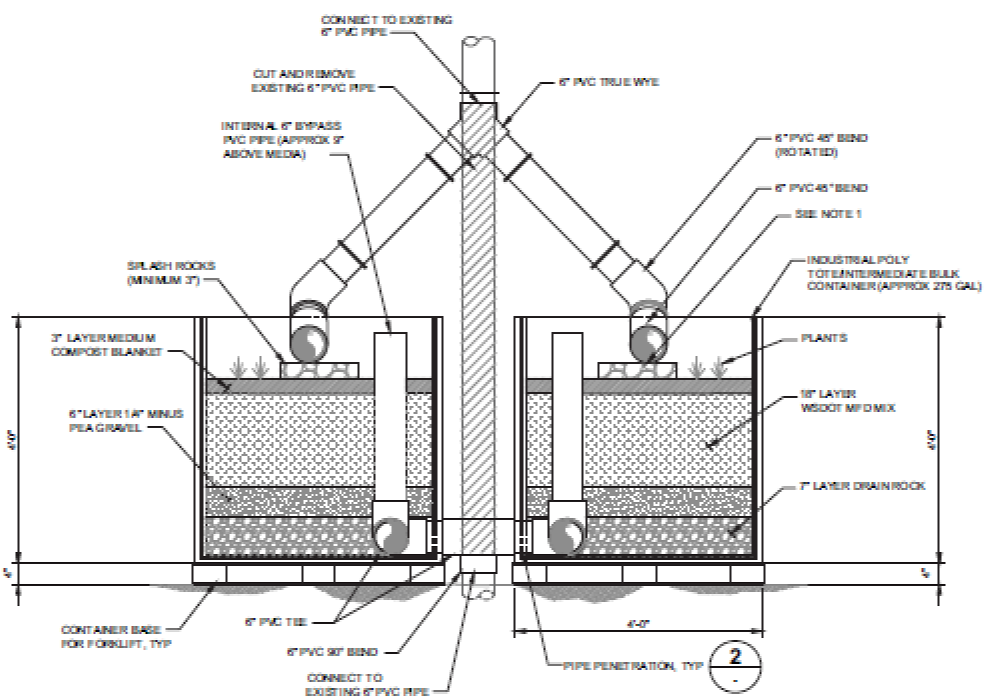


Figure 7. Existing Roof Downspout MFUs on Warehouse 1.

4.3 Amount and Type of Chemical Used in Treatment Process

None—the proposed treatment improvements do not include chemical addition.

4.4 Provisions for Emergency Overflow

Provisions for emergency overflow vary depending on the nature and location of the treatment system as follows:

- Wharf Rehabilitation project: the Aquip treatment system includes two provisions for emergency overflow:
    1) The lift station includes a 24-inch-diameter pipe installed 6.73 feet above the bottom of the structure. Flows exceeding the capacity of the pumps will flow out this pipe to a junction structure and then the outfall B2A.
    2) The Aquip media filter has an emergency overflow pipe in case the treatment media becomes plugged and cannot keep up with the influent flow from the pump station. The overflow pipe is tied into the gravity discharge from the filter, which connects to the junction structure downstream of the pump station and flows to outfall B2A.
- Roof Downspout MFUs: Each MFU has a 6-inch-diameter overflow riser. The rim of the riser is about 9 inches above the treatment media. Flows exceeding the design flow rate for the unit enter the overflow riser and are conveyed to the outfall. No changes are proposed to the MFU emergency overflows.
- Basin 3 and 4 MFDs: Each MFD includes an outlet riser with an open top protected by a “bird cage” style trash rack. Flows exceeding the design treatment rate pond on the surface of the MFD, then overflow into the outlet riser and out the outfall. No changes are proposed to the MFD emergency overflows.
- Basin 1 media filter baskets: Flows exceeding the capacity of the media filter basket overflow the basket rim and fall to the waterway below, similar to sheet flow from the edge of a pier.

4.5 Constituent Removal and Disposal

The primary constituents requiring disposal will be (1) solids and debris removed from the treatment devices and (2) spent treatment media, including biochar filter socks, oyster shells, and Aquip treatment media. Solids and spent media will be characterized and disposed off-site, in accordance with all applicable local, state, and federal regulations.

4.6 Anticipated Performance

Based on the cessation of existing scrap metal cargo handling at the facility, stormwater concentrations prior to construction of the proposed treatment improvements are expected to generally meet benchmark, as they did prior to fourth quarter of 2022. With the stormwater treatment improvements proposed in this Engineering Report, including the substantial investment in the Aquip media filtration for the Wharf Rehabilitation project area, stormwater concentrations at BST are anticipated to meet all applicable benchmarks and effluent limits of the ISGP.

4.6.1 Compliance with Water Quality Management Plans

There are no local, state, or federal water quality management plans applicable to surface waters of Bellingham Bay or Whatcom Waterway. As described in Section 2.7, there are two Cleanup Action Plans and a TMDL that apply to sediments adjacent to BST. The proposed treatment improvements are consistent with these plans. The TMDL addresses stormwater sources, but does not include a load allocation specific to BST.

4.7 Operation and Maintenance

The treatment improvements will be owned and operated by the Port. The Port would designate and train employees on the operation and maintenance of Newterra Aquip treatment system, and maintenance of the other treatment improvements.

The primary operation and maintenance (O&M) requirements are:

- Monthly inspections of treatment BMPs
- Solids management and disposal
- Raking of surface of Aquip media surface
- Periodic replacement of biochar filter socks
- Routine maintenance of pumps and valves

An O&M manual will be developed for the Aquip treatment system by construction contractor. O&M requirements for the other treatment improvements will be added to the facility SWPPP.

4.8 Monitoring Locations

Four changes are anticipated to the monitoring program as a result of the Level 3 Corrective Action:

1) Once construction is complete on the Wharf Rehabilitation project, outfall B1D and its related monitoring point will no longer exist. Stormwater from this area will drain to monitoring point and outfall B2A.
2) Monitoring Point B1C will be moved south to be closer to area where most cargo handling activity occurs and will represent discharge through the media filter baskets.
3) Monitoring Point B2A will be moved to the new junction manhole downstream of the lift station.
4) Based on feedback from Ecology provided in May 2024, monitoring will begin at either B3A, B3B, or B3C. The two points not selected will be considered substantially identical to the selected point. The Port may also elect to cease monitoring at B4A and consider it substantially identical to the new Basin 3

monitoring point, or continue monitoring if the Port anticipates changing activities in Basin 4.

The Port will submit an Update Sample/Discharge Point Form to start monitoring B3A, B3B, or B3C beginning in third quarter 2024. Once construction of the Level 3 Corrective Action is completed, the Port will submit a second Update Sample/Discharge Point Form to update the monitoring locations as described above. No changes are proposed for current ISGP monitoring points W1C and B3F.

When sampling at monitoring point B2A, the Port will first observe if overflow from the lift station is occurring and, if not, the Port may elect to sample from the effluent sampling port on the Aquip unit for safety and convenience. If overflow is occurring, the sample should be collected from the junction manhole to represent the combination of treated effluent and overflow from the pump station.

5 Implementation Schedule

The schedule for implementation of the proposed structural source control and treatment BMPs to complete the Level 2 and Level 3 Corrective Actions at BST are identified in Table 6.

The Port applied for a Modification of Coverage to extend the schedule for implementing the Level 2 and Level 3 Corrective Actions on April 16, 2024. As of the deadline for submittal of the Engineering Report, Ecology's decision on the schedule extension is still pending.

Table 6. Implementation Schedule

Action	Duration	Schedule
Submit Engineering Report		**15-May-24**
Scrap Metal Cargo Handling Ceases at BST		*30-Jun-24*
Ecology Review	60 days	*14-Jul-24*
Review and resubmit (if necessary)	15 days	*29-Jul-24*
Ecology Review (if needed)	15 days	*13-Aug-24*
Construct Level 3 Corrective Action:		
W1 Treatment	~1.5 months	**30-Sep-24**
B1C Treatment	~3 months	**15-Nov-24**
B4A and Substantially Identical Treatment	~3 months	**15-Nov-24**
B1D and B2A Treatment:		
Construct stormwater system and electrical	40 days	*12-Jul-24*
Construction contingency	6 months	*12-Jan-25*
System online, treating Basin 2 and Roof of Warehouse 2		**12-Jan-25**
Pier demolition, replacement, and upland paving (Industrial activity returns to remainder of subbasin)	270 days	*14-May-25*
Construction contingency	~4.5 months	*30-Sep-25*
Annual Status Report (as component of ISGP annual report)		**15-May-25**
Level 3 Corrective Action Completed		**30-Sep-25**

6 References

Kennedy Jenks, 2016, Port of Bellingham, Bellingham Shipping Terminal, Site Resurfacing and Stormwater Treatment Improvements, 23 sheets, Dated September 22, 2016.

Moffatt & Nichol, 2023, Port of Bellingham, Bellingham Shipping Terminal, Marine Infrastructure and Dredging Engineering Plans, 72 sheets, Dated July 12, 2023.

Port of Bellingham, 2024, News Flash: Port Approves Lease Termination Agreement with ABC Recycling due to Environmental Concerns, March 25, 2024, https://www.portofbellingham.com/CivicAlerts.aspx?AID=416. Accessed on 4/18/2024.

StormwaterBiochar.com, 2024. Biochar Filter Socks, https://stormwaterbiochar.com/systems/filtration-bags/, Accessed on 4/1/2024.

Washington State Department of Ecology (Ecology), 2003, Inner Bellingham Bay Contaminated Sediments Total Maximum Daily Load. Detailed Implementation Plan. Pub No. 03-10-057. June 2003.

Washington State Department of Ecology (Ecology), 2013, Guidelines for the Preparation of Industrial Stormwater General Permit Engineering Reports, Publication no. 13-10-007. Water Quality Program, Washington State Department of Ecology, Olympia, WA, February 2013.

Washington State Department of Ecology (Ecology), 2014, Expanded Approval of CESF Treatment Using Liquifloc 1% to Allow Addition of BHR-P50, August 28,2014.

Washington State Department of Ecology (Ecology), 2017, Use Designations for Erosion and Sedimetn Control for Chitosan-Enhanced Sand Filtration using 1.0% ChitoVan™ chitosan acetate solution, February 2017.

Washington State Department of Ecology (Ecology), 2019, Stormwater Management Manual for Western Washington, Pub. No. 19-10-021, July 2019.

Washington State Department of Ecology (Ecology), 2023, General Use Level Designation for Erosion and Sediment Control for WaterTectonics' WaveIonics™ Electrocoagulation Subtractive Technology (ECST), April 2023.

Washington State Department of Ecology (Ecology), 2024a, General Use Level Designation for Basic(TSS), Metals and Phosphorus Treatment for Contech Engineered Solutions, LLC (Contech) Modular Wetlands Linear, January 2024.

Washington State Department of Ecology (Ecology), 2024b, General Use Level Designation for Basic, Metals and Phosphorus Treatment for StormwateRx, LLC Aquip Enhanced Stormwater Filtration System, January 2024.

Washington State Department of Ecology (Ecology), 2020, Industrial Stormwater General Permit, Washington State Department of Ecology, Olympia, WA.

WaterTectonics, 2019, Electrocoagulation Performance Data – Heavy Metals. http://www.watertectonics.com/wp-content/uploads/2015/12/WaveIonics-Heavy-Metals-Performance-Data.pdf

Washington State Department of Transportation (WSDOT), Hydraulics Manual, M 23-03.06. April 2019.

7 Limitations

Work for this project was performed for the Port of Bellingham (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

FIGURES

Site Vicinity Map

BST Engineering Report
Port of Bellingham
Bellingham, WA

Aspect CONSULTING	APR-2024	BY: OGR / HMD	FIGURE NO.
	PROJECT NO. 190345	REVISED BY: - - - / - - -	1

Data source credits: None || Basemap Service Layer Credits: Esri, NASA, NGA, USGS, FEMA, Esri, CGIAR, USGS, City of Bellingham, Whatcom County, WA State Parks GIS, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, USFWS, City of Bellingham, Whatcom County, WA State Parks GIS, Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, USFWS, NRCan, Parks Canada, Esri, HERE, Garmin, USGS, EPA, NPS

GIS Path: G:\projects\Port of Bellingham_SWSupport_190345\Project\BST_Level3ExtensionRequest\ProProject\BST_SWPPP.aprx_01_Site Location Map || User: haleyduran || Print Date: 5/14/2024

Facility Stormwater Map

BST Engineering Report
Port of Bellingham
Bellingham, Washington

Aspect CONSULTING	APR-2024	BY: OGR / WBL	FIGURE NO. 2
	PROJECT NO. AS190345	REVISED BY: HMD	

Data source credits: None || Basemap Service Layer Credits: NA

GIS Path: G:\projects\Port_of_Bellingham_SWSupport_190345\Project_BST_Level3ExtensionRequest\ProProject_BST_SWPPP.aprx: 02 - Facility Stormwater Map || User: haley.duran || Print Date: 5/14/2024

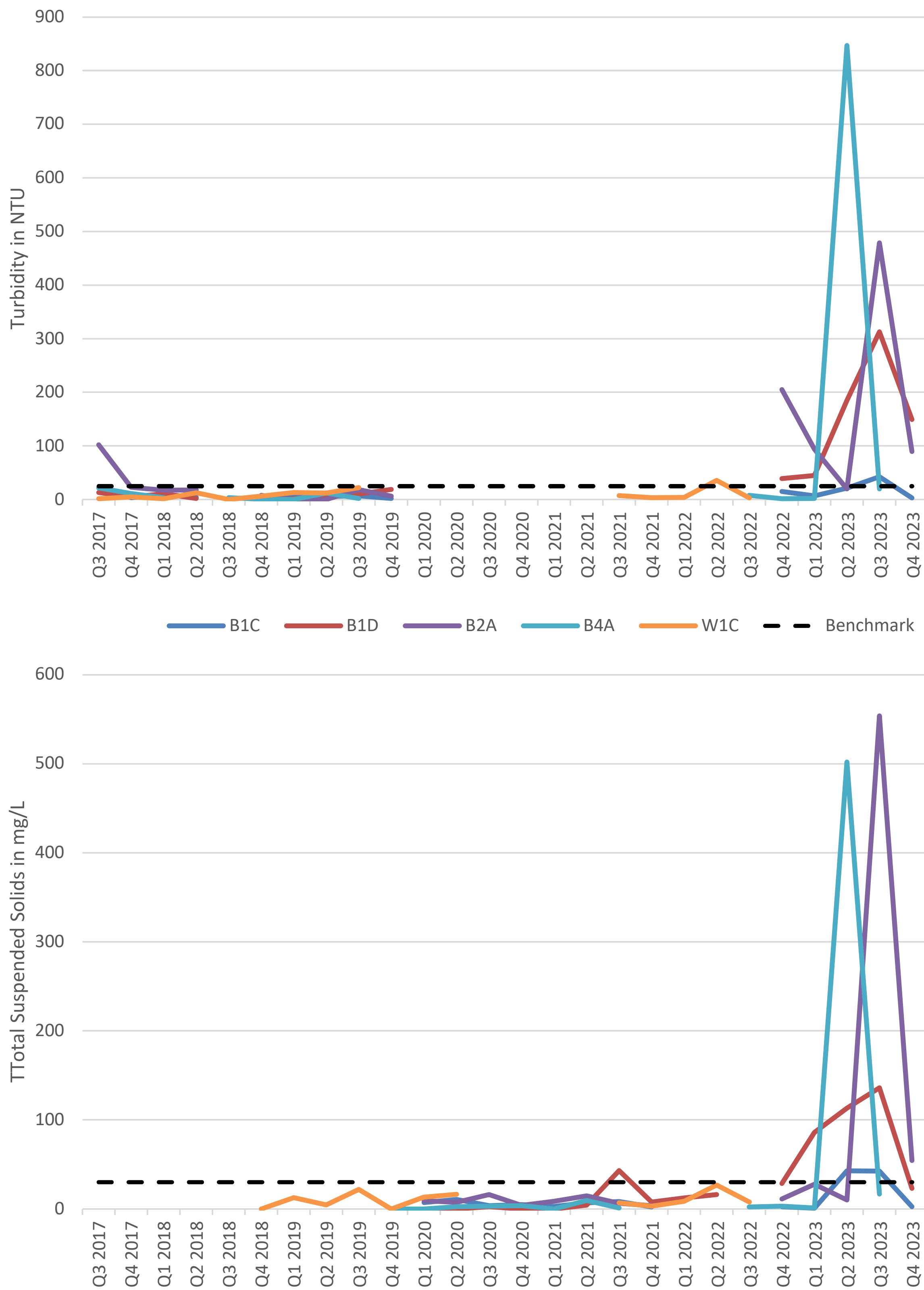


Figure 3

Turbidity and TSS Concentrations over Time

BST Engineering Report

Project No. AS190345A

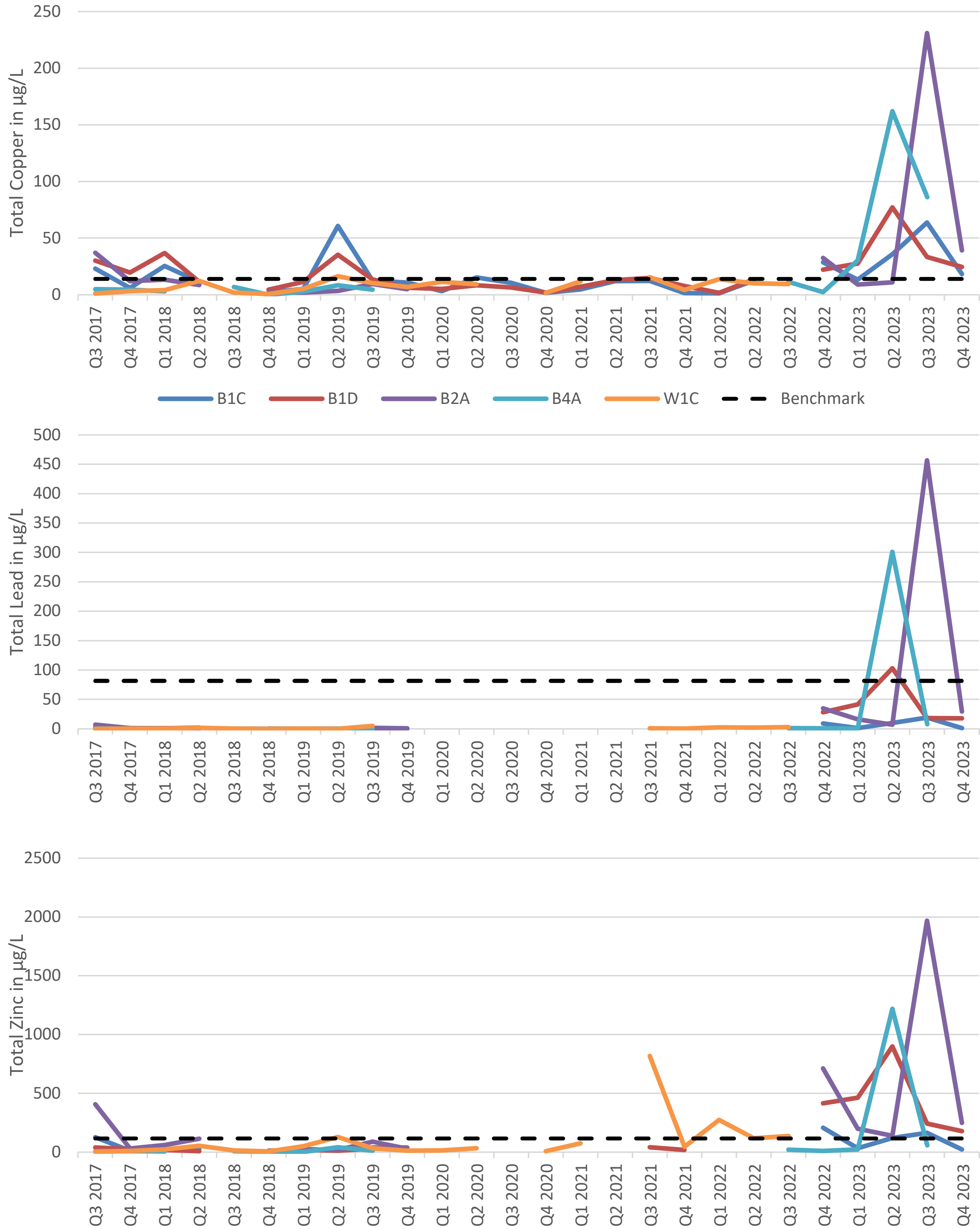


Figure 4

Total Metals Concentrations over Time

Aspect Consulting

4/29/2024

BST Engineering Report

S:\Port of Bellingham\NPDES Permit Support 190345\Report Drafts\BST 2024 Engineering Report\BST WQ_r1.xlsx

Project No. AS190345A

Outfall
Sampling Location
Existing Roof Downspout Treatment
Existing Media Filter Box
Existing Media Filter Drain
Stormwater Pipe
Catch Basin
Lift Station
Manhole
Aquip Treatment Unit
Pier Replacement Project Area
Additional Area for Treatment Improvements
Not Part of Level 3
Stormwater Basin
Approximate ISGP Boundary

0 100 200 Feet

Proposed Stormwater Treatment System

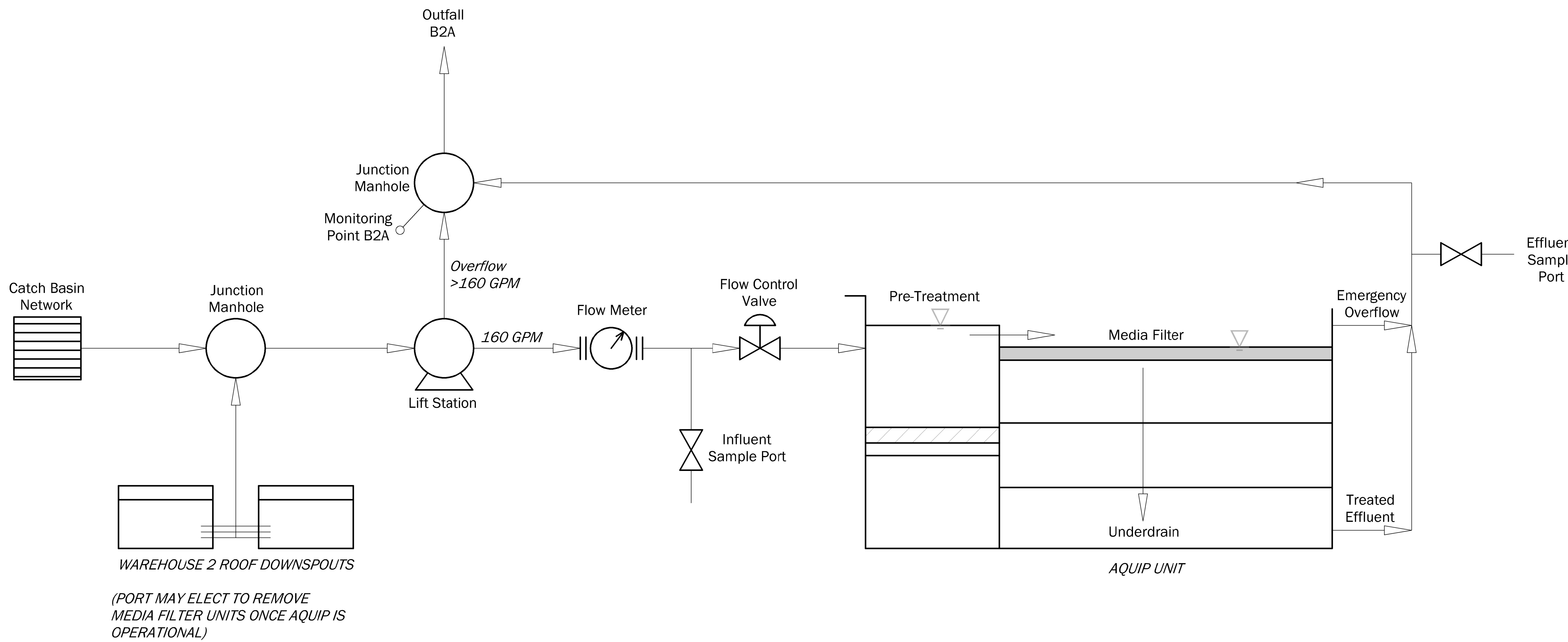
BST Engineering Report
Port of Bellingham
Bellingham, Washington

Aspect CONSULTING

APR-2024	BY: OGR / WBL	FIGURE NO.
PROJECT NO. AS190345	REVISED BY: HMD	5

GIS Path: G:\projects\Port_of_Bellingham_SWSupport_190345\Project\BST_Level3ExtensionRequest\ProProject\BST_SWPPP.aprx: 05 - Proposed Stormwater Treatment System | | User: haley.duran | | Print Date: 5/14/2024

Data source credits: None | | Basemap Service Layer Credits: NA



Legend

- Proposed System Components
- Proposed Stormwater Flow Paths

Treatment Process flow Diagram

BST Engineering Report
Port of Bellingham
Bellingham, Washington

Aspect CONSULTING	May-2024	BY: OGR/CMV	FIGURE NO. 6
	PROJECT NO. AS190345-001	REVISED BY: -	

APPENDIX A

Crosswalk with WAC 173-240 Requirements

Table A-1. Crosswalk with WAC 173-240 Requirements

WAC 173-240-130(2) Section	Summary of Requirement	Section in Engineering Report
a	Type of industry or business	2.2 and 2.3
b	Kind and quantity of finished product	3
c	Quantity and quality of water used by the industry and a description of how it is consumed or disposed of	2.5 and 3.2
d	Amount and kind of chemicals used in the treatment process, if any	4.3
e	Basic design data and sizing calculations of the treatment units	4.2
f	Discussion of the suitability of the proposed site for the facility	4.2
g	Description of the treatment process and operation, including a flow diagram	4.1, 4.2, and Figure 6
h	All necessary maps and layout sketches	Figures 1,2,3,6, and Appendix D
I	Provisions for bypass, if any	4.4
j	Physical provision for oil and hazardous material spill control or accidental discharge prevention or both	4.2
k	Results to be expected from the treatment process including the predicted wastewater characteristics, as shown in the waste discharge permit, where applicable	4.6
l	A description of the receiving water, location of the point of discharge, applicable water quality standards, and how water quality standards will be met outside of any applicable dilution zone	Section 2.7; ISGP Engineering Reports not required to address meeting water quality standards
m	Detailed outfall analysis	2.7
n	The relationship to existing treatment facilities, if any	4.2
o	Where discharge is to a municipal sewerage system, a discussion of that system's ability to transport and treat the proposed industrial waste discharge without exceeding the municipality's allocated industrial capacity. Also, a discussion on the effects of the proposed industrial discharge on the use or disposal of municipal sludge;	N/A – discharge to a municipal sewer system is not proposed.
p	Where discharge is through land application, including seepage lagoons, irrigation, and subsurface disposal, a geohydrologic evaluation of factors such as: …	N/A – not required for ISGP Engineering Reports
q	A statement expressing sound engineering justification through the use of pilot plant data, results from other similar installations, or scientific evidence from the literature, or both, that the effluent from the proposed	4.6

WAC 173-240-130(2) Section	Summary of Requirement	Section in Engineering Report
	facility will meet applicable permit effluent limitations or pretreatment standards or both;	
r	A discussion of the method of final sludge disposal selected and any alternatives considered with reasons for rejection;	4.5
s	A statement regarding who will own, operate, and maintain the system after construction;	4.7
t	A statement regarding compliance with any state or local water quality management plan or any plan adopted under the Federal Water Pollution Control Act as amended;	4.6.1
u	Provisions for any committed future plans;	4.2
v	A discussion of the various alternatives evaluated, if any, and reasons they are unacceptable;	3.3, 3.4
w	A timetable for final design and construction;	5
x	A statement regarding compliance with the State Environmental Policy Act (SEPA) and the National Environmental Policy Act (NEPA), if applicable;	2.8
y	Additional items for a solid waste leachate treatment system	N/A – a solid waste leachate treatment system is not proposed

Notes
N/A – not applicable

APPENDIX B

Monitoring Data and Target Treatment System Performance

Table B-1. Monitoring Data and Target Treatment System Performance

Project No. AS190345A, Bellingham, Washington

Monitoring Point	Quarter	Sample Date	Monitoring Results				
			Turbidity in NTU	**Copper in µg/L**	**Lead in µg/L**	**Zinc in µg/L**	**TSS in mg/L**
		Benchmark	25	14	64.6	117	30
		10/21/22	25.2	65.5	9.1	209	
		10/30/22					2.3
		11/22/22		11.2			
	Q4 2022	12/10/22		8.8			
	Q1 2023	1/18/23	6.58	13.2	1.1	32.4	0.77
	Q2 2023	4/17/23	21.1	**35.7**	10.1	**120**	**42.7**
B1C	Q3 2023	9/23/23	**42.6**	**63.7**	19.4	**163**	**42.3**
	Q4 2023	10/24/23	3.06	**18.2**	1.1	22.5	2.3
	Number of Samples		5	7	5	5	5
	Median		21.1	**18.2**	9.1	**120**	2.3
	Maximum		**42.6**	**65.5**	19.4	**209**	**42.7**
	Median Target Removal		0%	23%		3%	0%
	Max Target Removal		41%	79%		44%	30%
		10/21/22	**70.8**	**40.6**	28.2	**414**	**52**
		11/22/22	**27.4**	**15.1**			26.3
	Q4 2022	12/10/22	19.3	10.8			6.8
		1/18/23	**59.9**	**31.6**	41.5	**463**	**94.7**
	Q1 2023	2/7/23	**29.7**	**23.3**			**77**
	Q2 2023	4/17/23	**185**	**77.1**	**103**	**899**	**113**
B1D	Q3 2023	9/23/23	**313**	**33.3**	18	**243**	**136**
	Q4 2023	10/24/23	**149**	**24.4**	17.9	**179**	23
	Number of Samples		8	8	5	5	8
	Median		**65.35**	**28**	28.2	**414**	**64.5**
	Maximum		**313**	**77.1**	**103**	**899**	**136**
	Median Target Removal		62%	50%		72%	53%
	Max Target Removal		92%	82%	0.372816	87%	78%
		10/21/22	**205**	**61.4**	**65**	**711**	
		10/30/22					11
		11/22/22		6.1	6.1		
	Q4 2022	12/10/22		**29.7**	33.7		
		1/18/23	**93.7**	8.9	16.3	**199.5**	27.65
	Q1 2023	2/7/23	**121**	3.2		**247**	15.3
	Q2 2023	4/17/23	19.9	10.9	7.1	**138**	9.8
B2A	Q3 2023	9/23/23	**479**	**231**	**457**	**1970**	**554**
	Q4 2023	10/24/23	**89.5**	**39.2**	29.5	**248**	**54.3**
	Number of Samples		6	8	7	6	6
	Median		**107.4**	**20.3**	29.5	**247.5**	21.5
	Maximum		**479**	**231**	**457**	**1970**	**554**
	Median Target Removal		77%	31%		53%	0%
	Max Target Removal		95%	94%	0.858643	94%	95%
	Q4 2022	10/30/22	7.79	11.3	1	20.4	2
	Q1 2023	1/18/23	1.47	2.3	0.82	9.5	3
	Q2 2023	4/17/23	2.09	**30.3**	0.4	21.6	1
	Q3 2023	9/23/23	**847**	**162**	**301**	**1220**	**502**
		10/24/23	**38**	**86.1**	7.8	58.7	16.5
B4A	Q4 2023	11/1/23	1.6				
	Number of Samples		6	5	5	5	5
	Median		4.94	**30.3**	1	21.6	3
	Maximum		**847**	**162**	**301**	**1220**	**502**
	Median Target Removal		0%	54%		0%	0%
	Max Target Removal		97%	91%	0.785382	90%	94%
		10/21/22		**45.2**		**818**	
		10/30/22	7.14		0.6		6.7
		11/22/22		2.2			
		12/10/22		6.3			
	Q4 2022	12/27/22		7.7			
	Q1 2023	1/18/23	3.19	4.1	0.29	45.2	3
	Q2 2023	4/17/23	3.84	13.6	2.3	**273**	8.3
W1C	Q3 2023	9/23/23	**35.7**	10.1	2.13	117	26.7
	Q4 2023	10/24/23	2.9	9.3	3	**136**	7.7
	Number of Samples		5	8	5	5	5
	Median		3.84	8.5	2.13	**136**	7.7
	Maximum		**35.7**	**45.2**	3	**818**	26.7
	Median Target Removal		0%	0%		14%	0%
	Max Target Removal		83%	89%		99%	81%

Notes:

Bold indicates concentration is above the benchmark value; however, benchmarks apply to quarterly averages, not individual sample results if more than one sample is collected in a calendar quarter.

mg/L - milligrams per liter, µg/L - micrograms per liter, NTU - Nephelometric Turbidity Unit

APPENDIX C

Hydrologic and Hydraulic Calculations

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	POB Shipping Terminal_90 percent design
Site Name:	Port of Bellingham
Site Address:	Bellingham Shipping Terminal
City:	5/19/202 RCW
Report Date:	2/6/2024
Gage:	Blaine
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.857
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year
Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

Landuse Basin Data
Predeveloped Land Use

Predeveloped

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	2.46
Impervious Total	2.46
Basin Total	2.46

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.44
Impervious Total	1.44
Basin Total	1.44

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Predeveloped

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	2.46
Impervious Total	2.46
Basin Total	2.46

Element Flows To:

Surface	Interflow	Groundwater

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	1.44
Impervious Total	1.44
Basin Total	1.44

Element Flows To:

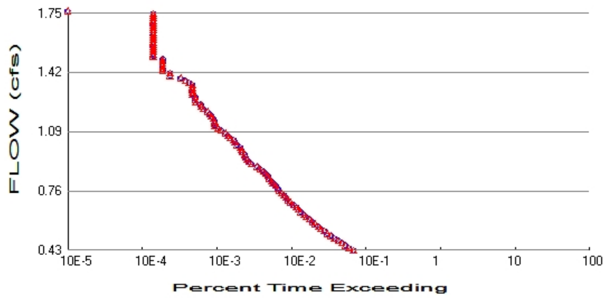
Surface	Interflow	Groundwater

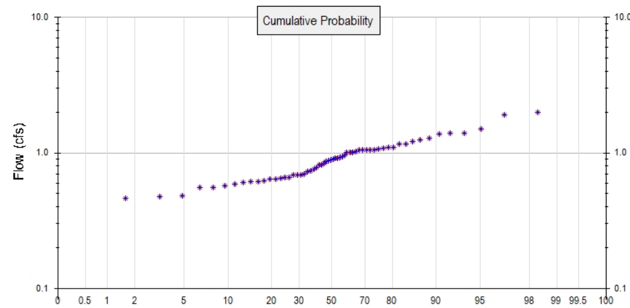
Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 2.46

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 2.46

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.855698
5 year	1.140783
10 year	1.330067
25 year	1.570459
50 year	1.750731
100 year	1.932247

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.855698
5 year	1.140783
10 year	1.330067
25 year	1.570459
50 year	1.750731
100 year	1.932247

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.651	0.651
1950	1.503	1.503
1951	0.615	0.615
1952	0.590	0.590
1953	0.689	0.689
1954	1.218	1.218
1955	0.811	0.811
1956	1.013	1.013
1957	1.049	1.049
1958	1.047	1.047

1959	0.643	0.643
1960	1.072	1.072
1961	0.482	0.482
1962	1.291	1.291
1963	1.105	1.105
1964	1.167	1.167
1965	1.377	1.377
1966	1.083	1.083
1967	0.776	0.776
1968	0.818	0.818
1969	0.740	0.740
1970	0.567	0.567
1971	0.557	0.557
1972	1.011	1.011
1973	0.556	0.556
1974	0.636	0.636
1975	0.756	0.756
1976	1.052	1.052
1977	1.908	1.908
1978	1.055	1.055
1979	1.056	1.056
1980	0.931	0.931
1981	1.249	1.249
1982	0.892	0.892
1983	0.626	0.626
1984	1.391	1.391
1985	0.874	0.874
1986	1.395	1.395
1987	1.094	1.094
1988	0.833	0.833
1989	1.980	1.980
1990	0.897	0.897
1991	0.696	0.696
1992	0.689	0.689
1993	0.660	0.660
1994	0.478	0.478
1995	0.611	0.611
1996	1.007	1.007
1997	0.941	0.941
1998	0.461	0.461
1999	0.963	0.963
2000	0.722	0.722
2001	1.024	1.024
2002	0.687	0.687
2003	0.661	0.661
2004	1.155	1.155
2005	0.863	0.863
2006	0.909	0.909
2007	0.917	0.917
2008	0.450	0.450
2009	0.605	0.605

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	1.9797	1.9797
2	1.9079	1.9079
3	1.5031	1.5031

4	1.3950	1.3950
5	1.3912	1.3912
6	1.3766	1.3766
7	1.2913	1.2913
8	1.2492	1.2492
9	1.2183	1.2183
10	1.1670	1.1670
11	1.1550	1.1550
12	1.1046	1.1046
13	1.0944	1.0944
14	1.0830	1.0830
15	1.0723	1.0723
16	1.0555	1.0555
17	1.0550	1.0550
18	1.0525	1.0525
19	1.0493	1.0493
20	1.0470	1.0470
21	1.0237	1.0237
22	1.0127	1.0127
23	1.0108	1.0108
24	1.0074	1.0074
25	0.9635	0.9635
26	0.9413	0.9413
27	0.9310	0.9310
28	0.9174	0.9174
29	0.9094	0.9094
30	0.8970	0.8970
31	0.8922	0.8922
32	0.8739	0.8739
33	0.8629	0.8629
34	0.8328	0.8328
35	0.8182	0.8182
36	0.8109	0.8109
37	0.7758	0.7758
38	0.7565	0.7565
39	0.7397	0.7397
40	0.7223	0.7223
41	0.6956	0.6956
42	0.6892	0.6892
43	0.6890	0.6890
44	0.6871	0.6871
45	0.6608	0.6608
46	0.6601	0.6601
47	0.6511	0.6511
48	0.6426	0.6426
49	0.6360	0.6360
50	0.6261	0.6261
51	0.6155	0.6155
52	0.6110	0.6110
53	0.6050	0.6050
54	0.5905	0.5905
55	0.5674	0.5674
56	0.5566	0.5566
57	0.5558	0.5558
58	0.4816	0.4816
59	0.4776	0.4776
60	0.4611	0.4611
61	0.4496	0.4496

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.4278	1442	1442	100	Pass
0.4412	1257	1257	100	Pass
0.4546	1134	1134	100	Pass
0.4679	1015	1015	100	Pass
0.4813	899	899	100	Pass
0.4947	804	804	100	Pass
0.5080	722	722	100	Pass
0.5214	646	646	100	Pass
0.5347	587	587	100	Pass
0.5481	526	526	100	Pass
0.5615	488	488	100	Pass
0.5748	442	442	100	Pass
0.5882	408	408	100	Pass
0.6016	372	372	100	Pass
0.6149	336	336	100	Pass
0.6283	314	314	100	Pass
0.6416	285	285	100	Pass
0.6550	264	264	100	Pass
0.6684	247	247	100	Pass
0.6817	226	226	100	Pass
0.6951	206	206	100	Pass
0.7085	192	192	100	Pass
0.7218	181	181	100	Pass
0.7352	169	169	100	Pass
0.7485	156	156	100	Pass
0.7619	145	145	100	Pass
0.7753	140	140	100	Pass
0.7886	130	130	100	Pass
0.8020	120	120	100	Pass
0.8154	115	115	100	Pass
0.8287	107	107	100	Pass
0.8421	102	102	100	Pass
0.8554	96	96	100	Pass
0.8688	89	89	100	Pass
0.8822	80	80	100	Pass
0.8955	74	74	100	Pass
0.9089	62	62	100	Pass
0.9223	57	57	100	Pass
0.9356	54	54	100	Pass
0.9490	52	52	100	Pass
0.9623	51	51	100	Pass
0.9757	46	46	100	Pass
0.9891	45	45	100	Pass
1.0024	44	44	100	Pass
1.0158	40	40	100	Pass
1.0292	37	37	100	Pass
1.0425	36	36	100	Pass
1.0559	32	32	100	Pass
1.0692	30	30	100	Pass
1.0826	28	28	100	Pass
1.0960	24	24	100	Pass
1.1093	22	22	100	Pass
1.1227	20	20	100	Pass

1.1361	20	20	100	Pass
1.1494	20	20	100	Pass
1.1628	19	19	100	Pass
1.1761	18	18	100	Pass
1.1895	17	17	100	Pass
1.2029	16	16	100	Pass
1.2162	14	14	100	Pass
1.2296	13	13	100	Pass
1.2430	13	13	100	Pass
1.2563	11	11	100	Pass
1.2697	11	11	100	Pass
1.2830	11	11	100	Pass
1.2964	10	10	100	Pass
1.3098	10	10	100	Pass
1.3231	10	10	100	Pass
1.3365	10	10	100	Pass
1.3499	10	10	100	Pass
1.3632	9	9	100	Pass
1.3766	8	8	100	Pass
1.3899	7	7	100	Pass
1.4033	5	5	100	Pass
1.4167	5	5	100	Pass
1.4300	4	4	100	Pass
1.4434	4	4	100	Pass
1.4568	4	4	100	Pass
1.4701	4	4	100	Pass
1.4835	4	4	100	Pass
1.4968	4	4	100	Pass
1.5102	3	3	100	Pass
1.5236	3	3	100	Pass
1.5369	3	3	100	Pass
1.5503	3	3	100	Pass
1.5637	3	3	100	Pass
1.5770	3	3	100	Pass
1.5904	3	3	100	Pass
1.6037	3	3	100	Pass
1.6171	3	3	100	Pass
1.6305	3	3	100	Pass
1.6438	3	3	100	Pass
1.6572	3	3	100	Pass
1.6706	3	3	100	Pass
1.6839	3	3	100	Pass
1.6973	3	3	100	Pass
1.7106	3	3	100	Pass
1.7240	3	3	100	Pass
1.7374	3	3	100	Pass
1.7507	3	3	100	Pass

Water Quality

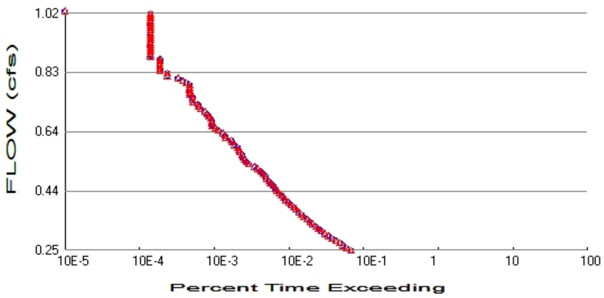
Water Quality BMP Flow and Volume for POC #1

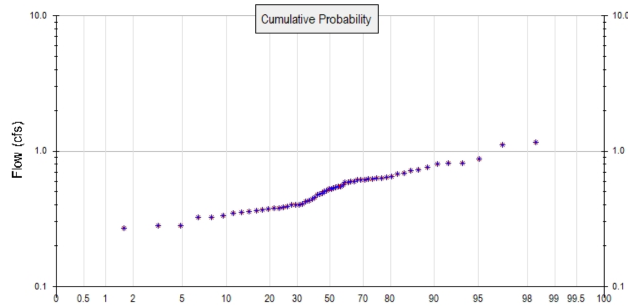
On-line facility volume:	0.2529 acre-feet
On-line facility target flow:	0.3494 cfs.
Adjusted for 15 min:	0.3494 cfs.
Off-line facility target flow:	0.1969 cfs.
Adjusted for 15 min:	0.1969 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

POC 2





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #2
Total Pervious Area: 0
Total Impervious Area: 1.44

Mitigated Landuse Totals for POC #2
Total Pervious Area: 0
Total Impervious Area: 1.44

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	**Flow(cfs)**
2 year	0.500896
5 year	0.667775
10 year	0.778575
25 year	0.919292
50 year	1.024817
100 year	1.131071

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	**Flow(cfs)**
2 year	0.500896
5 year	0.667775
10 year	0.778575
25 year	0.919292
50 year	1.024817
100 year	1.131071

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #2

Year	**Predeveloped**	**Mitigated**
1949	0.381	0.381
1950	0.880	0.880
1951	0.360	0.360
1952	0.346	0.346
1953	0.403	0.403
1954	0.713	0.713
1955	0.475	0.475
1956	0.593	0.593
1957	0.614	0.614
1958	0.613	0.613
1959	0.376	0.376

1960	0.628	0.628
1961	0.282	0.282
1962	0.756	0.756
1963	0.647	0.647
1964	0.683	0.683
1965	0.806	0.806
1966	0.634	0.634
1967	0.454	0.454
1968	0.479	0.479
1969	0.433	0.433
1970	0.332	0.332
1971	0.326	0.326
1972	0.592	0.592
1973	0.325	0.325
1974	0.372	0.372
1975	0.443	0.443
1976	0.616	0.616
1977	1.117	1.117
1978	0.618	0.618
1979	0.618	0.618
1980	0.545	0.545
1981	0.731	0.731
1982	0.522	0.522
1983	0.367	0.367
1984	0.814	0.814
1985	0.512	0.512
1986	0.817	0.817
1987	0.641	0.641
1988	0.487	0.487
1989	1.159	1.159
1990	0.525	0.525
1991	0.407	0.407
1992	0.403	0.403
1993	0.386	0.386
1994	0.280	0.280
1995	0.358	0.358
1996	0.590	0.590
1997	0.551	0.551
1998	0.270	0.270
1999	0.564	0.564
2000	0.423	0.423
2001	0.599	0.599
2002	0.402	0.402
2003	0.387	0.387
2004	0.676	0.676
2005	0.505	0.505
2006	0.532	0.532
2007	0.537	0.537
2008	0.263	0.263
2009	0.354	0.354

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	1.1589	1.1589
2	1.1168	1.1168
3	0.8798	0.8798
4	0.8166	0.8166

5	0.8144	0.8144
6	0.8058	0.8058
7	0.7559	0.7559
8	0.7313	0.7313
9	0.7132	0.7132
10	0.6831	0.6831
11	0.6761	0.6761
12	0.6466	0.6466
13	0.6406	0.6406
14	0.6340	0.6340
15	0.6277	0.6277
16	0.6179	0.6179
17	0.6176	0.6176
18	0.6161	0.6161
19	0.6142	0.6142
20	0.6129	0.6129
21	0.5993	0.5993
22	0.5928	0.5928
23	0.5917	0.5917
24	0.5897	0.5897
25	0.5640	0.5640
26	0.5510	0.5510
27	0.5450	0.5450
28	0.5370	0.5370
29	0.5324	0.5324
30	0.5251	0.5251
31	0.5223	0.5223
32	0.5115	0.5115
33	0.5051	0.5051
34	0.4875	0.4875
35	0.4789	0.4789
36	0.4747	0.4747
37	0.4541	0.4541
38	0.4428	0.4428
39	0.4330	0.4330
40	0.4228	0.4228
41	0.4072	0.4072
42	0.4034	0.4034
43	0.4033	0.4033
44	0.4022	0.4022
45	0.3868	0.3868
46	0.3864	0.3864
47	0.3811	0.3811
48	0.3762	0.3762
49	0.3723	0.3723
50	0.3665	0.3665
51	0.3603	0.3603
52	0.3577	0.3577
53	0.3542	0.3542
54	0.3456	0.3456
55	0.3321	0.3321
56	0.3258	0.3258
57	0.3254	0.3254
58	0.2819	0.2819
59	0.2796	0.2796
60	0.2699	0.2699
61	0.2632	0.2632

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2504	1441	1441	100	Pass
0.2583	1259	1259	100	Pass
0.2661	1129	1129	100	Pass
0.2739	1018	1018	100	Pass
0.2817	906	906	100	Pass
0.2896	805	805	100	Pass
0.2974	726	726	100	Pass
0.3052	646	646	100	Pass
0.3130	579	579	100	Pass
0.3208	530	530	100	Pass
0.3287	489	489	100	Pass
0.3365	442	442	100	Pass
0.3443	408	408	100	Pass
0.3521	372	372	100	Pass
0.3600	337	337	100	Pass
0.3678	318	318	100	Pass
0.3756	287	287	100	Pass
0.3834	264	264	100	Pass
0.3912	247	247	100	Pass
0.3991	226	226	100	Pass
0.4069	211	211	100	Pass
0.4147	193	193	100	Pass
0.4225	181	181	100	Pass
0.4304	169	169	100	Pass
0.4382	156	156	100	Pass
0.4460	146	146	100	Pass
0.4538	140	140	100	Pass
0.4616	130	130	100	Pass
0.4695	120	120	100	Pass
0.4773	115	115	100	Pass
0.4851	106	106	100	Pass
0.4929	102	102	100	Pass
0.5007	96	96	100	Pass
0.5086	89	89	100	Pass
0.5164	81	81	100	Pass
0.5242	74	74	100	Pass
0.5320	61	61	100	Pass
0.5399	57	57	100	Pass
0.5477	54	54	100	Pass
0.5555	52	52	100	Pass
0.5633	51	51	100	Pass
0.5711	46	46	100	Pass
0.5790	45	45	100	Pass
0.5868	44	44	100	Pass
0.5946	40	40	100	Pass
0.6024	37	37	100	Pass
0.6103	36	36	100	Pass
0.6181	30	30	100	Pass
0.6259	30	30	100	Pass
0.6337	28	28	100	Pass
0.6415	24	24	100	Pass
0.6494	22	22	100	Pass
0.6572	20	20	100	Pass

0.6650	20	20	100	Pass
0.6728	20	20	100	Pass
0.6807	19	19	100	Pass
0.6885	18	18	100	Pass
0.6963	17	17	100	Pass
0.7041	16	16	100	Pass
0.7119	14	14	100	Pass
0.7198	13	13	100	Pass
0.7276	13	13	100	Pass
0.7354	11	11	100	Pass
0.7432	11	11	100	Pass
0.7511	11	11	100	Pass
0.7589	10	10	100	Pass
0.7667	10	10	100	Pass
0.7745	10	10	100	Pass
0.7823	10	10	100	Pass
0.7902	10	10	100	Pass
0.7980	9	9	100	Pass
0.8058	8	8	100	Pass
0.8136	7	7	100	Pass
0.8214	5	5	100	Pass
0.8293	5	5	100	Pass
0.8371	4	4	100	Pass
0.8449	4	4	100	Pass
0.8527	4	4	100	Pass
0.8606	4	4	100	Pass
0.8684	4	4	100	Pass
0.8762	4	4	100	Pass
0.8840	3	3	100	Pass
0.8918	3	3	100	Pass
0.8997	3	3	100	Pass
0.9075	3	3	100	Pass
0.9153	3	3	100	Pass
0.9231	3	3	100	Pass
0.9310	3	3	100	Pass
0.9388	3	3	100	Pass
0.9466	3	3	100	Pass
0.9544	3	3	100	Pass
0.9622	3	3	100	Pass
0.9701	3	3	100	Pass
0.9779	3	3	100	Pass
0.9857	3	3	100	Pass
0.9935	3	3	100	Pass
1.0014	3	3	100	Pass
1.0092	3	3	100	Pass
1.0170	3	3	100	Pass
1.0248	3	3	100	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume:	0.148 acre-feet
On-line facility target flow:	0.2045 cfs.
Adjusted for 15 min:	0.2045 cfs.
Off-line facility target flow:	0.1152 cfs.
Adjusted for 15 min:	0.1152 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

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       1948 10 01        END    2009 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   POB Shipping Terminal_90 percent design.wdm
MESSU      25   PrePOB Shipping Terminal_90 percent design.MES
           27   PrePOB Shipping Terminal_90 percent design.L61
           28   PrePOB Shipping Terminal_90 percent design.L62
           30   POCPOB Shipping Terminal_90 percent design1.dat
           31   POCPOB Shipping Terminal_90 percent design2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Predeveloped                MAX                    1    2   30    9
    2        Basin  2                    MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         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           ***
  END GEN-INFO
  *** Section PWATER***

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

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

```
  END PRINT-INFO

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

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  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
  END PWAT-STATE1

END PERLND

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

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   *********
    1         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     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
```

```
    # -  # ***  RETS      SURS
    1            0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Predeveloped***
IMPLND   1                        2.46     COPY   501     15
Basin  2***
IMPLND   1                        1.44     COPY   502     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
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     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    0.857          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.857          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           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
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    502 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  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       1948 10 01        END    2009 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   POB Shipping Terminal_90 percent design.wdm
MESSU      25   MitPOB Shipping Terminal_90 percent design.MES
           27   MitPOB Shipping Terminal_90 percent design.L61
           28   MitPOB Shipping Terminal_90 percent design.L62
           30   POCPOB Shipping Terminal_90 percent design1.dat
           31   POCPOB Shipping Terminal_90 percent design2.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      IMPLND       1
      COPY       501
      COPY       502
      DISPLY       1
      DISPLY       2
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Predeveloped                MAX                    1    2   30    9
    2        Basin  2                    MAX                    1    2   31    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  502         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           ***
  END GEN-INFO
  *** Section PWATER***

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

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

```
  END PRINT-INFO

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

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
  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
  END PWAT-STATE1

END PERLND

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

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

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         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     ***
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
```

```
    # -  # ***  RETS      SURS
    1           0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Predeveloped***
IMPLND   1                        2.46     COPY   501     15
Basin  2***
IMPLND   1                        1.44     COPY   502     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
COPY   502 OUTPUT MEAN   1 1   48.4        DISPLY   2     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    0.857          PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.857          IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           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
COPY     2 OUTPUT MEAN   1 1     48.4      WDM    702 FLOW     ENGL      REPL
COPY   502 OUTPUT MEAN   1 1     48.4      WDM    802 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  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

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages.

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

Port of Bellingham - Bellingham Shipping Terminal
Job # 2022-083
5/16/2023

Manning's Equation for New Pipes

Target Flow Q (cfs)	Pipe Dia. (in)	Pipe Type n	Pipe Slope (ft/ft)	Q_F (pipe full) (cfs)	V (actual) (ft/sec)	Q (actual) (cfs)	Pipe location		
7.50	18	0.013	0.0050	7.45	4.80	7.50	Upstream of Lift Station		
11.90	24	0.013	0.0050	16.04	5.59	11.90	Dowstream of Lift Station		
0.31	6	0.013	0.0120	0.62	3.14	0.31	Return pipe, clean water from Aquip	About 104'	
4.40	18	0.013	0.0050	7.45	4.66	8.01	Pipe serving Phase 2		
0.31	24	0.013	0.0050	16.04	2.00	0.31	Dowstream of Lift Station	WQ Flow Only	Flow=0.1969 cfs + 0.1152

Site designed to have pipes at no less than the slope shown in the above calculations.

APPENDIX D

Engineering Plans

PORT OF BELLINGHAM

BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

PORT COMMISSIONERS:
MICHAEL SHEPARD, PRESIDENT
BOBBY BRISCOE, VICE PRESIDENT
KEN BELL, SECRETARY

EXECUTIVE DIRECTOR:
ROB FIX

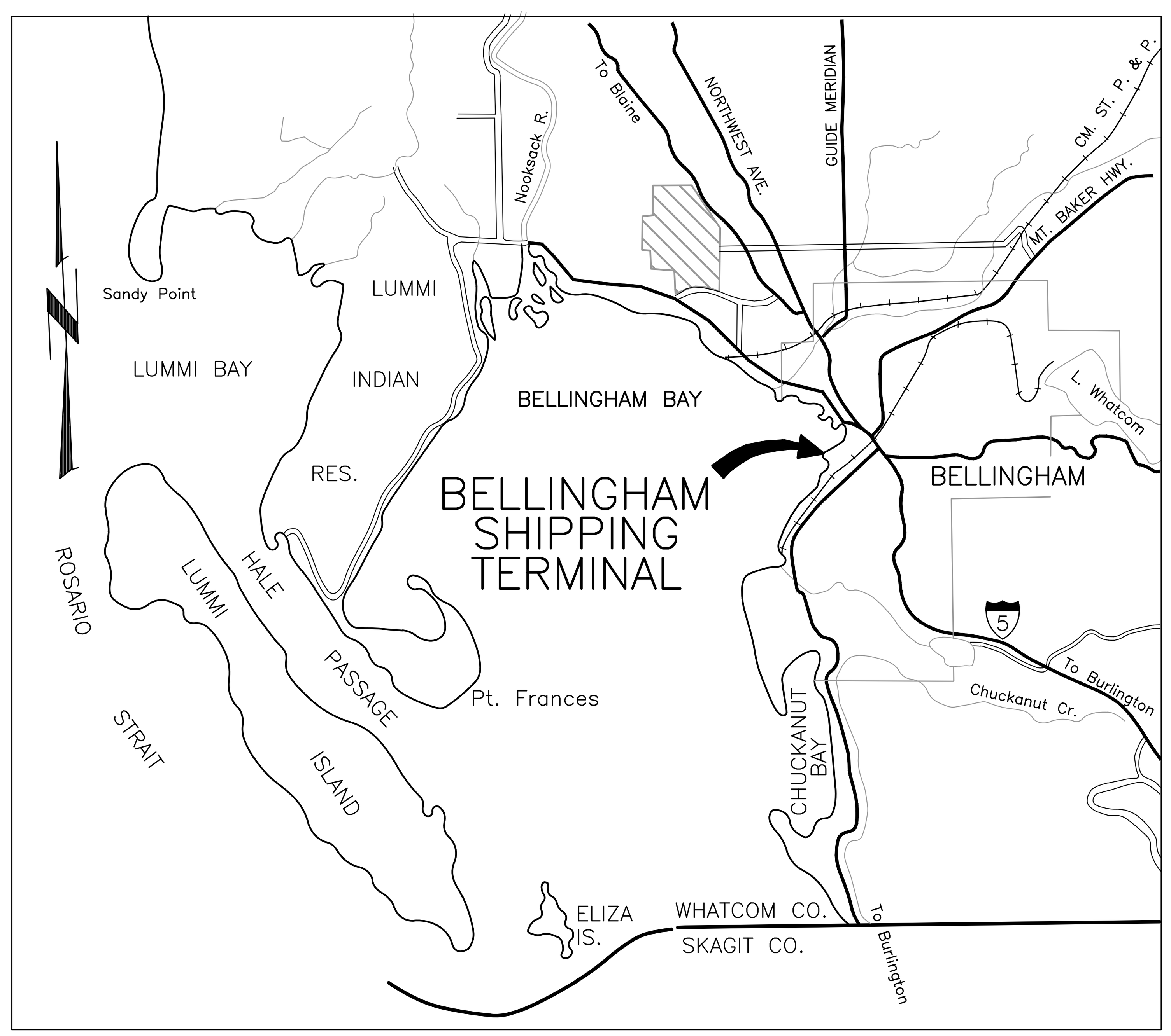
PORT PROJECT ENGINEER:
LARRY SCHOLTEN, P.E.

CIVIL/STRUCTURAL ENGINEER:
MOFFATT & NICHOL
600 UNIVERSITY STREET
SUITE#610
SEATTLE, WA 98101
(206) 622-0222

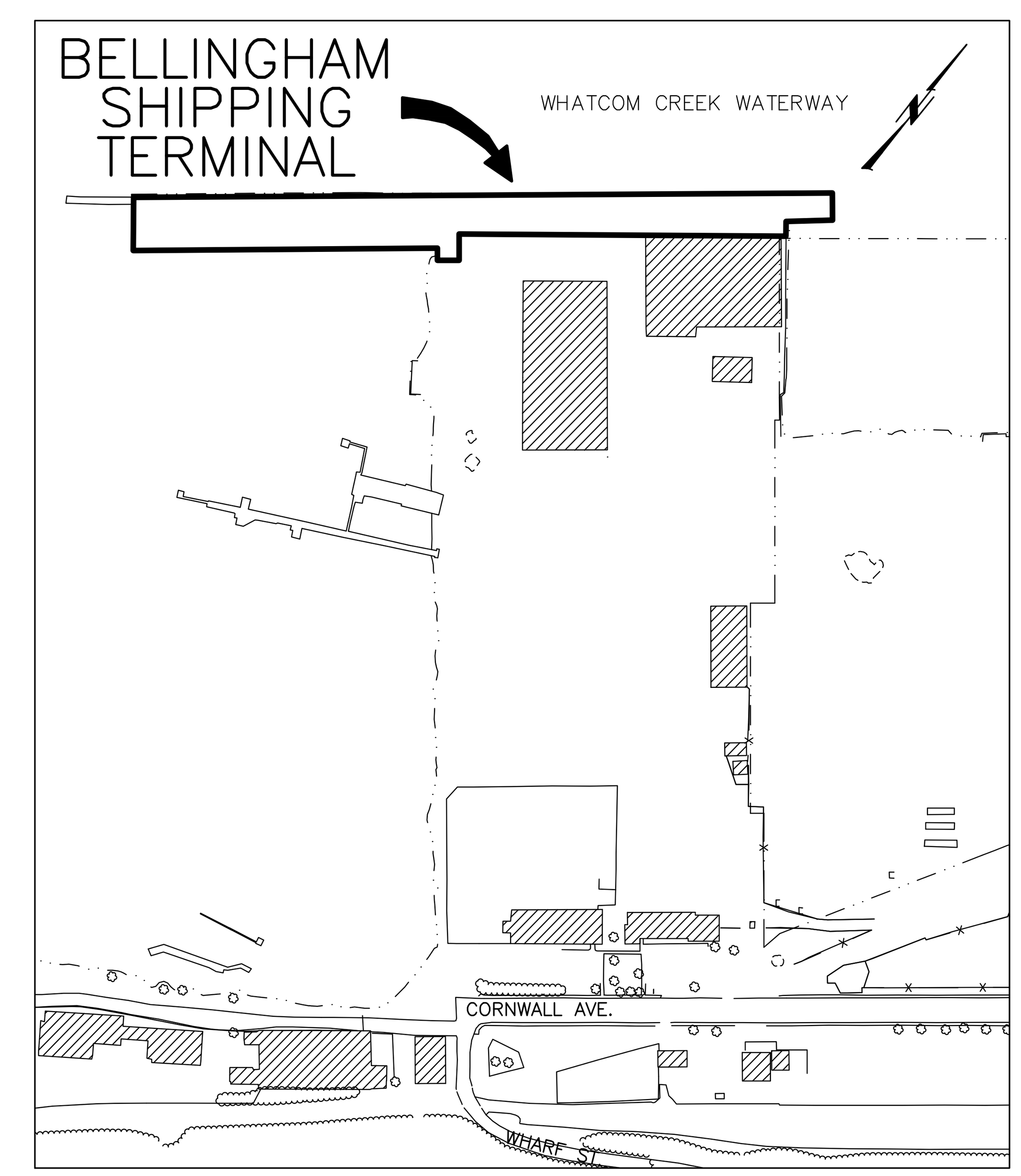
GEOTECHNICAL ENGINEER:
LANDAU ASSOCIATES
155 NE 100TH STREET
SUITE 302
SEATTLE, WA 98125

STORMWATER/WATER UTILITY ENGINEER:
WILSON ENGINEERING
805 DUPONT STREET
SUITE 7
BELLINGHAM, WA 98225

ELECTRICAL ENGINEER:
CROSS ENGINEERS
923 MARTIN LUTHER KING JR.WAY
TACOMA, WA 98405



VICINITY MAP
SCALE: NTS



SITE MAP
SCALE: NTS

FINAL SUBMITTAL
ISSUED 7/12/2023

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

COVER SHEET AND LOCATION PLAN

Designed by:	S.STRINGER
Dwn by:	M.TEDOAWS
Ckd by:	C.S.B
Reviewed by:	S.BRANLUND
Submitted by:	S.STRINGER MOFFATT & NICHOL
Date:	2023/07/12
Rev.:	-
M&N Project No.	221324
Drawing code:	
Drawing Scale:	Plot scale: 1:1 (D SHEET)

moffatt & nichol
600 UNIVERSITY STREET
SUITE#610
SEATTLE, WA 98101
(206) 622-0222

STUART J. STRINGER
STATE OF WASHINGTON
52367
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER
7/12/2023

Sheet Reference No.
G-001
INDEX: 1 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

File: Q:\SEA\221324\20 CADD_Active_SheetSet\221324_G-001; Plotted: 7/14/2023 12:37 PM by STRINGER, STUART; Saved: 7/14/2023 11:25 AM by SSTRINGER

INDEX #	SHEET #	SHEET TITLE
		GENERAL
1	G-001	COVER SHEET, AND LOCATION PLAN
2	G-002	DRAWING INDEX
3	G-003	GENERAL NOTES
4	G-004	ABBREVIATIONS AND LEGEND
		EXISTING CONDITIONS
5	V-101	OVERALL PLAN, CONSTRUCTION ACCESS, AND LAYDOWN AREA
6	V-102	SURVEY NOTES, MLLW DATUM
7	V-103	EXISTING CONDITIONS
		DEMOLITION
8	SD-101	STRUCTURAL DEMOLITION SITE PLAN
9	SD-102	STRUCTURAL DEMOLITION DETAILS – SHEET 1
10	SD-103	STRUCTURAL DEMOLITION DETAILS – SHEET 2
11	CD-101	CIVIL DEMOLITION PLAN
		CIVIL
12	C-101	PAVING PLAN
13	C-102	GRADING PLAN
14	C-103	GRADING SECTIONS
15	C-104	GRADING AND PAVING DETAILS
16	C-201	TESC PLAN (CIVIL)
17	C-202	TESC DETAILS
18	C-203	TESC NOTES
19	C-301	WATER SYSTEM PLAN
20	C-401	STORM DRAIN PLAN AND PROFILE
21	C-402	STORM DRAIN PLAN AND PROFILE
22	C-403	PAVING REPAIR PLAN
23	C-501	WATER SYSTEM DETAILS
24	C-502	STORMWATER DETAILS
25	C-503	STORMWATER TREATMENT SYSTEM DETAILS
26	C-504	STORMWATER TREATMENT SYSTEM DETAILS
		DREDGING
27	D-101	DREDGING – EXISTING CONDITIONS
28	D-102	DREDGING PLAN
29	D-103	DREDGING DETAILS
30	D-201	DREDGING PROFILE
31	D-301	DREDGING SECTIONS (1 OF 3)
32	D-302	DREDGING SECTIONS (2 OF 3)
33	D-303	DREDGING SECTIONS (3 OF 3)
		STRUCTURAL
34	S-001	STRUCTURAL NOTES
35	S-002	SPECIAL INSPECTION REQUIREMENTS
36	S-003	STRUCTURAL DESIGN CRITERIA
37	S-004	STRUCTURAL DESIGN CRITERIA AND LOADING KEY DIAGRAM
38	S-005	SUGGESTED CONSTRUCTION SEQUENCE
39	S-101	WHARF & SURFACE FEATURES PLAN
40	S-102	TYPICAL SECTION
41	S-103	PILE AND PILE CAP PLAN
42	S-104	DECK PANEL PLAN
43	S-201	STEEL PIPE PILE DETAILS
44	S-301	PILE CAP DETAILS – SHEET 1
45	S-302	PILE CAP DETAILS – SHEET 2
46	S-303	PILE CAP DETAILS – SHEET 3
47	S-401	DECK PANEL DETAILS – SHEET 1
48	S-402	DECK PANEL DETAILS – SHEET 2
49	S-403	DECK PANEL DETAILS – SHEET 3
50	S-501	BULKHEAD DETAILS
51	S-502	FENDER SYSTEM DETAILS – SHEET 1
52	S-503	FENDER SYSTEM DETAILS – SHEET 2
53	S-504	TRANSITION SPAN DETAILS
54	S-505	MOORING BOLLARD DETAILS
55	S-506	MISCELLANEOUS DETAILS – SHEET 1
56	S-507	MISCELLANEOUS DETAILS – SHEET 2

INDEX #	SHEET #	SHEET TITLE
57	S-601	OVERALL REPAIR PLAN
58	S-602	PILE REPAIR PLAN – SHEET 1
59	S-603	PILE REPAIR PLAN – SHEET 2
60	S-604	PILE REPAIR PLAN – SHEET 3
61	S-605	SUPERSTRUCTURE REPAIR PLAN – SHEET 1
62	S-606	SUPERSTRUCTURE REPAIR PLAN – SHEET 2
63	S-607	SUPERSTRUCTURE REPAIR PLAN – SHEET 3
64	S-608	SOUTH TERMINAL TRANSVERSE SECTIONS
65	S-609	SOUTH TERMINAL LONGITUDINAL SECTIONS
66	S-610	REPAIR DETAILS – SHEET 1
67	S-611	REPAIR DETAILS – SHEET 2
68	S-612	REPAIR DETAILS – SHEET 3
		ELECTRICAL
69	E-101	PARTIAL ELECTRICAL SITE PLAN
70	E-102	PARTIAL ELECTRICAL SITE PLAN/WAREHOUSE PLAN
71	E-103	ELECTRICAL DETAILS
72	E-104	ELECTRICAL DETAILS

PORT OF BELLINGHAM
Washington State

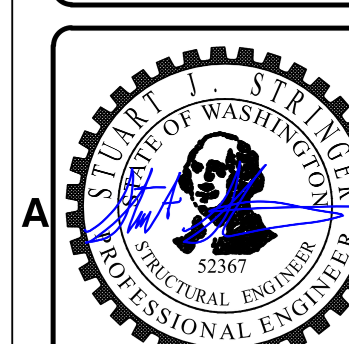
Mark	Description	Date	Appr.

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

DRAWING INDEX

Designed by: S.STRINGER
Dwn by: M.TEDDAMS
Ckd by: C.S.B
Reviewed by: S.BRANLUND
Submitted by: S.STRINGER MOFFATT & NICHOL
Date: 2023/07/12
Rev. –
M&N Project No. 221324
Drawing code:
Drawing Scale:
Plot scale: 1:1 (D SHEET)

moffatt & nichol
600 UNIVERSITY STREET
SUITE#610
SEATTLE, WA 98101
(206) 622-0222



FINAL SUBMITTAL
ISSUED 7/12/2023

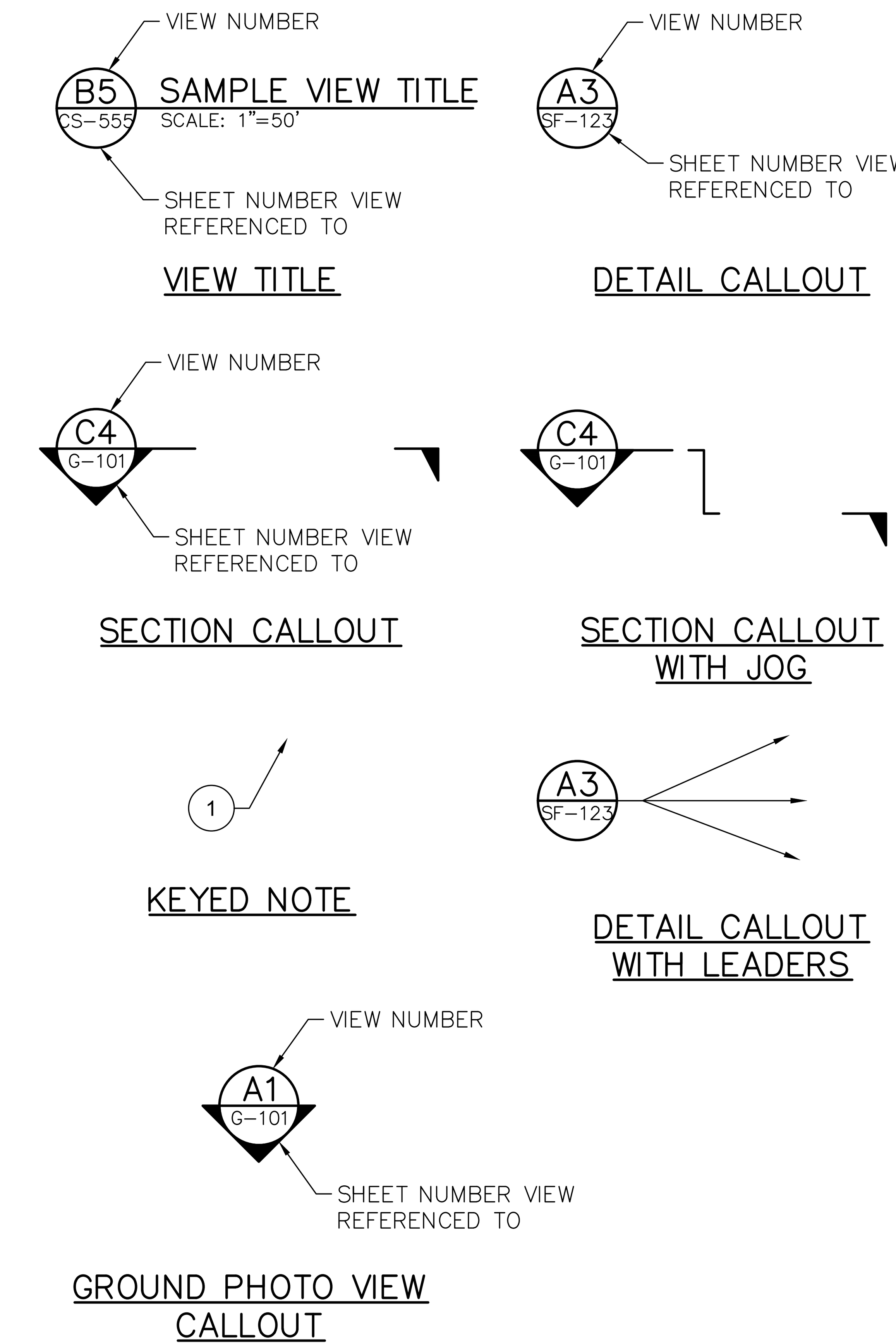
Sheet Reference No.
G-002
INDEX: 2 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

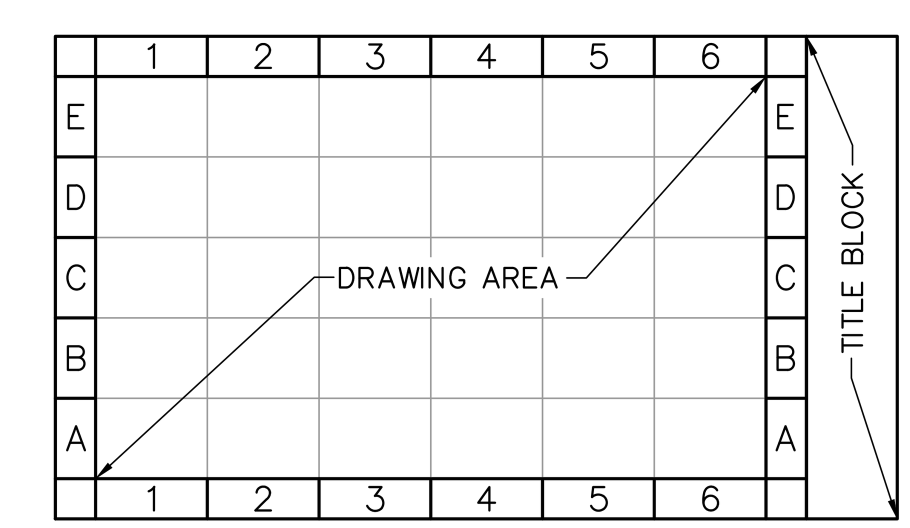
ABBREVIATIONS

ACP	ASPHALT CONCRETE PAVEMENT
ACI	AMERICAN CONCRETE INSTITUTE
ADDT'L	ADDITIONAL
APPROX	APPROXIMATE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
BLDG	BUILDING
BMPs	BEST MANAGEMENT PRACTICES
BTM	BOTTOM
C/C	CENTER ON CENTER
CIP	CAST-IN-PLACE
CL	CENTERLINE
CLE	CONTINGENCY LEVEL EARTHQUAKE
CLR	CLEAR
CONC	CONCRETE
CONT	CONTINUOUS or CONTINUE
CSBC	CRUSHED SURFACING BASE COURSE
DACS	DRAWING AREA COORDINATE SYSTEM
DE	DESIGN EARTHQUAKE
DEMO	DEMOLISH
DIA	DIAMETER
E	EAST
E	EXISTING
EA	EACH
ECON	ECONOMY
EF	EACH FACE
EG	EXISTING GRADE
EL/ELEV	ELEVATION
ES	EACH SIDE
EQ	EQUAL
EQUIV	EQUIVALENT
EX	EXISTING
EXP	EXPANSION
FT	FOOT or FEET
FY	YIELD STRENGTH
GA	GAGE
GALV	GALVANIZED(HOT-DIP)
GLM	GLULAM
GR	GRADE
HOWL	HIGHEST OBSERVED WATER LEVEL
H.A.S.	HEADED ANCHOR STUD
HDPE	HIGH DENSITY POLYETHYLENE
HSS	HOLLOW STRUCTURAL SECTION
HORIZ	HORIZONTAL
IBC	INTERNATIONAL BUILDING CODE
ICC	INTERNATIONAL CODE COUNCIL
ID	INSIDE DIAMETER
ID	IDENTIFICATION
IN.	INCHES
KSI	KIPS PER SQUARE INCH
L	LENGTH
LAM	LAMINATED
LOWL	LOWEST OBSERVED WATER LEVEL
LB	POUND
LF	LINEAR or LINEAL FEET
LG	LONG
LLH	LONG LEG HORIZONTAL
MAX	MAXIMUM
MHW	MEAN HIGH WATER
MHHW	MEAN HIGHER HIGH WATER
MIN	MINIMUM
MLW	MEAN LOW WATER
MLLW	MEAN LOWER LOW WATER
MPH	MILES PER HOUR
MTL	MEAN TIDE LINE
N	NORTH
NAVD	NORTH AMERICAN VERTICAL DATUM
N/A	NOT APPLICABLE
NE	NORTH EAST
NIC	NOT IN CONTRACT
NMAS	NOMINAL MAXIMIMUM AGGREGATE SIZE
NO.	NUMBER
NOAA	NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OLE	OPERATING LEVEL EARTHQUAKE
PCF	POUND PER CUBIC FOOT
PG	PROPOSED GRADE
PL	PLATE or PROPERTY LINE
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
REINF	REINFORCEMENT
REQD	REQUIRED
RMC	RESIDUAL MANAGEMENT COVER
RPFP	RAISED PATTERN FLOOR PLATE
S	SOUTH
SCH	SCHEDULE
SE	SOUTH EAST
SEC	SECONDARY
SECT	SECTION
SPA	SPACES
SPEC	SPECIFICATION
SS	STAINLESS STEEL or SANITARY SEWER
SST	STAINLESS STEEL
STD	STANDARD
STL	STEEL
T&B	TOP AND BOTTOM
TBD	TO BE DETERMINED
THRU	THROUGH
TESC	TEMPORARY EROSION & SEDIMENT CONTROL
TYP	TYPICAL
T/	TOP OF
UFC	UNIFIED FACILITY CRITERIA
UHMWPE	ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE
UON	UNLESS OTHERWISE NOTED
VIF	VERIFY IN FIELD
W	WEST
WA	WASHINGTON
WHS	WELDED HEADED STUD
WP	WEATHER PROOF OR WATER PROOF
WSDOT	WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
W/	WITH

CROSS-REFERENCE LEGEND



* VIEW NUMBER IS BASED ON THE LOCATION OF THE LOWER-LEFT EXTENTS OF THE VIEW ON THE REFERENCED SHEET. WHEN REFERENCING DRAWING INFORMATION BETWEEN SHEETS, BOTH THE VIEW AND SHEET NUMBERS MUST BE QUOTED TOGETHER – EITHER IN A CALLOUT FORMAT AS SHOWN ABOVE OR IN THE FORM;
"VIEW NO./SHEET NO." (EG A1/CS-5001)



DRAWING AREA COORDINATE SYSTEM (DACS)

FINAL SUBMITTAL
ISSUED 7/12/2023

PORT OF BELLINGHAM
Washington State

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

ABBREVIATIONS AND LEGEND

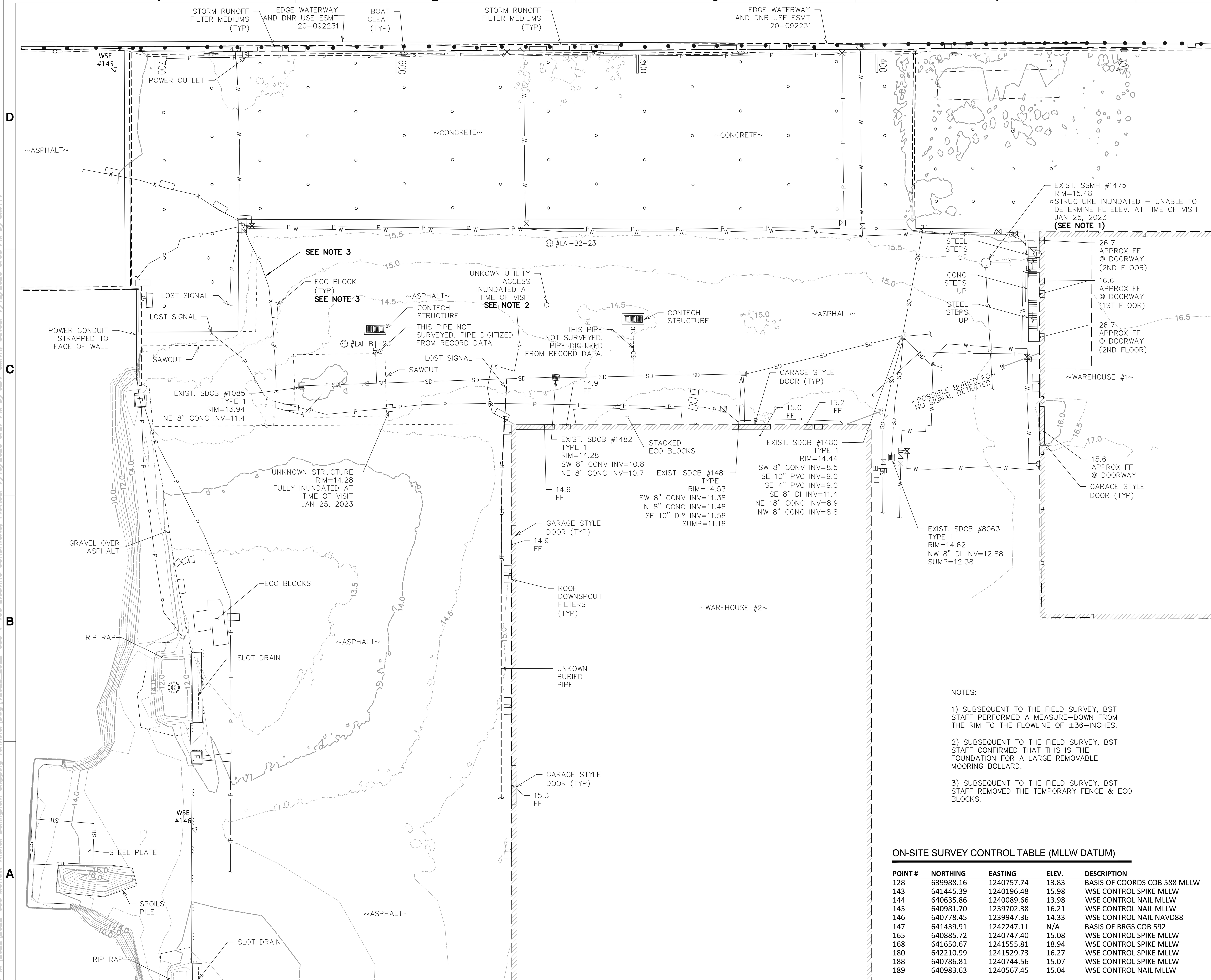
Rev.	–
Date:	2023/07/12
M&N Project No.	221324
Drawing code:	
Drawing Scale:	
Plot scale:	1:1 (D SHEET)
Designed by:	S.STINGER
Dwn by:	M.TEDOAWS
Ckd by:	C.S.B
Reviewed by:	S.BRANLUND
Submitted by:	S.STRINGER MOFFATT & NICHOL

600 UNIVERSITY STREET
SUITE#610
SEATTLE, WA 98101
(206) 622-0222
moffatt & nichol

STUART J. STRINGER, STATE OF WASHINGTON, 52367, STRUCTURAL ENGINEER, PROFESSIONAL ENGINEER, 7/12/2023

Sheet Reference No.
G-004
INDEX: 4 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING



NOTES:

1) SUBSEQUENT TO THE FIELD SURVEY, BST STAFF PERFORMED A MEASURE-DOWN FROM THE RIM TO THE FLOWLINE OF ±36-INCHES.

2) SUBSEQUENT TO THE FIELD SURVEY, BST STAFF CONFIRMED THAT THIS IS THE FOUNDATION FOR A LARGE REMOVABLE MOORING BOLLARD.

3) SUBSEQUENT TO THE FIELD SURVEY, BST STAFF REMOVED THE TEMPORARY FENCE & ECO BLOCKS.

FINAL SUBMITTAL
ISSUED 7/12/2023

20 0 20 40
SCALE HORIZONTAL SCALE FEET

Call 811 two business days before you dig

ON-SITE SURVEY CONTROL TABLE (MLLW DATUM)

POINT #	NORTHING	EASTING	ELEV.	DESCRIPTION
128	639988.16	1240757.74	13.83	BASIS OF COORDS COB 588 MLLW
143	641445.39	1240196.48	15.98	WSE CONTROL SPIKE MLLW
144	640635.86	1240089.66	13.98	WSE CONTROL NAIL MLLW
145	640981.70	1239702.38	16.21	WSE CONTROL NAIL MLLW
146	640778.45	1239947.36	14.33	WSE CONTROL NAIL NAVD88
147	641439.91	1242247.11	N/A	BASIS OF BRGS COB 592
165	640885.72	1240747.40	15.08	WSE CONTROL SPIKE MLLW
168	641650.67	1241555.81	18.94	WSE CONTROL SPIKE MLLW
180	642210.99	1241529.73	16.27	WSE CONTROL SPIKE MLLW
188	640786.81	1240744.56	15.07	WSE CONTROL SPIKE MLLW
189	640983.63	1240567.45	15.04	WSE CONTROL NAIL MLLW

MLLW DATUM

PORT OF BELLINGHAM

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

EXISTING CONDITIONS

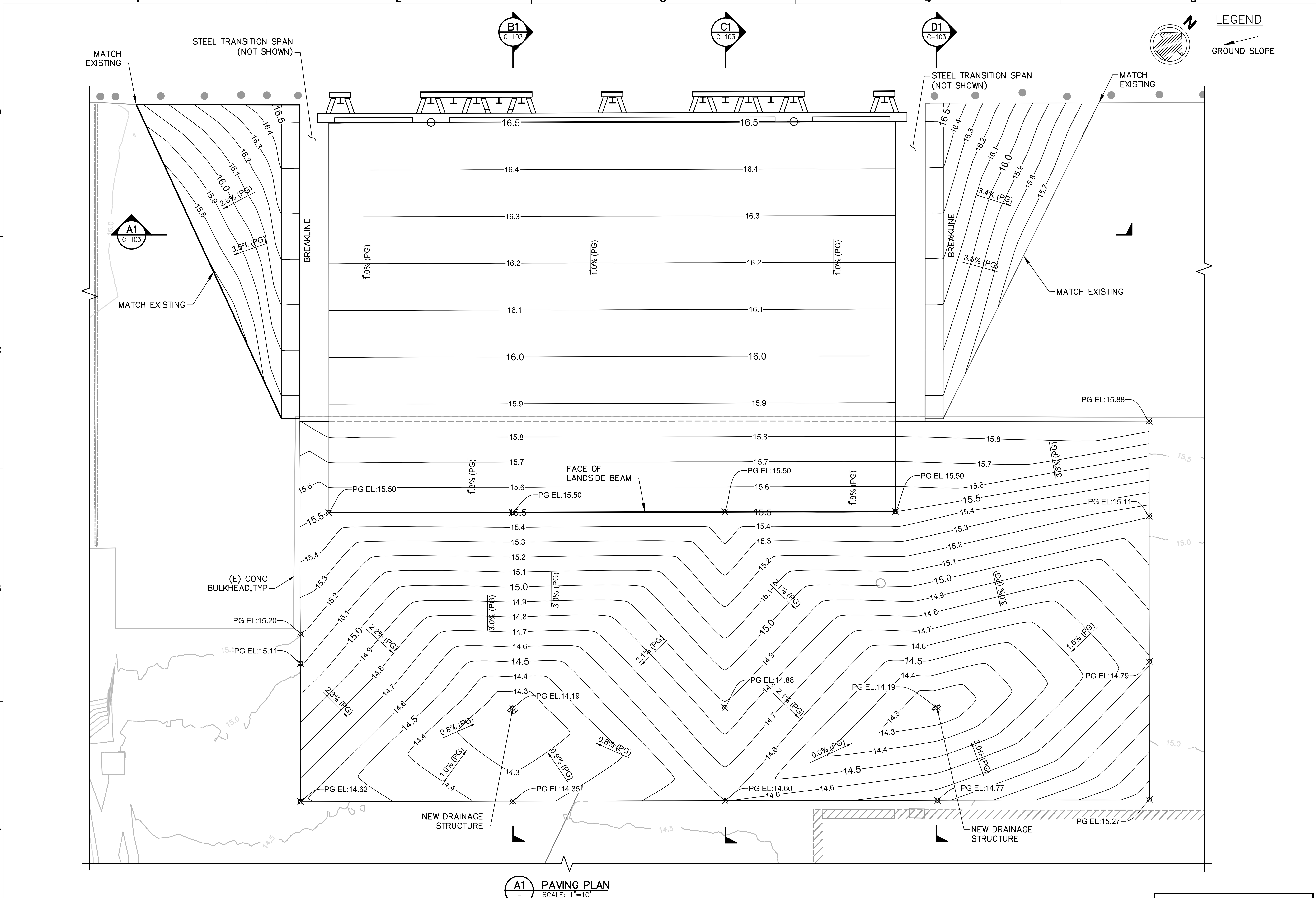
Designed by: | Date: 2023-7-12 | Rev. -
Dwn by: J. SMITH | Ckd by: J.T.B. | M&N Project No. 221324
Reviewed by: | Drawing code:
Submitted by: S.STRINGER MOFFATT & NICHOL | Drawing Scale: Plot scale: 1:1 (D SHEET)

WILSON ENGINEERING
WILSONENGINEERING.COM

JOHN THOMAS BREWSTER, STATE OF WASHINGTON, REGISTERED PROFESSIONAL LAND SURVEYOR, 7-13-2023

Sheet Reference No.
V-103
INDEX: 7 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING



A1 PAVING PLAN
SCALE: 1"=10'

10' 0' 10' 20'
SCALE: 1"=10'

FINAL SUBMITTAL
ISSUED 7/12/2023

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

PORT OF BELLINGHAM
Washington State

Mark | Date | Description | Date | Appr.

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

GRADING PLAN

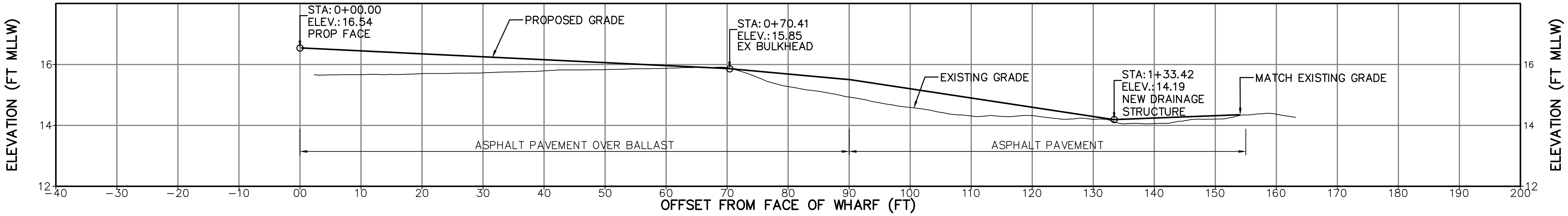
Rev.	–
Date:	2023/07/12
M&N Project No.	221324
Drawing code:	
Drawing Scale:	Plot scale: 1:1 (D SHEET)
Designed by:	S.STRINGER
Dwn by:	M.TEDDAWIS
Ckd by:	C.S.B
Reviewed by:	S.BRANLUND
Submitted by:	S.STRINGER MOFFATT & NICHOL

moffatt & nichol
600 UNIVERSITY STREET
SUITE #610
SEATTLE, WA 98101
(206) 622-0222

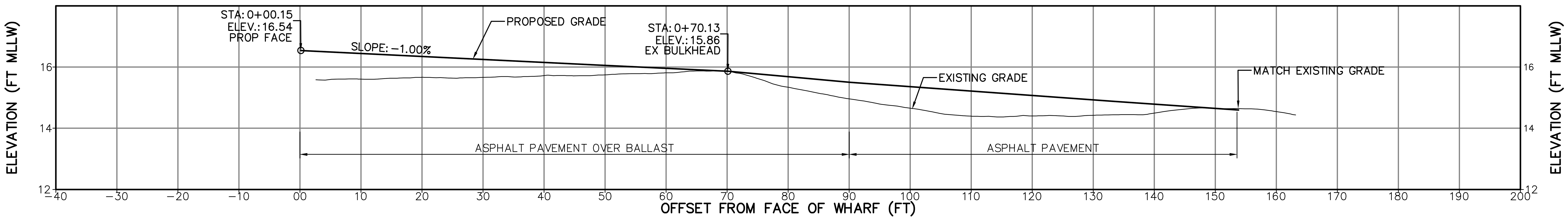
STUART J. STRINGER
STATE OF WASHINGTON
52367
STRUCTURAL ENGINEER
PROFESSIONAL ENGINEER
7/12/2023

Sheet Reference No.
C-102
INDEX: 13 OF 72

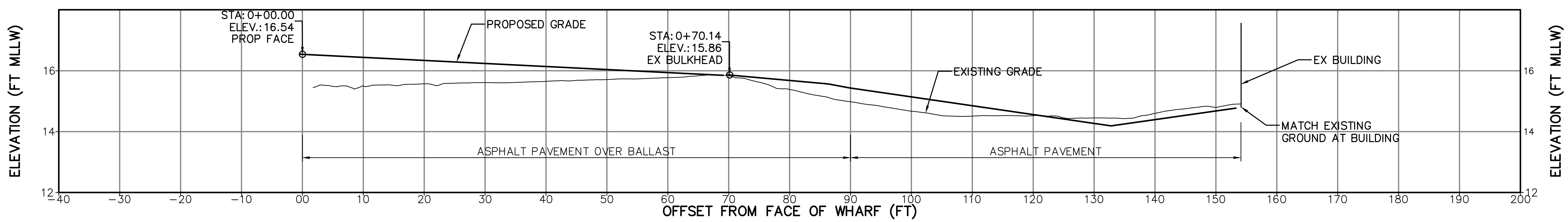
File: O:\SEA\221324\20 CADD_Active_SheetSet\221324_C-102; Plotted: 7/12/2023 6:56 PM by GREENE, CHRIS; Saved: 7/11/2023 9:43 PM by JTODD



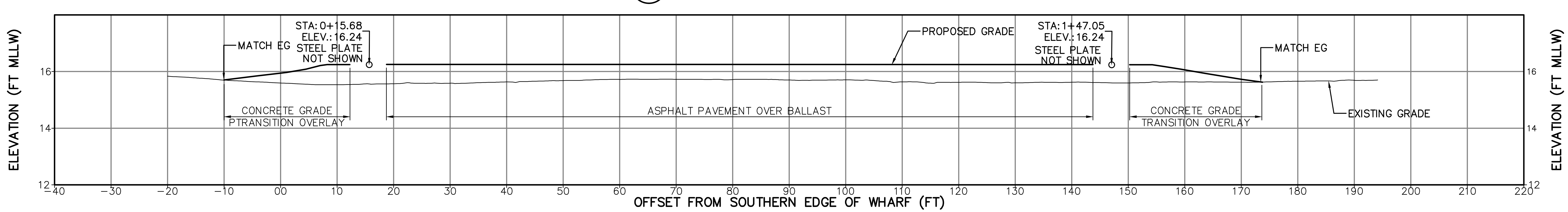
D1 C-102 SECTION 1
SCALE: GRAPHICAL



C1 C-102 SECTION 2
SCALE: GRAPHICAL



B1 C-102 SECTION 3
SCALE: GRAPHICAL



A1 C-102 SECTION 4
SCALE: GRAPHICAL

VERT. SCALE: 1 : 5 EXAGGERATION

HOR. SCALE: 1"=10'

FINAL SUBMITTAL
ISSUED 7/12/2023

PORT OF BELLINGHAM

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

GRADING SECTIONS

Designed by: STRINGER	Rev. -
Dwn by: M.TEDDAMS	Ckd by: C.S.B
Date: 2023/07/12	M&N Project No. 221324
Reviewed by: S.BRANLUND	Drawing code:
Submitted by: S.STRINGER MOFFATT & NICHOL	Drawing Scale: Plot scale: 1:1 (D SHEET)

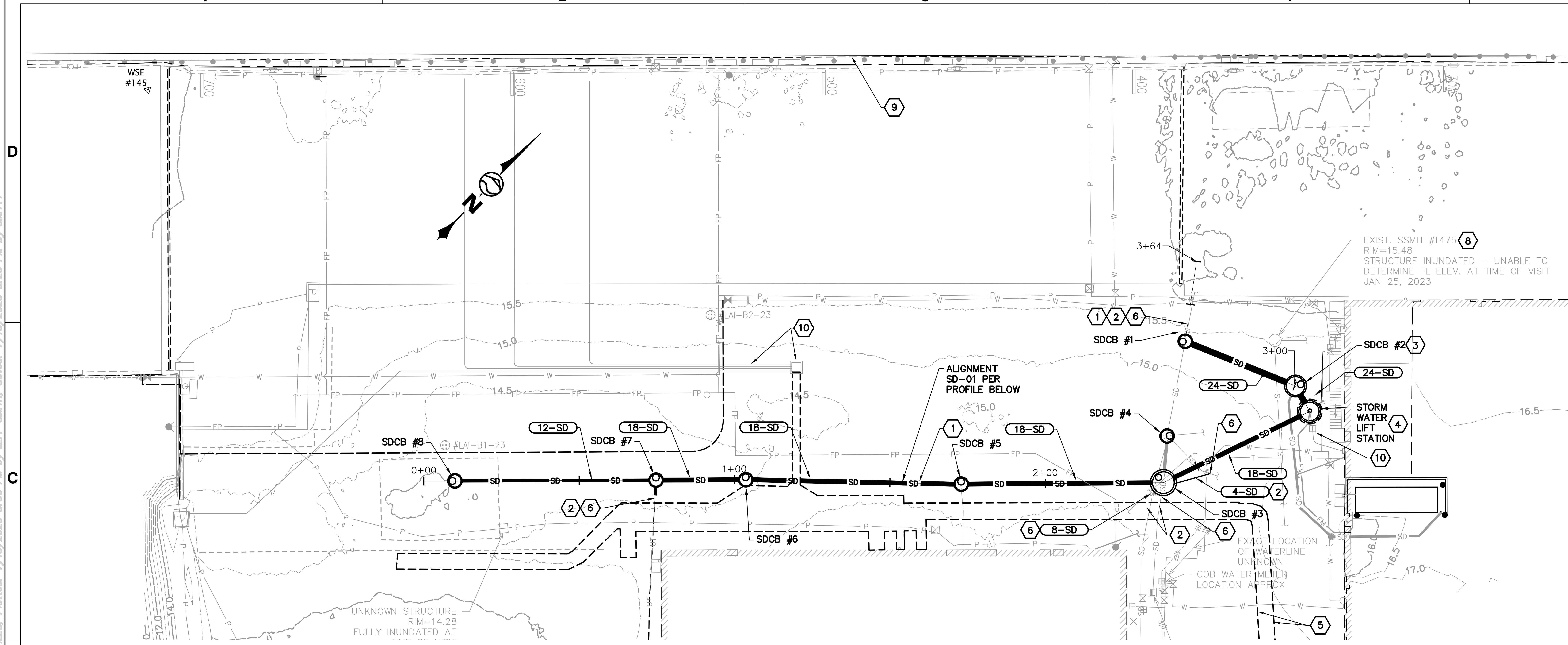
moffatt & nichol
600 UNIVERSITY STREET
SUITE #610
SEATTLE, WA 98101
(206) 622-0222

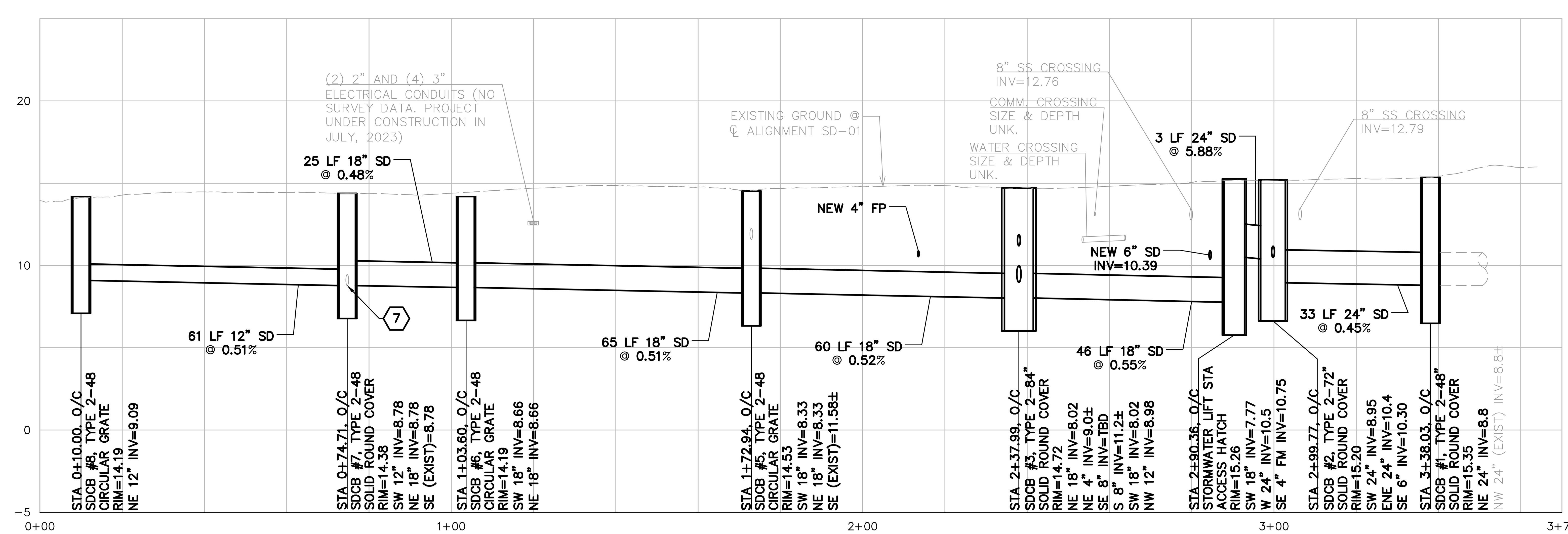
STUART J. STRINGER
STATE OF WASHINGTON
52367
PROFESSIONAL ENGINEER
STRUCTURAL ENGINEER
7/12/2023

Sheet Reference No.
C-103
INDEX: 14 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

File: O:\SEA\221324\20 CADD_Active_SheetSet\221324_C-103; Plotted: 7/12/2023 6:57 PM by GREENE, CHRIS; Saved: 6/6/2023 8:59 PM by RSAMANIEGO





ALIGNMENT SD-01

FINAL SUBMITTAL
ISSUED 7/12/2023

KEYED NOTES

1. = TIDE GATE, TIDEFLEX CHECKMATE OR APPROVED EQUAL LOCATED IN PIPE JUST DOWNSTREAM OF SDCB#1
2. = CONTRACTOR SHALL POTHOLE EXISTING STORM SEWER PIPES PRIOR TO INSTALLING SDCBs #1, #3, & #7. CONTRACTOR SHALL REPORT LOCATION, DEPTH, AND PIPE DIAMETER TO ENGINEER. CATCH BASIN LOCATION AND PIPE LOCATION MAY BE CHANGED 12" IN ANY DIRECTION BY ENGINEER AT THESE LOCATIONS AT NO ADDITIONAL COST TO THE PORT
3. = INCLUDE KNOCK-OUT FOR 24" DUCTILE IRON PIPE @ 68.2° CLOCKWISE FROM SW PIPE FOR FUTURE PIPE CONNECTION. INVERT FOR FUTURE PIPE=8.95'
4. = INCLUDE KNOCK-OUT FOR 18" DUCTILE IRON PIPE @ 36.7° CLOCKWISE FROM SW PIPE FOR FUTURE PIPE CONNECTION. INVERT OF FUTURE PIPE=6.00'
5. = FUTURE ELECTRICAL TRENCH LIMITS, APPROXIMATE
6. = CONNECT TO EXISTING STORM SEWER
7. = EXISTING PIPE INVERT ANTICIPATED TO BE LOWERED PRIOR TO CONSTRUCTION (BY OTHERS)
8. = SEE NOTE 1 ON V-103 FOR SEWER INVERT INFORMATION
9. = REINSTALL SALVAGED MEDIA FILTER DRAIN BOX (MFDB) AT LOW POINT CREATED BY BORDER BETWEEN NEW AND EXISTING PAVING ALONG BULL RAIL. INSTALLATION TO BE SIMILAR TO EXISTING. CONTRACTOR TO SUPPLY ALL REPLACEMENT PARTS NEEDED TO PROVIDE A COMPLETE INSTALLATION. EXACT LOCATION OF MFDB TO BE FIELD FITTED TO ENSURE ALL RUNOFF FLOWING TOWARD BULL RAIL IS COLLECTED. ADJUST OR REINSTALL RUBBER CURBS AS NEEDED TO DIRECT RUNOFF TOWARD MFDBs.
10. = SEE ELECTRICAL PLANS FOR ELECTRICAL DESIGN

NOTE

1) RESTORATION OF TRENCHES TO MATCH EXISTING GRADES & DRAINAGE PATTERNS UNLESS NOTED OTHERWISE. SEE STRUCTURAL PLANS FOR GRADING PLAN FOR AREAS WHERE GRADES CHANGE.

SHEET NOTES

1) SEE SHEET V-103 FOR EXISTING CONDITIONS

2) ALL PIPE IN TRAFFIC AREAS MUST HAVE A MINIMUM 4' OF COVER UNLESS CONNECTING TO EXISTING PIPE THAT HAS LESS COVER

HORIZONTAL SCALE: 20 0 20 40 FEET

VERTICAL SCALE: 5 0 5 10 FEET

Call 811 two business days before you dig

MLLW DATUM

PORT OF BELLINGHAM

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

STORM DRAIN PLAN & PROFILE

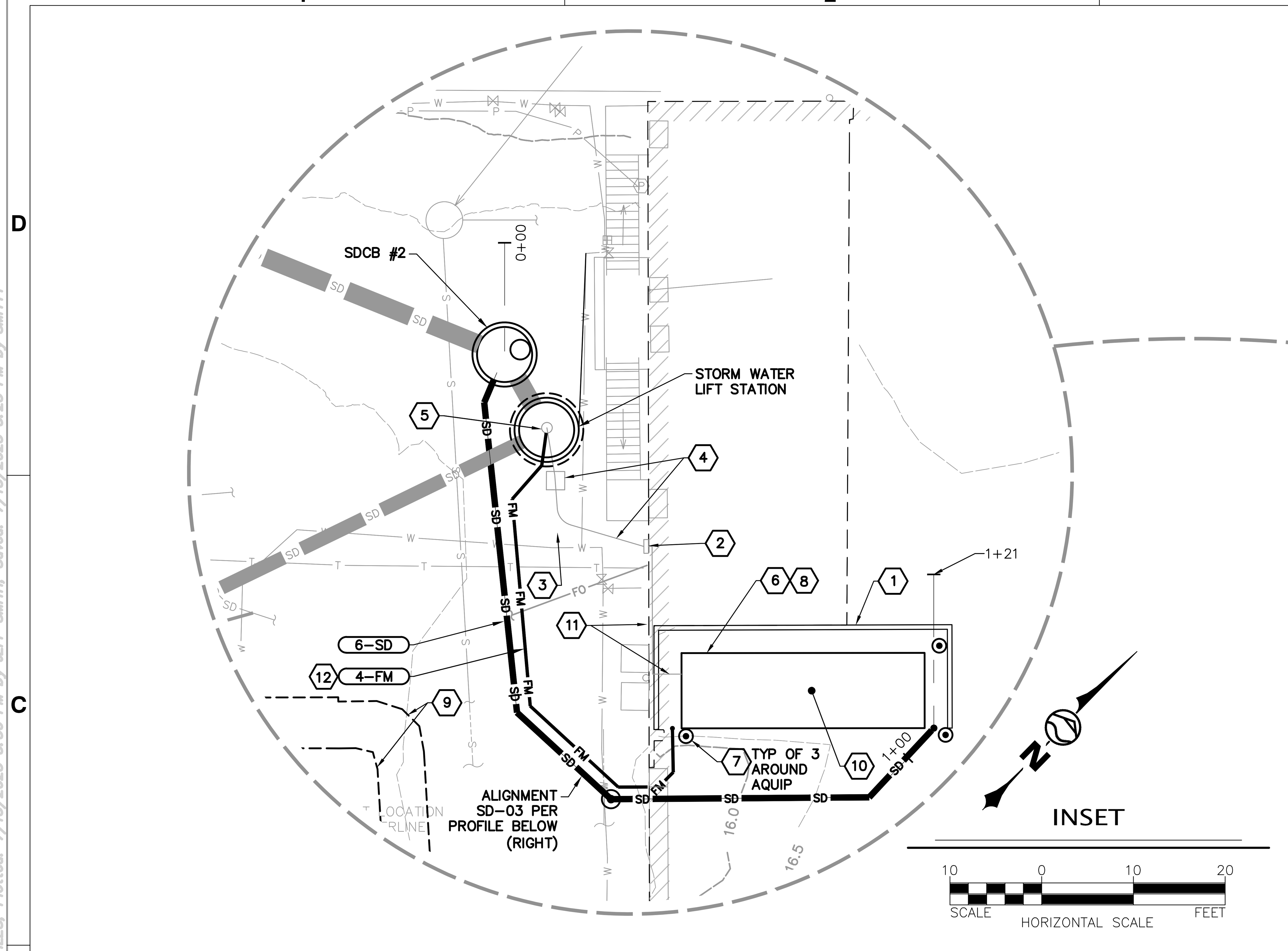
Designed by:	Date: 2023-7-12
Dwn by: J. SMITH	Ckd by: E.A.S.
M&N Project No.: 221324	Rev.: –
Reviewed by:	Drawing code:
Submitted by: S.STRINGER MOFFATT & NICHOL	Drawing Scale:
Plot scale: 1:1 (D SHEET)	

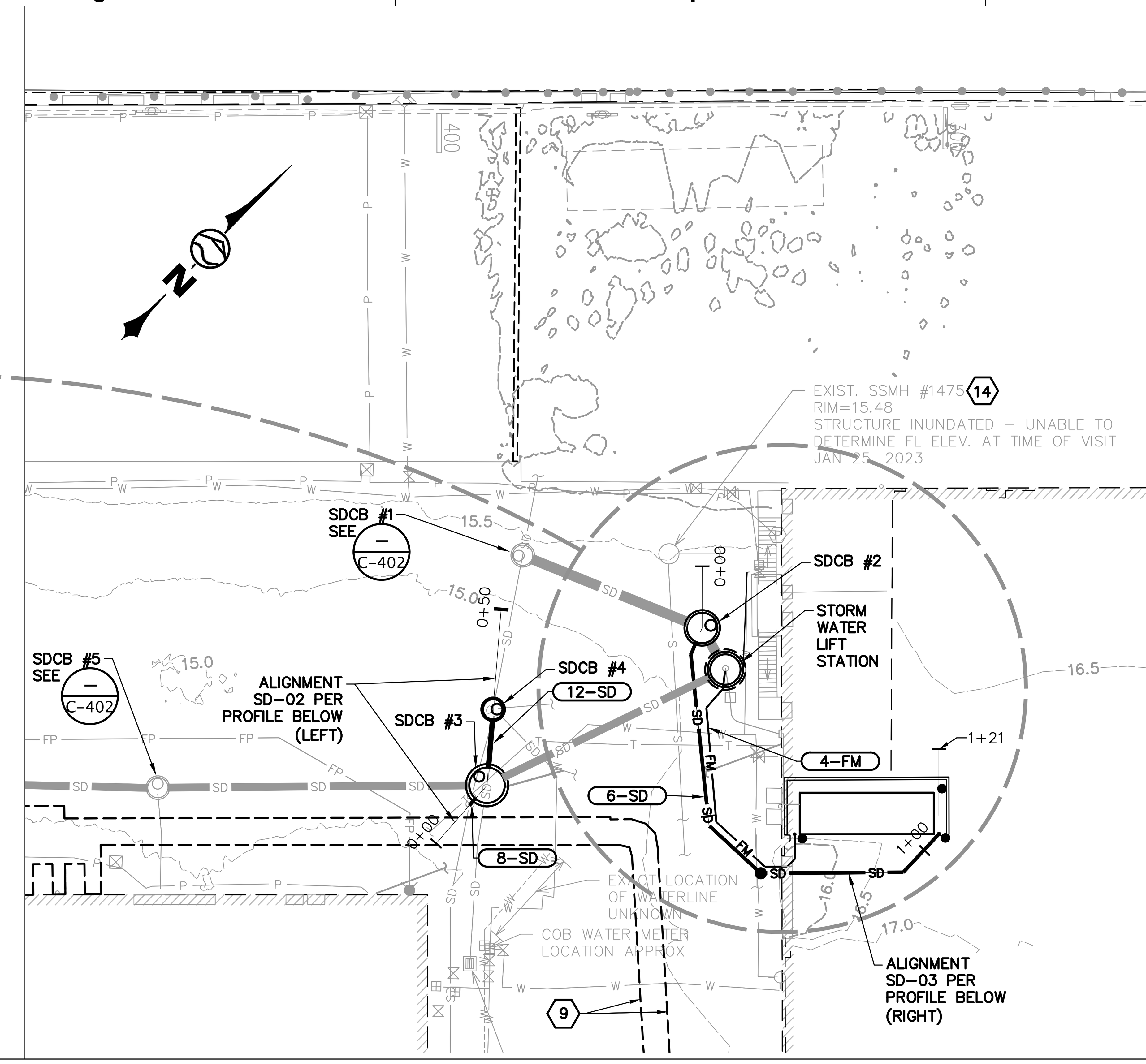
WILSON ENGINEERING
WILSONENGINEERING.COM

SCOTT COURTNEY WINTER, STATE OF WASHINGTON, 42520, REGISTERED PROFESSIONAL ENGINEER 7/13/23

Sheet Reference No.
C-401
INDEX: 20 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING





KEYED NOTES

1. = 6" CONCRETE CURB, SEE STRUCTURAL SHEET S-506 (BY MOFFATT & NICHOL)
2. = CONTROL PANEL
3. = PULL BOX, SEE ELECTRICAL DRAWINGS
4. = UNDERGROUND COMMUNICATION AND POWER FROM PUMP TO CONTROL PANEL, SEE ELECTRICAL DRAWINGS
5. = SINGLE SUMP PUMP
6. = STORMWATER Rx AQUIP 160S STORMWATER TREATMENT SYSTEM
7. = BOLLARD (TYP OF 3)
8. = CONCRETE PAD BELOW TREATMENT SYSTEM. NOT SHOWN FOR CLARITY. SEE STRUCTURAL PLAN S-506 (BY MOFFATT & NICHOL)
9. = FUTURE ELECTRICAL TRENCH LIMITS, APPROXIMATE
10. = CONCRETE SLAB ELEV=16.91
11. = ABOVE GROUND ELECTRICAL & COMMUNICATIONS WITHIN BUILDING FROM FLOW METER TO CONTROL PANEL. SEE ELECTRICAL DRAWINGS
12. = 53 LF 4" FORCE MAIN @ 2.5%. FORCE MAIN NOT SHOWN IN PROFILE FOR CLARITY. FOR BEGINNING OF FORCE MAIN INFORMATION SEE 3/C-504

    FOR CONTINUATION OF FORCE MAIN SEE 2/C-503

    FORCE MAIN TO BE INSTALLED WITH CONSISTENT SLOPE UPWARD FROM LIFT STATION TO STORMWATER RX. FORCEMAIN SHALL HAVE RESTRAINED JOINTS FOR ENTIRE LENGTH FROM LIFT STATION TO STORMWATER RX AQUIP.
13. = SDCO 5/C-502
14. = SEE NOTE 1 ON V-103 FOR SEWER INVERT INFORMATION

NOTE

1) RESTORATION OF TRENCHES TO MATCH EXISTING GRADES & DRAINAGE PATTERNS UNLESS NOTED OTHERWISE. SEE SHEET C-102 FOR GRADING PLAN FOR AREAS WHERE GRADES CHANGE (BY MOFFATT & NICHOL)

SHEET NOTES

1) SEE SHEET V-103 FOR EXISTING CONDITIONS

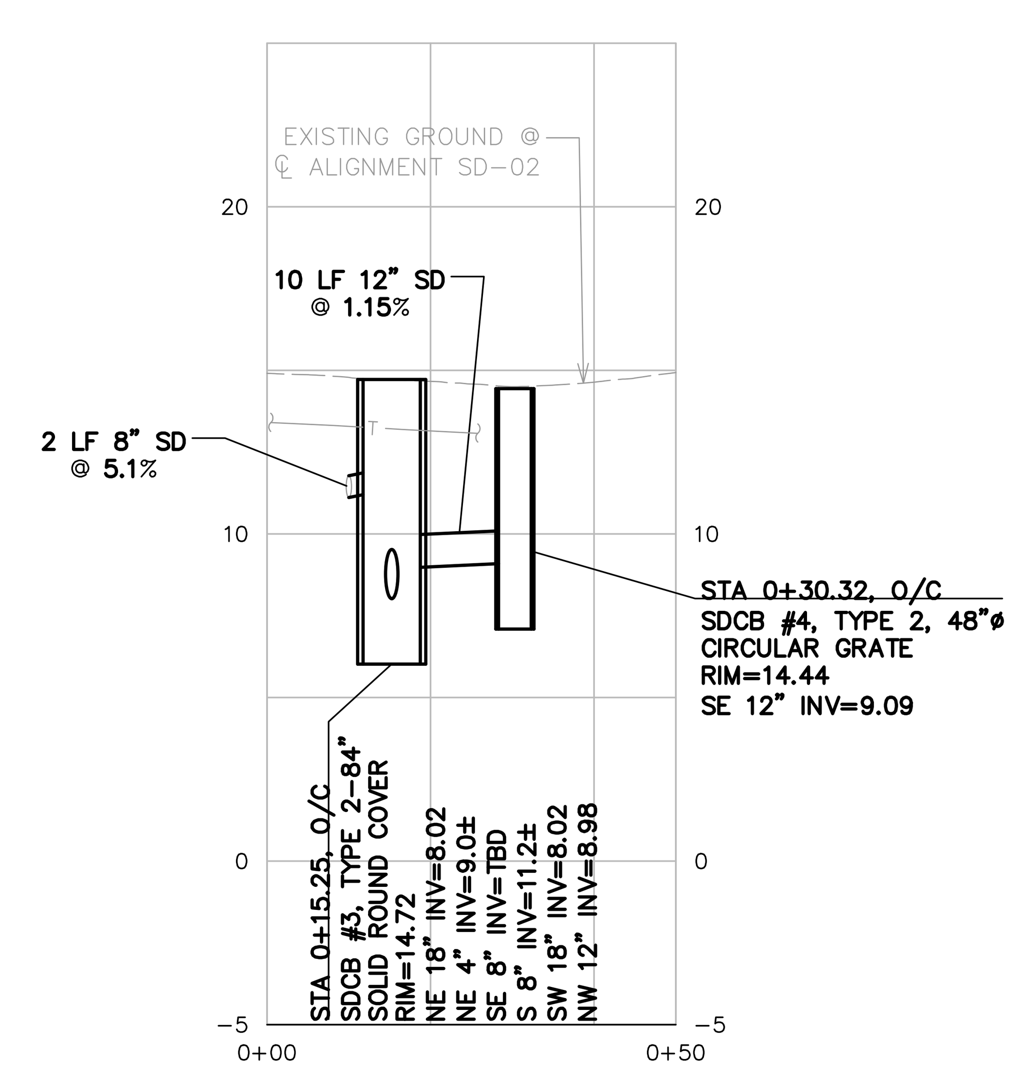
2) NO 90° BENDS ALLOWED. USE TWO 45° BENDS SPACED AT LEAST 2' APART. THE TWO 45° BENDS WHERE PIPE TURNS VERTICAL MAY BE CONNECTED WITH NO SPACE BETWEEN.

3) ALL PIPE IN TRAFFIC AREAS MUST HAVE A MINIMUM 4' OF COVER UNLESS CONNECTING TO EXISTING PIPE THAT HAS LESS COVER.

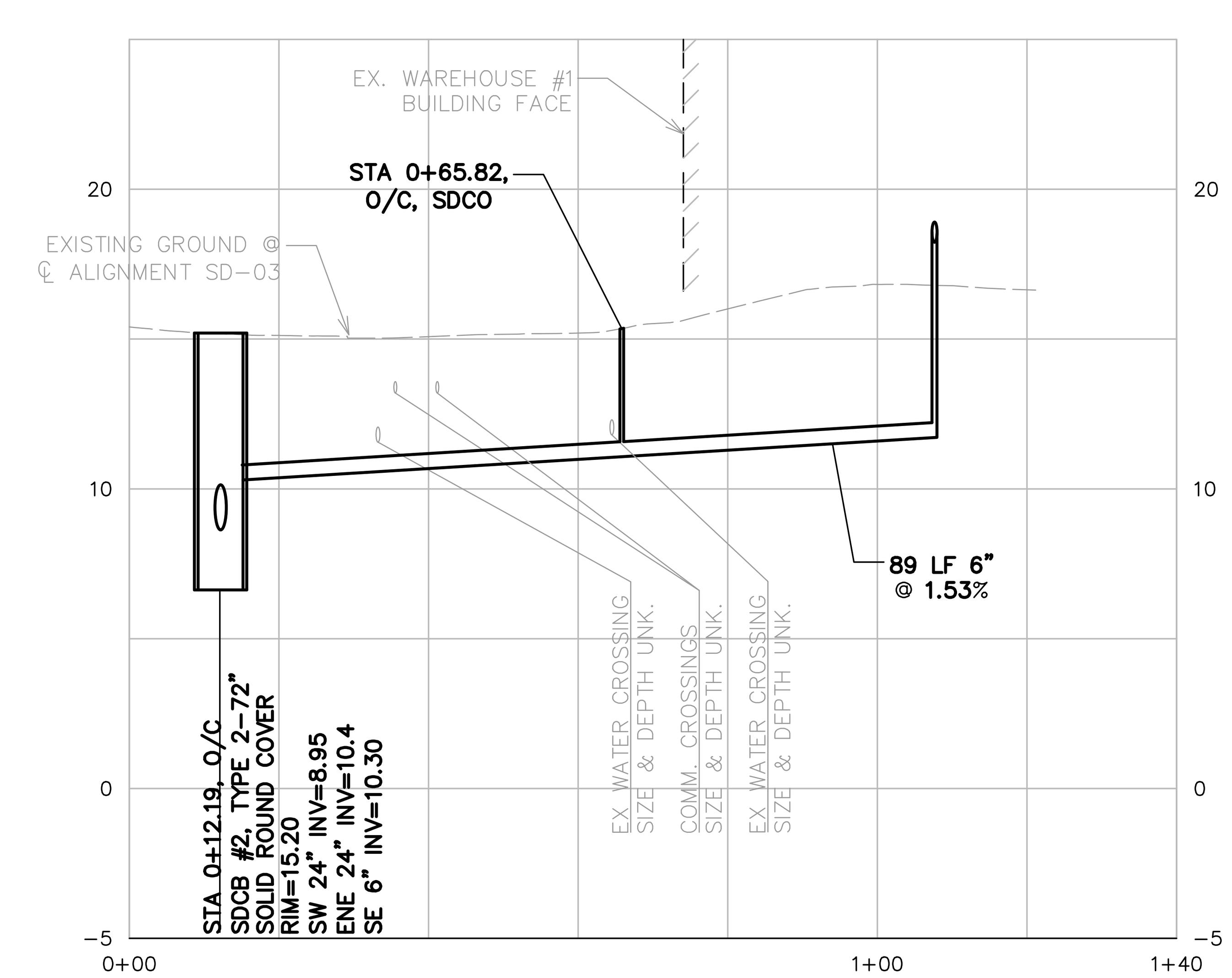
HORIZONTAL SCALE 20 0 20 40 FEET

VERTICAL SCALE 5 0 5 10 FEET

Call 811 two business days before you dig



ALIGNMENT SD-02



ALIGNMENT SD-03

FINAL SUBMITTAL
ISSUED 7/12/2023

MLLW DATUM

PORT OF BELLINGHAM Washington State

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

STORM DRAIN PLAN & PROFILE

Rev.	–
Date:	2023-7-12
M&N Project No.	221324
Designed by:	
Dwn by:	J. SMITH
Ckd by:	E.A.S.
Reviewed by:	
Drawing code:	
Submitted by:	S.STRINGER MOFFATT & NICHOL
Drawing Scale:	
Plot scale:	1:1 (D SHEET)

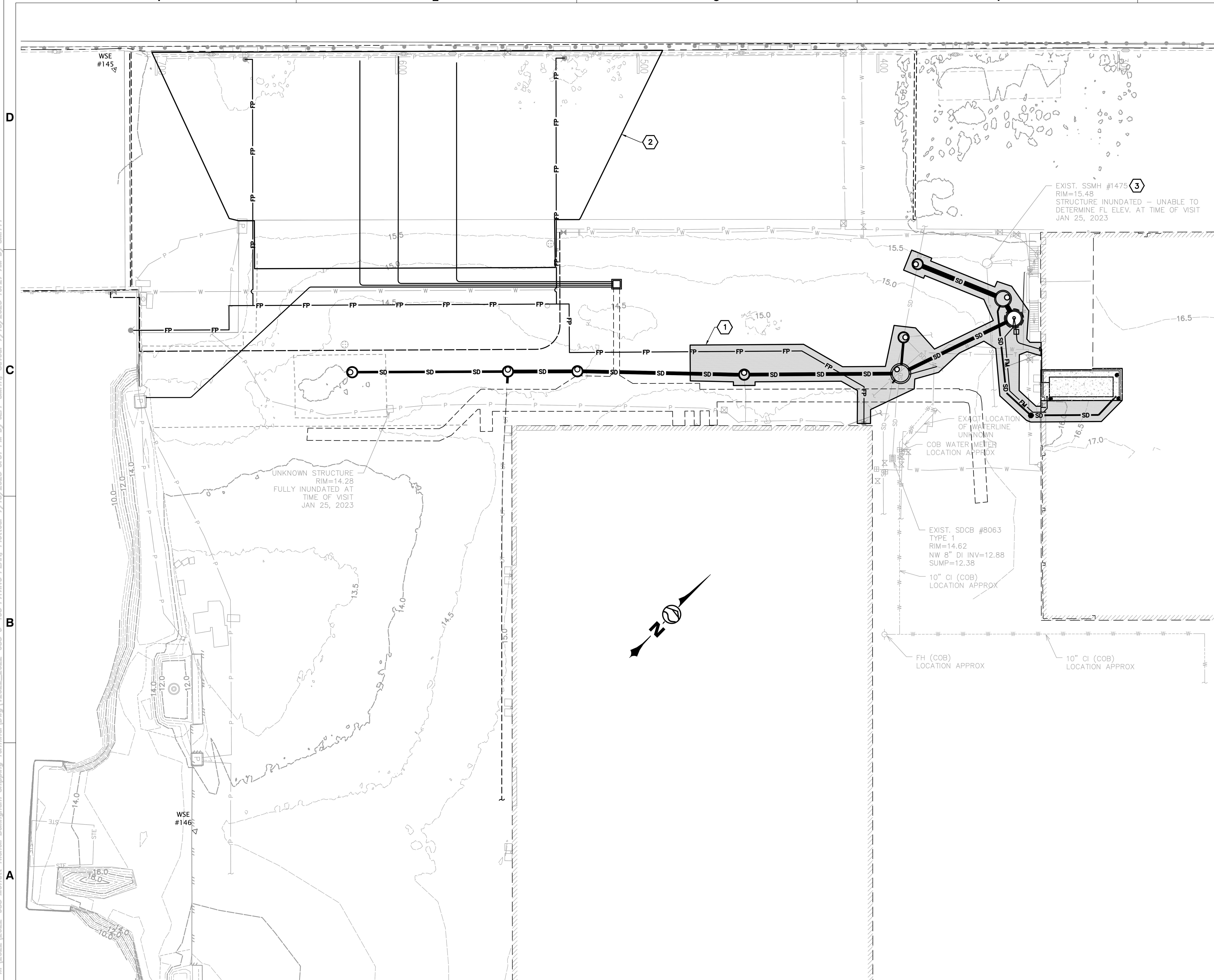
WILSON ENGINEERING
WILSONENGINEERING.COM

SCOTT COURTNEY WINTER, STATE OF WASHINGTON, 42520, REGISTERED PROFESSIONAL ENGINEER
7/13/23

Sheet Reference No.
C-402
INDEX: 21 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

File: W:\2022\2022-083 Moffatt-Nichol Bellingham Shipping Terminal\Dwg\2022_2022-083 C-401 STORM DRAIN PLAN & PROFILES; Plotted: 7/13/2023 3:30 PM by JEFF SMITH; Saved: 7/13/2023 3:25 PM by SMITTY



KEYED NOTES

1 = TRENCH RESTORATION PER 1/C-501

2 = RESTORATION WITHIN THIS AREA PER THE STRUCTURAL PLAN SHEET –/C-101

3 = SEE NOTE 1 ON V-103 FOR SEWER INVERT INFORMATION

FINAL SUBMITTAL
ISSUED 7/12/2023

SHEET NOTES
1) SEE SHEET V-103 FOR EXISTING CONDITIONS

20 0 20 40
SCALE HORIZONTAL SCALE FEET

811 Call 811 two business days before you dig

MLLW DATUM

PORT OF BELLINGHAM Washington State

Mark	Date	Description	Date	Appr.
#	#	#	#	#

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

PAVING REPAIR PLAN

Designed by:	Dwn by: J. SMITH	Ckd by: E.A.S.	Reviewed by:	Submitted by: S.STRINGER MOFFATT & NICHOL
Date: 2023-7-12	M&N Project No. 221324	Drawing code:	Drawing Scale: Plot scale: 1:1 (D SHEET)
Rev. –			

WILSON ENGINEERING
WILSONENGINEERING.COM

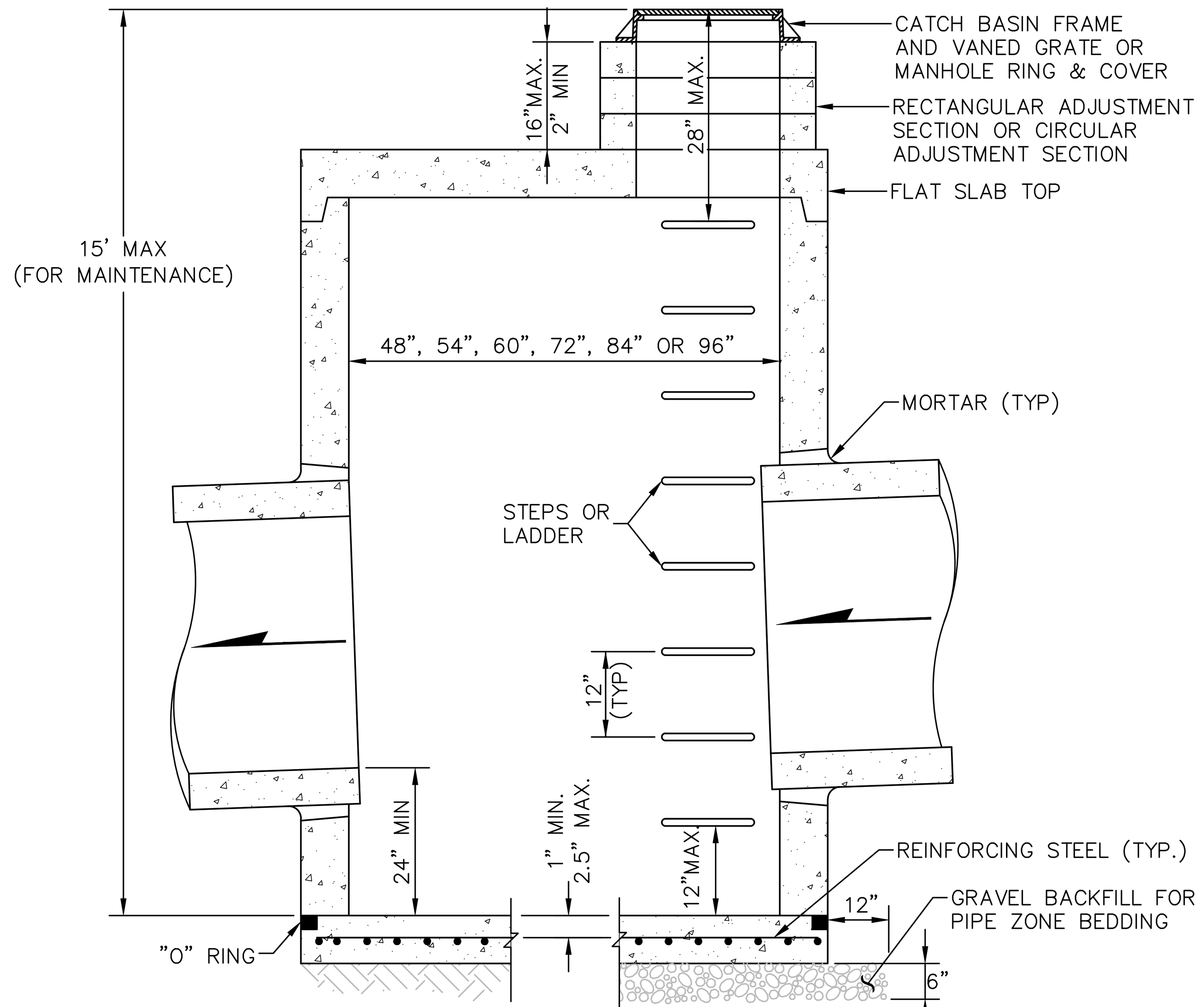
ELIZABETH ANNE STRINGER
STATE OF WASHINGTON
41548
REGISTERED PROFESSIONAL ENGINEER
7/12/2023

Sheet Reference No.
C-403
INDEX: 22 OF 72

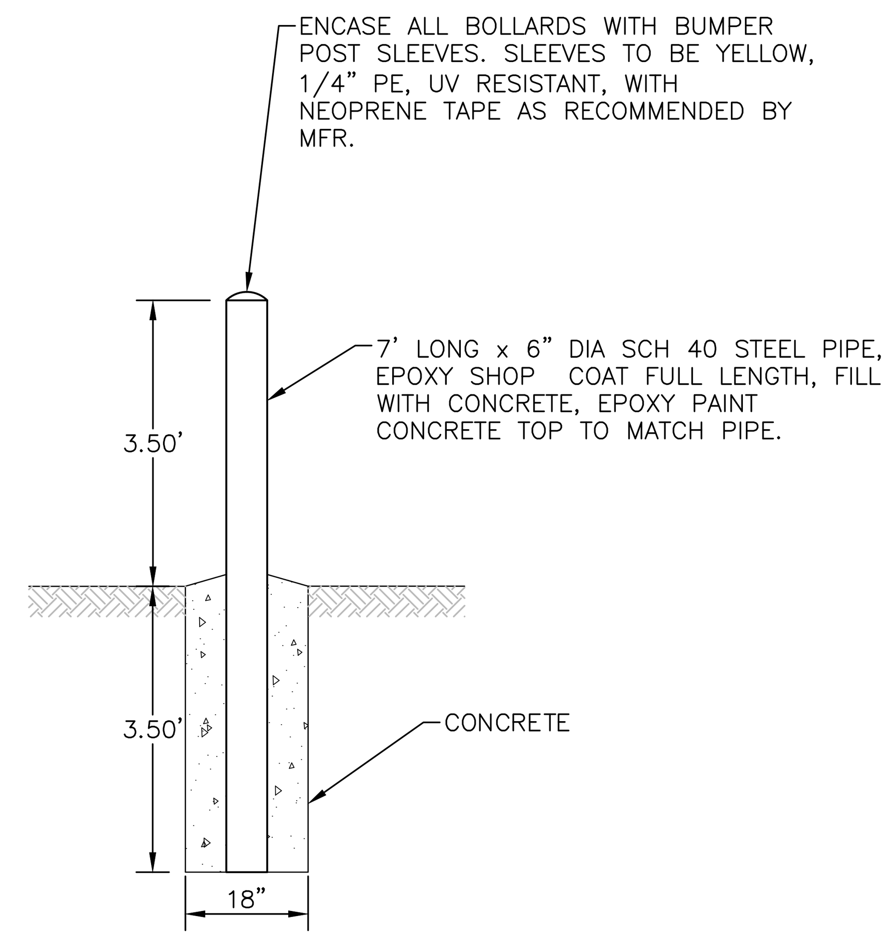
DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

File: W:\2022\2022-083 Moffatt-Nichol Bellingham Shipping Terminal\Dwg\2022_2022-083 C-403 PAVING PLAN; Plotted: 7/13/2023 3:31 PM by JEFF SMITH; Saved: 7/13/2023 10:27 AM by SMITTY

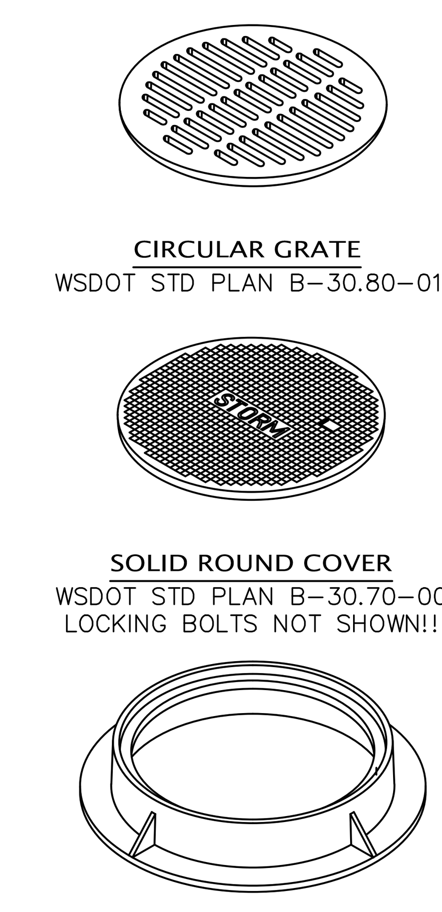
REFER TO WSDOT STANDARD
PLAN NUMBER B-10.20-00
FOR ADDITIONAL INFORMATION



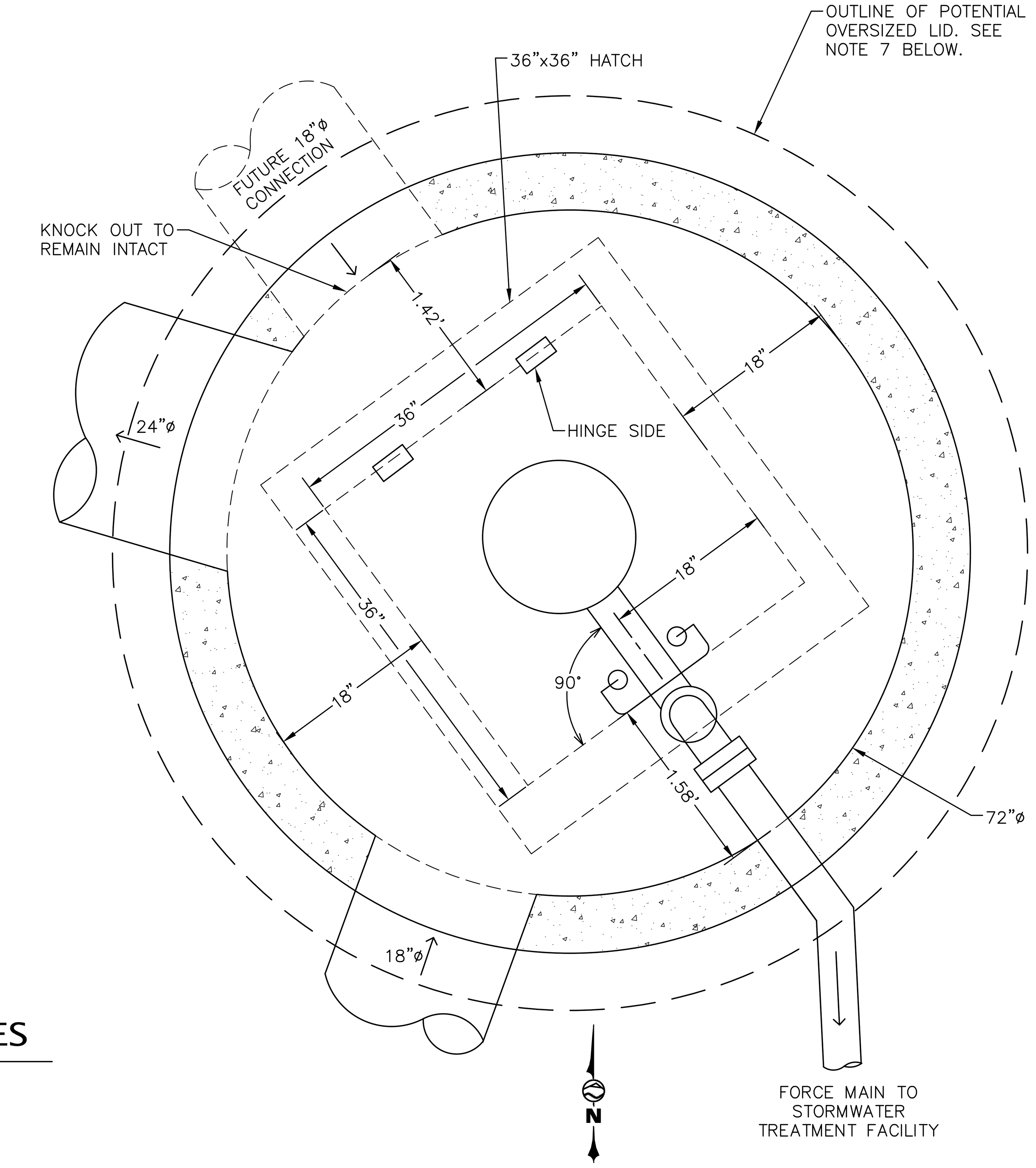
1 TYPE 2 CATCH BASIN DETAILS
NOT TO SCALE



2 BOLLARD DETAIL
NOT TO SCALE



3 CATCH BASIN CASTING TYPES
NOT TO SCALE

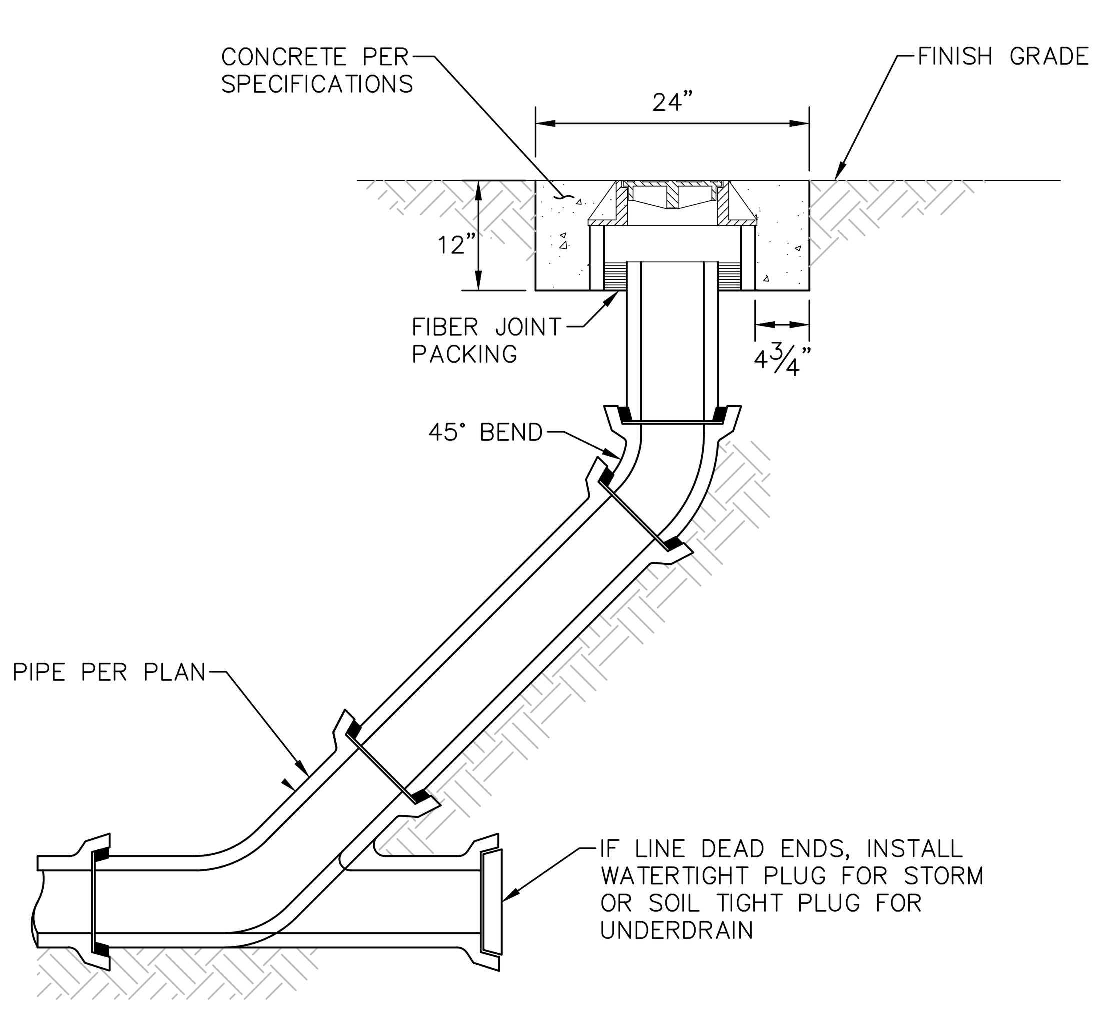


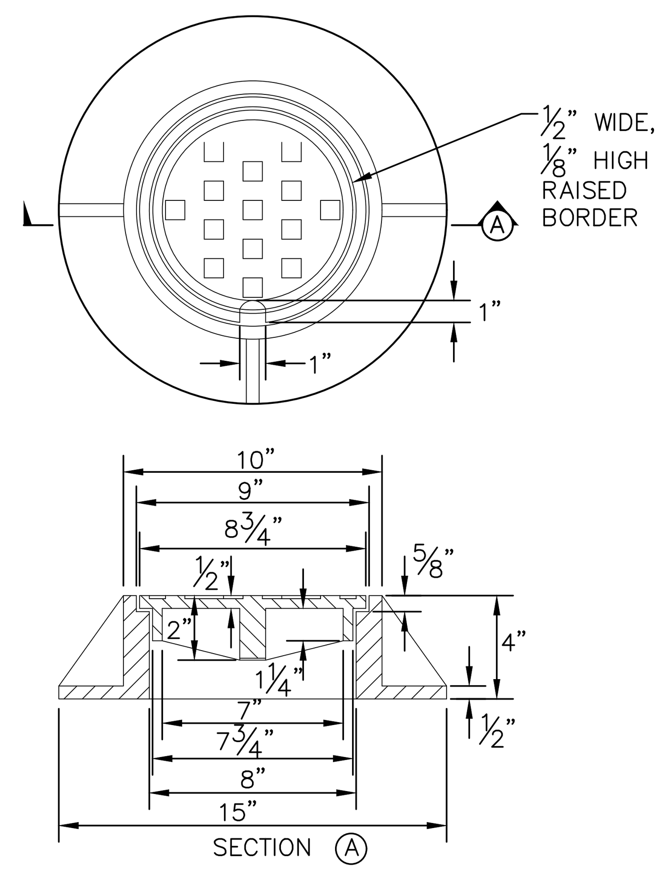
PLAN VIEW

NOTES:

1) LIFT STATION BASE AND RISER SECTIONS SHALL BE PER WSDOT STANDARD PLAN B-15.60-02 (MANHOLE TYPE 3).
2) ENTIRE LID SHALL BE 1/4" ABOVE SURROUNDING GRADES. HATCH SHALL BE CAST INTO LID AND ORIENTED AS SHOWN.
3) CONCRETE LID OPENING SHALL MATCH HATCH OPENING AND ALIGNED DIRECTLY BELOW HATCH.
4) CONDUIT AND FORCE MAIN PENETRATIONS SHALL UTILIZE A COR-N-SEAL BOOT OR APPROVED EQUAL.
5) CONDUIT PENETRATIONS SHALL BE AT SIMILAR ORIENTATION AS THE FORCE MAIN, BUT AT A DIFFERENT ELEVATION.
6) INSTALL ACCESS HATCH DRAIN PIPING IN PRECAST SLAB TO ROUTE RUNOFF WATER TO THE INTERIOR OF THE MANHOLE
7) LID MAY BE LARGER THAN THE MANHOLE IF NEEDED TO ACCOMMODATE THE HATCH. LID MUST HAVE GROOVE TO MATCH UP TO RISER SIMILAR TO STANDARD MANHOLE. IF LID IS LARGER THAN MANHOLE, STRUCTURAL CALCULATIONS MUST BE PROVIDED THAT DEMONSTRATE LID WILL NOT ROTATE WHEN 42.5 KIP POINT LOAD IS APPLIED TO THE OUTER EDGE. IF ROTATION IS EXPECTED, THEN MANHOLE MANUFACTURER MUST SUPPLY DESIGN THAT PREVENTS ROTATION OF THE LID. ANY DESIGN THAT LOCKS THE LID TO THE RISER MUST BE CAPABLE OF BEING DISCONNECTED WITHOUT HAVING TO EXCAVATE THE MANHOLE.

4 STORMWATER LIFT STATION DETAIL
NOT TO SCALE





CAST IRON RING AND COVER
WSDOT STD PLAN B-85.40-00

TYPE A (WSDOT)

NOTE: LID SHALL BE LOCKING

5 STORM CLEAN-OUT DETAILS
NOT TO SCALE

Call 811 two business days before you dig

MLLW DATUM

FINAL SUBMITTAL
ISSUED 7/12/2023

PORT OF BELLINGHAM
Washington State

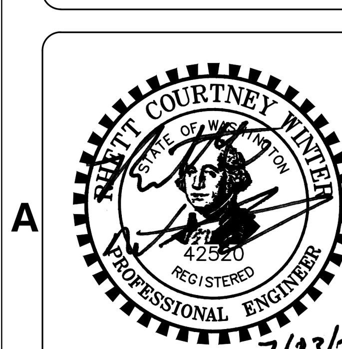
Mark	Date	Description	Date	Appr.
#	#		#	#
#	#		#	#
#	#		#	#
#	#		#	#
#	#		#	#
#	#		#	#
#	#		#	#
#	#		#	#
#	#		#	#
#	#		#	#

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

STORMWATER DETAILS

Date: 2023-7-12		Rev. -
Designed by:		M&N Project No. 221324
Dwn by: J. SMITH	Ckd by: E.A.S.	Drawing code:
Reviewed by:		Drawing Scale:
Submitted by: S.STRINGER MOFFATT & NICHOL		Plot scale: 1:1 (D SHEET)

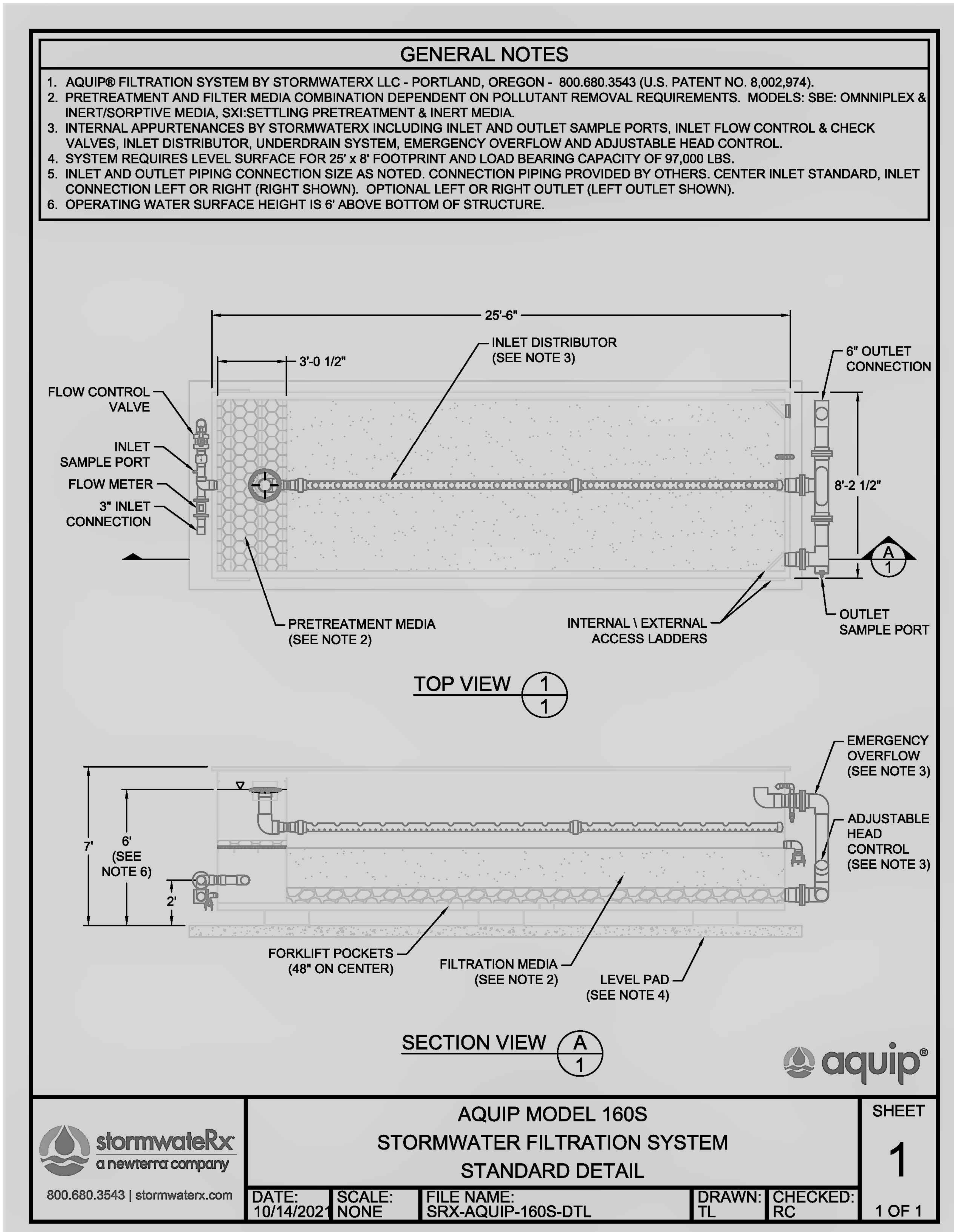
WILSON ENGINEERING
WILSONENGINEERING.COM



Sheet Reference No.
C-502
INDEX: 24 OF 72

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

File: W:\2022\2022-083 Moffatt-Nichol Bellingham Shipping Terminal\Dwg\2022_2022-083 C-502 STORMWATER DETAILS; Plotted: 7/13/2023 3:31 PM by JEFF SMITH; Saved: 7/13/2023 2:41 PM by RHETT



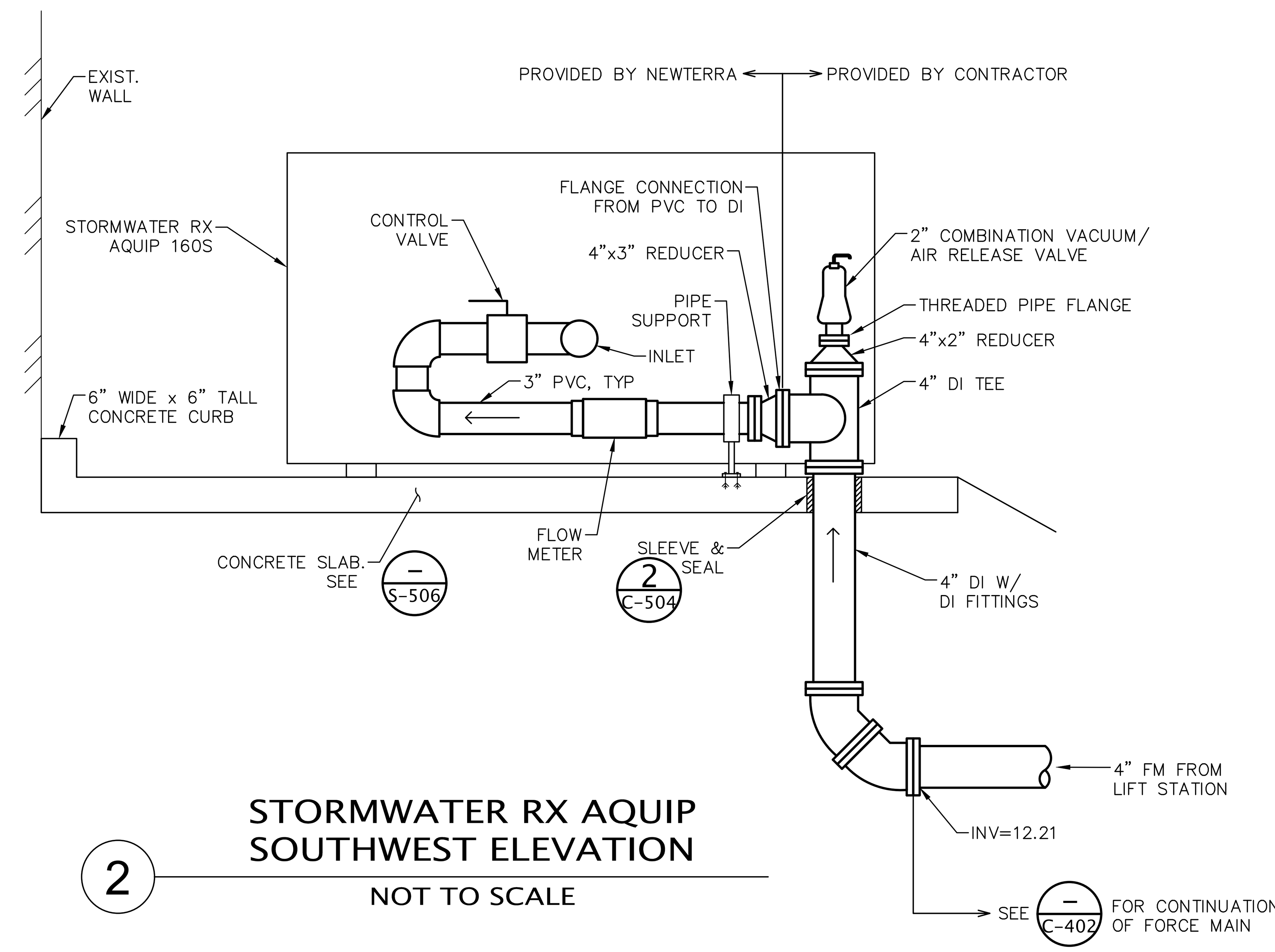
GENERAL NOTES

1. AQUIP® FILTRATION SYSTEM BY STORMWATERX LLC - PORTLAND, OREGON - 800.680.3543 (U.S. PATENT NO. 8,002,974).
2. PRETREATMENT AND FILTER MEDIA COMBINATION DEPENDENT ON POLLUTANT REMOVAL REQUIREMENTS. MODELS: SBE: OMNNIPLEX & INERT/SORPTIVE MEDIA, SXI:SETTLING PRETREATMENT & INERT MEDIA.
3. INTERNAL APPURTENANCES BY STORMWATERX INCLUDING INLET AND OUTLET SAMPLE PORTS, INLET FLOW CONTROL & CHECK VALVES, INLET DISTRIBUTOR, UNDERDRAIN SYSTEM, EMERGENCY OVERFLOW AND ADJUSTABLE HEAD CONTROL.
4. SYSTEM REQUIRES LEVEL SURFACE FOR 25' x 8' FOOTPRINT AND LOAD BEARING CAPACITY OF 97,000 LBS.
5. INLET AND OUTLET PIPING CONNECTION SIZE AS NOTED. CONNECTION PIPING PROVIDED BY OTHERS. CENTER INLET STANDARD, INLET CONNECTION LEFT OR RIGHT (RIGHT SHOWN). OPTIONAL LEFT OR RIGHT OUTLET (LEFT OUTLET SHOWN).
6. OPERATING WATER SURFACE HEIGHT IS 6' ABOVE BOTTOM OF STRUCTURE.

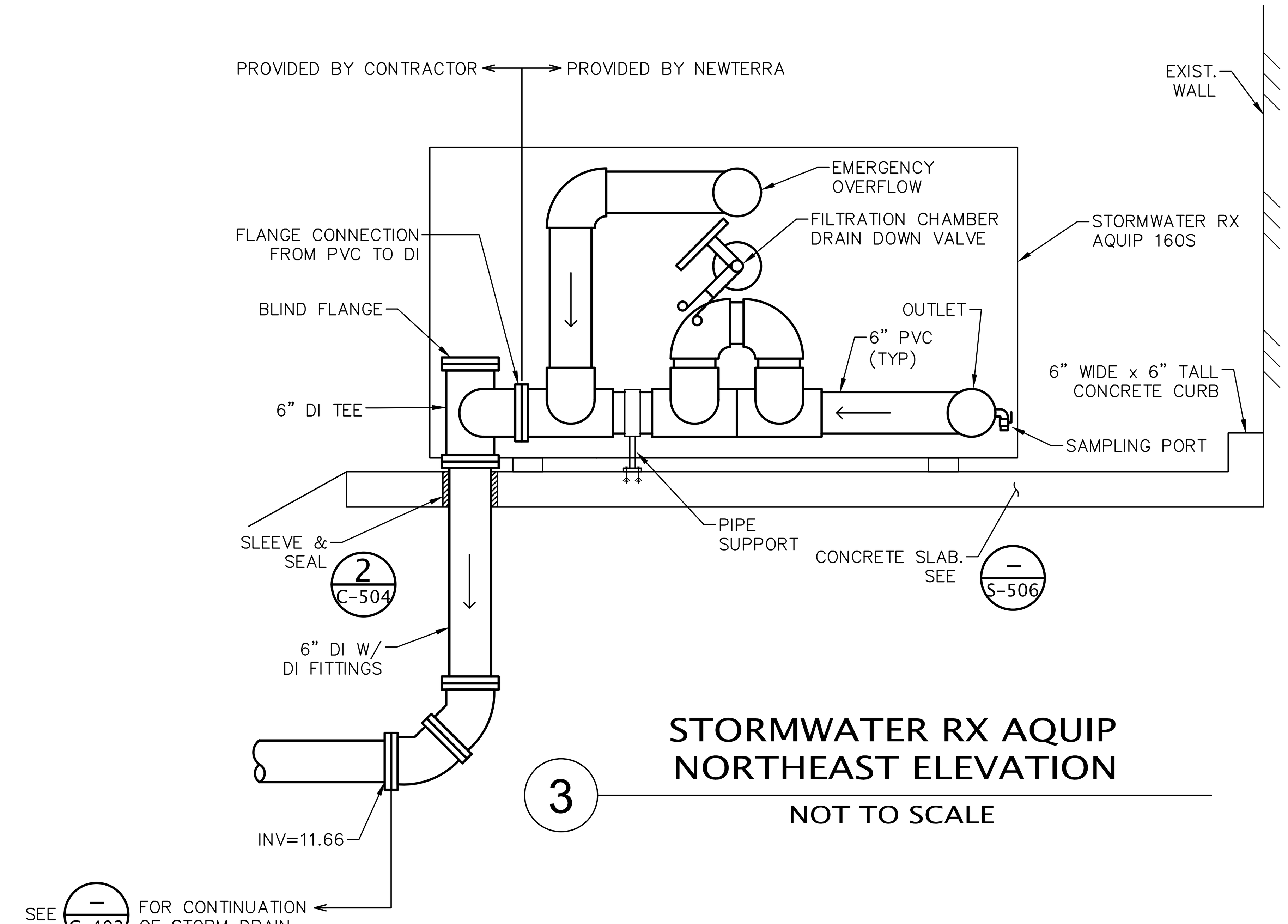
stormwateRx a newterra company 800.680.3543 | stormwaterx.com	AQUIP MODEL 160S STORMWATER FILTRATION SYSTEM STANDARD DETAIL				SHEET 1
	DATE: 10/14/2021	SCALE: NONE	FILE NAME: SRX-AQUIP-160S-DTL	DRAWN: TL	CHECKED: RC	1 OF 1

NOTE:
THIS DETAIL DOES NOT SHOW ACTUAL CONFIGURATION. RATHER, IT ONLY SHOWS SAMPLE CONFIGURATION.
FOR ACTUAL CONFIGURATION, SEE – C-402 & – C-502

1 STORMWATER TREATMENT FACILITY
NOT TO SCALE



2 STORMWATER RX AQUIP SOUTHWEST ELEVATION
NOT TO SCALE



3 STORMWATER RX AQUIP NORTHEAST ELEVATION
NOT TO SCALE

811 Call 811 two business days before you dig

FINAL SUBMITTAL
ISSUED 7/12/2023

MLLW DATUM

PORT OF BELLINGHAM *Washington State*

Mark	Date	Description	Appr.
##	##		##

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

STORMWATER TREATMENT SYSTEM DETAILS

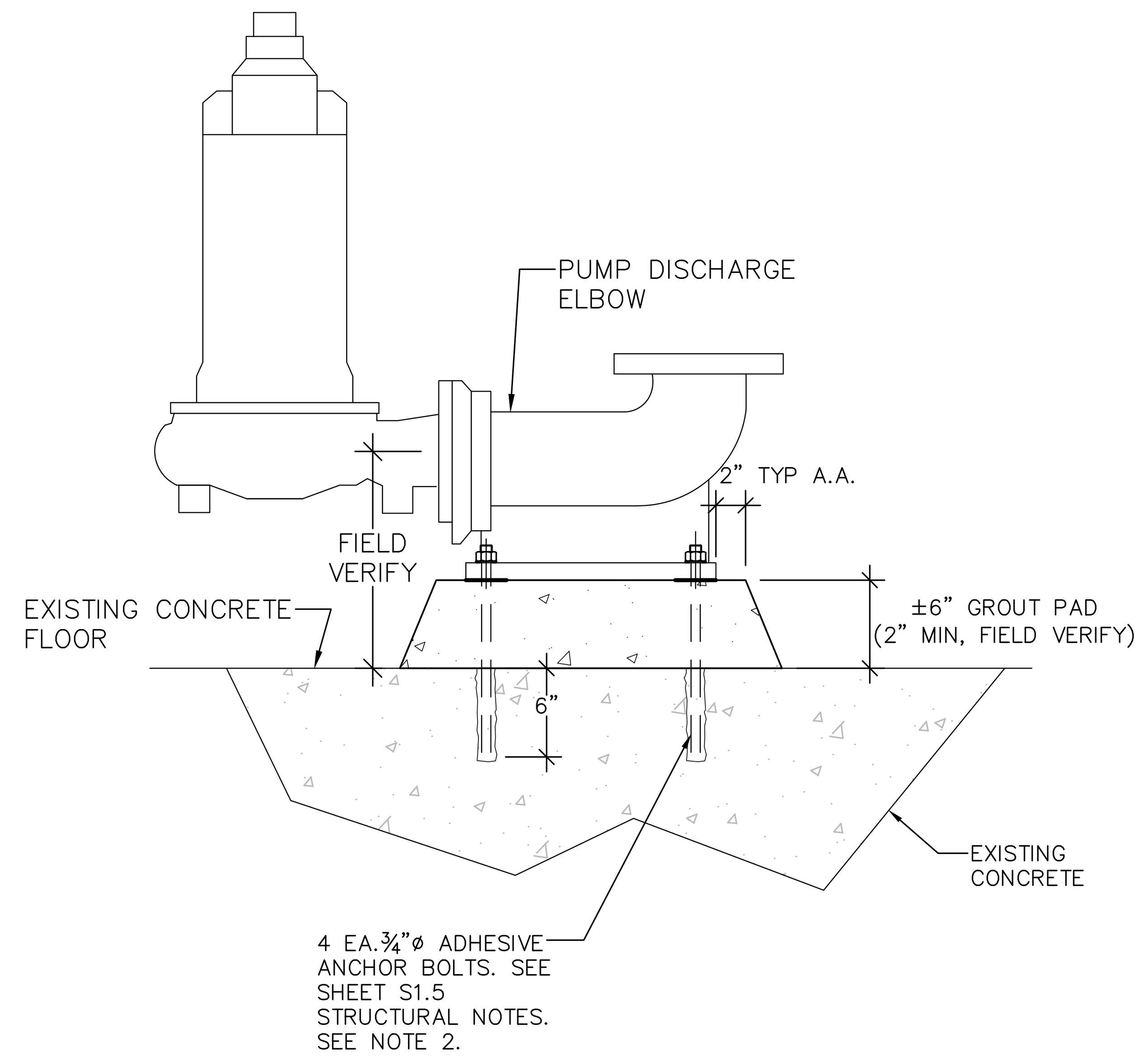
Designed by:	Date: 2023-7-12	Rev. –	
Dwn by: J. SMITH	Ckd by: E.A.S.	M&N Project No. 221324	
Reviewed by:		Drawing code:	
Submitted by: S.STRINGER MOFFATT & NICHOL		Drawing Scale:	Plot scale: 1:1 (D SHEET)

WILSON ENGINEERING
WILSONENGINEERING.COM

SCOTT COURTNEY WINTER, STATE OF WASHINGTON, 42520, REGISTERED PROFESSIONAL ENGINEER
7/13/23

Sheet Reference No.
C-503

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING



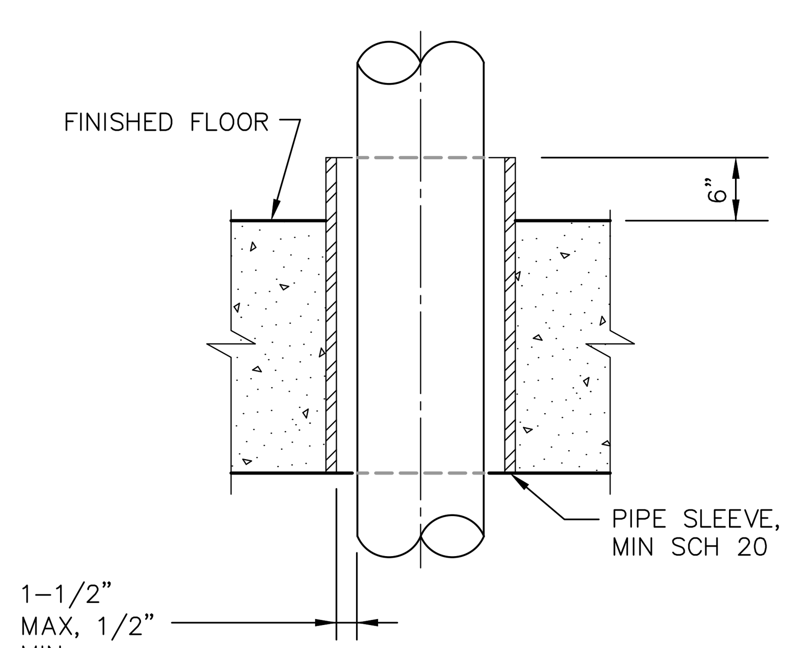
NOTES:

1. POST–INSTALLED ADHESIVE ANCHORS BOLTS SHALL BE OF STEEL CONFORMING TO THE REQUIREMENTS OF THE APPLICABLE ICC–ES REPORT FOR THE ADHESIVE SYSTEM. MAKE AND CLEAN HOLES WITH EQUIPMENT PER THE ICC–ES REPORT. SEE THE DRAWINGS FOR EMBEDMENT, OR USE 5" MINIMUM.

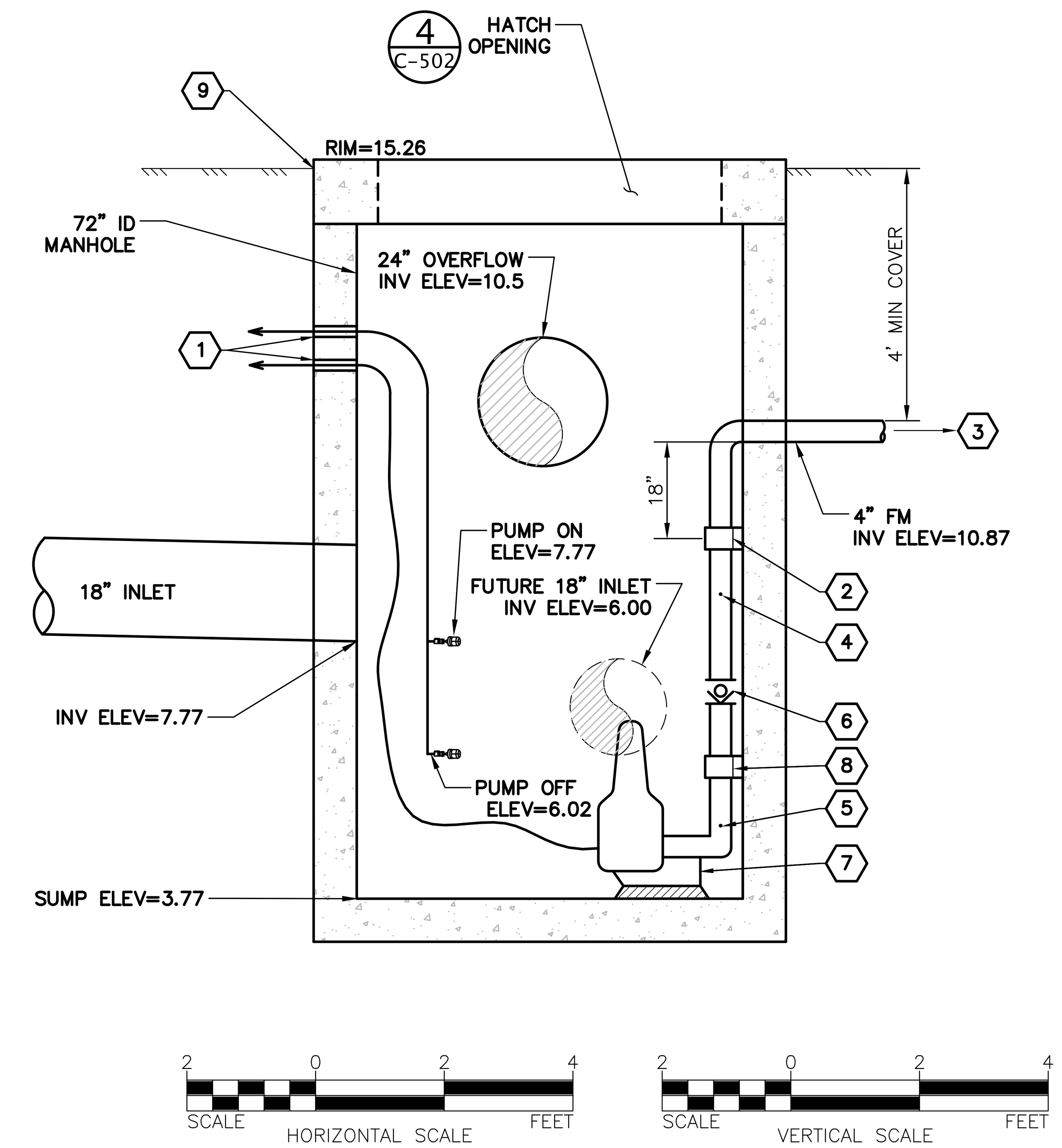
   ACCEPTED ADHESIVE PRODUCTS INCLUDE:
   A. ITW–RAMSET COMPANY: EPCON G5 SYSTEM
   B. HILTI INC: RE–500 SD SYSTEM
   C. SIMPSON STRONG–TIE COMPANY: SET–XP EPOXY
   D. OTHER SYSTEMS WITH WRITTEN APPROVAL OF THE ENGINEER OF RECORD

   FOR ANY PRODUCT TO BE ACCEPTED, IT SHALL HAVE A CURRENTLY VALID ICC–ES REPORT WITH TEST RESULTS INDICATING THAT IT IS SUITABLE FOR USE IN CRACKED CONCRETE. USE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS, INCLUDING AMBIENT TEMPERATURE AND MOISTURE CONDITIONS AT TIME OF USE.

1 PUMP BASE
NOT TO SCALE



2 PIPE PENETRATION FOR CONCRETE SLAB
NOT TO SCALE



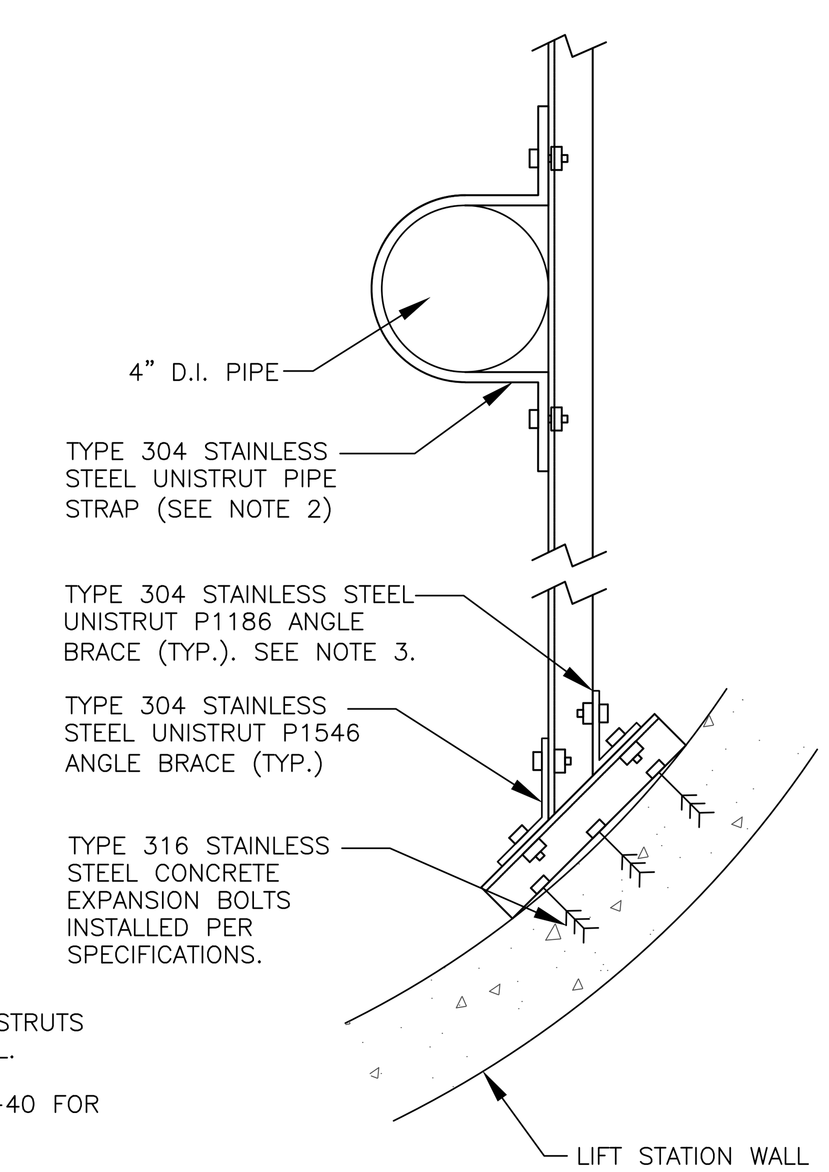
KEYED NOTES

1. = 2"ø CONDUIT FOR POWER & COMMUNICATIONS. FOR CONTINUATION, SEE – / C-402
2. = UNISTRUT PIPE SUPPORT PER 4 / –
3. = FOR CONTINUATION OF FORCE MAIN, SEE – / C-402
4. = 3/16" WEEP HOLE, ELEV=8.5
5. = 3/16" WEEP HOLE LOCATED 2" ABOVE PUMP DISCHARGE
6. = 4" BALL CHECK VALVE, MIDPOINT OF VALVE ELEV=7.0
7. = PUMP BASE PER 1 / –
8. = LOCATE UNISTRUT PIPE SUPPORT MIDWAY BETWEEN LOWER WEEP HOLE AND CHECK VALVE PER 4 / –
9. = LID SHALL BE 1/4" ABOVE SURROUNDING GRADES

NOTES:

1. FORCE MAIN AND CONDUIT PENETRATIONS THROUGH MANHOLE WALL SHALL HAVE KOR–N–SEAL BOOTS. ALL PIPE CONNECTIONS TO BE CORED, EXCEPT CONNECTIONS FOR FUTURE PIPES SHALL BE KNOCKOUTS.
2. FLOATS TO BE LOCATED NEAR FORCE MAIN, BUT SHOWN AWAY FROM FORCE MAIN FOR CLARITY.

3 STORMWATER LIFT STATION



NOTES:

1. ALL UNISTRUT FASTENERS, BRACES AND STRUTS SHALL BE TYPE 304 STAINLESS STEEL.
2. PIPE STRAP SHALL BE UNISTRUT P2558–40 FOR 4" DISCHARGE PIPING.
3. DRILL HOLE IN STRUT FOR BOLT.

4 PIPE SUPPORT DETAIL
NOT TO SCALE

Call 811 two business days before you dig

FINAL SUBMITTAL
ISSUED 7/12/2023

MLLW DATUM

DRAWING SCALES SHOWN BASED ON 22"x34" DRAWING

PORT OF BELLINGHAM Washington State

PORT OF BELLINGHAM
BELLINGHAM SHIPPING TERMINAL
MARINE INFRASTRUCTURE AND DREDGING

STORMWATER TREATMENT SYSTEM DETAILS

Rev.	–
Date:	2023–7–12
M&N Project No.	221324
Drawing code:	
Drawing Scale:	
Plot scale:	1:1 (D SHEET)
Designed by:	
Dwn by:	J. SMITH
Ckd by:	E.A.S.
Reviewed by:	
Submitted by:	S.STRINGER MOFFATT & NICHOL

WILSON ENGINEERING
WILSONENGINEERING.COM

SCOTT COURTNEY WINTER, STATE OF WASHINGTON, 42520, REGISTERED PROFESSIONAL ENGINEER, 7/13/23

Sheet Reference No.
C-504
INDEX: 26 OF 72

APPENDIX E

Product Information

Pure Rain™ STORMWATER TREATMENT

FILTER SOCKS

Pure Rain™ **Filter SOCKS** are designed for reducing turbidity, TSS, metals and other pollutants and are an excellent way to treat throughout a site. Filter Socks can be used for sheet flow, in vaults, catch basins, ditches or swales.

Filter Socks utilize a malleable material that bends and contours to any surface. They have a high UV resistance and are designed to have a long life. Choose either **BiocharBASIC**™ or **BiocharPEAT**™ Stormwater Filter Media to meet your site's individual needs.

Pure Rain™ **Filter SOCKS** Options:

- High UV resistant material
- Easy Deployment
- Easy Maintenance
- **Standard Lengths are 3' & 10' Long** by 8" diameter filled ~75% with **BiocharBASIC**™
- Choice of media **BiocharBASIC**™ or **BiocharPEAT**™
- Custom lengths available in 8", 12" or 18" Diameter Socks

StormwaterBIOCHAR.com

(503) 789-6760 info@StormwaterBIOCHAR.com Affordable Metal Removal Solutions AMERICAN MADE

Stormwater BIOCHAR .com

STORMWATER TREATMENT

FIELD ANALYSIS Treatment Systems

Simple · Proven · Effective

Biochar BASIC
Stormwater Treatment Filtration Media

Date of Test	Pollutant Tested	% Change	PRE Treatment	Unit of Measure	POST Treatment	Unit of Measure	Other Info about Site
1/28/20	Copper	**75%**	387	µg/L	95.8	µg/L	Four Socks Around a Catch Basin
1/28/20	Zinc	**75%**	2880	µg/L	708	µg/L	Four Socks Around a Catch Basin

2/4/20	Iron	62%	3500	µg/L	1340	µg/L	BioSwale Application

20 Socks laid throughout the swale

3/6/20	Aluminum	**73%**	1000	µg/L	270	µg/L	4 Socks in base of Catch Basin
3/6/20	Copper	**62%**	12	µg/L	4.6	µg/L	4 Socks in base of Catch Basin
3/6/20	Iron	**44%**	1800	µg/L	1000	µg/L	4 Socks in base of Catch Basin
3/6/20	Lead	**89%**	5.3	µg/L	0.59	µg/L	4 Socks in base of Catch Basin
3/6/20	Zinc	**73%**	77	µg/L	21	µg/L	4 Socks in base of Catch Basin

StormwaterBIOCHAR.com

Biochar *for stormwater treatment since 2010*

Stormwater **BIOCHAR** LLC

PHONE
(503) 789-6760

EMAIL
info@StormwaterBIOCHAR.com

Simple · Proven · Effective

THE RIGHT **BIOCHAR**,
THE RIGHT **BLEND**, DIALED IN.