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May 22nd, 2019

Stormwater Management Plan for Farnam Flats – LaCrosse WI

Overview:
Farnam Flats is a proposed four story above ground mixed use commercial/residential structure with an underground parking garage. The site is located three blocks north of Gundersen hospital and two blocks south of Hamilton Elementary School. The anticipated tenants of the commercial space would be neighborhood commercial type uses providing products and services primarily to residents located within a few blocks of the site or visitors/employees of Gundersen hospital and Hamilton Elementary School. 46 residential units will be created with a mix of studio, one- and two-bedroom units.

Storm Sewer

Public catchbasins are located in the southwest and northwest curb returns of 7th Street. Both catchbasin were reviewed for potential connections. Due to building mechanics, existing utilities and other circumstances, the only catchbasin which is proposed to be connected to is the one in northwest corner of the site at 7th Street and Hood Street.

The proposed system includes inlets and pipes to capture and convey runoff from the roof via interior downspouts, trench drains that will be pumped to gravity flow pipes onsite and an inlet in the grass area between the building and ramp to the basement. Runoff from the roof and grass area will be directly routed to the catchbasin without any stormwater pollutant treatment. All pipes were modeled in Hydraflow to ensure pipe capacity is not an issue. The pipe connecting to the public catchbasin is a 12” pipe.

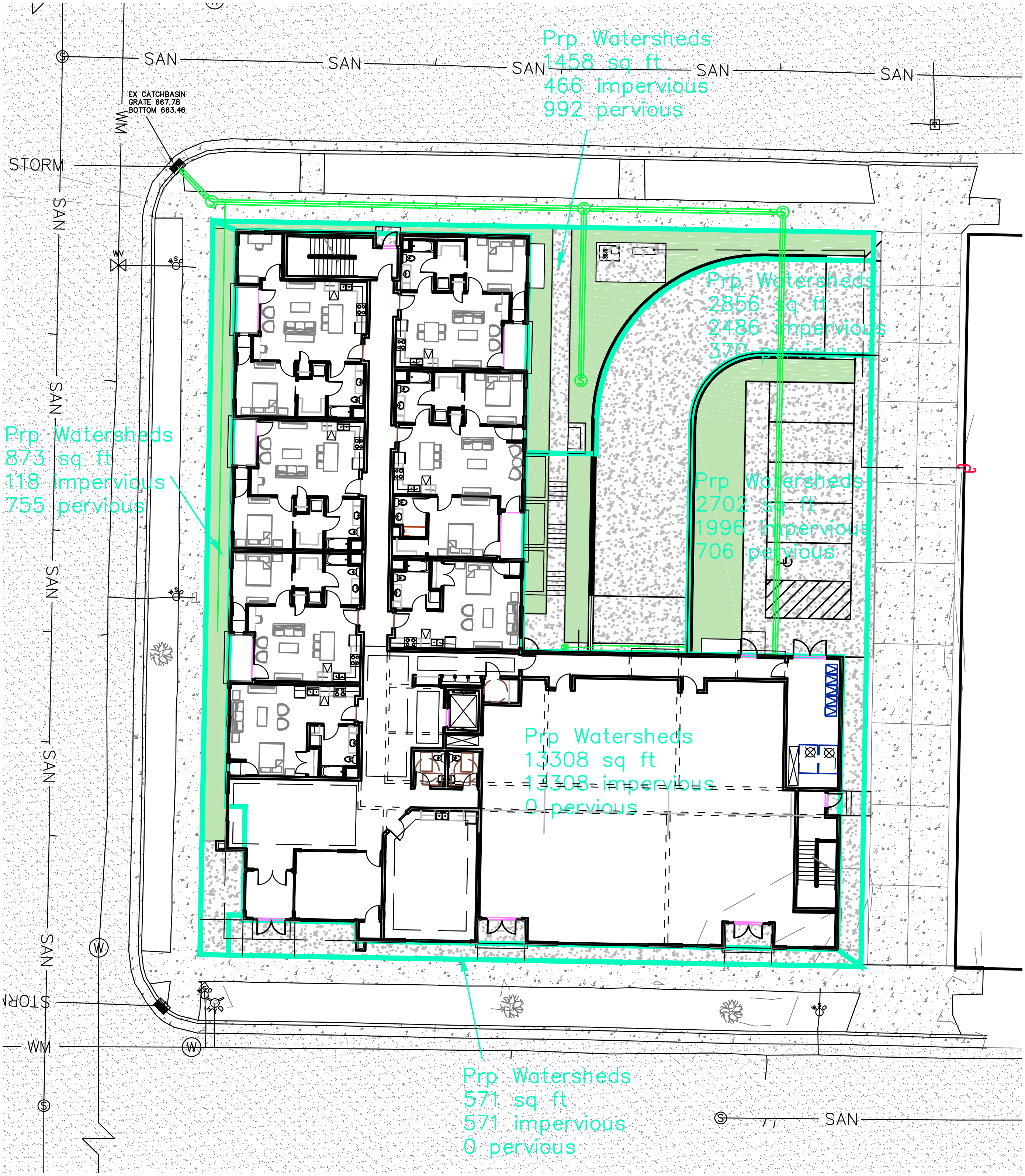
Runoff from the parking lot off the alley, ramp to the basement garage and drains within the garage will be routed through a Stormceptor STC450i Hydrodynamic Separator which will remove in excess of 40% of the TSS from the project. Details and proprietary calculations are attached for review.

The installation of the storm sewer requires that private infrastructure be constructed within the public right of way. A Revocable Occupancy/Street Privilege Permit Application will be applied for. Additionally, a Post Construction Stormwater Maintenance Agreement will be required.

Attachments:
Proposed Watersheds
Hydraflow Pipe Sizing Report
Stormceptor STC450i Hydrodynamic Separator typical sheet
Detailed Stormceptor Sizing Report
Stormceptor STC General Specifications
Chosen Valley Testing - Geotechnical Report

14070 Highway 52 Southeast, Chatfield, Minnesota 55923
Phone 507-867-1666 ♦ Fax 507-867-1665 ♦ www.ggg.to

PROPOSED WATERSHEDS



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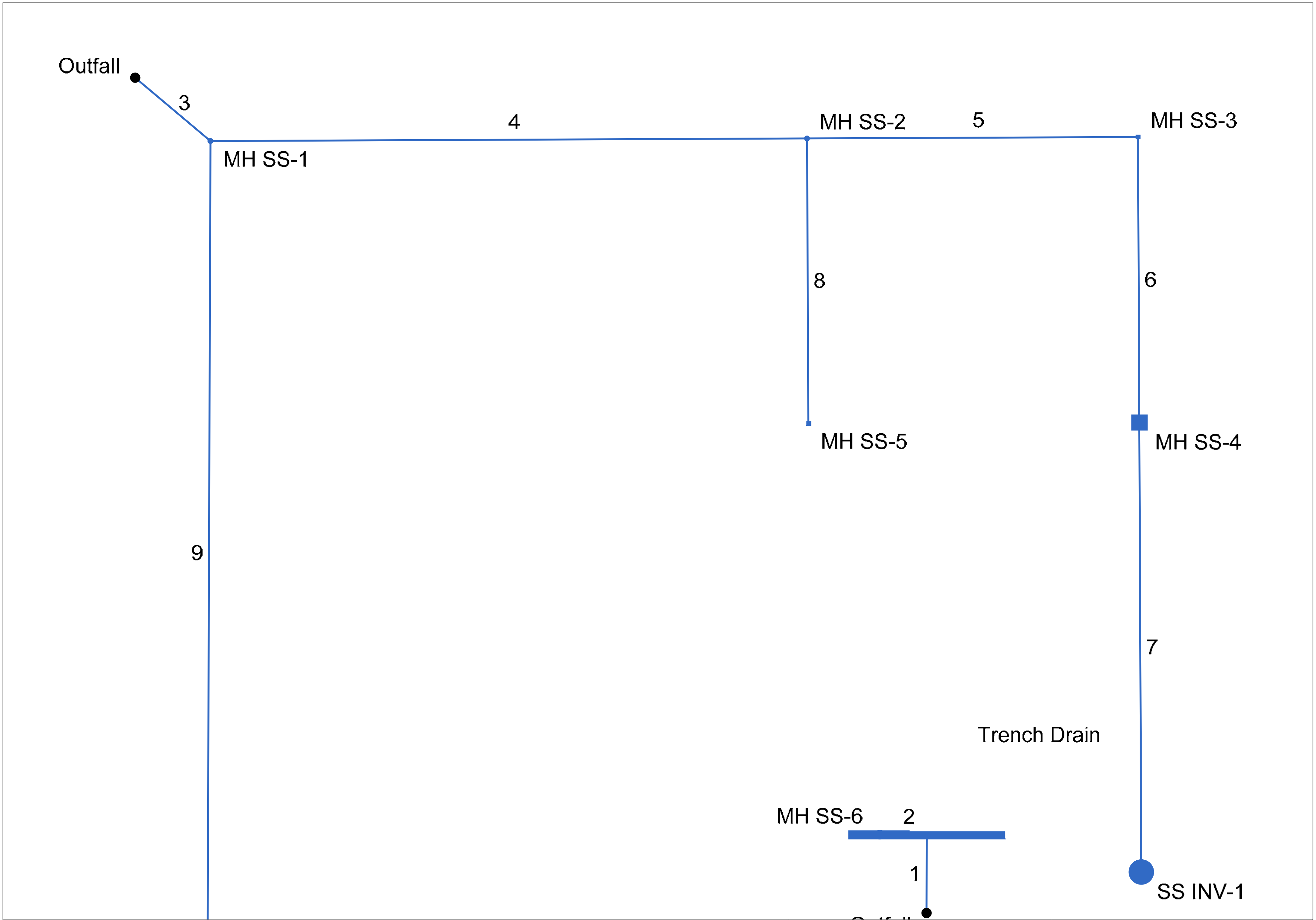
Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 19-019 Trench Drain.stm	Number of lines: 9	Date: 5/6/2019

19-019

Line No.	Inlet ID	DnStm Ln No	Line Length (ft)	Drng Area (ac)	Runoff Coeff (C)	Incr CxA	Inlet Time (min)	Pipe Travel (min)	i Inlet (in/hr)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Line Size (in)	Line Slope (%)	Invert Dn (ft)	Invert Up (ft)	HGL Dn (ft)	HGL Up (ft)	Gnd/Rim El Dn (ft)	Inlet ID
1	Trench Drain	Outfall	10.00	0.05	0.83	0.04	0.8	0.17	7.25	0.34	1.21	2.35	8	1.00	658.80	658.90	659.11	659.17 j	0.00	Trench Drain
2	MH SS-6	1	6.00	0.01	0.53	0.01	1.0	0.91	7.25	0.04	1.56	0.11	8	1.67	657.90	658.00	659.17	659.17	0.00	MH SS-6
3	MH SS-1	Outfall	12.55	0.00	0.00	0.00	0.0	0.08	0.00	2.15	2.25	2.79	12	0.40	664.67	664.72	665.62	665.66	667.78	MH SS-1
4	MH SS-2	3	76.00	0.00	0.00	0.00	0.0	0.67	0.00	1.48	2.27	2.00	12	0.41	664.72	665.03	665.75	665.87	668.87	MH SS-2
5	MH SS-3	4	42.17	0.00	0.00	0.00	0.0	0.52	0.00	1.06	2.26	1.53	12	0.40	665.03	665.20	665.94	665.97	669.35	MH SS-3
6	MH SS-4	5	36.50	0.00	0.00	0.00	0.0	0.45	0.00	1.06	2.28	1.70	12	0.41	665.20	665.35	666.01	666.04	669.20	MH SS-4
7	SS INV-1	6	57.50	0.12	0.83	0.10	1.0	0.71	7.25	1.06	2.25	2.83	12	0.40	665.60	665.83	666.08	666.31	668.26	SS INV-1
8	MH SS-5	4	36.44	0.07	0.83	0.06	1.0	0.79	7.25	0.42	1.40	0.79	10	0.41	665.03	665.18	665.94	665.95	669.35	MH SS-5
9	SS INV-2	3	102.35	0.11	0.83	0.09	1.0	1.41	7.25	0.66	1.39	1.27	10	0.40	664.72	665.13	665.75	665.84	668.87	SS INV-2

Project File: 19-019 Trench Drain.stm	Number of lines: 9	Date: 5/6/2019

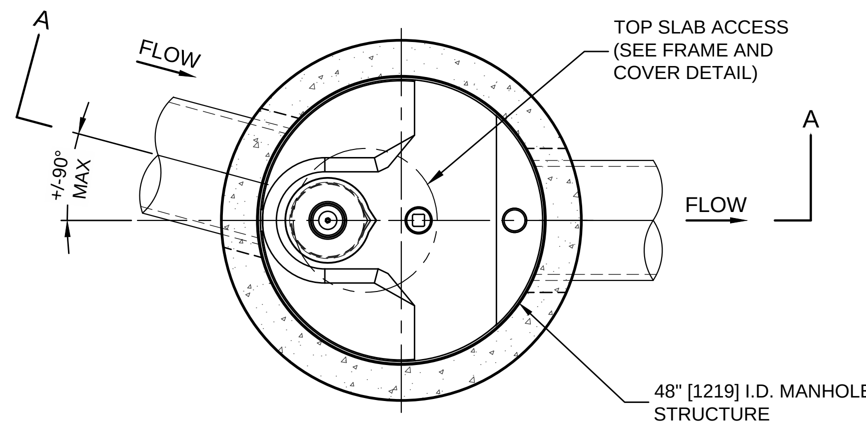
NOTES: Intensity = 32.31 / (Inlet time + 3.90) ^ 0.65 -- Return period = 10 Yrs. ; ** Critical depth

19-019

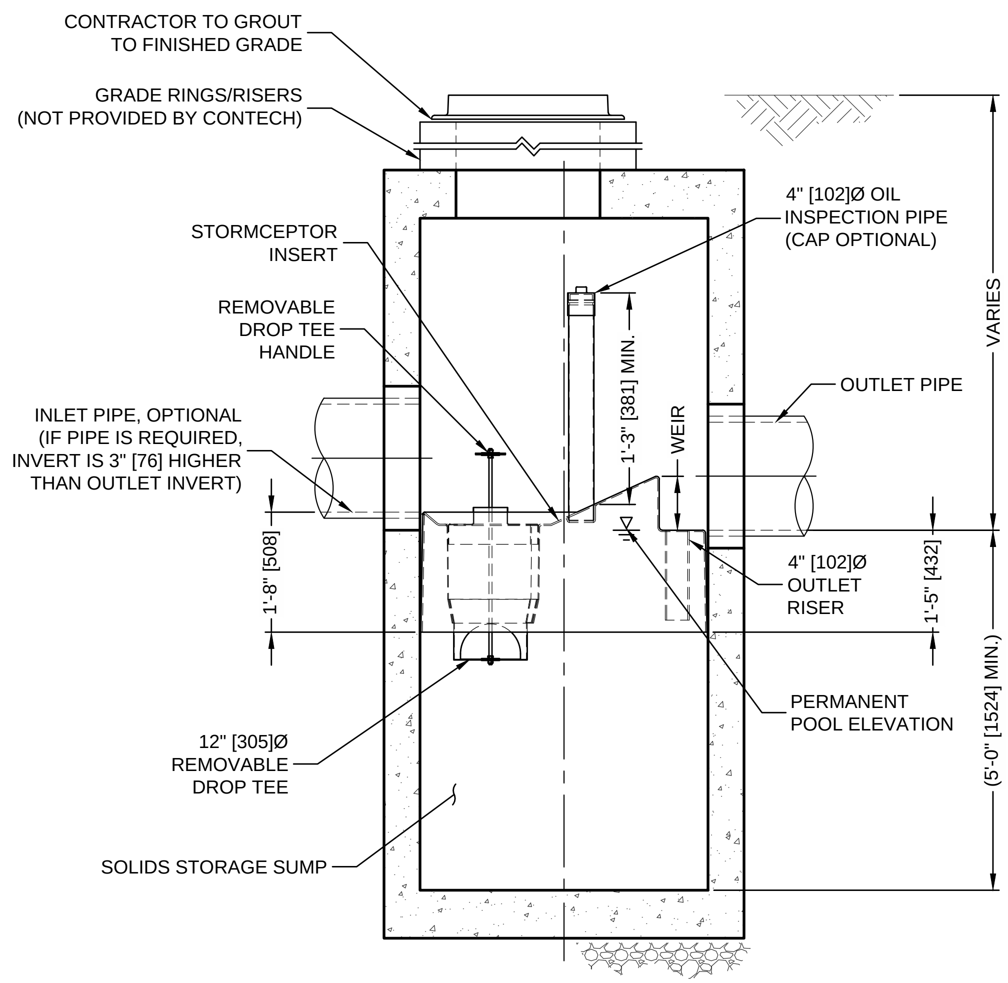
Gnd/Rim El Up (ft)	Gutter Spread (ft)	Grate Len (ft)	Grate Width (ft)	Q Carry (cfs)	Incr Q (cfs)	Inlet Eff (%)	Q Capt (cfs)	Q Byp (cfs)	Gutter Slope (ft/ft)	Inlet Depth (ft)	Line ID
0.00	11.10	1.00	20.00	0.00	0.30	100	0.30	0.00	0.001	0.09	Trench Drain to Sump Pump
659.75	3.32	2.94	1.25	0.00	0.04	100	0.04	0.00	Sag	0.01	MH SS-6 TO TRENCH DRAIN
668.87	....	....	....	....	0.00	....	....	....	....	....	MH SS-1 TO EX CB
669.35	....	....	....	....	0.00	....	....	....	....	....	MH SS-2 TO MH SS-1
669.20	....	....	....	....	0.00	....	....	....	....	....	MH SS-3 TO MH SS-2
668.26	14.12	2.94	1.25	1.06	0.00	100	1.06	0.00	Sag	0.12	MH SS-4 TO MH SS-3
670.15	....	....	....	....	1.06	....	....	....	....	....	SS INV-1 TO MH SS-4
669.00	....	....	....	....	0.42	....	....	....	....	....	MH SS-5 TO MH SS-2
670.15	....	....	....	....	0.66	....	....	....	....	....	SS INV-2 TO MH SS-1

Project File: 19-019 Trench Drain.stm | Number of lines: 9 | Date: 5/6/2019

NOTES: ** Critical depth



PLAN VIEW
TOP SLAB NOT SHOWN



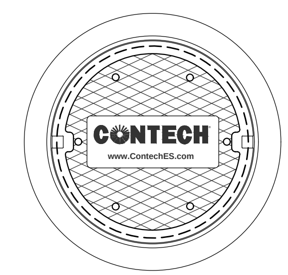
SECTION A-A

Stormceptor®
FOR PATENT INFORMATION, GO TO www.ContechES.com/IP

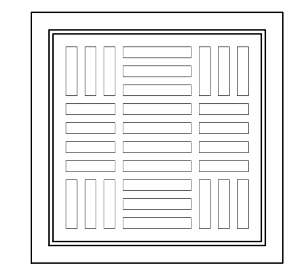
STORMCEPTOR DESIGN NOTES

THE STANDARD STC450I CONFIGURATION WITH ROUND, SOLID FRAME AND COVER, AND INLET PIPE IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES



FRAME AND COVER
(MAY VARY)
NOT TO SCALE



FRAME AND GRATE
(MAY VARY)
NOT TO SCALE

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (cfs [L/s])			
PEAK FLOW RATE (cfs [L/s])			
RETURN PERIOD OF PEAK FLOW (yrs)			
RIM ELEVATION			
PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
NOTES / SPECIAL REQUIREMENTS:			

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. STORMCEPTOR WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STORMCEPTOR STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2' [610], AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. STORMCEPTOR STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C478 AND AASHTO LOAD FACTOR DESIGN METHOD.
6. ALTERNATE UNITS ARE SHOWN IN MILLIMETERS [mm].

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMCEPTOR MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

STC450i
STORMCEPTOR
STANDARD DETAIL

I:\COMMON\CAD\TREATMENT\23 STORMCEPTOR\40 STANDARD DRAWINGS\IN PROCESS\STC450I-DTL.DWG 2/1/2019 3:12 PM

Stormceptor®

CONTECH ENGINEERED SOLUTIONS

Detailed Stormceptor Sizing Report – Farnam Flats

Project Information & Location			
Project Name	Farnam Flats	**Project Number**	19-019
City	Lacrosse	**State/ Province**	Wisconsin
Country	United States of America	**Date**	5/6/2019
Designer Information		**EOR Information (optional)**	
Name	Mark Welch	**Name**	
Company	G-cubed Inc	**Company**	
Phone #	507-867-1666	**Phone #**	
Email	markw@ggg.to	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Farnam Flats
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	40.0
TSS Removal (%) Provided	71
PSD	WiDNR NURP
Rainfall Station	LA CROSSE MUNICIPAL AIR

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	71
STC 900	80
STC 1200	81
STC 1800	82
STC 2400	86
STC 3600	87
STC 4800	90
STC 6000	91
STC 7200	92
STC 11000	95
STC 13000	95
STC 16000	96
StormceptorMAX	Custom

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The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Wisconsin	**Total Number of Rainfall Events**	3050
Rainfall Station Name	LA CROSSE MUNICIPAL AIR	**Total Rainfall (in)**	687.0
Station ID #	4370	**Average Annual Rainfall (in)**	11.8
Coordinates	43°52'44"N, 91°15'10"W	**Total Evaporation (in)**	62.8
Elevation (ft)	652	**Total Infiltration (in)**	105.7
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	518.5

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

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Drainage Area	
Total Area (acres)	0.49
Imperviousness %	84.0

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	40.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	665.35
Stormceptor Outlet Invert Elev (ft)	665.35
Stormceptor Rim Elev (ft)	668.26
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	12
Pipe Material	PVC - plastic
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	Yes

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

WiDNR NURP		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	2.0	2.65
2.0	12.0	2.65
3.0	9.0	2.65
4.0	6.0	2.65
5.0	6.0	2.65
6.0	6.0	2.65
7.0	5.0	2.65
8.0	5.0	2.65
9.0	2.0	2.65
10.0	3.0	2.65
11.0	2.0	2.65
12.0	2.0	2.65
13.0	2.0	2.65
14.0	1.0	2.65
15.0	2.0	2.65
20.0	6.0	2.65
25.0	4.0	2.65
30.0	3.0	2.65
35.0	2.0	2.65

40.0	2.0	2.65
50.0	2.0	2.65
60.0	3.0	2.65
80.0	2.0	2.65
100.0	2.0	2.65
150.0	3.0	2.65
200.0	2.0	2.65
300.0	2.0	2.65
500.0	2.0	2.65

Site Name	Farnam Flats

Site Details

Drainage Area	
Total Area (acres)	0.49
Imperviousness %	84.0

Surface Characteristics	
Width (ft)	292.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow	
Dry Weather Flow (cfs)	0

Winter Months	
Winter Infiltration	0

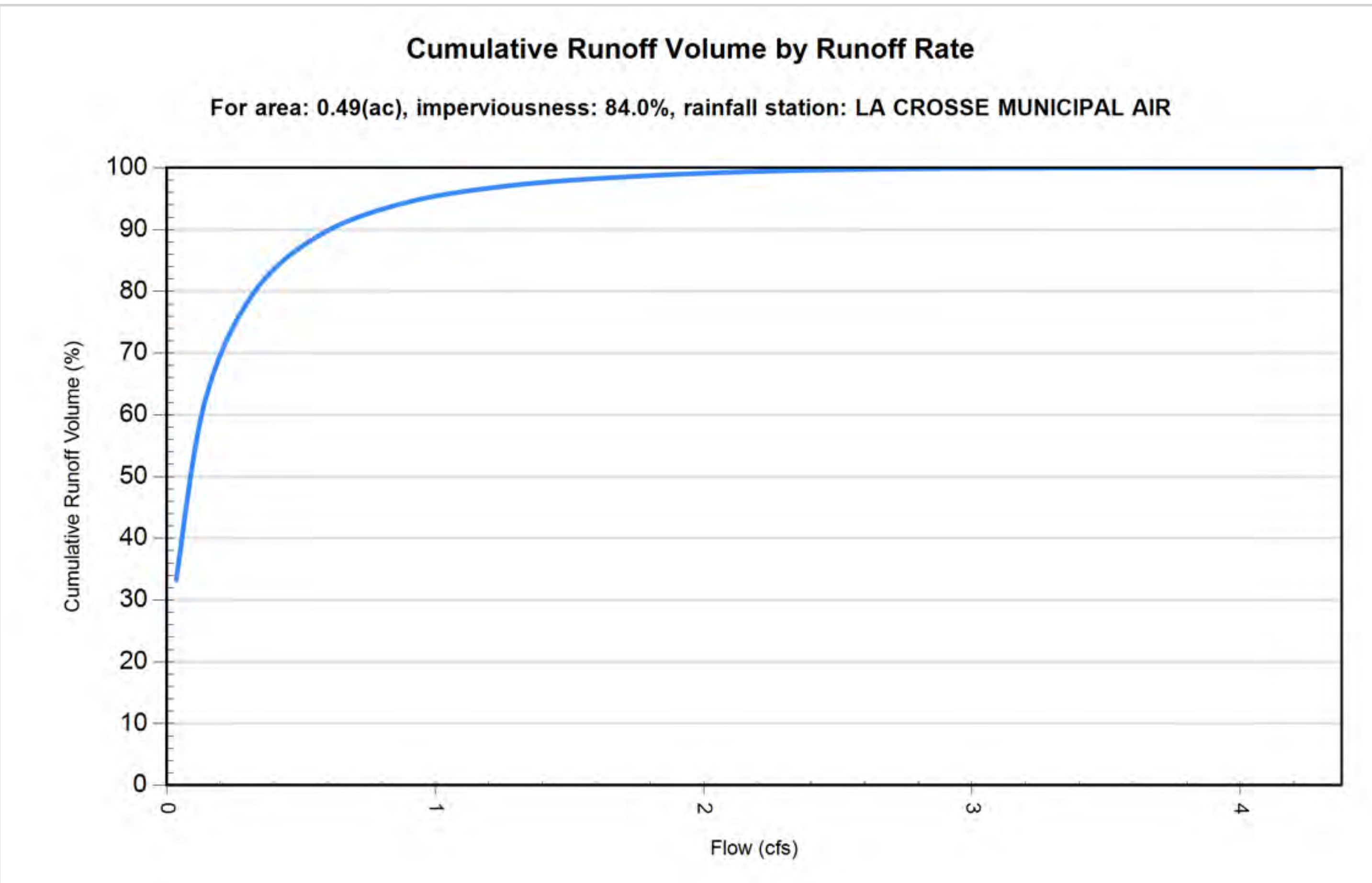
TSS Loading Parameters

TSS Loading Function	

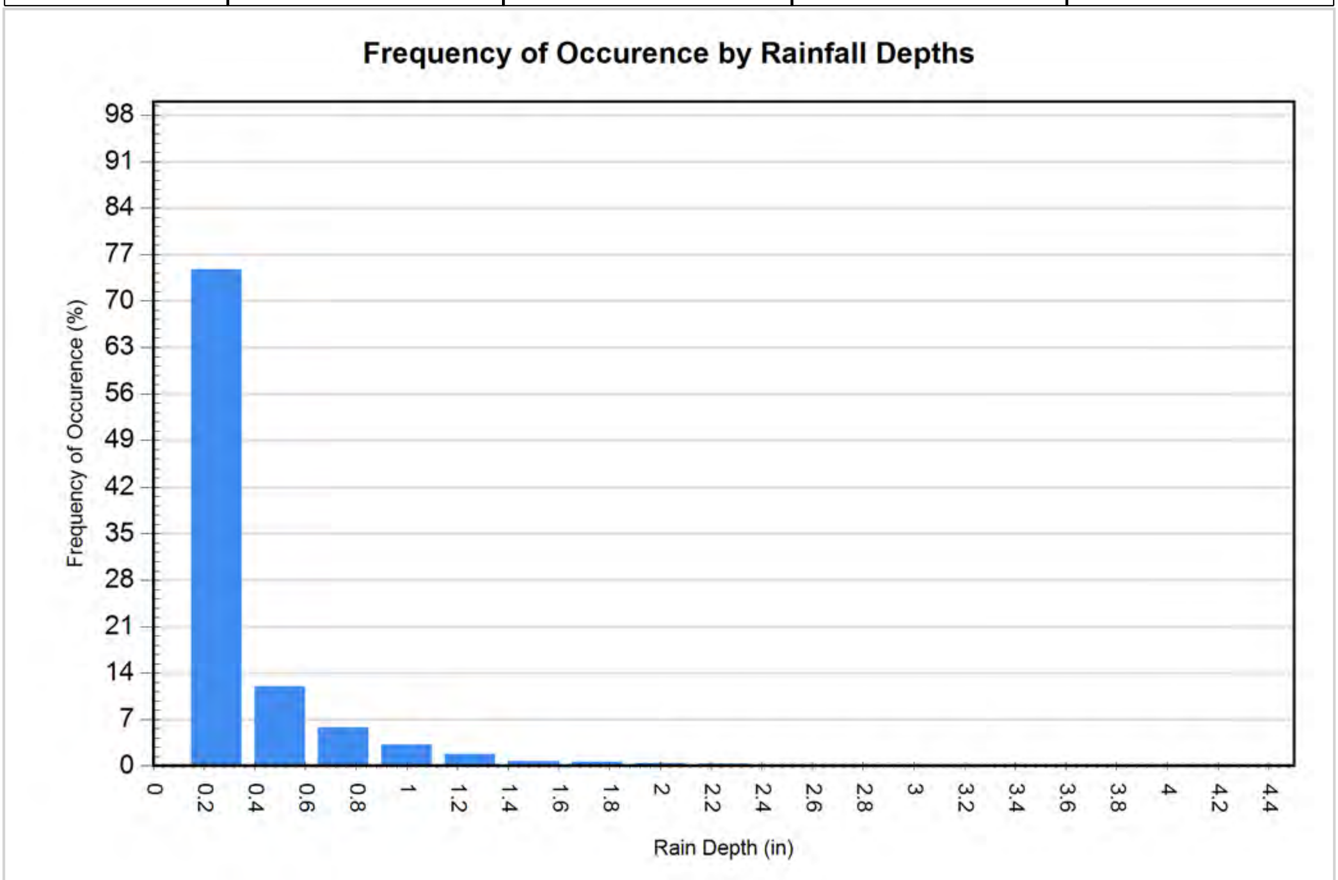
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	**Runoff Volume (ft³)**	**Volume Over (ft³)**	**Cumulative Runoff Volume (%)**
0.035	318521	639432	33.3
0.141	594026	363949	62.0
0.318	760766	197158	79.4
0.565	852327	105584	89.0
0.883	902853	55052	94.3
1.271	929678	28227	97.1
1.730	944752	13146	98.6
2.260	953195	4702	99.5
2.860	956602	1294	99.9
3.531	957639	258	100.0
4.273	957897	0	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	2281	74.8	166	24.2
0.50	367	12.0	133	19.3
0.75	178	5.8	109	15.9
1.00	97	3.2	84	12.2
1.25	55	1.8	61	8.8
1.50	20	0.7	27	3.9
1.75	18	0.6	29	4.2
2.00	11	0.4	20	2.9
2.25	9	0.3	19	2.8
2.50	5	0.2	12	1.8
2.75	2	0.1	5	0.8
3.00	3	0.1	8	1.2
3.25	1	0.0	3	0.5
3.50	2	0.1	7	1.0
3.75	1	0.0	4	0.5
4.00	0	0.0	0	0.0
4.25	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Section (____)
Stormwater Treatment Device

1. GENERAL

1.1. This section specifies requirements for constructing underground stormwater treatment chambers to construct the complete Stormceptor® hydrodynamic separator (HDS) device. Work includes supply and installation of concrete bases, precast sections, and the appropriate precast section with all internal components completely and correctly installed within the HDS device, water tight seals prior to arrival to the project site.

1.2. The following reference standards apply:

ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D2563: Standard Practice for Classification of Visual Defects in Reinforced Plastics
ASTM D2584: Test Method for Ignition Loss of Cured Reinforced Plastics

1.3. Shop drawings shall be submitted upon request with each order to the contractor then forwarded to the consulting engineer for review and acceptance. Shop drawings shall detail the precast concrete components and the precast concrete component detailing all HDS internal components pre-installed and watertight sealed at the precast facility prior to shipment, including the sequence for installation.

1.4. Prevent damage to materials during storage and handling.

1.41. Internal HDS device materials supplied by the Manufacturer for connection to the precast concrete shall be pre-fabricated and bolted to the precast and watertight sealed to the precast surface prior to delivery to the project site to ensure Manufacturer's internal assembly process and quality control processes are fully adhered to, and to prevent damage to the materials on site. No exceptions will be accepted.

1.4.2. Follow all instructions labeled on precast concrete components during installation.

2. MATERIALS

2.1. General

2.1.1. The HDS shall be circular and constructed from the pre-cast concrete circular riser and slab components.

2.1.2. The HDS shall include a fiberglass insert bolted and sealed, watertight inside the concrete precast chamber, prior to delivery to the project site. The fiberglass insert must provide a lining for oil storage and retention as a secondary containment system within the HDS.

2.1.3. The HDS shall be allowed to be specified as a bend or junction structure in the stormwater drainage system.

2.2. Precast Concrete Sections: All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications.

2.3. Joints: The concrete joints shall be water-tight and meet the design criteria according to ASTM C-443. Mastic sealants or butyl tape are not an acceptable alternative.

2.4. Frame and Cover: Frame and covers shall be manufactured in accordance with local regulatory specifications and shall be clearly embossed with manufacturer's product name.

2.5. Concrete: All concrete components shall conform to the appropriate CSA or ASTM specifications.

2.6. Fiberglass: The fiberglass portion of the water treatment device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.7. Ladders: Ladder rungs to be provided upon request.

2.8. Safety grate: A safety grate shall be installed within the chamber of the unit.

2.9. Inspection: All precast concrete sections shall be inspected to ensure dimensions, appearance, integrity of internal components, and quality of the product meets local municipal specifications and associated standards.

3. PERFORMANCE

3.1. The HDS device shall remove oil and sediment from stormwater during frequent wet weather events, and retain these pollutants within the device for later removal.

3.2. The HDS device shall be engineered, designed and sized to treat a minimum of 90 percent of the annual runoff volume using a widely accepted continuous simulation runoff model which uses rainfall data records which includes antecedent conditions as well as rainfall periods. Rainfall records should be comprised of 15-years of rainfall data or a longer continuous period if available for a given location, but in all cases at least a minimum of 5-years continuous rainfall.

3.3. The HDS device shall be capable of removing the Engineer-specified total suspended solids (TSS) load, without scouring previously captured pollutants.

3.4. The HDS device shall be engineered, designed and sized to treat a minimum of 90 percent of the annual runoff volume using a widely accepted continuous simulation runoff model which uses rainfall data records which includes antecedent conditions as well as rainfall periods. Rainfall records should be comprised of 15-years of rainfall data or a longer continuous period if available for a given location, but in all cases at least a minimum of 5-years continuous rainfall. The Peclet Number is not an approved method or model for calculating TSS removal, sizing, or scaling HDS devices.

3.5. The HDS device shall be sized to remove the Engineer-specified total suspended sediment (TSS) load using the particle size distribution (PSD) in Table 3.5, in addition to adhering to sections 3.2 & 3.4 of this specification. No alternative PSDs or deviations from Table 3.5 shall be accepted.

Table 3.5 – Particle Size Distribution		
Particle Size Distribution to be used to size HDS		
Particle Diameter (Micron)	**% by Mass of All Particles**	**Specific Gravity**
1000	5%	2.65
500	5%	2.65
250	15%	2.65
150	15%	2.65
100	10%	2.65
75	5%	2.65
50	10%	2.65
20	15%	2.65
8	10%	2.65
5	5%	2.65
2	5%	2.65

3.6. Verified scour testing

3.6.1 The HDS device shall have New Jersey Corporation for Advanced Technology (NJCAT) verification that the device is acceptable for on-line installation based on full-scale third-party scour testing performed with the device pre-loaded with the particle size distribution (PSD) illustrated in **TABLE 1 - Scour Test Particle Size Distribution**. Alternatively, the HDS device shall have Toronto and Region Conservation Authority (TRCA) verification of third-party scour testing performed in accordance with the Canadian ETV “Procedure for Laboratory Testing of Oil-Grit Separators.”

3.6.1.1. Scour testing data from laboratory scour testing performed with the HDS device pre-loaded with a coarser PSD than the PSD shown in TABLE 1 (i.e. the coarser PSD has no particles in the 1 – 50 micron size range) shall not be acceptable for the determination of the device’s suitability for on-line installation.

TABLE 1 - Scour Test Particle Size Distribution[1]	
Particle Size (Microns)	**Percent by Mass of All Particles**
500 – 1000	5%
250 – 500	5%
100 – 250	30%
50 – 100	15%
8 – 50	25%
2 – 8	15%
1 – 2	5%
1. The Materials shall be hard, firm and inorganic with a specific gravity of 2.65. The various particle sizes shall be uniformly distributed throughout the material prior to use.	

3.7. Design accounting for bypass

3.7.1. The HDS system design shall be specified to achieve the TSS removal performance and water quality objectives without washout of previously captured pollutants. To ensure that this is achieved, there are two design options with associated requirements:

3.7.1.1. The HDS device shall be placed **off-line** with an upstream external water quality bypass diversion structure (typically in an upstream manhole) that only allows the water quality volume to be diverted to the HDS device, and excessive flows diverted downstream around the HDS device to prevent high flow washout of pollutants previously captured. This design typically incorporates a triangular configuration layout including an upstream bypass manhole with an appropriately engineered weir wall, the HDS device, and a downstream junction manhole, which is connected to both the HDS device and bypass structure. In this case with an external bypass required, the HDS device manufacturer must provide calculations and designs for all structures, piping and any other required material applicable to the proper functioning of the system, stamped by a Professional Engineer.

3.7.1.2. Alternatively, HDS devices in compliance with Section 3.6.1 shall be acceptable for an on-line design configuration, thereby eliminating the requirement for an upstream bypass manhole and downstream junction manhole.

3.8. Sediment storage capacity

Manufacturer's sediment storage capacity guidelines for the HDS device shall be confirmed by the Engineer to be adequate for the anticipated sediment loadings. Sediment loadings shall be determined by land-use and defined as a minimum of 450 kg (992 lb) of sediment (TSS) per impervious hectare of drainage area per year or greater as noted in the "Typical Urban Areas and Pollutant Yields (Sediment)" table below. The HDS device shall be specified as to not require maintenance (sediment removal) more frequently than once per year.

Typical Urban Areas and Pollutant Yields (Sediment) (Burton and Pitt, 2002)

Pollutant	Pollutant Load by Land Use (Kg/ha/year)							
	Commercial	Parking Lot	Residential Density			Highways	Industrial	Shopping Centers
			High	Med.	Low			
TSS	1000	400	400	250	10	880	500	440

Source: U.S. EPA Stormwater Best Management Practice Design Guide, Volume 1, Appendix D, Table D-1

NOTE: to determine volume of adequate sediment storage capacity a bulk density of 1602 kg/m^3 (100 lbs/ft^3) shall be applied.

3.9. Petroleum hydrocarbon capture and storage

3.9.1 Petroleum hydrocarbon storage capacity in the HDS device shall be a minimum 35 gallons (132 Liters), or more as specified.

3.9.2 The HDS device internal hydrocarbon storage area shall include a minimum of 12 inches (305 mm) of double wall containment for the full circumference of the device to provide safe oil and other hydrocarbon material storage and ground water protection.

3.10. Surface loading rate scaling of different model sizes

The reference device for scaling shall be an HDS device that has been third-party laboratory tested and verified by NJCAT or TRCA. Other model sizes of the tested device shall be scaled such that the claimed TSS removal efficiency of the scaled device shall be no greater than the TSS removal efficiency of the tested device at identical **surface loading rate** (flow rate divided by settling surface area). Alternative scaling methodologies shall not be accepted without providing a minimum of three (3) full-scale third-party laboratory performance and scour testing of differing HDS model sizes. The Peclet Number is not an approved method for scaling GDS devices.

4. <u>EXECUTION</u>

4.1. Concrete installation: The installation of the concrete HDS device should conform to state highway, provincial, or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized below.

4.2. Excavation

4.2.1. Excavation for the installation of the stormwater quality treatment device should conform to state highway, municipal or local specifications. Topsoil that is removed during the excavation for the stormwater quality treatment device should be stockpiled in designated areas and should not be mixed with subsoil or other materials. Topsoil stockpiles and the general site preparation for the installation of the water quality device should conform to state highway, provincial or local specifications.

4.2.2. The HDS device should not be installed on frozen ground. Excavation should extend a minimum of 12 inch (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

4.2.3. In areas with a high water table, continuous dewatering should be provided to ensure that the excavation is stable and free of water.

4.3. Backfilling: Backfill material should conform to state highway, municipal or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300 mm) in depth and compacted to state highway, provincial or local specifications.

4.4. Water quality device construction sequence

4.4.1. The concrete water quality device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber section(s); shall include the internals bolted/secured to the precast walls and water tight sealed prior to arrival to the project site to ensure quality control
- transition slab (if required)
- bypass section
- connect inlet and outlet pipes
- riser section and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.4.2. The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer’s recommendations.

4.4.3. Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the stormwater quality treatment (HDS) device has been constructed, any lift holes must be plugged with mortar.

4.5. Drop pipe, riser pipe, and oil port: Once the upper chamber has been attached to the lower chamber, the inlet drop tee, and riser pipe must be attached. If an oil port is included, this must be attached as well. Pipe installation instructions and required materials shall be provided with the insert.

4.6. Inlet and outlet pipes: Inlet and outlet pipes should be securely set into the upper chamber using grout or approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight. Non-secure inlets and outlets will result in improper performance.

4.7. Frame and cover or frame and grate installation: Precast concrete adjustment units should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

5. INSPECTION & MAINTENENACE

The HDS manufacturer shall provide an Owner's Manual upon request.

5.1. A Quality Assurance Plan that covers inspection and maintenance for up to 5 years shall be included with the HDS, and written into the COA.

5.2. Inspection of the HDS device, which includes determination of sediment depth and presence of petroleum hydrocarbons, shall be easily conducted from finished grade.

5.3. Sediment removal from the HDS shall be conducted using a standard maintenance truck and vacuum apparatus.

5.2. No confined space for sediment removal or inspection of screens or other internal components shall be required for normal annual inspection or maintenance activity.

END OF SECTION

CVT

Chosen Valley Testing

Design Phase Geotechnical Report:

Proposed Farnam Flats Apartment Building
NE of the Intersection of Farnam St. and 7th St. S
La Crosse, Wisconsin

Prepared for:

Jeremy Kane
Schoeppner General Conctractor
1770 75th Street NE
Rochester, MN 55906

April 16, 2019
14679.19.WIL

WISCONSIN FREDERICK E. SCHUSTER E-46610 La CROSSE WI PROFESSIONAL ENGINEER	I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly registered engineer under the laws of the State of Wisconsin. Frederick E. Schuster, PE Geotechnical Engineer Registration Number 46610 Date: April 16, 2019

Chosen Valley Testing, Inc.

Geotechnical Engineering and Testing • 1019 2nd Ave. SW • Onalaska, WI 54650 • Telephone (608) 782-5505• Fax (608) 785-2818

Mr. Jeremy Kane
Schoeppner General Contractor
1770 75th Street NE
Rochester, MN 55906
jkane@schoeppnerinc.com

April 16, 2019

Re: Design Phase Geotechnical Evaluation Services
Proposed Farnam Flats Apartment Building
NE of the Intersection of Farnam St. and 7th St. S
La Crosse, Wisconsin
CVT Number: 14679.19.WIL

Dear Mr. Kane:

As authorized, we have completed the geotechnical evaluation for the proposed Farnam Flats apartment building in La Crosse, Wisconsin. This letter briefly summarizes the findings in the attached report.

Summary of Boring Results

At the surface, the borings encountered about 4 to 7½ feet of silty sand fill though occasionally first encountering about 1-foot of shallow topsoil or clayey sand fill.

Beneath the surface materials, the borings were dominated by clean alluvial sands. All of the borings terminated in these materials.

Water was not observed during drilling in any of the borings. We would expect groundwater levels to fluctuate similarly to nearby creeks and rivers, along with local weather patterns.

Summary of Analysis and Recommendations

Based on the data, the site conditions consist of fill materials in the upper depths of the site and clean natural sands at depth. We recommend removing fill materials from below the structure, along with all existing foundations and other unsuitable materials, and replacing these materials with engineered fill. Based on the data and the assumed elevations for the foundations and slabs, it appears that the basement level will bear below all of the unsuitable materials.

Footings are expected to bear on natural sands below the fill. As mentioned earlier, the natural sands were loose to medium dense, but generally loose. We recommend surface compacting the bearing soils with a large turtle type compactor.

Based on the assumed loads and implementation of the earthwork recommendations, we are of the opinion that foundations may be designed to exert pressures of up to 4,000 psf. Based on a bearing pressure of up to 4,000 psf, total post-construction settlements are expected to be on the order of 1 inch or less. Differential settlement between similarly loaded footings is expected to be on the order of ½ inch or less.

<u>Remarks</u>

We appreciate the opportunity to serve you. The attached report provides more details of our analysis. If you have any questions about our report, please feel free to contact us at (608) 782-5505.

Sincerely,
Chosen Valley Testing, Inc.

Frederick Schuster, PE
Geotechnical Engineer

Colby T. Verdegan, PE
Sr. Geotechnical/Materials Engineer

TABLE OF CONTENTS

Design Phase Geotechnical Report
Proposed Farnam Flats Apartment Building
NE of the Intersection of Farnam St. and 7th St. S
La Crosse, Wisconsin

CVT Project Number: 14679.19.WIL
Date: April 16, 2019

A. Introduction

The intent of this report is to present our findings to the client in the same logical sequence that led us to arrive at the opinions and recommendations expressed. Since our services often must be completed before the design is finished, assumptions are often needed to prepare a proper scope and to analyze the data. A complete and thorough review of the entire document, including its assumptions and its appendices, should be undertaken immediately upon receipt.

A.1. Purpose

This geotechnical report was prepared to aid in the design and construction of the proposed Farnam Flats apartment building in La Crosse, Wisconsin. Our services were authorized by Mr. Jeremy Kane, of Schoeppner General Contractor (Schoeppner).

A.2. Scope

To obtain data for analysis, a total of six borings were drilled on site. The borings were drilled to a depth of about 30 feet. Our engineering scope consisted of providing geotechnical recommendations for the proposed building and pavement design.

A.3. Boring Locations and Elevations

The boring locations were selected by CVT and selected based upon a site plan provided by Schoeppner. The sketch in the Appendix of this report shows the approximate boring locations as drilled.

Ground surface elevations at the borings were estimated using a laser level. The top nut of the fire hydrant northeast of the intersection of Farnam Street and 7th Street South was used as a reference and was assigned an elevation of 100.0 feet.

A.4. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Geologic maps indicate that the dominant soils in the area are mainly glacial outwash or alluvial deposits of sands and gravels. Bedrock is commonly found around 150 to 200 feet below the surface and likely consists of Cambrian system sandstone with some dolomite and shale from the Elk Mound group.

B. Subsurface Data

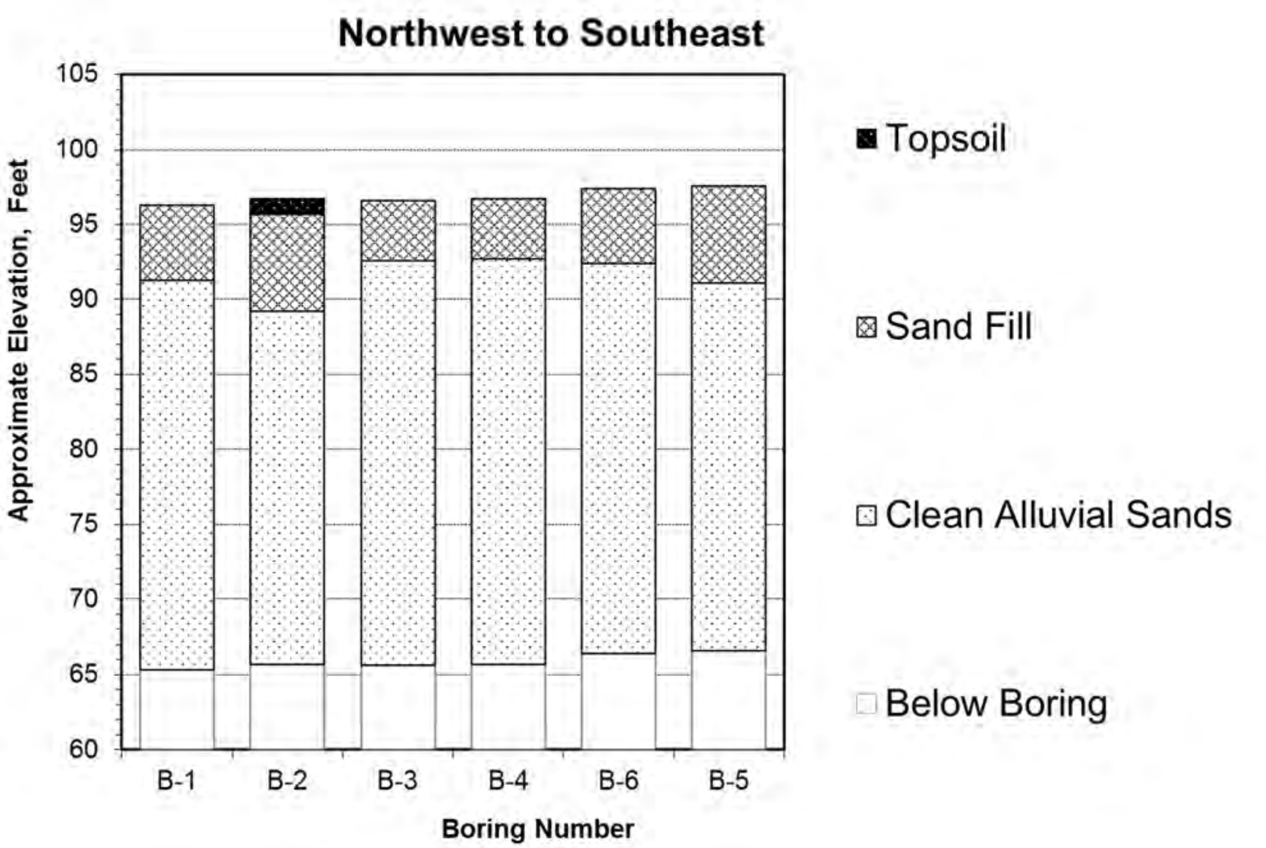
Procedures: The borings were performed using penetration test procedures (Method of Test D1586 of the American Society for Testing and Materials). This procedure allows for the extraction of intact soil specimen from deep in the ground. With this method, a hollow-stem auger is drilled to the desired sampling depth. A 2-inch OD sampling tube is then screwed onto the end of a sampling rod, inserted through the hole in the auger's tip, and then driven into the soil with a 140-pound hammer dropped repeatedly from a height of 30 inches above the sampling rod. The sampler is driven 18 inches into the soil, unless the material is too hard. The samples are generally taken at 2½ to 5-foot intervals. The core of soil obtained was classified and logged by the driller on site and a representative portion was then sealed and delivered to the geotechnical engineer for further review.

B.1. Stratification

At the surface, the borings encountered about 4 to 7½ feet of silty sand fill though occasionally first encountering about 1-foot of shallow topsoil or clayey sand fill.

Beneath the surface materials, the borings were dominated by clean alluvial sands. All of the borings terminated in these materials.

For the reader's convenience, we have summarized the soil boring data on the cross-section which follows. The reader is referred to the log sheets in the Appendix for more detailed information.



B.2. Penetration Test and Laboratory Test Results

The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, compaction tests are more meaningful.

A penetration resistance value ("N" Value) of 0 to 3 blows per foot (BPF) was recorded in the fill sands, indicating they were very loose. The clean sands encountered on site returned penetration resistance values ranging from 4 to 16 blows per foot, indicating the sands were loose to medium dense.

A key to descriptors used to qualify the relative density of soil (such as *soft, stiff, loose*, and *dense*) can be found on the Legend to Soil Description in the Appendix.

B.3. Groundwater Data

During drilling, the drillers may note the presence of moisture on the sampler, in the cuttings, or in the borehole itself. These findings are reported on the boring logs. Because water levels vary with weather, time of year, and other factors, the presence or lack of water during exploration is subject to interpretation and is not always conclusive.

Water was not observed during drilling in any of the borings. We would expect groundwater levels to fluctuate similarly to nearby creeks and rivers, along with local weather patterns.

C. Design Data

Because each structure has a different loading configuration and intensity, different grades, and different structural or performance tolerances, the results of a geotechnical exploration will mean different things for different facilities. If the facility changes, Chosen Valley Testing should be contacted to discuss possible implications of the changes. Without a chance to review such changes, the recommendations of the soils engineer may no longer be valid or appropriate.

The project consists of the construction of a 3 to 4-story apartment building with underground parking and possibly a 1st floor commercial space. We assume the structure will have concrete or masonry basement level walls, with a precast main floor and wood-framed superstructure. We have assumed that maximum foundation loads may be on be on the order of 250 to 350 kips per column and 4 to 8 kips per lineal foot for strip footings.

Final grades are expected to be close to or slightly above existing grades with the 1st floor level near elevation 98 feet on the datum used. The slab for underground parking is assumed to be about 12 feet below present grade. Bottom of footing elevation was assumed to be near elevation 86 feet on the datum for this report.

Design traffic volumes were not provided. It is assumed that the parking areas will experience primarily standard vehicle traffic with occasional heavy truck traffic.

D. Analysis

Based on the data, the site conditions consist of fill materials in the upper depths of the site and clean natural sands at depth. We recommend removing fill materials from below the structure, along with all existing foundations and other unsuitable materials, and replacing these materials with engineered fill. Based on the data and the assumed elevations for the foundations and slabs, it appears that the basement level will bear below all of the unsuitable materials.

Footings are expected to bear on natural sands below the fill. As mentioned earlier, the natural sands were loose to medium dense, but generally loose. We recommend surface compacting the bearing soils with a large turtle type compactor.

Based on the assumed loads and implementation of the earthwork recommendations, we are of the opinion that foundations may be designed to exert pressures of up to 4,000 psf. Based on a bearing pressure of up to 4,000 psf, total post-construction settlements are expected to be on the order of 1 inch or less. Differential settlement between similarly loaded footings is expected to be on the order of ½ inch or less.

The remainder of the report provides more details of our recommendations.

E. Recommendations-Excavation/Backfill

E.1. Grading Recommendations

E.1.a. Stripping and Excavation: We recommend removing all topsoil, fill, paving materials, foundations and any other unsuitable soils encountered from below the entire building area. All fill materials should be removed from below footings. The tabulation below shows the anticipated depth of excavation depth at the boring locations.

Boring	Approx. Surface Elevation on the Datum Used (feet)	Approx. Depth of Unsuitable Soils (feet)	Approx. Bottom Elevation on the Datum Used of Unsuitable Soils (feet)	Assumed Approx. Bottom Footing Elevation on the Datum Used (feet)
B-1	96 1/2	5	91 1/2	86
B-2	96 1/2	7 1/2	89	86
B-3	96 1/2	4	92 1/2	86
B-4	96 1/2	4	92 1/2	86
B-5	97 1/2	5	92 1/2	86
B-6	97 1/2	6 1/2	91	86

E.1.b. Subgrade Evaluation: The bearing soils in the excavations should be evaluated by CVT personnel before placing fill or foundations. Any unsuitable materials observed should be removed and replaced with engineered granular fill.

E.1.c. Oversizing: Any stripping or corrective excavations should be oversized at least 1 foot beyond the foundations for each foot of fill needed below footing grade. This oversizing can be reduced by up to 50%

if rather precise staking is present during grading.

E.1.d. Filling, Compaction, and Surface Compaction: Fill placed on site should be placed in lifts adjusted to the compactor being used and the material being compacted. We recommend limiting lifts to no more than 1 foot. This assumes large, self-propelled or tow-behind compactors are used. All materials below the building, in the oversized areas, or used as backfill for walls should be compacted to a minimum of 95% of its maximum standard Proctor density (ASTM D 698).

If imported fill is needed, for ease in construction, we recommend using clean sands or gravels having less than 12% particles passing a #200 sieve. The natural sands at the site are considered to be generally suitable for use as fill. Some of the fill materials appear to be suitably clean, but should be reviewed before use.

Footings are expected to bear on natural sands below the fill. As mentioned earlier, the natural sands were loose to medium dense, but generally loose. We recommend surface compacting the bearing soils with a large turtle type compactor before placing fill or foundations.

E.2. Building Design

E.2.a. Foundation Depth: We recommend placing foundations at least 48 inches below the exposed ground surface for frost protection. Interior foundations in heated areas may be placed directly below slabs. Footings for unheated structures should be placed at least 60 inches below the exposed ground surface.

E.2.b. Bearing Capacity: Based on the assumed loads and implementation of the earthwork recommendations, we are of the opinion that foundations may be designed to exert pressures of up to 4,000 psf. This allowable bearing pressure includes a safety factor of at least 3 against shear failure.

E.2.c. Seismic Design: According to the International Building Code (IBC 2012), the seismic acceleration parameters for the site are Ss of 0.05 and S1 of 0.04. The seismic soil classification of the area is considered to be a Site Class D according to Table 1613.5.2 of IBC (2006).

E.2.d. Settlement: Based on a bearing pressure of 4,000 psf, total post-construction settlements are expected to be on the order of 1 inch or less. Differential settlement between similarly loaded footings is expected to be on the order of ½ inch or less.

E.2.e. Vapor Barrier: If the slab will receive coverings that are less permeable than concrete, a vapor barrier should be placed below the slab. Some contractors prefer to place this barrier below the sand, to limit the potential for curling.

E.2.f. Slab Design: The completed slab subgrade is expected to consist of primarily engineered granular fill overlying natural clean sands. We recommend using a modulus of subgrade reaction of no more than 250 pounds per cubic inch for these conditions.

We recommend placing a layer of clean sand, having less than 5% particles passing the number 200 sieve, as fill in the upper 4 to 6 inches of the subgrade (just below slabs).

E.2.g. Lateral Earth Pressures: We recommend using clean, free-draining sands or gravels having less than 12% fines as fill against the retaining wall or other below-grade walls. This fill should be compacted to at least 95% of its maximum standard Proctor density (ASTM D 698). The top of the sand should be capped with clayey topsoil or pavement. A draintile is normally included at the base of the wall backfill to prevent moisture from collecting behind the wall. Because sands dominate at depth and groundwater was not observed, such a draintile would not likely receive water on this site.

The table following this paragraph provides recommended support values for the recommended clean sands. These values do not include a safety factor.

Poorly Graded Sands (SP) 95% standard Proctor density	
Internal Friction Angle (degrees)	34
Cohesion (psf)	0
Coefficient of Friction between Concrete and Soil	0.50
Moist Unit Weight (pcf)	120
At-Rest Coefficient (Ko)	0.44
Active Coefficient (Ka)	0.28
Passive Coefficient (Kp)	3.54

The actual loads exerted on the structure will depend on the movement or flexure of the structure. For sand fill, horizontal movement or flexure of about 0.2% of the height of soil retained may be sufficient to mobilize frictional forces from the at-rest state to the active state.

F. Pavement Recommendations

F.1. Grading Recommendations

We recommend stripping any highly organic topsoil, vegetation and root-zone from below the newly paved areas. The near surface soil encountered consisted primarily of silty sand and cleaner sands. Sands and silty sands excavated from the basement excavation can likely be used where new fill is needed below pavements, but should be reviewed and blended to provide more uniform subgrade support. The stripped surface receiving the fill should be similarly scarified and compacted to further encourage uniformity.

All fill should be compacted to at least 95% of its maximum standard Proctor density. Compaction to 90% is usually sufficient in green areas. The completed pavement subgrade should be able to pass a test roll. Areas not passing the test roll should be reworked and stabilized as needed to pass the test roll.

F.2. Pavement Design

We recommend designing pavements using support values with the following estimated characteristics:

Soil Type	AASHTO Classification	Frost Index	Design Group Index	K-Value	Soil Support Factor	Est. California Bearing Ratio
Silty Sand	A-2-4/A-4	F-3	10	200	4.5	5 – 15
Poorly-Graded Sand	A-3	F-2	6	250	5.0	10 – 20

Again, the proposed parking areas are assumed to experience primarily auto traffic and occasional commercial truck traffic. We recommend a minimum pavement section consisting of at least 3 inches of asphalt over 6 inches of aggregate base in auto traffic areas. In more frequent heavy truck traffic areas, we recommend increasing the pavement sections to at least 4 inches of asphalt over 8 inches of aggregate base.

These sections should be considered preliminary, subject to review by the project civil engineering consultant, and subject to their experience with pavement design and performance in the area of the project.

G. General Grading Recommendations

G.1. Excavation

Stripping can likely be performed with a variety of equipment, provided the soils are not too dry. The deep excavations will require the use of a backhoe. A backhoe with a smooth lipped bucket is recommended to limit disturbance of the natural bearing soils.

G.2. Sideslopes

The contractor will be required to slope or shore the excavations as needed to meet OSHA requirements for safety and to limit disturbance to surrounding structures. The existing fill and natural soils and imported sand fill are expected to be Type C soils as defined by OSHA.

G.3. Cold Weather

If the excavation occurs during freezing temperatures, good winter construction practices should be used. Frozen fill should be thawed before placing and filling should not be placed on frozen ground. Slab areas should be completely thawed prior to placing concrete.

G.4. Construction Testing and Documentation

The bottom of the excavations should be evaluated and documented by qualified geotechnical personnel to assess the soils at bearing depth. Any fill placed below building areas should be evaluated for conformance to the project gradation recommendations and should be tested for compaction. If filling proceeds during periods of freezing weather, full-time testing should be considered to help confirm that imported fill is thawed prior to and during compaction, and that all snow has been removed before placement of the fill.

Pockets of deep fill, debris or foundations are often encountered at unexpected locations when working near the downtown area. Geotechnical evaluations and documentation are strongly recommended during grading to help identify conditions, document over-sizing and evaluate options, if necessary.

Although our firm offers testing services relating to civil and structural components of the structure (such as concrete testing, reinforcement observations, etc.), specification of such services are beyond our work scope and the designer should be consulted as to such requirements.

H. Level of Care

The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.

Appendix

Boring Location Sketch

Log of Boring # 1-6

Legend to Soil Description

CVT

Chosen Valley Testing, Inc.

Legend

⊙ Boring Location

▲ Bench Mark

Boring Location Sketch

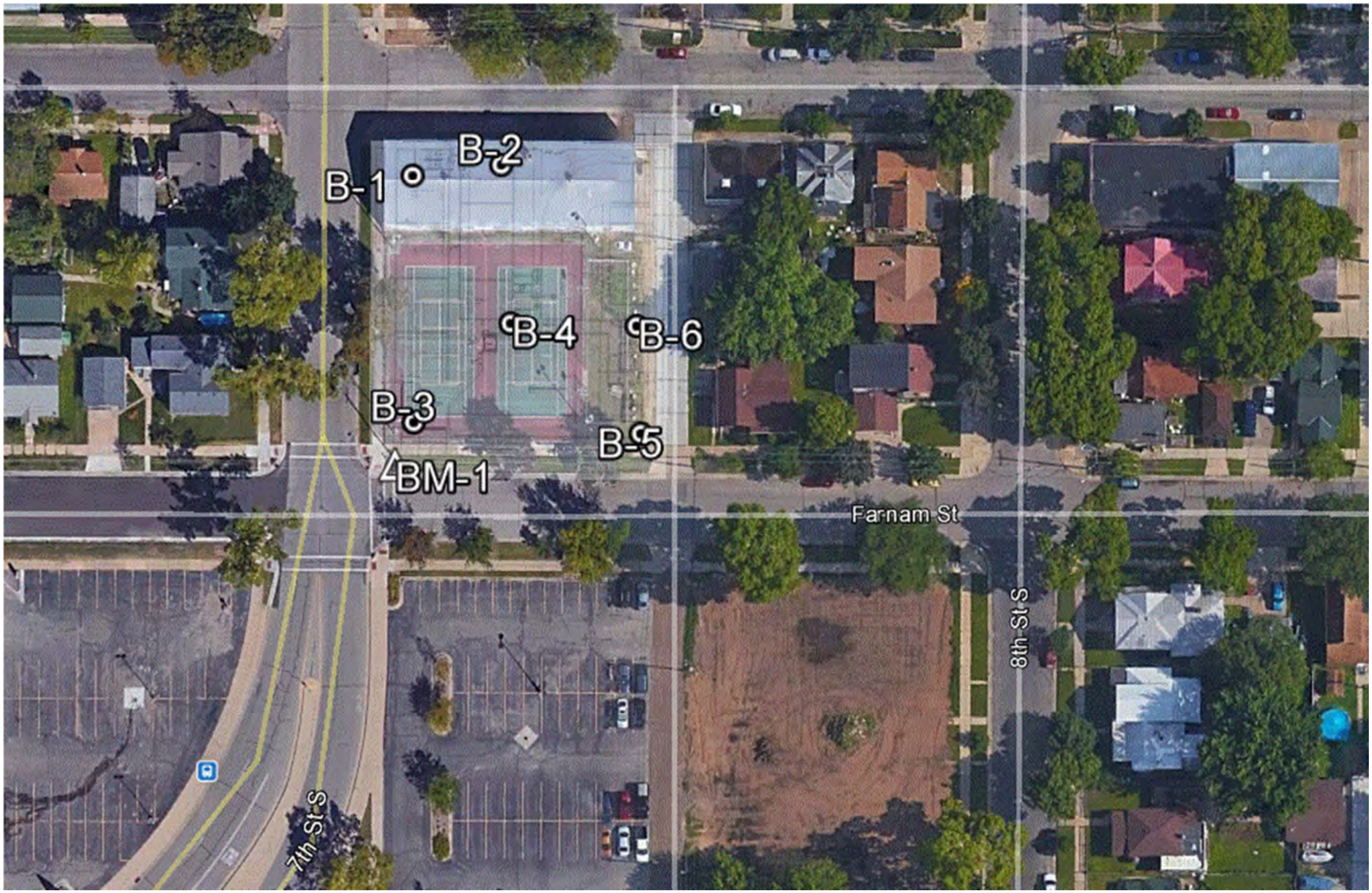
Proposed Farnam Flats Apartment Building

NE of the Intersection of Farnam St. and 7th St. S

La Crosse, Wisconsin

14679.19.WIL

N



LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 14679.19.WIL Design Phase Geotechnical Evaluation Proposed Farnman Flats Apartment Building NE of the intersection of Farnam St and 7th St S La Crosse, Wisconsin	BORING: **B-1** LOCATION: See attached sketch DATE: 4/4/2019 SCALE: 1" = 4'

Elev. 96.3	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
91.3	5.0	SM	**SILTY SAND** trace gravel, fine grained, dark brown, moist, very loose. (Fill) Pockets of lean clay around 2.5'	0		Benchmark: Top nut of the fire hydrant northeast of the intersection of Farnam Street and 7th Street South, assigned elevation 100 feet.
65.3	31.0	SP	**POORLY GRADED SAND** fine grained, brown, moist, loose. (Alluvium) Fine to medium grained below 6.5' Light brown below 6.5' Trace gravel around 7.5'	4 6 8 8 8 8 8 7		
			End of boring Boring sealed upon completion			

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 14679.19.WIL Design Phase Geotechnical Evaluation Proposed Farnman Flats Apartment Building NE of the intersection of Farnam St and 7th St S La Crosse, Wisconsin	BORING: **B-2** LOCATION: See attached sketch DATE: 4/4/2019 SCALE: 1" = 4'

Elev. 96.7	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
95.7	1.0	SM	**Slightly Organic SILTY SAND** fine grained, brown, moist. (Topsoil / Fill)			
		SM	**SILTY SAND** trace gravel, fine grained, dark brown, moist, very loose. (Fill)	2		
				0		
89.2	7.5		Trace concrete around 7'	6		
		SP	**POORLY GRADED SAND** fine to medium grained, light brown, moist, loose to medium dense. (Alluvium)			
				9		
				6		
				8		
			Trace gravel below 17.5'			
				10		
				10		
			Fine grained below 27.5' No gravel below 27.5'			
65.7	31.0			7		
			End of boring Boring sealed upon completion			

CVT STANDARD 14679.19.WIL (FARNAM FLATS APARTMENT BUILDING).GPJ LOG A GNNN06.GDT 4/10/19

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 14679.19.WIL Design Phase Geotechnical Evaluation Proposed Farnman Flats Apartment Building NE of the intersection of Farnam St and 7th St S La Crosse, Wisconsin	BORING: **B-3** LOCATION: See attached sketch DATE: 4/4/2019 SCALE: 1" = 4'

Elev. 96.6	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
94.6	2.0	SM	**SILTY SAND** trace gravel, fine grained, dark brown, moist. (Fill)			
92.6	4.0	SP SM	**POORLY GRADED SAND with SILT** trace gravel, fine grained, brown, moist, very loose. (Fill)	3		
65.6	31.0	SP	**POORLY GRADED SAND** fine grained, brown, moist, loose to medium dense. (Alluvium) Fine to medium grained below 6.5' Light brown below 6.5' Trace gravel around 7.5' Trace gravel around 20' Trace gravel around 30'	7 9 9 10 6 8 8 10		
			End of boring Boring sealed upon completion			

CVT STANDARD 14679.19.WIL (FARNAM FLATS APARTMENT BUILDING).GPJ LOG A GNNN06.GDT 4/10/19

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 14679.19.WIL Design Phase Geotechnical Evaluation Proposed Farnman Flats Apartment Building NE of the intersection of Farnam St and 7th St S La Crosse, Wisconsin	BORING: **B-4** LOCATION: See attached sketch
	DATE: 4/4/2019 — SCALE: 1" = 4'

Elev. 96.7	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
95.5	1.2	SM	**SILTY SAND** trace gravel, fine grained, dark brown, moist. (Fill)			
92.7	4.0	SP SM	**POORLY GRADED SAND with SILT** fine grained, brown, moist, very loose. (Fill)	2		
65.7	31.0	SP	**POORLY GRADED SAND** trace gravel, fine to medium grained, light brown, moist, loose. (Alluvium)	7		
				8		
			No gravel below 9'	8		
				8		
				8		
			Trace gravel around 20'	6		
				8		
				9		
			End of boring Boring sealed upon completion			

CVT STANDARD 14679.19.WIL (FARNAM FLATS APARTMENT BUILDING).GPJ LOG A GNNN06.GDT 4/10/19

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 14679.19.WIL Design Phase Geotechnical Evaluation Proposed Farnman Flats Apartment Building NE of the intersection of Farnam St and 7th St S La Crosse, Wisconsin	BORING: **B-5** LOCATION: See attached sketch DATE: 4/4/2019 SCALE: 1" = 4'

Elev. 97.6	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
		SM	**SILTY SAND** trace gravel, fine grained, dark brown, moist, very loose. (Fill)	2		
				2		
91.1	6.5	SP	**POORLY GRADED SAND** fine to medium grained, brown, moist, very loose to medium dense. (Alluvium)	10		
			Light brown below 9'	7		
			Trace gravel around 12.5'	7		
				6		
				3		
			Trace gravel below 22.5'	6		
66.6	31.0			10		
			End of boring Boring sealed upon completion			

CVT STANDARD 14679.19.WIL (FARNAM FLATS APARTMENT BUILDING).GPJ LOG A GNNN06.GDT 4/10/19

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 14679.19.WIL Design Phase Geotechnical Evaluation Proposed Farnman Flats Apartment Building NE of the intersection of Farnam St and 7th St S La Crosse, Wisconsin	BORING: **B-6** LOCATION: See attached sketch DATE: 4/4/2019 SCALE: 1" = 4'

Elev. 97.4	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
96.2	1.2	SC	**CLAYEY SAND** fine to medium grained, black, moist. (Fill)			
92.4	5.0	SM	**SILTY SAND** pockets of poorly graded sand, fine grained, dark brown, moist, very loose. (Fill)	1		
		SP	**POORLY GRADED SAND** fine to medium grained, light brown, moist, very loose to medium dense. (Alluvium) Trace gravel around 7.5'	1		
				7		
				6		
				8		
				6		
				14		
				16		
66.4	31.0		Trace gravel around 30'	8		
			End of boring Boring sealed upon completion			

CVT STANDARD 14679.19.WIL (FARNAM FLATS APARTMENT BUILDING).GPJ LOG A GNNN06.GDT 4/10/19

UNIFIED SOIL CLASSIFICATION (ASTM D-2487/2488)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	Cu>4 AND 1<Cc<3	GW	WELL-GRADED GRAVEL
			Cu>4 AND 1>Cc>3	GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	Cu>6 AND 1<Cc<3	SW	WELL-GRADED SAND
			Cu>6 AND 1>Cc>3	SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY
			PI>4 AND PLOTS<"A" LINE	ML	SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY
			PI PLOTS <"A" LINE	MH	ELASTIC SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT

Relative Proportions of Sand and Gravel

TERM	PERCENT
Trace	< 15
With	15 - 29
Modifier	> 30

Relative Proportions of Fines

TERM	PERCENT
Trace	< 5
With	5 - 12
Modifier	> 12

Grain Size Terminology

TERM	SIZE
Boulder	< 12 in.
Cobble	3 in. - 12 in.
Gravel	#4 sieve to 3 in.
Sand	#200 sieve to #4 sieve
Silt or Clay	Passing #200 sieve

SAMPLE TYPES

Hollow Stem

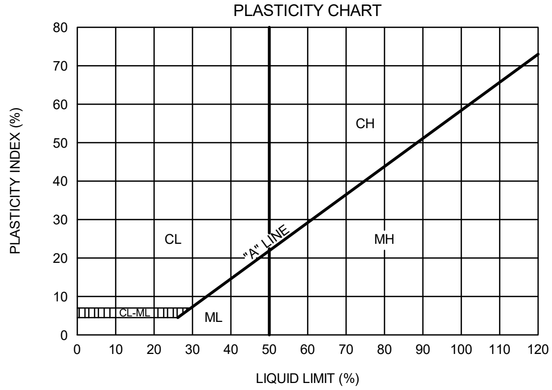
Standard Penetration Test

TEST SYMBOLS

MC	-	MOISTURE CONTENT
OC	-	ORGANIC CONTENT
CN	-	CONSOLIDATION
DD	-	DRY DENSITY
PP	-	POCKET PENETROMETER
RV	-	R-VALUE
SA	-	SIEVE ANALYSIS
P200	-	% PASSING #200 SIEVE
LL	-	LIQUID LIMIT
PI	-	PLASTISTITY INDEX
SW	-	SWELL TEST
UU		Unconsolidated Undrained triaxial

- WATER LEVEL (WITH TIME OF) MEASUREMENT

PLASTICITY CHART



PENETRATION RESISTANCE
(RECORDED AS BLOWS / 0.5 FT)

SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 1	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 3	0.25 - 0.50
MEDIUM DENSE	10 - 30	RATHER SOFT	4 - 5	0.50 - 1.0
DENSE	30 - 50	MEDIUM	6 - 8	
VERY DENSE	OVER 50	RATHER STIFF	9 - 12	1.0 - 2.0
		STIFF	13 - 16	
		VERY STIFF	17 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).