STORMWATER MANAGEMENT PLAN

PLAN COMMISSION DRAFT

The Neutral Project – Vanilla 301
519 & 521 W Main St.
Madison, WI 53015

PREPARED FOR:
The Neutral Project

DATE
MARCH 29, 2024

JT PROJECT 230116

JT Engineering, Inc.
281 W. Netherwood Rd, Suite 1
Oregon, WI 53575
608.204.0909

1.0 INTRODUCTION

JT Engineering was contracted by The Neutral Project to complete civil and site design services for the construction of a four-story apartment building. The project site is located on Lots 6 and the southwest half of Lot 7, Block 31 of the Plat of Madison (Plat Map 122600), City of Madison, Dane County, Wisconsin. As part of this development, the two current Tax ID parcels have been combined by Certified Survey Map (CSM) no. *[(TBD), V. ## P. ##, Document Number #######]*[1], Dane County Register of Deeds, hereinafter referred to as "the property". The property contains 13,209 square feet (0.303 acres).

The property is currently developed with two existing timber apartment buildings and a gravel drive/parking area. The proposed development would include the demolition of these buildings and the construction of a new four-storied apartment building with underground parking. The properties are currently zoned as DR2 Downtown Residential 2 and would remain zoned as such to accommodate the development. As part of the proposed site elements, storm sewer structures will convey stormwater to a new catch basin on the south side of West Main Street to handle stormwater requirements as outlined in Section 3 of this report. For additional information on the proposed site design, see Appendix A – Construction Plans.

Figure 1. Project Location Map

[1] This will be updated upon acceptance and recording of the associated CSM

2.0 EXISTING CONDITIONS

The property is zoned as DR2 Downtown Residential 2. Existing impervious surfaces cover approximately 0.241 acres of the site (79.59%). The development of the property is considered "Redevelopment" by The City of Madison Chapter 37, which defines redevelopment as any of the following activities:

(a) *Construction, alteration or improvement exceeding ten thousand (10,000) square feet of land disturbance performed on sites where the existing site is predominantly developed as commercial, industrial, institutional or multifamily residential uses and the proposed development is replacing older development.*

(b) *Construction, alteration or improvement exceeding ten thousand (10,000) square feet of land disturbance performed on sites where the existing site is predominantly developed as commercial, industrial, institutional or multifamily residential uses and the creation or expansion of impervious surface physically cannot exceed twenty thousand (20,000) square feet beginning August 22, 2001.*

(c) *Any combination of (a) and (b) above. Should the site have twenty thousand (20,000) square feet or more of land available for the creation or expansion of impervious surface since August 22, 2001 then the project may include a mix of new development and redevelopment.*

(d) *Resurfacing of a parking lot is not considered redevelopment for the purpose of this ordinance, nor is pulverizing and overlay of bituminous pavement. However, if base course (granular material below pavement) is disturbed, the resurfacing shall be considered redevelopment.*

The property is located within the Lake Monona-Yahara River watershed (Watershed Number 0709000207). Based on the WDNR's Surface Water Data Viewer, there are no surface water features within a 300-foot radius of the property. Existing stormwater patterns of the property generally go from northeast to southwest, with gradual grades of 2-6 percent. All water from the property currently overland flows to West Main Street, eventually being collected by the public storm system and discharging into Lake Monona.

The property falls on FEMA flood panel map no. 55025C0409G. Per FEMAs flood mapping, the property is classified Zone X – areas determined to be outside the 0.2% annual chance floodplain (See Appendix B – FEMA FIRM Panels).

General subsurface soil conditions on the property are silt loam with slopes ranging from 2-6 percent. The United States Department of Agriculture (USDA) Web Soil Survey (WSS) indicates that underlying soils on the property consist of the following:

Table 1. USGS Web Soil Survey: Site Area Soil Classifications

Map Unit Symbol	Map Unit Name	Percent of Site Area	Hydrologic Soil Group
BbB	Batavia silt loam, gravelly substratum, 2 to 6 percent slopes	100%	B

Soil borings conducted for this development showed a layer of lean clay across the site underlain by native sand, underlain by native silt. For additional soil information, See Appendix C – USGS Web Soil Survey Report and Appendix D – Geotechnical Report.

3.0 DESIGN CRITERIA

Stormwater management for this site must meet the requirements outlined in the Codes and Ordinances listed below. If the codes overlap or contradict each other, the design must meet the most stringent requirement of each:

Technical Standards and Ordinances

- Wisconsin Administrative Code – Chapter NR 151
- Wisconsin Administrative Code – Chapter NR 216
- City of Madison Municipal Code – Chapter 37

The proposed development exceeds criteria (b) for redevelopment outlined in the City of Madison Municipal Code – Chapter 37 (see section 2, this report), requiring the site to meet stormwater performance standards outlined in Chapter 37.09 (3) (c) (3).

Chapter 37.09 (3)(c)3. lists the following requirements for this redevelopment project:

(a) Reduce peak runoff rates from the site by 15% compared to existing conditions during a 10-year design storm.

(b) Reduce runoff volumes from the site by 5% compared to existing conditions during a 10-year design storm.

(c) The required rate and volume reductions shall be completed, using green infrastructure that captures at least the first 1/2 inch of rainfall over the total site impervious area. If additional stormwater controls are necessary beyond the first 1/2 inch of rainfall, either green or non-green infrastructure may be used.

(d) The following guidance shall be used in interpreting these requirements:

- *I. An intensive green roof with a media depth of 12" or more shall have a runoff CN of 68.*
- *II. An extensive green roof with media depth of a minimum of 4" shall have a runoff CN of 76.*
- *III. Pervious pavement designed to comply with the Wisconsin WDNR's guidance for post-construction stormwater practices shall have a runoff CN of 74.*

(e) Regardless of how or what green infrastructure features are used to meet the above requirements (37.09(3)(c)3.a., b. and c.), they shall require the recording of a maintenance agreement for the features against the appropriate parcel.

This project is considered redevelopment and is less than 1 acre, so this project is exempt from the requirements of the Wisconsin Administrative Code – Chapter NR 151 and Chapter NR 216.

3.1 PEAK RUNOFF DISCHARGE STANDARDS

Per the requirements listed in Section 3.0, devices must reduce the peak runoff rate from the site by 15% and reduce the total runoff volume from the site by 5% compared to existing conditions during a 10-year storm event.

Stormwater peak flows will be analyzed events and rainfall depths listed in the City of Madison Municipal Code Section 37.04 (shown in Table 3 of this report). The runoff curve number will be weighted based on the existing and proposed land use areas. The time of concentration (tc) will be set at a minimum of 6-minutes.

Table 3. Design Storm Year Events and Rainfall Depths

Storm Year Event	Rainfall Depth (in)
10-Year MSE4 NRCS	4.09

3.2 GREEN INFRASTRUCTURE STANDARDS

- Per the City of Madison Municipal Code Section 37, the required volume and rate reductions required in Section 3.1 need to be completed using green infrastructure that captures at least the first 1/2 inch of rainfall over the total site impervious area.

3.3 RUNOFF QUALITY PERFORMANCE STANDARDS

- Per the City of Madison Municipal Code Section 37, this site is exempt from runoff quality performance standards.

3.4 INFILTRATION STANDARDS

- Per the City of Madison Municipal Code Section 37, this site is exempt from infiltration design standards.

3.5 OIL AND GREASE CONTROL

- Per the City of Madison Municipal Code Section 37, this site is exempt from oil and grease design standards.

4.0 STORMWATER MANAGEMENT ANALYSIS / DESIGN

Stormwater runoff will be handled by drain basins located around the site, along with permeable pavers and a green roof. The green roof is designed as a hybrid of intensive and extensive media, assuming a depth of 8 inches and a CN value of 72. A trench drain will catch the stormwater runoff from the ramp to the underground parking. This project proposes the installation of a new roadway inlet along the south side of West Main Street to convey the site's stormwater to the public storm system. See Sheet C200 in Appendix A for additional information on the storm sewer design.

4.1 STORMWATER QUANTITY – PEAK RUNOFF RATE & VOLUME

Stormwater peak flow runoff rate and volume conditions were analyzed using HydroCAD to ensure the requirements as discussed in Section 3.1 of this report were met. The values below were calculated using the MSE4 rainfall distribution and rainfall depths listed in Table 3. See Appendix E - HydroCAD Report for additional stormwater modeling information.

Peak Flow Rate (*Required reduction: 5%)*:

Existing:	1.36 cfs
Proposed:	1.19 cfs
Reduction:	**12.50%**

Peak Flow Volume (*Required reduction: 15%)*:

Existing:	3,165 cf
Proposed:	2,660 cf
Reduction:	**15.95%**

4.2 GREEN INFRASTRUCTURE

Permeable pavers, landscaping, and a semi-intensive green roof will capture stormwater on the site to meet the green infrastructure requirement.

5.0 EROSION CONTROL ANALYSIS / DESIGN

Erosion and sediment will be controlled during and following construction with the use of a rock construction entrance, silt fence, sediment logs, curb inlet sediment barriers and inlet protection. These measures will remain in place and shall be maintained until the site has been permanently stabilized. Within sixty (60) days after disturbed areas have been permanently stabilized, temporary erosion control devices shall be removed from the site and disposed of properly.

Proposed Erosion Control BMPs were logged into the USLE Soil Loss & Sediment Discharge Calculation Tool and resulted in no additional percent reduction required (see Appendix F – USLE Soil Loss Equation Spreadsheet [*Not included in this DRAFT*]).

5.1 SCHEDULE OF IMPLEMENTATION FOR SWMP

- All erosion control devices listed in Section 5.0 and shown on the plans shall be installed before any land-disturbing activities and shall be maintained until 30 days after final site stabilization.
- After all erosion control devices are installed, demolition and clearing/grubbing may begin.
- Following demolition and clearing/grubbing, initial site grading and stormwater BMP work can begin.
- Construction of remaining site improvement items including foundation work, aggregate base course installation, curb and gutter construction, pavement construction, etc. may begin.
- Before final site seeding/stabilization, the contractor shall scarify all pervious areas of the site (landscaped, grass, etc.) to a minimum of 6 inches
- After the site has been stabilized for more than 30 days and less than 60 days, temporary erosion control devices must be removed.

5.2 Estimated Cost for Completion

Item Description	Unit	Total	Unit Price	Item Total
Silt Fence	LF	365	$3.00	$1,095.00
Silt Fence Maintenance	LF	365	$0.17	$62.05
Inlet Protection	EA	6	$150.00	$900.00
Filter Bag Sediment Barrier	EA	44	$12.00	$528.00
Silt Sock	LF	85	$10.00	$850.00
Rock Construction Entrance	EA	1	$500.00	$500.00
				$3,935.05

6.0 CONCLUSION

Using a semi-intensive green roof and permeable pavers, the development achieves the goals of rate and volume reductions required by the City of Madison's Stormwater Ordinance. Any changes to this stormwater management plan or Erosion control measures must be submitted and approved through the project engineer and the City of Madison, Wisconsin.

7.0 MAINTENANCE

The Property Owner shall be directly responsible for the implementation and maintenance of all post-development BMPs installed. The following designed BMPs must be maintained:

1. Trench Drain
2. Drain Basins
3. Underdrain
4. Permeable Pavers

The maintenance requirements of all BMPs are outlined in Appendix G – Long-term Maintenance Agreement. *(Long Term Maintenance Agreement not included in this DRAFT).*

8.0 APPENDICES

Appendix A – Construction Plans
Appendix B – FEMA FIRM Panels
Appendix C – USGS Web Soil Survey Report
Appendix D – Geotechnical Report
Appendix E – HydroCAD Report
Appendix F – USLE Soil Loss Equation Spreadsheet *[Not included in this DRAFT]*
Appendix G – Long-term Maintenance Agreement *[Not included in this DRAFT]*

9.0 SOFTWARE/TOOLS USED

- HydroCAD Stormwater Modeling Software v.10.10-5a
- USDA Web Soil Survey Mapping
- AutoCAD Civil3D 2022

APPENDIX A
CONSTRUCTION PLANS
(BOUND SEPARATELY)

APPENDIX B
FEMA FLOOD MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 16. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was provided by Dane County Land Information Office and Fly Dane Partnership. The aerial photography was acquired in the spring of 2005 to create 1" 200' scale digital orthophotos with 1-foot ground resolution and resampled to a 1-meter ground resolution.

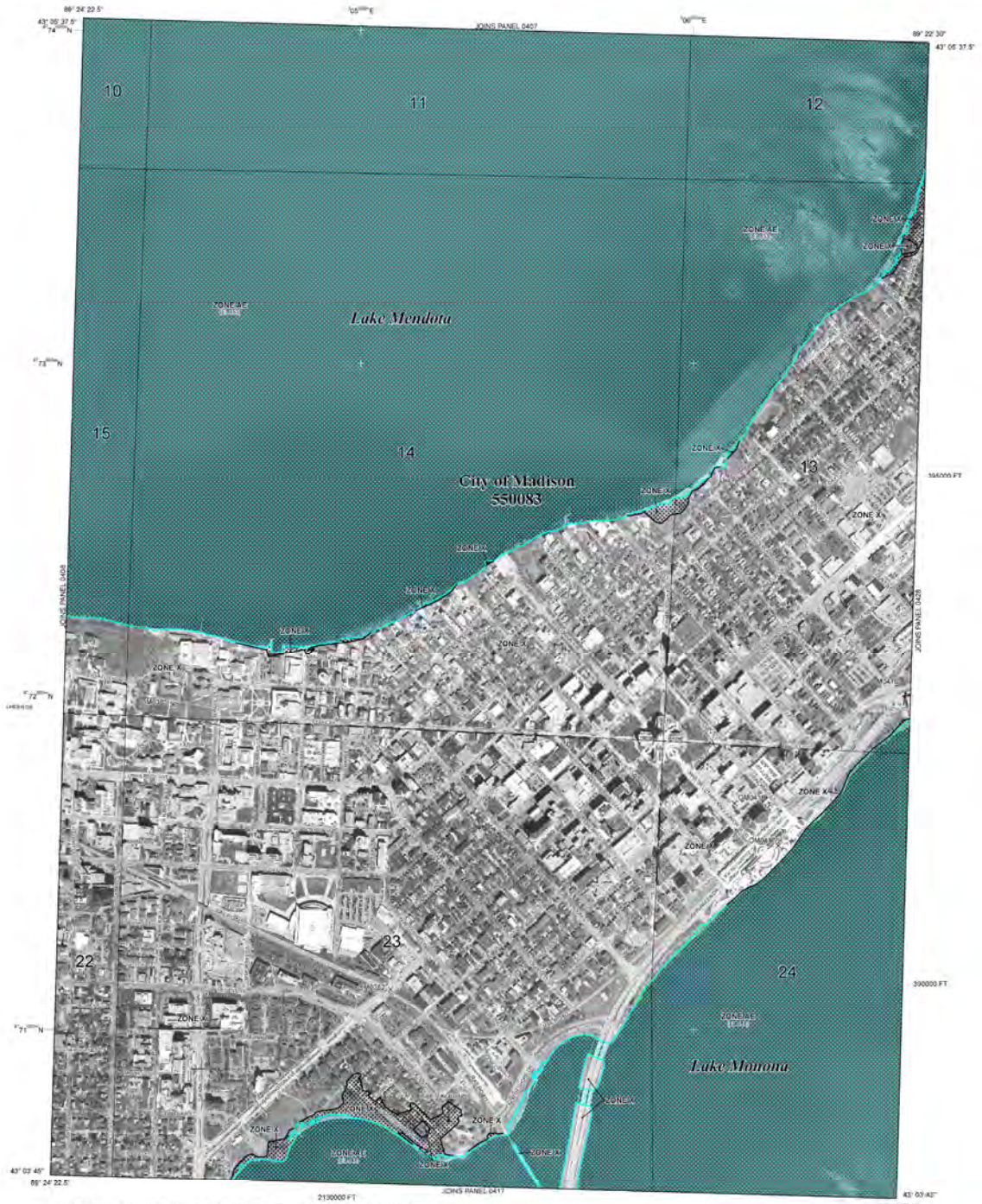
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 7 NORTH, RANGE 9 EAST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** No Base Flood Elevations determined.
- **ZONE AE** Base Flood Elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** Area to be protected from 1% annual chance flood by a federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway Boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 (EL 987) Base Flood Elevation line and value; elevation in feet*
- (EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A (A) Cross section line
- 23 (23) Transect line
- 43° 02' 08", 89° 20' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 1000000 FT 5000-foot ticks: Wisconsin State Plane South Zone (FIPS Zone 4803), Lambert Conformal Conic projection
- 5000 FT N 1000-meter Universal Transverse Mercator grid values, zone 16N
- 6135512 Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
June 17, 2008

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
January 2, 2009 – to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, to reflect updated topography information, and to incorporate revisions based on Letters of Map Revision

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0409G

FIRM

FLOOD INSURANCE RATE MAP

DANE COUNTY, WISCONSIN AND INCORPORATED AREAS

PANEL 409 OF 850
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MADISON, CITY OF	550083	0409	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
55025C0409G
MAP REVISED
JANUARY 02, 2009

Federal Emergency Management Agency

APPENDIX C

USGS WEB SOIL SURVEY REPORT

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 Dane County, Wisconsin

The Neutral Project - Vanilla 301

March 27, 2024

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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

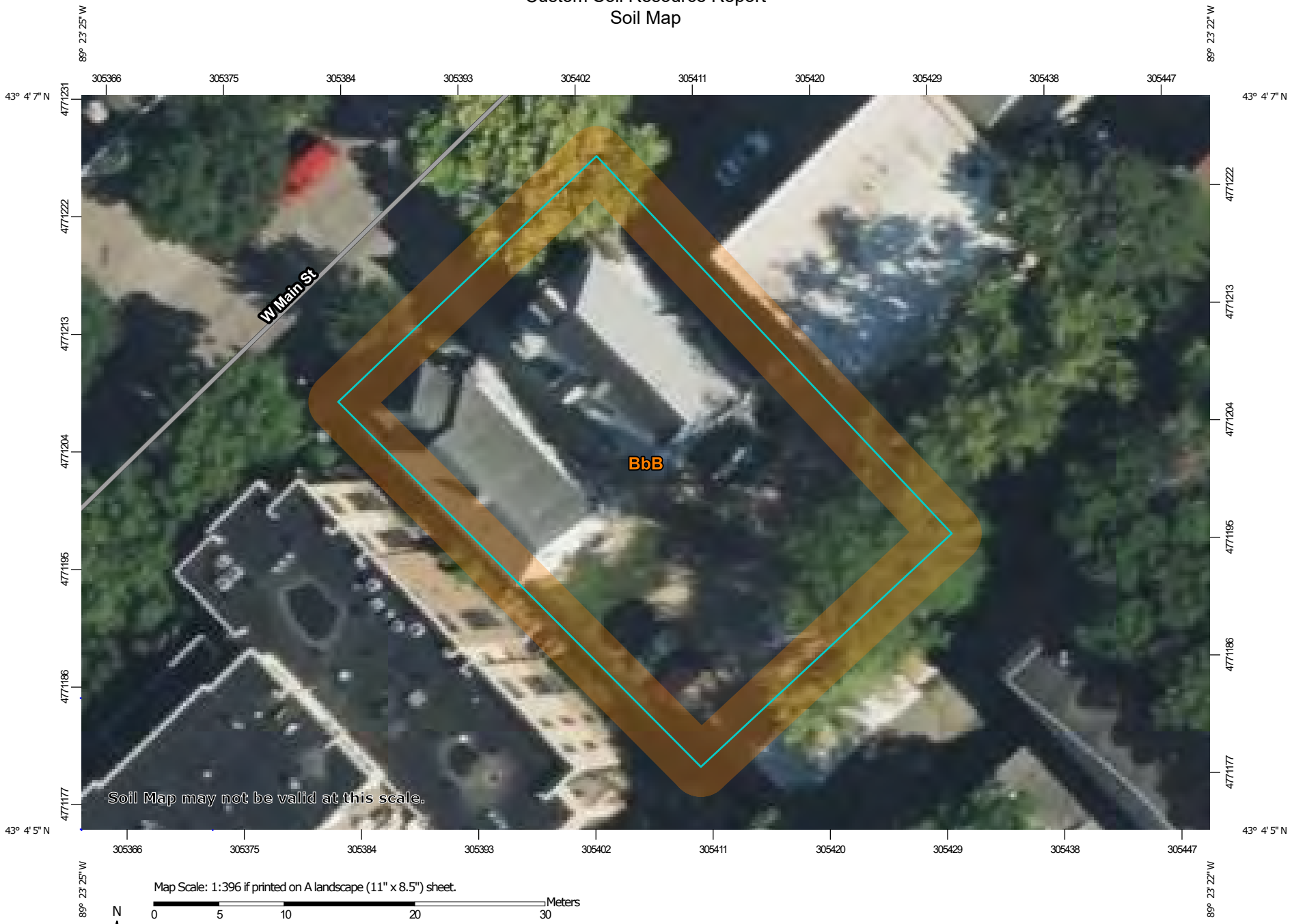
alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

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



Map Scale: 1:396 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 15 30 60 90

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

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 1:15,800.

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: Dane County, Wisconsin
Survey Area Data: Version 22, Sep 8, 2023

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

Date(s) aerial images were photographed: Aug 4, 2022—Sep 13, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background 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
BbB	Batavia silt loam, gravelly substratum, 2 to 6 percent slopes	0.3	100.0%
Totals for Area of Interest		**0.3**	**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.

Dane County, Wisconsin

BbB—Batavia silt loam, gravelly substratum, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: t919
Elevation: 750 to 1,200 feet
Mean annual precipitation: 28 to 33 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 160 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Batavia, gravelly substratum, and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Batavia, Gravelly Substratum

Setting

Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Deep loess over loamy outwash

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 44 inches: silty clay loam
H3 - 44 to 50 inches: gravelly clay loam
H4 - 50 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 2 to 6 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
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F095XB010WI - Loamy and Clayey Upland
Forage suitability group: High AWC, adequately drained (G095BY008WI)
Other vegetative classification: High AWC, adequately drained (G095BY008WI)
Hydric soil rating: No

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APPENDIX D
GEOTECHNICAL REPORT

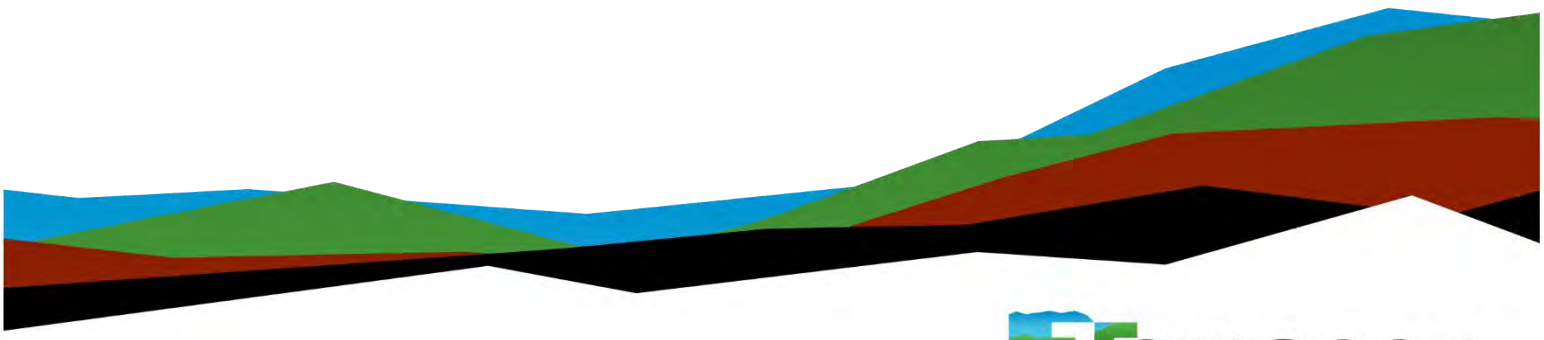
Vanilla Apartments

Geotechnical Engineering Report

November 2, 2023 | Terracon Project No. 58225235

Prepared for:

The Neutral Project



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November 2, 2023

The Neutral Project

Attn: Yue Shao
P: (617) 893-9577
E: yue@thenuetralproject.com

Re: Geotechnical Engineering Report
Vanilla Apartments
519 W Main Street
Madison, Wisconsin
Terracon Project No. 58225235

Dear Ms. Shao:

We have completed the scope of Geotechnical Engineering services for the referenced project in general accordance with the agreement for services dated August 27, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Juan Arreola
Field Engineer

Paul Koszarek, P.E., C.S.T.
Principal

Table of Contents

Attachments

Exploration and Testing Procedures
Site Location and Exploration Plans
Exploration and Laboratory Results
Supporting Information

Note: This report was originally delivered in a web-based format. Blue Bold text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Vanilla Apartments Development to be located at 519 South West Main Street in Madison, Wisconsin. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Foundation design and construction
- Seismic site classification per IBC
- Floor slabs
- Below grade walls

The geotechnical engineering Scope of Services for this project included the advancement of four (4) test borings to the approximate depth of 30 feet below the existing grades, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the Site Location and Exploration Plan, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the Exploration Results section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	An email request for proposal was provided by The Neutral Project, dated September 19, 2023. The request included a preliminary site plan showing the proposed building. Additionally, a preliminary site plan and planned building profile was provided October 10, 2023.

Item	Description
Project Description	It is understood that the project will include the construction of a four story, apartment building, consisting of about 16 units. The approximate footprint of the building is 5,000 square feet. The building will include partially underground basement parking consisting of 12 spaces.
Finished Floor Elevation (FFE)	Finished floor elevation is proposed to be at approximately at an elevation of 856 feet.
Maximum Loads (assumed)	We were not provided the maximum column, wall, and slab loads. We will use the following assumed loads in estimating settlement based on our experience with similar projects. ■ Columns: 300 kips ■ Walls: 8 to 10 kips per linear foot (klf) ■ Slabs: 150 pounds per square foot (psf)
Grading	Not provided but anticipated to be on the order of approximately 2 feet of cut and/or fill to be required to develop final grades around the building but likely up to 13 feet of cut to create the below grade parking level.
Below-Grade Structures	The building will include partially underground parking approximately 13 feet below existing grade.
Free-Standing Retaining Walls / Slopes	None anticipated
Pavements	None anticipated

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 519 W. Main Street in Madison, Wisconsin. Latitude/Longitude: 43.0686 -89.3900 See Site Location
Existing Improvements	The site is currently occupied by a residential building that is planned to be demolished for this project.
Current Ground Cover	Occupied lot covered with grass and gravel driveways.
Existing Topography	Based on the provided topography survey, the site slopes downwards from east to west. The eastern edge of the site is at an elevation of approximately 869 ft, and the western edge of the site is at an elevation of 865 ft.

Geotechnical Characterization

Subsurface Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the Exploration Results attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Existing Surface Material	Topsoil 2 inches thick. Gravel base 3 to 4 inches thick.
2	Native Cohesive	Native sandy lean clay with various amounts of gravel. Hand penetrometer values ranged from 3.75 to 4.50+ tons per square foot (tsf). Moisture contents ranged from 11% to 17%. Clays were typically observed in the upper 1.5 to 5 feet.
3	Native Sand	Native silty sand with varying gravel contents. Observed in a medium dense to very dense condition.

		Blow counts ranging from 12 to 50 blows per foot (bpf). Moisture content ranging from 6% to 8%.
4	Native Silt	Native silt with varying sand and gravel contents. Observed in a medium dense to very dense condition. Blow counts ranging from 23 to 50 blows per foot (bpf). Moisture content ranging from 6% to 8%.

The geotechnical characterization forms the basis of our geotechnical evaluation of site preparation, foundation options and pavement options. As noted in General Comments, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the Exploration Results section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Subsurface Water Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Free water was observed in all borings. Water levels were observed in borings B-1, B-2, B-3, and B-4 at depths of 17, 22, 22, and 19 feet respectively. Moisture contents of the recovered soil samples can be found on the boring logs in Exploration Results.

Based on the groundwater levels observed in the borings and the granular nature of the soils, it is anticipated that the long-term groundwater level is at an elevation of approximately 848 feet.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Geotechnical Overview

The results of this exploration indicate that the subsurface conditions at the site are generally suitable for the use of typical shallow foundations for support of the proposed structural loads, provided the foundations extend to suitable native soils.

The Shallow Foundations section addresses foundation support of structures. It is our opinion that the structure can be supported on typical spread footings extending to bear

directly on the native inorganic soils that have been redensified once exposed, or on newly placed structural fill or lean concrete extending to suitable native bearing soils.

The General Comments section provides an understanding of the report limitations.

Earthwork

The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations and pavements.

Site Preparation

Prior to placing structural fill, topsoil, trees (including entire root bulb), vegetation, and other surficial unsuitable material for an area extending at least 5 feet beyond the edges of the proposed structures' footprint and pavements should be removed.

Following site stripping, the exposed soils should be proof compacted in the presence of a Terracon representative. A Terracon representative should observe proof compaction of the exposed soils. Proof compaction can be accomplished using a smooth drum vibratory roller with a gross weight of at least 10 tons and minimum diameter of 4 feet. Areas of loose, soft, or otherwise unsuitable materials should be undercut and replaced with either new structural fill or suitable, existing on site materials.

Fill Material Types

Fill required to achieve design grade in building and pavement areas should be classified as structural fill. General fill applies to other non-structural areas. Structural fill is material used below, or within 5 feet of structures, pavements, or constructed slopes. General fill is material used to achieve grade outside of these areas. Earthen materials used for structural and general fill should meet the following material property requirements.

Soil Type [1, 2]	USCS Classification	Acceptable Locations for Placement
Cohesive	CL [3], CL/ML [3] (LL ≤ 45 and PI ≤ 20)	Not recommended for fill below the building

Soil Type [1, 2]	USCS Classification	Acceptable Locations for Placement
Granular	GW, GP, GM, GC SW, SP, SM, SC 5% to 15% passing #200 sieve	Backfill for utilities and foundations. Can also be used below/adjacent pavements. If used below pavements, drainage should be considered
Granular	Crushed limestone or crushed concrete meeting WisDOT Section 305 for 1¼ dense graded base	Undercut areas below foundations. Aggregate base below slabs and pavements. Can also be used for utility and structural backfill

1. Structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation prior to use on this site.
2. Any organic materials, rock fragments larger than 3 inches, and other unsuitable materials should be removed prior to use as structural fill.
3. Highly susceptible to frost; unstable when wet, are commonly used for pavement support with the knowledge that additional maintenance and/or shorter pavement life are likely.

Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Description
Maximum Fill Lift Thickness	■ 9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used ■ 4 inches in loose thickness when hand-guided equipment (i.e., a jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2, 3]	■ 95% of the maximum dry density as obtained by the modified Proctor (ASTM D1557)
Moisture Content Range [1]	■ within 2% below to 3% above the modified Proctor optimum moisture content at the time of placement and compaction ■ granular materials should be compacted within workable moisture levels

Item	Description

1. We recommend that structural fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. If the granular material is coarse sand, crushed limestone, or gravel, is of a uniform size, or has a low fines content, compaction should be observed to ensure that each lift is placed in the recommended thickness and compacted using proper equipment. The clean granular soils should be compacted to at least 65% of relative density until they are not observed to yield.
3. Specifically, moisture levels should be maintained to achieved compaction without bulking during placement or pumping when proofrolled.

Utility Trench Backfill

Bedding sand for sanitary, water and storm utility conduits should conform to the material requirements specified in the “Standard Specifications for Sewer and Water Construction in Wisconsin.” The zone of compacted granular fill immediately around the pipe and bedding sand should extend laterally beyond the edges and above the pipe a minimum distance of 2 feet, and below the pipe 1 foot. Utility trench backfill placed above the bedding sand of civil related utilities should meet the following material property requirements:

Soil Type [1]	USCS Classification	Acceptable Locations for Placement
Cohesive	CL, CL/ML (LL ≤ 45 and PI ≤ 20)	Not recommended for utility trench backfill
Granular	GW, GP, GM, GC SW, SP, SM, SC 5% to 15% passing #200 sieve	For utility trench backfill outside of bedding zone in structure or pavement areas
Granular	Crushed limestone, gravel, or concrete meeting WisDOT Section 305 for 1¼ inch dense graded base	For utility trench backfill outside of bedding zone in structure or pavement areas

Soil Type [1]	USCS Classification	Acceptable Locations for Placement
Unsuitable	CH, MH, ML, OL, OH, PT	Not recommended for utility trench backfill

1. Utility trench backfill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

Grading and Drainage

All grades should provide effective drainage away from the building during and after construction. Water permitted to pond next to the building can result in soil movements greater than those discussed in this report. These greater movements can result in unacceptable differential foundation movements, cracked slabs and walls, and roof leaks. Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained. The roof should have gutters/drains with downspouts that discharge into storm sewer or onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structure, we recommend a maintenance program to effectively seal and maintain joints to prevent surface water infiltration.

Earthwork Construction Considerations

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of controlled compacted fills, and backfilling of excavations into the completed subgrade.

Upon completion of filling and grading, care should be taken to maintain the soil subgrade's moisture content. Construction traffic over completed soil subgrades should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Any water that collects over or adjacent to construction areas should be promptly removed. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be

removed and replaced with structural fill, or these materials should be scarified, moisture conditioned, and recompacted prior construction and observed by Terracon.

Where present, care should be taken to avoid disturbance of prepared subgrade soils. The on-site soils are easily disturbed, especially by construction traffic. Construction traffic should not operate directly on saturated or low strength soils. If the subgrade becomes saturated, desiccated, or disturbed, the affected materials should either be scarified and compacted or be removed and replaced as previously discussed. Subgrades should be observed and tested by Terracon prior to construction.

Based on conditions encountered at the boring locations, typical depths of shallow foundations or earthwork activities are not expected to encounter sustained or prevalent groundwater. Some seepage could be encountered if isolated granular seams containing free water are uncovered during excavations. If seepage is encountered, the contractor is responsible for employing appropriate dewatering methods to control seepage and facilitate construction. In our experience, dewatering of shallow excavations in fine grained soils can typically be accomplished with sump pits and pumps.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, as well as other applicable codes, and in accordance with any applicable local, state, and federal safety regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed those specified by these safety regulations.

Flatter slopes than those dictated by these regulations may be required depending upon the soil conditions encountered and other external factors. These regulations are strictly enforced and if they are not followed, the owner, the contractor, and/or earthwork and utility subcontractor could be liable and subject to substantial penalties. Under no circumstances should the information provided in this report be interpreted to mean that Terracon is responsible for construction site safety or the contractor’s activities. Construction site safety is the sole responsibility of the contractor who shall also be solely responsible for the means, methods, and sequencing of the construction operations.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of topsoil, demolition/backfilling of existing structures/pavements/utilities, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill, if required, should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and

5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should be contacted to discuss mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

If the site has been prepared in accordance with the requirements noted in Earthwork, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing pressure [1, 2]	4,000 psf
Required Bearing Stratum [3]	Native sand soils in firm and mechanically redensified condition with DCP results commensurate with at least an SPT N Value of 12 blows per foot.
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Minimum Embedment below Finished Grade [4]	Exterior footings in unheated areas: 60 inches Exterior footings in heated areas: 48 inches Interior footings in heated areas: 18 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2]	⅔ of the total settlement between columns and over 50 lineal feet along walls

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.

Item	Description

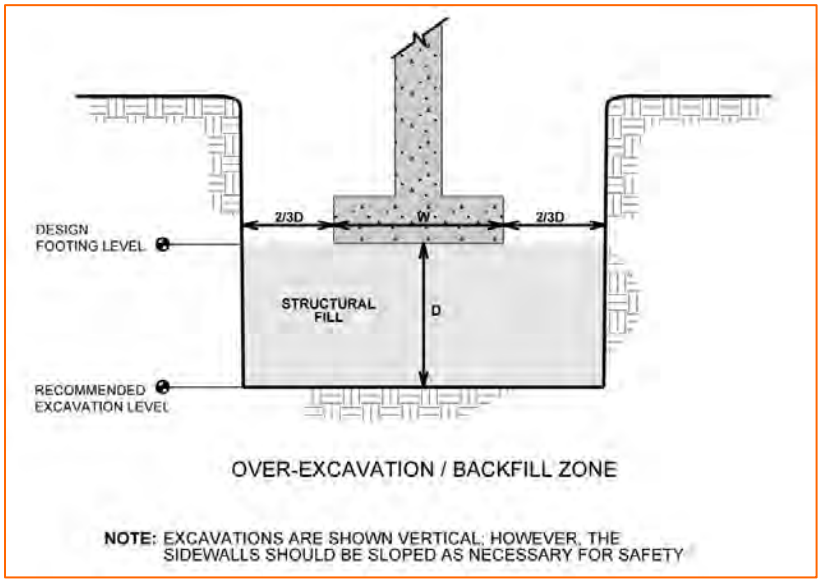
2. Values provided are for maximum loads noted in Project Description.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in Foundation Construction Considerations.
4. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.

Foundation Construction Considerations

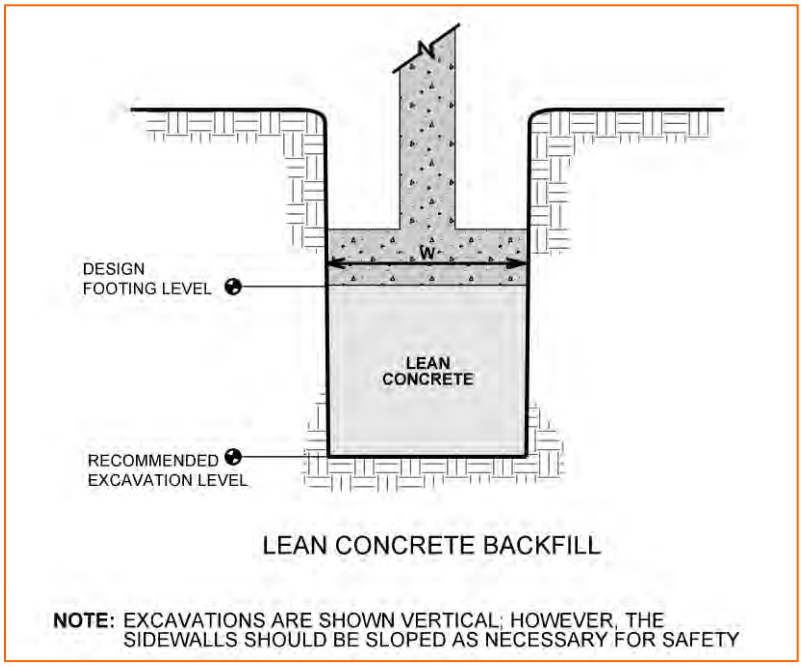
As noted in Earthwork, the foundation excavations should be evaluated under the direction of the Geotechnical Engineer. Based on the granular soils being present, they will become loose due to the excavation process. The granular soils should be redensified using a ho pac or diesel plate compactor prior to construction of the footings. All foundation excavations should be free of water and soft/loose soil, prior to placing concrete. Concrete/structural fill should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

The excavation process could significantly loosen the granular bearing soils; therefore, upon reaching planned elevation, the native granular soils should be recompacted using a ho-pac or heavy diesel plate compactor. Concrete should be placed soon after excavating to reduce bearing soil disturbance.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level, or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



If suitable native soils are present at the base of deepened excavations, the footings could bear directly on these soils at the lower level, or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



The excavation process could significantly loosen the granular bearing soils; therefore, upon reaching planned elevation, the native granular soils should be recompacted using a ho-pac or heavy diesel plate compactor. Concrete should be placed soon after excavating to reduce bearing soil disturbance.

Floor Slabs

Design parameters for floor slabs assume the requirements for Earthwork have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Suitable non-organic native soil, or new structural fill materials that have been prepared in accordance with the Earthwork section and tested/approved by Terracon
Granular Leveling Course	A minimum 4 inches of well-graded crushed stone meeting WisDOT Section 310 for an open graded base course material compacted to non-yielding condition
Modulus of Subgrade Reaction	200 pounds per square inch per inch (psi/in) for a soil subgrade prepared as recommended in this report

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

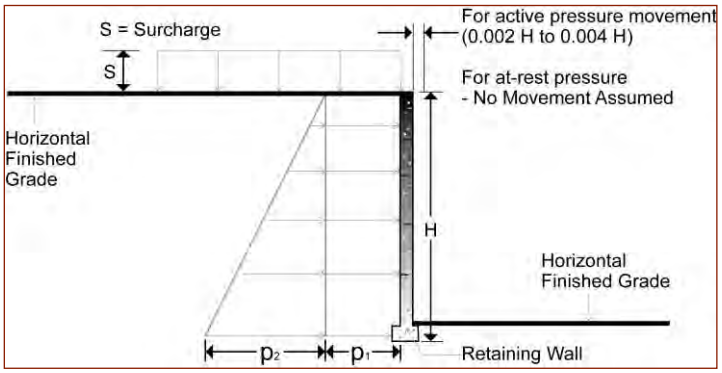
Seismic Considerations

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our opinion that the Seismic Site Class is D. Subsurface explorations at this site were extended to a maximum depth of 30 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

Lateral Earth Pressures

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures for the active, near at-rest, at-rest and passive conditions do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Lateral Earth Pressure Design Parameters			
Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure p_1 (psf) [3, 4]	Equivalent Fluid Pressures p_2 (psf) [2, 6]
Active (Ka)	Granular - 0.33	(0.33)S	(40)H
Near At-Rest (K)	Granular – 0.40	(0.40)S	48 H
At-Rest (Ko)	Granular - 0.50	(0.50)S	(60)H
Passive (Kp) [5]	Granular - 3.00	---	(360)H

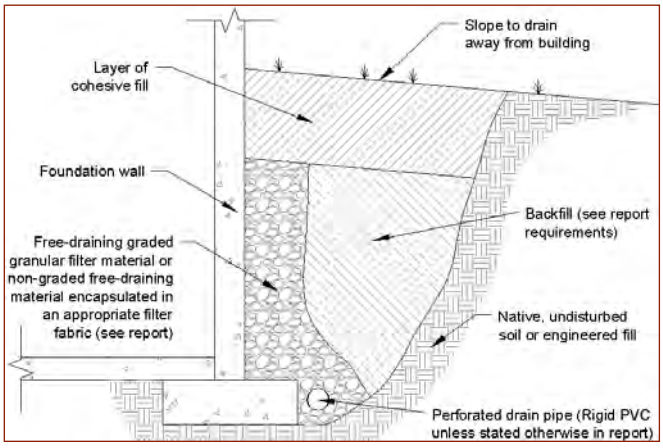
1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95 percent of the ASTM D 1557 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values. We recommend using a minimum factor of safety of 2 for calculations including passive earth pressures to account for the large strains required to mobilize the full passive resistance.
6. Assumes drainage will be installed behind walls to prevent hydrostatic loading behind the wall.

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below Grade Walls

Where possible, grades should be raised, or the basement depth could be shortened in order to keep the basement slab above the long-term water level. We recommend that the basement floors and walls be properly waterproofed with membranes and water stops. The basement slab and walls will either need to be designed to resist hydrostatic uplift and pressures, or a below slab drainage and perimeter wall drainage system will need to be implemented, with dual pumps and stand-by power.

A perforated rigid plastic drain line installed behind the base of walls and extending below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. As noted above, where the basement slab is placed below the groundwater level, this sump pit should include with dual pumps and stand-by power. The drain line should be surrounded by clean, free-draining granular material having less than 3 percent passing the No. 200 sieve. The free-draining aggregate should be encapsulated in a filter fabric. The filter fabric should consist of a non-woven geotextile with an Apparent Opening Size (AOS) in the range of 70 to 100. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



For interior locations, such as elevator pits, the granular fill should extend up to the floor slab granular leveling course. Elevator pit walls should be fully waterproofed and water stops be placed between the pit walls and foundations. Elevator pit walls and slabs should be designed for full hydrostatic pressures.

Frost Considerations

The soils on this site are frost susceptible, and water present or migrating beneath structures in non-climate-controlled areas can affect the performance of the slabs on-grade, sidewalks and pavements. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill or structural slabs (for instance, structural stoops in front of building doors). Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs.
- Install drains around the perimeter of the building, stoops, below exterior slabs and pavements, and connect them to the storm drainage system.
- Grade subgrades, so groundwater potentially perched in overlying more permeable subgrades and/or engineered-fills, slope toward a site drainage system.
- Place NFS fill as backfill beneath slabs and pavements critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS fill and other soils.
- Place NFS materials in critical sidewalk areas.

As an alternative to extending NFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS material. Footings for heated structures should be 48 inches below perimeter grade and 60 inches below perimeter grade for unheated structures.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the

owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet) [1]	Location
4	30	Building Footprint

1. Below the existing grade.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±20 feet) and using existing site features. Elevations were interpolated from the provided topography survey.

Subsurface Exploration Procedures: We advanced the soil borings using continuous hollow stem augers. Four samples were obtained in the upper 10 feet of each boring, and at 5-foot intervals thereafter to termination depths. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples were placed in appropriate containers, taken to our laboratory for testing, and classified by the project engineer. In addition, we observed and recorded subsurface water levels during drilling and after boring completion. The borings were backfilled with bentonite chips and auger cuttings after drilling.

Our exploration team prepared field boring logs as part of standard drilling operations. These logs include sampling depths, penetration distances, and other relevant sampling information, visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Report logs were prepared from the field logs and incorporated the project engineer's interpretation of the field logs and include modifications based on observations and laboratory tests of the samples in our laboratory.

Laboratory Testing

The samples were tested in the laboratory to measure their natural water content which are provided on the boring logs in Exploration Results. The samples were also classified in the laboratory based on visual observation, texture, and plasticity. The soil

descriptions presented on the boring logs are in accordance with the General Notes and Unified Soil Classification System (USCS) included in Supporting Information. The estimated USCS group symbols for native soil samples are shown on the boring logs, and a brief description of the USCS is included in Supporting Information.

Site Location and Exploration Plans

Contents:

Note: All attachments are one page unless noted above.

Site Location

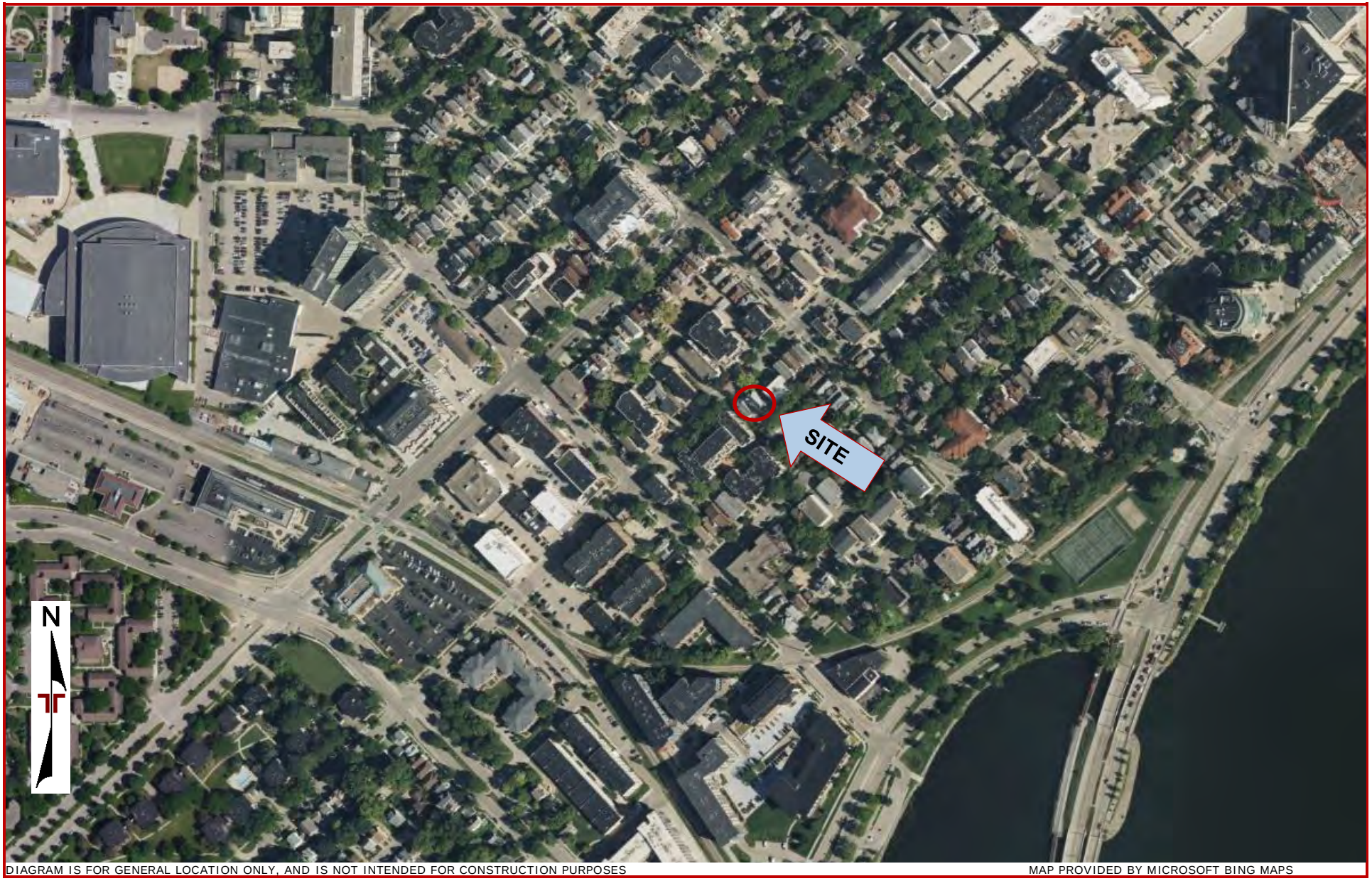


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

Vanilla - Madison
519 W Main Street | Madison, WI
Terracon Project No. 58235235

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 43.0687° Longitude: -89.3902°

Depth (Ft.)	Elevation.: 865 (Ft.)	Field Test Results	HP (tsf)	Water Content (%)
0.1	**TOPSOIL**, (Not Measured) 864.9			
1.5	**SANDY LEAN CLAY (CL)**, trace gravel, brown, hard 863.5	3-7-6 N=13	4.5+ (HP)	12.9
	SILTY SAND (SM), trace gravel, medium grained, light brown, moist, medium dense	10-9-8 N=17		6.1
		10-11-15 N=26		7.0
8.0	857			
	SANDY SILT (ML), trace to with gravel, light brown, moist, medium dense	9-11-14 N=25		8.1
		6-9-13 N=22		8.4
17.0	848			
	SILTY SAND (SM), trace gravel, medium grained, light brown, wet, dense to very dense	10-17-22 N=39		10.3
		20-28-31 N=59		8.9
27.0	838			
	SANDY SILT (ML), trace gravel and clay, light brown, wet, very dense	13-39-50/4"		9.4
29.8	835.2			
	Boring Terminated at 29.8 Feet			

Depth (Ft.): 5, 10, 15, 20, 25

Water Level Observations: ▽ at 17'

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ Water observed at 17' while drilling

Notes
Elevation Reference: Elevations were interpolated from a topographic site plan.

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
D-120

Hammer Type
Automatic

Driller
Marc/Nico

Logged by

Boring Started
10-12-2023

Boring Completed
10-12-2023

Vanilla - Madison
519 W Main Street | Madison, WI
Terracon Project No. 58235235

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 43.0686° Longitude: -89.3900°

Depth (Ft.)	Elevation.: 869 (Ft.)	Field Test Results	HP (tsf)	Water Content (%)
0.3	**AGGREGATE BASE COURSE**, (4' Thick) 868.67			
	SANDY LEAN CLAY (CL), brown, very stiff	2-3-4 N=7	3.25 (HP)	16.8
5.0	864	2-3-2 N=5	2.75 (HP)	15.1
	SILTY SAND (SM), trace gravel, medium grained, light brown, moist, medium dense	3-6-6 N=12		7.9
8.0	861			
	SANDY SILT (ML), trace gravel, light brown, moist, medium dense	7-10-14 N=24		6.2
		7-9-14 N=23		7.0
17.0	852			
	SILTY SAND WITH GRAVEL (SM), medium grained, light brown, very moist to wet, medium dense to very dense	10-14-15 N=29		9.7
		15-24-34 N=58		9.3
		12-30-26 N=56		9.9
30.0	839			
	Boring Terminated at 30 Feet			

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

Water observed at 22' while drilling

Drill Rig
D-120

Hammer Type
Automatic

Driller
Marc/Nico

Logged by

Boring Started
10-12-2023

Boring Completed
10-12-2023

Notes

Elevation Reference: Elevations were interpolated from a topographic site plan.

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Vanilla - Madison
519 W Main Street | Madison, WI
Terracon Project No. 58235235

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 43.0686° Longitude: -89.3899°

Depth (Ft.) | Elevation.: 869 (Ft.)

Graphic Log	Depth (Ft.)	Elevation	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Water Content (%)
	0.3	868.75					
AGGREGATE BASE COURSE, (3" Thick) **SANDY LEAN CLAY (CL)**, brown, hard					3-5-6 N=11	4.5+ (HP)	10.6
	4.0	865					
SILTY SAND WITH GRAVEL (SM), medium grained, light brown, moist, loose to medium dense					3-3-2 N=5		6.9
					11-14-11 N=25		3.4
					10-14-15 N=29		5.8
	12.0	857					
SANDY SILT WITH GRAVEL (ML), light brown, moist, medium dense to dense					10-14-13 N=27		6.6
					16-26-21 N=47		7.8
	22.0	847	▽				
SILTY SAND WITH GRAVEL (SM), medium grained, light brown, wet, very dense					16-50/2"		10.1
					14-23-31 N=54		11.4
	30.0	839					
Boring Terminated at 30 Feet							

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

▽ Water observed at 22' while drilling

Notes

Elevation Reference: Elevations were interpolated from a topographic site plan.

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
D-120

Hammer Type
Automatic

Driller
Marc/Nico

Logged by

Boring Started
10-12-2023

Boring Completed
10-12-2023

Vanilla - Madison
519 W Main Street | Madison, WI
Terracon Project No. 58235235

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 43.0687° Longitude: -89.3900°

Depth (Ft.)	Elevation.: 862 (Ft.)	Field Test Results	HP (tsf)	Water Content (%)
0.2	**TOPSOIL**, (2" Thick) 861.83			
	SANDY LEAN CLAY (CL), trace gravel, dark brown, hard	2-2-4 N=6	4.5+ (HP)	12.2
2.5	859.5			
	SILTY SAND WITH GRAVEL (SM), medium grained, light brown, moist, medium dense	9-10-11 N=21		2.4
		8-10-11 N=21		5.0
8.0	854			
	SANDY SILT WITH GRAVEL (ML), light brown, moist, medium dense to dense	7-10-17 N=27		6.0
		12-13-20 N=33		7.9
17.0	845			
	SILTY SAND (SM), trace gravel, medium grained, light brown, very moist to wet, dense to very dense	12-17-17 N=34		10.1
		17-23-29 N=52		8.0
29.3	832.7	31-50/3"		9.6
	Boring Terminated at 29.3 Feet			

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

▽ Water observed at 19' while drilling

Notes

Elevation Reference: Elevations were interpolated from a topographic site plan.

Advancement Method
3 1/4" HSA

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
D-120

Hammer Type
Automatic

Driller
Marc/Nico

Logged by

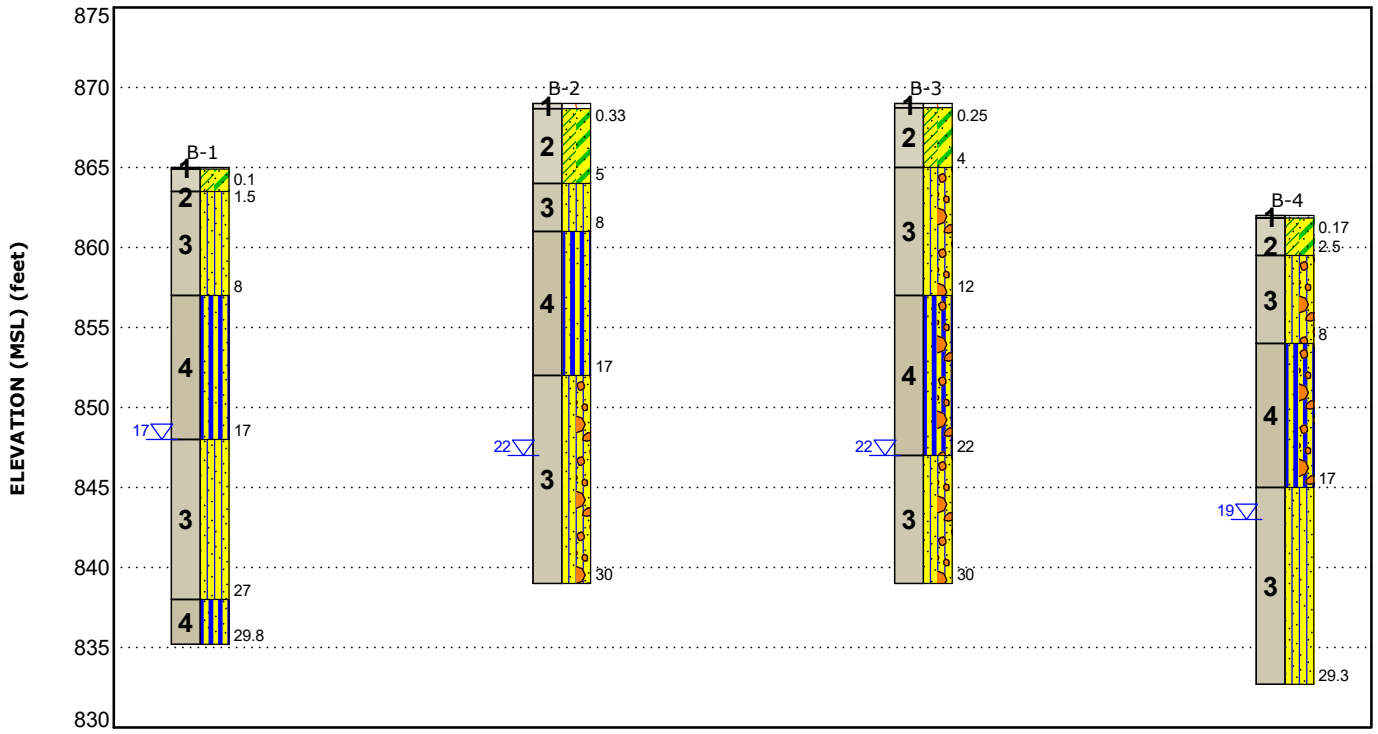
Boring Started
10-12-2023

Boring Completed
10-12-2023

Vanilla - Madison
519 W Main Street | Madison, WI
Terracon Project No. 58235235

Terracon
4900 South Pennsylvania Avenue, Suite 100
Cudahy, WI

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Surface Material	Topsoil 2 inches thick. Gravel base 3 to 4 inches thick.
2	Native Cohesive	Native sandy lean clay with various amounts of gravel. Hand penetrometer values ranged from 3.75 to 4.50+ tons per square foot (tsf).
3	Native Sand	Native silty sand with varying gravel contents. Observed in a medium dense to very dense condition. Blow counts ranging from 12 to 50 blows per foot (bpf).
4	Native Silt	Native silt with varying sand and gravel contents. Observed in a medium dense to very dense condition. Blow counts ranging from 23 to 50 blows per foot (bpf).

Legend

- Topsoil
- Sandy Lean Clay/Clayey Sand
- Silty Sand
- Sandy Silt
- Aggregate Base Course
- Silty Sand with Gravel
- Sandy Silt with Gravel

▽ First Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

Supporting Information

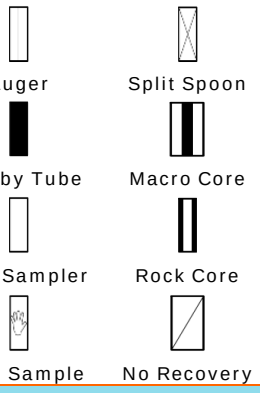
Contents:

Note: All attachments are one page unless noted above.

General Notes

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Subsurface water level variations will occur over time. In low permeability soils, accurate determination of subsurface water levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer
(DCP)	Dynamic Cone Penetrometer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS

(More than 50% retained on No. 200 sieve)
Density determined by Standard Penetration Resistance

Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 – 3
Loose	4 – 9
Medium Dense	10 – 29
Dense	30 – 50
Very Dense	> 50

CONSISTENCY OF FINE-GRAINED SOILS

(50% or more passing the No. 200 sieve)
Consistency determined by laboratory shear strength testing, field visual-manual procedures, or standard penetration resistance

Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, tsf	Standard Penetration or N-Value Blows/Ft.
Very Soft	Less than 0.25	0 – 1
Soft	0.25 to 0.50	2 – 4
Medium Stiff	0.50 to 1.00	4 – 8
Stiff	1.00 to 2.00	8 – 15
Very Stiff	2.00 to 4.00	15 – 30
Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive term(s) of other constituents	Percent (%) of dry weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major component of sample	Particle size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive term(s) of other constituents	Percent (%) of dry weight
Trace	< 5
With	5 – 12
Modifier	> 12

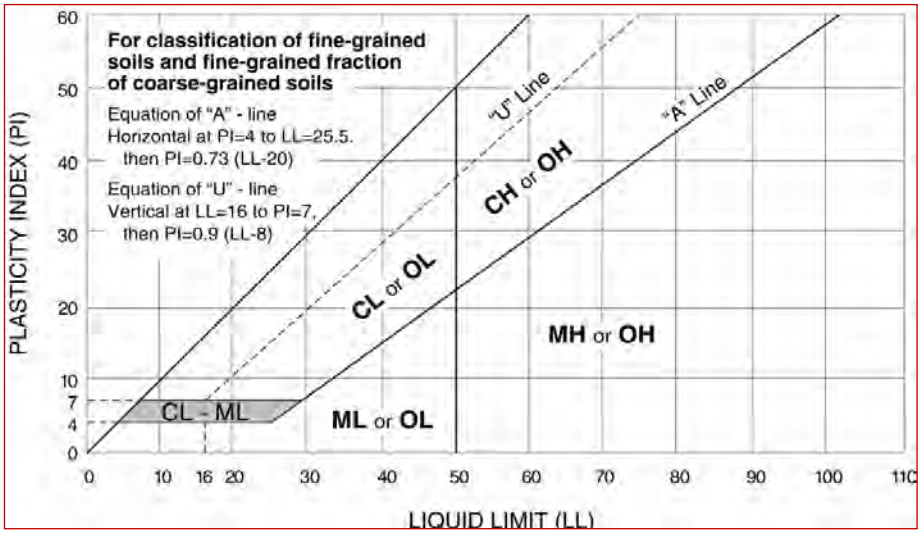
PLASTICITY DESCRIPTION

Term	Plasticity Index
Non plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

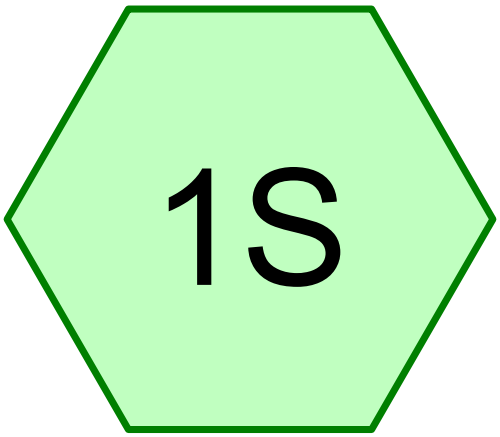
Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 4 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



APPENDIX E
HYDROCAD REPORT



Existing Site Area

Subcat Reach Pond Link

Routing Diagram for 230116 Existing HydroCAD
Prepared by {enter your company name here}, Printed 3/27/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	10-Year	MSE 24-hr	4	Default	24.00	1	4.09	2

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
5,920	96	Gravel surface, HSG B (1S)
2,703	61	Green Area (1S)
1,146	98	Impervious (1S)
3,440	98	Roof Area (1S)
13,209	**90**	**TOTAL AREA**

Summary for Subcatchment 1S: Existing Site Area

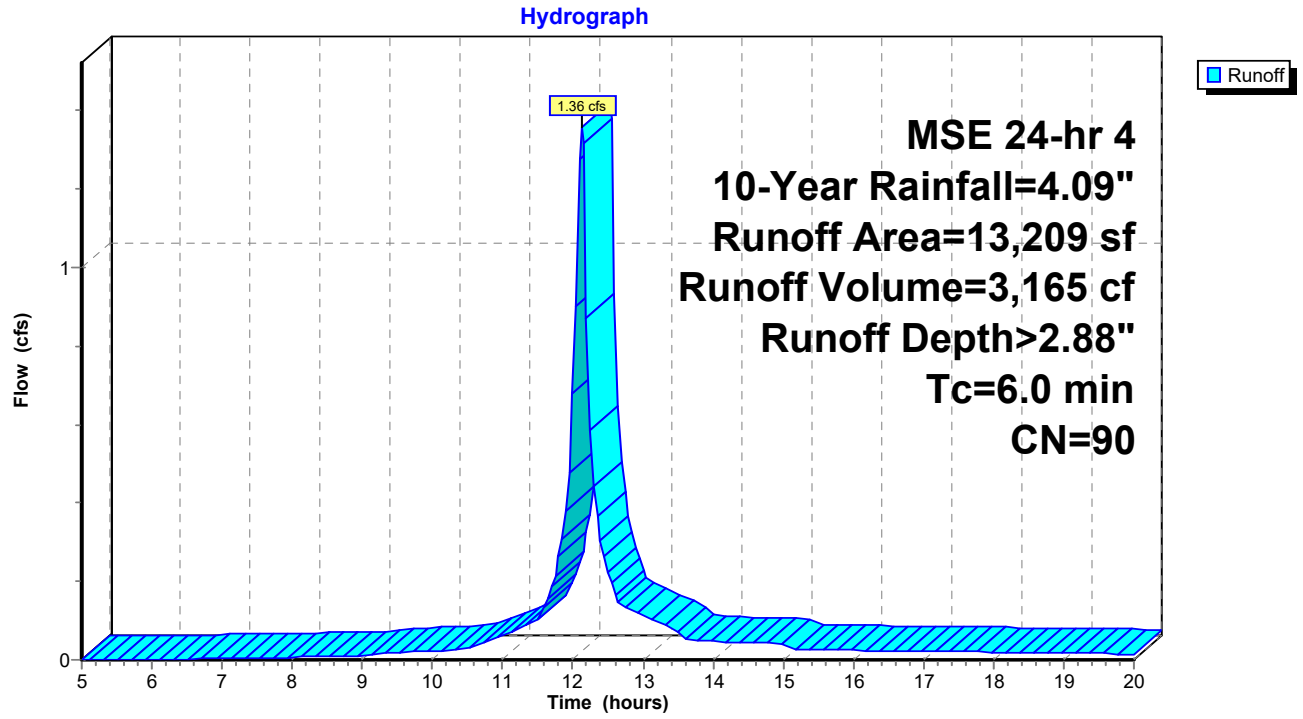
Runoff = 1.36 cfs @ 12.13 hrs, Volume= 3,165 cf, Depth> 2.88"

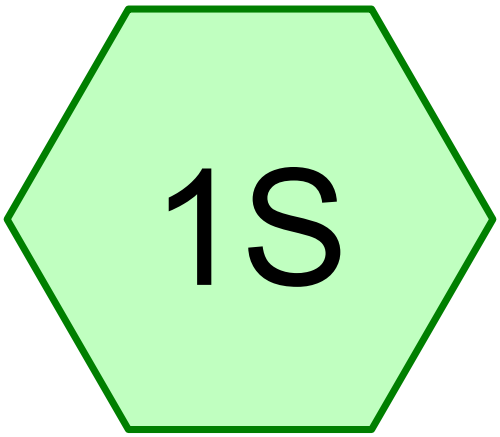
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 10-Year Rainfall=4.09"

	Area (sf)	CN	Description
*	1,146	98	Impervious
*	3,440	98	Roof Area
	5,920	96	Gravel surface, HSG B
*	2,703	61	Green Area
	13,209	90	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 1S: Existing Site Area





Proposed Site Area

Subcat Reach Pond Link

Routing Diagram for 230116 Proposed HydroCAD
Prepared by {enter your company name here}, Printed 3/29/2024

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	10-Year	MSE 24-hr	4	Default	24.00	1	4.09	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
1,764	98	Impervious Area (1S)
1,802	71	Pervious Area (1S)
1,989	74	Pervious Pavers (1S)
3,000	72	Roof Area (Green Roof) (1S)
4,654	98	Roof Area (Impervious) (1S)
13,209	**85**	**TOTAL AREA**

Summary for Subcatchment 1S: Proposed Site Area

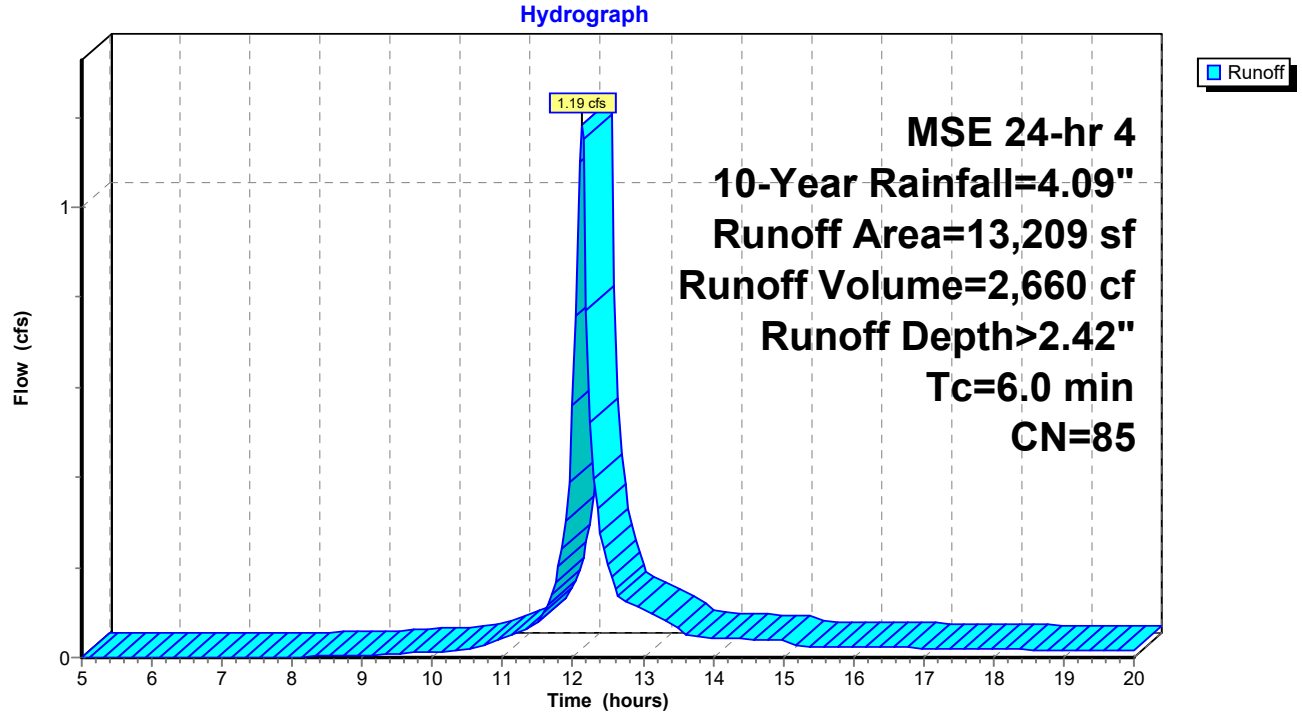
Runoff = 1.19 cfs @ 12.13 hrs, Volume= 2,660 cf, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 4 10-Year Rainfall=4.09"

	Area (sf)	CN	Description
*	1,764	98	Impervious Area
*	1,802	71	Pervious Area
*	4,654	98	Roof Area (Impervious)
*	3,000	72	Roof Area (Green Roof)
*	1,989	74	Pervious Pavers
	13,209	85	Weighted Average
	6,791		51.41% Pervious Area
	6,418		48.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Subcatchment 1S: Proposed Site Area



APPENDIX F

USLE SOIL LOSS EQUATION SPREADSHEET

Not included in this DRAFT

APPENDIX G

LONG-TERM MAINTENANCE AGREEMENT

Not included in this DRAFT