Geosyntec consultants

10600 N. Port Washington Road
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Mequon, WI 53092
PH 262.377.9828
www.geosyntec.com

Letter of Transmittal

[X] U.S. Mail [ ] Overnight Mail [ ] Delivered

To: Ms. Jennifer Dorman
Environmental Program Associate
Remediation and Redevelopment Program
Wisconsin Department of Natural Resources
2300 N. Dr. Martin Luther King Jr. Drive
Milwaukee, WI 53212-3128

Date: July 6, 2020

Project Name: Metro North Service Center

Geosyntec Proj. No.: CHE8094OQ

[ ] Letter [ ] Proposal

[ ] Report [ ] Computer Disks/CDs

[ ] Work Plan [X] Other

Number of Copies	Date	Description
1	6/29/2020	WDNR submital portal email confirmation
1	6/29/2020	WDNR Form 4400-237
1	6/26/2020	WDNR review fee check

[X] For Review [ ] As Requested [ ] Other

[ ] For File [ ] For Distribution

Comments:	WDNR FID #: 241311510
	WDNR BRRTS #: 02-41-583015

cc: Frank Dombrowski, WEC Energy Group - Business Services
David Jaeckels, WEC Energy Group - Business Services

From: Jeremiah Johnson
262.834.0228
jpjohnson@geosyntec.com

State of Wisconsin
Department of Natural Resources
PO Box 7921, Madison WI 53707-7921
dnr.wi.gov

Technical Assistance, Environmental Liability Clarification or Post-Closure Modification Request

Form 4400-237 (R 12/18)

Notice: Use this form to request **a written response (on agency letterhead)** from the Department of Natural Resources (DNR) regarding technical assistance, a post-closure change to a site, a specialized agreement or liability clarification for Property with known or suspected environmental contamination. A fee will be required as is authorized by s. 292.55, Wis. Stats., and NR 749, Wis. Adm. Code., unless noted in the instructions below. Personal information collected will be used for administrative purposes and may be provided to requesters to the extent required by Wisconsin's Open Records law [ss. 19.31 - 19.39, Wis. Stats.].

Definitions

"Property" refers to the subject Property that is perceived to have been or has been impacted by the discharge of hazardous substances.

"Liability Clarification" refers to a written determination by the Department provided in response to a request made on this form. The response clarifies whether a person is or may become liable for the environmental contamination of a Property, as provided in s. 292.55, Wis. Stats.

"Technical Assistance" refers to the Department's assistance or comments on the planning and implementation of an environmental investigation or environmental cleanup on a Property in response to a request made on this form as provided in s. 292.55, Wis. Stats.

"Post-closure modification" refers to changes to Property boundaries and/or continuing obligations for Properties or sites that received closure letters for which continuing obligations have been applied or where contamination remains. Many, but not all, of these sites are included on the GIS Registry layer of RR Sites Map to provide public notice of residual contamination and continuing obligations.

Select the Correct Form

This from should be used to request the following from the DNR:

- Technical Assistance
- Liability Clarification
- Post-Closure Modifications
- Specialized Agreements (tax cancellation, negotiated agreements, etc.)

Do not use this form if one of the following applies:

- Request for an **off-site liability exemption or clarification** for Property that has been or is perceived to be contaminated by one or more hazardous substances that originated on another Property containing the source of the contamination. Use DNR's Off-Site Liability Exemption and Liability Clarification Application Form 4400-201.
- Submittal of an Environmental Assessment for the **Lender Liability Exemption**, s 292.21, Wis. Stats., **if no response or review by DNR is requested**. Use the Lender Liability Exemption Environmental Assessment Tracking Form 4400-196.
- Request for an **exemption to develop on a historic fill site** or licensed landfill. Use DNR's Form 4400-226 or 4400-226A.
- **Request for closure** for Property where the investigation and cleanup actions are completed. Use DNR's Case Closure - GIS Registry Form 4400-202.

All forms, publications and additional information are available on the internet at: dnr.wi.gov/topic/Brownfields/Pubs.html.

Instructions

1. Complete sections 1, 2, 6 and 7 for all requests. Be sure to provide adequate and complete information.
2. Select the type of assistance requested: Section 3 for technical assistance or post-closure modifications, Section 4 for a written determination or clarification of environmental liabilities; or Section 5 for a specialized agreement.
3. Include the fee payment that is listed in Section 3, 4, or 5, unless you are a "Voluntary Party" enrolled in the Voluntary Party Liability Exemption Program **and** the questions in Section 2 direct otherwise. Information on to whom and where to send the fee is found in Section 8 of this form.
4. Send the completed request, supporting materials and the fee to the appropriate DNR regional office where the Property is located. See the map on the last page of this form. A paper copy of the signed form and all reports and supporting materials shall be sent with an electronic copy of the form and supporting materials on a compact disk. For electronic document submittal requirements see: http://dnr.wi.gov/files/PDF/pubs/rr/RR690.pdf"

The time required for DNR's determination varies depending on the complexity of the site, and the clarity and completeness of the request and supporting documentation.

Section 1. Contact and Recipient Information

Requester Information

This is the person requesting technical assistance or a post-closure modification review, that his or her liability be clarified or a specialized agreement and is identified as the requester in Section 7. DNR will address its response letter to this person.

Last Name	First	MI	Organization/ Business Name		
Dombrowski	Frank		WEC Energy Group - Business Services		
Mailing Address			City	State	ZIP Code
333 W. Everett St., A231			Milwaukee	WI	53203
Phone # (include area code)	Fax # (include area code)		Email		
(414) 221-2156			frank.dombrowski@wecenergygroup.com		

The requester listed above: (select all that apply)

- ☒ Is currently the owner
- ☐ Is considering selling the Property
- ☐ Is renting or leasing the Property
- ☐ Is considering acquiring the Property
- ☐ Is a lender with a mortgagee interest in the Property
- ☐ Other. Explain the status of the Property with respect to the applicant:

Contact Information (to be contacted with questions about this request) ☒ Select if same as requester

Contact Last Name	First	MI	Organization/ Business Name		
Dombrowski	Frank		WEC Energy Group - Business Services		
Mailing Address			City	State	ZIP Code
333 W. Everett St., A231			Milwaukee	WI	53203
Phone # (include area code)	Fax # (include area code)		Email		
(414) 221-2156			frank.dombrowski@wecenergygroup.com		

Environmental Consultant (if applicable)

Contact Last Name	First	MI	Organization/ Business Name		
Johnson	Jeremiah		Geosyntec Consultants		
Mailing Address			City	State	ZIP Code
10600 N. Port Washington Rd, Suite 100			Mequon	WI	53092
Phone # (include area code)	Fax # (include area code)		Email		
(262) 834-0228			jpjohnson@geosyntec.com		

Section 2. Property Information

Property Name			FID No. (if known)		
We Energies Metro North Service Center			241311510		
BRRTS No. (if known)			Parcel Identification Number		
02-41-583015			3261641000		
Street Address			City	State	ZIP Code
3100 W. North Ave.			Milwaukee	WI	53208
County	Municipality where the Property is located		Property is composed of:		Property Size Acres
Milwaukee	◉ City ○ Town ○ Village of		◉ Single tax parcel ○ Multiple tax parcels		6

1. Is a response needed by a specific date? (e.g., Property closing date) Note: Most requests are completed within 60 days. Please plan accordingly.

◯ No ◉ Yes

Date requested by: 07/31/2020

Reason: Remedial action implementation will be conducted in conjunction with Site building reconstruction scheduled to begin in October 2020. Design Report components need to be incorporated into the upcoming contractor bid specification and procurement process.

2. Is the "Requester" enrolled as a Voluntary Party in the Voluntary Party Liability Exemption (VPLE) program?

◉ No. **Include the fee that is required for your request in Section 3, 4 or 5.**

◯ Yes. **Do not include a separate fee.** This request will be billed separately through the VPLE Program.

Fill out the information in Section 3, 4 or 5 which corresponds with the type of request:
Section 3. Technical Assistance or Post-Closure Modifications;
Section 4. Liability Clarification; or Section 5. Specialized Agreement.

Section 3. Request for Technical Assistance or Post-Closure Modification

Select the type of technical assistance requested: **[Numbers in brackets are for WI DNR Use]**

☐ No Further Action Letter (NFA) (Immediate Actions) - NR 708.09, [183] - **Include a fee of $350.** Use for a written response to an immediate action after a discharge of a hazardous substance occurs. Generally, these are for a one-time spill event.

☐ Review of Site Investigation Work Plan - NR 716.09, [135] - **Include a fee of $700.**

☐ Review of Site Investigation Report - NR 716.15, [137] - **Include a fee of $1050.**

☐ Approval of a Site-Specific Soil Cleanup Standard - NR 720.10 or 12, [67] - **Include a fee of $1050.**

☐ Review of a Remedial Action Options Report - NR 722.13, [143] - **Include a fee of $1050.**

☒ Review of a Remedial Action Design Report - NR 724.09, [148] - **Include a fee of $1050.**

☐ Review of a Remedial Action Documentation Report - NR 724.15, [152] - **Include a fee of $350**

☐ Review of a Long-term Monitoring Plan - NR 724.17, [25] - **Include a fee of $425.**

☐ Review of an Operation and Maintenance Plan - NR 724.13, [192] - **Include a fee of $425.**

Other Technical Assistance - s. 292.55, Wis. Stats. [97] (For request to build on an abandoned landfill use Form 4400-226)

☐ Schedule a Technical Assistance Meeting - **Include a fee of $700.**

☐ Hazardous Waste Determination - **Include a fee of $700.**

☐ Other Technical Assistance - **Include a fee of $700.** Explain your request in an attachment.

Post-Closure Modifications - NR 727, [181]

☐ Post-Closure Modifications: Modification to Property boundaries and/or continuing obligations of a closed site or Property; sites may be on the GIS Registry. This also includes removal of a site or Property from the GIS Registry. **Include a fee of $1050, and:**

☐ Include a fee of $300 for sites with residual soil contamination; and

☐ Include a fee of $350 for sites with residual groundwater contamination, monitoring wells or for vapor intrusion continuing obligations.

Attach a description of the changes you are proposing, and documentation as to why the changes are needed (if the change to a Property, site or continuing obligation will result in revised maps, maintenance plans or photographs, those documents may be submitted later in the approval process, on a case-by-case basis).

Skip Sections 4 and 5 if the technical assistance you are requesting is listed above and complete Sections 6 and 7 of this form.

Section 4. Request for Liability Clarification

Select the type of liability clarification requested. Use the available space given or attach information, explanations, or specific questions that you need answered in DNR's reply. Complete Sections 6 and 7 of this form. **[Numbers in brackets are for DNR Use]**

☐ "Lender" liability exemption clarification - s. 292.21, Wis. Stats. [686]

❖ **Include a fee of $700.**

Provide the following documentation:

(1) ownership status of the real Property, and/or the personal Property and fixtures;

(2) an environmental assessment, in accordance with s. 292.21, Wis. Stats.;

(3) the date the environmental assessment was conducted by the lender;

(4) the date of the Property acquisition; for foreclosure actions, include a copy of the signed and dated court order confirming the sheriff's sale.

(5) documentation showing how the Property was acquired and the steps followed under the appropriate state statutes.

(6) a copy of the Property deed with the correct legal description; and,

(7) the Lender Liability Exemption Environmental Assessment Tracking Form (Form 4400-196).

(8) If no sampling was done, please provide reasoning as to why it was **not** conducted. Include this either in the accompanying environmental assessment or as an attachment to this form, and cite language in s. 292. 21(1)(c)2.,h.-i., Wis. Stats.:

h. The collection and analysis of representative samples of soil or other materials in the ground that are suspected of being contaminated based on observations made during a visual inspection of the real Property or based on aerial photographs, or other information available to the lender, including stained or discolored soil or other materials in the ground and including soil or materials in the ground in areas with dead or distressed vegetation. The collection and analysis shall identify contaminants in the soil or other materials in the ground and shall quantify concentrations.

i. The collection and analysis of representative samples of unknown wastes or potentially hazardous substances found on the real Property and the determination of concentrations of hazardous waste and hazardous substances found in tanks, drums or other containers or in piles or lagoons on the real Property.

☐ "Representative" liability exemption clarification (e.g. trustees, receivers, etc.) - s. 292.21, Wis. Stats. [686]

❖ **Include a fee of $700.**

Provide the following documentation:

(1) ownership status of the Property;

(2) the date of Property acquisition by the representative;

(3) the means by which the Property was acquired;

(4) documentation that the representative has no beneficial interest in any entity that owns, possesses, or controls the Property;

(5) documentation that the representative has not caused any discharge of a hazardous substance on the Property; and

(6) a copy of the Property deed with the correct legal description.

☐ Clarification of local governmental unit (LGU) liability exemption at sites with: (select all that apply)

☐ hazardous substances spills - s. 292.11(9)(e), Wis. Stats. [649];

☐ Perceived environmental contamination - [649];

☐ hazardous waste - s. 292.24 (2), Wis. Stats. [649]; and/or

☐ solid waste - s. 292.23 (2), Wis. Stats. [649].

❖ **Include a fee of $700, a summary of the environmental liability clarification being requested, and the following:**

(1) clear supporting documentation showing the acquisition method used, and the steps followed under the appropriate state statute(s).

(2) current and proposed ownership status of the Property;

(3) date and means by which the Property was acquired by the LGU, where applicable;

(4) a map and the ¼, ¼ section location of the Property;

(5) summary of current uses of the Property;

(6) intended or potential use(s) of the Property;

(7) descriptions of other investigations that have taken place on the Property; and

(8) (for solid waste clarifications) a summary of the license history of the facility.

Section 4. Request for Liability Clarification (cont.)

☐ Lease liability clarification - s. 292.55, Wis. Stats. [646]

- ❖ **Include a fee of $700 for a single Property, or $1400 for multiple Properties and the information listed below:**

(1) a copy of the proposed lease;

(2) the name of the current owner of the Property and the person who will lease the Property;

(3) a description of the lease holder's association with any persons who have possession, control, or caused a discharge of a hazardous substance on the Property;

(4) map(s) showing the Property location and any suspected or known sources of contamination detected on the Property;

(5) a description of the intended use of the Property by the lease holder, with reference to the maps to indicate which areas will be used. Explain how the use will not interfere with any future investigation or cleanup at the Property; and

(6) all reports or investigations (e.g. Phase I and Phase II Environmental Assessments and/or Site Investigation Reports conducted under s. NR 716, Wis. Adm. Code) that identify areas of the Property where a discharge has occurred.

General or other environmental liability clarification - s. 292.55, Wis. Stats. [682] - Explain your request below.

- ❖ **Include a fee of $700 and an adequate summary of relevant environmental work to date.**

☐ No Action Required (NAR) - NR 716.05, [682]

- ❖ **Include a fee of $700.**

Use where an environmental discharge has or has not occurred, and applicant wants a DNR determination that no further assessment or clean-up work is required. Usually this is requested after a Phase I and Phase II environmental assessment has been conducted; the assessment reports should be submitted with this form. This is not a closure letter.

☐ Clarify the liability associated with a "closed" Property - s. 292.55, Wis. Stats. [682]

- ❖ **Include a fee of $700.**

- Include a copy of any closure documents if a state agency other than DNR approved the closure.

Use this space or attach additional sheets to provide necessary information, explanations or specific questions to be answered by the DNR.

Section 5. Request for a Specialized Agreement

Select the type of agreement needed. Include the appropriate draft agreements and supporting materials. Complete Sections 6 and 7 of this form. More information and model draft agreements are available at: dnr.wi.gov/topic/Brownfields/lgu.html#tabx4.

☐ Tax cancellation agreement - s. 75.105(2)(d), Wis. Stats. [654]

- ❖ **Include a fee of $700, and the information listed below:**

(1) Phase I and II Environmental Site Assessment Reports,

(2) a copy of the Property deed with the correct legal description.

☐ Agreement for assignment of tax foreclosure judgement - s.75.106, Wis. Stats. [666]

- ❖ **Include a fee of $700, and the information listed below:**

(1) Phase I and II Environmental Site Assessment Reports,

(2) a copy of the Property deed with the correct legal description.

☐ Negotiated agreement - Enforceable contract for non-emergency remediation - s. 292.11(7)(d) and (e), Wis. Stats. [630]

- ❖ **Include a fee of $1400, and the information listed below:**

(1) a draft schedule for remediation; and,

(2) the name, mailing address, phone and email for each party to the agreement.

Section 6. Other Information Submitted

Identify all materials that are included with this request.

Send both a paper copy of the signed form and all reports and supporting materials, and an electronic copy of the form and all reports, including Environmental Site Assessment Reports, and supporting materials on a compact disk.

Include one copy of any document from any state agency files that you want the Department to review as part of this request. The person submitting this request is responsible for contacting other state agencies to obtain appropriate reports or information.

- ☐ Phase I Environmental Site Assessment Report - Date: _____
- ☐ Phase II Environmental Site Assessment Report - Date: _____
- ☐ Legal Description of Property (required for all liability requests and specialized agreements)
- ☐ Map of the Property (required for all liability requests and specialized agreements)
- Analytical results of the following sampled media: Select all that apply and include date of collection.
  - ☐ Groundwater ☐ Soil ☐ Sediment ☐ Other medium - Describe: _____
  - Date of Collection: _____
- ☐ A copy of the closure letter and submittal materials
- ☐ Draft tax cancellation agreement
- ☐ Draft agreement for assignment of tax foreclosure judgment
- ☐ Other report(s) or information - Describe: _____

For Property with newly identified discharges of hazardous substances only: Has a notification of a discharge of a hazardous substance been sent to the DNR as required by s. NR 706.05(1)(b), Wis. Adm. Code?

- ◯ Yes - Date (if known): _____
- ◯ No

Note: The Notification for Hazardous Substance Discharge (non-emergency) form is available at: dnr.wi.gov/files/PDF/forms/4400/4400-225.pdf.

Section 7. Certification by the Person who completed this form

- ☒ I am the person submitting this request (requester)
- ☐ I prepared this request for: _____
  Requester Name

I certify that I am familiar with the information submitted on this request, and that the information on and included with this request is true, accurate and complete to the best of my knowledge. I also certify I have the legal authority and the applicant's permission to make this request.

Signature	Date Signed: 6-29-20
Title: Principal Environmental Consultant	Telephone Number (include area code): (414) 221-2156

Section 8. DNR Contacts and Addresses for Request Submittals

Send or deliver one paper copy and one electronic copy on a compact disk of the completed request, supporting materials, and fee to the region where the property is located to the address below. Contact a DNR regional brownfields specialist with any questions about this form or a specific situation involving a contaminated property. For electronic document submittal requirements see: http://dnr.wi.gov/files/PDF/pubs/rr/RR690.pdf.

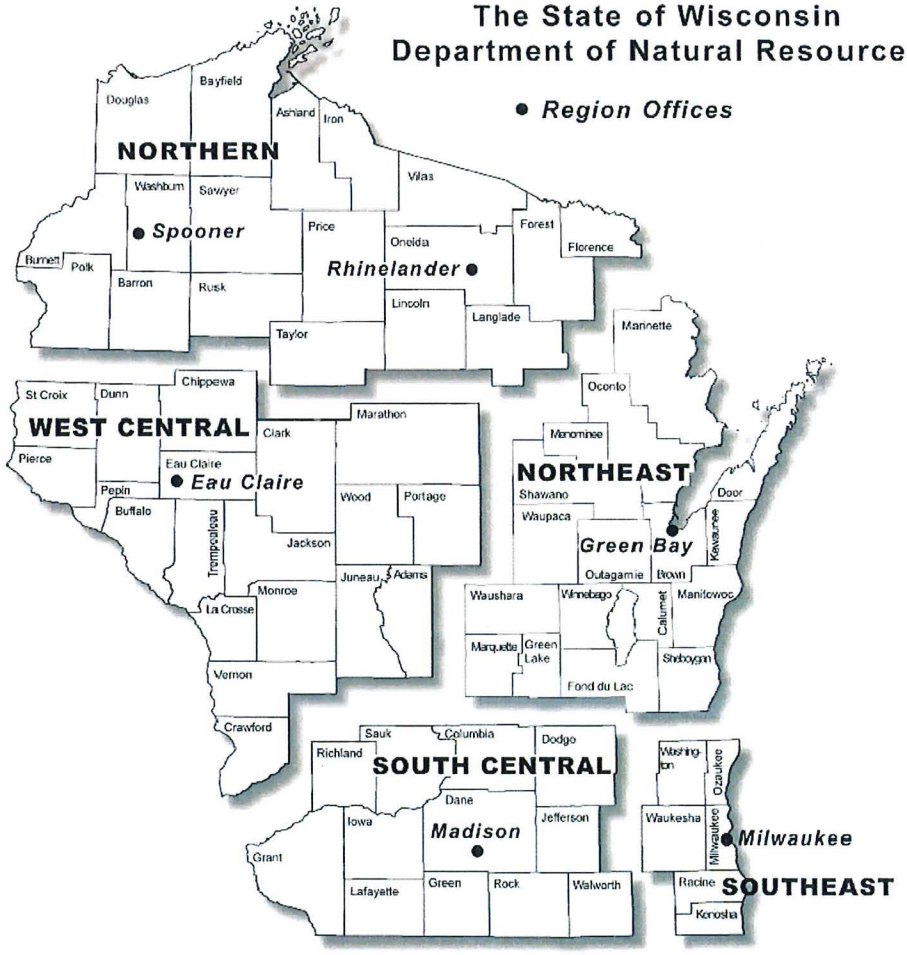
DNR NORTHERN REGION
Attn: RR Program Assistant
Department of Natural Resources
223 E Steinfest Rd Antigo, WI 54409

DNR NORTHEAST REGION
Attn: RR Program Assistant
Department of Natural Resources
2984 Shawano Avenue
Green Bay WI 54313

DNR SOUTH CENTRAL REGION
Attn: RR Program Assistant
Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg WI 53711

DNR SOUTHEAST REGION
Attn: RR Program Assistant
Department of Natural Resources
2300 North Martin Luther King Drive
Milwaukee WI 53212

DNR WEST CENTRAL REGION
Attn: RR Program Assistant
Department of Natural Resources
1300 Clairemont Ave.
Eau Claire WI 54702



Note: These are the Remediation and Redevelopment Program's designated regions. Other DNR program regional boundaries may be different.

DNR Use Only			
Date Received	Date Assigned	BRRTS Activity Code	BRRTS No. (if used)
DNR Reviewer	Comments		
Fee Enclosed? ◯ Yes ◯ No	Fee Amount $	Date Additional Information Requested	Date Requested for DNR Response Letter
Date Approved	Final Determination		

We Energies
231 W. Michigan Street
Milwaukee, WI 53203

www.we-energies.com

June 29, 2020

Ms. Theadora Jorgensen
Environmental Program Associate
Remediation and Redevelopment Program
Wisconsin Department of Natural Resources
2300 N. Dr. Martin Luther King Jr. Drive
Milwaukee, WI 53212-3128

Subject: **REMEDIAL ACTION DESIGN REPORT**
Metro North Service Center
3100 West North Avenue, Milwaukee, Wisconsin
WDNR BRRTS # 02-41-583015
WDNR FID # 241311510

Dear Ms. Jorgensen,

Please find attached the Remedial Action Design Report (Report) for the subject site for Wisconsin Department of Natural Resources (WDNR) review and approval.

This Report is being submitted via WDNR's online Submittal Portal. Pursuant to WDNR's current Covid-19 policy, a hard copy of the report is not being submitted. The review fee check and Form 4400-237 are being submitted via regular mail under a separate transmittal.

Please feel free to contact me at your convenience at (414) 587-4467 (cell) or via email at frank.dombrowski@wecenergygroup.com if you have any questions.

Sincerely,

Frank Dombrowski
Principal Environmental Consultant
WEC Energy Group – Business Services

Attachment

Cc: Project File
David Jaeckels, WEC Energy Group – Business Services
Jeremiah Johnson, Geosyntec Consultants
Adam McIlheran, WDNR

Prepared for

Wisconsin Electric Power Company
(d.b.a, We Energies)

REMEDIAL ACTION DESIGN REPORT

Metro North Service Center
3100 West North Avenue
Milwaukee, Wisconsin 53208
WDNR BRRTS # 02-41-583015
WDNR FID # 241311510

Prepared by

Geosyntec consultants

10600 N. Port Washington Road, Suite 100
Mequon, Wisconsin 53092
Project Number CHE8094OQ

June 29, 2020

REMEDIAL ACTION DESIGN REPORT

Metro North Service Center
3100 West North Avenue
Milwaukee, Wisconsin 53208
WDNR BRRTS # 02-41-583015
WDNR FID # 241311510

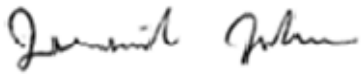
Prepared for

Wisconsin Electric Power Company
(d.b.a, We Energies)
333 West Everett Street
Milwaukee, WI 53203

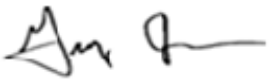
Prepared by

Geosyntec Consultants
10600 N. Port Washington Road, Suite 100
Mequon, Wisconsin 53092
Project Number CHE8094OQ

June 29, 2020



Jeremiah Johnson, P.G.
Project Geologist
(Licensed P.G. in WI)



Gregory L. Johnson, P.G., P.H., P.E.
Senior Engineer, P.E. #: 29898-006
(Licensed P.E. in WI, P.H. in WI, P.G. in IL, WI)

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1. INTRODUCTION

This Remedial Design Report (Report) was prepared by Geosyntec Consultants (Geosyntec) on behalf of Wisconsin Electric Power Company (d.b.a, We Energies) for Metro North Service Center (MNSC) located at 3100 West North Avenue, Milwaukee, Wisconsin 53208 (Site).

The purpose of this Report is to satisfy the requirements of NR 724.09 of the Wisconsin Administrative Code. The NR 712.09 submittal certification is provided in **Appendix 1**. This Report follows the following correspondence with the Wisconsin Department of Natural Resources (WDNR):

- Notification For Hazardous Substance Discharge (WDNR Form 4400-225), January 4, 2019.
- WDNR "Reported Contamination at Metro North Service Center" letter to We Energies, January 24, 2019.
- Consultant Notification letter, February 15, 2019.
- Site Investigation Work Plan, March 12, 2019 (received by WDNR on March 19, 2019).
- WDNR "Review of Site Investigation Work Plan for Metro North Service Center" letter to We Energies, May 15, 2019.
- "Response to WDNR Comments" letter, June 18, 2019.
- WDNR "Review of Comments Response" email, July 2, 2019.
- Technical Assistance Meeting, March 6, 2020.
- Site Investigation and Remedial Action Options Report, April 30, 2020.

This Report includes the following sections:

- Section 1: Introduction
- Section 2: General and Background Information
- Section 3: Remedial Action Objectives and Components
- Section 4: Source Area Unsaturated Soil Remedial Action
- Section 5: Source Area Shallow Groundwater Remedial Action
- Section 6: Vapor Mitigation System
- Section 7: Barrier
- Section 8: Groundwater Monitored Natural Attenuation
- Section 9: WDNR WRRD Registry and Continuing Obligations
- Section 10: Public Health and Environmental Laws and Standards
- Section 11: Project Schedule
- Section 12: References

2. GENERAL AND BACKGROUND INFORMATION

Detailed Site background information is documented in the April 30, 2020 Site Investigation and Remedial Action Options Report (SI-RAO Report). The purpose of this section is to satisfy the requirements of NR 724.09(1) and NR 724.09(2). This section provides Site contact, location, and description information and a brief summary of the nature and extent of Site impacts.

2.1 Contact Information

The following table summarizes the contact information for the responsible party, consultant and contractors that will be involved in the Site remedial action.

Responsible Party	We Energies Frank Dombrowski, Principal Environmental Consultant 333 Everett Street, Milwaukee, WI 53203 Email: frank.dombrowski@wecenergygroup.com Phone: 414-221-2156
Consultant	Geosyntec Consultants Jeremiah Johnson, P.G., Project Geologist Greg Johnson, P.G., P.H., P.E., Senior Engineer 10600 North Port Washington Rd. Suite 100, Mequon, WI 53092 Email: jpjohnson@geosyntec.com and gjohnson@geosyntec.com Phone: 262-377-9828
Contractors	TBD

2.2 Site Location

The Site is identified by the property address of 3100 West North Avenue, Milwaukee, Wisconsin and Parcel (Taxkey) Number 3261641000.

The Site is located in the southwest ¼ of the southeast ¼ of Section 13, Township 7 North, Range 21 East, and at Wisconsin Transverse Mercator (WTM) coordinates 686676, 289696 on WDNR's RR Sites Map. The Site location is depicted on **Figure 1**.

2.3 Site Description

The Site is a 6.28-acre parcel developed with an approximately 46,500 square foot single story building (built after 1985) consisting of office space, garage/storage areas, and a vehicle service bay. The building exterior consists of concrete walkways and landscaped planters with retaining walls and asphalt parking with concrete curb and gutter and landscaped islands. The Site property is zoned IL2, Industrial-Light. The

existing Site conditions are depicted on **Figure 2**. Site utilities and adjacent West North Avenue and North 32nd Street utilities are also depicted on **Figure 2**.

We Energies plans to reconstruct and renovate the existing Site building. The reconstruction includes demolition of the southwest portion of the building to facilitate a new building addition and expanding the garage area to the east. Site reconstruction also includes modifying exterior pavement and landscaped areas.

Historical Sanborn® maps dated 1951 and 1969 depict steam laundry and dry-cleaning facilities, respectively, for a historical building formerly located at the southwest portion of the current Site building area. The approximate location of the historical dry cleaner is depicted on SI-RAO Report Figure 4 (Historical Dry Cleaner Map) included in **Appendix 2**.

2.4 Summary of Nature and Extent of Site Impacts

The nature and extent of unsaturated soil, soil gas, shallow groundwater and deeper groundwater are described in detail in the SI-RAO Report. The following is a generalized summary of the Site investigation findings:

- Primary Source: the historical cleaner formerly located in the southwest portion of the Site building area is the source area for soil, groundwater, indoor air, and soil vapor impacts at the Site.

- Contaminant of Concern (COC): tetrachloroethene (PCE) is the primary Site contaminant. The Site investigation data indicated very little degradation of PCE to its daughter/degradation products at the Site.

- Unsaturated Soil: unsaturated PCE soil impacts are substantially limited to the source area and immediate vicinity. The most significant soil impacts were primarily encountered at depths ranging from approximately 3 to 8 feet below ground surface (ft bgs) in this area. The unsaturated soil impacts are underlain by native clay soil. The horizontal and vertical distribution of unsaturated soil impacts is depicted on SI-RAO Report Figure 5 (Soil Map) and Figures 10 and 11 (Sections A-A' and B-B') included in **Appendix 2**. These SI-RAO figures also depict the extent of unsaturated soil impacts greater than the established PCE Site-specific soil performance standard of 1,000 micrograms per kilogram (µg/kg) (refer to SI-RAO Report Section 5.2).

- Groundwater: the horizontal and vertical extent of groundwater impacts has been substantially established. PCE groundwater impacts greater than the NR 140 enforcement standard (ES) significantly attenuate with distance from the

source area and do not appear to extend off-site and significantly decrease with depth in the source area. The horizontal and vertical distribution of groundwater impacts is depicted on SI-RAO Report Figures 6 and 7 (Shallow Groundwater Map and Deep Groundwater Map) and on Figures 10 and 11 (Sections A-A' and B-B') included in **Appendix 2**.

- Soil Vapor: building indoor air concentrations are less than applicable Wisconsin Department of Natural Resources (WDNR) indoor air vapor action levels (VALs) and soil vapor impacts greater than WDNR deep soil gas vapor risk screening levels (VRSLs) appear to be limited to the vicinity of the source area and generally decrease with distance from the source area. Indoor air and soil vapor data are summarized on SI-RAO Report Figure 8 (Indoor Air Map) and Figure 9 (Soil Vapor Map), respectively.

3. REMEDIAL ACTION OBJECTIVES AND COMPONENTS

3.1 Remedial Action Objectives

As documented in SI-RAO Report Section 5.1, the overall remedial action objectives, based on the pre-remedial action exposure pathway evaluation and Site-specific considerations, are as follows:

- effectively and efficiently reduce source area contaminant (PCE) mass by removing accessible source area unsaturated soil with PCE concentrations greater than the established Site-specific soil performance standard and post-soil removal source area shallow groundwater in-situ chemical oxidation (ISCO);
- mitigate the vapor intrusion pathway for the planned source area building reconstruction; and
- address the soil to groundwater migration pathway and enhance the natural attenuation of residual groundwater impacts.

3.2 Selected Remedial Action Components

As documented in SI-RAO Report Section 5.3, the following remedial action components were selected for the Site:

- source area unsaturated soil remedial action (excavation and disposal);
- source area shallow groundwater remedial action (ISCO);
- active vapor mitigation system (VMS);
- barrier (infiltration);
- groundwater monitored natural attenuation (MNA); and
- WDNR WRRD registry and continuing obligations

Pursuant to NR 724.09(3) to NR 724.09(6), Sections 4 through 9 provide a description; design criteria, concepts, and assumptions; treatability study information (as applicable); and a summary of permits, licenses, and approvals for the selected remedial action components. Pursuant to NR 724.09(7), Section 10 provides a summary of salient public health and environmental laws and standards for implementing the selected remedial action components.

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4. SOURCE AREA UNSATURATED SOIL REMEDIAL ACTION

4.1 Description [NR 724.09(3)]

Accessible unsaturated soil with PCE concentrations greater than the established Site-specific soil performance standard (refer to SI-RAO Section 5.2) will be excavated and disposed in an off-site licensed Subtitle D landfill.

Prior to excavation, a portion of the impacted soil [with concentrations exceeding the PCE land disposal restriction (LDR) concentration] will be treated by ISCO to allow for landfill disposal. Pre-treatment to achieve the PCE LDR concentration will also attain the WDNR PCE "contained-out" concentration allowing for disposal of the excavated soil at a Subtitle D landfill in accordance WDNR *Guidance for Hazardous Waste Remediation* (WDNR, 2014a) and WDNR *"Contained-Out" Values for PCE, TCE and Vinyl Chloride* (WDNR, 2013b).

Figure 3 depicts approximate source area unsaturated soil excavation areas, including the approximate area of ISCO pre-treatment. The estimated areas and volumes of the depicted unsaturated soil excavation areas are summarized in the following table:

Figure Depicted Area	Approximate Area (sf)	Estimated Depth (ft bgs)	Approximate Volume (cy)
Building Reconstruction Area (solid red line on **Figure 3**)	5,400	8	2,100
Building Reconstruction Area (dashed red line on **Figure 3**)	900	4	200
Parking Lot Area (solid red line on **Figure 3**)	400	8	200
		Estimated Total	2,500

Note: The approximate volume includes a 20 % bulking factor and a 10% side slope factor.

The estimated area and in-place volume of the unsaturated soil pretreatment area depicted on **Figure 3** are approximately 900 square feet (sf) and 300 cubic yards (cy), respectively.

4.2 Design Criteria, Concepts and Assumptions [NR 724.09(4)]

The source area unsaturated soil remedial action design was based on the following criteria, concepts, and assumptions:

Component	Criteria, Concepts and Assumptions	
	Quantitative	**Qualitative**
Lateral Limits of Excavation	▪ site-specific SPS of 1,000 micrograms per kilogram (ug/kg)	▪ maintain excavation stability in accordance with 29 CFR 1926, Subpart P (Excavations) ▪ maintain stability of building foundations and slabs to remain ▪ maintain stability of utilities to remain
Vertical Limits of Excavation	▪ groundwater depth of approximately 8 feet bgs	
Pre-Excavation Treatment (ISCO) Objectives	▪ < PCE LDR of 60,000 ug/kg (CFR, 2020a) ▪ < PCE contained-out concentration of 153,000 ug/kg (WDNR, 2013a)	▪ NA
Pre-Excavation Treatment (ISCO) Oxidant and Concentration	▪ sodium permanganate at a 10% concentration (refer to Section 4.3)	▪ subject to WDNR approval of Infiltration and Injection Request (NR 140 exemption)
Pre-Excavation Treatment (ISCO) Verification Sampling	▪ 1 sample per 20 cy (approximately 1 sample per truckload) ▪ 1 trip (methanol) blank for each shipping container	▪ volatile organic compounds (VOCs) by EPA 8260
Air Monitoring and Emissions Control	▪ to be established in Site-specific Air Monitoring Plan and Fugitive Emissions Management Plan	▪ perimeter ambient air monitoring ▪ continuous during impacted soil disturbance ▪ VOCs and particulates
Post-Excavation Sampling	▪ approximate 25-ft intervals of excavation sidewalls (center of sidewall) ▪ 1 duplicate sample for every 10 or less samples ▪ 1 trip (methanol) blank for each shipping container	▪ base samples will not be collected (excavation will extend to groundwater table to the extent feasible) ▪ VOCs by EPA 8260
Backfill and Compaction	to be established and coordinated with building reconstruction specifications; refer to Section 5 and **Figure 4** for backfill for horizontal perforated piping placed at the bottom of the excavation	

4.3 Treatability Study Information [NR 724.09(5)]

As documented in SI-RAO Report Section 5.4, a bench-scale treatability study was conducted by Carus LLC (Carus) to evaluate the use of ISCO for source area soil (and source area shallow groundwater) for PCE reduction. Based on the study results, both

tested oxidants, sodium permanganate (Carus RemOx® L ISCO Reagent) and a blend of sodium permanganate and sodium persulfate [Carus Mixed Liquid Oxidant (MLO)] were effective for PCE removal over a range of dosing concentrations within 24 to 72 hours. Based on the study results, a 10% concentration of sodium permanganate will be used for soil pre-treatment. The Carus *Bench-Scale Treatability Study Report* was included in Appendix 8 of the SI-RAO Report.

4.4 Permits, Licenses, and Approvals [NR 724.09(6)]

An Infiltration and Injection Request (I/I Request) will be prepared and submitted to the WDNR for review and approval to implement ISCO mixing of a portion of the source area unsaturated soil to attain the PCE LDR prior to disposal. The I/I Request will be prepared pursuant to NR 140.28 and in accordance with WDNR guidance *Infiltration and Injection Requests* (WDNR, 2013a).

Excavated soil will be disposed at Waste Management, Inc. (WM) Orchard Ridge Recycling and Disposal Facility (RDF) in Menomonee Falls, Wisconsin under a previously established disposal profile (WM Profile # 131996WI).

Soil remedial action land disturbing activity will require a City of Milwaukee (City) approved construction erosion control plan based on the following criteria:

- land disturbing activity (grading, vegetation removal, excavation, land filling, etc.) affecting a surface area of 4,000 square feet or more;
- excavation, filling, or storage (or a combination thereof) affecting a volume of 100 cubic yards or more of excavated or fill material; and
- Sites involving demolition, razing, or major repair of any building where soil could be exposed to wind or rain.

Because the soil remedial action work will be coordinated with the overall Site reconstruction project, it is anticipated that remedial action work would be completed under a City-approved construction erosion control plan prepared for the Site reconstruction project.

Soil remedial action land disturbing activity will be less than 1 acre; therefore, the remedial action work will not specifically require a City of Milwaukee storm water management plan (SWMP) or a WDNR construction site storm water permit (and an associated erosion and stormwater plan) pursuant to NR 216.42. However, it is anticipated that the Site reconstruction project land disturbing activity will be greater than 1 acre; therefore, the remedial action work will be subject to the requirements of a City-approved SWMP and a WDNR construction site storm water permit obtained for the Site reconstruction project.

4.5 General Procedures

Following the establishment of permits and approvals and prior to soil pre-treatment and excavation, the following pre-excavation activities will be completed:

- Digger's Hotline and private locate utility clearance;
- surveying and staking soil pre-treatment and excavation limits;
- abandoning groundwater monitoring wells located within the excavation limits in accordance with NR 141; and
- establishing (and maintaining) health and safety, site, stormwater management and erosion, and dust and VOC emissions monitoring and controls (refer to Section 10).

Soil pre-treatment to achieve the PCE LDR will be conducted by excavator mixing of sodium permanganate (Carus RemOx® L ISCO Reagent) in accordance with a WDNR-approved I/I Request. Following the mixing and designated treatment period, treatment verification sampling will be conducted. The samples will be submitted to a NR 149 accredited laboratory under standard chain-of-custody protocols.

Excavation will be performed using conventional excavation methods. The excavated soil will be live loaded, as feasible, to limit temporary stockpiling of impacted soil. If temporary stockpiling is conducted, impacted soil will be placed upon and covered with secured plastic-sheeting within a bermed/controlled area to mitigate erosion and dust/VOC emissions generation.

Removal of contact water (perched groundwater or storm water that comes in contact with impacted soil) will only be conducted, as required, to facilitate excavation completion. Removed contact water will be contained (with secondary containment) for characterization sampling and disposal.

Post-excavation soil sampling will be conducted prior to backfill. The samples will be submitted to a NR 149 accredited laboratory under standard chain-of-custody protocols.

The final excavation limits and depths will be surveyed and photo-documented.

The bottom of the excavation will be backfilled with granular backfill around the horizontal perforated piping placed at the bottom of the excavation (refer to Section 5 and **Figure 4**) followed by structural backfill in accordance with building reconstruction specifications. The backfill materials will be placed and compacted in accordance with building reconstruction specifications.

4.6 Construction Soil Management

It is anticipated that additional unsaturated PCE-impacted soil (outside the planned source area unsaturated soil excavation areas) will be excavated to facilitate Site reconstruction. A Site-specific construction soil management plan (SMP) will be prepared and implemented for this work. This additional soil excavation and management will be documented in the remedial action construction documentation report.

5. SOURCE AREA SHALLOW GROUNDWATER REMEDIAL ACTION

5.1 Description [NR 724.09(3)]

Post-excavation ISCO will be conducted in source area shallow groundwater by direct mixing of the oxidant in saturated soil at the bottom of the source area soil excavation prior to backfill in accordance with a WDNR-approved I/I Request.

Horizontal perforated piping will be placed at the bottom of the excavation (and connected to a riser pipe) to allow for potential future oxidant placement. The piping will be bedded and backfilled with granular backfill to two feet above the top of the pipe. The planned piping layout and details are depicted on **Figure 4**.

5.2 Design Criteria, Concepts and Assumptions [NR 724.09(4)]

Source area shallow groundwater ISCO will be conducted to reduce source area contaminant (PCE) mass and enhance groundwater MNA at the Site. This remedial action component makes use of the access to shallow groundwater by the source area soil removal.

A 3-foot target saturated mixing zone thickness is assumed over the approximate area depicted on **Figure 4** (approximately 5,400 sf). An excavator bucket will be used to mix a 5% concentration of Carus MLO (blend of sodium permanganate and sodium persulfate) solution into the mixing zone (refer to Section 5.3).

5.3 Treatability Study Information [NR 724.09(5)]

As documented SI-RAO Report Section 5.4, a bench-scale treatability study was conducted by Carus LLC (Carus) to evaluate the use of ISCO for source area shallow groundwater. Based on the study results, both tested oxidants, sodium permanganate (Carus RemOx® L ISCO Reagent) and a blend of sodium permanganate and sodium persulfate (Carus MLO) were effective for PCE removal over a range of dosing concentrations. Based on these results and the following rationale, a 5% concentration of Carus MLO will be used for shallow groundwater.

MLO is a 1:1 mixture of sodium permanganate and un-activated persulfate. Both permanganate and persulfate are strong oxidants capable of PCE destruction, although the reaction kinetics of un-activated persulfate are slow. One of the byproducts of sodium permanganate ($NaMnO_4$) oxidation is manganese dioxide (MnO_2). Manganese dioxide serves as an activator for persulfate, creating sulfate radicals, which increase the persulfate reaction kinetics and make it a suitable complement to permanganate for PCE

oxidative destruction. One of the benefits of this combined chemistry is that sulfate radicals have a lower affinity for natural soil organic material than permanganates (Brown, et. al, 2003). Thus, activated persulfate is less likely to be "wasted" on reactions with naturally occurring soil organic materials. Given this and its relative stability in the subsurface, activated persulfate may provide more effective PCE destruction in groundwater over a larger area than permanganate alone.

The Carus Bench-Scale Treatability Study Report was included in Appendix 8 of the SI-RAO Report.

5.4 Permits, Licenses, and Approvals [NR 724.09(6)]

An I/I Request will be prepared and submitted to the WDNR for review and approval to implement shallow groundwater ISCO. The I/I Request will be prepared pursuant to NR 140.28 and in accordance with WDNR guidance *Infiltration and Injection Requests* (WDNR, 2013a). It is anticipated that the initial I/I Request will include the initial saturated zone mixing and one future oxidant addition event with the installed piping system. For groundwater ISCO, the I/I Request will include an associated Wisconsin Pollutant Discharge Elimination System (WPDES) Notice of Intent.

5.5 Monitoring, Operation and Maintenance [NR 724.09(8)]

Residual MLO concentrations in groundwater will be evaluated in the field using a Hach DR 890 colorimeter. MNA groundwater monitoring, as described in Section 8, will commence in accordance with a WDNR-approved Groundwater Monitoring Plan when residual MLO concentration is less than approximately 0.5 mg/L.

Future oxidant addition (with the installed piping system) will be based on MNA groundwater monitoring, with particular focus on the results of the initial year of semi-annual MNA groundwater monitoring.

6. VAPOR MITIGATION SYSTEM

6.1 Description [NR 724.09(3)]

Although the Site investigation data indicated indoor air concentrations less than WDNR VALs, a VMS will be integrated into the building reconstruction area proximate to the source area for long-term risk management. The VMS will be an active sub-slab depressurization system (SSDS). The area of the VMS is approximately 19,800 square feet (sf) as depicted on **Figure 5**.

VMS installation will be integrated with building reconstruction and sequenced following building addition foundation construction, existing building interior slab removal, utility stub-up and subgrade preparation (and prior to floor slab construction). The VMS will consist of venting layer connected by riser pipes to roof-mounted blowers, a two-component barrier layer (geomembrane sheeting base layer and spray-applied membrane top layer), and a barrier protection layer. The VMS layout and details are depicted on **Figure 5** and **Figure 6**, respectively.

Venting Layer and Blower

The venting layer will be placed on the prepared subgrade. The venting layer will consist of a 6-inch coarse granular layer with incorporated GEOVENT™ conveyance units (1-foot wide by 1-inch thick, three-dimensional vent core wrapped in a non-woven, needle-punched filter fabric). A GEOVENT™ technical data sheet is included in **Appendix 3**. The venting layer design includes approximately 925 linear feet of GEOVENT™ as depicted on **Figure 5**.

The venting layer will be connected to multiple 4-inch diameter polyvinyl chloride (PVC) vent riser pipes installed at column locations as depicted on **Figure 5**. The riser pipes will extend to blowers installed on the roof as depicted on **Figure 6**. The final riser and blower locations will be field verified based on the building interior and roof layout. The blower will be sized based on in-field diagnostic testing.

Each riser pipe will be fitted with instrumentation for balancing flow (ball valve) and measuring vacuum (magnehelic gauge), and flow monitoring (sample port for thermal anemometer). An alarm will also be installed at each riser to provide visual and/or auditory indication that blower has stopped operating. The blowers will be connected to the building power supply through a dedicated electrical breaker and each blower will have a power disconnect switch.

Barrier Layer

The barrier layer will be installed following the placement of the venting layer. The barrier layer will consist of a 20-mil VI-20™ polyethylene geomembrane overlain by a minimum 60-mil LIQUID BOOT® spray-applied barrier (a.k.a., "LIQUID BOOT® Plus" system). Technical data sheets for the VI-20™ polyethylene geomembrane and LIQUID BOOT® products are included in **Appendix 3**. The VI-20™ geomembrane will be placed over the venting layer. The geomembrane seams will be overlapped a minimum of six (6) inches. The geomembrane will be cut tight around penetrations and along the perimeter edges. A thin tack coat of LIQUID BOOT® will be sprayed over the seams, around the penetrations and along the perimeter edges prior to full LIQUID BOOT® application. LIQUID BOOT® will be spray-applied to a minimum 60-mil minimum dry (cured) thickness. All penetrations will be sealed (around and up the penetrations) in accordance with the manufacturer's standard specifications as generally depicted on **Figure 6**.

Barrier Protection Layer

Following quality control testing, a barrier protection layer (UltraShield™ G-1000 polypropylene, non-woven geotextile) will be placed over the barrier layer (to protect the barrier layer from damage during subsequent slab construction) as depicted on **Figure 6**. The protective geotextile will be placed close to the edges and penetrations. A technical data sheet for the UltraShield™ G-1000 geotextile is included in **Appendix 3**.

Vapor Probes

The VMS installation will include sub-slab vapor probes for the purpose of pressure field extension (PFE) (i.e., zone of influence/communication) testing to demonstrate PFE (differential negative pressure) over the VMS area. The approximate vapor probe locations are depicted on **Figure 5** and the vapor probe construction is depicted on **Figure 6**. The final vapor probe locations will be field verified based on the building interior layout and operations.

6.2 Design Criteria, Concepts and Assumptions [NR 724.09(4)]

The extent of the VMS was established based on the building reconstruction plans and the extent of shallow groundwater impacts greater than NR 140 enforcement standards as depicted on SI/RAO Report Figure 6 (Shallow Groundwater Map) included in **Appendix 2**.

The VMS design criteria, concepts and assumptions are generally based on the following guidance:

- WDNR *Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin, Wis. Stat. ch. 292; Wis. Admin. Code ch. NR 700* (WDNR, 2018).
- American National Standards Institute (ANSI)/American Association of Radon Scientists and Technologists (AARST) Standard CC-1000-2018, *Soil Gas Control Systems in New Construction of Building* (ANSI/AARST, 2018).
- Naval Facilities Engineering Command (NAVFAC) *Vapor Intrusion Mitigation in Construction of New Buildings Fact Sheet* (NAVFAC, 2011).

The VMS was designed with three (3) venting layer risers based on ANSI/AARST minimum recommended area (7,100 sf) for a 4-inch riser pipe size and "the durable air barrier between soil gas and indoor air is virtually airtight (e.g., spray applied vapor barriers or other geomembranes intended to form homogenous closure)".

The 6-inch granular venting layer component satisfies the ANSI/AARST recommendation of "A uniform layer not less than 4 inches (10 cm) in depth of gravel or crushed stone".

The GEOVENT™ venting layer component satisfies the ANSI/AARST recommendation that "All duct inner dimensions, including secondary trunk and branches that route only a portion of the system air volume, shall not be less in size than the nominal cross-sectional inside diameter of 3-inch (7.6 cm) pipe".

The planned number and location of vapor probes satisfy the ANSI/AARST recommendation of "Not less than one test port for each outer quadrant area of the building".

6.3 Permits, Licenses, and Approvals [NR 724.09(6)]

To satisfy the requirements of NR 406, during startup, the total VOC mass discharge from the VMS will be assessed by collecting discharge samples from each of the venting layer riser/blower stacks. It is anticipated that a request for an exemption from construction permit requirements will prepared in accordance with NR 406.04 and submitted to WDNR for approval prior to full-time operation of the VMS.

It is anticipated that VMS installation will be completed under the Site/building reconstruction work City electrical; heating, ventilation, and air conditioning (HVAC), and plumbing permits, as applicable.

6.4 Monitoring, Operation and Maintenance [NR 724.09(8)]

VMS monitoring will consist of construction quality assurance (CQA) monitoring, performance and baseline conditions monitoring, and long-term operation, monitoring and maintenance.

6.4.1 Construction Quality Assurance Monitoring

CQA monitoring will consist of the following components:

- visually inspecting and photo-documenting the venting and barrier component products upon delivery (and upon acceptance, obtaining written warranties for all products);
- visually inspecting and photo-documenting subgrade surface preparation (to confirm it is compacted, finished smooth and uniform, and free of debris, stones, and standing water);
- visually inspecting, photo-documenting and surveying venting component installation (granular layer, GEOVENT™, risers and blowers);
- visually inspecting and photo-documenting barrier for coverage and integrity (holes, thinning, shrinkage, and any other damage) and the sealing of seams, utility penetrations, footings, and walls;
- conducting destructive testing of cured barrier layer to confirm minimum thickness;
- conducting smoke leak testing of the barrier layer to confirm sealing; and
- visually inspecting and photo-documenting riser, blower, and alarm installation and operation.

6.4.2 Performance and Baseline Conditions Monitoring

Performance and baseline condition monitoring will consist of the following:

- conducting PFE testing using installed vapor probes to demonstrate that PFE (differential negative pressure) for the VMS area is achieved (3 events over the first 6 months of operation);
- measuring vacuum and air flow for each blower at the same time that PFE is measured;
- conducting indoor air sampling at two consecutive PFE measurement events to confirm indoor air concentrations are less than WDNR VALs; and
- conducting an operational alarm test.

6.4.3 Long-Term Operation, Monitoring and Maintenance

VMS long-term operation, monitoring and maintenance (OM&M) will be conducted in accordance with a site-specific VMS OM&M Plan prepared in accordance with WDNR guidance *Maintenance Plans for Vapor Mitigation Systems/Vapor Intrusion Response Actions/Vapor Barriers* (WDNR, 2014b). The VMS OM&M Plan will be included in the NR 724 VMS Construction Documentation Report.

7. BARRIER

7.1 Description [NR 724.09(3)]

The Site building slabs and pavements will be maintained as an infiltration barrier. **Figure 7** depicts the current and planned Site/building slab and pavement surface at the Site.

7.2 Design Criteria, Concepts and Assumptions [NR 724.09(4)]

Incorporation of the barrier as a remedial action component is based on the qualitative assumption that the current groundwater plume is a function of the current Site infiltration (based on current impermeable and permeable Site improvements).

As depicted on **Figure 7**, building slab and pavement surface will increase in the source area following Site reconstruction. Site/building reconstruction architectural plans indicate that the overall Site property impermeable surface will increase from 86.6% to 89.4% (Newman Architects, 2019).

7.3 Permits, Licenses, and Approvals [NR 724.09(6)]

A Barrier Maintenance Plan will be prepared in accordance WDNR *Maintenance Plan Example Template for a Straightforward Site* (WDNR, 2014c) and will be submitted to WDNR for approval with the Case Closure Request.

7.4 Inspection and Maintenance [NR 724.09(8)]

The barrier will be inspected annually. The inspections and any repairs will be documented on WDNR Form 4400-305, *Continuing Obligations Inspection and Maintenance Log*. We Energies will maintain copies of the logs at the facility and in We Energies corporate records.

8. GROUNDWATER MONITORED NATURAL ATTENUATION

8.1 Description [NR 724.09(3)]

Routine post-remedial action groundwater monitoring will be conducted to demonstrate that natural attenuation is capable of remediating residual PCE groundwater impacts (i.e., to sufficiently establish stable or decreasing PCE groundwater concentrations at the Site).

It is anticipated that most if not all of the existing groundwater monitoring wells will be abandoned during Site reconstruction and soil remedial action activities. The groundwater monitoring wells will be abandoned in accordance with NR 141.

Following source area unsaturated soil and shallow groundwater remedial action and Site/building reconstruction, a groundwater monitoring well network will be installed to support MNA assessment. The proposed (replacement) groundwater monitoring well network is depicted on **Figure 8.** Each location will consist of a nested shallow groundwater monitoring well and a deep groundwater monitoring well. At the three nest locations, a deep groundwater piezometer is also proposed. The estimated groundwater monitoring well and piezometer screen intervals are summarized in the following table:

Monitoring Wells/Piezometers	**Approximate Screen Interval (ft bgs)**	**Basis**
shallow groundwater monitoring wells	5-15	screened across water table within fill and clay soil (refer to SI-RAO Report Figures 10 and 11, included in **Appendix 2**)
deep groundwater monitoring wells	ranging from 40-50 to 45-55	screened across interface of sand and gravel unit and lower silt and clay unit; as documented in the SI-RAO Report, the sand and gravel unit was observed to be unsaturated (substantially dry) with the exception of the lower portion above the silt and clay unit. (refer to SI-RAO Report Figures 10 and 11, included in **Appendix 2**)
deep groundwater piezometer	60-65	within silt and clay unit (refer to SI-RAO Report Figures 10 and 11, included in **Appendix 2**)

The proposed groundwater monitoring well network depicted on **Figure 8** may be modified based on field verification of access constraints following building reconstruction.

Groundwater samples will be submitted to a NR 149 accredited laboratory for analysis under standard chain-of-custody protocols.

8.2 Design Criteria, Concepts and Assumptions [NR 724.09(4)]

Consistent with WDNR Guidance *Understanding Chlorinated Hydrocarbon Behavior in Groundwater: Guidance on Investigation, Assessment and Limitations of Monitored Natural Attenuation* (WDNR, 2019), "MNA is best used to address residual groundwater contamination after active remedies have removed the majority of the contamination."

The former dry cleaner operations ceased by 1985, eliminating the primary source of PCE at the Site. Non-aqueous phase liquid (NAPL) has not been encountered at the Site. The planned active unsaturated soil and shallow groundwater remedial action will address the highest concentrations of PCE in soil and groundwater, thereby significantly reducing residual source mass. Therefore, MNA is expected to be an effective final remedy to address residual groundwater impacts at the Site.

The groundwater sampling data indicate very little biological degradation of PCE to its daughter products [trichloroethene (TCE), dichloroethane (DCE) and vinyl chloride]. TCE was only detected at one shallow groundwater monitoring well location and at one shallow groundwater temporary groundwater sampling point (both located in the source area) and DCE and vinyl chloride have not been detected in groundwater at the Site.

Biological degradation of chlorinated ethenes typically occurs under anaerobic conditions where there is a ready source of total organic carbon (TOC), typically greater than 20 milligrams per liter (mg/L). As summarized in **Table 1**, the TOC concentrations in Site groundwater range from 0.42 to 3.5 mg/L. As further summarized in **Table 1**, the geochemistry of shallow groundwater is characterized by variable dissolved oxygen (DO) concentrations (0.05 to 6.19 mg/L), neutral pH (6.52 to 7.39) and oxidizing conditions [oxidation reduction potential (ORP) 29.1 to 203.2). The deep groundwater is characterized by variable (and generally lower) DO concentrations (0.09 to 2.11 mg/L), neutral pH (6.54 to 7.40) and variable redox conditions (ORP -444.7 to +156.6).

Based on these data (i.e., low TOC and generally neutral to oxidizing conditions), Site geochemical conditions do not appear to readily support reductive dechlorination of PCE. Further, abiotic processes such as co-metabolism are not typically effective on PCE. Therefore, MNA for PCE in Site groundwater is most likely to occur through a combination of physical processes such as dilution, dispersion, sorption and volatilization. In addition, the plume migration appears to be retarded by slow shallow

groundwater flow across the Site. Groundwater flow conditions will be further evaluated following planned in-situ conductivity testing of existing wells (refer to Section 8.4).

Based on this analysis, the groundwater MNA monitoring parameters will include the following:

Parameter	**Basis**
water level measurement	gradient, flow direction
field parameters (pH, ORP, DO)	geochemical trend analysis
VOCs	contaminant concentration trend analysis
dissolved manganese	manganese will be introduced into shallow groundwater through the addition of oxidant, and will be monitored for changes relative to background

The proposed groundwater monitoring well network was established based on the following concepts and assumptions:

- The distribution of shallow and deep groundwater impacts depicted on **Figure 8** and on SI-RAO Report Figures 6 and 7 included in **Appendix 2**.
- The primary well network criteria identified WDNR guidance *Understanding Chlorinated Hydrocarbon Behavior in Groundwater: Guidance on the Investigation, Assessment and Limitation of Monitored Natural Attenuation* (WDNR, 2019):
  - ✓ along the flow path to assess natural attenuation processes;
  - ✓ in a transect of perpendicular to the groundwater flow path to the track lateral and vertical movement of the plume over time; and
  - ✓ downgradient of the plume (sentinel wells).
- On-site building exterior and interior well installation access constraints.
- Off-site access constraints.

8.3 Permits, Licenses, and Approvals [NR 724.09(6)]

Existing groundwater monitoring wells will be abandoned, and new groundwater monitoring wells will be installed in accordance with NR 141.

A Groundwater Monitoring Plan will be prepared in accordance with NR 724.17(2) and submitted to WDNR for review and approval. The groundwater monitoring plan will

detail the sampling parameters, sampling and analytical methods, and monitoring frequency.

8.4 Monitoring [NR 724.09(8)]

As indicated in SI-RAO Report Section 3.3.2, and prior to well abandonment, one additional round of groundwater sampling and in-situ hydraulic conductivity (slug) testing will be conducted to support MNA evaluation.

MNA groundwater monitoring will commence following source shallow groundwater oxidant depletion. As the oxidant (MLO) reacts in the subsurface, the oxidant concentration will decrease. As indicated in Section 5.5, residual oxidant (MLO) concentrations will be evaluated in the field using a Hach DR 890 colorimeter. MNA groundwater monitoring will commence in accordance with the WDNR-approved Groundwater Monitoring Plan when residual MLO concentrations are less than 0.5 mg/L.

It is anticipated that MNA groundwater monitoring will be conducted semi-annually until MNA is demonstrated to be effective.

9. WDNR WRRD REGISTRY AND CONTINUING OBLIGATIONS

It is anticipated that WRRD registry for soil and groundwater and continuing obligations will be components of WDNR case closure. Continuing obligations will include operation, monitoring and maintenance of the VMS; inspection and maintenance of the barrier; soil management provisions; and water well prohibition.

10. PUBLIC HEALTH AND ENVIRONMENTAL LAWS AND STANDARDS

Pursuant to NR 724.09(7), this section provides a summary of salient public health and environmental laws and standards including health and safety, Site controls, stormwater management and erosion control, dust and emissions monitoring and control, equipment and vehicle decontamination, and transport and disposal.

10.1 Health and Safety

Remedial action construction will comply with 29 CFR 1910 Occupational Safety and Health Standards and 29 CFR 1926 Safety and Health Regulations for Construction. Site contractors will conduct the remedial action work in accordance with Site-specific, Work-specific Health and Safety Plans that meet the minimum requirements of the Project Health and Safety Plan.

Oxidant storage, handling and mixing will be closely monitored and will be conducted in accordance with the oxidant Safety Data Sheets (**Appendix 4**) and contractor-established Site-specific task-hazard analyses. Oxidant safety management will be inspected and documented daily.

Soil excavations will comply with 29 CFR 1926, Subpart P. Excavations will be sloped as required to maintain sidewall stability. A remedial action contractor designated "competent person" (as defined in 29 CFR 1926, Subpart P) will inspect and document excavation safety conditions daily.

10.2 Site Controls

Secured construction fencing, signage and traffic controls will be employed to protect the public during remedial action construction activities.

10.3 Stormwater Management and Erosion Control

Erosion and stormwater best management practices (BMPs) will be implemented during impacted soil disturbing and handling activities to prevent the erosion and migration of impacted soil from impacted-soil disturbance areas. The BMPs will be implemented in accordance with Site reconstruction project plans and permits (refer to Section 4.4). It is anticipated that the BMPs will include a tracking pad, silt fencing, and inlet protection. Paved Site work areas and public streets will be swept daily, or more frequently as needed.

10.4 Dust and Emissions Monitoring and Control

Perimeter ambient air monitoring and dust and emissions controls will be implemented in accordance with the Site-specific Air Monitoring Plan and Fugitive Emissions Management Plan.

Dust control measures will be implemented at all times during impacted soil disturbing and handling activities to prevent the formation and migration of dust. Conventional methods will be used to suppress dust generated during impacted soil disturbing and handling activities including, but not limited to, the following: applying a light water spray, covering impacted soil stockpiles, limiting vehicle speeds in impacted soil disturbance areas, and keeping the drop heights to a minimum while loading vehicles.

VOC emission control measures will be implemented as necessary based on perimeter ambient air monitoring. VOC emission control measures may include covering disturbed soil or stockpiles and/or applying VOC emission/odor suppressants (e.g., foam and/or misting suppressant applications) to active and/or inactive work areas.

10.5 Equipment and Vehicle Decontamination

Equipment and vehicle decontamination will be conducted to prevent cross-contamination of on-Site work areas and on-Site and off-Site tracking of contaminated materials.

A decontamination pad/facility will be installed and maintained. The decontamination pad/facility may be co-located with the tracking pad and will be constructed to facilitate the collection and removal of decontamination solids and liquids. Decontamination activities will include the removal of solids/debris from equipment and vehicles using a combination of physical/mechanical removal (to minimize wastewater generation) and high-pressure washing and rinsing.

Accumulated decontamination solids will be managed consistent with excavated soil. If decontamination liquids are accumulated, the liquids will be contained in labeled 55-gallon drums (within secondary containment) for characterization sampling and disposal.

10.6 Transport and Disposal

Impacted soil will be transported by a licensed hauler in accordance with Federal, State, and local marking, labeling, placarding, and manifesting requirements. Wisconsin

Department of Transportation Standard (WisDOT) designated truck routes will be utilized to extent practicable.

Flaggers will be used as necessary when haul trucks enter and exit the public right-of-way to protect pedestrian and vehicle safety.

11. PROJECT SCHEDULE

The following table summarizes the anticipated project remedial action schedule:

Remedial Action Component	Estimated Completion [1]
Additional Sampling/Testing (groundwater, indoor air, and soil vapor)	2Q/3Q 2020
Infiltration and Injection Requests (NR140 exemption applications)	2Q/3Q 2020
Remedial Action Project (Implementation) Plans [2] Health and Safety Plan (update to current Project Health and Safety Plan) Air Monitoring Plan and Fugitive Emissions Management Plan Construction Soil Management Plan	3Q 2020
NR 724 Groundwater Monitoring Plan	3Q/4Q 2020
Remedial Action Implementation (in conjunction with Site building reconstruction)	4Q 2020/1Q 2021
NR 406 Exemption Request (VMS) NR 724 Construction Documentation Report(s) NR 724 VMS Operation, Monitoring and Maintenance Plan Barrier Maintenance Plan	1Q/2Q 2021

Notes:

(1) The project schedule is dependent on Public Service Commission of Wisconsin (PSCW) approval of the Certificate of Authority (CA) for the project.

(2) The listed remedial action project (implementation) plans will not be submitted to WDNR for review and approval; however, it is anticipated that the Air Monitoring Plan and Fugitive Emissions Management Plan will be submitted to WDNR and the City of Milwaukee Health Department for informational purposes.

Schedule updates will be provided to WDNR in the NR 700 semi-annual progress reports.

12. REFERENCES

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Brown, R.A., D. Robinson and G. Skladany (2003). Response to Naturally Occurring Organic Material: Permanganate verses Persulfate", ConSoil 2003, Ghent Belgium.

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CFR (2020c). Safety and Health Regulations for Construction, 29 CFR 1926.

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Newman Architects (2019). Preliminary (Not for Construction) Site/building reconstruction plan and detail sheets.

USGS (2018). Milwaukee, Wisconsin, 7.5 Minute Series (Topographic) Quadrangle Map, 2018.

WDNR (2013a). Infiltration and Injection Requests, RR-935, March 2013.

WDNR (2013b). "Contained-Out" Values for PCE, TCE and Vinyl Chloride, RR-969, December 2013.

WDNR (2014a). Guidance for Hazardous Waste Remediation, RR-705, January 2014.

WDNR (2014b). Maintenance Plans for Vapor Mitigation Systems/Vapor Intrusion Response Actions/Vapor Barriers, RR-981, April 2014.

WDNR (2014c). Maintenance Plan Example Template for a Straightforward Site, RR-980, April 2014.

WDNR (2018). Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin Wis. Stat. ch. 292; Wis. Admin. Code ch. NR 700, RR-800, January 2018.

WDNR (2019). Understanding Chlorinated Hydrocarbon Behavior in Groundwater: Guidance on the Investigation, Assessment and Limitation of Monitored Natural Attenuation, RR-699, October 2014 (updated September 2019).

TABLES

TABLE 1

Summary of Groundwater Geochemical Data

Metro North Service Center (MNSC)

3100 West North Avenue

Milwaukee, Wisconsin

Monitoring Well/Sample ID	Screen Interval	9/10/2019, 9/11/2019*				11/21/2019, 11/25/2019				3/17/2020 to 3/19/2020			
		TOC	DO	ORP	pH	TOC	DO	ORP	pH	TOC	DO	ORP	pH
	(ft bgs)	(mg/L)	(mg/L)	(mV)	(std. units)	(mg/L)	(mg/L)	(mV)	(std. units)	(mg/L)	(mg/L)	(mV)	(std. units)
Shallow Groundwater Monitoring Wells													
MW-01-2019	6-16	2.0	4.32	73.6	6.76	--	--	--	--	3.5	0.91	147.4	7.28
MW-01-2019 DUP		--	--	--	--	--	--	--	--	2.4			
MW-02-2019	6-16	1.3	4.03	87.5	6.52	--	--	--	--	0.73	0.05	184.4	6.88
MW-03-2019	6-16	0.81	0.67	29.1	7.23	--	--	--	--	2.0	0.09	139.7	7.39
MW-03-2019 DUP		--	--	--	--	--	--	--	--	1.8			
MW-04-2019	10-20	1.0	3.22	76.4	7.03	--	--	--	--	1.5	1.47	174.3	6.93
MW-06-2019	6-16	0.79	2.01	56.3	7.29	--	--	--	--	0.46	3.62	203.2	7.03
MW-07-2019	6-16	0.56	5.63	94.8	6.98	--	--	--	--	1.1	0.18	140.6	6.84
MW-07-2019 DUP		0.55				--	--	--	--	--	--	--	--
MW-08-2019	6-16	0.42	3.71	89.9	7.12	--	--	--	--	0.94	3.91	199	7.09
MW-09-2019	5-15	1.2	6.19	114.9	6.52	--	--	--	--	0.57	0.88	190.9	7.01
Deep Groundwater Monitoring Wells/Piezometers													
P-01-2019	44-54	--	--	--	--	2.6	0.64	-175.7	6.89	0.98	0.09	-17.7	6.54
P-01-2019 DUP		--	--	--	--	2.6				--	--	--	--
P-05-2019	48-58	--	--	--	--	0.57	1.28	-153	7.05	0.47	0.12	14.7	6.68
P-07-2019	42-52	--	--	--	--	0.70	0.27	-444.7	6.58	0.35	0.11	39.1	6.58
P-08-2019	42-52	--	--	--	--	0.38	0.28	-419	6.80	0.33	0.19	39.9	6.93
P-09-2019	42-47	0.68	3.08	43.4	7.40	--	--	--	--	0.43	0.48	156.6	6.95
P-09A-2019	60-65	--	--	--	--	0.60	2.11	-33.0	7.16	0.31	0.60	-39.4	6.88

Notes:

-- not analyzed or not applicable

* - field instrument had operation/calibration issues

DO - dissolved oxygen

ft bgs - feet below ground surface

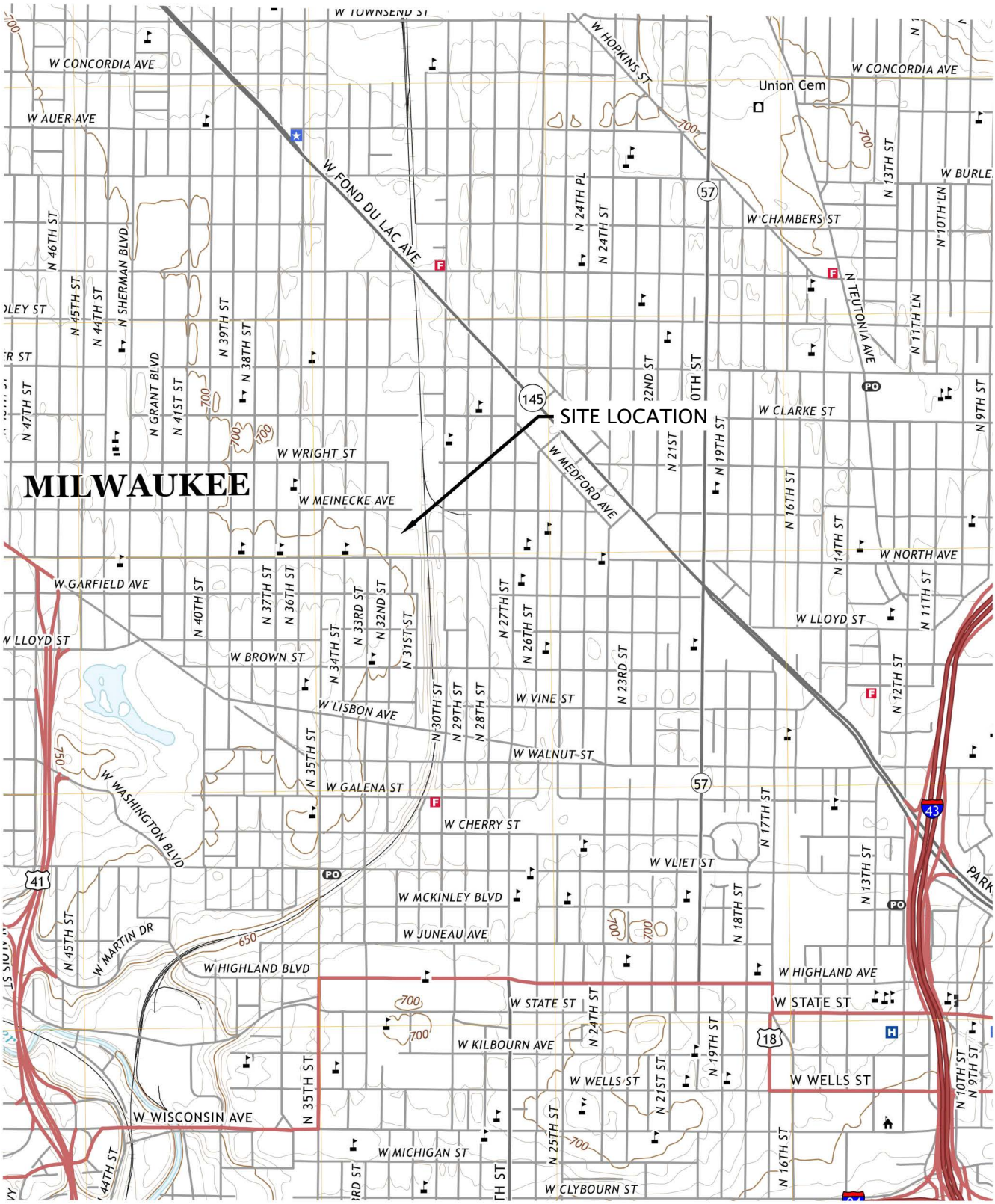
mg/L - milligrams per liter

mV - millivolt

ORP - oxidation reduction potential

TOC - total organic carbon

FIGURES



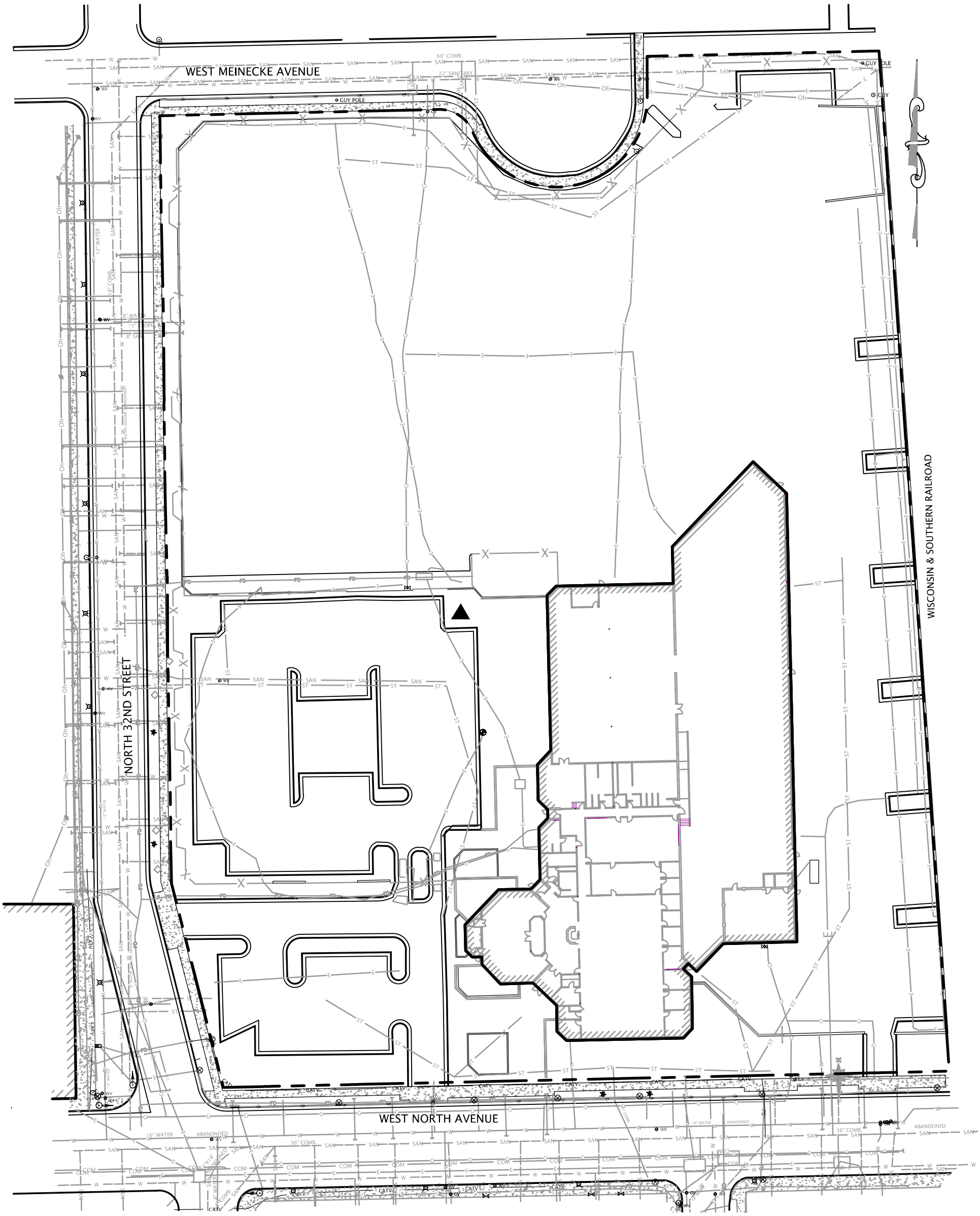
SOURCE: USGS MILWAUKEE, WISCONSIN QUADRANGLE
TOPOGRAPHIC MAPS 2018

SCALE IN FEET

0 2,000'

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SITE LOCATION MAP
PROJECT: CHE8094OQ	FIGURE NO.: 1
DATE: June 11, 2020	FILE NO.: 2005MNSCP2001
DRAWING NO.:	1 OF 8



SCALE IN FEET

0 60'

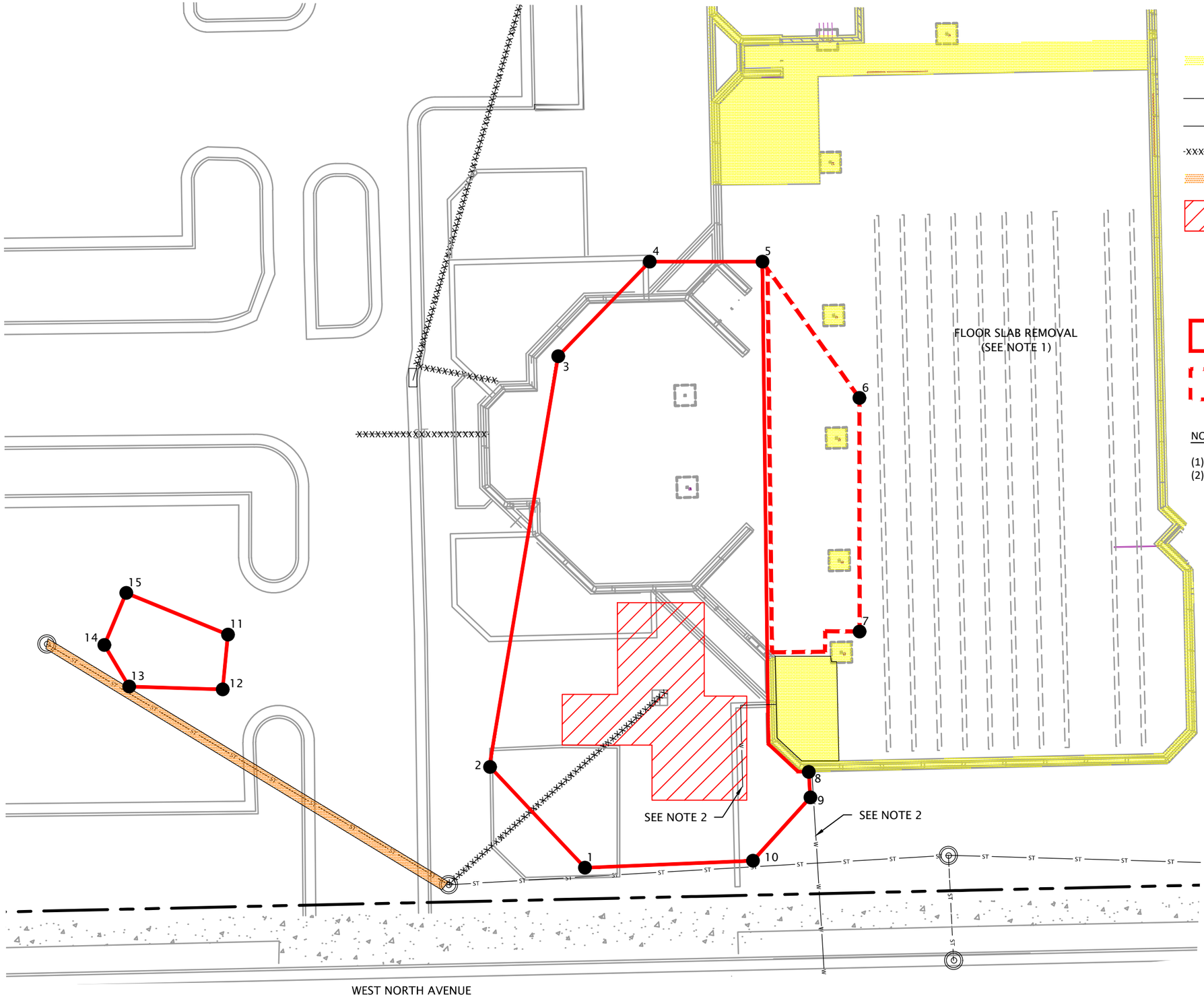
LEGEND:

- APPROXIMATE SITE PROPERTY LINE
- EXISTING SITE PROPERTY BUILDING
- STORM SEWER LINE
- SANITARY SEWER LINE
- WATER UTILITY LINE
- ELECTRIC UTILITY LINE
- GAS UTILITY LINE
- TELEPHONE UTILITY LINE
- BUREAU OF ELECTRIC SERVICE LINE
- FENCE LINE
- CATCH BASIN
- MANHOLE
- HYDRANT
- WATER VALVE
- LIGHT POLE
- ELECTRICAL EQUIPMENT
- COMMUNICATIONS TOWER

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SITE LAYOUT MAP

PROJECT: CHE8094OQ	FIGURE NO.: 2	DRAWING NO.: 2 OF 8
DATE: June 11, 2020	FILE NO: 2005 MNSCP2 01	



LEGEND:

- EXISTING BUILDING FOUNDATION AND FLOOR SLAB TO REMAIN
- EXISTING STORM SEWER TO REMAIN
- EXISTING WATER LINE (SEE NOTE 2)
- STORM SEWER TO BE REMOVED
- STORM SEWER TO BE REMOVED AND REPLACED
- APPROXIMATE SOIL PRE-TREATMENT AREA
- SOIL REMOVAL CONTROL POINT

SOURCE AREA UNSATURATED SOIL REMOVAL:

- APPROXIMATE 8-FT BGS (DEPTH TO GROUNDWATER)
- APPROXIMATE FIELD ESTABLISHED DEPTH (TO MAINTAIN STABILITY OF BUILDING FOUNDATIONS AND UTILITIES TO REMAIN)

NOTES:

(1) UNDERFLOOR ELECTRICAL DUCTS TO BE REMOVED WITH FLOOR SLAB.
(2) FIELD VERIFY EXISTING WATER LINE LOCATION PRIOR TO SOIL REMOVAL; EXISTING WATER LINE TO BE REMOVED AND REPLACED.

SOIL REMOVAL CONTROL POINTS

CONTROL POINT	NORTHING	EASTING
1	393525.17	2514907.51
2	393544.91	2514888.91
3	393625.36	2514902.24
4	393643.88	2514920.20
5	393643.87	2514942.26
6	393617.18	2514961.29
7	393571.44	2514961.33
8	393543.95	2514951.36
9	393538.94	2514951.68
10	393526.53	2514940.41
11	393570.84	2514837.54
12	393560.11	2514836.50
13	393560.67	2514818.16
14	393568.80	2514813.32
15	393579.00	2514817.60

SCALE IN FEET
0 20'

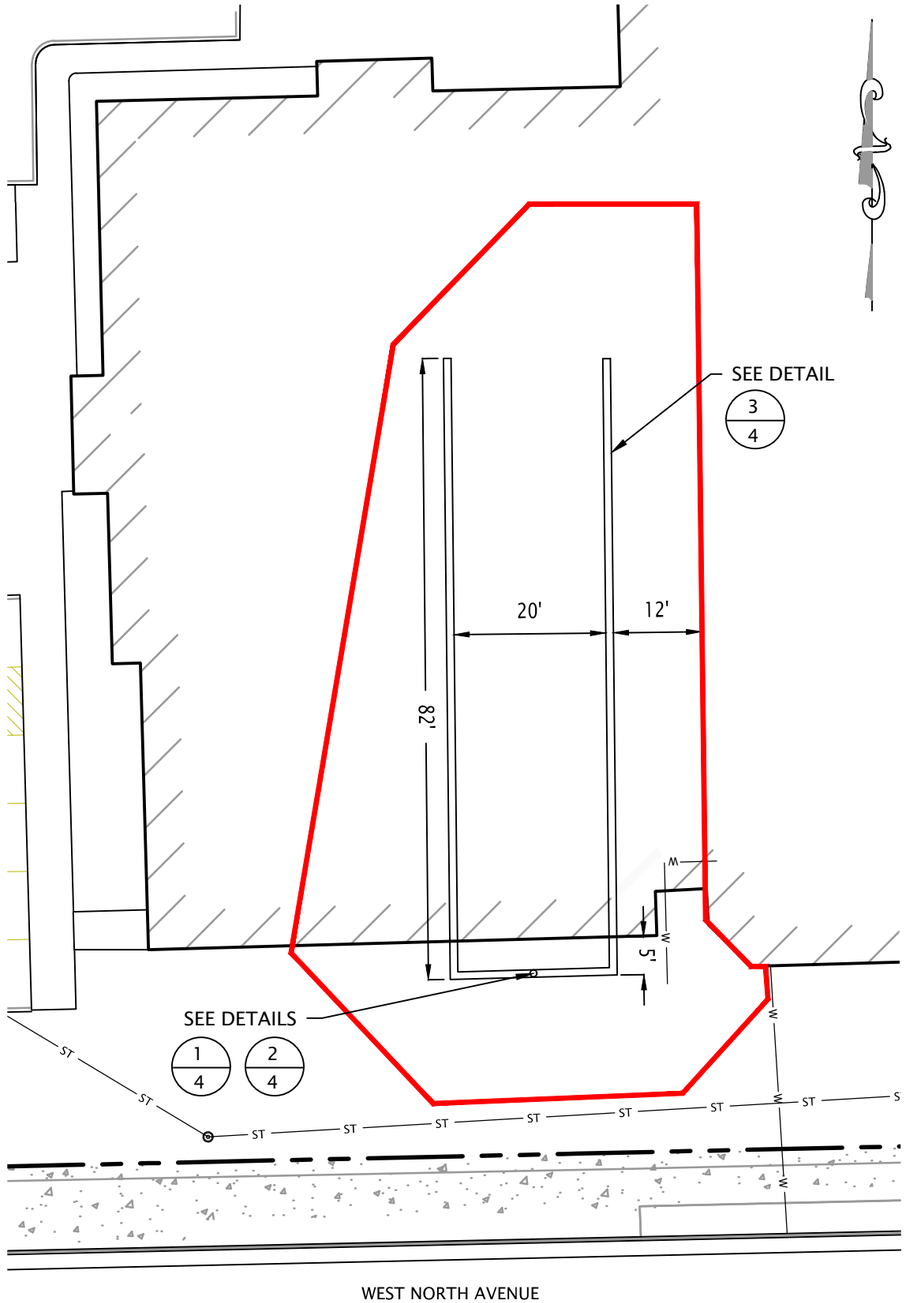
Geosyntec consultants

CLIENT: WE ENERGIES

PROJECT: METRO NORTH SERVICE CENTER (MNSC)
3100 WEST NORTH AVENUE
MILWAUKEE, WISCONSIN

TITLE: UNSATURATED SOIL EXCAVATION PLAN

PROJECT: CHE8094OQ	FIGURE NO.: 3	DRAWING NO.: 3 OF 8
DATE: June 25, 2020	FILE NO.20-05 MNSCP2 003	

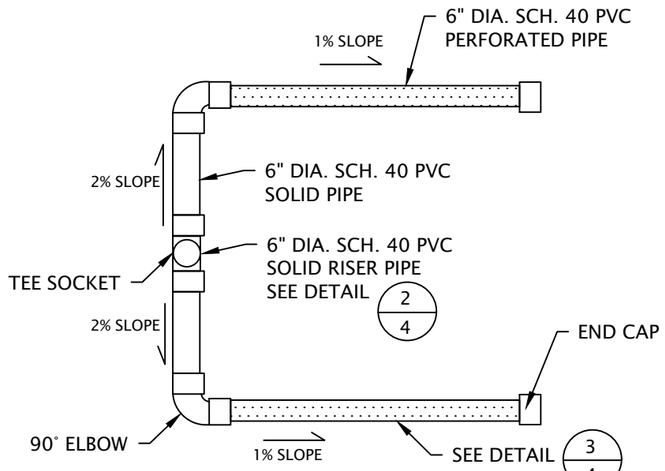


LEGEND:

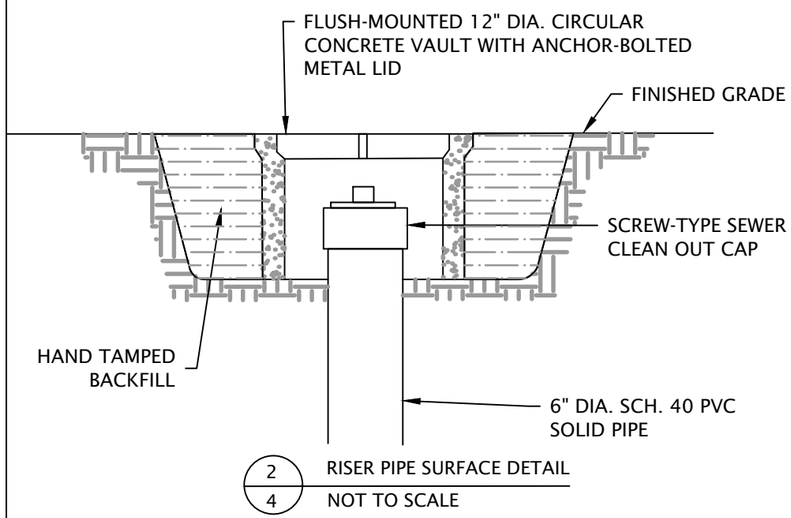
ST	EXISTING STORM SEWER TO REMAIN
W	EXISTING WATER LINE (SEE NOTE 2 ON FIGURE 3)
	APPROXIMATE SHALLOW GROUNDWATER REMEDIAL ACTION AREA

SCALE IN FEET

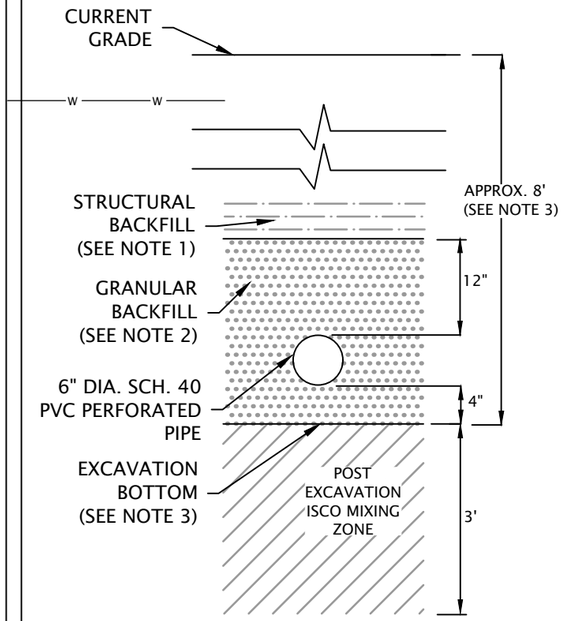
0 20'



1/4 PIPING LAYOUT DETAIL
NOT TO SCALE



2/4 RISER PIPE SURFACE DETAIL
NOT TO SCALE



NOTES:

(1) STRUCTURAL BACKFILL IN ACCORDANCE WITH BUILDING RECONSTRUCTION SPECIFICATIONS
(2) BACKFILL COMPACTION IN ACCORDANCE WITH BUILDING RECONSTRUCTION SPECIFICATIONS
(3) THE EXCAVATION WILL BE ADVANCED TO THE DEPTH OF GROUNDWATER (APPROXIMATELY 8 FEET BELOW CURRENT GROUND SURFACE)

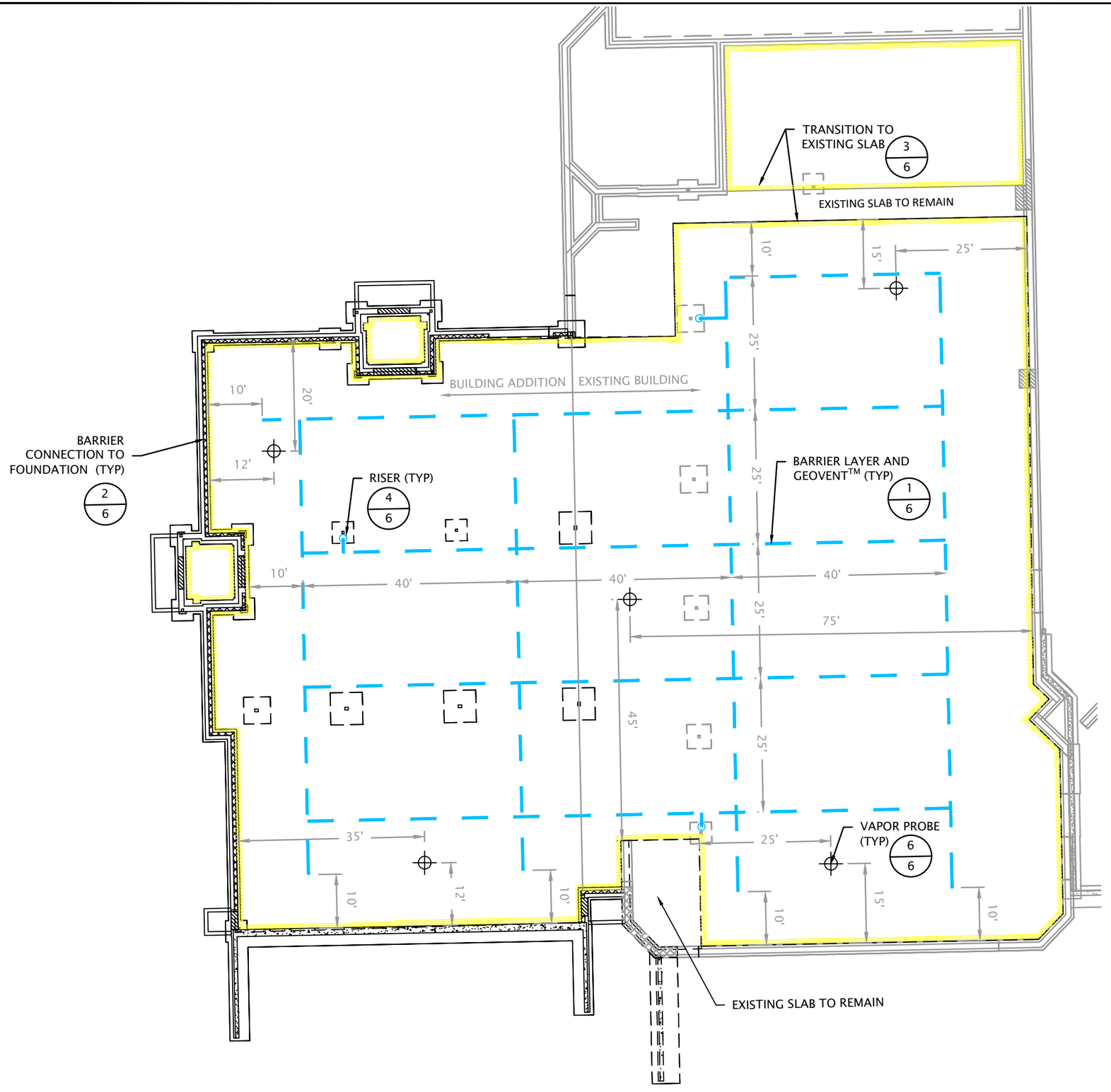
ISCO - IN-SITU CHEMICAL OXIDATION
PVC - POLYVINYL CHORIDE

3/4 TYPICAL PIPING SECTION
NOT TO SCALE

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SHALLOW GROUNDWATER REMEDIAL ACTION PLAN AND DETAILS

PROJECT: CHE8094OQ	FIGURE NO.: 4	DRAWING NO.: 4 OF 8	
DATE: June 23, 2020	FILE NO.20-05 MNSCP2 003		



LEGEND:

- EXTENT OF VMS BARRIER LAYER
- VMS VENTING LAYER GEOVENT™ LOCATION
- 4" DIA RISER PIPE LOCATION
- COLUMN FOOTING LOCATION
- APPROXIMATE VAPOR PROBE LOCATION (SEE NOTE 1)

NOTES:

VMS - VAPOR MITIGATION SYSTEM

(1) - VAPOR PROBE LOCATIONS WILL BE FIELD VERIFIED BASED ON NEW BUILDING INTERIOR LAYOUT

SCALE IN FEET

0 20'

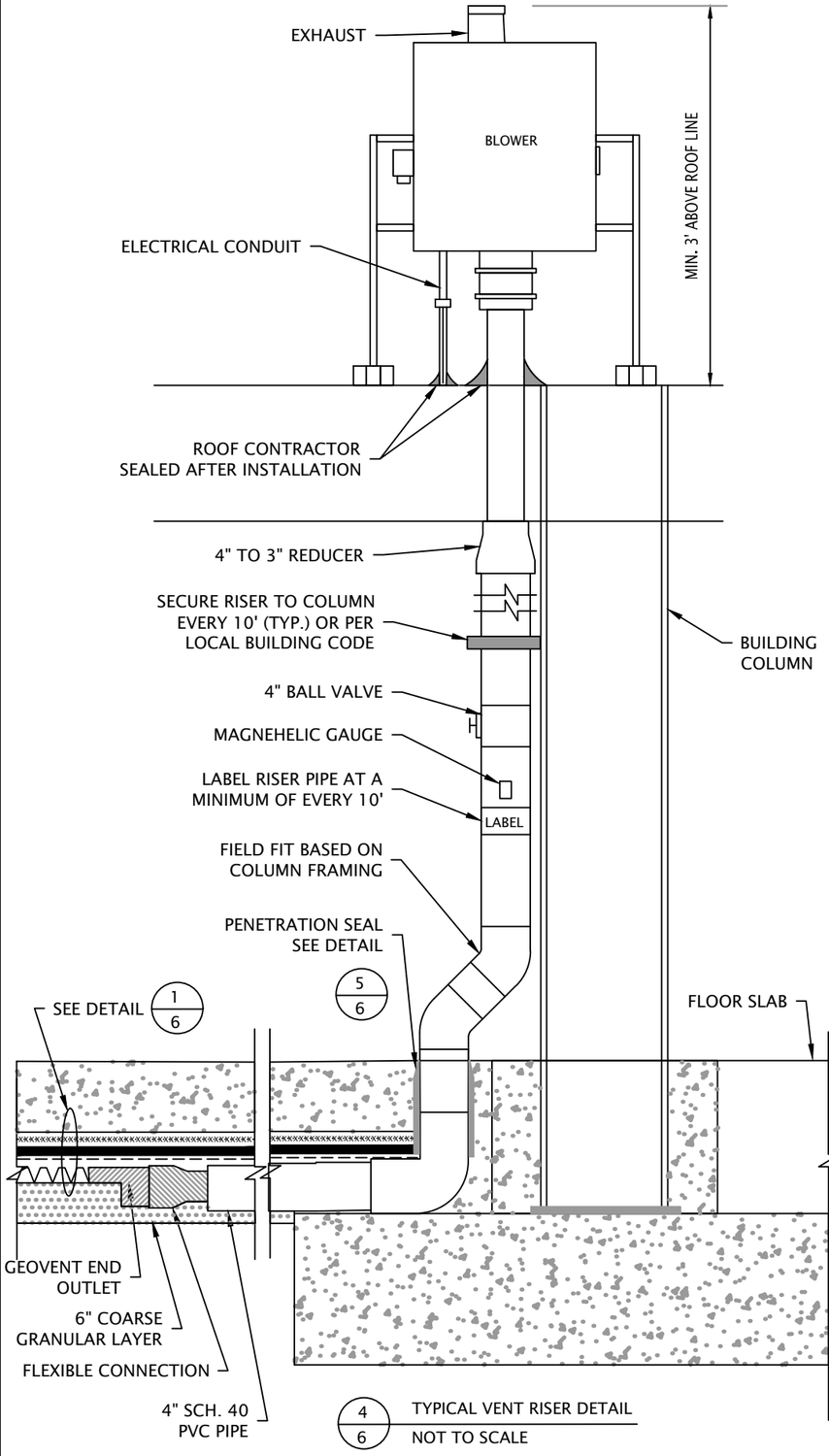
SOURCE:

BASE IMAGE FROM 5/22/20 FOUNDATION PLAN 'A' (NEWMAN ARCHITECTURE)

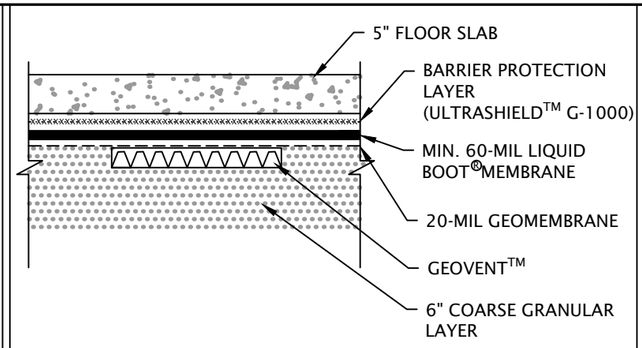
Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	VAPOR MITIGATION SYSTEM PLAN

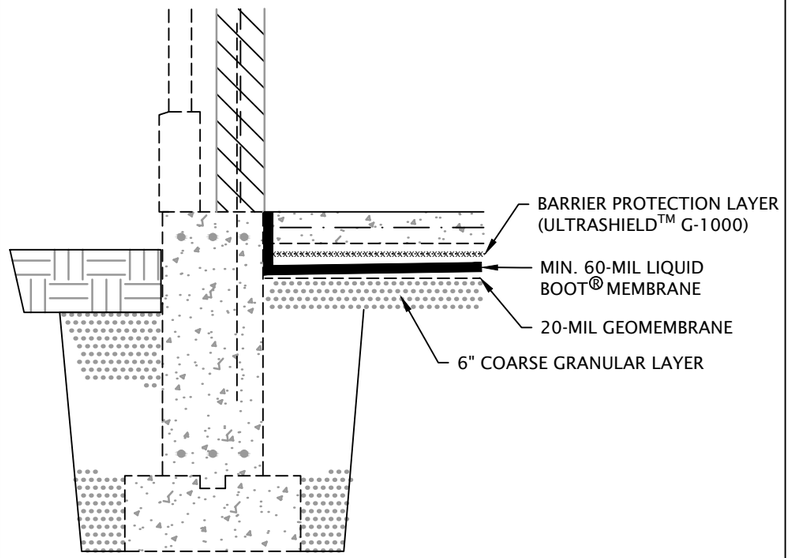
PROJECT: CHE8094OQ	FIGURE NO.: 5	DRAWING NO.: 5 OF 8
DATE: June 22, 2020	FILE NO.: 20-05 MNSCP 003	



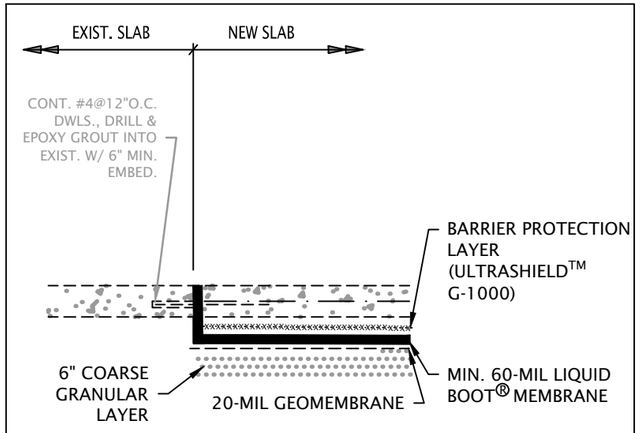
4/6 TYPICAL VENT RISER DETAIL
NOT TO SCALE



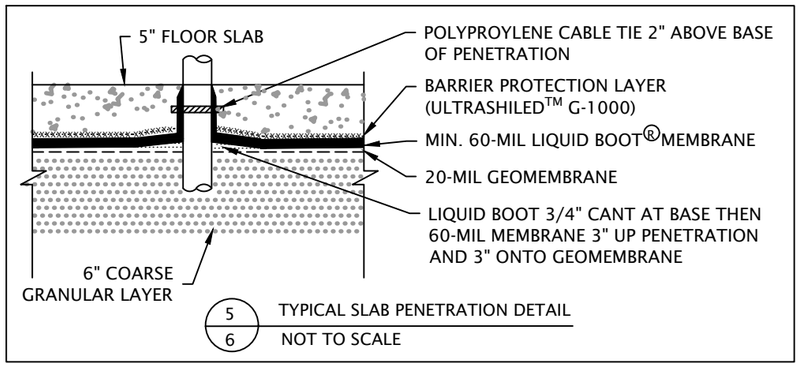
1/6 TYPICAL VAPOR MITIGATION SYSTEM SECTION
NOT TO SCALE



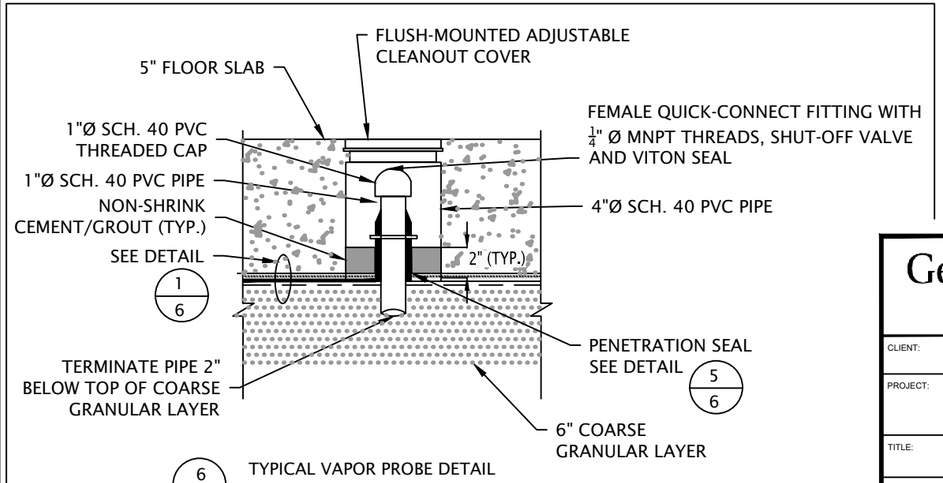
2/6 TYPICAL WALL SECTION
NOT TO SCALE



3/6 TRANSITION BETWEEN EXISTING AND NEW SLAB
NOT TO SCALE



5/6 TYPICAL SLAB PENETRATION DETAIL
NOT TO SCALE



6/6 TYPICAL VAPOR PROBE DETAIL
NOT TO SCALE

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	VAPOR MITIGATION SYSTEM DETAILS

PROJECT: CHE8094OQ	FIGURE NO.: 6	DRAWING NO.: 6 OF 8	
DATE: June 11, 2020	FILE NO.: 20-05 MNSCP 001		

EXISTING CONDITIONS

PLANNED CONDITIONS

LEGEND:

- APPROXIMATE PROPERTY LINE
- BUILDING
- PAVEMENT / EXTERIOR SLABS
- LANDSCAPING
- GRAVEL

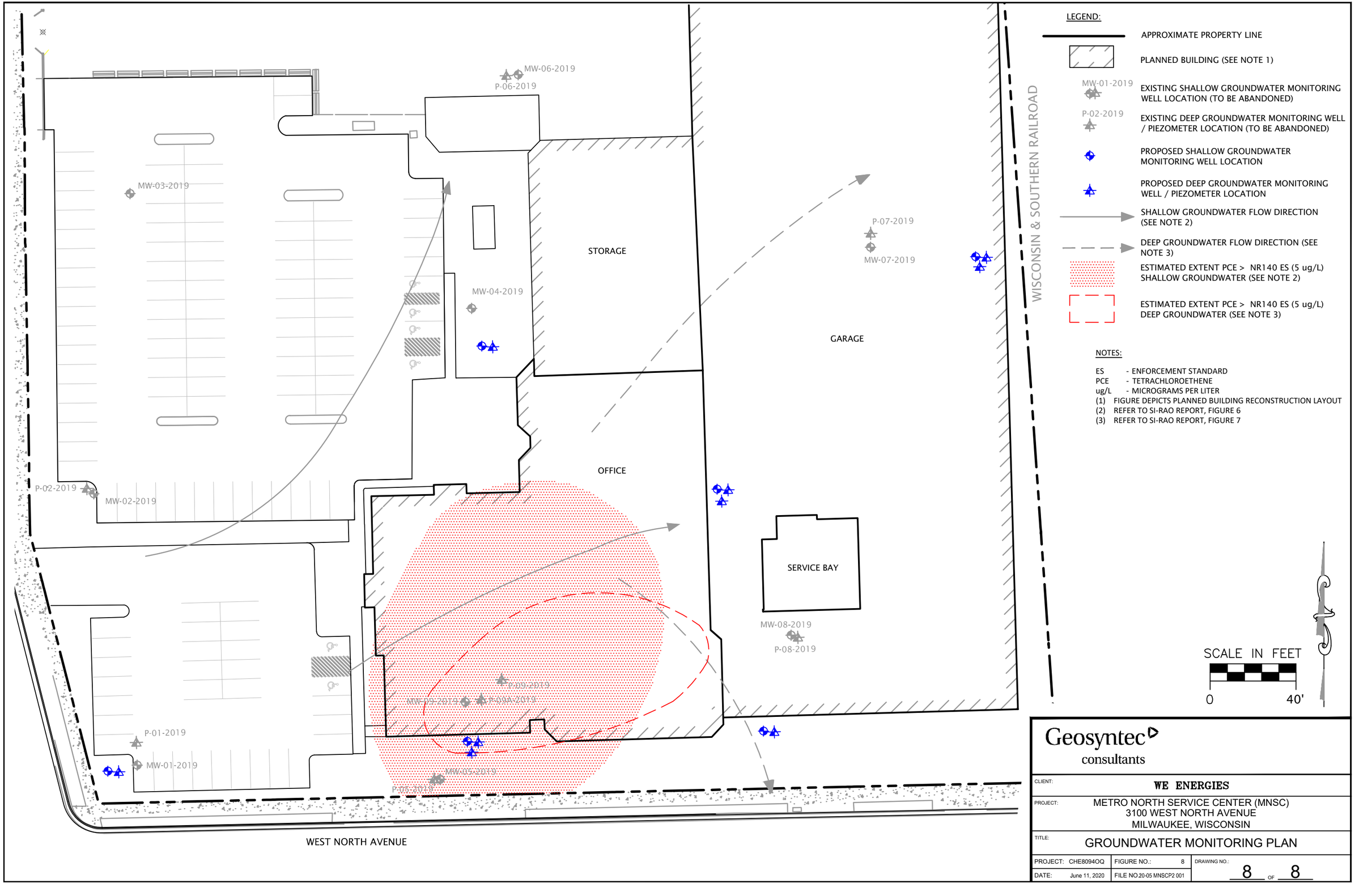
SCALE IN FEET

0 60'

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	BARRIER MAP

PROJECT: CHE8094OQ	FIGURE NO.: 7	DRAWING NO.: 7 OF 8
DATE: June 11, 2020	FILE NO.:20-05 MNSCP 001	



LEGEND:

- APPROXIMATE PROPERTY LINE
- PLANNED BUILDING (SEE NOTE 1)
- MW-01-2019 — EXISTING SHALLOW GROUNDWATER MONITORING WELL LOCATION (TO BE ABANDONED)
- P-02-2019 — EXISTING DEEP GROUNDWATER MONITORING WELL / PIEZOMETER LOCATION (TO BE ABANDONED)
- PROPOSED SHALLOW GROUNDWATER MONITORING WELL LOCATION
- PROPOSED DEEP GROUNDWATER MONITORING WELL / PIEZOMETER LOCATION
- SHALLOW GROUNDWATER FLOW DIRECTION (SEE NOTE 2)
- DEEP GROUNDWATER FLOW DIRECTION (SEE NOTE 3)
- ESTIMATED EXTENT PCE > NR140 ES (5 ug/L) SHALLOW GROUNDWATER (SEE NOTE 2)
- ESTIMATED EXTENT PCE > NR140 ES (5 ug/L) DEEP GROUNDWATER (SEE NOTE 3)

NOTES:

ES - ENFORCEMENT STANDARD
PCE - TETRACHLOROETHENE
ug/L - MICROGRAMS PER LITER
(1) FIGURE DEPICTS PLANNED BUILDING RECONSTRUCTION LAYOUT
(2) REFER TO SI-RAO REPORT, FIGURE 6
(3) REFER TO SI-RAO REPORT, FIGURE 7

SCALE IN FEET
0 40'

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	GROUNDWATER MONITORING PLAN

PROJECT: CHE8094OQ	FIGURE NO.: 8	DRAWING NO.: 8 OF 8
DATE: June 11, 2020	FILE NO.20-05 MNSCP2 001	

APPENDIX 1

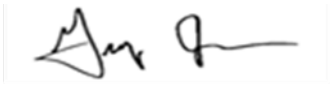
NR 712.09 Submittal Certification

Remedial Action Design Report
Metro North Service Center
3100 West North Avenue
Milwaukee, Wisconsin
WDNR BRRTS # 02-41-583015
WDNR FID # 241311510

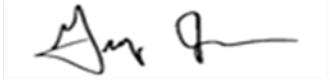
NR 712.09 Submittal certification.

Document Name	REMEDIAL ACTION DESIGN REPORT
Document Date	June 29, 2020
Site Name	Metro North Service Center
WDNR BRRTS #	02-41-583015

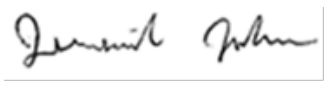
"I, Greg Johnson, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

 Greg Johnson, P.H., P.G., P.E. Senior Engineer P.E. #: 29898-006	 6/29/2020
Signature, title and P.E. number	P.E. stamp

"I, Greg Johnson, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, am registered in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code, or licensed in accordance with the requirements of ch. GHSS 3, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

	6/29/2020
Signature and title	Date

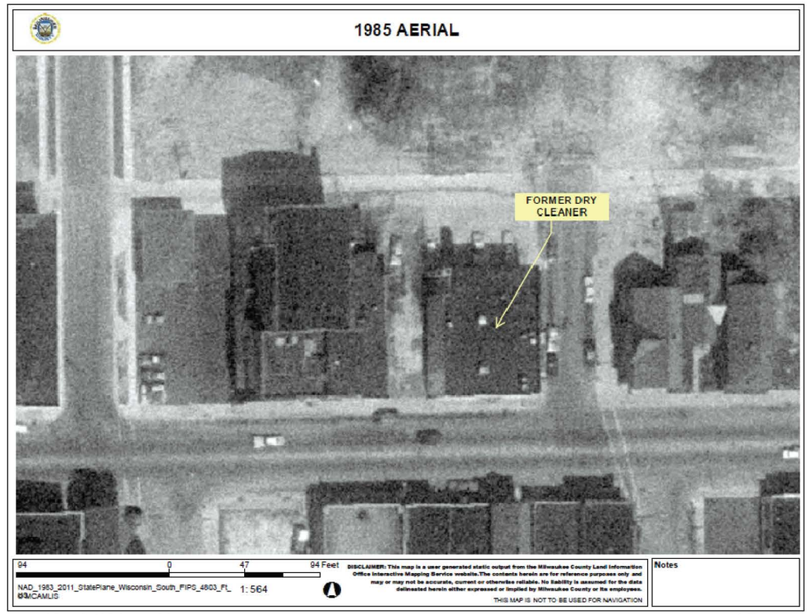
"I, Jeremiah Johnson, hereby certify that I am a scientist as that term is defined in s. NR 712.03 (3), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

	6/29/2020
Signature and title	Date

APPENDIX 2

Site Investigation and Remedial Action Options Report Figures

Historical Dry Cleaner Map (Figure 4)
Soil Map (Figure 5)
Shallow Groundwater Map (Figure 6)
Deep Groundwater Map (Figure 7)
Section A-A' (Figure 10)
Section B-B' (Figure 11)
Source Area Remedial Action Plan (Figure 12)



LEGEND:

- APPROXIMATE SITE PROPERTY BOUNDARY
- EXISTING SITE BUILDING
- APPROXIMATE PLANNED BUILDING RECONSTRUCTION AREA
- APPROXIMATE FORMER DRY CLEANER LOCATION

NORTH 32ND STREET

WEST NORTH AVENUE

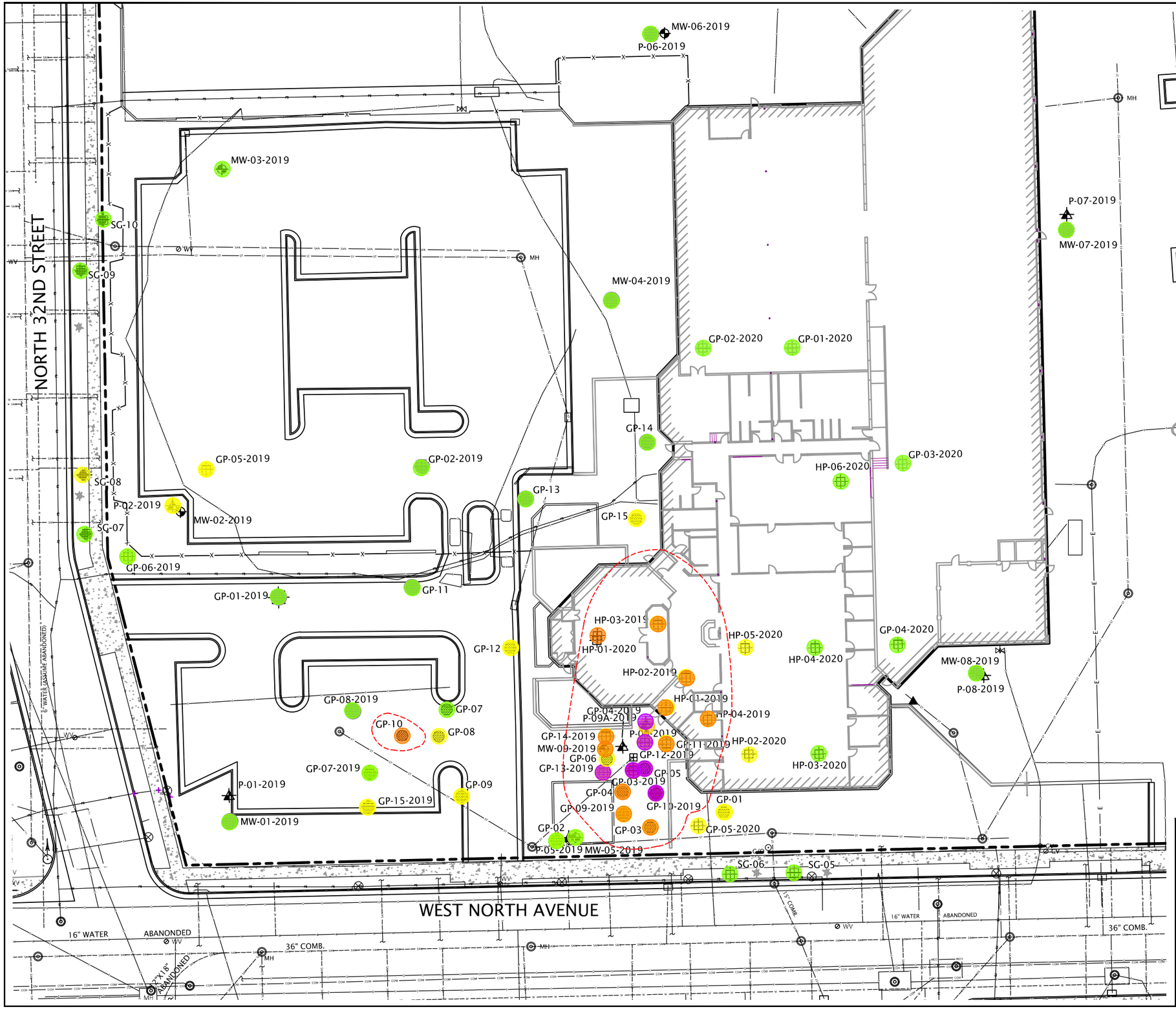
SCALE IN FEET

0 40'

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	HISTORICAL DRY CLEANER MAP

PROJECT: CHE8094OQ	FIGURE NO.: 4	DRAWING NO.: 4 OF 12
DATE: April 21, 2020	FILE NO.: 20-04 MNSC 009	



LEGEND:

- GP-03 — APPROXIMATE GEOPROBE® SOIL BORING LOCATION (DECEMBER 2018)
- MW-01-2019 — GROUNDWATER MONITORING WELL LOCATION (JULY & SEPTEMBER 2019)
- P-01-2019 — PIEZOMETER LOCATION (JULY & SEPTEMBER 2019)
- GP-01-2019 — GEOPROBE® SOIL BORING LOCATION (JULY AND NOVEMBER 2019)
- GP-03-2020 — GEOPROBE® SOIL BORING LOCATION (FEBRUARY 2020)
- SG-07 — GEOPROBE® SOIL BORING/SOIL GAS PROBE LOCATION (JANUARY 2020)

PCE SOIL CONCENTRATION (UNSATURATED)

- < 4.5 ug/kg (WDNR RCL_{GW})
- > 4.5 AND < 1,000 ug/kg
- > 1,000 AND < 60,000 ug/kg (EPA LDR)
- > 60,000 ug/kg AND < 145,000 ug/kg
- > 145,000 ug/kg (WDNR RCL_{DC-I})
- SOIL PCE > 1,000 ug/kg (UNSATURATED SOIL PERFORMANCE STANDARD)

NOTES:

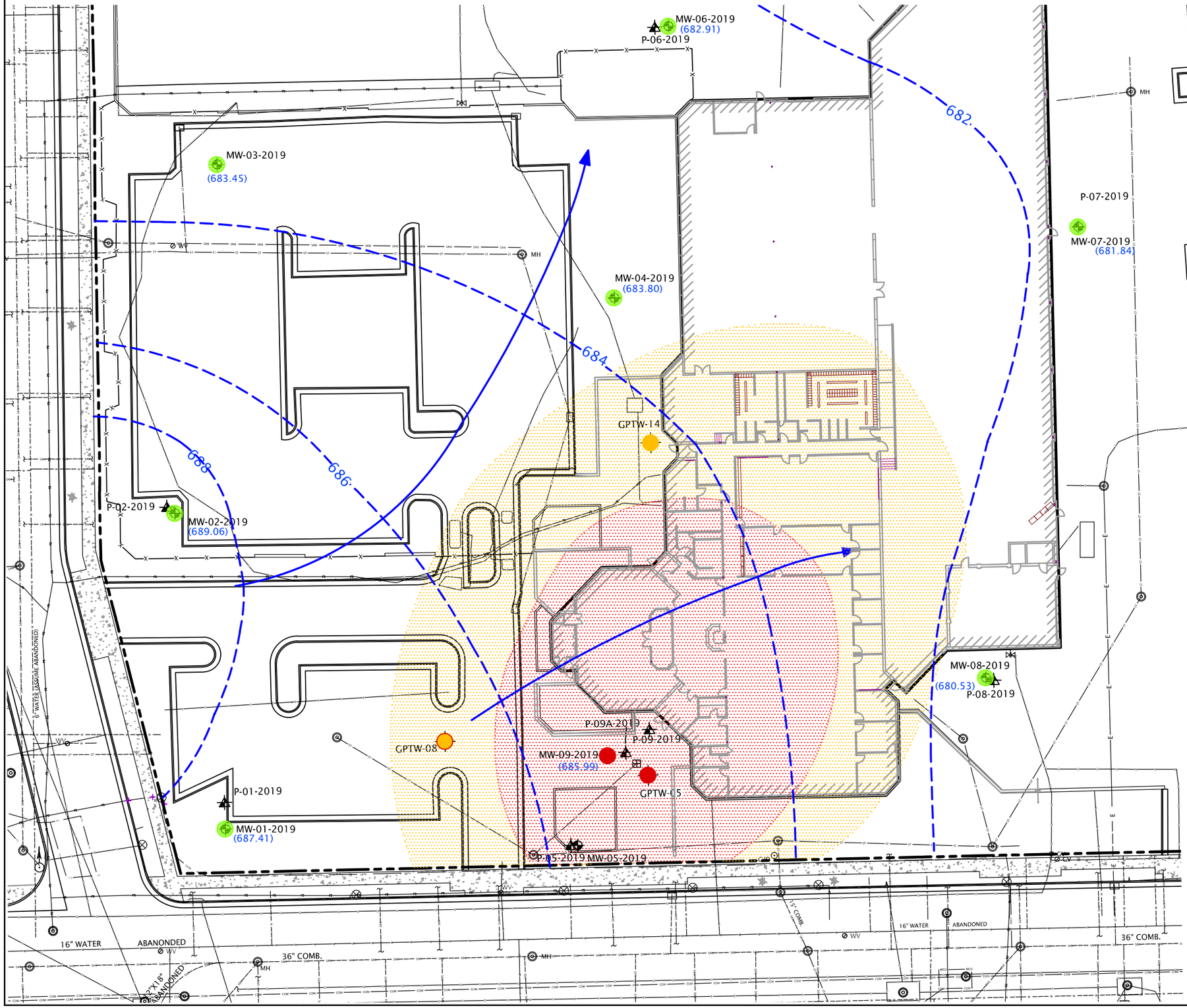
EPA	- U.S. ENVIRONMENTAL PROTECTION AGENCY
LDR	- LANDFILL DISPOSAL RESTRICTION
PCE	- TETRACHLOROETHENE
RCL	- RESIDUAL CONTAMINANT LEVEL
RCL_{GW}	- WDNR GROUNDWATER PATHWAY RCL
RCL_{DC-I}	- WDNR INDUSTRIAL DIRECT CONTACT RCL
ug/kg	- MICROGRAMS PER KILOGRAM
WDNR	- WISCONSIN DEPARTMENT OF NATURAL RESOURCES

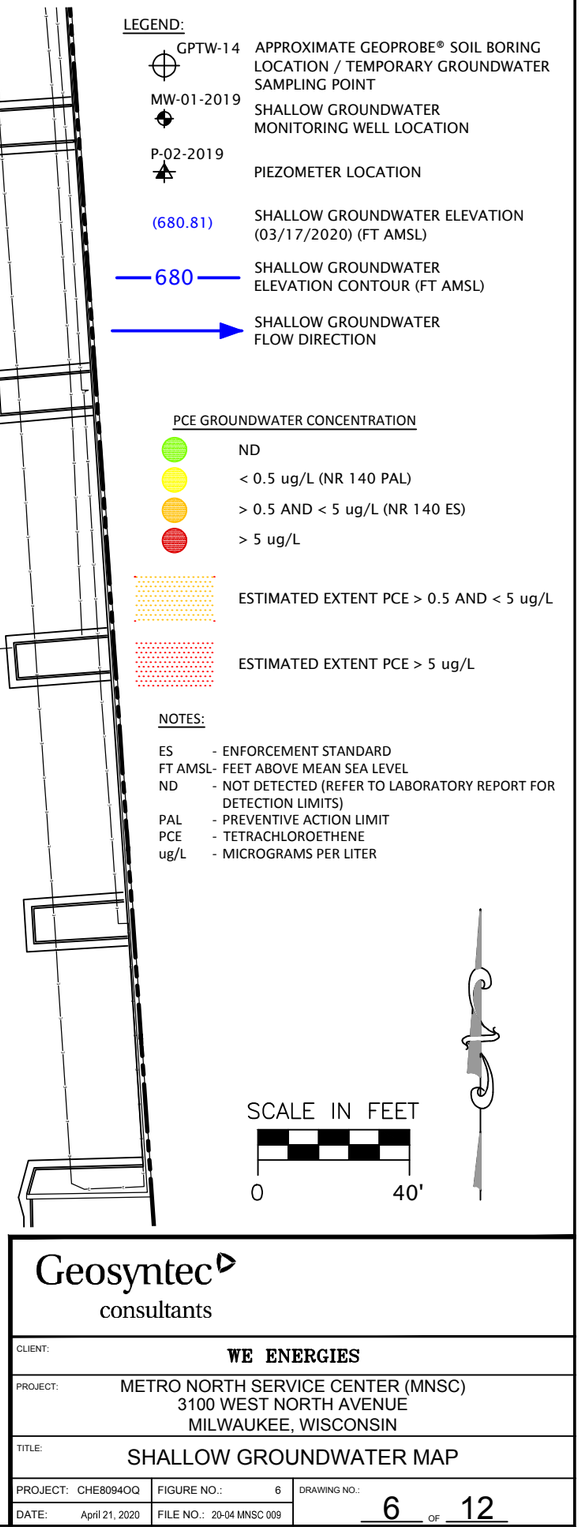
SCALE IN FEET

0 40'

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SOIL MAP
PROJECT: CHE8094OQ	FIGURE NO.: 5
DATE: April 21, 2020	FILE NO.: 20-02 MNSC 009
DRAWING NO.:	5 OF 12





LEGEND:

- GPTW-14 — APPROXIMATE GEOPROBE® SOIL BORING LOCATION / TEMPORARY GROUNDWATER SAMPLING POINT
- MW-01-2019 — SHALLOW GROUNDWATER MONITORING WELL LOCATION
- P-02-2019 — PIEZOMETER LOCATION
- (680.81) — SHALLOW GROUNDWATER ELEVATION (03/17/2020) (FT AMSL)
- 680 — SHALLOW GROUNDWATER ELEVATION CONTOUR (FT AMSL)
- SHALLOW GROUNDWATER FLOW DIRECTION

PCE GROUNDWATER CONCENTRATION

- ND
- < 0.5 ug/L (NR 140 PAL)
- > 0.5 AND < 5 ug/L (NR 140 ES)
- > 5 ug/L
- ESTIMATED EXTENT PCE > 0.5 AND < 5 ug/L
- ESTIMATED EXTENT PCE > 5 ug/L

NOTES:

ES - ENFORCEMENT STANDARD
FT AMSL- FEET ABOVE MEAN SEA LEVEL
ND - NOT DETECTED (REFER TO LABORATORY REPORT FOR DETECTION LIMITS)
PAL - PREVENTIVE ACTION LIMIT
PCE - TETRACHLOROETHENE
ug/L - MICROGRAMS PER LITER

SCALE IN FEET
0 40'

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SHALLOW GROUNDWATER MAP
PROJECT: CHE8094OQ	FIGURE NO.: 6
DATE: April 21, 2020	FILE NO.: 20-04 MNSC 009
DRAWING NO.:	6 OF 12

LEGEND:

- GPTW-14 — APPROXIMATE GEOPROBE® SOIL BORING LOCATION / TEMPORARY SHALLOW GROUNDWATER SAMPLING POINT
- MW-01-2019 — SHALLOW GROUNDWATER MONITORING WELL LOCATION
- P-02-2019 — PIEZOMETER LOCATION
- (680.81) — DEEP GROUNDWATER ELEVATION (03/17/2020) (FT AMSL)
- 680 — DEEP GROUNDWATER ELEVATION CONTOUR (FT AMSL)
- DEEP GROUNDWATER FLOW DIRECTION

PCE GROUNDWATER CONCENTRATION

- ND
- < 0.5 ug/L (NR 140 PAL)
- > 0.5 AND < 5 ug/L (NR 140 ES)
- > 5 ug/L
- ESTIMATED EXTENT PCE > 0.5 AND < 5 ug/L
- ESTIMATED EXTENT PCE > 5 ug/L

NOTES:

ES - ENFORCEMENT STANDARD
FT AMSL- FEET ABOVE MEAN SEA LEVEL
ND - NOT DETECTED (REFER TO LABORATORY REPORT FOR DETECTION LIMITS)
PAL - PREVENTIVE ACTION LIMIT
PCE - TETRACHLOROETHENE
ug/L - MICROGRAMS PER LITER

SCALE IN FEET
0 40'

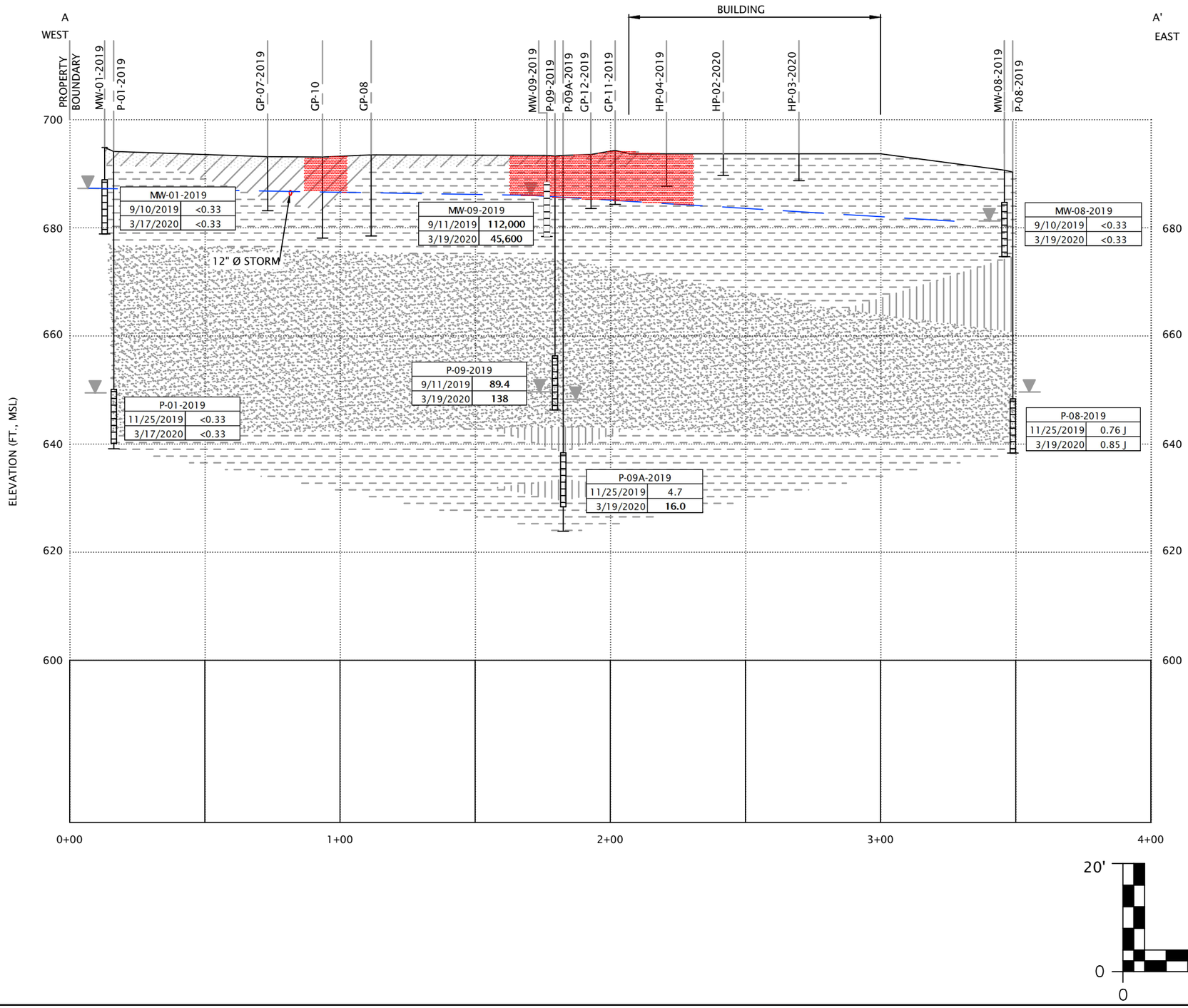
Geosyntec consultants

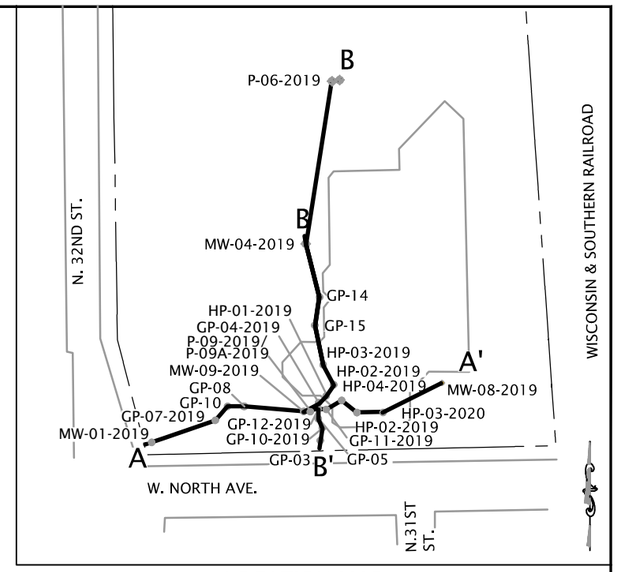
CLIENT: WE ENERGIES

PROJECT: METRO NORTH SERVICE CENTER (MNSC)
3100 WEST NORTH AVENUE
MILWAUKEE, WISCONSIN

TITLE: DEEP GROUNDWATER MAP

PROJECT: CHE8094OQ	FIGURE NO.: 7	DRAWING NO.: 7 OF 12
DATE: April 16, 2020	FILE NO.: 20-04 MNSC 009	





LOCATION MAP
N.T.S.

LEGEND:

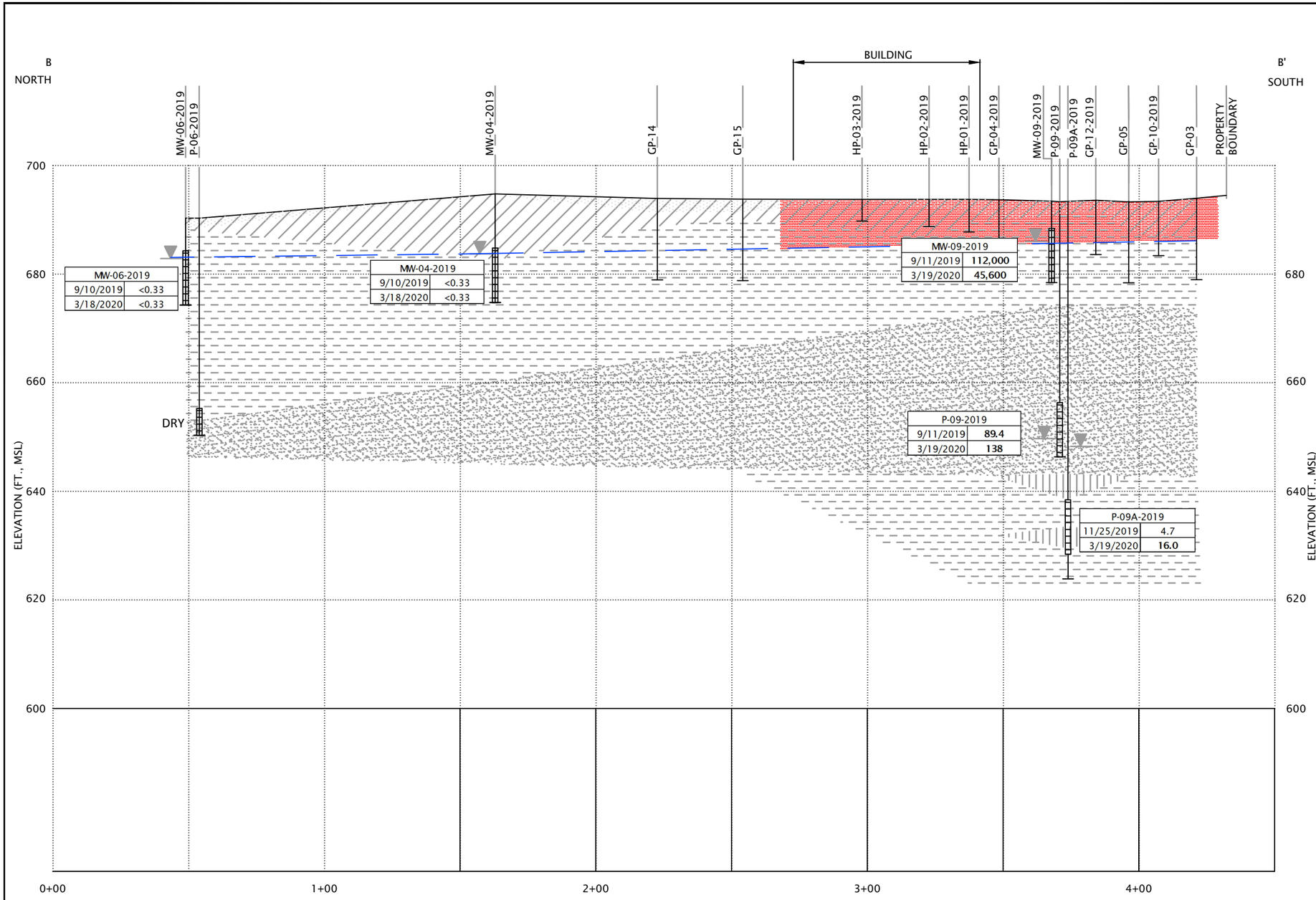
- EXISTING GROUND SURFACE
- GROUNDWATER TABLE
- FILL (SAND/GRAVEL)
- FILL (CLAY TO SILTY CLAY, TRACE SAND/GRAVEL)
- CLAY
- SILT
- SAND/GRAVEL
- CONCEPTUAL SOIL REMEDIATION TARGET ZONE [PCE > 1,000 ug/kg (UNSATURATED SOIL PERFORMANCE STANDARD)]
- GROUNDWATER MONITORING WELL SCREEN INTERVAL
- GROUNDWATER ELEVATION (12/2/2019)
- 4.7 — PCE GROUNDWATER CONCENTRATION (ug/L)

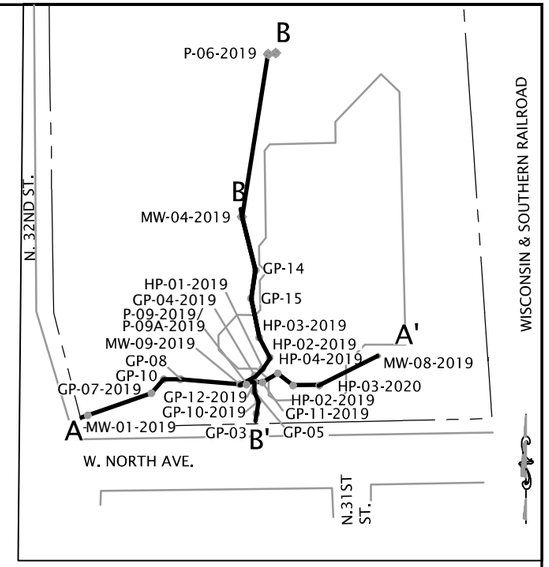
NOTES:

BOLD	-	PCE GROUNDWATER CONCENTRATION > NR 140 ES
ES	-	ENFORCEMENT STANDARD
FT, MSL	-	FEET ABOVE MEAN SEA LEVEL
J	-	ESTIMATED CONCENTRATION AT OR ABOVE THE LIMIT OF DETECTION AND BELOW THE LIMIT OF QUANTITATION
PCE	-	TETRACHLOROETHENE
ug/Kg	-	MICROGRAM PER KILOGRAM
ug/L	-	MICROGRAMS PER LITER

Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SECTION A-A'
PROJECT: CHE8094OQ	FIGURE NO.: 10
DATE: April 21, 2020	FILE NO.: 20-04 MNSC 009
DRAWING NO.:	10 OF 12





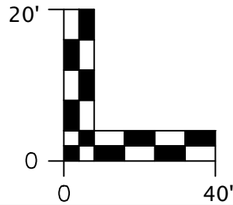
LOCATION MAP
N.T.S.

LEGEND:

- EXISTING GROUND SURFACE
- GROUNDWATER TABLE
- FILL (SAND/GRAVEL)
- FILL (CLAY TO SILTY CLAY, TRACE SAND/GRAVEL)
- CLAY
- SILT
- SAND/GRAVEL
- CONCEPTUAL SOIL REMEDIATION TARGET ZONE [PCE > 1,000 ug/kg (UNSATURATED SOIL PERFORMANCE STANDARD)]
- GROUNDWATER MONITORING WELL SCREEN INTERVAL
- GROUNDWATER ELEVATION (12/2/2019)
- 4.7 — PCE GROUNDWATER CONCENTRATION (ug/L)

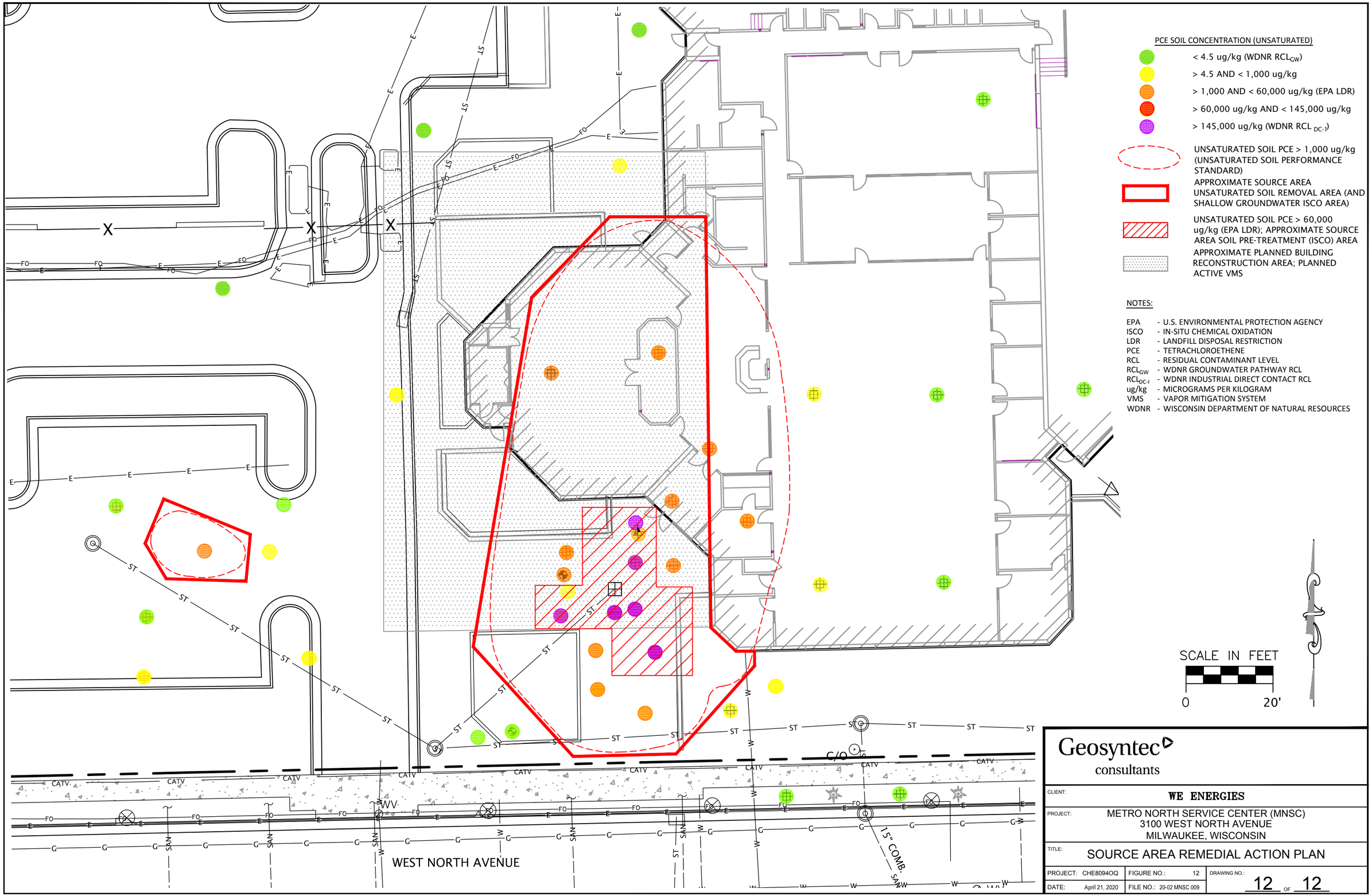
NOTES:

BOLD	-	PCE GROUNDWATER CONCENTRATION > NR 140 ES
ES	-	ENFORCEMENT STANDARD
FT, MSL	-	FEET ABOVE MEAN SEA LEVEL
J	-	ESTIMATED CONCENTRATION AT OR ABOVE THE LIMIT OF DETECTION AND BELOW THE LIMIT OF QUANTITATION
PCE	-	TETRACHLOROETHENE
ug/Kg	-	MICROGRAM PER KILOGRAM
ug/L	-	MICROGRAMS PER LITER



Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SECTION B-B'
PROJECT: CHE8094OQ	FIGURE NO.: 11
DATE: April 21, 2020	FILE NO.: 20-04 MNSC 009
DRAWING NO.:	11 OF 12



Geosyntec consultants

CLIENT:	WE ENERGIES
PROJECT:	METRO NORTH SERVICE CENTER (MNSC) 3100 WEST NORTH AVENUE MILWAUKEE, WISCONSIN
TITLE:	SOURCE AREA REMEDIAL ACTION PLAN

PROJECT: CHE8094OQ	FIGURE NO.: 12	DRAWING NO.: 12 OF 12
DATE: April 21, 2020	FILE NO.: 20-02 MNSC 009	

APPENDIX 3

Vapor Mitigation System Information

Remedial Action Design Report
Metro North Service Center
3100 West North Avenue
Milwaukee, Wisconsin
WDNR BRRTS # 02-41-583015
WDNR FID # 241311510

GEOVENT™

ACTIVE/PASSIVE GAS VENTING SYSTEM

DESCRIPTION

GEOVENT™ consists of a three-dimensional vent core that is wrapped in a non-woven, needle-punched filter fabric.

GEOVENT™ End Outlets are available for use in conjunction with GEOVENT™ active/passive gas venting systems.

APPLICATION

GEOVENT™ is designed for use in the following application:

- An active or passive venting when used with CETCO vapor intrusion mitigation systems.

BENEFITS

- Installed directly on subgrade eliminating trenching and potential interference or damage to existing underground utilities
- Placed in closer proximity to the vapor intrusion barrier allowing for more effective venting of any accumulated gas
- Greater opening area per lineal foot of pipe and integral filter fabric allows for higher ventilation efficiency

PACKAGING

GEOVENT™ is available in the following packaging option:

- 1 ft. x 165 ft. (0.3 m x 50 m) Rolls

GEOVENT™ allows for ease of installation directly on the subgrade, eliminating the need for costly and labor-intensive trenching.

GEOVENT™ allows for ease of installation directly on the subgrade, eliminating the need for costly and labor-intensive trenching.

PHYSICAL PROPERTIES

CORE PROPERTY	TEST METHOD	RESULTS
Compressive Strength	ASTM D 1621	8,500 – 11,000 psf (407 – 527 kN/m²)
Thickness	ASTM D 1777	1.0 in. (2.54 cm)
Flow Rate (Hydraulic gradient = .1)	ASTM D 4716	30 gpm/ft width (372 lpm/m)

FABRIC PROPERTY	TEST METHOD	RESULTS
A.O.S.	ASTM D 4751	70 US Sieve (0.212 mm)
Grab Tensile Strength	ASTM D 4632	100 lbs. (0.45 kN)
CBR Puncture Strength	ASTM D 6241	250 lbs. (1.11 kN)
Flow Rate	ASTM D 4491	140 gpm/ft² (5,704 lpm/m²)

North America: 847.851.1800 | 800.527.9948 | www.cetco.com

UPDATED: MAY 2017

FORM: TDS_GEOVENT_AM_EN_201705_V2

LIQUID BOOT®

SPRAY-APPLIED GAS VAPOR BARRIER

DESCRIPTION

LIQUID BOOT® is a seamless, spray-applied, water-based membrane containing no VOCs, which provides a barrier against vapor intrusion into structures. LIQUID BOOT® is installed under slab and on below grade vertical walls as a gas vapor barrier to minimize vapor and nuisance water migration into buildings. LIQUID BOOT® spray-application directly to penetrations, footings, grade beams, pile caps and other irregular surfaces, provides for a fully-adhered gas vapor barrier system.

APPLICATIONS

LIQUID BOOT® is used as an underslab and below-grade vertical wall gas vapor barrier, used to minimize vapor and nuisance water (non-hydrostatic conditions) migration into buildings. LIQUID BOOT® is ideal for methane migration control. LIQUID BOOT® is also NSF® certified for use as a potable water liner in concrete water reservoirs and tanks greater than 300,000 gallons to protect the concrete from water seepage.

BENEFITS

- Spray-application provides excellent sealing of penetrations, eliminating the need for mechanical fastening
- Seamless, monolithic membrane eliminates seaming-related membrane failures
- Unique formulation provides superior protection from methane gases and water vapor
- Fully adhered system reduces risk of gas migration
- Protection from methane gas, VOCs, chlorinated solvents and other contaminates

INSTALLATION

Protect all adjacent areas not to receive gas vapor barrier. Ambient temperature shall be within manufacturer's specifications. All plumbing, electrical, mechanical and structural items to be under or passing through the gas vapor barrier shall be secured in their proper positions and appropriately protected prior to membrane application. Gas vapor barrier shall be installed before placement of rein-forcing steel. Expansion joints must be filled with a conventional waterproof expansion joint material. Surface preparation shall be per manufacturer's specification. A minimum thickness of 60 dry mils, unless specified otherwise.

LIMITED WARRANTY

CETCO warrants its products to be free of defects. This warranty only applies when the product is applied by Approved Applicators trained by CETCO. As factors which affect the result obtained from this product, including weather, equipment, construction, workmanship and other variables are all beyond CETCO's control, we warrant only that the material herein conforms to our product specifications. Under this warranty we will replace at no charge any product proved to be defective within 12 months of manufacture, provided it has been applied in accordance with our written directions for uses we recommend as suitable for this product. This warranty is in lieu of any and all other warranties expressed or implied (including any implied warranty of merchantability or fitness for a particular use), and the Manufacturer shall have no further liability of any kind including liability for consequential or incidental damages resulting from any defects or any delays caused by replacement or otherwise. This warranty shall become valid only when the product has been paid for in full.

In addition to superior chemical resistance performance, LIQUID BOOT® spray-application effectively seals penetrations, footings, grade beams and other irregular surfaces that are considered critical vapor intrusion pathways.

EQUIPMENT

- COMPRESSOR: Minimum output of 155–185 cubic feet per minute (CFM)
- PUMPS: For "A" drum, an air-powered piston pump of 4:1 ratio (suggested model: Graco, 4:1 Bulldog). For "B" drum, an air-powered diaphragm pump (0–100 psi)
- HOSES: For "A" drum, ½" wire hose with a solvent resistant core (for diesel cleaning flush), hose rated for 500 psi minimum. For "B" drum, a 3/8" fluid hose rated at only 300 psi may be used.
- SPRAY WAND: Only the spray wand sold by CETCO is approved for the application of LIQUID BOOT®.
- SPRAY TIPS: Replacement tips can be purchased separately from CETCO.

PACKAGING

LIQUID BOOT® is available in the following packaging options:

- 55 Gallon Drum
- 275 Gallon Tote

LIQUID BOOT®

SPRAY-APPLIED GAS VAPOR BARRIER

TESTING DATA

CHEMICAL & PHYSICAL PROPERTIES		
CHEMICAL PROPERTY	TEST METHOD	RESULT
Acid Exposure (10% H_2SO_4 for 90 days)	ASTM D543	Less than 1% weight change
Benzene Diffusion Test	Tested at 43,000 ppm	2.90 x 10^{-11} m^2/day
Chemical Resistance: VOCs, BTEXs (tested at 20,000 ppm)	ASTM D543	Less than 1% weight change
Chromate Exposure (10% Chromium6+ salt for 31 days)	ASTM E96	Less than 1% weight change
Diesel (1000 mg/l), Ethylbenzene (1000 mg/l), Naphthalene (5000 mg/l) and Acetone (500 mg/l) Exposure for 7 days	ASTM D543	Less than 1% weight change; Less than 1% tensile strength change
Hydrogen Sulfide Gas Permeability	ASTM D1434	None Detected
Methane Permeability	**ASTM 1434-82**	**Passed***
Microorganism Resistance	**ASTM D4068-88**	**Passed***
Oil Resistance	**ASTM D543-87**	**Passed***
PCE Diffusion Coefficient	Tested at 120 mg/L	1.32 x 10^{-13} m^2/sec
Radon Permeability	Tested by US Dept. of Energy	Zero permeability to Radon (222Rn)
TCE Diffusion Coefficient	Tested at 524 mg/L	9.07 x 10^{-13} m^2/sec

LIQUID BOOT®

SPRAY-APPLIED GAS VAPOR BARRIER

TESTING DATA

CHEMICAL & PHYSICAL PROPERTIES		
PHYSICAL PROPERTY	TEST METHOD	RESULT
Accelerated Weathering and Ultraviolet Exposure	ASTM D822	No adverse effect after 500 hours
Air Infiltration	ASTM E283-91	0 cfm/sq. ft.
Bonded Seam Strength Tests	ASTM D6392	Passed*
Coefficient of Friction (with geotextile both sides)	ASTM D5321	0.72
Cold Bend Test	ASTM D146	Passed. Ø cracking at –25°F
Dead Load Seam Strength	City of Los Angeles	Passed*
Electric Volume Resistivity	ASTM D257	1.91 x 1010 ohms-cm
Elongation	ASTM D412	1,332% Ø reinforcement, 90% recovery
Elongation w/8 oz. non-woven geotextile both sides	ASTM D751	100% (same as geotextile tested separately)
Environmental Stress-Cracking	ASTM D1693-78	Passed*
Flame Spread	ASTM E108	Class A with top coat (comparable to UL790)
Freeze-Thaw Resistance (100 Cycles)	ASTM A742	Meets criteria. Ø spalling or disbondment
Heat Aging	ASTM D4068-88	Passed*
Hydrostatic Head Resistance	ASTM D751	Tested to 138 feet or 60 psi
Potable Water Containment	ANSI/NSF 61	NSF Certified for tanks >300,000 gal
Puncture Resistance w/8 oz. non-woven geotextile both sides	ASTM D4833	286 lbs. (travel of probe = 0.756 in)
Sodium Sulfate (2% water solution)	ASTM D543, D412, D1434	Less than 1% weight change
Soil Burial	ASTM E154-88	Passed
Tensile Bond Strength to Concrete	ASTM D413	2,556 lbs/ft² uplift force
Tensile Strength	ASTM D412	58 psi without reinforcement
Tensile Strength w/8 oz. non-woven geotextile both sides	ASTM D751	196 psi (same as geotextile tested separately)
Toxicity Test	22 CCR 66696	Passed
Water Penetration Rate	ASTM D2434	$<7.75 \times 10^{-9}$ cm/sec
Water Vapor Permeance	ASTM E96	0.069 perms

North America: 847.851.1800 | 800.527.9948 | www.cetco.com

UPDATED: DECEMBER 2017

FORM: TDS_LIQUID_BOOT_AM_EN_201712_V3

ULTRASHIELD™ G-1000

NON-WOVEN GEOTEXTILE FABRIC

DESCRIPTION

ULTRASHIELD™ G-1000 is a polypropylene, staple fiber, non-woven geotextile. The fibers are needled-punched, forming a stable network that retains dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and biological and chemical environments found in soils. Manufacturing Quality Control tests have been performed and are accredited by the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP).

APPLICATION

ULTRASHIELD™ G-1000 is designed for use as a underslab adhesion protection course specially designed and required for underslab LIQUID BOOT® applications where the membrane must remain attached to the underslab of the building. This is to ensure the membrane remains in place despite soil settlement, which is common when building is on a landfill.

BENEFITS

ULTRASHIELD™ G-1000 is installed directly over the finished LIQUID BOOT® vapor intrusion barrier, providing superior protection from other trades.

PACKAGING

- 15 ft. x 180 ft. (4.5 m x 55 m) Rolls

ULTRASHIELD™ G-1000 is a needle-punched, non-woven geotextile with superior tensile strength and puncture resistance.

TESTING DATA

PHYSICAL PROPERTIES			
PROPERTY	TEST METHOD	RESULT (ENGLISH)	RESULT (METRIC)
Tensile Bond Strength to Concrete[3]	ASTM C 297-94	7 psi	
Mass/Unit Area	ASTM D 5261	10.0 oz/yd²	339 g/m²
Thickness	ASTM D 5199	105 mils	2.7 mm
Tensile Strength	ASTM D 4632	270 lbs.	1202 N
Elongation	ASTM D 4632	50%	50%
CBR Puncture Strength	ASTM D6241	725 lbs.	3226 N
Trapezoid Tear	ASTM D 4533	105 lbs.	467 N
UV Resistance	ASTM D 4355	70%	70%
A.O.S.	ASTM D 4751	100 U.S. Sieve	0.150 mm
Permittivity	ASTM D 4491	1.2 sec^{-1}	1.2 sec^{-1}
Permeability	ASTM D 4491	0.30 cm/sec	0.30 cm/sec
Water Flow Rate	ASTM D 4491	85 gal/min//ft²	3463 l/min/m²

NOTES:

1. The property values listed above are effective 04/2011 and are subject to change without notice.
2. All values shown are in weaker principal direction and are Minimum average roll values (MARV), except for AOS, which is a Maximum average roll value.
3. Historical value, based on past testing.

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UPDATED: MAY 2017

FORM: TDS_ULTRASHIELD_G-1000_AM_EN_201705_V2

VI-20™ GEOMEMBRANE

HIGH-PERFORMANCE VAPOR INTRUSION BARRIER

DESCRIPTION

VI-20™ is a 7-layer co-extruded geomembrane made using high quality virgin-grade polyethylene and EVOH resins that provide unmatched impact strength as well as superior resistance to VOC vapor transmission. EVOH technology serves as a highly resilient underslab and vertical wall barrier designed to restrict methane, radon and other harmful chemicals. Applications for EVOH originated in the manufacturing of automotive fuel systems to control emissions of hydrocarbons, whose use was mandated by the US EPA and the CA Air Resources Board (CARB) to reduce VOC emissions.

APPLICATION

VI-20™ is a 20-mil, high performance polyethylene-EVOH copolymer geomembrane, specially designed for use as a VOC barrier when used in conjunction with Liquid Boot® spray-applied vapor intrusion membrane to minimize vapor intrusion and nuisance water (non-hydrostatic conditions) migration into buildings. VI-20™ is ideal for applications with chlorinated solvents, BTEX and other PAHs.

BENEFITS

- Polyethylene layers provide excellent chemical resistance and physical properties
- EVOH barrier technology provides superior protection against diffusion of chemicals when compared to typical HDPE geomembranes
- Manufactured at ISO 9001:2008 certified plant

INSTALLATION

For use as a component of the Liquid Boot® Plus system, VI-20™ geomembrane is rolled out on prepared sub-grade, overlapping seams a minimum of six inches (6”). The geomembrane is cut around penetrations so that it lays flat on the sub-grade and tight at all inside corners. A thin (20 mil) tack coat of Liquid Boot® (“A” side without catalyst) is sprayed within the seam overlap. Once the VI-20™ geomembrane is installed, penetrations are then treated with VI-20™ Detailing Fabric prior to installation of the Liquid Boot® spray-applied vapor intrusion membrane and UltraShield™ G-1000 protection course.

EVOH technology provided in VI-20™ geomembrane has been shown to have VOC diffusion coefficients 20 times lower than an 80 mil (2 mm) HDPE geomembrane.

PACKAGING

VI-20™ Geomembrane is available in the following packaging option:

- 10 ft. x 150 ft. (3 m x 45 m) Rolls

VI-20™ GEOMEMBRANE

HIGH-PERFORMANCE VAPOR INTRUSION BARRIER

VI-20™ CHEMICAL & PHYSICAL PROPERTIES		
CHEMICAL PROPERTY	TEST METHOD	RESULT
Benzene Diffusion Coefficient	EPA Method 8260	4.5×10^{-15} m²/s
Ethylbenzene Diffusion Coefficient	EPA Method 8260	4.0×10^{-15} m²/s
m&p-Xylenes Diffusion Coefficient	EPA Method 8260	3.7×10^{-15} m²/s
Methane Permeance	ASTM D1434	$< 1.7 \times 10^{-10}$ m²/d•atm
o-Xylene Diffusion Coefficient	EPA Method 8260	3.7×10^{-15} m²/s
Radon Diffusion Coefficient	SP Test Method	$<0.25 \times 10^{-12}$ m²/s
Toluene Diffusion Coefficient	EPA Method 8260	4.2×10^{-15} m²/s
PHYSICAL PROPERTY	TEST METHOD	RESULT
Membrane Composite Thickness	ASTM D5199	20 mil (0.5 mm)
Impact Resistance	ASTM D1709	2,600 g
Tensile Strength	ASTM E154 Section. 9	58 lbf/in (1.0 N/m)
Water Vapor Transmission	ASTM E154 & E96	0.004 grains/hr-ft² (0.0028 g/hr-m²)
Water Vapor Retarder Classification	ASTM E1745	Class A, B & C

NOTE:
These are typical property values.

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UPDATED: MAY 2017

FORM: TDS_VI-20_GEOMEMBRANE_AM_EN_201705_V2

APPENDIX 4

Oxidant Safety Data Sheets

SAFETY DATA SHEET

1. Identification of the substance or mixture and of the supplier

1.1 GHS product identifier **LIQUOX® sodium permanganate**

1.2 Other means of identification

SDS number -

1.3 Recommendations and restrictions on the use of substances or mixtures

Recommended use Liquid oxidant recommended for applications that require a concentrated permanganate solution.

Recommended restrictions Use in accordance with supplier's recommendations.

1.4 Supplier's details

Manufacturer/Supplier CARUS CORPORATION

Address 315 Fifth Street,
Peru, IL 61354, USA

Telephone 815 223-1500 - All other non-emergency inquiries about the product should be directed to the company

e-mail salesmkt@caruscorporation.com

Website www.caruscorporation.com

Contact person Dr. Chithambarathanu Pillai

Emergency telephone number For Hazardous Materials [or Dangerous Goods] Incidents ONLY

(spill, leak, fire, exposure or accident), call CHEMTREC at
CHEMTREC®, Thailand (toll free): 001-800-13-203-9987
CHEMTREC®, India (toll free): 000-800-100-7141
CHEMTREC®, Other countries: 001 (703) 527-3887

2. Hazards identification

2.1 GHS classification of substance or mixture, and national or regional information

Physical hazards	Oxidizing liquids	Category 2
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 1
	Serious eye damage/eye irritation	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1

2.2 GHS label elements

Hazard symbol(s)

Signal word Danger

Hazard Statement(s) May intensify fire; oxidiser. Harmful if swallowed. Causes severe skin burns and eye damage. May cause respiratory irritation. Very toxic to aquatic life with long lasting effects.

Precautionary Statement(s)

Prevention Keep away from heat. Take any precaution to avoid mixing with combustibles. Keep/Store away from clothing and other combustible materials. Wear protective gloves/protective clothing/eye protection/face protection. Wash hands thoroughly after handling. Do not eat, drink or smoke when using this product. Do not breathe mist or vapour. Use only outdoors or in a well-ventilated area. Avoid release to the environment.

Response In case of fire: Use water for extinction. IF SWALLOWED: Immediately call a POISON CENTRE or doctor/physician. Rinse mouth. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing. Collect spillage.

Storage Store locked up. Store in a well-ventilated place. Keep container tightly closed.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

2.3 Other hazards which do not result in GHS classification Not available.

3. Composition/information on ingredients

3.2 Mixture

Chemical identity	Common name and synonym	CAS number and other unique identifiers	Concentration or concentration range
Sodium permanganate		10101-50-5	36 - 40

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

4.1 Description of first-aid measures

Inhalation Remove victim to fresh air and keep at rest in a position comfortable for breathing. For breathing difficulties, oxygen may be necessary. Get medical attention immediately.

Skin contact Take off immediately all contaminated clothing. (Caution: Solution may ignite certain textiles). Immediately flush skin with plenty of water. Get medical attention immediately. Wash contaminated clothing before reuse.

Contact with skin may leave a brown stain of insoluble manganese dioxide. This can be easily removed by washing with a mixture of equal volume of household vinegar and 3% hydrogen peroxide, followed by washing with soap and water.

Eye contact Immediately flush with plenty of water for up to 15 minutes. Remove any contact lenses and open eyelids wide apart. Continue rinsing. Get medical attention immediately.

Ingestion Immediately rinse mouth and drink plenty of water. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical attention immediately.

4.2 Most important symptoms/effects, acute and delayed Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result.

4.3 Indication of immediate medical considerations and important specific treatment that should be performed Provide general supportive measures and treat symptomatically. In case of shortness of breath, give oxygen. Decomposition products are alkaline. Brown stain is insoluble manganese dioxide.

5. Fire-fighting measures

5.1 Prohibited extinguishing media and suitable extinguishing media

Suitable extinguishing media Flood with water from a distance, water spray or fog.

Unsuitable extinguishing media The following extinguishing media are ineffective: Dry chemical. Foam. Carbon dioxide (CO2). Halogenated materials.

5.2 Specific hazards arising from chemicals May intensify fire; oxidiser. May ignite combustibles (wood, paper, oil, clothing, etc.). Contact with incompatible materials or heat (135 ºC / 275 ºF) could result in violent exothermic chemical reaction. Oxidizing agent, may cause spontaneous ignition of combustible materials. By heating and fire, corrosive vapours/gases may be formed.

5.3 Special protective equipment and precautions for fire-fighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures Keep unnecessary personnel away. Keep upwind. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Avoid inhalation of vapours and contact with skin and eyes. Wear protective clothing as described in Section 8 of this safety data sheet. Local authorities should be advised if significant spillages cannot be contained.

6.2 Environmental precautions Do not allow to enter drains, sewers or watercourses. Contact local authorities in case of spillage to drain/aquatic environment.

6.3 Methods and materials for containment and cleaning up

Keep combustibles (wood, paper, oil etc) away from spilled material. Should not be released into the environment. This product is miscible in water. Stop leak if possible without any risk. Dike the spilled material, where this is possible. Proceed with either of the following two options depending upon the size of the spill and the availability of the neutralising agents:

Option # 1: Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralise with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water.

Option # 2: Absorb with inert media like diatomaceous earth or inert floor dry, collect into a drum and dispose of properly. Do not use saw dust or other incompatible media. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations pertaining to permanganates.

To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as described above.

Never return spills in original containers for re-use. For waste disposal, see Section 13.

7. Handling and storage

7.1 Precautions for safe handling, use and storage

Take any precaution to avoid mixing with combustibles. Do not get this material in your eyes, on your skin, or on your clothing. Do not breathe mist or vapour. If clothing becomes contaminated, remove and wash off immediately. Spontaneous ignition may occur in contact with cloth or paper. When using, do not eat, drink or smoke. Good personal hygiene is necessary. Wash hands and contaminated areas with water and soap before leaving the work site. Avoid release to the environment. Use Personal Protective Equipment recommended in section 8 of the SDS.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed and in a well-ventilated place. Store in a cool, dry place. Store away from incompatible materials (See Section 10). Store locked up. Follow applicable local/national/international recommendations on storage of oxidisers.

8. Exposure controls/personal protection

8.1 Control parameters

Occupational exposure limits

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	0.1 mg/m3	Inhalable fraction.
		0.02 mg/m3	Respirable fraction.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Follow standard monitoring procedures.

8.2 Appropriate engineering controls Provide adequate general and local exhaust ventilation. An eye wash and safety shower must be available in the immediate work area.

8.3 Personal protective measures

Eye/face protection Wear safety glasses with side shields (or goggles). Wear face shield if there is risk of splashes.

Skin protection

Hand protection Wear chemical-resistant, impervious gloves. Use protective gloves made of: Rubber or plastic. Suitable gloves can be recommended by the glove supplier.

Other Wear appropriate chemical resistant clothing.

Respiratory protection In case of inadequate ventilation or risk of inhalation of vapors, use suitable respiratory equipment.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practices.

9. Physical and chemical properties

9.1 Appearance Dark purple liquid.

Physical state Liquid.

Form Aqueous solution.

Colour Dark purple.

9.2 Odor Odourless.

9.3 Odor threshold limit	Not available.
9.4 pH	5 - 8
9.5 Melting point/freezing point	< -4 °C (< 24.8 °F)
9.6 Initial boiling point and boiling range	> 101 °C (> 213.8 °F)
9.7 Flash point	Does not flash.
9.8 Evaporation rate	As water.
9.9 Flammability (solid, gas)	Not applicable.
9.10 Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not applicable.
Flammability limit - upper (%)	Not applicable.
Explosive limit - lower (%)	Not available.
Explosive limit – upper (%)	Not available.
9.11 Vapor pressure	760 mm Hg (105 °C)
9.12 Vapor density	Not available.
9.13 Relative density	1.37 - 1.4 (20 °C) (Water = 1)
9.14 Solubilit(ies)	Miscible with water.
9.15 Partition coefficient: n-octanol/water	Not available.
9.16 Auto-ignition temperature	Not available.
9.17 Decomposition temperature	Not available.
9.18 Viscosity	Not available.
Other information	
Explosive properties	Not explosive. Can explode in contact with sulphuric acid, peroxides and metal powders.
Oxidizing properties	Strong oxidising agent.

10. Stability and reactivity

10.1 Reactivity	The product is non-reactive under normal conditions of use, storage and transport.
10.2 Chemical stability	Stable at normal conditions.
10.3 Possibility of hazardous reactions	Contact with combustible material may cause fire. Can explode in contact with sulphuric acid, peroxides and metal powders.
10.4 Conditions to avoid	Contact with incompatible materials or heat (135 °C / 275 °F) could result in violent exothermic chemical reaction.
10.5 Incompatible materials	Acids. Peroxides. Reducing Agents. Combustible material. Metal powders.
10.6 Hazardous decomposition products	By heating and fire, corrosive vapours/gases may be formed. Contact with hydrochloric acid liberates chlorine gas.

11. Toxicological information

11.1 Information on likely routes of exposure	
Ingestion	Harmful if swallowed.
Inhalation	May cause irritation to the respiratory system.
Skin contact	Causes severe skin burns.
Eye contact	Causes serious eye damage.
11.2 Symptoms related to physical, chemical and toxicological characteristics	Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result.
11.3 Delayed and immediate effects, including chronic effects from short- and long-term exposure	Occupational exposure to the substance or mixture may cause adverse effects.
11.4 Numerical values of toxicity	
Acute toxicity	Harmful if swallowed.

Components	Species	Test results
Potassium permanganate (CAS 7722-64-7)		
Acute		
Dermal		
LD50	Rat	2000 mg/kg
Oral		
LD50	Rat	2000 mg/kg

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Skin corrosion/irritation Causes severe skin burns.

Serious eye damage/eye irritation Causes serious eye damage.

Respiratory or skin sensitisation

Respiratory sensitisation Not classified.

Skin sensitisation Not classified.

Germ cell mutagenicity Not classified.

Carcinogenicity Not classified.

Reproductive toxicity Not classified.

Specific target organ toxicity - single exposure May cause irritation of respiratory tract.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Not classified.

Further information Chronic effects are not expected when this product is used as intended. Prolonged exposure, usually over many years, to manganese oxide fume/dust can lead to chronic manganese poisoning, chiefly affecting the central nervous system.

12. Ecological information

12.1 Ecological toxicity Very toxic to aquatic life with long lasting effects.

Components		Species	Test results
Potassium permanganate (CAS 7722-64-7)			
Aquatic			
Fish	LC50	Bluegill (Lepomis macrochirus)	2.7 mg/l, 96 hours, static
			2.3 mg/l, 96 hours, flow through
			2.3 mg/l, 96 hours
			1.8 - 5.6 mg/l
		Carp (Cyprinus carpio)	3.16 - 3.77 mg/l, 96 hours
			2.97 - 3.11 mg/l, 96 hours
		Goldfish (Carassius auratus)	3.3 - 3.93 mg/l, 96 hours, static
		Milkfish, salmon-herring (Chanos chanos)	> 1.4 mg/l, 96 hours
		Rainbow trout (Oncorhynchus mykiss)	1.8 mg/l, 96 hours
			1.08 - 1.38 mg/l, 96 hours
			0.77 - 1.27 mg/l, 96 hours
		Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.275 - 0.339 mg/l, 96 hours

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

12.2 Persistence and degradability Expected to be readily converted by oxidisable materials to insoluble manganese oxide.

12.3 Bioaccumulative potential Potential to bioaccumulate is low.

12.4 Mobility in soil The product is miscible with water. May spread in water systems.

12.5 Other adverse effects None known.

13. Disposal considerations

Disposal instructions Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Waste from residues / unused products	Do not allow this material to drain into sewers/water supplies.
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied. Rinse container at least three times to an absence of pink color before disposing. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

ADR

14.1 UN number	UN3214
14.2 UN proper shipping name	Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
14.3 Transport hazard class(es)	
Class	5.1
Label(s)	5.1
14.4 Packing group	II
14.5 Environmental hazards	Yes
14.6 Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

RID

14.1 UN number	UN3214
14.2 UN proper shipping name	Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
14.3 Transport hazard class(es)	
Class	5.1
Label(s)	5.1
14.4 Packing group	II
14.5 Environmental hazards	Yes

IATA

14.1 UN number	UN3214
14.2 UN proper shipping name	Permanganates, inorganic, aqueous solution, n.o.s. (Sodium permanganate)
14.3 Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Label(s)	5.1
14.4 Packing group	II
14.5 Environmental hazards	Yes
ERG Code	5L
14.6 Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Other information	
Cargo aircraft only	Allowed.

IMDG

14.1 UN number	UN3214
14.2 UN proper shipping name	PERMANGANATES, INORGANIC, AQUEOUS SOLUTION, N.O.S. (Sodium permanganate)
14.3 Transport hazard class(es)	
Class	5.1
Subsidiary risk	-
Label(s)	5.1
14.4 Packing group	II
14.5 Environmental hazards	
Marine pollutant	Yes
EmS	F-H, S-Q
14.6 Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.

15. Regulatory information

Federal regulations

Thailand. Notification of the Ministry of Interior, Re: Work Safety Relating to Dangerous Chemicals

Not regulated.

Thailand. Notification of the Ministry of Interior, Re: Work Safety Relating to More Dangerous Chemicals

Not regulated.

Thailand. Reportable Hazardous Substances (Notification of Ministry of Industry Re: Bases respecting report of quantity of hazardous materials under Department of Industrial Works, B.E. 2547)

Not regulated.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	Yes
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 27-November-2013

Revision date -

Version No. 01

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SAFETY DATA SHEET

1. Identification

Product identifier	**RemOx® MLO Reagent**
Other means of identification	None.
Recommended use	Remediation.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Company name	CARUS CORPORATION
Address	315 Fifth Street, Peru, IL 61354, USA
Telephone	+1 815 223-1500 - All other non-emergency inquiries about the product should be directed to the company
E-mail	salesmkt@caruscorporation.com
Website	www.caruscorporation.com
Contact person	Shelley Corban
Emergency Telephone	For Hazardous Materials [or Dangerous Goods] Incidents ONLY (spill, leak, fire, exposure or accident), call CHEMTREC at CHEMTREC®, USA: 001 (800) 424-9300 CHEMTREC®, Mexico (Toll-Free - must be dialed from within country): 01-800-681-9531 CHEMTREC®, Other countries: 001 (703) 527-3887

2. Hazard(s) identification

Physical hazards	Not classified.	
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 1B
	Serious eye damage/eye irritation	Category 1
	Sensitization, respiratory	Category 1
	Sensitization, skin	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	Harmful if swallowed. Causes severe skin burns and eye damage. May cause an allergic skin reaction. May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause respiratory irritation. Very toxic to aquatic life with long lasting effects.

Precautionary statement

Prevention	Do not breathe mist/vapors. Use only outdoors or in a well-ventilated area. In case of inadequate ventilation wear respiratory protection. Do not eat, drink or smoke when using this product. Wear protective gloves/protective clothing/eye protection/face protection. Wash thoroughly after handling. Contaminated work clothing must not be allowed out of the workplace. Avoid release to the environment.

Response	If swallowed: Rinse mouth. Do NOT induce vomiting. If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If skin irritation or rash occurs: Get medical advice/attention. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. Wash contaminated clothing before reuse. Collect spillage.
Storage	Store in a well-ventilated place. Keep container tightly closed. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.
Supplemental information	None.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Sodium permanganate	10101-50-5	1 - 28
Sodium persulfate	7775-27-1	1 - 28

All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. For breathing difficulties, oxygen may be necessary. Get medical attention immediately.
Skin contact	Take off immediately all contaminated clothing. (Caution: Solution may ignite certain textiles). Immediately flush skin with plenty of water. Get medical attention immediately. Wash contaminated clothing before reuse. Contact with skin may leave a brown stain of insoluble manganese dioxide. This can be easily removed by washing with a mixture of equal volume of household vinegar and 3% hydrogen peroxide, followed by washing with soap and water.
Eye contact	Immediately flush with plenty of water for up to 15 minutes. Remove any contact lenses and open eyelids wide apart. Continue rinsing. Get medical attention immediately.
Ingestion	Immediately rinse mouth and drink plenty of water. Never give anything by mouth to a victim who is unconscious or is having convulsions. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Get medical attention immediately.
Most important symptoms/effects, acute and delayed	Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result. May cause an allergic skin reaction. Dermatitis. Rash. May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause respiratory irritation.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. In case of shortness of breath, give oxygen. Decomposition products are alkaline. Brown stain is insoluble manganese dioxide.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Flood with water from a distance, water spray or fog.
Unsuitable extinguishing media	The following extinguishing media are ineffective: Dry chemical. Foam. Carbon dioxide (CO2). Halogenated materials.
Specific hazards arising from the chemical	May ignite combustibles (wood, paper, oil, clothing, etc.). Contact with incompatible materials or heat (135 ºC / 275 ºF) could result in violent exothermic chemical reaction. Oxidizing agent, may cause spontaneous ignition of combustible materials. During fire, gases hazardous to health may be formed such as: Sodium oxides. Manganese oxides. Sulfur Oxides (SOx).
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.
Fire fighting equipment/instructions	Move container from fire area if it can be done without risk. Cool containers exposed to flames with water until well after the fire is out. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply. Dike fire control water for later disposal. Water runoff can cause environmental damage.

General fire hazards The product is not flammable. May ignite combustibles (wood, paper, oil, clothing, etc.). Contact with incompatible materials or heat (135 °C / 275 °F) could result in violent exothermic chemical reaction.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Keep unnecessary personnel away. Keep upwind. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Avoid inhalation of vapors and contact with skin and eyes. Wear protective clothing as described in Section 8 of this safety data sheet. Local authorities should be advised if significant spillages cannot be contained.

Methods and materials for containment and cleaning up Keep combustibles (wood, paper, oil, etc.) away from spilled material. Should not be released into the environment. This product is miscible in water. Stop leak if possible without any risk. Dike the spilled material, where this is possible. Proceed with either of the following two options depending upon the size of the spill and the availability of the neutralizing agents:

Option # 1: Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water.

Option # 2: Absorb with inert media like diatomaceous earth or inert floor dry, collect into a drum and dispose of properly. Do not use saw dust or other incompatible media. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations pertaining to permanganates.

To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as described above.

Never return spills in original containers for re-use. For waste disposal, see section 13 of the SDS.

Environmental precautions Do not allow to enter drains, sewers or watercourses. Contact local authorities in case of spillage to drain/aquatic environment.

7. Handling and storage

Precautions for safe handling Take any precaution to avoid mixing with combustibles. Keep away from clothing and other combustible materials. Do not get this material in your eyes, on your skin, or on your clothing. Do not breathe mist or vapor. Use Personal Protective Equipment recommended in section 8 of the SDS. If clothing becomes contaminated, remove and wash off immediately. Spontaneous ignition may occur in contact with cloth or paper. When using, do not eat, drink or smoke. Good personal hygiene is necessary. Wash hands and contaminated areas with water and soap before leaving the work site. Avoid release to the environment.

Conditions for safe storage, including any incompatibilities Store locked up. Keep container tightly closed and in a well-ventilated place. Store in a cool, dry place. Store away from incompatible materials (See Section 10).

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Sodium permanganate (CAS 10101-50-5)	Ceiling	5 mg/m3

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	TWA	0.1 mg/m3	Inhalable fraction.
		0.02 mg/m3	Respirable fraction.
Sodium persulfate (CAS 7775-27-1)	TWA	0.1 mg/m3	

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
Sodium permanganate (CAS 10101-50-5)	STEL	3 mg/m3	Fume.
	TWA	1 mg/m3	Fume.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines	Follow standard monitoring procedures.
Appropriate engineering controls	Provide adequate general and local exhaust ventilation. An eye wash and safety shower must be available in the immediate work area.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses with side shields (or goggles). Wear face shield if there is risk of splashes.
Skin protection	
Hand protection	Wear chemical-resistant, impervious gloves. Use protective gloves made of: Rubber or plastic.
Skin protection	
Other	Wear appropriate chemical resistant clothing. Rubber or plastic apron.
Respiratory protection	In case of inadequate ventilation or risk of inhalation of vapors, use suitable respiratory equipment. In the United States of America, if respirators are used, a program should be instituted to assure compliance with OSHA 29 CFR 1910.134.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	When using, do not eat, drink or smoke. Keep from contact with clothing and other combustible materials. Remove and wash contaminated clothing promptly. Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance	Purple liquid.
Physical state	Liquid.
Form	Liquid.
Color	Dark purple
Odor	Odorless
Odor threshold	Not available.
pH	5.5 - 7.2
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.

Upper/lower flammability or explosive limits

Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	1.05 - 1.4 at 22°C
Solubility(ies)	
Solubility (water)	Soluble
Partition coefficient (n-octanol/water)	Not applicable for inorganic substances.
Auto-ignition temperature	Not available.
Decomposition temperature	172.4 °F (78 °C)
Viscosity	Not available.
Other information	
Density	1.05 - 1.40 at 22°C
Explosive properties	Not explosive.
Oxidizing properties	Not oxidizing.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Contact with combustible material may cause fire. Can explode in contact with sulfuric acid, peroxides and metal powders.
Conditions to avoid	Contact with incompatible materials or heat (135 °C / 275 °F) could result in violent exothermic chemical reaction.
Incompatible materials	Acids. Peroxides. Reducing agents. Combustible material. Metal powders.
Hazardous decomposition products	By heating and fire, corrosive vapors/gases may be formed. Contact with hydrochloric acid liberates chlorine gas.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May cause irritation to the respiratory system. May cause allergic respiratory reaction.
Skin contact	Causes severe skin burns. May cause allergic skin reaction.
Eye contact	Causes serious eye damage.
Ingestion	Harmful if swallowed. Causes digestive tract burns.
Symptoms related to the physical, chemical and toxicological characteristics	Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result. May cause an allergic skin reaction. Rash. Dermatitis. May cause allergy or asthma symptoms or breathing difficulties if inhaled. May cause respiratory irritation.

Information on toxicological effects

Acute toxicity Harmful if swallowed.

Components	Species	Test Results
Potassium permanganate (CAS 7722-64-7)		
Acute		
Dermal		
LD50	Rat	2000 mg/kg
Oral		
LD50	Rat	2000 mg/kg
Sodium persulfate (CAS 7775-27-1)		
Acute		
Dermal		
LD50	Rat	> 2000 mg/kg, 24 Hours
Inhalation		
LC50	Rat	> 5.1 mg/l, 4 Hours
Oral		
LD50	Rat	742 mg/kg

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Skin corrosion/irritation	Causes severe skin burns.
Serious eye damage/eye irritation	Causes serious eye damage.

Respiratory or skin sensitization

Respiratory sensitization	May cause allergic respiratory reaction.
Skin sensitization	May cause allergic skin reaction.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.

IARC Monographs. Overall Evaluation of Carcinogenicity

Not listed.

NTP Report on Carcinogens

Not listed.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Reproductive toxicity Not classified.

Specific target organ toxicity - single exposure May cause irritation of respiratory tract.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Not classified.

Chronic effects Chronic effects are not expected when this product is used as intended. Prolonged exposure, usually over many years, to manganese oxide fume/dust can lead to chronic manganese poisoning, chiefly affecting the central nervous system.

12. Ecological information

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Components		Species	Test Results
Potassium permanganate (CAS 7722-64-7)			
Aquatic			
Fish	LC50	Bluegill (Lepomis macrochirus)	2.7 mg/l, 96 hours static
			2.3 mg/l, 96 hours flow through
			2.3 mg/l, 96 hours
			1.8 - 5.6 mg/l
		Carp (Cyprinus carpio)	3.16 - 3.77 mg/l, 96 hours
			2.97 - 3.11 mg/l, 96 hours
		Goldfish (Carassius auratus)	3.3 - 3.93 mg/l, 96 hours static
		Milkfish, salmon-herring (Chanos chanos)	> 1.4 mg/l, 96 hours
		Rainbow trout (Oncorhynchus mykiss)	1.8 mg/l, 96 hours
			1.08 - 1.38 mg/l, 96 hours
			0.77 - 1.27 mg/l, 96 hours

Toxicity data are not available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate.

Persistence and degradability Expected to be readily converted by oxidizable materials to insoluble manganese oxide.

Bioaccumulative potential Potential to bioaccumulate is low.

Mobility in soil The product is miscible with water. May spread in water systems.

Other adverse effects None known.

13. Disposal considerations

Disposal instructions Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose of in accordance with local regulations.

Hazardous waste code The Waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Do not allow this material to drain into sewers/water supplies. Dispose of in accordance with local regulations.

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied. Rinse container at least three times to an absence of pink color before disposing. Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. Transport information

DOT

UN number UN1760

UN proper shipping name Corrosive liquids, n.o.s. (Sodium permanganate; sodium persulfate)

Transport hazard class(es)

Class 8

Subsidiary risk -

Label(s) 8

Packing group	II
Environmental hazards	
Marine pollutant	Yes
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	B2, IB2, T11, TP2, TP27
Packaging exceptions	154
Packaging non bulk	202
Packaging bulk	242

IATA

UN number	UN1760
UN proper shipping name	Corrosive liquid, n.o.s. (Sodium permanganate; sodium persulfate)
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	II
Environmental hazards	Yes
ERG Code	8L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN1760
UN proper shipping name	CORROSIVE LIQUID, N.O.S. (Sodium permanganate; sodium persulfate)
Transport hazard class(es)	
Class	8
Subsidiary risk	-
Packing group	II
Environmental hazards	
Marine pollutant	Yes
EmS	F-A, S-B
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable.
General information	DOT Regulated Marine Pollutant.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

Sodium permanganate (CAS 10101-50-5) Listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Toxic Substances Control Act (TSCA) All components of the mixture on the TSCA 8(b) inventory are designated “active”.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical	Yes
Classified hazard categories	Acute toxicity (any route of exposure) Skin corrosion or irritation Serious eye damage or eye irritation Respiratory or skin sensitization Specific target organ toxicity (single or repeated exposure)

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Sodium permanganate	10101-50-5	1 - 20

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Sodium permanganate (CAS 10101-50-5)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Sodium permanganate (CAS 10101-50-5) 6588

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Sodium permanganate (CAS 10101-50-5) 15 %WT

DEA Exempt Chemical Mixtures Code Number

Sodium permanganate (CAS 10101-50-5) 6588

US state regulations

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Sodium permanganate (CAS 10101-50-5)
Sodium persulfate (CAS 7775-27-1)

US. Pennsylvania Worker and Community Right-to-Know Law

Sodium permanganate (CAS 10101-50-5)

US. Rhode Island RTK

Not regulated.

California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 2016 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. For more information go to www.P65Warnings.ca.gov.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	No
Canada	Non-Domestic Substances List (NDSL)	Yes
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
Taiwan	Taiwan Chemical Substance Inventory (TCSI)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date	23-May-2019
Revision date	22-August-2019
Version #	02
Further information	HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings

Health: 3*
Flammability: 0
Physical hazard: 0

NFPA ratings

List of abbreviations

GHS: Globally Harmonized System of Classification and Labeling of hazardous properties of Chemicals.

TWA: Time weighted average.
LD50: Lethal Dose, 50%.
LC50: Lethal Concentration, 50%.
IMDG: International Maritime Dangerous Goods.
IATA: International Air Transport Association.
MARPOL: International Convention for the Prevention of Pollution from Ships.
STEL: Short-term Exposure Limit.

References

HSDB® - Hazardous Substances Data Bank
Registry of Toxic Effects of Chemical Substances (RTECS)
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

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