

Stormwater Report

OBH – Express Care Clinic

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Project Overview

This report has been prepared to outline the existing and proposed stormwater conditions for the Ocean Beach Clinic project. This report is intended to meet the City of Ilwaco Development Standards of 2015 and the 2024 Stormwater Management Manual for Western Washington (SWMMWW) requirements.

The proposed project is located within the Ocean Beach Hospital (OBH) campus on the corner of First Avenue (US-101) and Ash Street in Ilwaco, Washington. The main existing driveway is located on First Avenue and a smaller driveway connecting to Ash Street is located at the back of the existing paved parking lot. The project includes a building addition to an existing clinic building and a new parking lot.

Existing site includes a medical clinic building, a residential building, a helicopter pad, a paved asphalt parking lot, and an additional gravel parking lot. The site topography consists of relatively flat areas with gradual slopes in the surrounding landscape areas on the project site.

The existing on-site stormwater conveyance system consists of catch basins, manholes, roof drains, and the connections between them. A majority of the site drains from the northwest corner and flows southeast, dropping approximately 4-feet from the highest point to the lowest point. Flows continue offsite to the southeast and eventually to a natural stream in a wetlands area approximately 155-feet from the lowest corner of the site. The westernmost section of the site and the existing sidewalk drain towards the roads that border the north and west edges of the property.

The proposed stormwater systems have been designed to manage as close to the same amount of existing drainage as possible. The stormwater flow is limited to not exceed the pre-development rate in accordance with the standards. Table 1 below provides a breakdown of relevant area types, magnitudes, and impervious percentages. (See Appendix 1a and 1b – Existing Basin Map and Proposed Basin Map, respectively.)

TABLE 1: Basin Area Breakdown

Basin Area Breakdown					
Area Type	Impervious Area (SF)	Pervious Area (SF)	Total (SF)	Total (AC)	% Impervious
Existing condition	21,140	9,600	30,740	0.706	69%
Proposed condition	24,070	6,670	30,740	0.706	78%

An erosion and sediment control plan has been prepared for the construction of the proposed condition (see Appendix 2b – Demolition and Erosion Control Plan).

Minimum Requirements

The proposed redevelopment constitutes land-disturbing activity. Based on Section 5.2 of the City of Ilwaco Development Standards, on-site detention or infiltration systems shall be provided to ensure that stormwater flow rates following development do not exceed the pre-development rate in accordance with the Stormwater Management Manual for Western Washington (SWMMWW). Details of these requirements can be found in the 2024 SWMMWW. Table 2 below contains a breakdown of the minimum requirements, management strategy, and references within the report that pertain to each minimum requirement.

TABLE 2: Minimum Requirements Summary

2024 Stormwater Management Manual for Western Washington			
Minimum Requirements Summary			
Requirement	Requirement Summary	Requirement Management Strategy	Reference
1 - Preparation of Stormwater Site Plans	All projects shall prepare a Stormwater Site Plan for local government review. Stormwater Site Plans shall use site-appropriate development principles, as required and encouraged by local development codes, to retain native vegetation and minimize impervious surfaces to the extent feasible (I-3.4.1).	Site plans have been prepared for the proposed site stormwater management strategy.	N/A
2 - Construction Stormwater Pollution Prevention (SWPP)	All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters (I-3.4.2).	A draft SWPPP will be provided to the contractor and updated as necessary.	N/A
3- Source Control of Pollution	All known, available and reasonable source control BMPs must be applied to all projects. Source control BMPs must be selected, designed, and maintained according to this manual (I-3.4.3).	Appropriate source control BMPs have been applied to limit pollution to the stormwater system. Erosion control measures will also be put in place during construction to manage source control pollution.	See Appendix 5b – Demolition and Erosion Control Plan

TABLE 2: Minimum Requirements Summary (continued)

2024 Stormwater Management Manual for Western Washington			
Minimum Requirements Summary			
Requirement	Requirement Summary	Requirement Management Strategy	Reference
4 - Preservation of Natural Drainage Systems and Outfalls	Natural drainage patterns shall be maintained and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties (I-3.4.4).	The ultimate outfall connection to the existing City of Ilwaco stormwater system remains the same as the existing conditions.	N/A
5 - On-Site Stormwater Management	Projects shall employ on-site Stormwater Management BMPs in accordance with the following: project thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts (I-3.4.5).	LID performance standards have been met using the below-grade detention BMP (arch chamber system) used to meet MR 7 – Flow Control. See Appendix 3c – MGS Flood Report for the system passing the LID criteria.	See Appendix 3c – MGS Flood Report
6 - Runoff Treatment	Projects shall employ Runoff Treatment BMPs in accordance with the following thresholds, standards, and requirements to remove pollutants from stormwater runoff (I-3.4.6).	StormFilter catch basins have been sized to treat all pollution-generating surfaces draining onsite.	See Appendix 3a and 3b – Stormwater Cartridge Selection and MGS Flood Output Respectively.
7 – Flow Control	Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions (I-3.4.7).	The proposed project controls flow through the use of proprietary systems and a flow control manhole sized using approved continuous modeling software for western Washington.	See Appendix 3c – MGS Flood Report
8 - Wetland Protection	The requirements apply only to projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system (I-3.4.8).	The proposed project does not discharge into a wetland.	N/A
9 - Operation and Maintenance	An operation and maintenance manual shall be provided for proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified (I-3.4.9).	An Operation and Maintenance Manual is included in Appendix 4 – Operations and Maintenance Plan.	See Appendix 4 – Operations and Maintenance Plan.

Soils Evaluation

The Natural Resources Conservation Service's (NRCS) hydrologic soil group map was used to determine the hydrologic soil group as type B and can be found in Appendix 5a.

The Geotech report noted the Washington DNR Map categorizes the soil site class as D-E and agrees with the class D classification. They also mention that soils onsite contain 40.3-50.6% moisture content and an Atterberg limit test resulting in SILT of high liquid limit. See Appendix 5b – Geotechnical Report. For this reason, a soil ground D/saturated was used for modeling purposes.

The field investigation performed by Rapid Soil Solutions, Inc. (RSS) indicated that the soils were a mixture of Missoula flood deposits. Determining through the infiltration tests that the soils at a depth of 4-feet were determined to be silty clay. HA#1 showed an infiltration rate of 7 in/hr and HA#2 showed an infiltration rate of 0.7 in/hr. Groundwater, according to the Washington Department of Ecology, was estimated at 9-feet below the site grades. During the investigation, RSS found water at approximately 11.5-feet below grade near HA#2. This would put the groundwater at an approximate elevation of 87.00. See Appendix 5c – Field Investigation.

Source Control

The primary pollutant that poses a risk for release into the surrounding environment during and after construction is sediment. If native soils or imported stockpiled materials are exposed to rain during grading activities, storm runoff can suspend loose soil particles and carry them downstream. During construction, the necessary erosion control measures will be installed to reduce the possibility of releasing pollutants offsite (see Appendix 2b – Demolition and Erosion Control Plans).

Post-construction, the use of “trapped” area drains and filtered catch basins will effectively prevent sediment from moving offsite. All pervious areas will either be re-seeded or landscaped and covered with mulch to prevent sediment-laden runoff as well.

Post-construction drainage contaminated by dissolved metals is due mainly to the operation of automobiles. The main contributors to metal pollution are car brake pads and oil deposits on asphalt roadways. Given the site's low traffic, metal pollution is not considered a substantial pollutant risk. Per the SWMMWW Table I-4.4, our project can be classified as a low-pollutant generating site. Therefore, the facilities implemented onsite should satisfy the required treatment for solids, oils, and metals (see Table I-4.5 in the SWMMWW). All catch basins installed in this project will be “filtered” catch basins, which will keep floatable materials like oil within the catch basin and limit the discharge of oils and other pollutants.

On-site Stormwater Management

The proposed design methodology for on-site stormwater management will incorporate filtered catch basins, an underground arch chamber detention system, landscape area drains, and a flow control manhole.

The primary method of conveyance to stormwater management facilities is sheet flow into filtered catch basins or landscape area drains connected to the arch chamber detention system before tying into the existing storm system.

Runoff Treatment Analysis and Design

Per the SWMMWW requirements, all infiltration treatment facilities are to be preceded by a method of pretreatment. This requirement has been met through the use of Contech StormFilter catch basins designed to treat runoff from pollution-generating surfaces.

Flow Control Analysis and Design

Flow control requirements will be met through the use of an Arch Chamber as a detention system controlled with a flow control manhole. See Appendix 2c – Details and Appendix 3c – MGS Flood Report.

Section 5.2-H of the City of Ilwaco Development Standards notes that “all infiltration systems shall be open at the top to allow for maintenance.” However, a Chambermaxx Detention system was used as the basis of design due to the infeasibility of an above-ground infiltration system, given the site size and the maintainability of the Chambermaxx system. The system will include a diversion manhole designed for access to a containment row for inspection and maintenance. The containment row is intended to act as a low-treatment strategy since sediment loading is expected to be minimal within the arch chamber system.

While the Chambermaxx system is referred to as a detention system, separation fabric will be used to allow for limited infiltration into the native soils. A factored infiltration rate of 0.315 in/hr was determined using Table V-5.4 of the SWMMWW and applying the total correction factor of 0.45 to the 0.7 in/hr infiltration rate determined at the HA#2 location in the field investigation by RSS. See Table 3 below for assumed correction factors.

TABLE 3: Correction Factors

Correction Factor	Range	Design Value Selected
Site variability and number of locations tested (CF_v)	0.33-1.0	1.0
Uncertainty of test method (CF_t)	<u>Test Method</u> 0.75 for large-scale PIT 0.50 for small-scale PIT <u>Grain Size Method.</u> 0.40 for % passing No.200 > 10 0.50 for % passing No.200 < 10 but > 5 0.75 for % passing No.200 < 5	0.5
Degree of influent control to prevent siltation and bio-buildup (CF_m)	0.9 for all BMPs other than bioretention and permeable pavement 1.0 for bioretention and permeable pavement	0.9
Quality of pavement aggregate base material (CF_b)	0.9-1.0 for permeable pavement 1.0 for all BMPs other than permeable pavement	1.0
Total Correction Factor (CF_T)	$=CF_b * CF_m * CF_t$	0.45

Conveyance System

Storm

All proposed stormwater piping was designed to convey the 25-year 24-hour design storm. Pipe sizing is based on the Santa Barbara Urban Hydrograph (SBUH) runoff rates. Modeling of the conveyance system was performed using Autodesk Storm and Sanitary Analysis (SSA). A basin map showing areas considered in conveyance calculations can be found in Appendix 1b. Inlet structures associated with basins and detailed conveyance calculations can be found in Appendix 3d – Subbasin Summary and 3e – Conveyance Summary. Surcharging occurs in the run of pipe from CB-02 to the Arch Chamber system due to the depth of water in the system, and the inability to raise the pipe higher because of the surface elevation at that corner of the site. Surcharging is also shown occurring in the pipe from the Arch Chamber system to FCMH-01 because the pipe is flat and part of the detention system. No ponding of structures occurs during the 24-hour, 25-year, or 100-year storm events.

All areas on site are conveyed to the arch chamber system below the proposed parking lot before passing through a flow control manhole and tying into the existing storm system in First Ave. N. A flow control manhole with an orifice allows flow to be released at a rate which meets the requirements in the SWMMWW and is modelled using MGS-Flood, a continuous modeling system approved for use in this region. (See Appendix 2c – Details and Appendix 3c – MGS Flood Report). An overflow structure is also provided within the overflow manhole, allowing the system to discharge as necessary during larger storm events. SSA was also used to verify that no structures overtop during the 24-hour 100-year storm event.

Basin 1 consists of pervious landscape, an existing sidewalk being replaced, and a proposed sidewalk providing a route to the new expansion. The existing drainage path in this area drains to the existing intersection northwest of the site and the proposed condition maintains this same direction. This area is not managed by the detention system and flows offsite.

Basin 2 consists of landscape areas and drainage from the concrete mechanical enclosure and is picked up by an area drain before being conveyed to the Arch chamber system.

Basin 3 is split into 5 subbasins (a-e) that each connect to their own stubs. The main roof drains to the north and is split equally among the northernmost 3 stubs, while the walkways between the existing building and the expansion each have their own small connections.

Basin 4 consists of a concrete plaza between the covered walkways and the existing and proposed buildings.

Basin 5 consists of a landscape area near the main entrance to the expansion.

Basin 6 consists of runoff from the proposed sidewalk on site, the access drive, and the existing landscape island. Runoff is directed to a StormFilter catch basin to be treated before being directed to the Arch chamber system.

Basin 7 consists of runoff from a majority of the proposed parking lot, landscape islands, and some sidewalks, as well as a section of Ash Street to the north that drains onsite. Runoff is directed to a StormFilter catch basin to be treated before being directed to the Arch chamber system.

Basin 8 consists of existing impervious area being replaced in the paved parking lot south of the site and is not being managed as part of this project. No pervious area is being converted to impervious and no additional area is being directed towards this location. Stormwater from this area appears to drain to existing stormwater management facilities constructed under a previous project southeast of the existing parking lot. No documentation on the existing facilities has been found.

Alignment SD-1 collects runoff from area drains, building roof leaders, and the proposed access drive through a filtered catch basin before conveying everything to the arch chamber system below the proposed parking lot.

Alignment SD-2 runs from the arch chamber system to the existing storm in First Avenue. Stormwater runoff from the entire site is detained in the underground arch chamber detention system and slowly released through a flow control manhole to the existing storm system and is allowed to overflow during large storm events.

Operations and Maintenance

See Appendix 4 – Operations and Maintenance for the operation and maintenance procedures for all the stormwater systems that can be found within the site.

Engineering Conclusions

Based on the requirements of the City of Ilwaco and the Stormwater Management Manual for Western Washington, flow control, treatment, and conveyance components will be met and have enough capacity to manage the storm events to the maximum extent feasible and should be approved as designed.

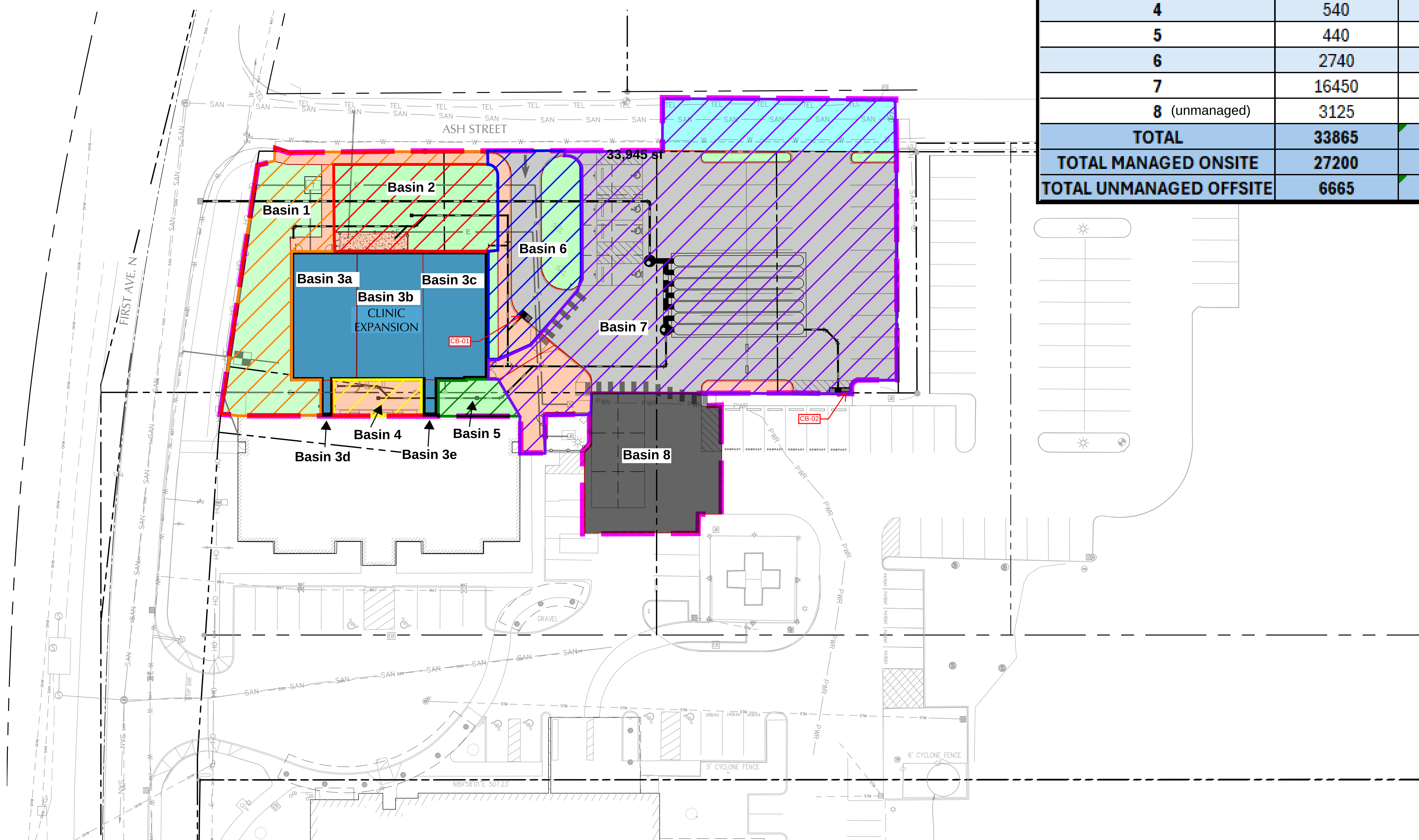
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Appendix 1

Existing Basin Map

Proposed Basin Map

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BASIN	TOTAL AREA		IMPERVIOUS	PERVIOUS	% IMPERVIOUS
	(sf)	(ac)	(sf)	(sf)	
1 (unmanaged)	3540	0.081	750	2790	21%
2	2440	0.056	240	2200	10%
3a	1490	0.034	1490	0	100%
3b	1490	0.034	1490	0	100%
3c	1490	0.034	1490	0	100%
3d	60	0.001	60	0	100%
3e	60	0.001	60	0	100%
4	540	0.012	540	0	100%
5	440	0.010	0	440	0%
6	2740	0.063	1710	1030	62%
7	16450	0.378	16240	210	99%
8 (unmanaged)	3125	0.072	3125	0	100%
TOTAL	33865	0.777	27195	6670	80%
TOTAL MANAGED ONSITE	27200	0.624	23320	3880	86%
TOTAL UNMANAGED OFFSITE	6665	0.153	3875	2790	58%

LEGEND

Pollution-Generating Impervious (Roads, Parking Lots)

Non-Pollution-Generating Impervious (sidewalks)

Non-Pollution-Generating Impervious (Roof Area)

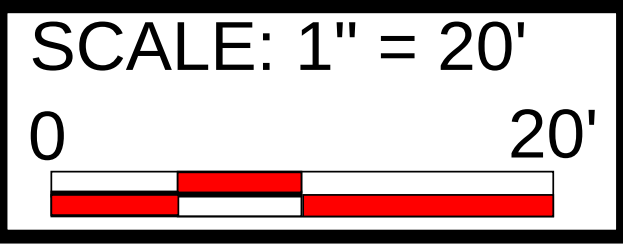
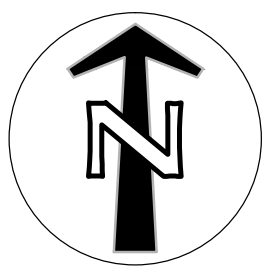
Pervious (Landscape Area)

Pollution-Generating Impervious (Offsite Road Area draining to site)

Pollution-Generating Impervious (Onsite mobile MRI pad draining offsite)

Structure ID	PGIA*	
	(sf)	(ac)
CB-01	1110	0.025
CB-02	14900	0.342

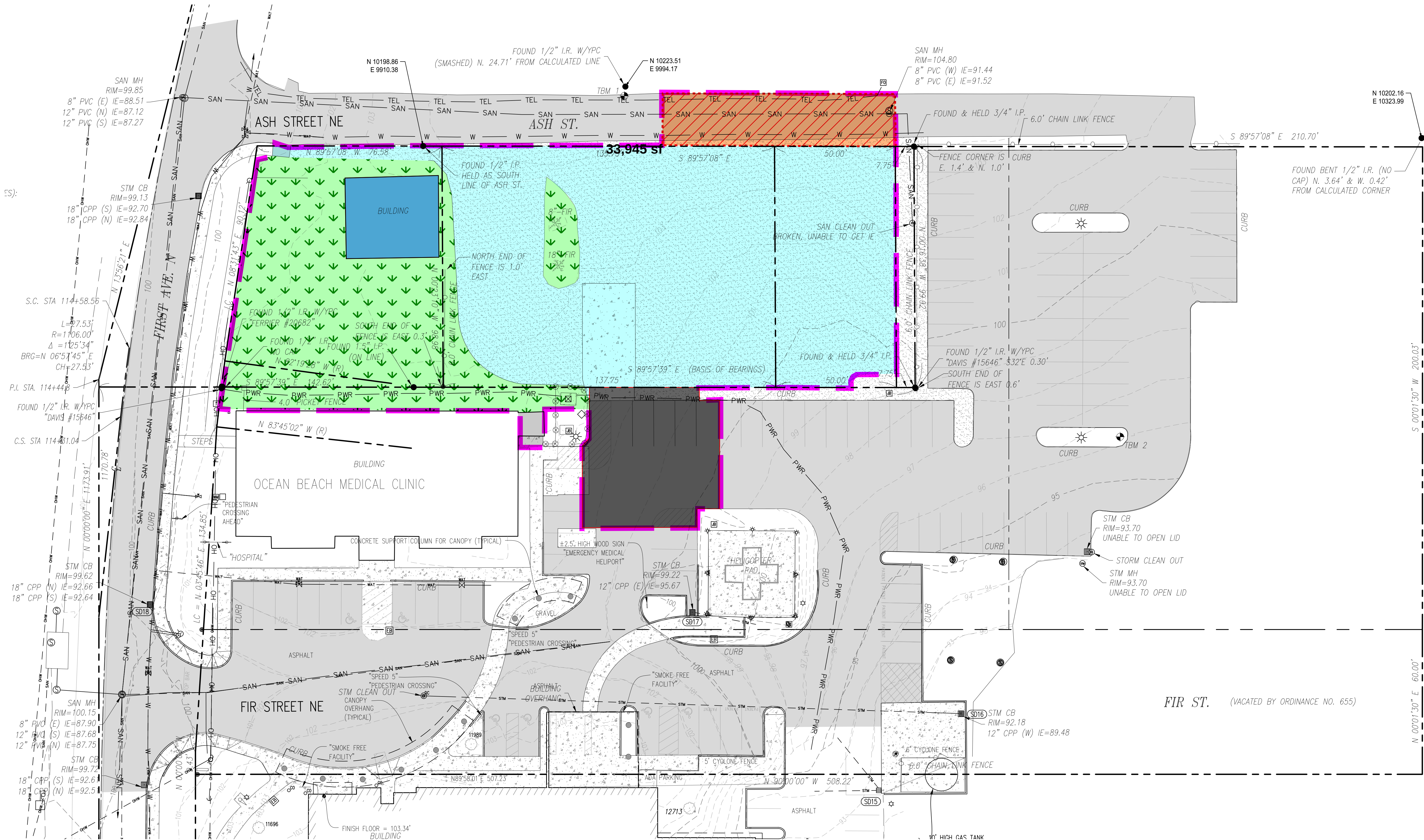
*Pollution-generating impervious area



PROPOSED BASIN MAP
FOR
OBH - CLINIC

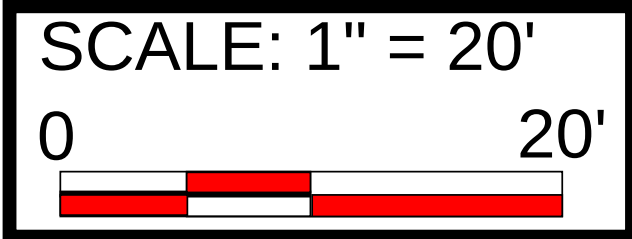
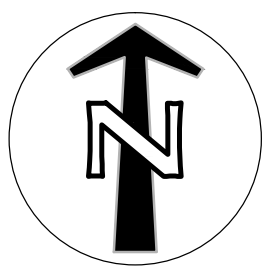
EXHIBIT 1b

BASIN	TOTAL AREA		IMPERVIOUS	PERVIOUS	% IMPERVIOUS
	(sf)	(ac)	(sf)	(sf)	
Existing	33865	0.777	24265	9600	72%



LEGEND

- Existing Offsite Area Draining to Site
- Existing Roof Area
- Existing Pervious Area
- Existing Impervious Area
- Existing Impervious Area Draining Offsite



**EXISTING BASIN MAP
FOR
OBH - CLINIC**

EXHIBIT 1a

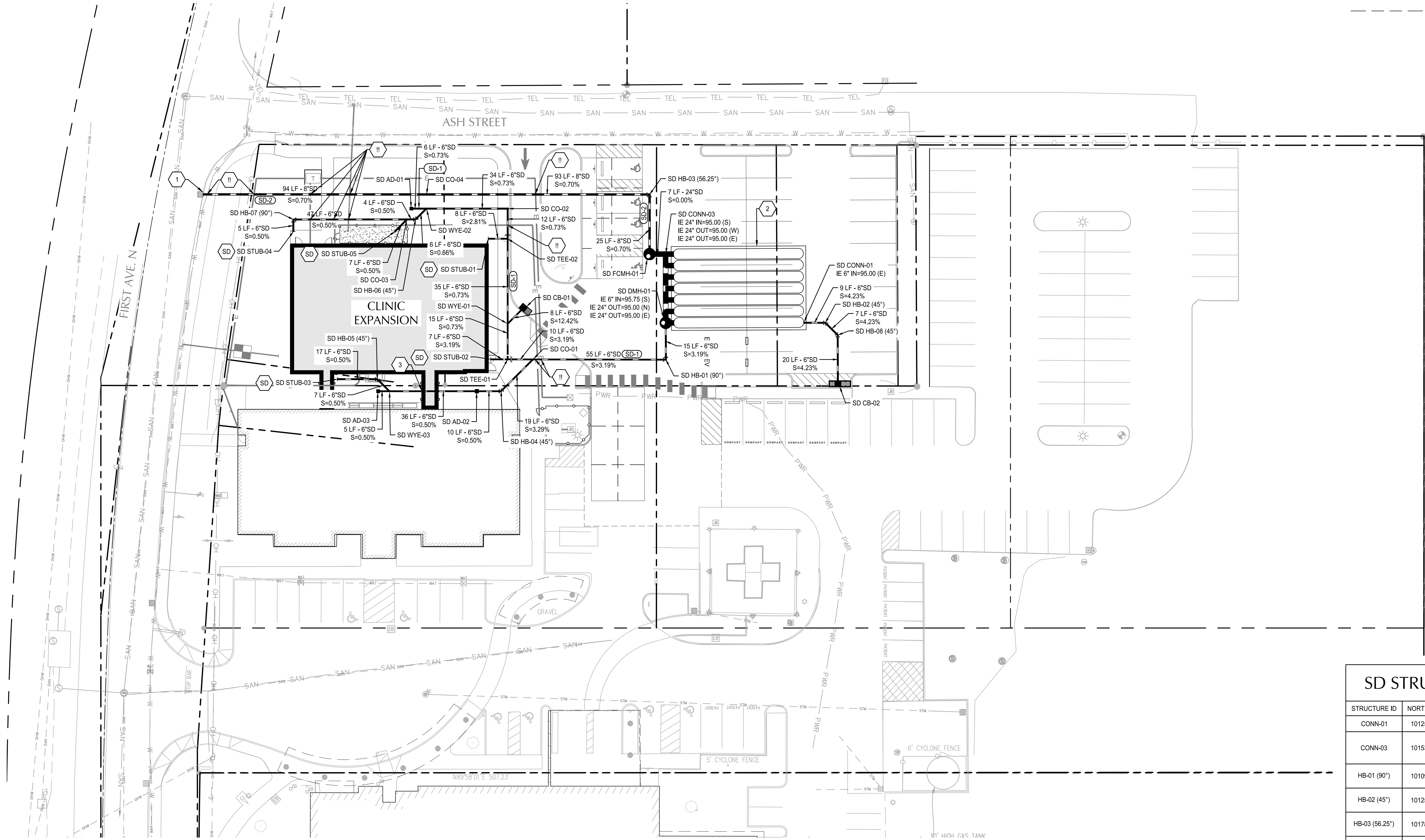
Appendix 2

Storm Drainage Plan

Demolition and Erosion Control Plan

Details

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SHEET NOTES

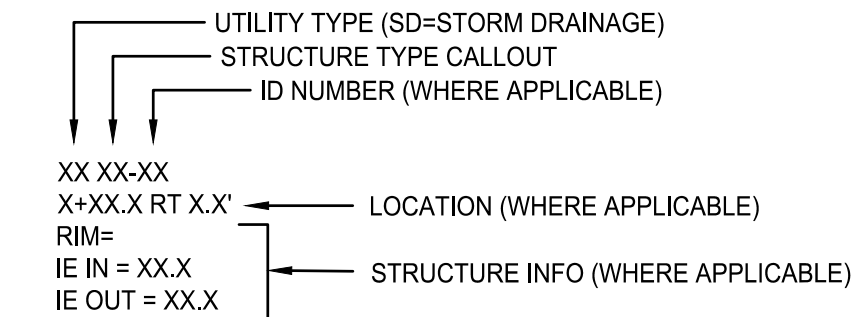
- ON-SITE PIPE BEDDING AND BACKFILL FOR ALL UTILITIES PER DETAIL 2/C7.01.
- STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.

STORM DRAINAGE KEY NOTES

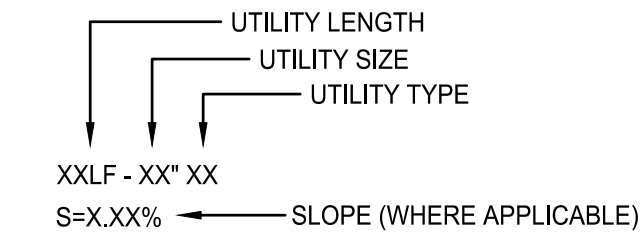
NOTE	DESCRIPTION	DETAIL REF.
1	CONNECT TO EXISTING CB IN FIRST AVE. N. CONTRACTOR TO FIELD VERIFY LOCATION AND INVERT PRIOR TO CONSTRUCTION.	
2	BASIS OF DESIGN IS AN UNDERGROUND ARCH CHAMBER DETENTION SYSTEM. REFER TO CONTECH CHAMBERMAXX STORMWATER RETENTION SYSTEM STANDARD DETAILS ON SHEET C7.02. SYSTEM IS SIZED FOR A MINIMUM VOLUME OF 3,530-CF.	1&2/C7.02
3	ADD DUCTILE IRON SLEEVE FOR PIPE RUN UNDER BUILDING. COORDINATE FOOTING ELEVATIONS TO BE BELOW PIPE INVERTS.	
SD	CONNECT TO STORM DRAIN/ROOF DRAIN. SEE PLUMBING PLANS FOR ROOF DRAIN LOCATIONS, INVERTS, AND CONTINUATION. SIZE AS NOTED.	
1'	UTILITY CROSSING. PROVIDE 12" MIN. CLEARANCE, U.N.O.	1/C7.01

UTILITY LABEL LEGEND

STRUCTURE LABEL



PIPE LABEL



STRUCTURE TYPE

CALLOUT	DESCRIPTION	DETAIL REF.
AD	AREA DRAIN	8/C7.01
CB	CONCRETE FILTER CATCHBASIN	3&4/C7.02
CO	CLEANOUT TO GRADE	3/C7.01
DMH	DIVERSION MANHOLE	10/C7.01
FCMH	FLOW CONTROL MANHOLE	6/C7.01
STUB	STUB	
TEE	TEE CONNECTION	
WYE	WYE CONNECTION	

SD STRUCTURE TABLE

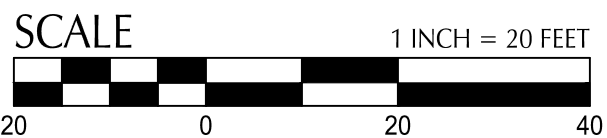
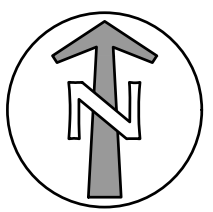
STRUCTURE ID	NORTHING	EASTING	RIM ELEVATION	INVERT ELEVATIONS
AD-01	10172.30	9904.78	102.00	IE 6" OUT=99.08 (E)
AD-02	10096.62	9931.90	102.20	IE 6" IN=98.66 (W) IE 6" OUT=98.66 (E)
AD-03	10096.62	9890.97	102.29	IE 6" OUT=98.86 (E)
CB-01	10130.34	9950.41	101.75	IE 6" OUT=99.45 (SW)
CB-02	10099.70	10081.49	98.84	IE 6" OUT=96.54 (N)
CO-01	10109.80	9955.11	102.28	IE 6" IN=98.00 (W) IE 6" IN=98.00 (SW) IE 6" OUT=98.00 (E)
CO-02	10172.30	9944.66	104.18	IE 6" IN=98.79 (W) IE 6" OUT=98.79 (S)
CO-03	10167.82	9902.91	100.64	IE 6" IN=99.10 (W) IE 6" IN=99.10 (SW) IE 6" OUT=99.10 (E)
CO-04	10178.18	9910.94	102.77	IE 6" IN=94.18 (E) IE 6" OUT=94.18 (W)
DMH-01	10124.95	10010.16	102.02	IE 6" IN=95.75 (S) IE 24" OUT=95.00 (N) IE 24" OUT=95.00 (E)
EX-CB	10178.20	9817.34	99.10	IE IN=92.84 (N) IE 6" IN=93.53 (E) IE OUT=92.70 (S)
FCMH-01	10153.46	10003.45	103.08	IE 24" IN=95.00 (E) IE 8" OUT=95.00 (N)

SD STRUCTURE TABLE

STRUCTURE ID	NORTHING	EASTING	INVERT ELEVATIONS
CONN-01	10125.00	10067.31	IE 6" IN=95.00 (E)
CONN-03	10153.46	10010.09	IE 24" IN=95.00 (S) IE 24" OUT=95.00 (W) IE 24" OUT=95.00 (E)
HB-01 (90°)	10108.69	10010.23	IE 6" IN=96.24 (W) IE 6" OUT=96.24 (N)
HB-02 (45°)	10125.00	10076.30	IE 6" IN=95.38 (SE) IE 6" OUT=95.38 (W)
HB-03 (56.25°)	10178.15	10003.45	IE 8" IN=94.83 (S) IE 8" OUT=94.83 (W)
HB-04 (45°)	10096.62	9941.90	IE 6" IN=98.61 (W) IE 6" OUT=98.61 (NE)
HB-05 (45°)	10101.62	9890.63	IE 6" IN=98.88 (W) IE 6" OUT=98.88 (SE)
HB-06 (45°)	10167.83	9906.47	IE 6" IN=99.08 (W) IE 6" OUT=99.08 (NE)
HB-07 (90°)	10167.79	9855.84	IE 6" IN=99.34 (S) IE 6" OUT=99.34 (E)
HB-08 (45°)	10119.88	10081.42	IE 6" IN=95.69 (S) IE 6" OUT=95.69 (NW)

SD STRUCTURE TABLE

STRUCTURE ID	NORTHING	EASTING	INVERT ELEVATIONS
STUB-01	10159.82	9936.59	IE 6" OUT=98.93 (E)
STUB-02	10109.84	9937.58	IE 6" OUT=98.56 (E)
STUB-03	10101.62	9874.09	IE 6" OUT=98.96 (E)
STUB-04	10162.79	9855.84	IE 6" OUT=99.37 (N)
STUB-05	10162.82	9897.92	IE 6" OUT=98.14 (NE)
TEE-01	10109.82	9944.66	IE 6" IN=98.33 (W) IE 6" IN=98.33 (N) IE 6" OUT=98.33 (E)
TEE-02	10159.82	9944.66	IE 6" IN=98.70 (W) IE 6" IN=98.70 (N) IE 6" OUT=98.70 (S)
WYE-01	10124.59	9944.66	IE 6" IN=98.44 (NE) IE 6" IN=98.44 (N) IE 6" OUT=98.44 (S)
WYE-02	10172.30	9910.94	IE 6" IN=99.04 (W) IE 6" IN=99.04 (SW) IE 6" OUT=99.04 (E)
WYE-03	10096.62	9895.63	IE 6" IN=98.84 (W) IE 6" IN=98.84 (NW) IE 6" OUT=98.84 (E)



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PROJECT P246864.00

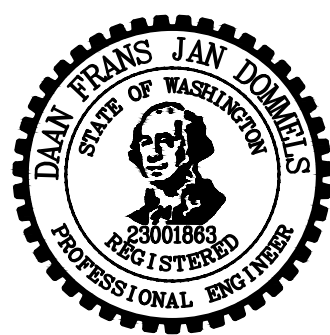
OBH EXPRESS CARE CLINIC AND ILWACO CLINIC RENOVATION

176 1ST AVENUE N.
ILWACO, WA 98624

BID SET

BID SET 12 MAR 2026

REVISIONS	DESCRIPTION	DATE
1		

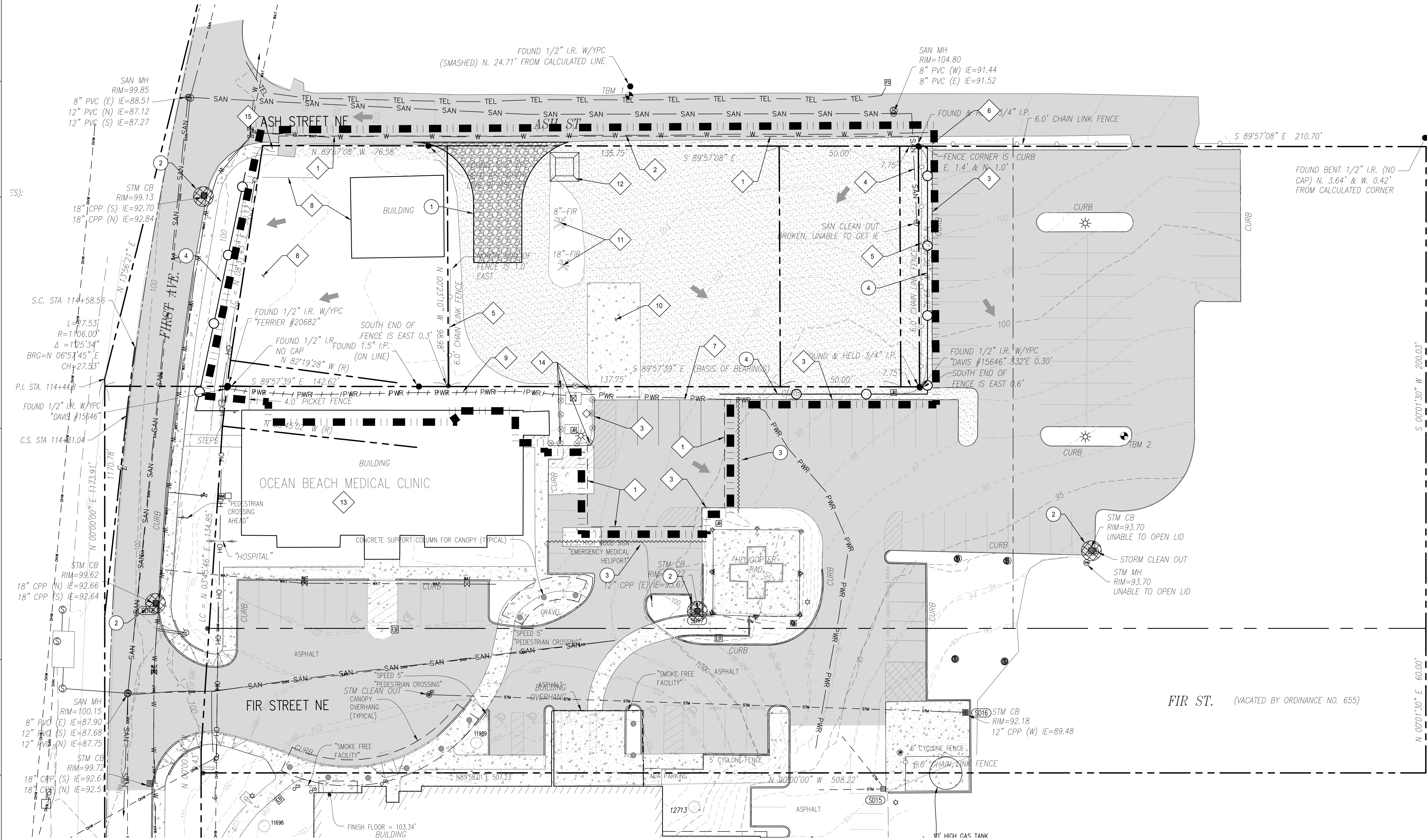


SHEET TITLE

STORM DRAINAGE PLAN

SHEET NUMBER

C5.00



SHEET NOTES

1. CONTRACTOR MAY STAGE WITHIN LIMITS OF DEMOLITION. COORDINATE WITH OWNER FOR CONSTRUCTION STAGING OUTSIDE OF LIMITS OF DEMOLITION AND INSIDE THE PROJECT PROPERTY.
2. REMOVE ALL SITE COMPONENTS AND RECYCLE COMPONENTS AS REQUIRED IN THE SPECIFICATIONS.
3. GENERAL DEMOLITION PERMIT SHALL BE SECURED BY THE CONTRACTOR.
4. ALL TRADE LICENSES AND PERMITS NECESSARY FOR THE PROCUREMENT AND COMPLETION OF THE WORK SHALL BE SECURED BY THE CONTRACTOR PRIOR TO COMMENCING DEMOLITION.
5. THE CONTRACTOR SHALL PRESERVE AND PROTECT FROM DAMAGE ALL EXISTING RIGHT-OF-WAY SURVEY MONUMENTATION DURING DEMOLITION. THE CONTRACTOR IS RESPONSIBLE FOR COORDINATING AND PAYING FOR THE REPLACEMENT BY A LICENSED SURVEYOR OF ANY DAMAGED OR REMOVED MONUMENTS.
6. PROTECT ALL ITEMS ON ADJACENT PROPERTIES AND IN THE RIGHT OF WAY INCLUDING BUT NOT LIMITED TO SIGNAL EQUIPMENT, PARKING METERS, SIDEWALKS, STREET TREES, STREET LIGHTS, CURBS, PAVEMENT AND SIGNS. CONTRACTOR SHALL BE RESPONSIBLE FOR RESTORING ANY DAMAGED ITEMS TO ORIGINAL CONDITION.
7. PROTECT STRUCTURES, UTILITIES, SIDEWALKS, AND OTHER FACILITIES IMMEDIATELY ADJACENT TO EXCAVATIONS FROM DAMAGES CAUSED BY SETTLEMENT, LATERAL MOVEMENT, UNDERMINING, WASHOUT AND OTHER HAZARDS.
8. SAWCUT STRAIGHT LINES IN SIDEWALK, AS NECESSARY.
9. CONTRACTOR IS RESPONSIBLE TO CONTROL DUST AND MUD DURING THE DEMOLITION PERIOD, AND DURING TRANSPORTATION OF DEMOLITION DEBRIS. ALL STREET SURFACES OUTSIDE THE CONSTRUCTION ZONE MUST BE KEPT CLEAN.

DEMOLITION KEY NOTES

- 1 SAWCUT LINE
- 2 PROTECT WATER LINE
- 3 PROTECT CURB
- 4 PROTECT SANITARY LATERAL
- 5 REMOVE NORTH-SOUTH ALIGNMENT OF FENCE
- 6 PROTECT EAST-WEST ALIGNMENT OF FENCE
- 7 REMOVE CURB TO EDGE OF SAWCUT
- 8 RESIDENTIAL BUILDING, FENCE, VEGETATION, AND TREES REMOVED BY OWNER.
- 9 REMOVE ELECTRICAL SERVICE. SEE ELECTRICAL PLANS FOR DIRECTION ON MODIFICATION.
- 10 REMOVE CONCRETE PAD
- 11 PROTECT TREE - REFERENCE LANDSCAPE PLANS FOR PROTECTION DETAILS
- 12 CONCRETE WASHOUT
- 13 PROTECT CLINIC BUILDING. SEE ARCHITECTURAL AND STRUCTURAL PLANS FOR SELECTIVE DEMOLITION AS PART OF THE BUILDING EXPANSION.
- 14 REMOVE ALL WOOD BOLLARDS SURROUNDING ELECTRICAL EQUIPMENT
- 15 PROTECT PUBLIC CONCRETE SIDEWALK

EROSION CONTROL KEY NOTES

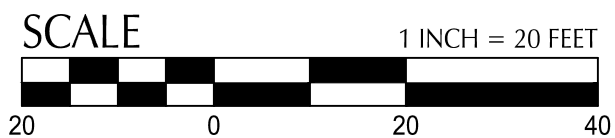
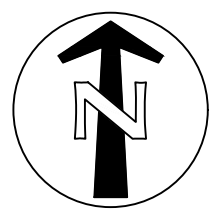
- 1 TEMPORARY CONSTRUCTION ENTRANCE
- 2 INLET PROTECTION
- 3 STRAW WATTLES
- 4 SEDIMENT CONTROL FENCE

SHEET LEGEND

- | | | | |
|---|--|----|--------|
| — | PROPERTY LINE | 1 | 18.00' |
| — | DEMOLITION WORK LIMITS (SHOWN OFFSET FOR CLARITY) | 2 | 18.00' |
| — | SAWCUT LINE | 3 | 18.00' |
| — | REMOVE OR ABANDON UTILITY LINE IN PLACE | 4 | 18.00' |
| — | EXISTING CONTOUR | 5 | 18.00' |
| — | SEDIMENT CONTROL FENCE, PLACE AT PROPERTY LINES, UNO (SHOWN OFFSET FOR CLARITY). | 6 | 18.00' |
| — | INLET PROTECTION | 7 | 18.00' |
| — | STRAW WATTLES | 8 | 18.00' |
| — | SURFACE FLOW DIRECTION | 9 | 18.00' |
| — | INSTALL CONCRETE WASHOUT | 10 | 18.00' |
| — | TEMPORARY CONSTRUCTION ENTRANCE | 11 | 18.00' |
| — | REMOVE TREE | 12 | 18.00' |

EROSION CONTROL NOTES

1. ALL BASE ESC MEASURES (INLET PROTECTION, PERIMETER SEDIMENT CONTROL, GRAVEL CONSTRUCTION ENTRANCES, ETC.) MUST BE IN PLACE, FUNCTIONAL, AND APPROVED IN AN INITIAL INSPECTION PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITIES.
2. SEDIMENT BARRIERS APPROVED FOR USE INCLUDE SEDIMENT FENCE, BERMS CONSTRUCTED OUT OF MULCH, CHIPPINGS, OR OTHER SUITABLE MATERIAL, STRAW WATTLES, OR OTHER APPROVED MATERIALS.
3. SENSITIVE RESOURCES INCLUDING, BUT NOT LIMITED TO, TREES, WETLANDS, AND RIPARIAN PROTECTION AREAS SHALL BE CLEARLY DELINEATED WITH ORANGE CONSTRUCTION FENCING OR CHAIN LINK FENCING IN A MANNER THAT IS CLEARLY VISIBLE TO ANYONE IN THE AREA, NO ACTIVITIES ARE PERMITTED TO OCCUR BEYOND THE CONSTRUCTION BARRIER.
4. CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES INCLUDING, BUT NOT LIMITED TO, STREET SWEEPING, AND VACUUMING, MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
5. RUN-ON AND RUN-OFF CONTROLS SHALL BE IN PLACE AND FUNCTIONING PRIOR TO BEGINNING SUBSTANTIAL CONSTRUCTION ACTIVITIES. RUN-ON AND RUN-OFF CONTROL MEASURES INCLUDE: SLOPE DRAINS (WITH OUTLET PROTECTION), CHECK DAM, SURFACE ROUGHENING, AND BANK STABILIZATION.



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PROJECT P246864.00

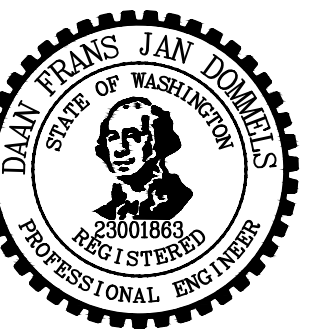
**OBH EXPRESS
CARE CLINIC AND
ILWACO CLINIC
RENOVATION**

176 1ST AVENUE N.
ILWACO, WA 98624

BID SET

BID SET 12 MAR 2026

REVISIONS	DESCRIPTION	DATE
1		

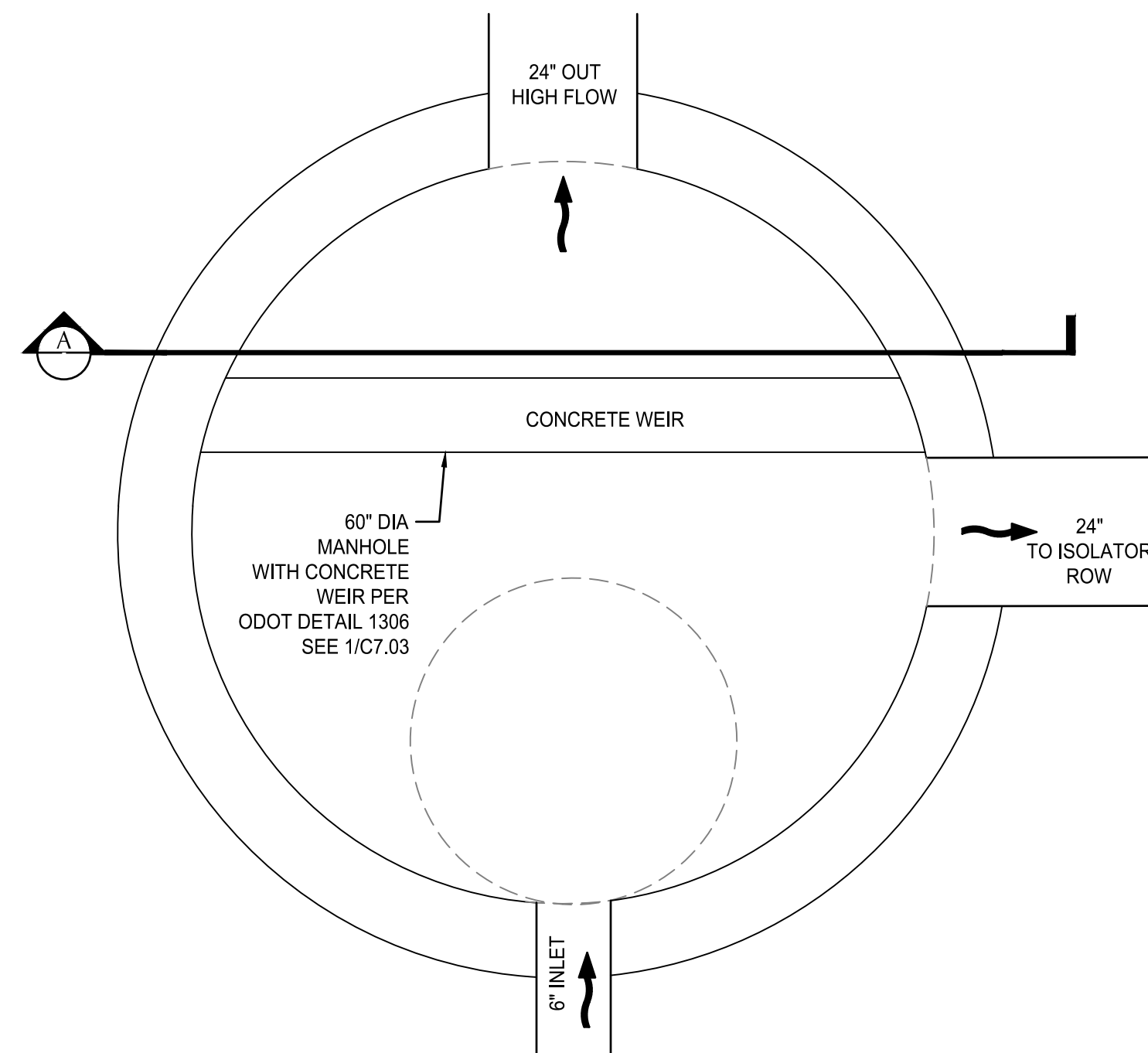


SHEET TITLE

**DEMOLITION AND
EROSION CONTROL
PLAN**

SHEET NUMBER

C2.00

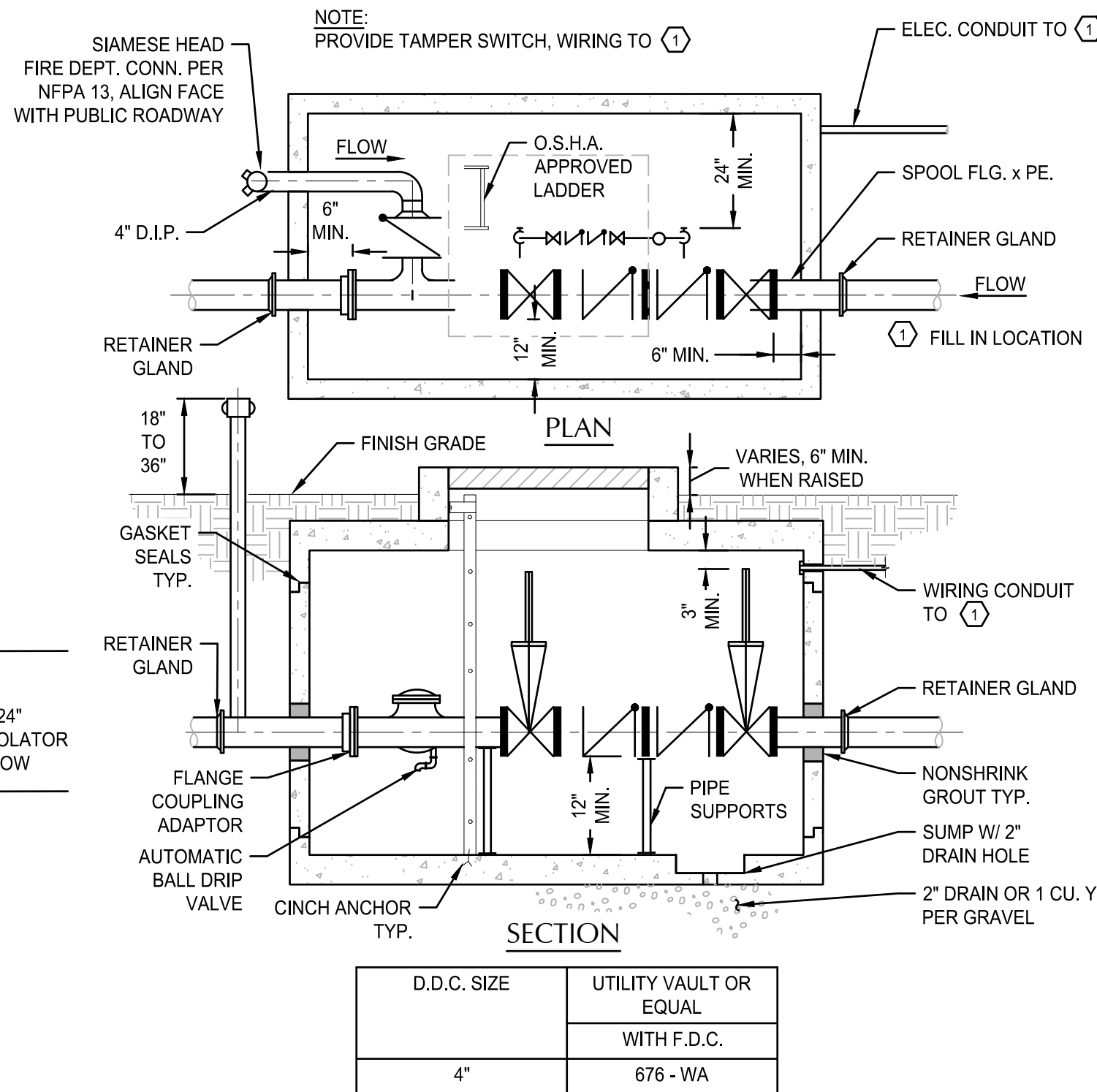


NOTES:

- 60-INCH FLAT TOP MANHOLE.
- REFERENCE FLAT TOP MANHOLE DETAIL 5/C7.01 & SPLIT MANHOLE FLOW WEIR DETAIL 1/C7.03.
- SEE STANDARD DETAIL 1306/C406 FOR ADDITIONAL REQUIREMENTS.
- BAFFLE WALL SHALL HAVE REINFORCING PER DETAIL 1/C7.01.
- BAFFLE SHALL BE KEYS AND GROUTED IN PLACE. JOINT BETWEEN CONCRETE BAFFLE AND MANHOLE WALL SHALL BE WATERTIGHT.
- FRAME AND LADDER OR STEPS ARE TO BE OFFSET SO THAT CLIMB-DOWN SPACE IS CLEAR OF BAFFLE WALL AND INCOMING PIPES.
- MANHOLE CERTIFICATION REQUIRED FOR TRAFFIC LOADING.
- PROVIDE SHOP DRAWING FOR APPROVAL.

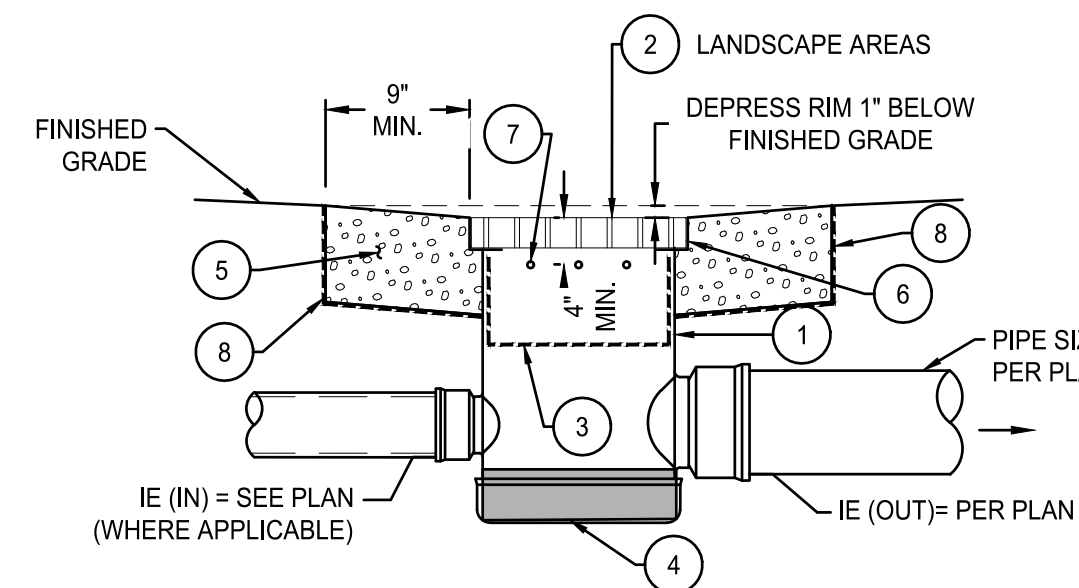
10 FLOW SPLITTER MANHOLE

SCALE: NTS



7 DOUBLE CHECK DETECTOR FIRE SERVICE VAULT W/ DRAIN TO GROUND

SCALE: NTS

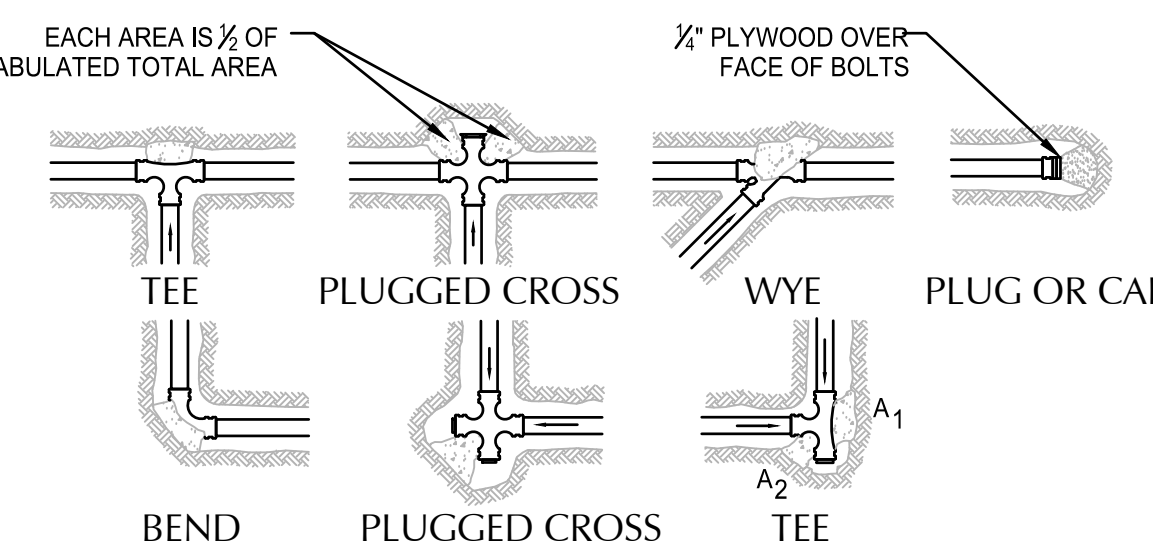


X KEY NOTES

- 12" NYLOPLAST DRAIN BASIN, OR APPROVED EQUAL.
- 12" STANDARD HINGED GRATE, H-10 RATED BY ADS, OR APPROVED EQUAL.
- FLEXSTORM SHORT CATCH-IN INLET SEDIMENT BAG, OR APPROVED EQUAL.
- INSTALL 12" DIA SUMP INSERT (NYLOPLAST PART NUMBER 3812AGSI) TO ELIMINATE SUMP IN BASIN.
- PEA GRAVEL (6" MIN. DEEP) SURROUNDING DRAIN.
- EPOXY GRATE FRAME TO DRAIN BASIN TO PREVENT REMOVAL.
- DRILL 1/2" DIA. WEEP HOLES EVERY 6" AROUND BASIN.
- WRAP BOTTOM AND SIDES WITH DRAINAGE FABRIC.

8 AREA DRAIN - LANDSCAPE AREAS

SCALE: NTS



- CONCRETE THRUST BLOCKING TO BE POURED AGAINST UNDISTURBED EARTH.
- KEEP CONCRETE CLEAR OF JOINT AND ACCESSORIES.
- THE REQUIRED THRUST BEARING AREAS FOR SPECIAL CONNECTIONS ARE SHOWN ENCIRCLED ON THE PLAN; e.g. (15) INDICATES 15 SQUARE FEET BEARING AREA REQUIRED.
- IF NOT SHOWN ON PLANS REQUIRED BEARING AREAS AT FITTING SHALL BE AS INDICATED BELOW. ADJUST IF NECESSARY, TO CONFORM TO THE TEST PRESSURE(S) AND ALLOWABLE SOIL BEARING STRESS (ES) STATED IN THE SPECIAL SPECIFICATIONS.
- BEARING AREAS AND SPECIAL BLOCKING DETAILS SHOWN ON PLANS TAKE PRECEDENCE OVER BEARING AREAS AND BLOCKING DETAILS SHOWN ON THIS STANDARD DETAIL.

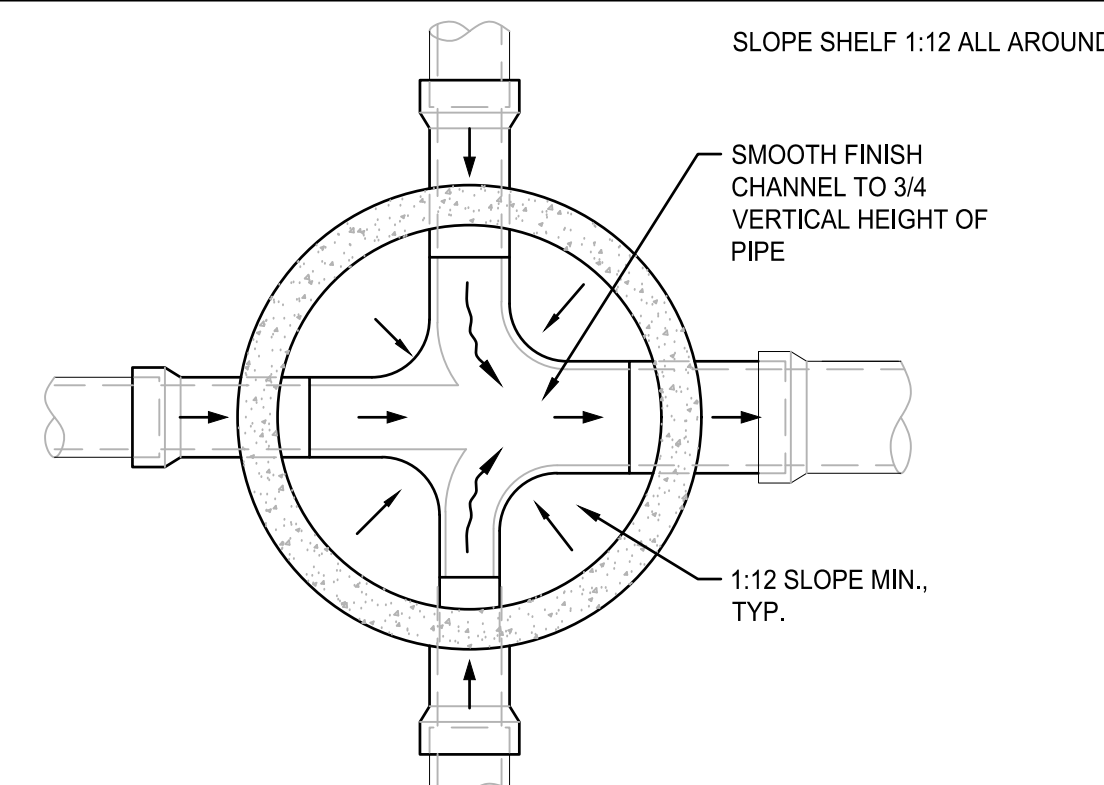
BEARING AREA OF THRUST BLOCK IN SQUARE FOOT

FITTING SIZE	TEE, WYE, PLUG, OR CAP	90° BEND PLUGGED CROSS	A1	A2	45° BEND	22 1/2° BEND	11 1/4° BEND
4	1.0	1.4	1.9	1.4	1.0		
6	2.1	3.0	4.3	3.0	1.8	1.0	
8	3.8	5.3	7.6	5.4	2.9	1.5	1.0
10	5.9	8.4	11.8	8.4	4.6	2.4	1.2

NOTE:
ABOVE BEARING AREAS BASED ON TEST PRESSURE OF 150 p.s.i. AND AN ALLOWABLE SOIL BEARING STRESS OF 2000 p.s.i. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURE AND SOIL BEARING STRESSES, USE THE FOLLOWING EQUATION: BEARING AREA = (TEST PRESSURE/150)(2000/ SOIL BEARING STRESS)(TABLE VALUE).

9 THRUST BLOCK

SCALE: NTS

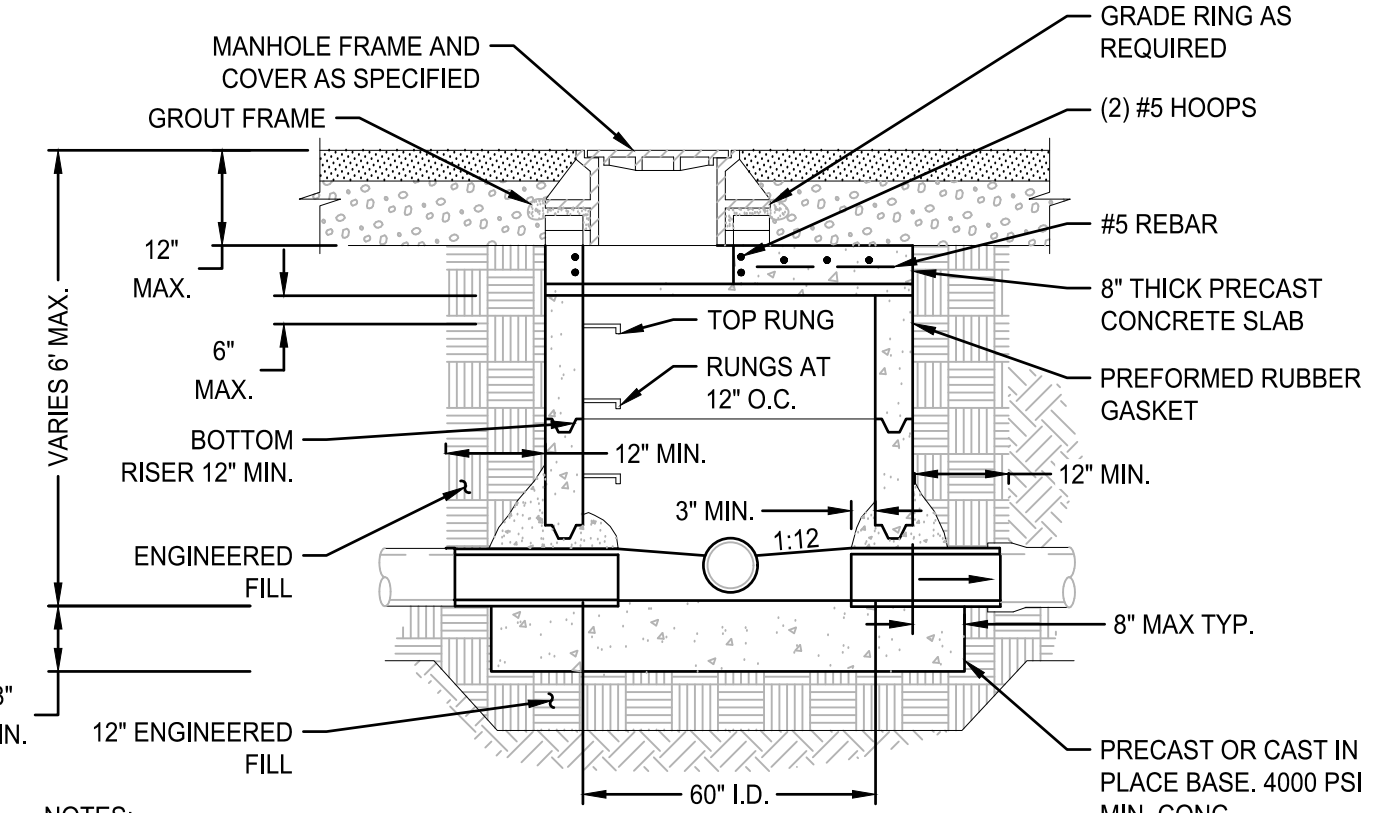


NOTES:

- BASED MAY BE PRECAST OR CAST IN PLACE.
- ALL PRECAST SECTIONS SHALL CONFORM TO REQUIREMENTS OF ASTM C-478.
- CONCRETE SHALL BE COMMERCIAL GRADE.
- CHANNELS SHALL BE CONSTRUCTED TO PROVIDE SMOOTH SLOPES AND RADIUS TO OUTLET PIPE.
- EXTEND PIPE INTO MANHOLE AND GROUT SMOOTH. PIPE(S) MAY EXTEND 2" MAX BEYOND THE INTERIOR MANHOLE WALL.

4 MANHOLE BASE - STANDARD

SCALE: NTS

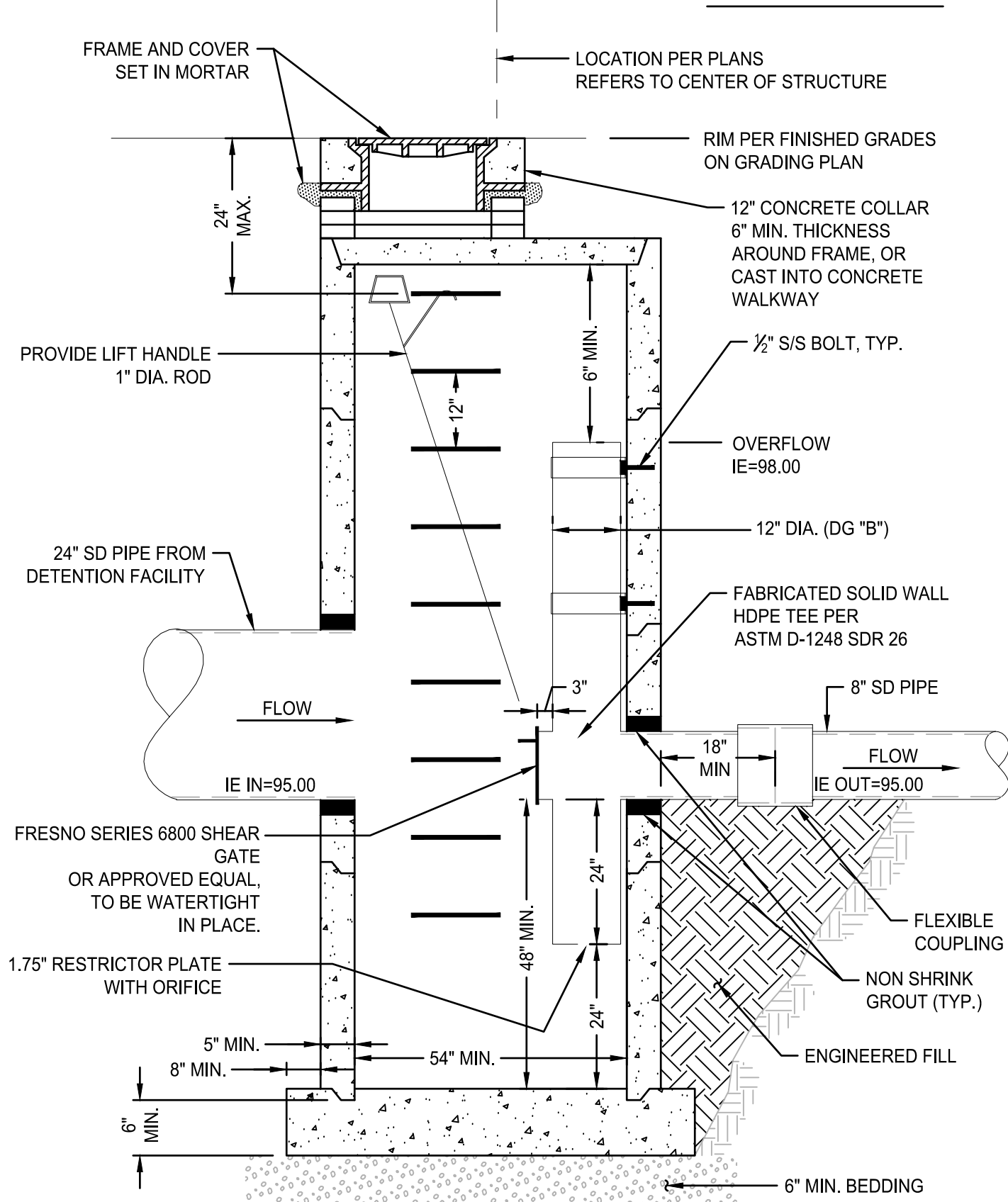
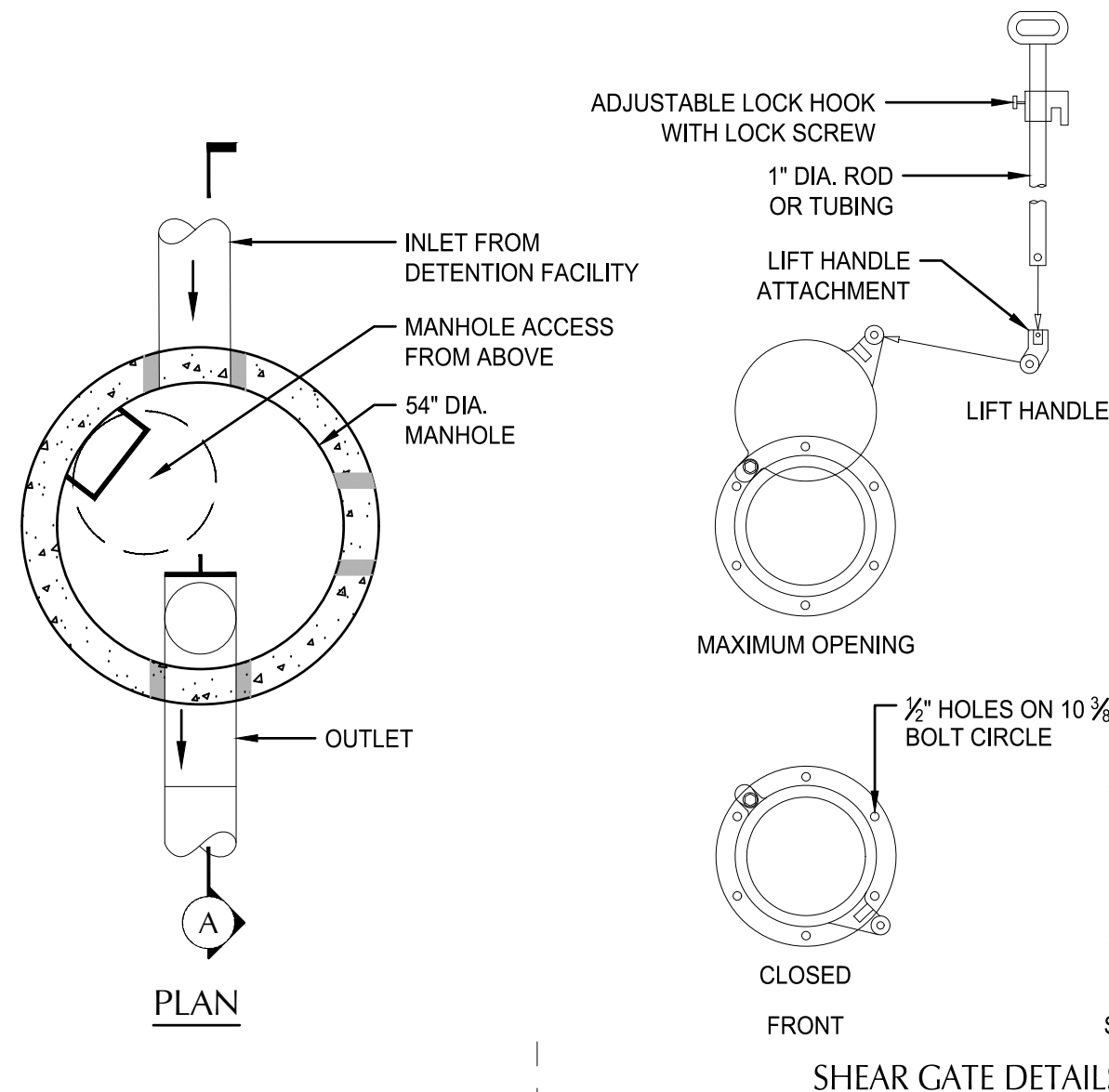


NOTES:

- ALL PRECAST SECTIONS SHALL CONFORM TO REQUIREMENTS OF ASTM C-478.
- MANHOLE BASE MAY BE PRECAST OR CAST IN PLACE. SEE STANDARD MANHOLE BASE DETAIL 4/C7.01.
- ALL CONNECTING PIPES SHALL HAVE FLEXIBLE, GASKETED AND UNRESTRAINED JOINT WITHIN 18" OF MANHOLE VAULT.
- ALL MANHOLE PENETRATIONS SHALL BE BOOTED.

5 60" FLATTOP MANHOLE

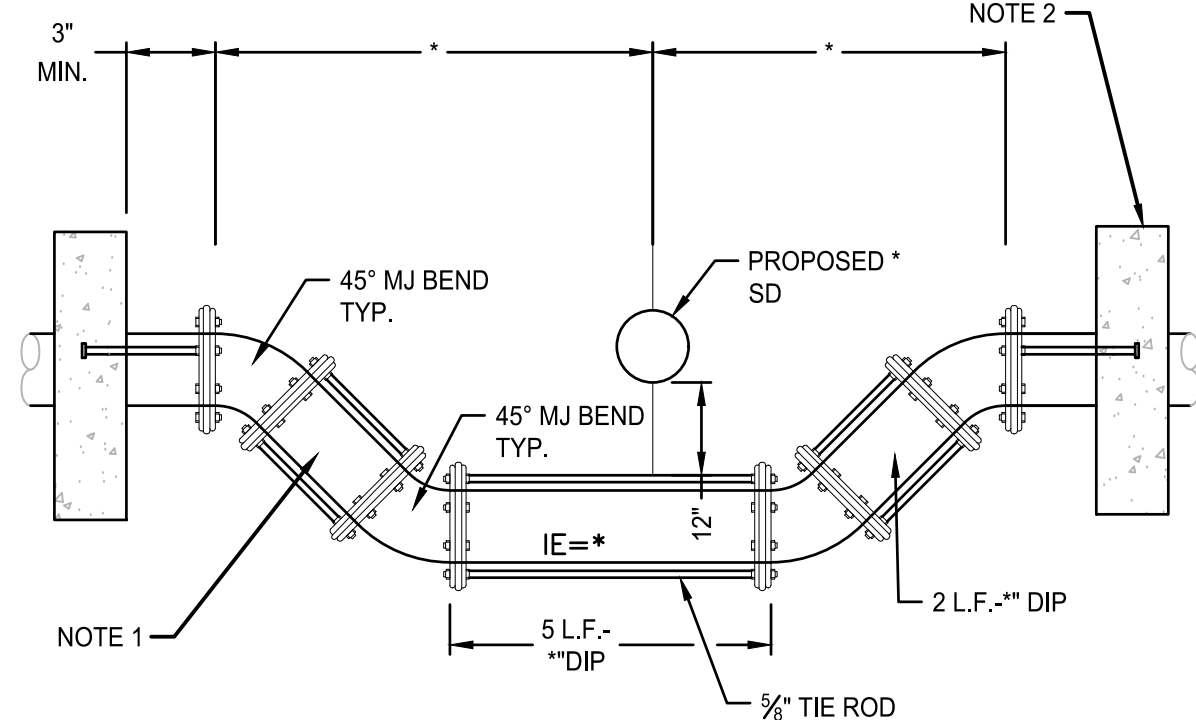
SCALE: NTS



6 FLOW CONTROL MANHOLE

SCALE: NTS

PER WSDOT STD PLAN B-10.40-00

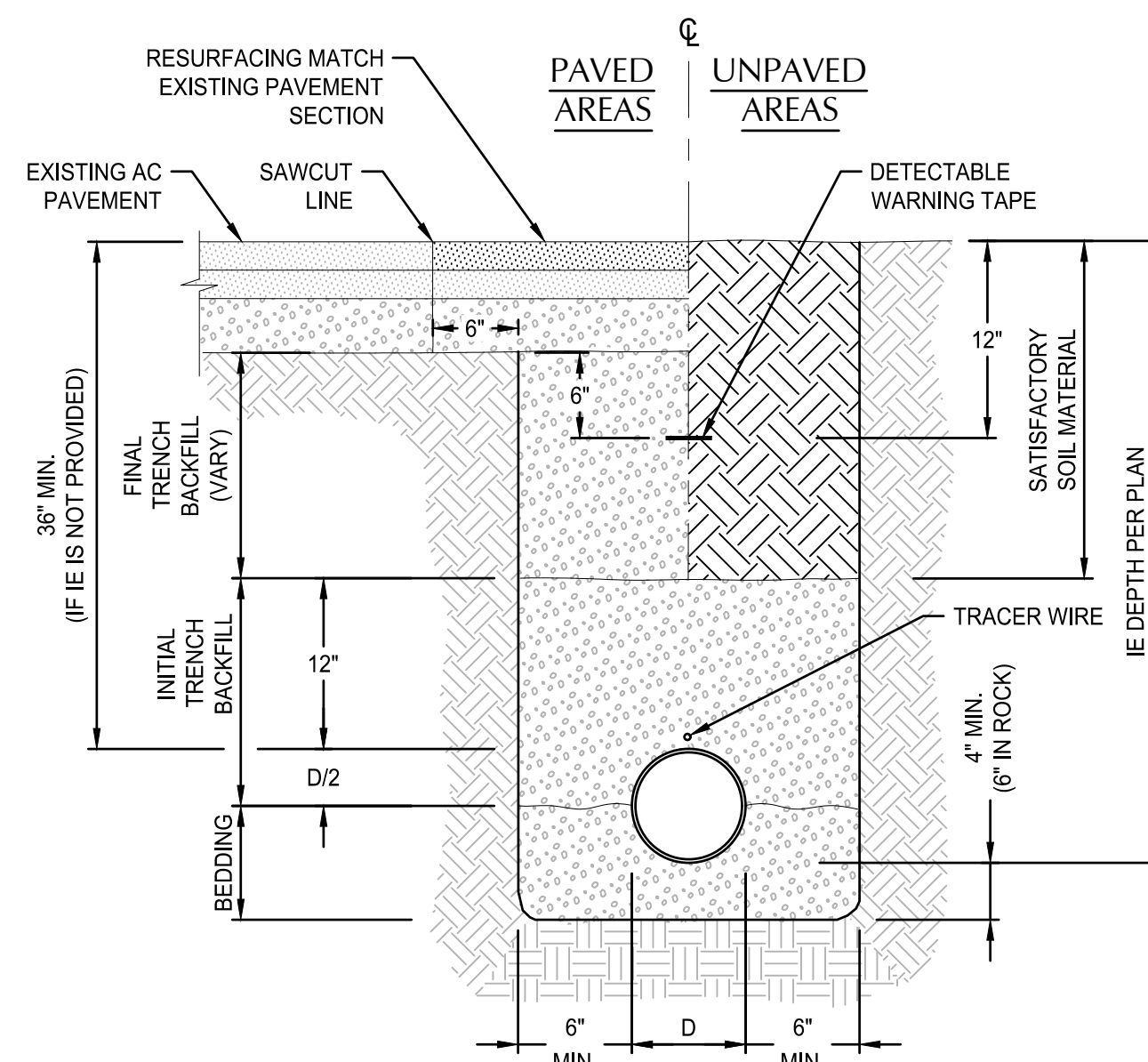


NOTES:

- DIP MJ SPOOL. * L.F. * DIP CONTRACTOR TO VERIFY LENGTH OF * DIP NECESSARY TO MEET WATERLINE CLEARANCE TYP.
- CONC. ANCHOR BLOCK W/ TIE BOLTS, DUCT LUGS OR STEEL PLATE AS APPROVED

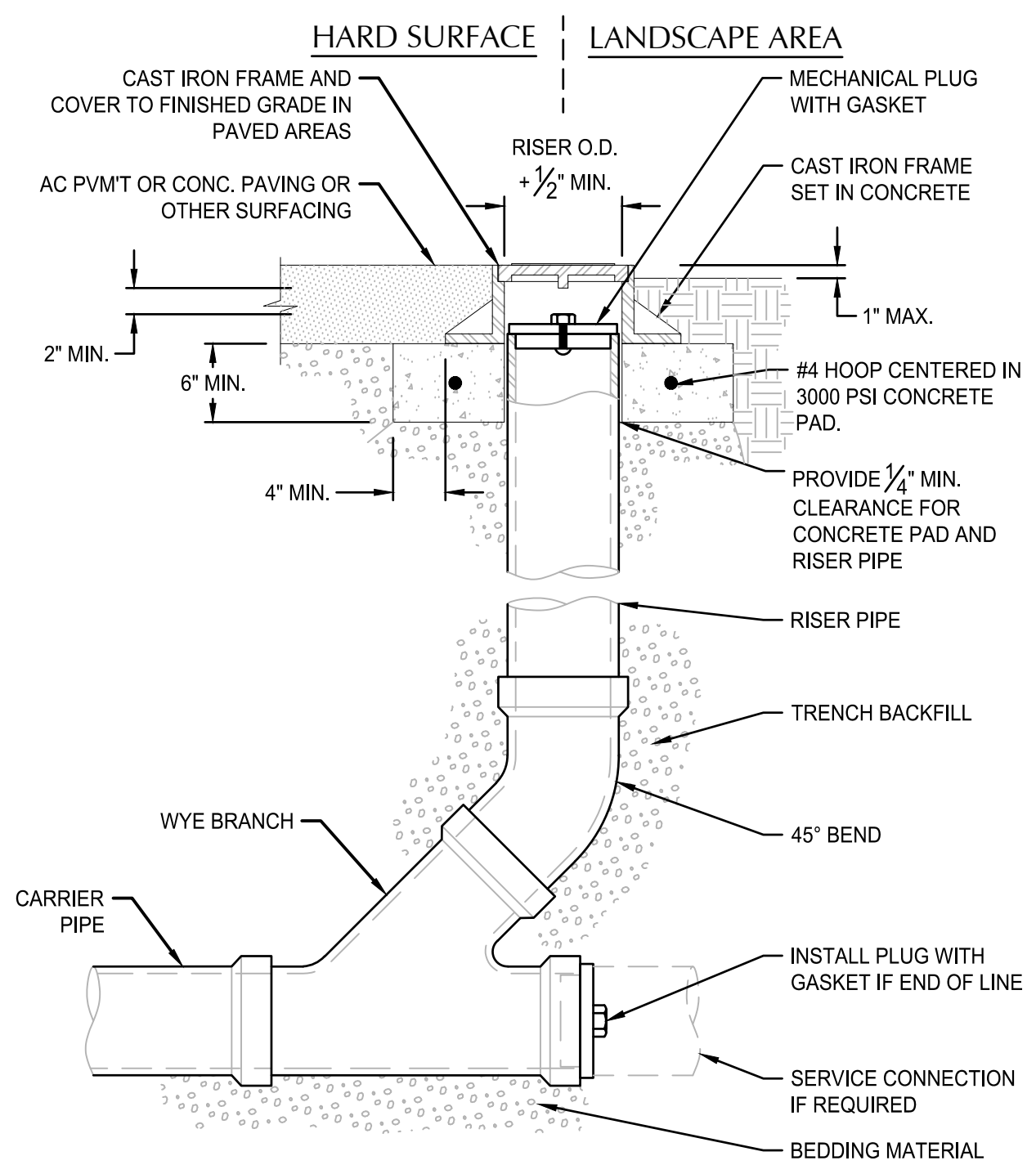
1 TYPICAL WATERLINE UTILITY CROSSING

SCALE: NTS



2 TYPICAL PIPE BEDDING AND BACKFILL

SCALE: NTS



NOTES:

- CAST IRON FRAME AND COVER SHALL MEET H-20 LOAD REQUIREMENT.
- FOR CARRIER PIPE SIZE 6" Ø AND LESS, PROVIDE RISER PIPE SIZE TO MATCH CARRIER PIPE.
- FOR CARRIER PIPE SIZE 8" Ø AND LARGER, RISER PIPE SHALL BE 8" Ø.
- RISER PIPE MATERIAL TO MATCH CARRIER PIPE MATERIAL.

3 STANDARD CLEANOUT (COTG)

SCALE: NTS

PROJECT P246864.00

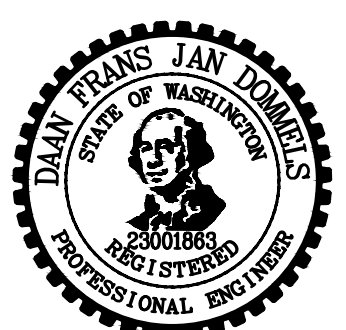
OBH EXPRESS CARE CLINIC AND ILWACO CLINIC RENOVATION

176 1ST AVENUE N.
ILWACO, WA 98624

BID SET

BID SET 12 MAR 2026

REVISIONS	DESCRIPTION	DATE



SHEET TITLE

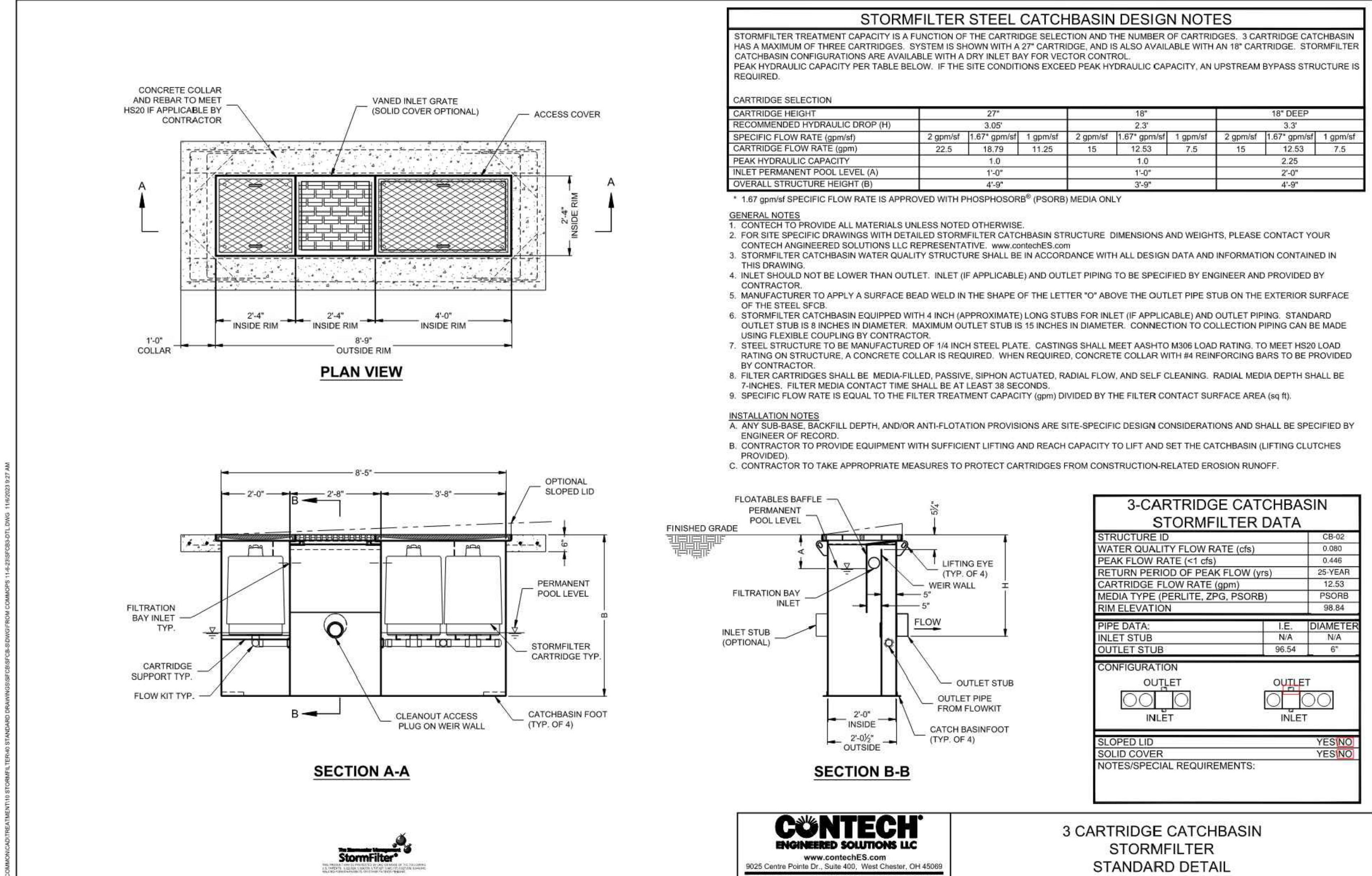
CIVIL DETAILS

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C7.01

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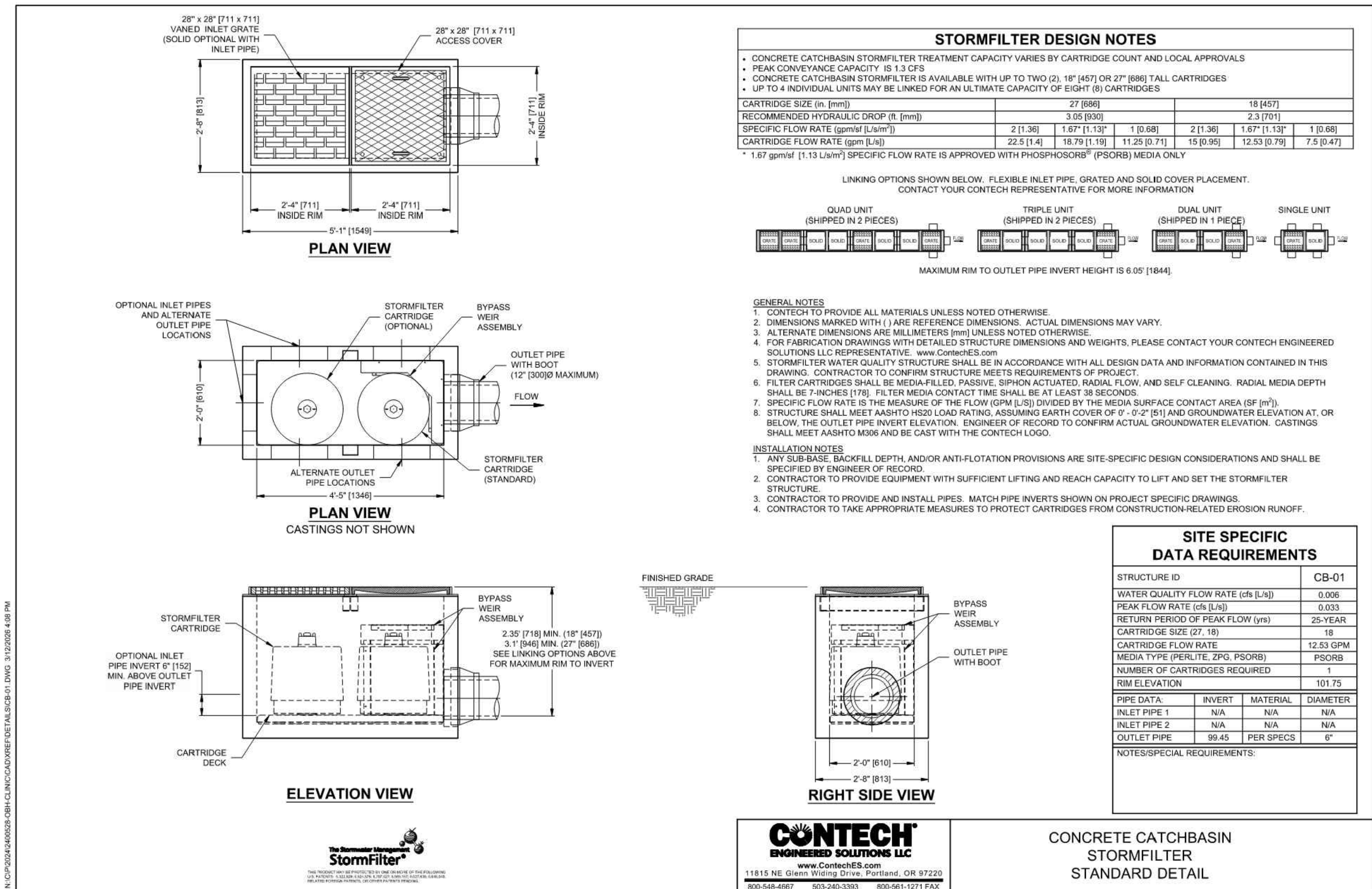
CONTECH ENGINEERED SOLUTIONS LLC
11815 NE 58th Street, Suite 400, Portland, OR 97222
503-545-4987 503-545-7000 503-545-7993 FAX



4 CONCRETE CATCHBASIN STORMFILTER - CB-02
SCALE: NTS

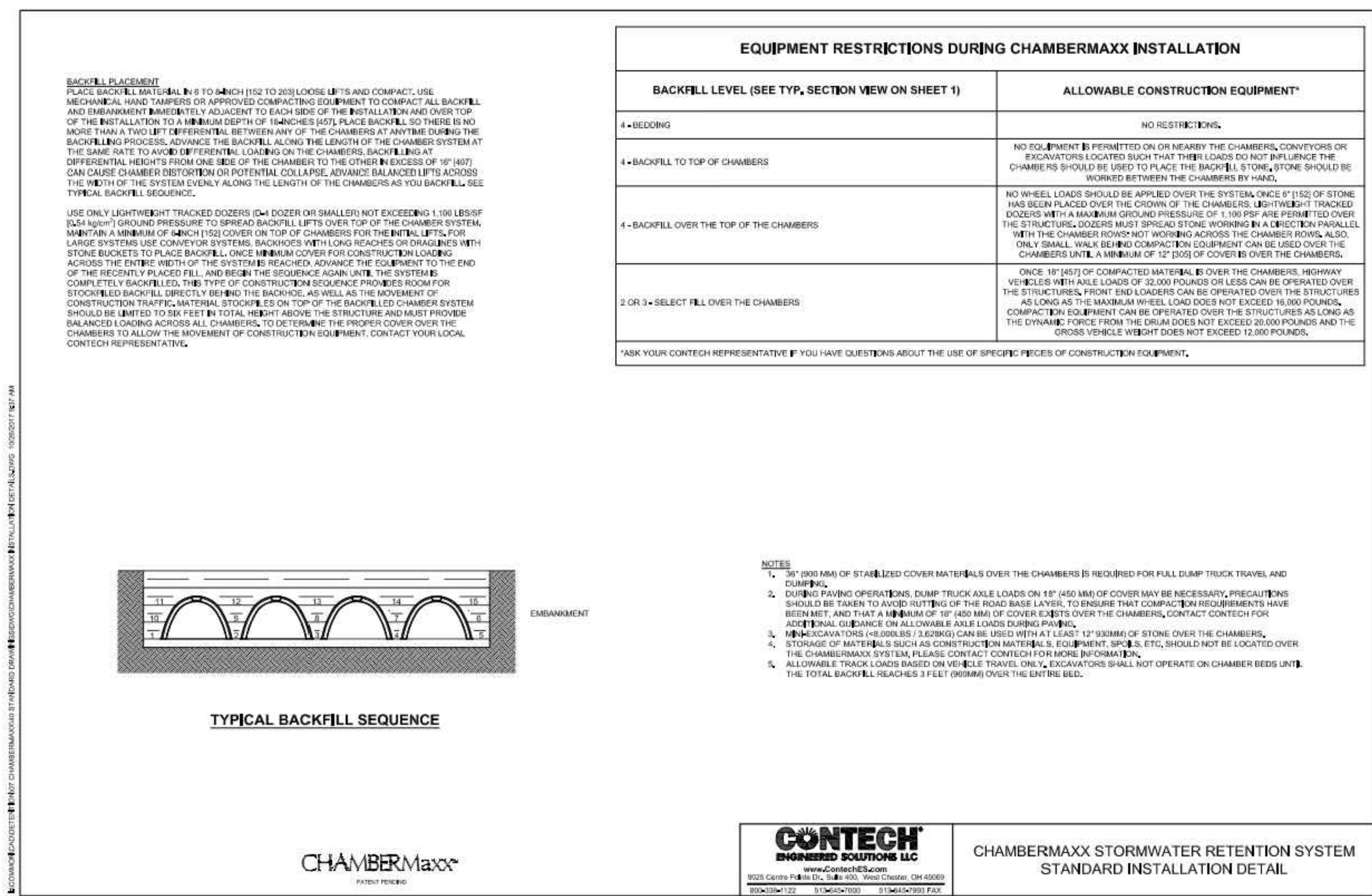
3 CONCRETE CATCHBASIN STORMFILTER - CB-01
SCALE: NTS

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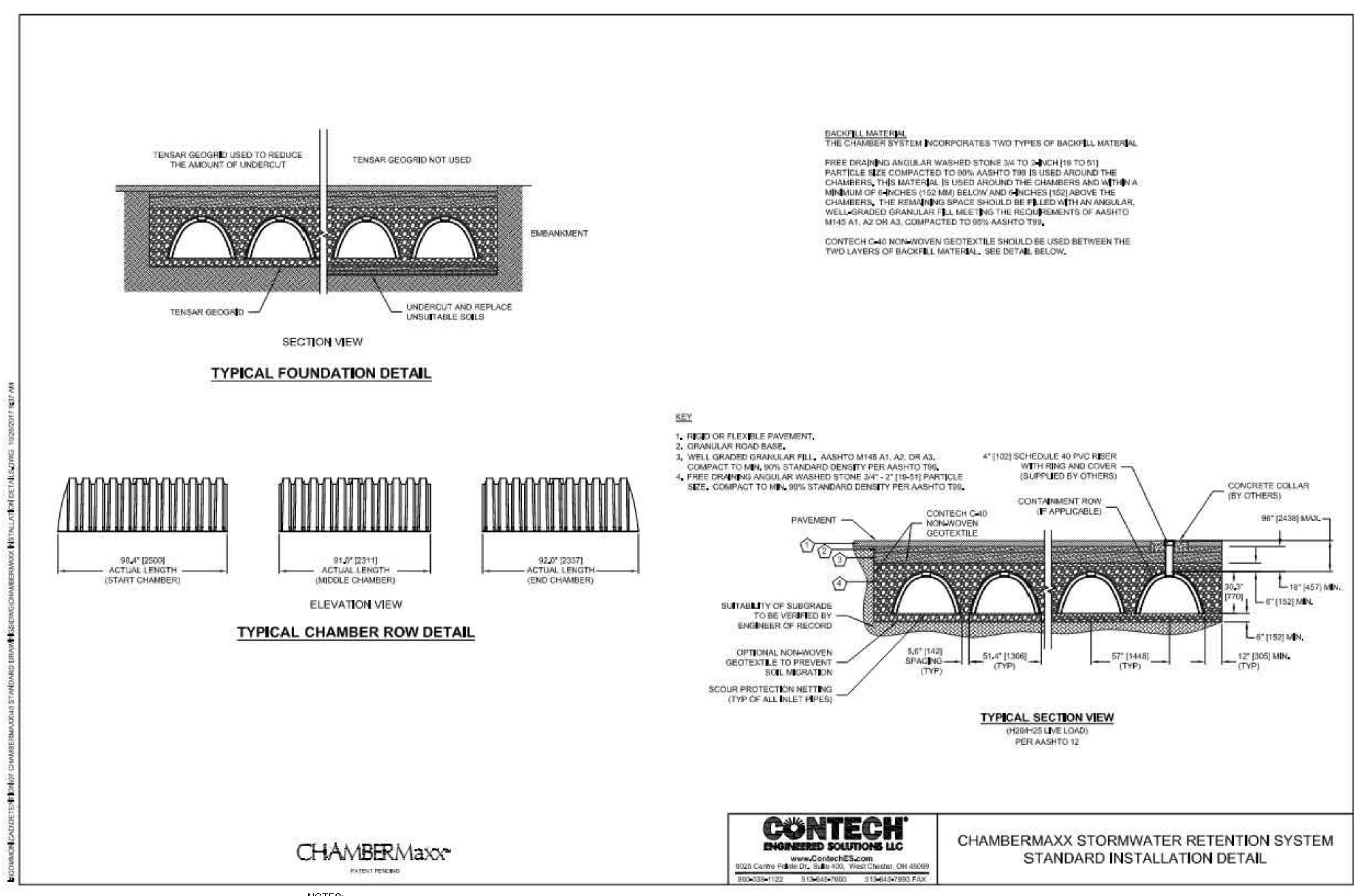


CONCRETE CATCHBASIN STORMFILTER STANDARD DETAIL

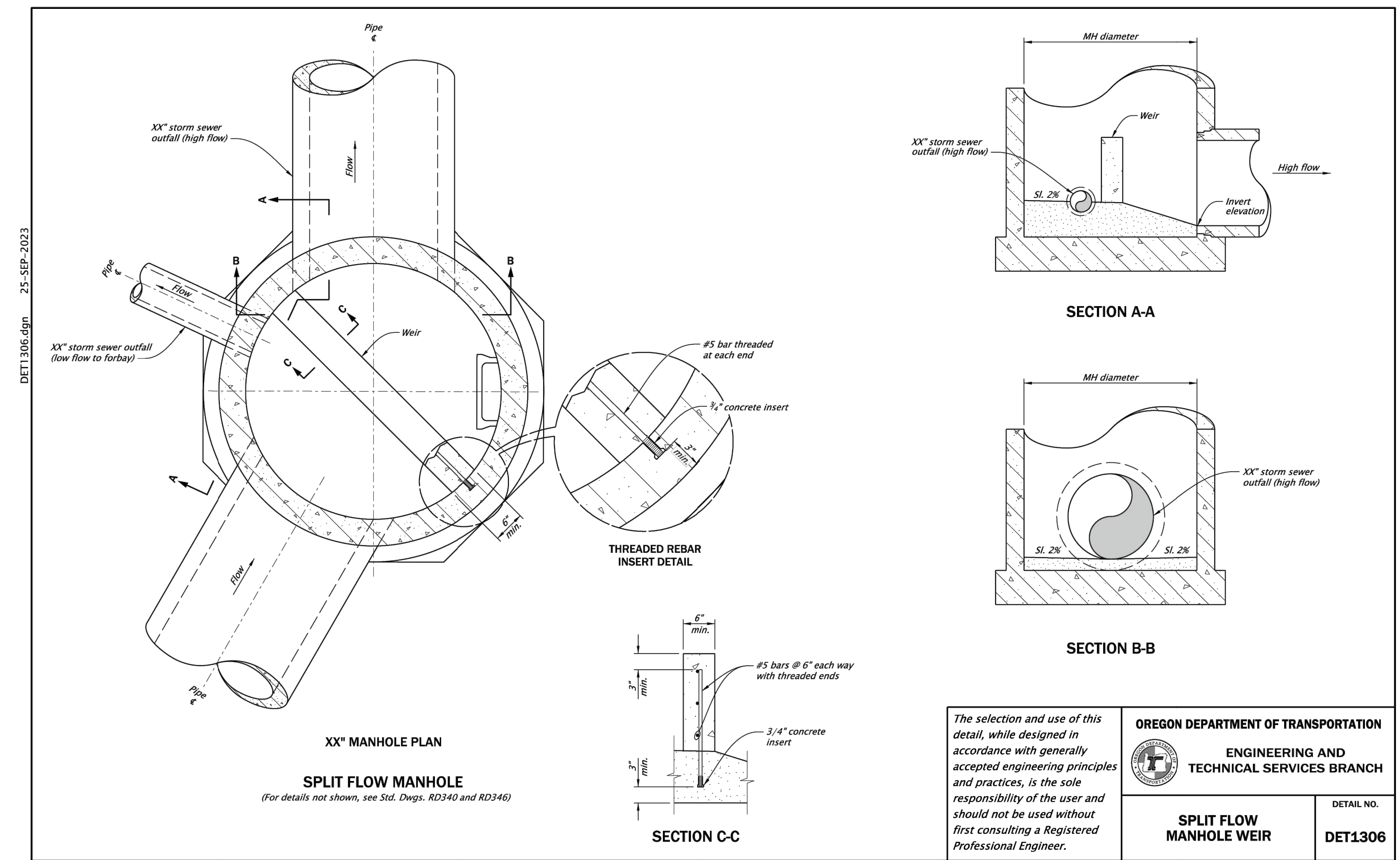
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2 CHAMBERMAXX STORMWATER RETENTION SYSTEM STANDARD INSTALLATION DETAIL CONTINUED
SCALE: NTS



CHAMBERMAXX STORMWATER RETENTION SYSTEM STANDARD INSTALLATION DETAIL



1 ODOT SPLIT FLOW MANHOLE WEIR
SCALE: NTS

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Appendix 3

Stormwater Cartridge Selection

MGS Flood Output

MGS Flood Report

Subbasin Summary

Conveyance Summary

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Appendix 3a

Stormwater Cartridge Selection

Stormwater Cartridge Selection

Assumptions

StormFilter Design Flow Rates per 18" Cartridge **12.53 gpm or 0.0279 cfs** Per Table 1 of the General Use Level Designation for Basic TSS Treatment from the Washington Department of Ecology

StormFilter Design Flow Rates per 27" Cartridge **18.79 gpm or 0.0419 cfs** Per Table 1 of the General Use Level Designation for Basic TSS Treatment from the Washington Department of Ecology

*Q is equal to the Water Quality 15-min On-Line Design Discharge Rate calculated in MGSFlood

Contech Water Quality Catch Basin Cartridges Selection

Structure	Contributing Basin	Contributing Pollution Generating Impervious Area		Qmax* (cfs)	Qtreatment (cfs)		# of Cartridges		Selection
		sf	ac		18"	27"	18"	27"	
CB-01	6	1,110	0.025	0.006	0.028	0.042	1	1	18"
CB-02	7	14,900	0.342	0.080	0.028	0.042	3	2	18"



Calculation Spreadsheet:
**OBH CLINIC STORM
MGS FLOOD OUTPUT**
Appendix 3b

Job Name: OBH - Clinic
KPFF Job #: 2400528
Design Engineer: JS
Check: MvB

CB-01 OUTPUT:

(Use on-line discharge rate, per pg 509 2024SWMMWW.)

Water Quality Data - CB-01

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):

Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):

Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)

Compute Infiltration/Filtration Statistics

Total Runoff Volume	17.93 ac-ft	Percent Treated (Infiltrated+Filtered)/Total	0.00%
Total Runoff Infiltrated	0.00 ac-ft 0.00%		
Total Runoff Filtered	0.00 ac-ft 0.00%		

Compute 2-yr Discharge Rate for Link Outflow (cfs)

Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs):

Off-Line Facility Design Discharge Rate (cfs):

CB-02 OUTPUT:

(Use on-line discharge rate, per pg 509 2024SWMMWW.)

Water Quality Data - CB-02

Water Quality Data | Flow Splitter Calculator

Compute Water Quality Treatment Volume for Link

Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):

Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):

Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)

Compute Infiltration/Filtration Statistics

Total Runoff Volume	245.35 ac-ft	Percent Treated (Infiltrated+Filtered)/Total	0.00%
Total Runoff Infiltrated	0.00 ac-ft 0.00%		
Total Runoff Filtered	0.00 ac-ft 0.00%		

Compute 2-yr Discharge Rate for Link Outflow (cfs)

Compute Water Quality 15-Minute Design Discharge for Link Inflow

On-Line Facility Design Discharge Rate (cfs):

Off-Line Facility Design Discharge Rate (cfs):

MGS FLOOD PROJECT REPORT

Program Version: MGSFlood 4.70
Program License Number: 202110007
Project Simulation Performed on: 03/11/2026 7:16 PM
Report Generation Date: 03/11/2026 7:16 PM

Input File Name: 20260310-ARCH-CHAMBERS-updated.fld
Project Name: OBH
Analysis Title: PRELIMINARY SIZING
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected

Full Period of Record Available used for Routing

Climatic Region Number: 41
Precipitation Station : 98009005 Coastal 90 in_5min 10/01/1948-10/01/2008
Evaporation Station : 981090 Coastal 90 in MAP

Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : Ecology Default

***** Default HSPF Parameters Used (Not Modified by User) *****

***** WATERSHED DEFINITION *****

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.624	0.624
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.624	0.624

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

----- Subbasin : EX-BASIN-2 -----
-----Area (Acres) -----
SAT, Forest, Mod 0.624

Subbasin Total 0.624

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

----- Subbasin : SITE -----
-----Area (Acres) -----
A/B, Lawn, Mod 0.089
ROADS/FLAT 0.048
ROOF TOPS/FLAT 0.105
SIDEWALKS/MOD 0.062
PARKING/MOD 0.320

Subbasin Total 0.624

***** LINK DATA *****

-----SCENARIO: PREDEVELOPED

Number of Links: 0

***** LINK DATA *****

-----SCENARIO: POSTDEVELOPED

Number of Links: 2

Link Name: New Copy Lnk1

Link Type: Copy

Downstream Link Name: FCMH-01

Link Name: FCMH-01

Link Type: Structure

Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft) : 94.50
Riser Crest Elevation (ft) : 98.00
Max Pond Elevation (ft) : 100.00
Storage Depth (ft) : 3.50
Pond Bottom Length (ft) : 34.3
Pond Bottom Width (ft) : 34.3
Pond Side Slopes (ft/ft) : Z1= 0.00 Z2= 0.00 Z3= 0.00 Z4= 0.00
Bottom Area (sq-ft) : 1176.
Area at Riser Crest El (sq-ft) : 1,176.
(acres) : 0.027
Volume at Riser Crest (cu-ft) : 4,118.
(ac-ft) : 0.095
Area at Max Elevation (sq-ft) : 1176.
(acres) : 0.027
Vol at Max Elevation (cu-ft) : 6,471.
(ac-ft) : 0.149

Constant Infiltration Option Used

Infiltration Rate (in/hr): 0.32

Riser Geometry

Riser Structure Type : Circular
Riser Diameter (in) : 12.00
Common Length (ft) : 0.000
Riser Crest Elevation : 98.00 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1---

Device Type : Circular Orifice
Control Elevation (ft) : 95.00
Diameter (in) : 1.75
Orientation : Horizontal
Elbow : Yes

*****FLOOD FREQUENCY AND DURATION STATISTICS*****

-----SCENARIO: PREDEVELOPED

Number of Subbasins: 1

Number of Links: 0

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

Number of Links: 2

***** Link: FCMH-01

***** Link WSEL Stats

WSEL Frequency Data(ft)

(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs) WSEL Peak (ft)

=====	
1.05-Year	95.942
1.11-Year	96.206
1.25-Year	96.475
2.00-Year	96.893
3.33-Year	97.305
5-Year	97.636
10-Year	97.975
25-Year	98.070
50-Year	98.080
100-Year	98.101

*******Groundwater Recharge Summary*******

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation	
Model Element	Recharge Amount (ac-ft)

Subbasin: EX-BASIN-2	63.051

Total:	63.051

Total Post Developed Recharge During Simulation	
Model Element	Recharge Amount (ac-ft)

Subbasin: SITE	31.555
Link: New Copy Lnk1	Not Applicable
Link: FCMH-01	122.628

Total:	154.183

Total Predevelopment Recharge is Less than Post Developed

Average Recharge Per Year, (Number of Years= 60)

Predeveloped: 1.051 ac-ft/year, Post Developed: 2.570 ac-ft/year

*******Water Quality Facility Data*******

-----**SCENARIO: PREDEVELOPED**

Number of Links: 0

-----**SCENARIO: POSTDEVELOPED**

Number of Links: 2

***** Link: FCMH-01

Basic Wet Pond Volume (91% Exceedance): 4945. cu-ft

Computed Large Wet Pond Volume, 1.5*Basic Volume: 7417. cu-ft

2-Year Discharge Rate : 0.107 cfs

15-Minute Timestep, Water Quality Treatment Design Discharge

On-line Design Discharge Rate (91% Exceedance): 0.15 cfs

Off-line Design Discharge Rate (91% Exceedance): 0.08 cfs

Time to Infiltrate 91% Treatment Volume, (Hours): 160.11

Infiltration/Filtration Statistics-----

Inflow Volume (ac-ft): 223.36
Inflow Volume Including PPT-Evap (ac-ft): 223.36
Total Runoff Infiltrated (ac-ft): 122.63, 54.90%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 100.91
Secondary Outflow To Downstream System (ac-ft): 0.00
Volume Lost to ET (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 54.90%

*****Compliance Point Results *****

Scenario Predeveloped Compliance Subbasin: EX-BASIN-2

Scenario Postdeveloped Compliance Link: FCMH-01

*** Point of Compliance Flow Frequency Data ***

Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.277	2-Year	0.107
5-Year	0.361	5-Year	0.126
10-Year	0.406	10-Year	0.162
25-Year	0.443	25-Year	0.334
50-Year	0.525	50-Year	0.378
100-Year	0.606	100-Year	0.475
200-Year	**	200-Year	**
500-Year	**	500-Year	**

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

**** Flow Duration Performance ****

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-96.7%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-72.4%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	0.0%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

**** LID Duration Performance ****

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-5.5%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-3.2%	PASS

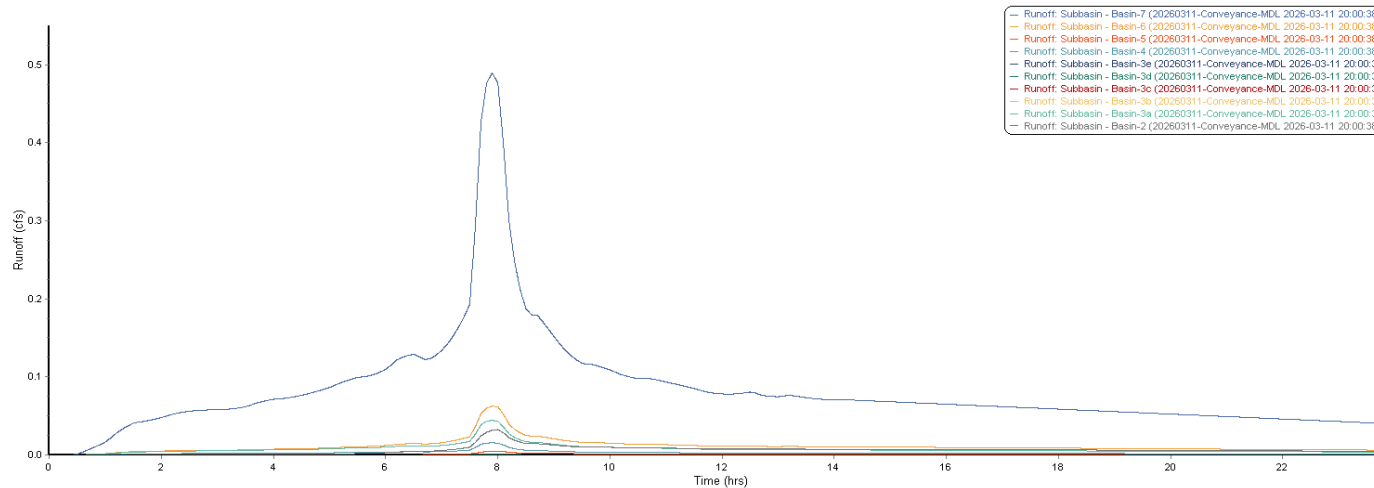
MEETS ALL LID DURATION DESIGN CRITERIA: PASS



OBH CLINIC STORM SUBBASIN SUMMARY 25-YEAR 24-HR STORM

Appendix 3d

Basin	Drainage Node	Area (sf)	Time of Concentration (min)	Impervious Area %	Impervious Area CN	Pervious Area CN	Peak Runoff (cfs)
Basin-2	AD-01	2,440	5	10%	98	69	0.033
Basin-3a	STUB-04	1,490	5	100%	98	69	0.044
Basin-3b	STUB-05	1,490	5	100%	98	69	0.044
Basin-3c	STUB-01	1,490	5	100%	98	69	0.044
Basin-3d	STUB-03	60	5	100%	98	69	0.001
Basin-3e	STUB-02	60	5	100%	98	69	0.001
Basin-4	AD-03	540	5	100%	98	69	0.016
Basin-5	AD-02	440	5	0%	98	69	0.005
Basin-6	CB-01	2,740	5	62%	98	69	0.062
Basin-7	CB-02	16,450	5	99%	98	69	0.490

Rainfall Intensity Graph**SEE APP 3e FOR PIPE ANALYSIS**



OBH CLINIC STORM DRAINAGE CONVEYANCE SUMMARY

Appendix 3e

From (Inlet) Node	To (Outlet) Node	Slope (%)	Pipe Diameter (in)	Manning's Roughness	Full Flow Flow Capacity (cfs)	25 Year Peak Flow (cfs)	Peak Flow Velocity (ft/sec)	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged (min)
HB-03(56.25%%d)	CO-04	0.70	8	0.013	1.010	0.190	2.12	0.19	0.30	0.00
EXST-CB	Out-01	0.50	18	0.013	7.430	0.190	1.80	0.03	0.11	0.00
AD-01	WYE-02	0.65	6	0.013	0.450	0.030	0.60	0.07	0.32	0.00
AD-03	WYE-03	0.43	6	0.013	0.370	0.020	0.85	0.04	0.15	0.00
AD-02	HB-04(45%%d)	0.50	6	0.013	0.400	0.020	1.39	0.05	0.13	0.00
STUB-01	TEE-02	2.85	6	0.013	0.950	0.040	1.04	0.05	0.28	0.00
CO-02	TEE-02	0.72	6	0.013	0.480	0.120	1.61	0.25	0.41	0.00
TEE-02	WYE-01	0.74	6	0.013	0.480	0.160	1.73	0.34	0.49	0.00
CB-01	WYE-01	14.64	6	0.013	2.150	0.060	1.10	0.03	0.34	0.00
HB-04(45%%d)	CO-01	3.27	6	0.013	1.010	0.020	0.68	0.02	0.23	0.00
WYE-01	TEE-01	0.74	6	0.013	0.480	0.230	2.19	0.47	0.52	0.00
TEE-01	CO-01	3.15	6	0.013	1.000	0.230	3.49	0.23	0.37	0.00
CB-02	HB-08(45%%d)	4.21	6	0.013	1.150	0.490	4.05	0.42	0.93	0.00
CO-01	HB-01(90%%d)	3.19	6	0.013	1.000	0.250	4.10	0.25	0.63	0.00
HB-02(45%%d)	Arch-Chamber	4.23	6	0.013	1.150	0.490	3.91	0.42	1.00	592.00
Arch-Chamber	FCMH-01	0.00	24	0.013	2.780	1.100	0.89	0.40	0.97	0.00
WYE-02	CO-02	0.74	6	0.013	0.480	0.120	1.76	0.25	0.38	0.00
WYE-03	AD-02	0.50	6	0.013	0.400	0.020	0.88	0.04	0.15	0.00
STUB-03	HB-05(45%%d)	0.48	6	0.013	0.390	0.000	0.41	0.00	0.05	0.00
HB-05(45%%d)	WYE-03	0.57	6	0.013	0.420	0.000	0.17	0.00	0.10	0.00
STUB-02	TEE-01	3.25	6	0.013	1.010	0.000	0.06	0.00	0.21	0.00
STUB-04	HB-07(90%%d)	0.60	6	0.013	0.430	0.040	1.23	0.10	0.24	0.00
HB-07(90%%d)	CO-03	0.51	6	0.013	0.400	0.040	0.83	0.11	0.32	0.00
STUB-05	CO-03	0.57	6	0.013	0.420	0.040	0.67	0.10	0.38	0.00
CO-03	HB-06(45%%d)	0.56	6	0.013	0.420	0.090	1.24	0.21	0.39	0.00
HB-06(45%%d)	WYE-02	0.63	6	0.013	0.450	0.090	1.36	0.20	0.37	0.00
HB-08(45%%d)	HB-02(45%%d)	4.28	6	0.013	1.160	0.490	3.36	0.42	1.00	438.00
CO-04	EXST-CB	0.69	8	0.013	1.010	0.190	2.16	0.19	0.30	0.00

**OBH CLINIC STORM DRAINAGE CONVEYANCE SUMMARY**
Appendix 3e

From (Inlet) Node	To (Outlet) Node	Slope (%)	Pipe Diameter (in)	Manning's Roughness	Full Flow Flow Capacity (cfs)	25 Year Peak Flow (cfs)	Peak Flow Velocity (ft/sec)	Max Flow / Design Flow Ratio	Max Flow Depth / Total Depth Ratio	Total Time Surcharged (min)
HB-01(90%%d)	DMH-01	3.21	6	0.013	1.010	0.250	3.25	0.25	1.00	186.00
DMH-01	Arch-Chamber	0.00	24	0.013	1.340	0.230	0.50	0.17	0.97	0.00

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Appendix 4

Operations and Maintenance Manual

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Operations & Maintenance Plan

OBH – Express Care Clinic

Prepared for: Boulder Associates

Prepared by: Jennica Siemsen

Project Engineer: Daan Dommels, PE, PMP, DBIA

March 2026 | KPFF Project #2400528

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Appendices

Appendix A

Proposed Basin Map

Operations and Maintenance Log

Appendix B

SWMMWW Maintenance Standards

Appendix C

Contech StormFilter Catch Basin Operation and Maintenance Guide

Appendix D

Chambermaxx Design Guide

I. Description

Purpose of this Report

This report describes the Operations and Maintenance for the proposed stormwater management systems. The basis of this report is the requirements of the City of Ilwaco and the Washington State Department of Ecology (WSDOE) Stormwater Management Manual for Western Washington. The purpose of the proposed stormwater management facilities is to protect existing stormwater infrastructure and improve the overall health of the watershed.

Project Location

The proposed project is located within the Ocean Beach Hospital (OBH) campus on the corner of First Avenue (US-101) and Ash Street in Ilwaco, Washington. The main existing driveway is located on First Avenue and a smaller driveway connecting to Ash Street is located at the back of the existing paved parking lot. The project includes a building addition to an existing clinic building and a new parking lot.

The existing site includes a medical clinic building, a residential building, a helicopter pad, a paved asphalt parking lot, and an additional gravel parking lot. The site topography consists of relatively flat areas with gradual slopes in the surrounding landscape areas on the project site.

Responsibility

The stormwater infrastructure on this site is to be maintained by Ocean Beach Hospital personnel or their contractor. Owner and facilities staff should refer to the City of Ilwaco and the Washington State Department of Ecology Stormwater Management Manual for Western Washington for additional responsibilities. Facilities staff will conduct regular inspections of the stormwater infrastructure and perform any required tasks to keep it in working order, such as removing trash and debris from stormwater inlets and associated components. Any maintenance tasks that require special equipment should be conducted by a professional contractor. Stormwater infrastructure must be accessible for monitoring and maintenance.

II. Schedule

Each part of the system shall be inspected and maintained quarterly within the first two years. After two years, all facilities should be inspected twice a year. All facilities should be inspected 48 hours after each major storm event. For this O&M Plan, a major storm event is defined as 1 inch or more of rain in 24 hours. All components of the storm system, as described above, must be inspected and maintained regularly to ensure they continue to function effectively. The facility owner shall keep a log, recording all inspection dates, observations and maintenance activities. Receipts shall be saved when maintenance is performed and there is a record of expense.

III. Inspection and Maintenance Procedures

Importance of Maintenance

The purpose of a stormwater treatment facility is to remove pollutants, including suspended solids, by capturing sediment, which includes sediment, dirt, leaves and litter. These materials can restrict or clog the

facility. Timely sediment removal will improve infiltration rates and water quality, prevent clogging, and reduce flooding.

Stormwater facilities often collect a variety of trash and debris. Trash and debris, especially floating debris, can clog pipes or treatment media. It can also cause odors through decay. Stormwater facilities are designed to help prevent pollutants from entering rivers and streams.

System Description

Stormwater generated onsite will be directed through several area drains in the proposed landscape and pedestrian areas, and two StormFilter Catch Basins (WSDOE Manufactured Media Filters) located in the proposed access road and parking lot. Storm runoff from pollution-generating surfaces will be treated and then conveyed to an Arch Chamber detention system under the parking lot before being allowed to discharge through a flow control manhole to the public storm system. All WSDOE minimum requirements will be addressed. In addition to the following operations and maintenance measures, the Owner shall follow and adhere to the WSDOE O&M standards listed in Appendix B1 and the online WSDOE Stormwater Management Manual for Western Washington (2024) Volume V Appendix V-A.

TABLE 1: FACILITIES DESCRIPTION TABLE

Facility Name	Bottom Area (sf)	Area Managed	Impervious Area Managed (sf)	Discharge Point
CB-01 WSDOE Manufactured Media Filters	N/A	• Access Road • Pedestrian Pavement • Landscape	1,710	Arch Chamber System (via 6" lines from CB-01 to Arch Chamber System)
CB-02 WSDOE Manufactured Media Filters	N/A	• Parking Lot • Pedestrian Pavement • Landscape	16,240	Arch Chamber System (via 6" lines from CB-02 to Arch Chamber System)
AD-01	N/A	• Landscape • Mechanical equipment pad	240	Arch Chamber System (via 6" lines from AD-01 to Arch Chamber System)
AD-02	N/A	• Landscape	0	Arch Chamber System (via 6" lines from AD-02 to Arch Chamber System)
AD-03	N/A	• Pedestrian Pavement	540	Arch Chamber System (via 6" lines from AD-03 to Arch Chamber System)
Arch Chamber System	1940	• Access Road and Parking Lot • Pedestrian Pavement • Landscape • Roof Drainage • Offsite Road Drainage	23,320	EXST-CB (via 8" lines from the Arch Chamber system to EXST-CB)

See Appendix B1 for Manufactured Media Filter O&M requirements.

Water and Sediment Disposal

When deciding how to dispose of sediment, consider the types of activities and pollutants onsite. As the generator of this waste, you are responsible for deciding how to properly manage and remove solids.

- **Contaminated Water and Sediment**

Stormwater facilities in areas used for chemical or hazardous waste storage, material handling, or equipment maintenance may collect chemicals used in these activities from spills or via stormwater runoff. If you observe an oily sheen, odors, discoloration, or other signs of pollution, hire a professional laboratory or sampling firm to assess whether the material needs specialized hauling, treatment, or disposal to comply with the Washington State Department of Ecology. If you need assistance deciding whether the solids should be managed as hazardous waste, contact WSDOE Hazardous Waste and Toxics at 360-407-6700.

- **Non-Contaminated Water and Sediment**

Dispose of it in a sanitary sewer through a shop drain, sink, toilet, or other appropriate drains.

If the pollutant load is non-hazardous, water may also be spread across onsite vegetation. Let the solids dry, then properly dispose of them. Dry materials may be reused elsewhere on your site, may be eligible for reuse by others, or can be disposed of at a designated solid waste facility.

Maintenance Procedures

AREA DRAINS (AD), CLEANOUTS (CO), MANHOLES, AND DETENTION SYSTEM

Component	What to look for	What to do	Season
Piping	Debris and garbage buildup	Clear piping to facility when blockage occurs.	All
	Cracked drain pipe	Repair/seal cracks. Replace when repair is insufficient.	All
Trap/Outlet Hood	Debris and garbage buildup	Clear hooded outlet.	All
Sump	Depth of accumulated sediments has reached 1/3 of the capacity	Remove sediment using vactor truck (manholes) or shovel (area drains and catch basins only).	All
Structure walls	Cracks	Repair/seal cracks. Replace when repair is insufficient	All
Cover	Missing grate or cover	Replace missing grate or cover	All
	Cracks in grate or cover	Replace cracked grate or cover	All
	Uneven cover	Remove debris from frame/collar and ensure cover is level and secured. If settling has occurred so that cover is no longer level with surrounding grades, adjust rim to remove tripping hazard.	All

Procedure Notes:

1. It is illegal to hose sediments through your system. Sediments often can be removed by hand.
2. Large facilities and underground facilities will need to be cleaned with heavy equipment, such as vacuum trucks, by trained professionals.
3. See Appendix C and D for StormFilter Catch Basin and Chambermaxx System maintenance procedures. Access shall be maintained for all facilities so operations and maintenance can be performed as regularly scheduled.

IV. Financial Responsibilities

The facility is to be maintained by Lower Columbia College facilities staff. The preparer has worked closely with personnel to design a system that can be easily maintained by maintenance staff.

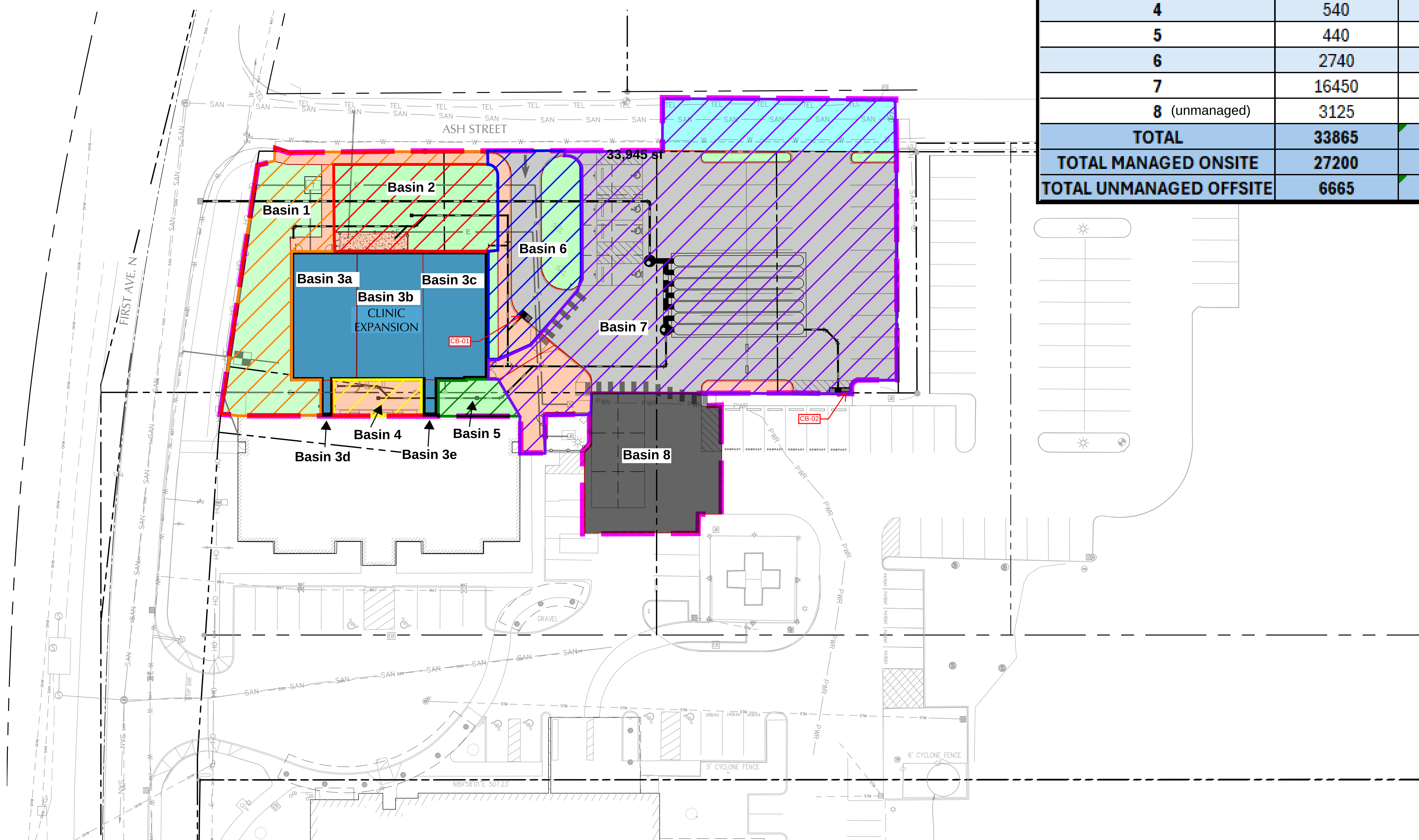
A copy of the O&M Plan shall be provided to the property owner.

Appendix A

Proposed Basin Map

Operations and Maintenance Log

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BASIN	TOTAL AREA		IMPERVIOUS	PERVIOUS	% IMPERVIOUS
	(sf)	(ac)	(sf)	(sf)	
1 (unmanaged)	3540	0.081	750	2790	21%
2	2440	0.056	240	2200	10%
3a	1490	0.034	1490	0	100%
3b	1490	0.034	1490	0	100%
3c	1490	0.034	1490	0	100%
3d	60	0.001	60	0	100%
3e	60	0.001	60	0	100%
4	540	0.012	540	0	100%
5	440	0.010	0	440	0%
6	2740	0.063	1710	1030	62%
7	16450	0.378	16240	210	99%
8 (unmanaged)	3125	0.072	3125	0	100%
TOTAL	33865	0.777	27195	6670	80%
TOTAL MANAGED ONSITE	27200	0.624	23320	3880	86%
TOTAL UNMANAGED OFFSITE	6665	0.153	3875	2790	58%

LEGEND

Pollution-Generating Impervious (Roads, Parking Lots)

Non-Pollution-Generating Impervious (sidewalks)

Non-Pollution-Generating Impervious (Roof Area)

Pervious (Landscape Area)

Pollution-Generating Impervious (Offsite Road Area draining to site)

Pollution-Generating Impervious (Onsite mobile MRI pad draining offsite)

Structure ID	PGIA*	
	(sf)	(ac)
CB-01	1110	0.025
CB-02	14900	0.342

*Pollution-generating impervious area

SCALE: 1" = 20'

020'

PROPOSED BASIN MAP FOR OBH - CLINIC

APP-A1

Operations and Maintenance Log

[illegible]

Appendix B

SWMMWW Maintenance Standards

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Table V-A.15: Maintenance Standards - Sand Filters (Belowground/Enclosed) (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
		Cracks wider than 0.5 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	let pipe.
	Baffles/Internal walls	Baffles or walls corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and/or misaligned.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel.

V-A.17 Maintenance Standards - Manufactured Media Filters

Table V-A.16: Maintenance Standards - Manufactured Media Filters

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accumulation on Media	Sediment depth exceeds 0.25 inches.	No sediment deposits that would impede permeability of the media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6 inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on filter bed.	Trash and debris removed from the filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 0.5 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 0.5 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 0.25 inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
Below Ground Cartridge Type	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and/or misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
	Filter Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

Table V-A.5: Maintenance Standards - Control Structures (continued)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Clean-out Gate	Damaged or Missing	Clean-out gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Access Opening	See V-A.5 Maintenance Standards - Tanks and Vaults		
Catch Basin	See V-A.7 Maintenance Standards - Catch Basins		

V-A.7 Maintenance Standards - Catch Basins

Table V-A.6: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60% of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g. methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60% of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e. separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regouted and secure at basin wall.
	Settlement/ Mis-alignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pol-	See V-A.2 Maintenance Standards - Detention Ponds	No pollution present.

Table V-A.6: Maintenance Standards - Catch Basins (continued)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	lution		
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Cover/grate is in place, meets design standards, and is secured.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (if applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place, meets the design standards, and is installed and aligned with the flow path.

V-A.8 Maintenance Standards - Debris Barriers (e.g. Trash Racks)

Table V-A.7: Maintenance Standards - Debris Barriers (e.g. Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

V-A.9 Maintenance Standards - Energy Dissipators

Table V-A.8: Maintenance Standards - Energy Dissipators

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.

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Appendix C

Contech StormFilter Catch Basin Operation and Maintenance Guide (WSDOE
Manufactured Media Filter)

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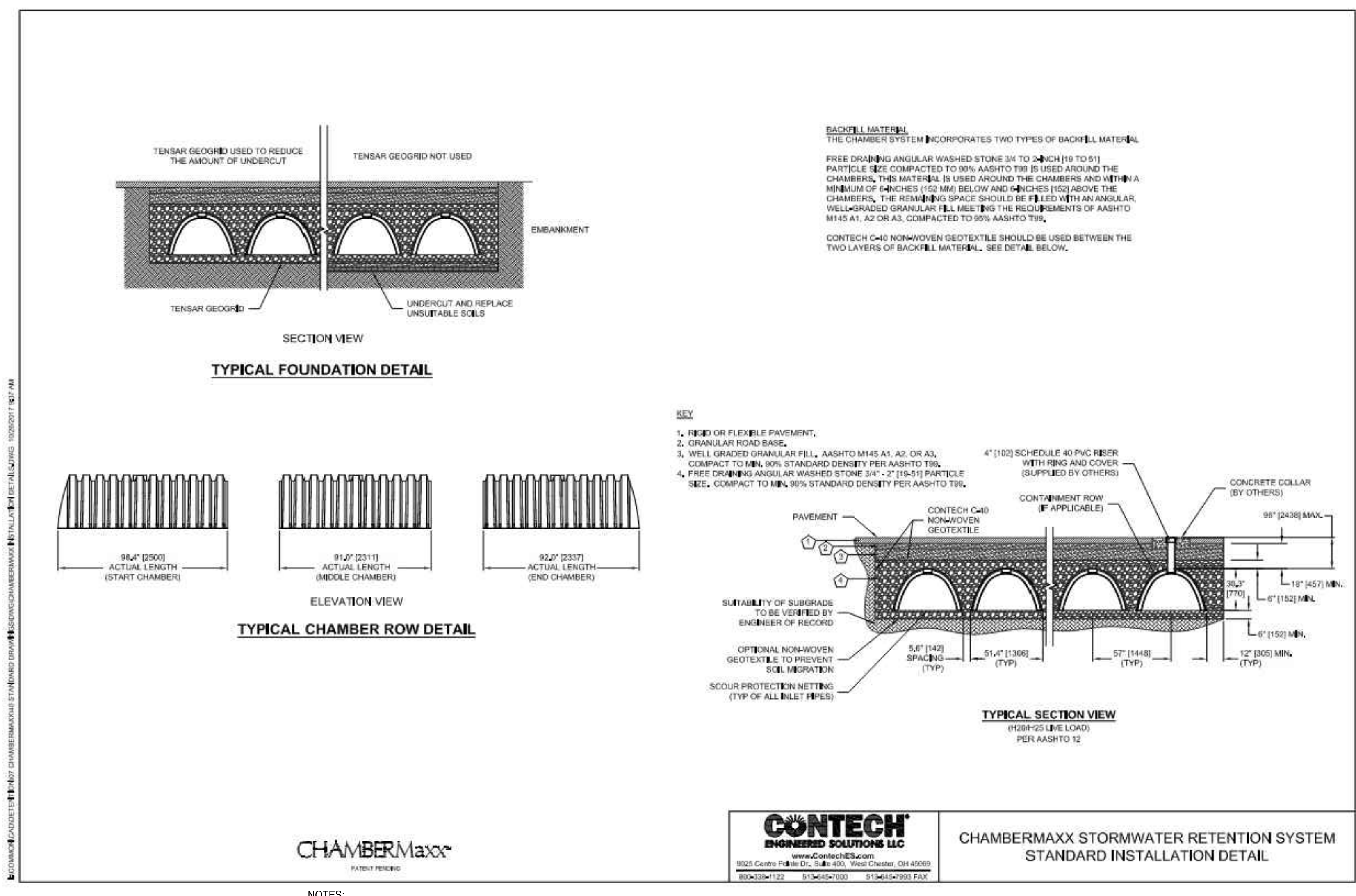
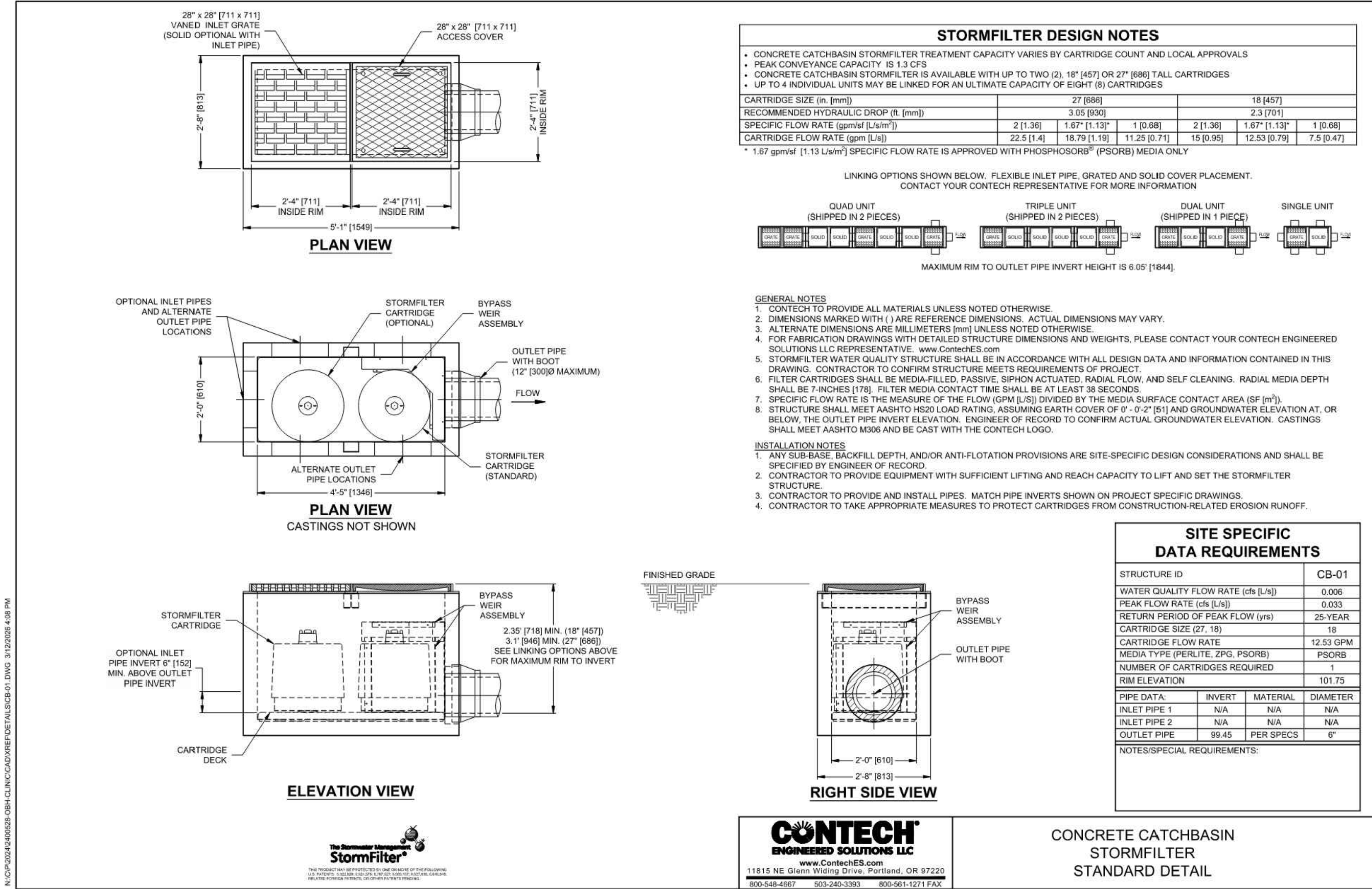
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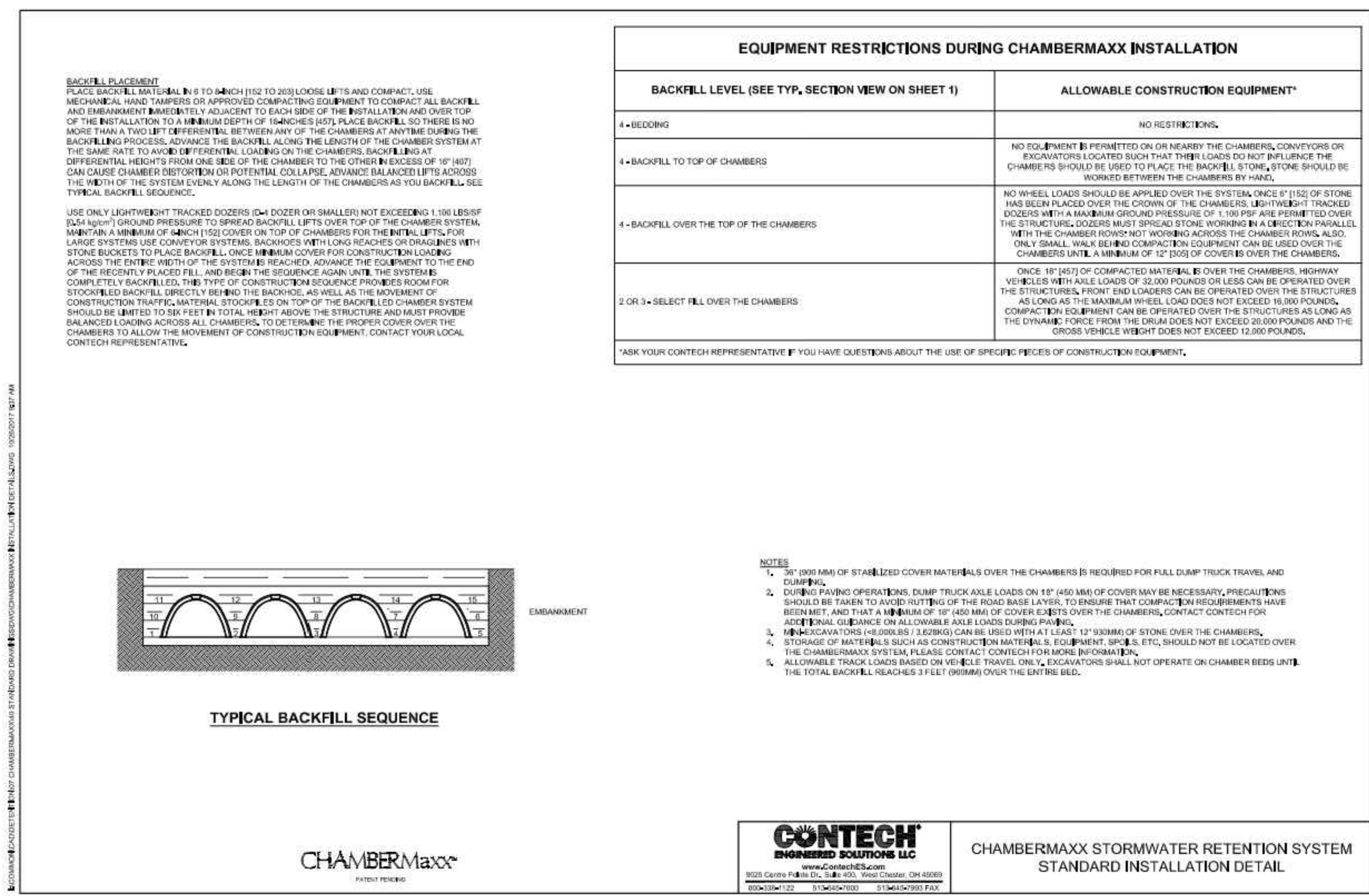
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CONCRETE CATCHBASIN STORMFILTER - CB-01
SCALE: NTS



CHAMBERMAXX STORMWATER RETENTION SYSTEM
STANDARD INSTALLATION DETAIL CONTINUED
SCALE: NTS

2



CatchBasin StormFilter™

Important: These guidelines should be used as a part of your site stormwater plan.

Overview

The CatchBasin StormFilter™ (CBSF) consists of a multi-chamber steel, concrete, or plastic catch basin unit. The steel CBSF is offered both as a standard and as a deep unit for additional internal overflow and sediment capacity.

The CBSF is installed flush with the finished grade and is applicable for both constrained lot and retrofit applications. Steel and concrete units can accept surface and piped influent for roof leaders or similar applications.

The steel, concrete and plastic CBSF units have capacities of 4, 8 and 2 cartridges, respectively. Internal overflow capacity varies by system type from 0.5 cfs for the plastic, 1.3 cfs for the concrete and 1.0 or 1.8 cfs for the steel unit.

Design Operation

The CBSF is installed as the primary receiver of runoff, similar to a standard, grated catch basin. The steel and concrete CBSF units have an H-20 rated, traffic bearing lid that allows the filter to be installed in parking lots, and for all practical purposes, takes up no land area. Plastic units can be used in landscaped areas or other non-traffic-bearing applications.

The steel CBSF consists of a sumped inlet chamber and cartridge chamber(s). Runoff enters the sumped inlet chamber either by sheet flow from a paved surface or from an inlet pipe discharging directly to the unit vault. The inlet chamber is equipped with an internal baffle, which traps debris and floating oil and grease, and an overflow weir. While in the inlet chamber, heavier solids are allowed to settle into the deep sump, while lighter solids and soluble pollutants are directed into the cartridge chamber through a port between the baffle and the overflow weir.

The concrete and plastic units operate similarly minus the presence of the inlet chamber or deep sump.

Once in the cartridge chamber, polluted water ponds and percolates horizontally through the media in the filter cartridges. Treated water collects in the cartridge's center tube from where it is directed to the outlet chamber and discharged to the outlet pipe on the downstream side of the overflow weir.

When influent flows exceed the water quality design value, excess water spills over the overflow weir, bypassing the cartridge bay, and discharges to the outlet pipe.

Applications

The CBSF is particularly useful where small flows are being treated or for sites that have little available hydraulic head. The unit is ideal for applications in which standard catch basins are to be used. Both water quality and catchment issues can be resolved with the use of the CBSF.

Retro-Fit

The retrofit market has many possible applications for the CBSF. The CBSF can be installed by replacing an existing catch basin without having to "chase the grade," thus reducing the high cost of re piping the storm system.

CatchBasin StormFilter™

Maintenance Guidelines

Maintenance procedures for typical catch basins can be applied to the CatchBasin StormFilter (CBSF). The filter cartridges contained in the CBSF are easily removed and replaced during maintenance activities according to the following guidelines.

1. Establish a safe working area as per typical catch basin service activity.
2. Remove steel grate and diamond plate cover (weight 100 lbs. each) or plastic grating.
3. Turn cartridge(s) approximately ¼ turn counter-clockwise to disconnect from pipe manifold.
4. Remove cartridge(s) from catch basin by hand or with appropriate hoisting equipment.
5. Remove accumulated sediment via vactor truck from all interior chambers.
6. Rinse interior of both bays and vactor remaining water and sediment.
7. Install fresh cartridge(s), by rotating ¼ turn clockwise, taking care not to damage cartridge connectors.
8. Replace cover(s).
9. Dispose of accumulated debris and spent media in accordance with local regulations.
10. Return used, empty cartridges to Contech for refurbishing.

Media may be removed from the filter cartridges using the vactor truck before the cartridges are removed from the catch basin structure once the top cap and hood are removed. The vactor truck must be equipped with a hose capable of reaching areas of restricted clearance.

Empty cartridges can be easily removed from the catch basin structure by hand. Empty cartridges should be reassembled and returned to Contech as appropriate.

Refurbished cartridges are available from Contech on an exchange basis. Contact the maintenance department of Contech at 513-645-7770 for more information.

Onsite maintenance is estimated at 26 minutes once setup for a single cartridge unit. Add approximately 5 minutes for each additional cartridge.

Mosquito Abatement

In certain areas of the United States, mosquito abatement is desirable to reduce the incidence of vectors.

In BMPs with standing water, which could provide mosquito breeding habitat, certain abatement measures can be taken.

1. Periodic observation of the standing water to determine if the facility is harboring mosquito larvae.
2. Regular catch basin maintenance.
3. Use of larvicides containing *Bacillus thuringiensis israelensis* (BTI). BTI is a bacterium toxic to mosquito and black fly larvae.

In some cases, the presence of petroleum hydrocarbons may interrupt the mosquito growth cycle.

Using Larvicides in the CatchBasin StormFilter

Larvicides should be used according to manufacturer's recommendations.

Two widely available products are Mosquito Dunks and Summit B.t.i. Briquets. For more information, visit <https://www.amvac.com/products/summit-bti-briquets>.

The larvicide must be in contact with the permanent pool. The larvicide should also be fastened to the CatchBasin StormFilter to prevent displacement by high flows. A magnet can be used with a steel catch basin.

For more information on mosquito abatement in stormwater BMPs, refer to the following: <https://anrcatalog.ucanr.edu/pdf/8125.pdf>.

PhosphoSorb® Media

PhosphoSorb®

Effectively targets TSS and Total Phosphorus

Manufactured in an environmentally-friendly manner, PhosphoSorb is a lightweight media built from a Perlite base. This innovative, engineered filtration media removes total phosphorus (TP) from stormwater runoff by absorbing dissolved-P and filtering particulate-P simultaneously. Field tests of the PhosphoSorb media showed a load reduction of 89% TSS and 82% total phosphorus with an average influent concentration of 380 mg/L and 0.33 mg/L respectively.

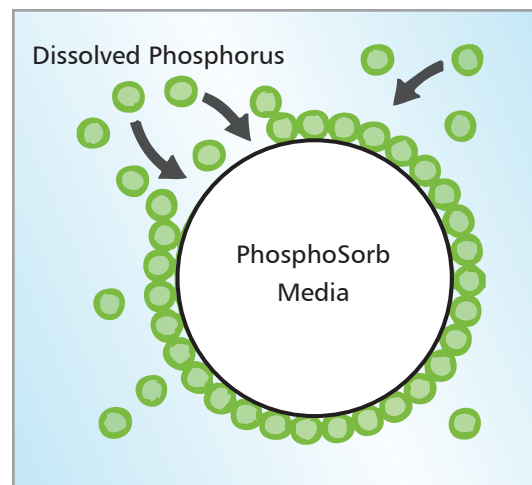
PHYSICAL CHARACTERISTICS OF PHOSPHOSORB

Nominal Size (mm)	1.4 - 6.3
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Bulk Density (lbs/ft ³)	20 - 25
-------------------------------------	---------

Effective Bed Porosity	65% - 80%
------------------------	-----------

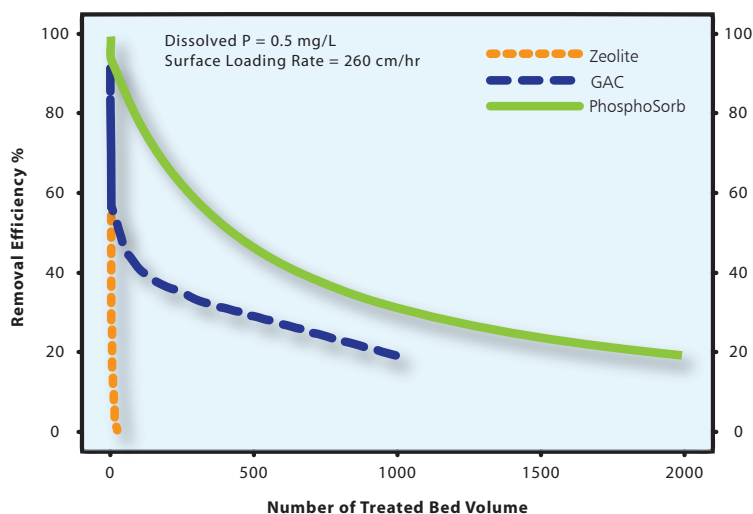
Specific Surface Area (m ² /g)	20 - 30
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Learn More:
www.ContechES.com/phosphosorb

Key Benefits:

- Removes both TSS and TP from stormwater runoff
- Removal of both soluble and total Phosphorus can exceed 50%
- Low impact product life cycle – no production by-products
- Lightweight media – easy to handle, ship and deploy
- Reliable performance and longevity using the laboratory and field-proven Stormwater Management StormFilter® cartridge



In laboratory testing, PhosphoSorb removed 50% of the first 1,000 treated empty bed volumes (EBVs) of 0.5 mg/L influent dissolved P solution, and lasted for at least 2,000 treated EBVs.

Effectively target TSS and Total Phosphorus

CONTECH
ENGINEERED SOLUTIONS

StormFilter Inspection and Maintenance Procedures



Maintenance Guidelines

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

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

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. Inspection

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

2. Maintenance

- Cartridge replacement
- Sediment removal

Inspection and Maintenance Timing

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

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

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

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

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

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

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





Inspection Procedures

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

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

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit and the unit's role, relative to detention or retention facilities onsite.

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

Maintenance Decision Tree

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

Please note Stormwater Management StormFilter devices installed downstream of, or integrated within, a stormwater storage facility typically have different operational parameters (i.e. draindown time). In these cases, the inspector must understand the relationship between the retention/detention facility and the treatment system by evaluating site specific civil engineering plans, or contacting the engineer of record, and make adjustments to the below guidance as necessary. Sediment deposition depths and patterns within the StormFilter are likely to be quite different compared to systems without upstream storage and therefore shouldn't be used exclusively to evaluate a need for maintenance.

1. Sediment loading on the vault floor.
 - a. If $>4"$ of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
 - a. If $>1/4"$ of accumulation, maintenance is required.
3. Submerged cartridges.
 - a. If $>4"$ of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
 - a. While not required in all cases, inspection of the media within the cartridge may provide valuable additional information.
 - b. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
 - a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
 - a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
 - a. If pronounced scum line (say $\geq 1/4"$ thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

- B. Remove the used cartridges (up to 250 lbs. each) from the vault.



Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

- C. Set the used cartridge aside or load onto the hauling truck.
- D. Continue steps a through c until all cartridges have been removed.

Method 2:

- A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.
- B. Unscrew the cartridge cap.
- C. Remove the cartridge hood and float.
- D. At location under structure access, tip the cartridge on its side.
- E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.
- F. Set the empty, used cartridge aside or load onto the hauling truck.
- G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.



Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____ Months in Service: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

List Safety Procedures and Equipment Used: _____

System Observations

Months in Service: _____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?): _____

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:



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Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

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Appendix D

Chambermaxx Design Guide

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ChamberMaxx[®]
Design Guide



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Detention System Design Tools

Design Your Own Detention System (DYODS®)

Contech's DYODS is an exclusive, online design tool that allows you to design your own detention or infiltration system. DYODS fully automates the layout process for stormwater detention and infiltration systems and produces CAD and PDF files that can be used for creating plans and specs, and for estimating total installed costs.

Features of the new tool include:

- Optimizes design and layout for cost efficiency
- "Drag and drop" feature allow users to customize layout
- Design multiple systems per project and save for future use
- Provides instant access to customized, project specific drawings
- CAD/PDF files provided for use in creating plans and specs

The DYODS tool is available at www.conteches.com/DYO.

Online Product Design Worksheet (PDW)

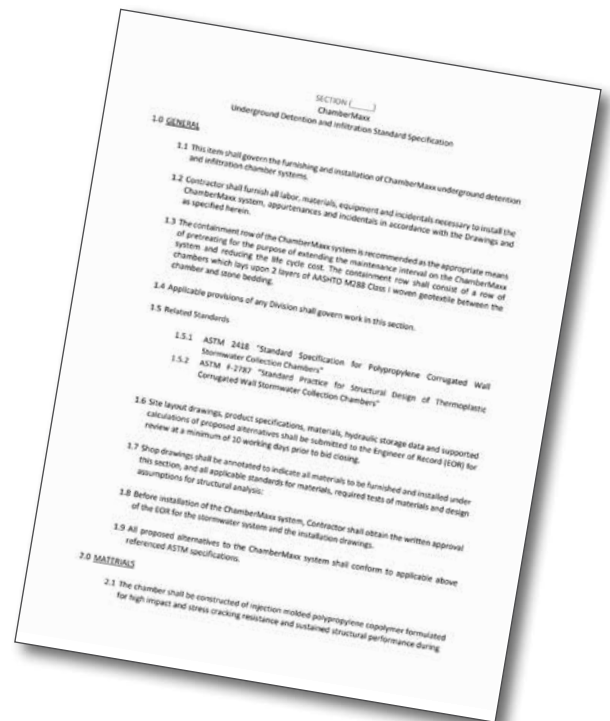
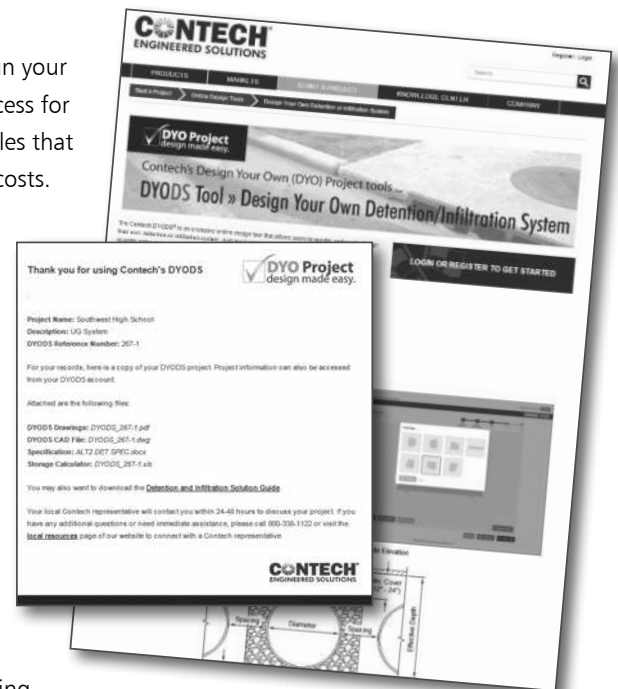
Our in-house team of engineers can support you through the entire permitting process. Just enter your information into the online form, and one of our in-house engineers will contact you with specific recommendations for your project.

The Detention Product Design Worksheet is available at www.conteches.com/detentionpdw

Engineering Services & Support

Contech has regional engineering offices and local stormwater consultants trained to provide the following services:

- Regulatory guidance and permitting assistance
- Preliminary standard details and/or site specific final drawings and specifications
- Low Impact Development design assistance
- Engineering calculations for hydraulics/hydrology, buoyancy, and stage-storage
- Review of preliminary site design, feasibility screening, and layout assistance
- Value Engineering - cost estimates and options analysis
- Pre-construction support, project scheduling, and contractor coordination
- Installation and construction support
- Maintenance support, including: guidance manuals, training/demonstrations, and certified contractor identification



ChamberMaxx Overview

The ChamberMaxx corrugated, open-bottom chamber system allows you to meet runoff reduction requirements by providing economic infiltration. Design your low impact development (LID) site by incorporating this belowgrade system to maximize available land for development or green space. ChamberMaxx is most effective on sites where the depth from finished grade to storm sewer outlet is less than 54-inches (1.37-meters).

The ChamberMaxx polypropylene stormwater detention/infiltration chamber has undergone extensive development and structural qualification investigation meeting the performance requirements of the ASTM F2418 Standard Specification for Polypropylene Corrugated Wall Stormwater Collection Chambers. The following is a summary of the design qualification.

The ChamberMaxx chamber is produced by an injection molding process with a high quality UV stabilized co-polymer polypropylene which meets the ASTM F2418 material classification requirement as PP0330B99945 per ASTM D4101. An extensive test program demonstrates that the ChamberMaxx chambers exceed the minimum material performance requirements set forth by the product specification for short term and both 50 and 75 year strength, stiffness, and toughness, including material environmental stress crack resistance (ESCR) which exceeds industry requirements.

The ChamberMaxx structural qualification to ASTM F2418 includes a CANDE FEA predicted installed structural performance which safely meets the AASHTO LRFD Section 12 Design Specification for Buried Structures. As required, performance verification through full scale installation and monitoring was conducted in successful support of the safety of the chamber design and installation.

The ChamberMaxx chamber installation was evaluated for safety with AASHTO load factors for the vehicle and earth fill condition of 1.75 and 1.95 respectively. The general installation capabilities in accordance with AASHTO are:

- Live Load AASHTO Design Truck HS25 (HL93)
- Minimum Cover (HS25): 18 in.
- Maximum Cover, 75 years: 8 ft.

Chamber Manufacturing

The ChamberMaxx chamber and virtually all of its materials of construction are manufactured at ISO 9001 certified US facilities. The chambers are produced with state of the art structural web injection molding equipment resulting in a reliable, high quality product. Weighing approximately 80 pounds, the chamber has a minimum average wall thickness of .175 inches (4.45 mm) and measures approximately 51 x 30 x 91 inches (1.30 x .76 x 2.31 meters) in overall dimension.

A ChamberMaxx system is comprised of start chambers, middle chambers, and end chambers. The end cap of the chamber is integrated into the start and end chambers, thereby making chamber installation fast and efficient.

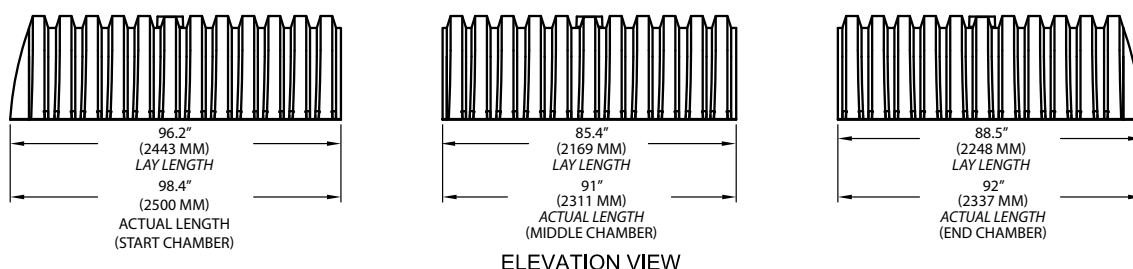
Application-System Configurations

The open-bottom plastic chamber allows infiltration into surrounding soil, effectively achieving runoff reduction objectives often required by an LID design. By utilizing subsurface infiltration, space is preserved for development, runoff is reduced or eliminated and groundwater recharge can occur. The ChamberMaxx is ideal when you need to maximize storage capacity in a shallow footprint.

Subsurface Infiltration

An open bottom plastic chamber the ChamberMaxx allows infiltration into surrounding soils, effectively achieving runoff reduction objectives often required by in an LID (low impact development) design.

Best practice designs for subsurface infiltration include pretreatment to reduce cost and frequency of maintenance while ensuring the infiltration capacity of the facility. Contech has multiple options for pretreatment.



Bioretention

ChamberMaxx is designed with a minimum of 6" stone above and below the units. The ChamberMaxx can help make bioretention practical by storing 75.1 CF per unit, including storage in stone, before discharging back into the surrounding soil.

Detention

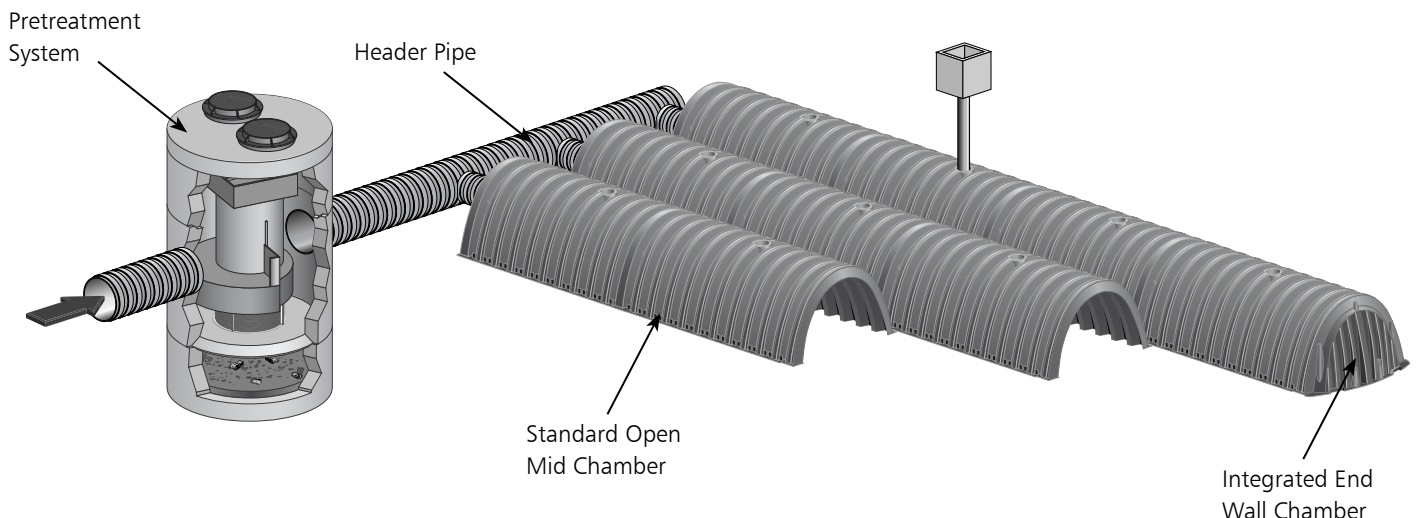
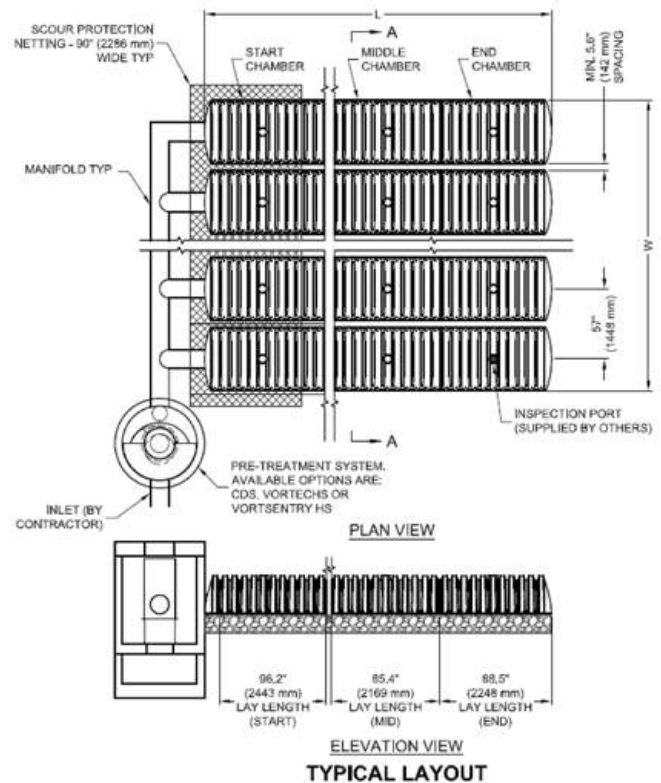
ChamberMaxx systems can also be used for detention applications where infiltration of stored water is minimized. Minimization of infiltration can be accomplished by wrapping the entire chamber system and stone backfill in an impermeable thermoplastic liner.

Inlet Configurations

ChamberMaxx systems are compatible with various inlet configurations. The inlet configuration selected for a design should be based on the site requirements and local regulations. Pretreatment is recommended for all detention/retention systems regardless of type. The initial removal of sediment in a pretreatment device allows easy inspection and unobstructed maintenance. Contech offers standard inlet pretreatment configurations in the form of upstream pretreatment devices or the ChamberMaxx Containment Row.

Pretreatment Devices

In some jurisdictions, it is required to use devices for pretreatment of stormwater prior to entry to stormwater systems. By pretreating the stormwater prior to entry into the ChamberMaxx system, pollutants such as hydrocarbons and sediment may be captured, thereby extending the service life of the chamber system. Pretreatment devices vary in complexity and effectiveness. Several non-proprietary options exist in the form of deep sump manholes, oil grit separators, and bio-swales. Contech offers pretreatment devices such as the CDS and VortSentry HS for designs that require more stringent levels of pollutant removal. See Contech's website to design your own pretreatment device: www.conteches.com/dyohds.



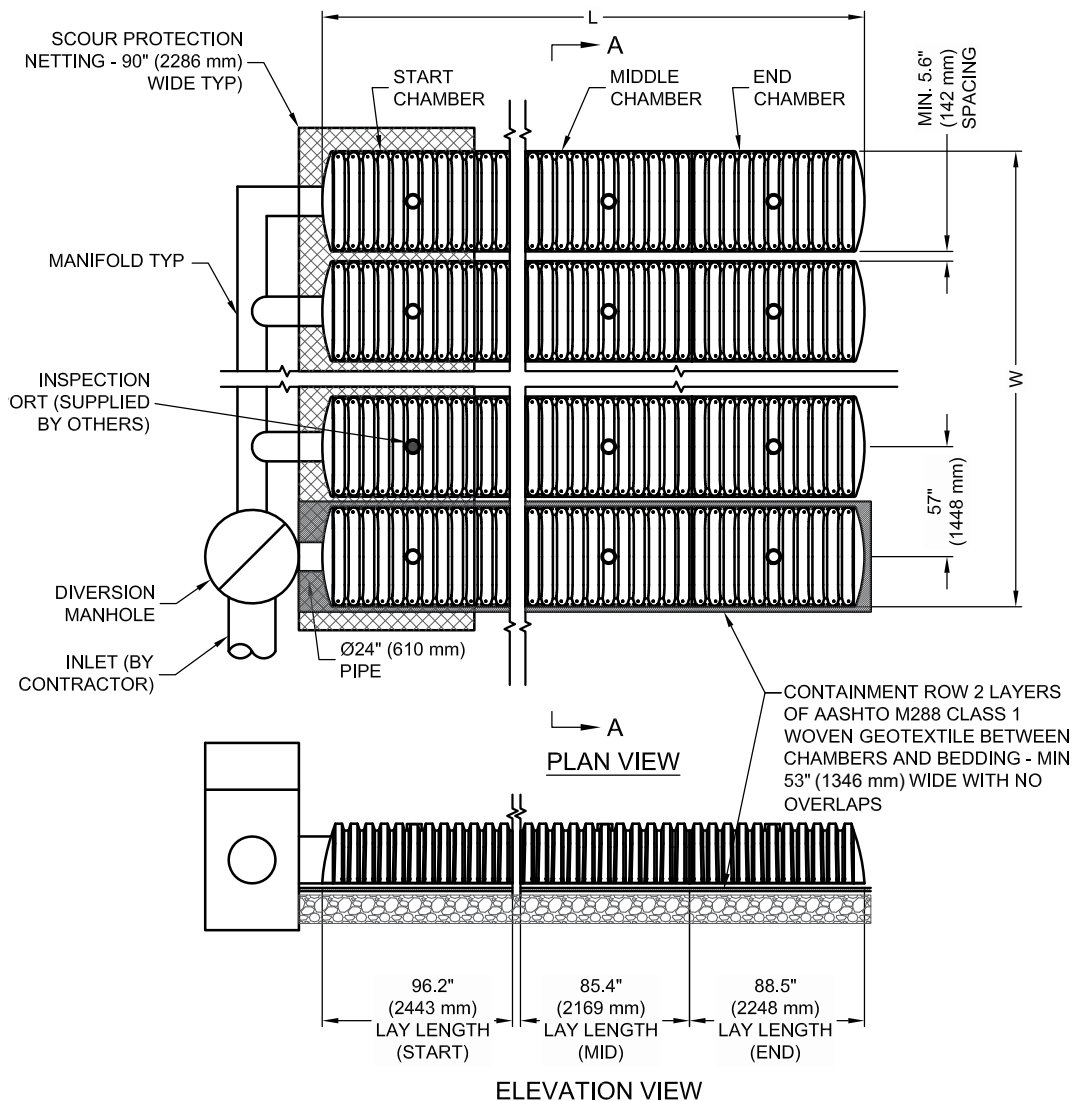
ChamberMaxx Containment Row

Hydrodynamic separators and filtration devices provide the most efficient sediment removal and extended maintenance interval, and are recommended as pretreatment for ChamberMaxx systems. The ChamberMaxx Containment Row should be considered as basic, low cost treatment strategy and should only be considered where sediment loading to the ChamberMaxx system is assumed to be minimal.

The Containment Row is designed to provide TSS removal by direct screening through 2 layers of AASHTO M288 Class 1 Woven Geotextile, located between the containment row chamber and the stone bedding.

The ChamberMaxx Containment Row should be designed with a sumped diversion manhole at the inlet of the Containment Row. The diversion manhole should be designed to allow access for inspection and maintenance of the Containment Row in addition to diverting the required amount of stormwater into the Containment Row for treatment, and a sump for collection of sediment. Once the Containment Row has reached capacity, the overflow should then be distributed to the remainder of the chamber rows by a manifold.

Containment Rows can be sized for water quality volume or water quality flow rate. Contact your local Contech representative at 800-338-1122 for project specific sizing of a Containment Row.



Inlet Manifold Design

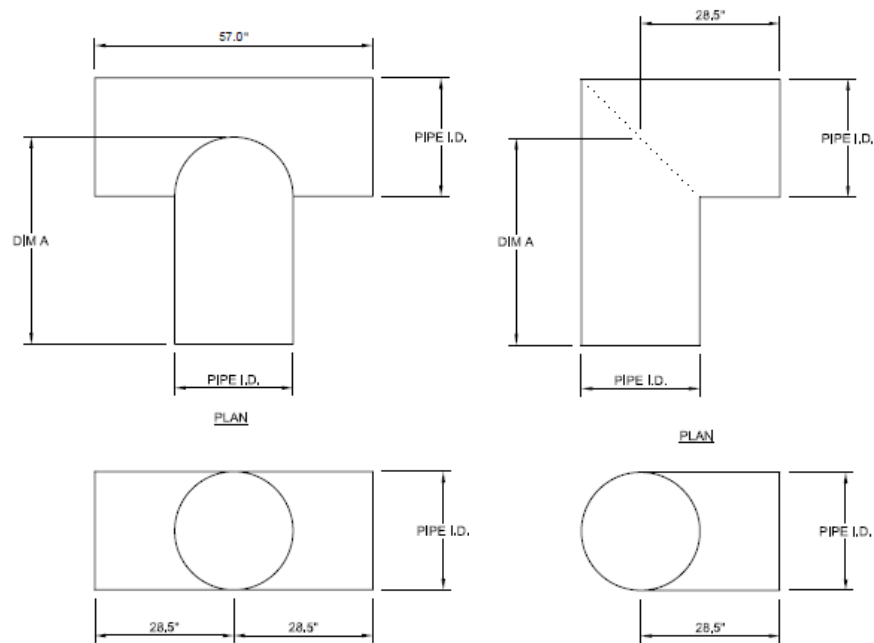
All ChamberMaxx systems require inlet manifolds to ensure that the incoming flow is distributed throughout all chamber rows. The integral end cap of the chamber system can accept up to a 24-inch (0.61m) inlet pipe.

The inlet manifold should be designed to provide ample conveyance of peak flows without creating an unacceptable backwater condition on the upstream structures and piping. To reduce the scour potential of the foundation stone under the chambers from the influent flow, Contech requires the installation of scour protection netting at the manifold entrance to any inlet chamber, extending 1' (0.30 m) beyond the outside edge of the chamber.

When designing an inlet manifold for a ChamberMaxx system, the specifying engineer is responsible for confirmation that the manifold meets the hydraulic needs of the project. The manifold diameter should be equal to or larger than the upstream pipe leading from the site to the chamber system. Contech offers standard high density polyethylene (HDPE) manifold fittings in various sizes to accommodate most project needs.

Contech provides Mar Mac Polyseal couplers to connect manifold fittings, please reference www.MarMac.com for additional information on the provided couplers.

ChamberMaxx cannot accept a pipe directly into the side of the chamber. To accommodate this configuration, the row should be broken up by use of one end chamber and one start chamber to create two separate rows. The inlet pipe should then be joined to a manifold tee that connects into the new start and end chambers. Otherwise, all pipe connections should be made at a manifold or directly stubbed into the end a chamber.



STANDARD MANIFOLD COMPONENTS				
	AVAILABLE DIAMETERS (IN)			
TEE	12	15	18	24
ELBOW	12	15	18	24
DIM A	42	42	48	48

GENERAL NOTES:

1. FITTING MATERIAL TO BE MANUFACTURED FROM CORRUGATED HIGH DENSITY POLYETHYLENE, AASHTO M294 PIPE.
2. FITTINGS TO BE FABRICATED IN ACCORDANCE WITH THE REQUIREMENTS OF AASHTO M294.
3. FITTINGS DESIGNED TO PROTRUDE 8" INTO END OF THE INLET CHAMBERS.
4. MANIFOLD TEE AND ELBOW JOINTS TO BE CONNECTED UTILIZING MAR-MAC POLYSEAL COUPLERS. REFERENCE WWW.MARMAC.COM

Outlet Manifold Design

Some ChamberMaxx systems may require an outlet for volumes in excess of the chamber system capacity. An outlet manifold should be designed to ensure that excess volume or peak flows can be conveyed to downstream structures.

In circumstances where infiltration into the surrounding soil is not an option, an underdrain may be used to completely drain the stone bed below the invert of the chamber. The underdrain should connect to the downstream drainage structure and should accommodate free drainage as required.

Other outlet scenarios may include outlet pipes located higher than the invert of the chambers to allow a designed volume to infiltrate through the base stone before exiting the system, or an outlet control structure external to the chamber system to achieve the same effect. These are common scenarios used for recharging groundwater and replicating a site's pre-construction runoff characteristics.

Outlet manifolds should not directly connect to a Containment Row but should be connected to as many standard chamber rows as required to achieve the desired hydraulic conditions. The outlet manifold fittings provided by Contech are the same HDPE fittings used for inlet manifolds and should be installed and connected in the same way.

Foundation Requirements

ChamberMaxx systems require a bedding of at least 6 inches (152.4mm) of crushed stone below the chambers. With a 6 inch (152.4mm) bedding depth a soil bearing capacity of 4 ksf (191.52 kPa) is required for 8 feet of cover over the top of the chambers and a soil bearing capacity of 2ksf (95.76 kPa) is needed for 18 inches (457.2mm) of cover over the top of the chambers. If the soil bearing pressure does not meet the minimum requirements, a geotechnical engineer should evaluate the application and make the appropriate recommendations to improve the bearing capacity to suit the application.

System Sizing

ChamberMaxx systems store water in the chamber itself and also in the void space of the stone backfill. The "Installed Storage Volume" in the table below shows the water storage capacity for the chamber and stone system assuming a 40% stone void ratio.

The ChamberMaxx DYODS (Design Your Own Detention System) is available for online sizing of ChamberMaxx systems. This tool can be found at www.ContechES.com. For assistance sizing a ChamberMaxx system, Contech Design Engineering services can be contacted at 1-800-338-1122 or through your local Contech representative. Modeling for the ChamberMaxx system is also available in HydroCAD®.

Sizing a ChamberMaxx System

The steps outlined below provide the necessary calculations to size a ChamberMaxx System.

1. Determine the Storage Volume (V_s).
Required Storage Volume should be determined by the design engineer per project requirements.
2. Determine the number of chambers required (C).

Chamber Part	Width		Height		Weight		Actual Length		Installed Length*		Storage Volume		Installed Storage Volume*	
	in	(m)	in	(m)	lbs	(kg)	in	(m)	in	(m)	cf	(m³)	cf	(m³)
Start	51.4	(1.31)	30.3	(0.77)	83.0	(37.65)	98.4	(2.50)	96.2	(2.44)	50.2	(1.42)	78.1	(2.21)
Middle	51.4	(1.31)	30.3	(0.77)	73.0	(33.11)	91.0	(2.31)	85.4	(2.17)	47.2	(1.34)	75.1	(2.13)
End	51.4	(1.31)	30.3	(0.77)	76.0	(34.47)	92.0	(2.34)	88.5	(2.25)	46.2	(1.31)	74.1	(2.10)

* 6" (152 mm) of stone above and below chamber, 5.6" (142 mm) chamber spacing and 40% porosity.

To calculate the number of chambers needed to store the required volume (V_s), divide the storage volume by the volume of the chamber. For systems with a predetermined number of rows (r), multiply the sum of the start and end chamber volumes by the row count to determine the remainder of middle chambers required.

$$C = C_{\text{start}} + C_{\text{mid}} + C_{\text{end}}$$

$$C_{\text{start}} \text{ \& } C_{\text{end}} = \text{number of rows, } r$$

$$C_{\text{mid}} = V_s / [(V_{\text{start}} + V_{\text{end}}) * r + V_{\text{mid}}]$$

For systems with an undetermined number of rows, the chamber count can be estimated by using the volume of the middle chamber, ignoring the start and middle chambers.

$$C = V_s / V_{\text{mid}}$$

3. Determine the system footprint.

To determine the system length: Divide the number of middle chambers required (C_{mid}) by the number of rows (r), rounding up (n). This will be number of middle chambers required in the longest row. Add up the installed lengths of 1 start, 1 end, and the required count of middle chambers. After adding the length of perimeter stone around start and end chambers (minimum 12" or .3048 m), the total length is the system length.

$$n = C_{\text{mid}} / r$$

$$L = 12'' + L_{\text{start}} + n * L_{\text{mid}} + L_{\text{end}} + 12''$$

$$(.3048\text{m} + L_{\text{start}} + n * L_{\text{mid}} + L_{\text{end}} + .3048\text{m})$$

To determine the system width: Multiply the chamber width (51.4" or 1.31 m) by the number of rows (r). Add the total chamber width plus chamber spacing multiplied by ($r-1$) and the perimeter stone (minimum 12" or 0.30 mm). Standard spacing between chambers is 5.6" (396.2 mm). The resulting sum is the system width.

$$W = 12'' + r * 51.4'' + (r-1) * 5.6'' + 12''$$

$$(.3048\text{m} + r * 1.306\text{m} + (r-1) * 0.3962\text{m} + .3048\text{m})$$

4. Determine the amount of stone (V_{st}).

To determine the amount of clean, crushed, angular stone is required for the ChamberMaxx System, multiply the number of start, middle, and end chambers by their respective stone volumes in the table below.

Chamber Type	Amount of stone needed per chamber (cubic feet)	Amount of stone needed per chamber (cubic meters)
Start Chamber	78.69	2.228
Middle Chamber	69.85	1.978
End Chamber	72.36	2.049

Stage Storage Table

	Elevation		Chamber Storage Volume		Stone Storage Volume		Cumulative Volume Increment		Cumulative Storage Volume	
	(in)	(m)	(cf)	(m ³)	(cf)	(m ³)	(cf)	(m ³)	(cf)	(m ³)
STONE	42.30	1.07	47.20	1.34	27.94	0.79	1.13	0.03	75.14	2.13
	41.30	1.05	47.20	1.34	26.82	0.76	1.13	0.03	74.02	2.09
	40.30	1.02	47.20	1.34	25.69	0.73	1.13	0.03	72.89	2.06
	39.30	1.00	47.20	1.34	24.56	0.70	1.13	0.03	71.76	2.03
	38.30	0.97	47.20	1.34	23.44	0.66	1.13	0.03	70.64	2.00
	37.30	0.95	47.20	1.34	22.31	0.63	1.13	0.03	69.51	1.97
CHAMBERMAXX CHAMBERS	36.30	0.92	47.20	1.34	21.18	0.60	0.62	0.02	68.38	1.94
	35.00	0.89	47.20	1.34	20.56	0.58	1.13	0.03	67.76	1.92
	34.00	0.86	47.20	1.34	19.43	0.55	1.13	0.03	66.63	1.89
	33.00	0.84	47.20	1.34	18.30	0.52	1.13	0.03	65.50	1.85
	32.00	0.81	47.20	1.34	17.18	0.49	1.56	0.04	64.38	1.82
	31.00	0.79	46.48	1.32	16.34	0.46	1.76	0.05	62.82	1.78
	30.00	0.76	45.43	1.29	15.63	0.44	1.83	0.05	61.06	1.73
	29.00	0.74	44.26	1.25	14.98	0.42	1.90	0.05	59.23	1.68
	28.00	0.71	42.97	1.22	14.36	0.41	1.96	0.06	57.33	1.62
	27.00	0.69	41.58	1.18	13.79	0.39	2.02	0.06	55.37	1.57
	26.00	0.66	40.09	1.13	13.26	0.38	2.07	0.06	53.35	1.51
	25.00	0.64	38.53	1.09	12.76	0.36	2.11	0.06	51.29	1.45
	24.00	0.61	36.89	1.04	12.29	0.35	2.15	0.06	49.18	1.39
	23.00	0.58	35.18	1.00	11.84	0.34	2.18	0.06	47.03	1.33
	22.00	0.56	33.42	0.95	11.42	0.32	2.22	0.06	44.84	1.27
	21.00	0.53	31.60	0.89	11.02	0.31	2.24	0.06	42.63	1.21
	20.00	0.51	29.74	0.84	10.64	0.30	2.27	0.06	40.38	1.14
	19.00	0.48	27.84	0.79	10.27	0.29	2.29	0.06	38.11	1.08
	18.00	0.46	25.90	0.73	9.92	0.28	2.31	0.07	35.82	1.01
	17.00	0.43	23.93	0.68	9.59	0.27	2.33	0.07	33.51	0.95
	16.00	0.41	21.92	0.62	9.26	0.26	2.35	0.07	31.18	0.88
	15.00	0.38	19.88	0.56	8.95	0.25	2.37	0.07	28.83	0.82
	14.00	0.36	17.82	0.50	8.65	0.24	2.39	0.07	26.46	0.75
	13.00	0.33	15.72	0.44	8.36	0.24	2.40	0.07	24.08	0.68
	12.00	0.30	13.59	0.38	8.09	0.23	2.42	0.07	21.68	0.61
	11.00	0.28	11.43	0.32	7.82	0.22	2.45	0.07	19.25	0.54
	10.00	0.25	9.23	0.26	7.58	0.21	2.47	0.07	16.81	0.48
	9.00	0.23	6.99	0.20	7.34	0.21	2.50	0.07	14.34	0.41
	8.00	0.20	4.71	0.13	7.13	0.20	2.52	0.07	11.84	0.34
	7.00	0.18	2.38	0.07	6.93	0.20	2.56	0.07	9.32	0.26
	6.00	0.15	0.00	0.00	6.76	0.19	1.13	0.03	6.76	0.19
STONE	5.00	0.13	0.00	0.00	5.63	0.16	1.13	0.03	5.63	0.16
	4.00	0.10	0.00	0.00	4.51	0.13	1.13	0.03	4.51	0.13
	3.00	0.08	0.00	0.00	3.38	0.10	1.13	0.03	3.38	0.10
	2.00	0.05	0.00	0.00	2.25	0.06	1.13	0.03	2.25	0.06
	1.00	0.03	0.00	0.00	1.13	0.03	0.00	0.00	1.13	0.03

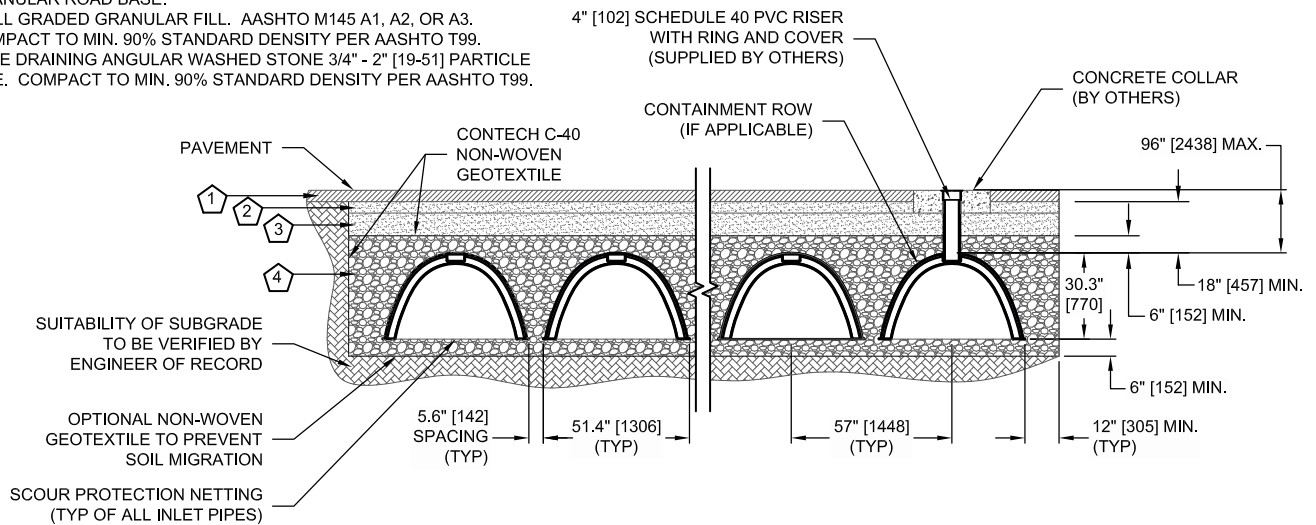
ChamberMaxx Flow Routing

Proper design of any detention system typically requires that flow routing be performed. Engineers at Contech can be a valuable resource when designing a ChamberMaxx retention system. Typically, stage-storage curves are utilized in the analysis. A Contech stage-storage calculator is available for download on www.ContechES.com. This information can simply be inserted into common hydrology/ hydraulic software such as HydroCAD, HydroFlow, PondPack or TR20. This makes a flow routing design with ChamberMaxx just as simple as an aboveground pond design.

ChamberMaxx - Backfill Detail

KEY

1. RIGID OR FLEXIBLE PAVEMENT.
2. GRANULAR ROAD BASE.
3. WELL GRADED GRANULAR FILL. AASHTO M145 A1, A2, OR A3. COMPACT TO MIN. 90% STANDARD DENSITY PER AASHTO T99.
4. FREE DRAINING ANGULAR WASHED STONE 3/4" - 2" [19-51] PARTICLE SIZE. COMPACT TO MIN. 90% STANDARD DENSITY PER AASHTO T99.



BACKFILL MATERIAL

THE CHAMBER SYSTEM INCORPORATES TWO TYPES OF BACKFILL MATERIAL

FREE DRAINING ANGULAR WASHED STONE 3/4 TO 2-INCH [19 TO 51] PARTICLE SIZE COMPACTED TO 90% AASHTO T99 IS USED AROUND THE CHAMBERS. THIS MATERIAL IS USED AROUND THE CHAMBERS AND WITHIN A MINIMUM OF 6-INCHES (152 MM) BELOW AND 6-INCHES [152] ABOVE THE CHAMBERS. THE REMAINING SPACE SHOULD BE FILLED WITH AN ANGULAR, WELL-GRADED GRANULAR FILL MEETING THE REQUIREMENTS OF AASHTO M145 A1, A2 OR A3, COMPACTED TO 95% AASHTO T99.

CONTECH C-40 NON-WOVEN GEOTEXTILE SHOULD BE USED BETWEEN THE TWO LAYERS OF BACKFILL MATERIAL. SEE DETAIL BELOW.

Inspection And Maintenance

ChamberMaxx Safety

Before entering into any storm sewer or underground retention/detention system check to make sure all OSHA and local safety regulations and guidelines are observed during the maintenance process. Hard hats, safety glasses, steel-toed boots and any other appropriate personal protective equipment shall be worn at all times.

Inspection Frequency

Inspections are recommended at a minimum annually. The first year of operation may require more frequent inspections. Frequency of inspections will vary significantly on the local site conditions. An individual inspection schedule should be established for each site.

Inspections

Inspection is the key to effective maintenance and is easily performed. Inspections may need to be performed more often in the winter months in climates where sanding operations may lead to rapid sediment accumulations, or in equipment washdown areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

The entire treatment train should be inspected and maintained. The treatment train may consist of an upstream sump manhole, manifold system or pre-treatment HDS device. Inspections should start at the upstream device and continue downstream to the discharge orifice if incorporated into the chamber system.

Pre-Treatment Device Inspection

Inspection and maintenance procedures provided by the manufacturer should be followed for pre-treatment systems such as a CDS®, Vortechs®, VortSentry® or VortSentry® HS. Expected pollutants will be floatable trash, sediment and oil and grease. Pre-treatment devices are recommended for all detention/retention devices regardless of type.

Containment Row™ Inspection

The optional Containment Row consists of a diversion concrete manhole with a weir, and a row of chambers placed on woven geotextile. The diversion weir directs the first flush flows into the Containment Row of chambers. The majority of sediment will be captured in the Containment Row due to the extended detention time which allows the particles to settle out. Higher flows overtop (bypass) the weir into the manifold system.

The Containment Row will typically be located in the first row of chambers connected to the diversion manhole. Inspection can be done through accessing the diversion manhole and visually inspecting the Containment Row through the inlet pipe. Inspection ports throughout the system can be used for visual observation and measurement of sediment accumulation using a stadia rod. When the depth of sediment accumulates over 4-inch (102 mm), cleanout is recommended.

Manifold System Inspection

The main manifold pipe can be inspected from the diversion manhole upstream. When a quarter of the pipe volume has been filled with sediment the header system should be maintained.

Visual Inspection

Maintenance or further investigation may be required if any of the following conditions exist:

- Evidence of an unusual amount of silt and soil build-up on the surface.
- Clogged outlet drainpipe.
- System does not drain to the elevation of the lowest pipe in dry conditions.
- Evidence of potholes or sinkholes

Maintenance

Underground stormwater retention/detention systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities rather than the size or configuration of the system. If accumulated silt is interfering with the operation of the detention system (i.e.: blocking outlet pipes or deposits significantly reduce the storage capacity of the system) it should be removed.

It is easiest to maintain a system when there is no flow entering. For this reason, cleanout should be scheduled during dry weather.

A vacuum truck or other similar devices can be used to remove sediment from the treatment train. Starting upstream, maintain manholes with sumps and any pre-treatment devices (following manufacturer recommended procedures). Once maintenance is complete, replace all caps, lids and covers. It is important to document maintenance events on the Inspection and Maintenance Log.

Header System Maintenance

If maintenance is required, use a high pressure nozzle with rear facing jets to wash the sediments and debris into the diversion manhole. Use the vacuum hose stinger nozzle to remove the washed sediments from the sump of the diversion manhole. It is important to not flush sediments into the chamber system during the maintenance process.

Containment Row™ Maintenance

If maintenance is required, a JetVac truck utilizing a high pressure nozzle (sledge dredging tool) with rear facing jets will be required. Insert the nozzle from the diversion manhole into the Containment Row through the inlet pipe. Turn the water feed hose on and feed the supply hose until the nozzle has reached the end of the Containment Row. Withdraw the nozzle slowly.

The tool will backflush the Containment Row forcing debris into the diversion manhole sump. Use the stringer vacuum hose to remove the sediments and debris from the sump of the diversion manhole. Multiple passes may be required to fully cleanout the Containment Row. Vacuum out the diversion manhole and remove all debris. See Figure 1.



Figure 1. Containment Row shown with high pressure cleaning nozzle.

APPENDIX A: ChamberMaxx Specification with Pretreatment

SPECIFICATION:

ChamberMaxx

Underground Detention and Infiltration Standard Specification with Pretreatment Device

1.0 GENERAL

1.1 This item shall govern the furnishing and installation of ChamberMaxx underground detention and infiltration chamber systems.

1.2 Contractor shall furnish all labor, materials, equipment and incidentals necessary to install the ChamberMaxx system, appurtenances and incidentals in accordance with the Drawings and as specified herein.

1.3 A stormwater treatment device upstream of the ChamberMaxx system is recommended as the appropriate means of pretreating for the purpose of extending the maintenance interval on the ChamberMaxx system and reducing the life cycle cost. Both engineered solutions shall be provided by a single supplier/manufacturer. Filtration by wrapping a chamber row with geotextile is not an acceptable means of pretreatment.

1.4 Applicable provisions of any Division shall govern work in this section.

1.5 Related Standards

1.5.1 ASTM 2418 "Standard Specification for Polypropylene Corrugated Wall Stormwater Collection Chambers"

1.5.2 ASTM F-2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers"

1.6 Site layout drawings, product specifications, materials, hydraulic storage data and supported calculations of proposed alternatives shall be submitted to the Engineer of Record (EOR) for review at a minimum of 10 working days prior to bid closing.

1.7 Shop drawings shall be annotated to indicate all materials to be furnished and installed under this section, and all applicable standards for materials, required tests of materials and design assumptions for structural analysis:

1.8 Before installation of the ChamberMaxx system, Contractor shall obtain the written approval of the EOR for the stormwater system and the installation drawings.

1.9 All proposed alternatives to the ChamberMaxx system shall conform to applicable above referenced ASTM specifications.

2.0 MATERIALS

2.1 The chamber shall be constructed of injection molded polypropylene copolymer formulated for high impact and stress cracking resistance and sustained structural performance during high temperatures. The chamber shall be designed and manufactured in accordance to ASTM F-2418 and F-2787.

2.2 The chamber shall be designed to AASHTO LRFD Bridge Design Specifications (Section 12), as applied to material and performance requirements for buried thermoplastic pipes. Design live load shall be the AASHTO HS-20 and HS-25 truck, including multiple lane presence factors, over a minimum cover of 18 inches and chamber row spacing of 5 inches or greater.

2.3 The chamber system shall be comprised of three chamber configurations: The MIDDLE chambers shall be open-ended to allow unobstructed hydraulic flow, inspection, and maintenance. The START and END chambers shall each have an integral end wall designed to resist loading at the start and end of the chamber rows. The chambers within a row shall be installed with overlapping end corrugations.

2.4 The nominal dimensions of the START chamber shall be 51.4 inches wide, 30.3 inches tall, and 98.4 inches long. The nominal dimensions of the MIDDLE chamber shall be 51.4 inches wide, 30.3 inches tall, and 91.0 inches long. The nominal dimensions of the END chamber shall be 51.4 inches wide, 30.3 inches tall, and 92.0 inches long. The nominal storage volume inside the chamber shall be 77 cubic feet when utilizing 6" of stone above and below chamber with 40% stone porosity per ChamberMaxx standard detail.

2.5 The chamber shall have a continuously-curved, arch-shaped section profile.

2.6 The START and END chamber integral end wall shall be structurally suitable for cutting and inserting inlet pipes and shall provide a range of pipe diameter indicants up to 24" diameter as cutting templates.

2.7 The chamber shall be a corrugated, open-bottom design and top vent orifices for hydraulic pressure equalization. Corrugation valleys and crests shall be sub-corrugated to increase stiffness.

2.8 The chamber shall have a circular cut line for an optional reinforced inspection port configured to accept a 4" Schedule 40 pipe.

2.9 The END chambers shall be capable of being cut to shorter lengths to accommodate site specific requirements.

2.10 The chamber shall be supported by integral structural

footings comprised of load dispersing toe ribs and longitudinally aligned stiffening ribs.

2.11 The manufacturer of the ChamberMaxx system shall be one that has regularly been engaged in the engineering design and production of these systems for at least eight (8) years and which has a history of successful production, acceptable to the Engineer of Record (EOR). In accordance with the Drawings, the ChamberMaxx system shall be supplied by:

Contech Engineered Solutions
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

3.0 PERFORMANCE

3.1 The ChamberMaxx system proposal shall be sized in accordance to the design provided and approved by the Engineer of Record (EOR). Any Contractor deviating from the design shown on the plans, to include: material, footprint, etc., shall provide to the EOR a summary report on stage-storage curves, design calculations, HydroCAD modeling and engineering drawings.

3.2 ChamberMaxx row spacing and stone base thickness cannot be altered with consultation from Contech Engineered Solutions, LLC.

3.3 The ChamberMaxx system shall be designed so as the hydraulic grade line will increase evenly throughout whereas transverse movement from one storage compartment to another shall not be permitted. All storage compartments shall be connected via manifold (or connecting pipe) versus by entirely transporting stormwater through stone.

3.4 A stormwater pretreatment device is recommended upstream of the ChamberMaxx system as follows:

3.4.1 Infiltration: Where feasible, the selected stormwater treatment device upstream of an infiltration system shall be a filter system and have General Use Level Designation (GULD) for Basic Treatment by the Washington State Department of Ecology or demonstrate equivalent performance in independently verified field testing following a peer reviewed testing protocol, and must be sized consistent with the system producing those results.

3.4.2 Detention: Where feasible, the selected Stormwater treatment device upstream of a detention system shall be a separator system and have GULD for Pretreatment by the WADOE or demonstrate equivalent performance in independently verified field testing following a peer reviewed testing protocol, and must be sized consistent with the system producing those results.

3.4.3 Selected pretreatment stormwater device shall incorporate a physical barrier capable of capturing and retaining trash and debris (i.e.: floatable and neutrally buoyant materials) for all flows up to the treatment capacity of the device.

3.4.4 The application of wrapping a system with geotextile of any branding or material type, that allows the passage of stormwater, shall not be regarded as an acceptable treatment or pretreatment device.

3.4.5 The manufacturer of the selected Stormwater treatment device shall have been regularly engaged in the engineering design and production of systems for the physical treatment of Stormwater runoff for 15 years.

3.4.6 In order to not restrict the Owner's ability to maintain the stormwater pretreatment device, the minimum dimension providing access from the ground surface to the sump chamber shall be 20 inches in diameter.

4.0 EXECUTION

4.1 The ChamberMaxx system shall be installed per the Contech "ChamberMaxx Stormwater Retention System Standard Installation Detail", available from local Contech representative or from www.conteches.com.

4.2 For temporary construction vehicle loads, an extra amount of compacted cover may be required over the top of the chambers. The Height-of-Cover shall meet the minimum requirements shown in the Contech "ChamberMaxx Stormwater Retention System Standard Installation Detail". The use of heavy construction equipment necessitates greater protection for the chambers than finished grade cover minimums for normal highway traffic.

4.3 The contractor shall follow Occupational Safety and Health Association (OSHA) guidelines for safe practices in executing the installation process in accordance with the manufacturer/supplier installation recommendations.

4.4 Contractor is required to participate in an on-site preconstruction meeting with the supplier prior to the scheduled delivery date of the ChamberMaxx system.

APPENDIX B: ChamberMaxx Specification with Containment Row

ChamberMaxx

Underground Detention and Infiltration Standard Specification with Containment Row

5.0 GENERAL

5.1 This item shall govern the furnishing and installation of ChamberMaxx underground detention and infiltration chamber systems.

5.2 Contractor shall furnish all labor, materials, equipment and incidentals necessary to install the ChamberMaxx system, appurtenances and incidentals in accordance with the Drawings and as specified herein.

5.3 The containment row of the ChamberMaxx system is recommended as the appropriate means of pretreating for the purpose of extending the maintenance interval on the ChamberMaxx system and reducing the life cycle cost.

5.4 Applicable provisions of any Division shall govern work in this section.

5.5 Related Standards

5.5.1 ASTM 2418 "Standard Specification for Polypropylene Corrugated Wall Stormwater Collection Chambers"

5.5.2 ASTM F-2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers"

5.6 Site layout drawings, product specifications, materials, hydraulic storage data and supported calculations of proposed alternatives shall be submitted to the Engineer of Record (EOR) for review at a minimum of 10 working days prior to bid closing.

5.7 Shop drawings shall be annotated to indicate all materials to be furnished and installed under this section, and all applicable standards for materials, required tests of materials and design assumptions for structural analysis:

5.8 Before installation of the ChamberMaxx system, Contractor shall obtain the written approval of the EOR for the stormwater system and the installation drawings.

5.9 All proposed alternatives to the ChamberMaxx system shall conform to applicable above referenced ASTM specifications.

6.0 MATERIALS

6.1 The chamber shall be constructed of injection molded polypropylene copolymer formulated for high impact and stress cracking resistance and sustained structural performance during high temperatures. The chamber shall be designed and manufactured in accordance to ASTM F-2418 and F-2787.

6.2 The chamber shall be designed to AASHTO LRFD Bridge Design Specifications (Section 12), as applied to material and performance requirements for buried thermoplastic pipes. Design live load shall be the AASHTO HS-20 and HS-25 truck, including multiple lane presence factors, over a minimum cover of 18 inches and chamber row spacing of 5 inches or greater.

6.3 The chamber system shall be comprised of three chamber configurations: The MIDDLE chambers shall be open-ended to allow unobstructed hydraulic flow, inspection, and maintenance. The START and END chambers shall each have an integral end wall designed to resist loading at the start and end of the chamber rows. The chambers within a row shall be installed with overlapping end corrugations.

6.4 The nominal dimensions of the START chamber shall be 51.4 inches wide, 30.3 inches tall, and 98.4 inches long. The nominal dimensions of the MIDDLE chamber shall be 51.4 inches wide, 30.3 inches tall, and 91.0 inches long. The nominal dimensions of the END chamber shall be 51.4 inches wide, 30.3 inches tall, and 92.0 inches long. The nominal storage volume inside the chamber shall be 77 cubic feet when utilizing 6" of stone above and below chamber with 40% stone porosity per ChamberMaxx standard detail.

6.5 The chamber shall have a continuously-curved, arch-shaped section profile.

6.6 The START and END chamber integral end wall shall be structurally suitable for cutting and inserting inlet pipes and shall provide a range of pipe diameter indicants up to 24" diameter as cutting templates.

6.7 The chamber shall be a corrugated, open-bottom design and top vent orifices for hydraulic pressure equalization. Corrugation valleys and crests shall be sub-corrugated to increase stiffness.

6.8 The chamber shall have a circular cut line for an optional reinforced inspection port configured to accept a 4" Schedule 40 pipe.

6.9 The END chambers shall be capable of being cut to shorter lengths to accommodate site specific requirements.

6.10 The chamber shall be supported by integral structural footings comprised of load dispersing toe ribs and longitudinally aligned stiffening ribs.

6.11 The manufacturer of the ChamberMaxx system shall be one that has regularly been engaged in the engineering design and production of these systems for at least eight (8) years and which has a history of successful production, acceptable to the Engineer of Record (EOR). In accordance with the Drawings, the ChamberMaxx system shall be supplied by:

Contech Engineered Solutions
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

7.0 PERFORMANCE

7.1 The ChamberMaxx system proposal shall be sized in accordance to the design provided and approved by the Engineer of Record (EOR). Any Contractor deviating from the design shown on the plans, to include: material, footprint, etc., shall provide to the EOR a summary report on stage-storage curves, design calculations, HydroCAD modeling and engineering drawings.

7.2 ChamberMaxx row spacing and stone base thickness cannot be altered with consultation from Contech Engineered Solutions, LLC.

7.3 The ChamberMaxx system shall be designed so as the hydraulic grade line will increase evenly throughout whereas transverse movement from one storage compartment to another shall not be permitted. All storage compartments shall be connected via manifold (or connecting pipe) versus by entirely transporting stormwater through stone.

8.0 EXECUTION

8.1 The ChamberMaxx system shall be installed per the Contech "ChamberMaxx Stormwater Retention System Standard Installation Detail", available from local Contech representative or from www.conteches.com.

8.2 For temporary construction vehicle loads, an extra amount of compacted cover may be required over the top of the chambers. The Height-of-Cover shall meet the minimum requirements shown in the Contech "ChamberMaxx Stormwater Retention System Standard Installation Detail". The use of heavy construction equipment necessitates greater protection for the chambers than finished grade cover minimums for normal highway traffic.

8.3 The contractor shall follow Occupational Safety and Health Association (OSHA) guidelines for safe practices in executing the installation process in accordance with the manufacturer/supplier installation recommendations.

8.4 Contractor is required to participate in an on-site preconstruction meeting with the supplier prior to the scheduled delivery date of the ChamberMaxx system.

END SECTION



800-338-1122
www.ContechES.com

Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our engineers.

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Appendix 5

NRCS Soils Report

Geotechnical Report

Field Investigation

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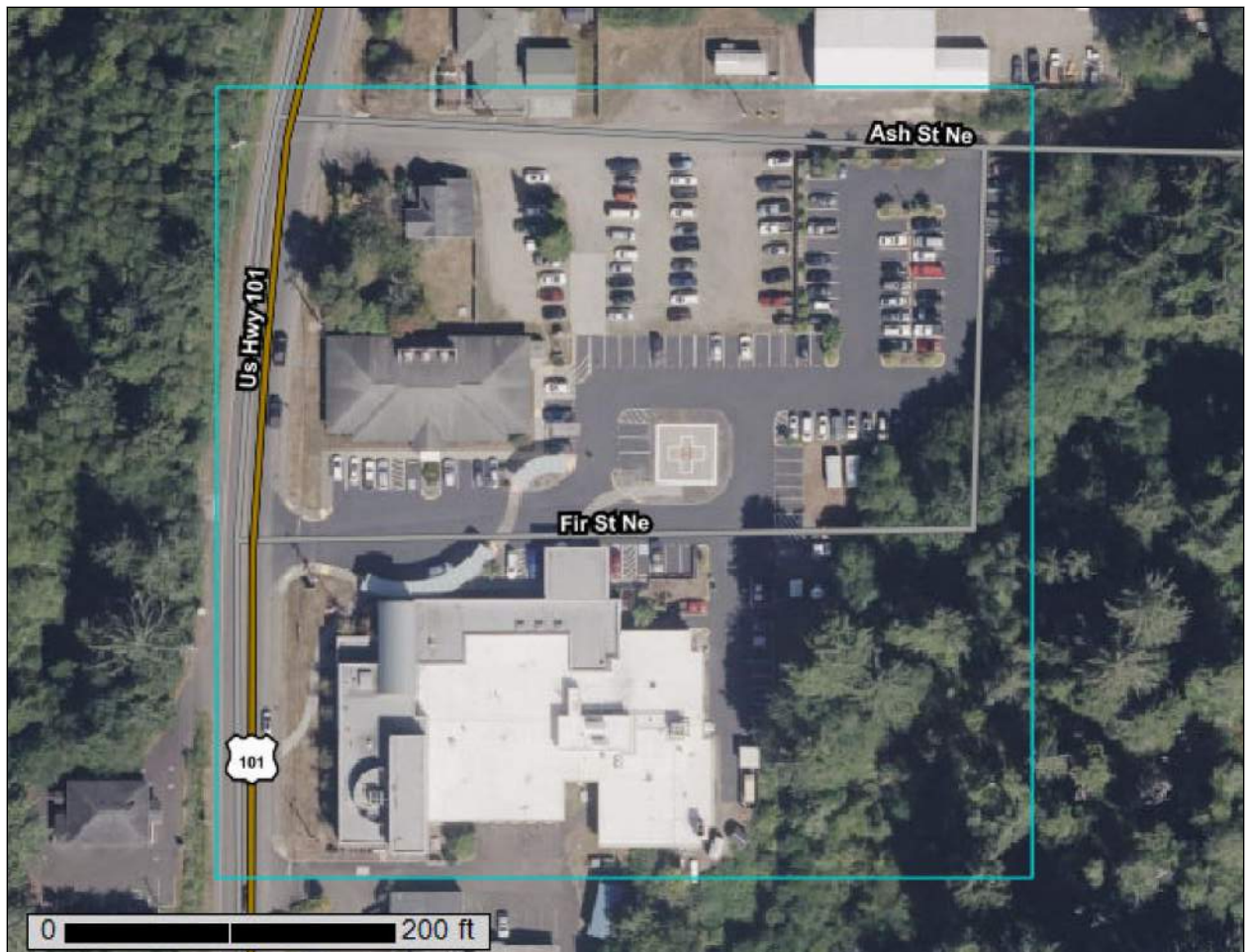
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington



March 10, 2026

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington
Survey Area Data: Version 24, Aug 28, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 8, 2022—Sep 25, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
67	Lebam silt loam, cool, 5 to 30 percent slopes	4.1	75.5%
104	Ocosta silty clay loam	0.5	8.6%
115	Palix silt loam, cool, 30 to 65 percent slopes	0.9	15.9%
Totals for Area of Interest		5.4	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Grays Harbor County Area, Pacific and Wahkiakum Counties, Washington

67—Lebam silt loam, cool, 5 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2gn8

Landscape: Uplands

Elevation: 30 to 300 feet

Mean annual precipitation: 80 to 120 inches

Mean annual air temperature: 48 degrees F

Frost-free period: 180 to 220 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Lebam and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lebam

Setting

Landscape: Uplands

Parent material: Residuum weathered from siltstone

Typical profile

H1 - 0 to 21 inches: medial silt loam

H2 - 21 to 60 inches: silty clay loam

Properties and qualities

Slope: 5 to 30 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very high (about 13.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B

Ecological site: F004AB404WA - Coastal Upland Warm Forest

Forage suitability group: Soils with Moderate Limitations (G004AC602WA)

Other vegetative classification: Soils with Moderate Limitations (G004AC602WA)

Hydric soil rating: No

104—Ocosta silty clay loam

Map Unit Setting

National map unit symbol: 2gj6
Elevation: 20 to 150 feet
Mean annual precipitation: 70 to 100 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 180 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Ocosta, protected, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ocosta, Protected

Setting

Landform: Flood plains, Deltas
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 12 inches: silty clay loam
H2 - 12 to 20 inches: silty clay
H3 - 20 to 60 inches: clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: About 12 to 35 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: R004AB200OR - Tidal Marsh and Estuary
Forage suitability group: Seasonally Wet Soils (G004AC202WA)
Other vegetative classification: Seasonally Wet Soils (G004AC202WA)
Hydric soil rating: Yes

Minor Components

Nuby, undrained

Percent of map unit: 5 percent
Landform: Flood plains
Other vegetative classification: Wet Soils (G004AC102WA)
Hydric soil rating: Yes

Rennie, undrained

Percent of map unit: 5 percent

Landform: Flood plains

Other vegetative classification: Wet Soils (G004AC102WA)

Hydric soil rating: Yes

Ocosta, unprotected

Percent of map unit: 3 percent

Landform: Flood plains, Deltas

Ecological site: R004AB200OR - Tidal Marsh and Estuary

Other vegetative classification: Wet Soils (G004AC102WA)

Hydric soil rating: Yes

Seastrand, undrained

Percent of map unit: 2 percent

Landform: Depressions

Other vegetative classification: Wet Soils (G004AC102WA)

Hydric soil rating: Yes

115—Palix silt loam, cool, 30 to 65 percent slopes

Map Unit Setting

National map unit symbol: 2gjl

Landscape: Uplands

Elevation: 0 to 300 feet

Mean annual precipitation: 80 to 120 inches

Mean annual air temperature: 48 degrees F

Frost-free period: 180 to 220 days

Farmland classification: Not prime farmland

Map Unit Composition

Palix and similar soils: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Palix

Setting

Landscape: Uplands

Landform: Slumps

Parent material: Colluvium derived from siltstone

Typical profile

H1 - 0 to 18 inches: medial silt loam

H2 - 18 to 46 inches: medial silty clay loam

H3 - 46 to 50 inches: weathered bedrock

Properties and qualities

Slope: 30 to 65 percent

Depth to restrictive feature: 40 to 60 inches to paralithic bedrock

Drainage class: Well drained

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Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7e

Hydrologic Soil Group: B

Ecological site: F004AA402WA - Coastal Headland

Hydric soil rating: No

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Custom Soil Resource Report

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Geotechnical Investigation

First Avenue N
Ilwaco, WA

Prepared for:
Ocean Beach Hospital

17 June 2025



3915 SW Plum Street
Portland, OR 97219
503-816-3689

1 INTRODUCTION

Rapid Soil Solutions Inc (RSS) has prepared this geotechnical report, as requested, for the proposed development at the Pacific County tax lot assigned with situs address 218 Ash Street, Ilwaco. RSS understands that the 0.27 acres site is to be developed with a 7,327-sf Ocean Beach Express Care Clinic. The new clinic will consist of offices, exam rooms, and a common waiting area and reception area that will serve both the new and existing clinics. The designated parking area is located due east of the site, involving the parcels 10113313885, 10113313157, and 10113313168. *The project building has the potential to be two (2) stories at the final build out.*

This report is based on visual observations of the project site, three (3) shallow hand auger holes, and a review of available literature as referenced at the end of this report. Slopes and disturbance envelopes discussed in this report are approximate, primarily based on onsite observations by RSS staff. RSS conducted site investigations on 10 June 2025.

2 SITE DESCRIPTION

2.1 Location

The site is nestled within the city central of Ilwaco, within a Low Density Commercial (C2) district. C2 zoning is intended to support retail trade, services, tourist recreation, and public/semi-public uses for residents and visitors. Commercial properties neighbouring the site vary in size from 0.1 acres to 9 acres with structures that were mostly constructed prior to 1980s.

The subject site is situated on the southeastern corner of Ash Street and First Avenue N (Hwy-101). The site borders the existing Ocean Beach Medical Clinic to the south and a gravel surfaced parking area to the right. The subject site is located about 180' south of School Rd, 0.28 miles north of Lake St SE, 0.39 miles east of N Head Rd, and 0.39 miles southeast from the intersection of Hwy-101 and Sandridge Rd. The site can be found in the northeast quarter of Section 33, Township 10-North, Range 11-West (W.M.) in Pacific County and distinguished by the tax lot number 10113313985. The latitude and longitude of the site are 46.312166 and -124.043058 (46°18'43.8"N, 124°02'35.0"W). The site can be found in the northern end of the Cape Disappointment, WA-OR 7.5-minute quadrangle.

2.2 Slopes

The city of Ilwaco is regionally tucked at the south end of the Long Beach peninsula, a moderately narrow protrusion of sand extending northwards from the Columbia River. This peninsula is mainly built of parallel beach ridges and bounded by Willapa Bay and the associated Shoalwater Bay to the east; the western edge of the peninsula is bound by the Pacific Ocean.

The site is located within the commercial district of the city of Ilwaco, directly east of Hwy-101. Our review of the lidar derived contour and slope model, presented by the City of Ilwaco maps, depicted that the site accommodates nearly level slopes (within 5%) and less than 4' of elevation change. Properties neighboring the site to the north, east, and south directions exhibit minimal elevation change and slopes of less than 5%. Moderate grade change is located roughly 50'-60' west of the site, where the vacant and wooded area west of Hwy-101 descends towards a wetland. This segment of the bank that borders the west side of Hwy-101 descends to roughly 15'-20' on slopes of up to 30%.

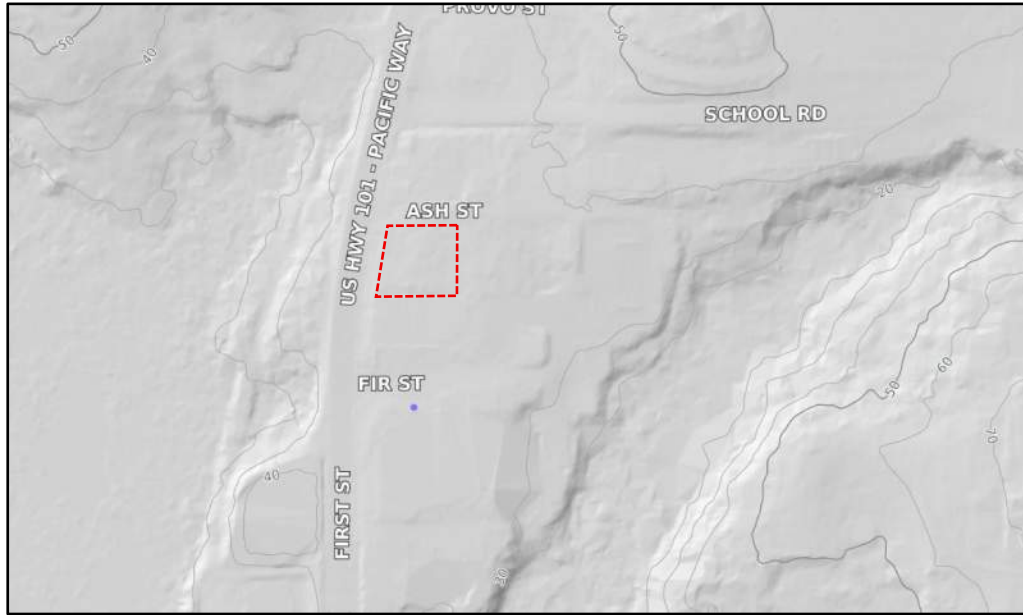


Figure 1: 10ft contour and bare earth lidar image at the site, excerpt from the City of Ilwaco maps. The proposed location of new clinic is delineated in red.

2.3 Built Conditions

The review of historical aerial images depicted that the existing residential dwelling at the site was established prior to the year 1981. The main building of the Ocean Beach Hospital was also constructed before 1981; the clinic building located directly south of the subject site was added between 1981-1996. The adjacent lot east of the site was utilized as a parking area by 2011.

Overall, reviews of images collected from the year 1981 through 2024 depicted no major change to the subject site. No developments were observed adjacent to the site.

3 GEOLOGY

3.1 Regional Geology

The City of Ilwaco contains varied topography, typically dominated by peaks/ridges, bold headlands, and marine embayment. The local peaks/ridges extend to about 73 meters above sea level. The ridge rising to the north-northeast of the project site is perched roughly 60 meters AMSL. The local ridge is primarily blanketed of accreted oceanic sediments and synchronously deposited igneous rocks (where the sediments overlay, underlay and are intruded by the volcanic flows). After the accretion of the Siletz Terrane to the edge of North America, a thick pile of silt, sand, and mud accumulated on the adjacent sea floor. Over tens of millions of years, sediment accumulation continued alongside tectonic impacts of the Cascadia subduction zone and sea level fluctuations. Over time the sedimentary material was scraped onto the edge of the continental plate; uplift, faulting and folding (associated with margin-parallel shortening in the Cascadia subduction zone) lifted the thick stack of sedimentary rock into the heights of the modern mountain range. The majority of local residential developments are within the lowland located south of the city.

3.2 Site Geology

Current geologic literature classifies the slopes at the subject site as comprised of Holocene aged Surficial Deposits – Fluvial and Estuarine Deposits. The unit is generally described as unconsolidated clay, silt, sand, and gravel alluvium deposited along rivers and streams. Along the Columbia and Naselle Rivers and in the Shoalwater Bay, the unit includes stabilized tidal flat deposits.

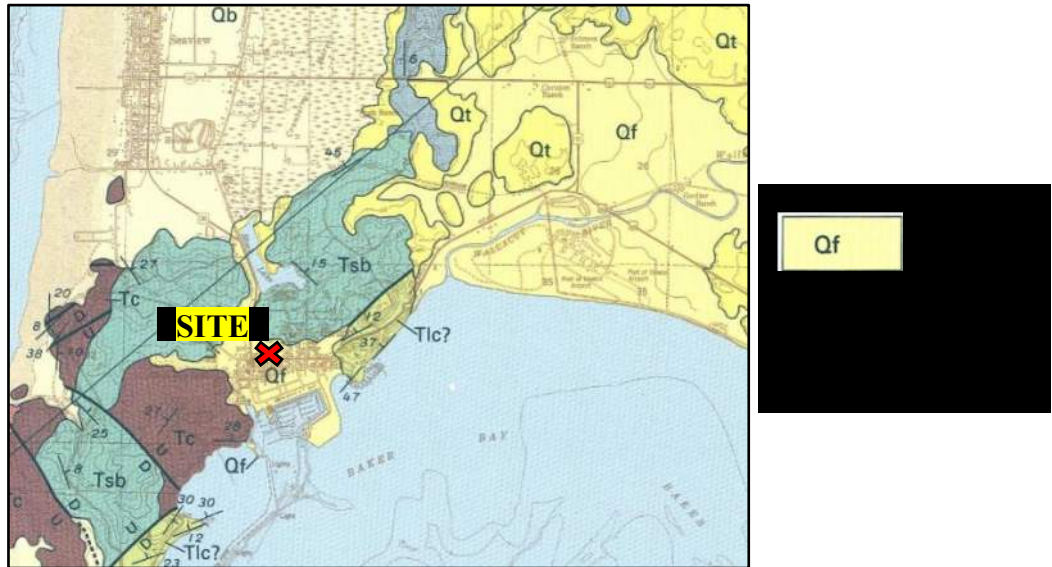


Figure 1: Site geology excerpt from Wells, R.E., 1989, I-1832.

3.3 Geologic Hazards Review

The Washington State Department of Natural Resources Division of Geology and Earth Resources' Interactive Natural Hazards map, Pacific County maps, and the City of Ilwaco gis maps, were reviewed to investigate mapped geological hazards.

The flood hazard review indicates that the site is situated outside the floodplain area. Mapped wetlands are located at greater than 200' distance from the site.

There is no mapped quaternary active fault within 5 miles radius to the site.

The expected earthquake-shaking across the site during a Cascade Seismic event is classified as 'severe' (VIII on the instrumental intensity map). During this level of shaking, the potential damage is slight to specially designed structures, slight to moderate in well-built ordinary structures, and considerable damage in poorly built structures.

The Washington DNR map classifies the subject site as within soil site class 'D-E'. A soil site class E corresponds to soft soil and class D corresponds to stiff soil profile. Based on the results of our subsurface explorations and experience in the area, we classified the site as within Soil Site Class 'D'.

The liquefaction susceptibility of the property is mapped as 'moderate to high'.

There are no mapped landslides on or directly adjacent to the subject site. The local area accommodates low to moderate topographic relief, lessening the likelihood of landslides.

4 GEOTECHNICAL INVESTIGATION

4.1 Surface Conditions

RSS directly observed the slope at and adjacent to the property. During our visit, RSS noted the following characteristics about the site:

- Observed slopes at the site generally matched the local contour and slope models. The entire property accommodates slopes of less than 5%, descending slightly towards the northwest corner of the lot. Elevation change across the site is within 4'.
- The existing residence is located near the northeast corner of the site. The property is dominated by low story grass. Several mature trees are located along the western half of the site.
- At the time of the visit, no standing water was observed across the subject property.

4.2 Subsurface Conditions

RSS drilled three (3) shallow hand auger borings at the site to characterize subsurface soil and to provide samples for laboratory analysis. Three fine-grained dominated samples were collected and transported to the laboratory for further classification in seal bags.

The logs were created using the Unified Soil Classification and Visual Manual Procedure (ASTM-D 2488). The soil descriptions were reviewed by a professional engineer. The logs and location of the boreholes are presented in the Appendix. Soil descriptions are summarized in the following Table 1.

Table 1: Soil Units Encountered

Soil Units		Soil Unit Depths (ft)		
Description	USCS	HA-1	HA-2	HA-3
<u>Topsoil (Silt)</u> : Moist, dark brown, very soft to soft, slightly sticky.	TP (ML)	0 – 0.5'	0 – 0.5'	0 – 0.5'
<u>Silt</u> : Moist to damp, dark brown to brown, soft to medium stiff.	ML	0.5' – 2.0'	0.5 – 4'	0.5 – 6'

Note: np not present, USCS Unified Soil Classification System Group Symbol (from ASTM D 2487) based on visual observation

4.3 Laboratory Testing and Results

All the samples collected were analyzed for soil moisture content. One sample was analyzed for Atterberg limit test to determine the soil classification and strength correlations based on moisture contents at which fine-grained material transition between solid, semi-solid, plastic, and liquid states.

The moisture content of the samples is 40.3% to 50.6%. The Atterberg limit test resulted in SILT of high liquid limit. This means when the soils get wet, they lose their strength.

4.4 Groundwater

At the time of the visit, no groundwater was encountered in the boreholes. No standing/flowing water and no pockets of unusual vegetation were observed across the proximity of the proposed development area.

Please note that the level of groundwater can fluctuate due to various reasons (i.e., season, amount of rainfall, and surface water runoff). Perched groundwater is pervasive across the local region. The 2009 geotechnical boring for Ocean Beach Hospital noted static water level at depth of 15' during the month of September. See appendix for the report.

5 GEOTECHNICAL DESIGN AND RECOMMENDATIONS

5.1 Foundation Design

The foundations may be installed on either engineered fill or into the medium stiff native subgrade which was found at an average depth of 1' across the site. This depth may be locally variable and should be evaluated by a geotechnical engineer or their representative at the time of construction. *Please allow 48 hours' notice to call for foundation inspections.*

Footings placed on engineered fill or firm native sub-grade should be designed for an allowable bearing capacity of 2,000 pounds per square foot (psf). The recommended allowable bearing pressure can be doubled for short-term loads such as those resulting from wind or seismic forces.

Based on our analysis the total post-construction settlement is calculated to be less than 1 inch, with differential settlement of less than 0.5 inch over a 50-foot span for maximum column, perimeter footing loads of less than 100 kips and 6.0 kips per linear foot.

Lateral loads on footings can be resisted by passive earth pressure on the sides of the structures and by friction at the base of the footings. An allowable lateral bearing pressure of 150 pounds per cubic foot (psf/f) below grade may be used. Adjacent floor slabs, pavements or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance.

The near surface soil found onsite is moisture sensitive, high liquid limit. As such, when disturbed and exposed to prolonged periods of rain, these soils lose strength and will be unsuitable to support foundations. If construction is undertaken during periods of rain, we recommend a minimum of 2-inch-thick layer of compacted, crushed rock be placed over the footing subgrades as protection from disturbance due to the elements and foot traffic. See 'Wet Weather Conditions' section of this report.

Table 2: Engineering Values Summary

Bearing capacity	2,000 psf
Friction coefficient	0.30
Active pressure	40 pcf
Passive pressure	300 pcf

5.2 Retaining Walls and Embedded Walls

Default lateral soil load for the design of basement and retaining walls supporting level backfill shall be 35 psf/ft for laterally unrestrained retaining walls and 60 psf/ft for laterally restrained retaining walls.

For embedded building walls, a superimposed seismic lateral force should be calculated based on a dynamic force of $5H^2$ pounds per lineal foot of wall, where H is the height of the wall in feet and applied at $1/3$ H from the base of the wall. The wall footings should be designed in accordance with the guidelines provided in the 'Foundation Design' section of this report. These design parameters have been provided assuming that back-of-wall drains will be installed to prevent buildup of hydrostatic pressures behind all walls.

The backfill material placed behind the walls and extending a horizontal distance equal to at least half of the height of the retaining wall should consist of granular retaining wall backfill as specified in the 'Structural Fill' section of this report. The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D698. However, backfill located within a horizontal distance of 3 feet from the retaining walls should only be compacted to approximately 92 percent of the maximum dry density, as determined by ASTM D698. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (e.g., jumping jack or vibratory plate compactors). If flat work (e.g., sidewalks or pavements) is placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D698.

A minimum 12-inch-wide zone of drain rock, extending from the base of the wall to within 6 inches of finished grade, should be placed against the back of all retaining walls. Perforated collector pipes should be embedded at the base of the drain rock. The drain rock should meet the requirements provided in the 'Structural Fill' section of this report. The perforated collector pipes should be discharged at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into storm water drain systems, unless measures are taken to prevent backflow into the wall's drainage system. Settlements of up to 1 percent of the wall height commonly occur immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures.

5.3 Seismic Design Criteria

The seismic design criteria for this project found herein are based on the ASCE 7-16. A summary of IBC seismic design criterion is below it is generated from the USGS web site for earthquake hazards using a latitude of 46.312166 and a longitude of -124.043058 and soil site class **D**. (Null = See Section 11.4.8)

Table 3: Recommended Earthquake Ground Motion Parameters (ASCE 7-16)

	Short period ($T_s=0.2$ second)	1 second period ($T_s=1.0$ second)
Maximum Credible Earthquake Spectral Acceleration	$S_S = 1.429$ g	$S_1 = 0.739$ g
Adjusted Spectral Acceleration	$S_{MS} = 1.429$ g	$S_{M1} = \text{null}$
Design Spectral Response Acceleration	$S_{DS} = 0.952$ g	$S_{D1} = \text{null}$

5.4 Pavement Design

The following pavement design recommendations are based on the following assumptions:

- Equivalent Single Axle Loads (ESALs) of 50,000. No growth in traffic.
- Resilient modulus of 4,500 psi and 20,000 psi for native soil and base rock, respectively.
- Initial and terminal serviceability indexes of 4.2 and 2.5, respectively.
- Reliability and standard deviation of 85 percent and 0.45, respectively.
- Structural coefficients of 0.44 and 0.10 for asphalt and base rock, respectively.

Table 4: Minimum Pavement Sections

AC (inches)	Base rock (inches)
3.0	8.0

The base course shall be 2" thick of $\frac{3}{4}$ " minus over 6" thick of 1 $\frac{1}{2}$ " minus rock. RSS will need to proof roll the bare ground before the rock section is placed. Please allow for 48-hour notice with a phone call to RSS. If site work takes place during wet weather geo-textile fabric is required between the subgrade and the rock layer.

6 CONSTRUCTION RECOMMENDATIONS

6.1 Site Preparation

The initial site preparation will consist of topsoil stripping, and the removal of trees, where applicable. Removal of trees should include removal of the root ball, and any roots greater than $\frac{1}{2}$ -inch in diameter.

6.2 Excavations

Excavations can be accomplished with conventional excavating equipment. All excavations for footings and subgrades at the site should be performed by an excavator or backhoe equipped with a smooth-faced bucket (no teeth).

Because of safety considerations and the nature of temporary excavations, the Contractor should be made responsible for maintaining safe temporary cut slopes and supports for utility trenches, etc. We recommend that the Contractor incorporate all pertinent safety codes during construction, including the latest OSHA revised excavation requirements, and based on soil conditions and groundwater evidenced in cuts made during construction.

6.3 Wet Weather Conditions

The near-surface soil will be difficult to handle or traverse during/after extended periods of wet weather. Earthwork should be performed in small areas to minimize exposure to wet weather. Soils that have been disturbed during site preparation activities, or soft/loose zones identified during probing or proof rolling, should be removed and replaced with compacted structural fill.

Track-mounted excavating equipment will be required during wet weather. The imported granular material should be placed in one lift over the prepared, undisturbed sub-grade and compacted using a smooth drum, non-vibratory roller. Additionally, a geo-textile fabric should be placed as a barrier between the subgrade and imported granular material in areas of repeated traffic.

6.4 Structural Fills

Fills should be placed over subgrade which has been prepared in conformance with the 'Site Preparation' section of this report. Material used as structural fill should be free of organic matter, or other unsuitable materials and should meet specifications provided in OSSC, depending upon the application. Compaction tests are required for backfills of more than 2 ft thick and are done every 2 vertical feet. *Please allow 48-hour notice to call for compaction testing and at least a week for proctor.*

The imported granular material must be reasonably well graded to between coarse and fine material and have less than 5 percent by weight passing the US Standard No.200 Sieve. Imported granular material should be placed in lifts 8 to 12 inches and be compacted to not less than 92% of the Maximum Dry Density (MDD) as determined by the Modified Proctor Test (ASTM D-1557). Where imported granular material is placed over wet or soft soil subgrades, we recommend that a geotextile serves as a barrier between the subgrade and imported granular material.

6.5 Drainage Considerations

The Contractor shall be made responsible for temporary drainage of surface water and groundwater, as necessary, to prevent standing water and/or erosion at the working surface. We recommend removing only the foliage necessary for construction to help minimize erosion.

Slope the ground surface around the structure to create a minimum gradient of 2 percent away from the foundations for a distance of at least 5 feet. Surface water should be directed away from all buildings into drainage swales or into a storm drainage system.

7 CONSTRUCTION OBSERVATIONS

Satisfactory pavement and earthwork performance depends on the quality of construction. Sufficient monitoring of the activities of the contractor is a key part of determining that the work is completed in accordance with the construction drawings and specifications. I recommend that a geotechnical engineer observe general excavation, stripping, fill placement, and sub-grades in addition to base. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions requires experience. Therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

8 LIMITATIONS

This report has been prepared for the exclusive use of the addressee, and their architects and engineers for aiding in the design and construction of the proposed development. It is the addressee's responsibility to provide this report to the appropriate design professionals, building officials, and contractors to ensure correct implementation of the recommendations. The opinions, comments and conclusions presented in this report were based upon information derived from our literature review, field investigation, and laboratory testing. Conditions between, or beyond, our exploratory borings may vary from those encountered. Unanticipated soil conditions and seasonal soil moisture variations are commonly encountered and cannot be fully determined by merely taking soil samples or soil borings. Such variations may result in changes to our recommendations.

and may require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

If there is a substantial lapse of time between the submission of this report and the start of work at the site; if conditions have changed due to natural causes or construction operations at, or adjacent to, the site; or, if the basic project scheme is significantly modified from that assumed, it is recommended this report be reviewed to determine the applicability of the conclusions and recommendations. The work has been conducted in general conformance with the standard of care in the field of geotechnical engineering currently in practice in the Pacific Northwest for projects of this nature and magnitude. No warranty, express or implied, exists on the information presented in this report. By utilizing the design recommendations within this report, the addressee acknowledges and accepts the risks and limitations of development at the site, as outlined within the report.

9 REFERENCES

City of Ilwaco web maps - <https://gis.cartomation.com/ilwaco/planning>

Pacific County maps - <https://pacificwa-mapsifter.publicaccessnow.com/>

Washington Lidar Portal - <https://lidarportal.dnr.wa.gov/>

Topo View - <https://ngmdb.usgs.gov/topoview/>

Pacific County Assessor's Office - <https://www.co.pacific.wa.us/assessor/index.htm>

Slaughter, S.L., Walsh, T.J., Ypma, Anton, Stanton, K.M.D., Cakir, Recep, and Contreras, T.A., 2013, Landslide and liquefaction maps for the Long Beach Peninsula, Pacific County, Washington: Effects on tsunami inundation zones of a Cascadia subduction zone earthquake: Washington Division of Geology and Earth Resources, Report of Investigations 37, scale 1:18,000.

Cooper, W.S., 1958, Coastal sand dunes of Oregon and Washington: Geological Society of America, Memoir 72, scale 1:42,000.

Wells, R.E., 1989, Geologic map of the Cape Disappointment-Naselle River area, Pacific and Wahkiakum Counties, Washington: U.S. Geological Survey, Miscellaneous Investigations Series Map I-1832, scale 1:62,500.

Appendix

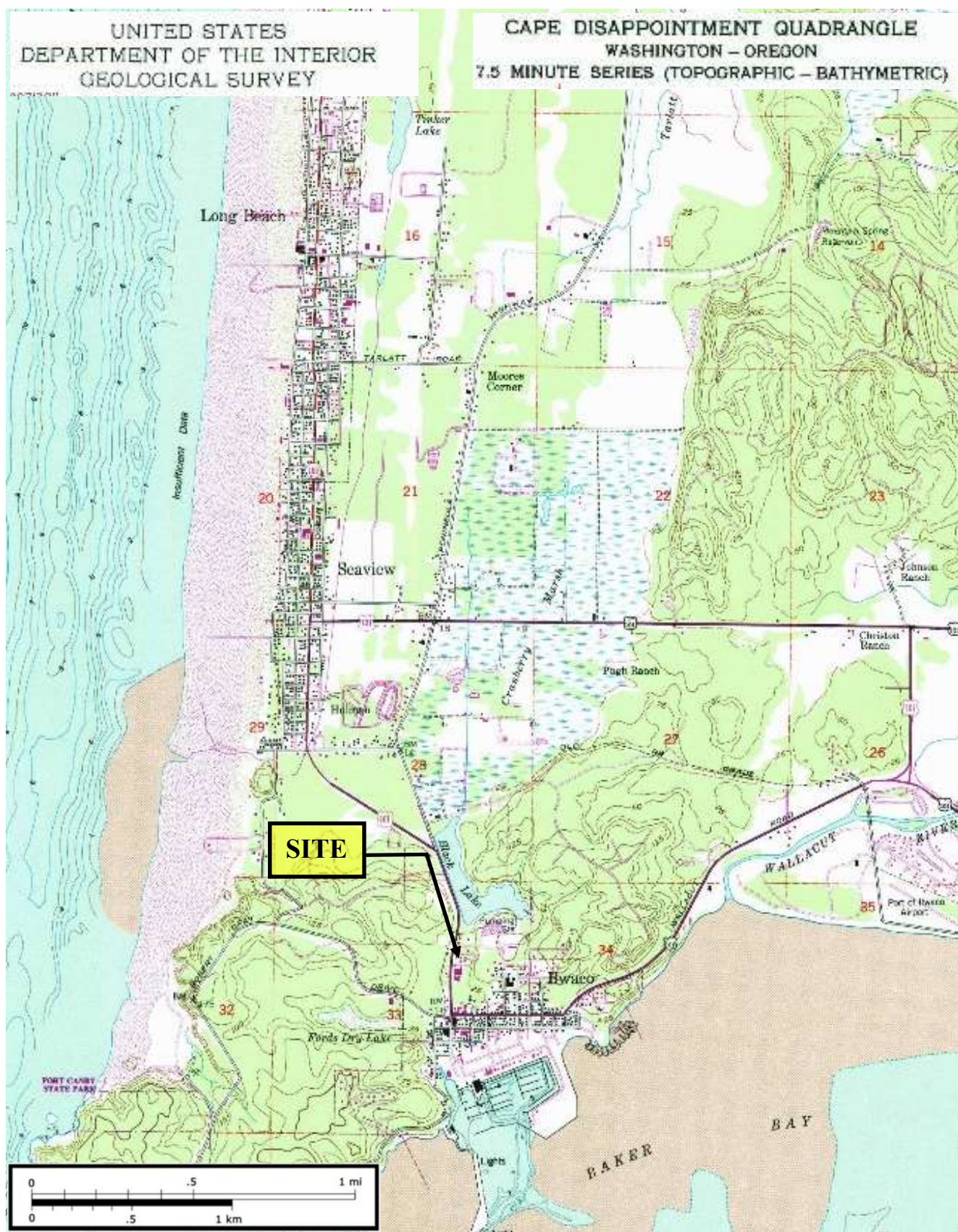


Figure 1: Site location on the northeast quarter of Cape Disappointment Quadrangle

Lab Results		Page 1 of 1
Project Name: 174 First Ave N, Ilwaco	Sample Date	6/10/2025

Moisture

	Sample number	HA-1	HA-2	HA-3		
1	Date and time in oven	6/11/25 11:09 AM	6/11/25 11:09 AM	6/11/25 11:09 AM		
2	Date and time out of oven	6/12/25 11:09 AM	6/12/25 11:09 AM	6/12/25 11:09 AM		
3	Depth (ft)	2	4	6		
4	Tare No.	1	2	3		
5	Tare Mass	235	236	236		
6	Tare plus sample moist	1189	807	593		
7	Tare plus sample dry	915	632	473		
8	Mass of water (g)	274	175	120		
9	Mass of soil (g)	680	396	237		
10	Water Content (%)	40.3	44.2	50.6		

Atterberg Limit Test

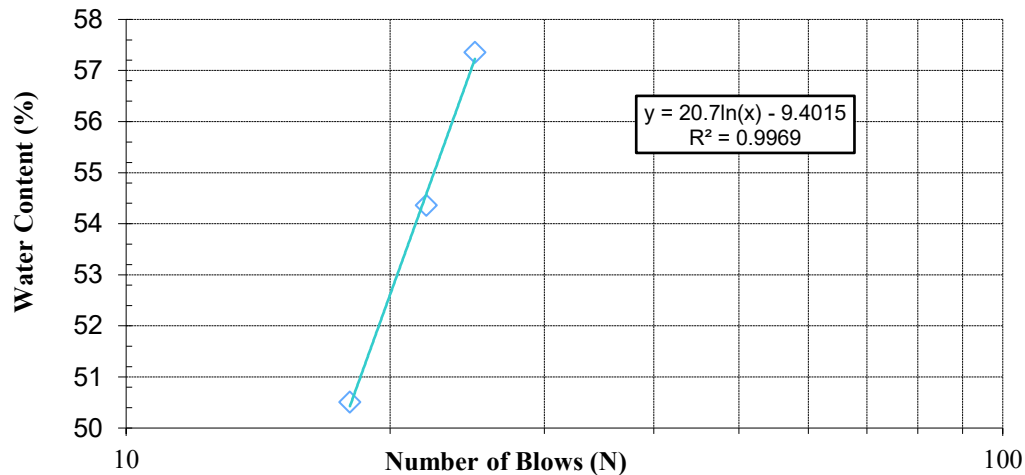
Sample Number: HA-3

Depth: 6-ft

Liquid Limit

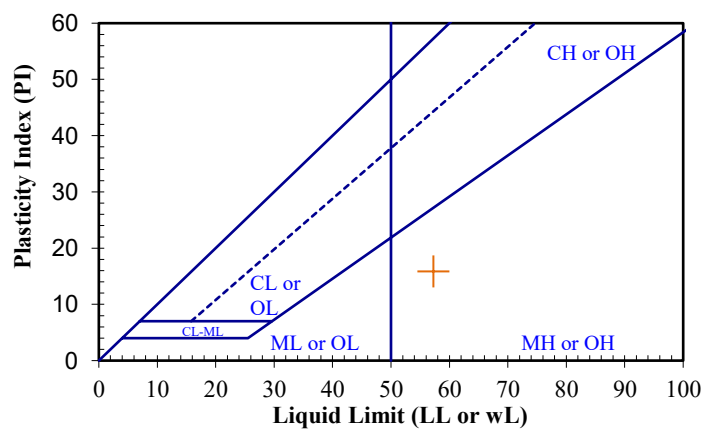
Plastic Limit

	Tare No.	d1.1	d1.2	d1.3	r1.1	r1.2
1	Tare Mass (g)	39.46	39.83	40.43	39.50	40.29
3	Tare Plus Wet Soil (g)	54.85	56.64	55.09	50.21	50.72
4	Tare Plus Dry Soil (g)	49.24	50.72	50.17	46.94	47.81
5	Mass of Water (g)	5.61	5.92	4.92	3.27	2.91
6	Mass of Soil (g)	9.78	10.89	9.74	7.44	7.52
7	Water Content (%)	57.36	54.36	50.51	43.95	38.70
8	No. Blows	25	22	18		



Liquid Limit (%) 57.2
Plastic Limit (%) 41.3
Plasticity Index (%) 15.9
USCS Classification of fines: MH

Rapid Soil Solutions INC



HA#1

Surface Elevation: 39 FT
 Boring Date: 06/10/25
 Boring Location: Ilwaco, WA
 Drilling Method: Hand Auger

Depth	Remarks	Moisture P/a	Dry Density	Blow Counts	Sample Type	Water Table
0					TP	Top Soil (Dry, dark brown, very friable, nonsticky, slightly plastic; many very fine and fine, common medium and coarse roots, soft to medium silt loam)
1					MH	Dry to barely damp dark brown to brown colored, slightly hard, very friable, nonsticky, soft to medium stiff, high plasticity Silt
2	40.3				END	Boring completed at depth of 2 ft
3						
4						
5						
6						
7						

SuperLog CivilTech Software, USA www.civiltech.com File: UNTITLED Date: 6/13/2025

LOG OF BORING

RAPID SOIL SOLUTIONS

174 First Ave N
 Ocean Beach Hospital

Plate 1

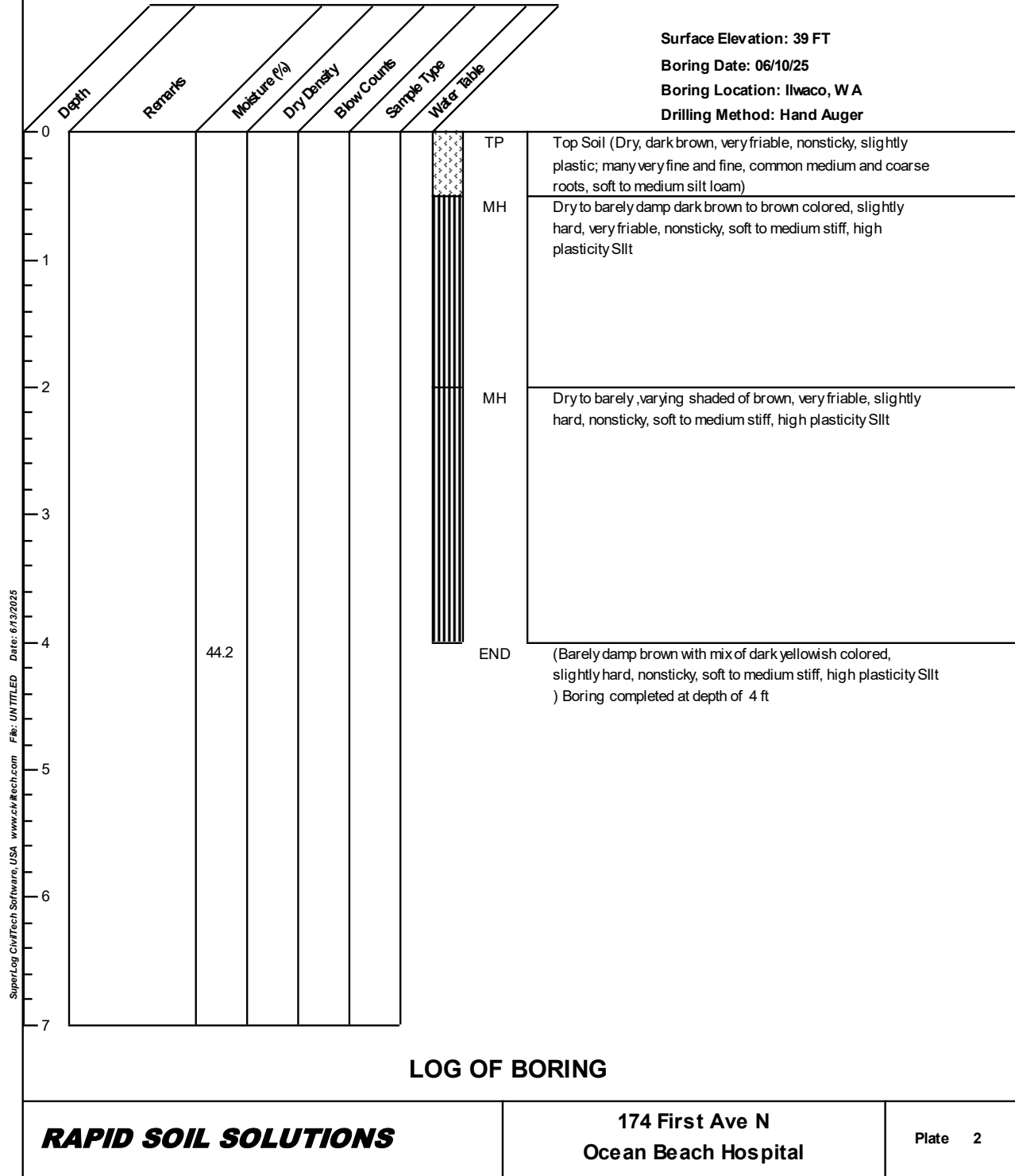
HA#2

Surface Elevation: 39 FT

Boring Date: 06/10/25

Boring Location: Ilwaco, WA

Drilling Method: Hand Auger



RAPID SOIL SOLUTIONS

174 First Ave N
Ocean Beach Hospital

Plate 2

HA#3

Surface Elevation: 39 FT
 Boring Date: 06/10/25
 Boring Location: Ilwaco, W A
 Drilling Method: Hand Auger

Depth	Remarks	Moisture (%)	Dry Density	Blow Counts	Sample Type	Water Table
0					TP	Top Soil (Dry, dark brown, very friable, nonsticky, slightly plastic; many very fine and fine, common medium and coarse roots, soft to medium silt loam)
1					MH	Dry to barely damp dark brown to brown colored, slightly hard, very friable, nonsticky, soft to medium stiff, high plasticity Silt
2					MH	Dry to barely damp dark brown to brown, very friable, slightly hard, nonsticky, soft to medium stiff, high plasticity Silt
3						
4					MH	Barely damp brown with mix of dark yellowish colored, slightly hard, nonsticky, soft to medium stiff, high plasticity Silt
5					MH	Barely damp grayish brown with mix of dark yellowish colored, friable, slightly hard, nonsticky, soft to medium stiff, high plasticity Silt
6	50.6				END	Boring completed at depth of 6 ft
7						

SuperLog CivilTech Software, USA www.civiltech.com File: UNTITLED Date: 6/13/2025

LOG OF BORING

RAPID SOIL SOLUTIONS

174 First Ave N
 Ocean Beach Hospital

Plate 3

Updated 11 November 2021

Larry Cohen
lcohen@oceanbeachhospital.com
Ron Clark
rclark@oceanbeachhospital.com

Re: Infiltration tests at 174 First Avenue N, Ilwaco, WA

Dear Mr. Cohen,

Field Investigation:

Rapid Soil Solutions (RSS) has performed a total of two (2) infiltration tests. Figure 1 shows the project site location. The site has a gentle 5% slope to the rear where testing took place. Soils found on site match those in by DOGMI, RSS found a mixture of Missoula flood deposits. Testing was performed for future dry well and testing existing dry well.

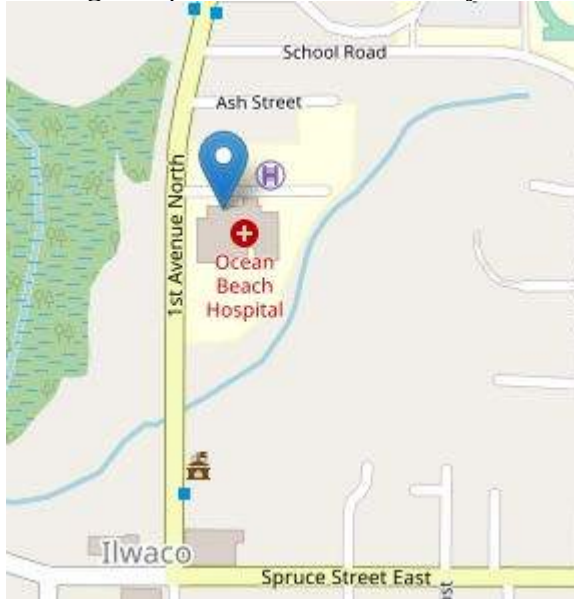


Figure 1 – site location

Infiltration Testing & Conclusion:

Infiltration testing was performed in a 4ft deep hand augur hole. RSS used the EPA failing head method for testing. Testing was performed three (3) times with a rate of 7in/hr. The spreadsheets with the soils found and testing duration.

In November 2021, we returned to the site and performed another infiltration near the proposed facility as well as sample and be able to classify the soils and dig for ground water. Attached is the results of the moisture sample we can on the soils from both locations as well as the atterburg limits so I can classify the soils at a depth of 4ft as a silty CLAY. I can use the modifier of it is a silty CLAY based upon visual testing of the soils and how the soils were viewed in my hands.

Depth to Ground Water

According to Washington Department of Ecology ground water is 9ft below the site. See the attached well log. RSS excavated a second boring near the new testing location and found water at **11.5ft**. See attached hand augur log.



The analysis, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of explorations. Any questions regarding this report please contact me at the below number or email.

Sincerely,



Mia Mahedy, PE GE.

Rapid Soil Solutions Infiltration Test Results



HA#1

Preliminary Information

Location:	174 First Ave N, Ilwaco, WA	Performed By: (Supervised by Mia Mahedy, PE, GE)	Olenka Duncan
Date & Time:	7/29/21 at 10:30 am	Instrument Used:	Hand auger
Weather:	70°, mostly sunny	Depth:	4ft

HA #1

Soil Profile Detail

Depth (ft)	Description		
0-1'	Topsoil		
1-3.5'	Damp, medium stiff, medium brown clayey silt		
3.5-4'	Damp, medium stiff, grey-brown clayey silt		
Time	Measurement (inches)	Level Refilled To (inches)	Rate (inches/hour)
10:45	-	14.5	-
11:15	9.25	15.25	10.5
11:45	11	14	8.5
12:15	10.75	15.5	6.5
12:45	11.75	15.5	7.5
1:15	12.25	15.5	6.5
1:45	12	-	7
Site Infiltration Rate (inches/hour)			7

Rapid Soil Solutions Infiltration Test Results



4ft and 12ft holes

Preliminary Information

Location:	174 First Avenue N, Ilwaco, WA	Performed By: (Supervised by Mia Mahedy, PE, GE)	Ian Buslach, EIT
Date & Time:	11/8/2021	Instrument Used:	Hand Auger
Weather:	Cloudy, 64	Depth:	4 ft

Soil Profile Detail

Depth (ft)	Description		
0-0.5	Cobble Drain Rock		
0.5-1.5	Damp, Gray, medium dense, well graded SAND		
1.5-2.0	Damp, Gray, medium dense, well graded SAND w/ Gravel		
2.0-4.0	Moist, tan with gray orange veins, medium stiff CLAY		
Time	Measurement (inches)	Filled to (in)	Rate (inches/hour)
11:10:00	17.6		
11:30:00	17.2		
11:50:00	16.8		
12:10:00	16.5	22.7	1.1
12:30:00	22.3		
12:50:00	22.1		
1:10:00	22.0	23.8	0.7
1:30:00	23.3		
1:50:00	23.1		
2:10:00	23.0		0.8
Site Infiltration Rate (inches/hour)			0.7

Lab Results

Page 1 of 1

Project Name: 174 First Ave N, Ilwaco, WA

Sample Date 11/8/2021

Moisture

	Sample number	HA#1	HA#2	HA#2	HA#2	HA#2
1	Date and time in oven	11/9/2021 @1:00 pm				
2	Date and time out of oven	11/10/2021 @12:00 PM				
3	Depth (ft)	4	4	8	12	
4	Tare No.	#1	#2	#3	#4	
5	Tare Mass	234	234	233	230	
6	Tare plus sample moist	789	1092	1192	944	
7	Tare plus sample dry	649	857	891	635	
8	Mass of water (g)	140	235	301	309	
9	Mass of soil (g)	415	623	658	405	
10	Water Content (%)	33.7	37.7	45.7	76.3	

Atterberg Limit Test

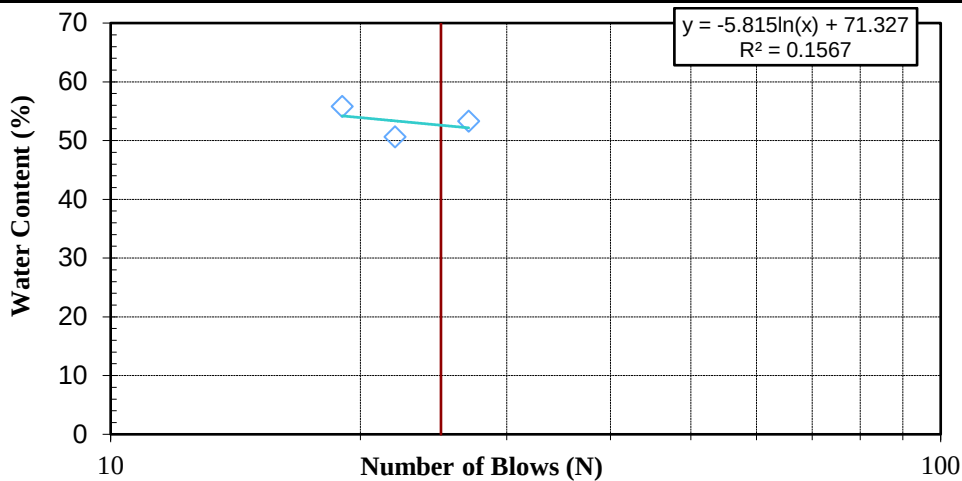
Sample Number: HA1

Depth: 4

Liquid Limit

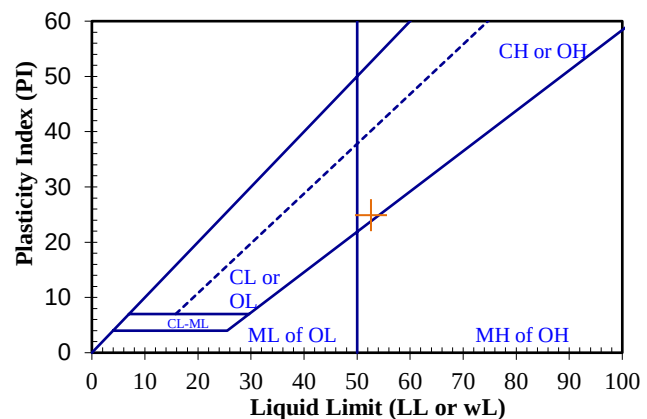
Plastic Limit

	Tare No.	D#1.1	D#1.2	D#1.3	R#1.1	R#1.2
1	Tare No.					
2	Tare Mass (g)	39.52	39.83	40.53	39.38	40.19
3	Tare Plus Wet Soil (g)	70.17	73.02	65.38	49.34	49.55
4	Tare Plus Dry Soil (g)	59.87	61.48	56.48	47.23	47.47
5	Mass of Water (g)	10.30	11.54	8.90	2.11	2.08
6	Mass of Soil (g)	20.35	21.65	15.95	7.85	7.28
7	Water Content (%)	50.61	53.30	55.80	26.88	28.57
8	No. Blows	22	27	19		



Liquid Limit (%) 52.6
Plastic Limit (%) 27.7
Plasticity Index (%) 24.9
USCS Classification of fines: CH

Rapid Soil Solutions INC



HA-1

Surface Elevation:
 Boring Date: 11/9/2021
 Boring Location: Ilwaco, W A
 Drilling Method: Hand Auger

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Users\Kira\Work\Documents\2021 Q4\Infiltration Test Results\First Ave N, Ilwaco WA\First Ave N.log Date: 11/10/2021

Depth	Remarks	Moisture (%)	Dry Density	Blow Counts	Sample Type	Water Table
0					GW	Large Landscape Cobbles (4-8in)
1					SW	Damp, gray, medium dense, well-graded SAND
2					SW	Damp, gray, medium dense, well-graded SAND w/ trace gravel
3					CH	Damp, tan with orange, medium stiff, fine CLAY
4	PI: 24.9% LL: 52.6%	33.7%				Boring completed at depth of 4ft
5						
6						
7						

LOG OF BORING

Rapid Soil Solutions Inc

174 First Ave N

Plate 1

HA-2

Surface Elevation:

Boring Date: 11/9/2021

Boring Location: Ilwaco, W A

Drilling Method: Hand Auger

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Users\Kira\Work\Documents\2021 Q4\Infiltration Test Results\First Ave N, Ilwaco WA\First Ave N.log Date: 11/10/2021

Depth	Remarks	Moisture (%)	Dry Density	Blow Counts	Sample Type	Water Table
0					GW	Large Landscape Cobbles (4-8in)
					SW	Damp, gray, medium dense, well-graded SAND
					SW	Damp, gray, medium dense, well-graded SAND w/ trace gravel
2					CH	Moist, tan with orange, medium stiff, fine CLAY
4	37.7%					
6					CH	Moist, tan with orange and gray, medium stiff, fine CLAY
8	45.7%					
10						
12	76.3%				CH	Wet, orange, soft, fine CLAY
14						

Boring completed at depth of 12ft

LOG OF BORING

Rapid Soil Solutions Inc

174 First Ave N

Plate 2

