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		
Wahl	Scott		Tyco Fire Products LP		
Mailing Address			City	State	ZIP Code
2700 Industrial Parkway South			Marinette	WI	54143
Phone # (include area code)	Fax # (include area code)		Email		

The requester listed above: (select all that apply)

- [x] 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		
Verburg	Ben		Arcadis		
Mailing Address			City	State	ZIP Code
126 N Jefferson Street, Suite 400			Milwaukee	WI	53202
Phone # (include area code)	Fax # (include area code)		Email		
(414) 276-7742			Ben.Verburg@arcadis.com		

Environmental Consultant (if applicable)

Contact Last Name	First	MI	Organization/ Business Name		
Verburg	Ben		Arcadis		
Mailing Address			City	State	ZIP Code
126 N Jefferson Street, Suite 400			Milwaukee	WI	53202
Phone # (include area code)	Fax # (include area code)		Email		
(414) 276-7742			Ben.Verburg@arcadis.com		

Section 2. Property Information

Property Name			FID No. (if known)	
Tyco Fire Technology Center - PFCs			438005590	
BRRTS No. (if known)		Parcel Identification Number		
0238580694				
Street Address		City	State	ZIP Code
2700 Industrial Parkway South		Marinette	WI	54143

County	Municipality where the Property is located	Property is composed of:	Property Size Acres
Marinette	○ City ○ Town ○ Village of Marinette	○ Single tax parcel ○ Multiple tax parcels	380

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: ________________

   Reason:

   ____

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 for

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: Conceptual Site Model - Tyco Fire Technology Center

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: Scott Wahl
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]	5/27/2020
Signature	Date Signed
Project Environmental Specialist	(312) 575-3732
Title	Telephone Number (include area code)

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

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		

David Neste
Remediation and Redevelopment Program
Wisconsin Department of Natural Resources
2984 Shawano Avenue
Green Bay, Wisconsin 54313-6727

Arcadis U.S., Inc.
126 North Jefferson Street
Suite 400
Milwaukee
Wisconsin 53202
Tel 414 276 7742
Fax 414 276 7603
www.arcadis.com

ENVIRONMENT

Subject:
Conceptual Site Model
Tyco Fire Technology Center
2700 Industrial Parkway South, Marinette, Wisconsin
BRRTS Activity#: 02-38-580694

Date:
May 26, 2020

Contact:
Michael Bedard

Phone:
267.685.1821

Email:
Michael.Bedard@
arcadis.com

Our ref:
30015294

Dear Mr. Neste:

On behalf of Tyco Fire Products LP (Tyco), and pursuant to a request from the Wisconsin Department of Natural Resources (WDNR), Arcadis US, Inc. (Arcadis) submits the attached *Conceptual Site Model* (CSM) for the Tyco Fire Technology Center for the WDNR Bureau for Remediation and Redevelopment Tracking System site number referenced above.

The CSM includes discussion of the sources, transport pathways, exposure pathways, and receptors associated with per- and poly-fluorinated alkyl substances (PFAS). The CSM summarizes the current understanding of the relationships among sources, nature and extent, fate and transport, and exposures and receptors. It is recommended that the CSM be reviewed in concert with the Interim Site Investigation Report submitted to WDNR on May 15, 2020. Review of these two documents together will provide an understanding of the data collected and an interpretation of the data.

Tyco and Arcadis look forward to hearing your thoughts on this report.

Sincerely,
Arcadis U.S., Inc.

Michael Bedard
Project Lead

Copy:
Jeffrey Danko, Scott Wahl and Rick Bethel – Johnson Controls

Enclosures:

Attachment

Conceptual Site Model Report

Tyco Fire Products LP

CONCEPTUAL SITE MODEL

Tyco Fire Technology Center
Marinette, Wisconsin

BRRTS No. 02-38-580694

May 2020

CONCEPTUAL SITE MODEL

Tyco Fire Technology Center
Marinette, Wisconsin
BRRTS No. 02-38-580694

Christopher S. Peters, PG
Principal Geologist

Benjamin J. Verburg, PE
Principal Engineer

Michael P. Bedard
Project Lead/Associate Vice President

Prepared for:

Tyco Fire Products LP
2700 Industrial Parkway South
Marinette
Wisconsin 54143
Tel 715 735 7411

Prepared by:

Arcadis U.S., Inc.
126 North Jefferson Street
Suite 400
Milwaukee
Wisconsin 53202
Tel 414 276 7742
Fax 414 276 7603

Our Ref:

30015294

Date:

May 26, 2020

CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AFFF	aqueous film-forming foam
amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
bgs	below ground surface
BRRTS	Bureau of Remediation and Redevelopment Tracking System
CIPPL	cured-in-place pipe lining
CSM	Conceptual Site Model
DC	direct contact
FS	feasibility study
ft	feet
ft/day	feet per day
FTC	Fire Technology Center
gpm	gallons per minute
HAL	Health Advisory Level
HPT	hydraulic profiling tool
in/yr	inches per year
Interim SIR	Interim Site Investigation Report
µg/kg	micrograms per kilogram
ng/L	nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NR	Natural Resources
NRCS	Natural Resources Conservation Service
OTA	Outdoor Testing/Training Area
PFHxA	perfluorohexanoic acid
PFAS	per- and poly-fluorinated alkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
POET	point-of-entry treatment
R&D	research and development

RCL	residual contaminant levels
SIR	Site Investigation Report
Site	Tyco Fire Technology Center located at 2700 Industrial Parkway South, Marinette, Wisconsin
SPLP	Synthetic Precipitation Leaching Procedure
SSRCL	site-specific residual contaminant level
TSS	total suspended solids
Tyco	Tyco Fire Products LP
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
VAP	vertical aquifer profiling
WDHS	Wisconsin Department of Health Services
WDNR	Wisconsin Department of Natural Resources
WWI	Wisconsin Wetlands Inventory

EXECUTIVE SUMMARY

On behalf of Tyco Fire Products LP (Tyco), Arcadis U.S., Inc. (Arcadis) prepared this Conceptual Site Model (CSM) to present an interpretation of the findings of environmental investigations regarding the presence of per- and poly-fluorinated alkyl substances (PFAS) associated with the Tyco Fire Technology Center (FTC), located at 2700 Industrial Parkway South in Marinette, Wisconsin (the Site). Tyco conducted investigations at the Site and adjacent areas in the City of Marinette and the Town of Peshtigo to evaluate the presence and migration pathways of PFAS in soil, stormwater, surface water, sediment, and groundwater. This CSM focuses on the portions of the City of Marinette and the Town of Peshtigo where investigations described in the Interim Site Investigation Report were completed. This investigation area encompasses approximately 7 square miles, from the Menominee River to the Little River, north to south, and from Green Bay to the western edge of the Site, east to west.

This CSM is an iterative feature in the site investigation and feasibility study (FS) process and describes the current understanding of the Site. A CSM includes discussion of the sources, transport pathways, exposure pathways, and receptors associated with site-related compounds and is a living model that is updated as new information is available (ASTM E1689-95(2014); United States Environmental Protection Agency 1988, 2000, 2005, 2006a, 2011; Wisconsin Administrative Code Natural Resources 716.07). This CSM was prepared in accordance with these guidance documents.

The specific objectives of this CSM include:

- Provide a framework for data completeness determination to prepare the Comprehensive Site Investigation Report.
- Summarize the current understanding of relationships among sources, nature and extent, fate and transport, and exposures and receptors at the Site.

The FTC is a fire suppressant training, testing, and research and development (R&D) facility, occupying approximately 380 acres. The FTC includes an Outdoor Testing/Training Area (OTA) comprised of the Firefighting School area (where firefighting scenarios are simulated) and the R&D area (where product testing occurs). The training area is an outside gravel lot containing concrete and clay pads and steel pans, some with props where a contained fire is started and extinguished to test the performance of fire suppression products. Aqueous film-forming foam (AFFF) was used as part of R&D, quality testing, and firefighting training activities, until outdoor use of AFFF was discontinued in 2017. The site buildings support training, R&D, quality testing activities, warehousing, and metal fire suppressant component manufacturing. The area of the Site outside the central campus comprises more than 300 acres of undeveloped forest and wetlands.

Hydrogeology

The investigation area is drained by ditches that flow to Green Bay. These ditches are not formally named but are referred to in this report by letter (A, B, C, D, and E). Ditch A receives runoff from the Site. Ditch A flows south through the Site, passing west of the OTA. Groundwater is present at shallow depths (typically less than 5 feet) within an unconsolidated aquifer that ranges in thickness from approximately 40 feet thick at the Site, to greater than 100 feet thick at the edge of Green Bay. The unconsolidated zone is predominantly sand but includes two major aquitards comprising a combination of silt, clay, and till. A middle aquitard that is present through most of the eastern and southern portions of the investigation area separates the sand into shallow and deep units. A deep aquitard separates the sand units from the underlying bedrock.

Groundwater from the Site flows generally east, with flow paths radiating along an arc from southeast to northeast, discharging to Green Bay and the Menominee River. Groundwater in the shallow sand unit interacts with surface water in the ditches, ponds, and wetlands within the investigation area. The ditches in the investigation area are predominantly gaining (i.e., groundwater discharge locations), with the exception of a segment of Ditch A approximately from University Drive to Madsen Road. This segment of the ditch flows over flat ground with a minimal stream gradient. South of this segment, Ditch A descends into a naturally eroded channel, and the ditch returns to a gaining condition.

Soil and Stormwater

AFFF application on the OTA is the primary PFAS source at the Site. PFAS migrated into soil at the OTA via infiltration. The highest perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) concentrations in soil are concentrated in the fire training area, the foam monitoring pad, and depressions that convey stormwater runoff to Ditch A, followed by locations associated with historical AFFF outdoor releases and their stormwater runoff pathways. Concentrations of PFOA and PFOS are below the Wisconsin Department of Natural Resources (WDNR) industrial direct contact residual contaminant levels for PFOA or PFOS in soils based on analytical testing results. Investigation data indicate there is stormwater transport of PFAS from the OTA to Ditch A.

Groundwater

PFAS migrated into groundwater via infiltration through soil at the OTA and from surface water in the losing segment of Ditch A from approximately University Drive to Madsen Road. Groundwater is interpreted to flow generally east, with flow paths radiating along an arc from southeast to northeast, discharging to Green Bay and the Menominee River. PFAS detections in groundwater form two lobes: one trending to the northeast, and one trending to the southeast. The highest concentrations of PFAS in groundwater were detected in the northern lobe in an area between the OTA and the eastern site boundary. A component of the northern lobe discharges to Ditch B east of the Site, while a deeper component extends farther northeast toward the Menominee River. The highest concentrations of PFAS in groundwater were detected in the northern lobe in an area between the OTA and the eastern site boundary. The southern lobe extends southeast from the Site into the Town of Peshtigo. A component of PFAS in the southern lobe is interpreted to have entered groundwater from the losing segment of Ditch A. The lobe extends southeast toward Green Bay with components potentially discharging to Ditch D.

The highest detected concentrations of PFAS in groundwater in the investigation area occur at the Site, in an area between the OTA and the eastern site boundary. Samples collected adjacent the OTA contained PFOA as high as 254,000 nanograms per liter (ng/L) and PFOS as high as 64,000 ng/L (exceeded laboratory detection range). PFOA was detected at greater than 100,000 ng/L in two vertical aquifer profile borings on the eastern property boundary. The highest PFAS concentrations observed off Site occur in the deep sand unit between the Site and Ditch B. The maximum concentration of PFOA detected offsite was 33,000 ng/L. The vertical distribution of PFAS varies within the plume extent, based on vertical circulation within the shallow and deep sand units and pattern of recharge and discharge to surface water.

The groundwater investigations completed to date have defined the lateral extent of PFAS relative to the Wisconsin Department of Health Services recommended groundwater enforcement standard of 20 ng/L for PFOA and PFOS, individually and combined. The plume extent encompasses a region that extends generally east from the Site and radiates northeast toward the Menominee River and southeast toward Green Bay, extending approximately as far south as Rader Road in Peshtigo. Consistent with the understanding of groundwater flow pathways, the plume radiates northeast toward the Menominee River, and southeast toward Green Bay, extending approximately as far south as Rader Road in Peshtigo. Groundwater in the shallow sand unit interacts with surface water in the ditches, ponds, and wetlands within the investigation area. The ditches in the investigation area are predominantly gaining (i.e., groundwater discharge locations), with the exception of a segment of Ditch A approximately from University Drive to Madsen Road.

Surface Water

Ditch A flows south from the Site through a series of connecting ditches through the Town of Peshtigo to Green Bay. Surface water concentrations in Ditch A on the Site are above WDNR water quality guidelines of 420 ng/L for PFOA and 11 ng/L for PFOS. Combined PFOA and PFOS concentrations in Ditch A at on-site locations and locations downgradient of the Site show a linear decreasing trend. As of January 2019, the majority of on-site flow in Ditch A is intercepted and treated to remove PFAS before exiting the site boundary. Ditch B is off Site to the north and east of the Site. In Ditch B, surface water samples collected from locations upgradient of the site-related impact exhibit minimal seasonal variations and concentrations. At the confluence of Ditch B with a northern tributary and slightly northeast of the OTA, combined detections of PFOA and PFOS in surface water increase. Downgradient of this location, increases in PFAS concentrations and seasonal variations are observed. These downgradient locations along Ditch B are generally due east of the OTA. This portion of the ditch appears to receive groundwater discharge from the groundwater plume originating from the Site. A treatment system is installed and operating in Ditch B to treat surface water. Surface water sample concentrations and variability along Ditch C and Ditch E are relatively low, and concentrations remained below the WDNR surface water quality guidelines during three 2018 and 2019 sampling events. Surface water samples from Ditch D had relatively stable seasonal concentrations with occasional concentrations exceeding the WDNR surface water quality guidelines. Surface water collected from five ponds during field events exhibit limited seasonal variability of concentrations. The two ponds just south of the Site contain PFOS surface water concentrations above WDNR surface water quality guideline, likely a result of groundwater discharge to surface water.

Based on 2018 and 2019 sampling data, PFOA and PFOS concentrations were present in surface water above those guidelines in portions of Ditches A, B, and D. The ditch segments where PFOA and/or PFOS concentrations exceeded the guidelines include:

- Ditch A, PFOA and PFOS concentrations in surface water samples were above the guidelines in sample locations extending from the Site to approximately where the ditch crosses Rader Road.

- Ditch B, PFOA and PFOS concentrations in surface water samples were above the guidelines in sample locations approximately from where the ditch crosses Pierce Avenue to Green Bay.
- Ditch D, PFOS concentrations intermittently in both surface water sample locations.

Sediment

The highest PFOA and PFOS concentrations detected in sediment on Site and off Site, are in Ditch A. On the Site, the highest concentrations are adjacent to the OTA down to University Drive. Off Site, the highest sediment concentrations are in Ditch A from University Drive to Madsen Drive. Concentrations identified in the remaining sediment samples from Ditches A and B were low and ranged from non-detect to 8.4 micrograms per kilogram for combined PFOS and PFOA. PFAS in the sediment is likely a result of OTA runoff, groundwater discharge to surface water, and surface water transport. Sediment does not appear to be a source of PFAS to groundwater as the ditches are primarily gaining (groundwater discharging to the ditches). While the predominant mass transport of PFAS to surface water is from groundwater discharge to surface water, there is the potential for PFAS to leach from sediment to surface water. However, if PFAS is leaching from sediment to surface water, it is likely a small mass contributor compared to the mass of PFAS in the groundwater. PFAS sorbed to sediment may be transported downstream in the ditches if sediment is eroded but it is unlikely to be sediment transport off Site because Ditch A is heavily vegetated. As surface water flows through the vegetation in Ditch A, potential suspended solids (i.e., eroded sediment) will be deposited.

Air

The only potential aerial release mechanism of PFAS at the Site is historical migration of foam from outdoor AFFF testing and training activities. An evaluation of site soil and groundwater data did not find evidence that aerial deposition of PFAS was either common enough or carried sufficient mass when it occurred to constitute an important transport mechanism to groundwater within or outside of the Site.

Receptors

Humans that may be exposed to PFAS via ingestion of PFAS-containing groundwater at concentrations greater than 70 ng/L are the primary receptors of concern. Based on the findings of PFAS groundwater investigation activities completed to date, Tyco is performing the following voluntary interim remedial actions with WDNR's approval:

- Providing ongoing bottle water service to private drinking water well owners/users in the private well sampling area.
- Maintain and monitoring 40 point-of-entry treatment systems of private well owners/users in the private well sampling area installed for wells with PFAS detections.
- Developing, designing, and pursuing regulatory approval for a municipal water line extension to service businesses and residences in the portions of the private well sampling area.

Ecological receptors may be exposed to PFAS via ingestion of PFAS-containing media. Ecological receptors will be evaluated based on fish and deer tissue data. Fish tissue will be collected from the ponds later in 2020. WDNR collected deer tissue on the Site in February 2020. WDNR has not provided the deer tissue data as of the date of this report.

1 INTRODUCTION

On behalf of Tyco Fire Products LP (Tyco), Arcadis U.S., Inc. (Arcadis) prepared this Conceptual Site Model (CSM) to present an interpretation of the findings of environmental investigations regarding the presence of per- and poly-fluorinated alkyl substances (PFAS) associated with the Tyco Fire Technology Center (FTC), located at 2700 Industrial Parkway South in Marinette, Wisconsin (Site location – **Figure 1;**). Tyco has conducted investigations at the Site and adjacent areas in the City of Marinette and the Town of Peshtigo to evaluate the presence and migration pathways of PFAS in soil, groundwater, surface water, and other media. The data from these investigations are presented in the *Interim Site Investigation Report* (Interim SIR; Arcadis 2020a).

A CSM includes discussion of the sources, transport pathways, exposure pathways, and receptors associated with site-related compounds (ASTM E1689-95 [2014]; United States Environmental Protection Agency [USEPA] 1988 , 2000, 2005, 2006, 2011; Wisconsin Administrative Code Natural Resources [NR] 716.07). Wisconsin Administrative Code NR 716 does not mention the term CSM but describes the components of a CSM in NR 716.07 and discusses site investigation scoping. A CSM is used to visualize and understand available information, hypothesized interpretation, and uncertainties (USEPA 2011). The CSM is used with an adaptive management approach to identify data gaps, develop site investigations, and select and implement remedies (USEPA 1988, 2005, 2011). The CSM synthesizes data to facilitate development of solutions that balance protectiveness, manage resources, and limit the environmental footprint of site cleanup activities (USEPA 2011). USEPA guidance advocates that a CSM be initiated at the start of a project and updated throughout the life of site activities as new data become available (USEPA 2000, 2005, 2011). This approach will be used with this CSM. This CSM was prepared in accordance with these guidance documents and discusses Site-related PFAS.

The specific objectives of this CSM include:

- Provide a framework for a data completeness determination to prepare the Comprehensive SIR.
- Summarize the current understanding of relationships among sources, nature and extent, fate and transport, and exposures and receptors at the Site.

As described by the Wisconsin Department of Natural Resources (WDNR) at a public meeting on March 13, 2019, the site investigation process typically consists of iterative steps. Accordingly, this CSM is an iterative feature of the site investigation and FS process and describes the current understanding of the Site.

This CSM focuses on the portions of the City of Marinette and the Town of Peshtigo where investigations described in the Interim SIR were completed. This “investigation area” (shown on **Figure 2**) encompasses approximately 7 square miles, from the Menominee River to the Little River, north to south, and from Green Bay to the western edge of the Site, east to west.

1.1 Site Description

The FTC is a fire suppressant training, testing, and research and development (R&D) facility, occupying approximately 380 acres in southern Marinette. The Site lies approximately 1 mile west of the Green Bay shoreline and 1.6 miles south of the Menominee River, which is the border with Michigan. The developed area of the Site is contained within an approximately 60-acre central campus comprising 10 buildings and a 9-acre plot referred to as the Outdoor Testing/Training Area (OTA). **Figure 3** shows the site layout. The FTC includes an OTA comprised of the Firefighting School area (where firefighting scenarios are simulated) and the R&D area (where product testing occurs). The training area is an open gravel lot containing concrete and clay pads and steel pans, some with props where a contained fire is started and extinguished to test the performance of the fire suppression products. The site buildings support training, R&D, quality testing activities, warehousing, and manufacturing. The area of the Site outside the central campus comprises more than 300 acres of undeveloped forest and wetlands.

The area near the Site is drained by ditches that flow to Green Bay. These ditches are not formally named but are referred to in this report by letter (A, B, C, D, and E), as identified on **Figure 2**. Only one surface water feature, Ditch A, receives runoff from the Site. Ditch A flows south through the Site, passing west of the OTA. As of January 2019, the majority of on-site flow in Ditch A is intercepted and treated to remove PFAS before exiting the site boundary. Ditch A flows south from the Site through a series of connecting ditches through the Town of Peshtigo to Green Bay.

1.2 Area Land Use

The Site is in a mixed-use area. The land-use for the investigation area is shown on **Figure 4**. Properties surrounding the Site are used for a variety of purposes, as follows:

- To the southeast, the Site is bordered by Golden Sands Mobile Home Court, a residential neighborhood.
- To the east and northeast, the Site is bordered by residential areas, undeveloped land, a cemetery, and Marinette High School.
- To the north, the Site is bordered by an industrial district that includes Winsert, a machinery parts manufacturer; United Parcel Service, a shipping and mailing center; Biehl Construction, a paving contractor; and D&S Mold & Tool, a manufacturer of rubber and plastic molds.
- To the west, the Site is bordered by a commercial district, including several shopping centers and a beauty supply manufacturer.
- To the south, the Site is bordered by the Aurora Bay Area Medical Center and the Marinette County Jail.

The investigation area includes portions of the City of Marinette extending northeast and east of the Site that are predominantly residential, but also includes commercial, religious, and educational properties, including the University of Wisconsin-Marinette. The southern portion of the investigation area includes portions of the Town of Peshtigo that are predominantly residential. A detailed natural and cultural resources records review for the investigation area was conducted in 2018 and reported in a Revised Site Investigation Work Plan (Arcadis 2018).

1.3 Site History

The FTC was constructed on previously undeveloped land in the early 1960s for testing, demonstrations, and training of a range of fire suppressants. Historical aerial photographs indicate that the Site was undeveloped and sparsely forested in 1954, but that the land had been cleared in the location of the OTA in 1958. Construction is believed to have included realignment of Ditch A.

The first significant building at the FTC was the Engineering Laboratory (Building 102), constructed in approximately 1962 on the western side of the OTA (**Figure 3**). Buildings were added to the campus over time. Much of the current campus was constructed by the mid-1970s, although additional renovations and new construction have continued to the present day.

Aqueous film-forming foam (AFFF) was used as part of R&D, quality testing, and firefighting training activities until outdoor use was discontinued in 2017. The historical uses of AFFF at the FTC are discussed further in Section 3.

2 PHYSICAL CHARACTERISTICS OF INVESTIGATION AREA

2.1 Topography and Drainage

The investigation area is located in a low-relief plain adjacent to Green Bay. The area's topography is shown on **Figure 5**, which depicts the topography on a shaded relief map. As shown on this figure, the land surface adjacent to Green Bay rises in two distinct terraces:

- From the lake, which averages approximately 585 feet above mean sea level (amsl), the land surface at the shoreline rises approximately 5 to 10 feet. The land surface within approximately 0.75 mile of the lake forms the lower terrace, a region of flat, frequently swampy ground, ranging in elevation from approximately 590 to 595 feet amsl.
- Approximately 0.75 mile from the shore, the land surface rises another 15 feet to a higher terrace. This terrace is also flat (averaging approximately 610 feet amsl at the Site), although it includes some small ridges, interpreted to be former sand dunes, that can rise another 10 to 20 feet. Much of this upper terrace, which extends approximately 5 miles west of the Site to the Peshtigo River, is also covered in wetlands.

Two rivers bound the northern and southern ends of the investigation area. The Menominee River, to the north, is a major river draining approximately 4,000 square miles of Wisconsin and Michigan and flows into Green Bay. The river is dammed just west of downtown Marinette. Downstream of the dam, the river is dredged to maintain the authorized navigational depth. The southern end of the investigation area extends to the Little River, which drains a much smaller area of approximately 14 square miles that includes portions of Peshtigo and Marinette.

The Green Bay shoreline near Marinette is shallow, with water depths adjacent to land ranging from 1 to 4 feet. Water depth increases gradually from west to east, reaching a depth of approximately 30 feet 2 miles from the shore.

Most of the investigation area is drained by ditches that connect to Green Bay. Ditch A is oriented generally north to south through the Site. Stormwater runoff from the OTA that does not infiltrate flows into Ditch A. Ditch A flows south, through a series of connecting ditches, and then east to Green Bay. Ditches B, C, D, and E discharge directly to Green Bay.

As reported in the Interim SIR, flow rate measurements in the ditches illustrate the size and variability of drainage in the investigation area. Flow measurements, summarized on **Figure 6**, were recorded at 24 ditch transects distributed across the investigation area, during five events timed to be representative of seasonal conditions. The flow measurements are as follows:

- **Ditch A.** On Site, Ditch A frequently has no flow; the average of measurable flow is 98 gallons per minute (gpm) during precipitation events at four measurement locations on Site. Flow remains low within Ditch A downstream of the Site until it joins a natural tributary flowing from the west. Flows in this western tributary (SW-13) are typically four times greater than the rate of flow in Ditch A. Flow in Ditch A continues to increase downstream, as additional tributaries join. As such the contribution of flow volume to the Ditch A drainage basin from the FTC site is relatively minor. The maximum rate recorded in Ditch A was 5,932 gpm, measured at the most downstream location (SW-34) before the ditch enters the Little River. The highest flow rates at each transect were typically observed during the spring. At three locations (SW-22, SW-24, SW-26), flow was observed only during the spring events with no discernible flow during the other events. As discussed in Section 4.2, under certain flow conditions, surface water in the northern part of Ditch A, north of Building 112 (**Figure 3**), may flow north and infiltrate into the soil.

- **Ditch B.** Flow rates observed within Ditch B were generally greater than those in Ditch A. Average measured flows in Ditch B north of the Site (i.e., at SW-20 and SW-21) were greater than 1,000 gpm. Those flow rates increased downstream until being discharged into Green Bay. The maximum rate recorded in Ditch B was 3,471 gpm at the most downstream location (SW-15). As in Ditch A, flow rates were highest during the spring gauging events. The Ditch B treatment system was designed to capture most of the base flow in Ditch B in the vicinity of the treatment system. During design of the Ditch B treatment system, the range of base flow measurements was from 450 to 580 gpm. A conservative base flow value of 600 gpm, above the high end of that range, was used in the design of the Ditch B treatment system. As discussed in Section 2.3, the past two years had higher average precipitation than typical. The upper values of flow measurements in Ditch B reflect the higher than average precipitation recently.
- **Ditch C.** Ditch C comprises multiple channels draining a wetland area adjacent to Green Bay. Flow rates averaged 447 gpm across the four transect locations (SW-28, SW-29, SW-30, and SW-31) and each seasonal event. One flow measurement at SW-30 observed a reversal of flow (i.e., rather than flowing to Green Bay, water was flowing from Green Bay into the ditch). Ditch C also does not exhibit any clear seasonal variability pattern, suggesting flow is driven more significantly by changes in lake stage.
- **Ditch D.** Ditch D flow rates from two transects (SW-33 and SW-36) ranged from 46 gpm to 934 gpm and averaged 423 gpm overall. The highest flow rates were observed at the downstream location and during the spring event.
- **Ditch E.** Flow in Ditch E was monitoring at one transect (SW-35) during three separate events. Flow rates ranged from 61 gpm to 312 gpm and averaged 179 gpm. The lowest flow rate was observed during the fall event and the highest flow rates were observed during the spring event.

The ditches are interpreted to be in direct contact with shallow groundwater throughout the investigation area. Investigations of groundwater-surface water interactions, as reported in the Interim SIR, show that the ditches are predominantly gaining, meaning they increase in flow moving downstream as a result of groundwater discharging into them. The only exception found is Ditch A, which shifts from being predominantly gaining on Site to predominantly losing from near University Drive to Madsen Road, where the ditch enters a natural channel flowing in from the west. South of this point, Ditch A is consistently gaining. Gaining and losing conditions are discussed further in Section 2.5.3.

2.2 Wetlands and Ponds

The investigation area includes multiple wetland areas. According to the Wisconsin Wetlands Inventory (WWI; https://dnr.wi.gov/topic/wetlands/inventory.html), the investigation area includes a mixture of emergent/wet meadow wetlands, scrub/shrub wetlands, forested wetlands, wetlands too small to delineate, and excavated ponds within the vicinity of the Site. These wetland areas, as defined in the WWI, are shown on **Figure 5**.

The wetlands within the investigation area occur in topographically low areas where the land surface and the water table intersect. As described in Section 2.5.3, these areas are interpreted to receive groundwater discharge and to contribute to surface water flow in adjacent ditches via small, unmapped channels.

Several small ponds are present in the investigation area, as shown on **Figure 6**. The ponds in the investigation area do not receive flow from the ditches, and most do not have outlets or overflows for drainage to the ditches. Like the wetlands, the ponds intersect shallow groundwater. Groundwater is interpreted to flow through the ponds, based on the local water table gradient.

2.3 Climate

Marinette has a continental climate. Based on data compiled by the Natural Resources Conservation Service (NRCS) Agricultural Applied Climate Information System Station USC00475091 (NRCS 2020) located in Marinette, the following climate conditions were reported over the 100-year period from 1919 to present:

- Average daily maximum temperatures ranged from 27.1 degrees Fahrenheit in January to 82.4 degrees Fahrenheit in July.
- Average daily minimum temperatures ranged from 9.8 degrees Fahrenheit in January to 59.6 degrees Fahrenheit in July.
- Average monthly precipitation ranged from 1.3 inches in February to 3.7 inches in June.
- Total annual precipitation averaged 31.1 inches.

Over the last 20 years (2000 to 2019), annual precipitation has ranged from 26 to 45 inches, with an average rate of 32.2 inches (National Oceanic and Atmospheric Administration [NOAA] 2020). The annual precipitation for the investigation period of 2016 through 2019 ranged from 32 to 45 inches per year (in/yr), with an average rate of 37.4 in/yr (NOAA 2020). This indicates that the past two years had higher average precipitation than typical. A comparison of annual average precipitation in the past 2, 20, and 100 years indicates a trend of higher average precipitation in recent years.

2.4 Geology

The geology in the Marinette and Peshtigo area is mapped by the United States Geological Survey as glacial lake deposits overlying Ordovician dolomite bedrock (Oakes and Hamilton 1973). Based on observations from boreholes in the investigation area, the glacial lake deposits include multiple facies:

- Shoreline beach and dune deposits, consisting primarily of sand, typically well-sorted but ranging in size in different beds from fine sand to coarse sand, with occasional pebbles.
- Alluvial channel and overbank deposits of silts and clays where former streams flowed into the lake.
- Nearshore or estuary deposits of finer sand and silt, and occasional peat.
- Lake-bottom sediments of silt and clay.

These glacial lake deposits generally overlie a layer of till that lies on top of the bedrock surface. The till is typically very dense, and consists of a poorly sorted mixture of clay, silt, sand, and gravel above bedrock.

The sequence and thickness of deposits vary within the investigation area, reflecting a shifting shoreline, changing sediment inputs, and multiple stages of deposition. In borings south of the Site, extending south into Peshtigo and west of Green Bay (e.g., PZ-35, MW-100B, PZ-43), a layer of till was observed between shallower and deeper sand deposits, suggesting that at least one glacial re-advance occurred on the lake shore.

The dolomite bedrock strata underlying the glacial sediments are nearly flat, dipping gently to the southeast at about 30 feet vertically per 1 mile horizontally. The bedrock surface, in contrast, is deeply eroded, cut by glaciers into a buried bedrock valley generally aligned with Green Bay. **Figure 7** shows the bedrock surface within the investigation area. West of the investigation area, the bedrock surface is nearly flat, lying only 20 to 30 feet below the ground surface. Starting on the western edge of the Site, the bedrock surface begins to slope steeply to the east-southeast, descending approximately 100 feet in elevation to the Green Bay shoreline (from 580 to 480 feet amsl).

Because of the slope of the bedrock surface, the overburden beneath the investigation area forms an approximate wedge shape, thickening from west to east. Overburden thickness ranges from less than 15 feet in parts of Marinette north of the Site, to approximately 45 feet beneath the OTA, to more than 100 feet at the Green Bay shoreline.

As described by Oakes and Hamilton (1973), the dolomite bedrock underlying the investigation area is shaley dolomite of the Sinnipee Group (Galena or Platteville Formations). In three bedrock borings completed to 205 feet (MW-100B, MW-101B, and MW-102B), the observed rock was highly competent with no significant fractures. The next stratigraphically deeper units (Saint Peter sandstone and Prairie du Chien Group dolomite) were not encountered in the three bedrock borings. Based on driller logs associated with wells near the Site, the estimated depth of the Cambrian sandstone aquifer (e.g., the top of the Jordan Formation) is approximately 400 feet.

2.5 Hydrogeology

2.5.1 Hydrostratigraphy

The geology observed in the investigation area can be organized into a sequence of major hydrostratigraphic units that group adjacent beds of similar hydrogeologic characteristics. The major hydrostratigraphic units observed are summarized below:

Hydrostratigraphic Unit	Lateral Extent	Nature of Unit
Shallow Sand	Present across entire investigation area.	Typically fine or fine to medium sand, occasionally silty.
Middle Aquitard	Present from eastern edge of Site to Green Bay.	Most commonly silt or clay, often with thin sand interbeds. Merges

Hydrostratigraphic Unit	Lateral Extent	Nature of Unit
		with till in southwestern portion of investigation area.
Deep Sand	Present east of Site where bedrock surface descends below about 560 feet amsl.	Sand, often fine to medium or medium to coarse. Generally coarser than the shallow sand.
Deep Aquitard	Present across entire investigation area. Observed to be absent at only one location (PZ-28, northeast of Site).	Often silt or clay above till, lying on the bedrock surface. Silt and clay occasionally absent.
Bedrock Surface	Laterally extensive.	Fractured and/or weathered zone with moderate permeability typically limited to the upper 5 to 10 feet below the rock surface.
Competent Bedrock	Laterally extensive.	Sparsely fractured silty dolomite with very low transmissivity.

These four major units are generally classified as 1) permeable sand units (shallow sand unit and deep sand unit), 2) low-permeability aquitards that include silt, clay, and till (middle aquitard unit and deep aquitard unit), moderately permeable fractured bedrock surface unit (bedrock surface unit), and deeper unfractured dolomite (competent bedrock).

Cross-section locations are shown on **Figure 7**. The hydrostratigraphy is illustrated on cross-sections A-A' (**Figures 8 and 9**) and B-B' (**Figure 10)**. As shown on the cross-sections, the middle aquitard separates the shallow and deep sands in the eastern portion of the investigation area. However, where the middle aquitard is absent, the shallow and deep units are effectively a single sand unit. **Figure 7** shows the approximate area where the shallow and deep sand units are vertically adjacent. As described in Section 2.5.2 below, the majority of groundwater flow that occurs vertically within the overburden occurs in this area.

The variable hydrogeologic properties of the soils in the unconsolidated zone are supported by multiple lines of evidence reported in the Interim SIR: hydraulic conductivity testing, hydraulic profiling tool (HPT) borings, geologic descriptions in boring logs, and grain-size analyses (Arcadis 2020a). These lines of evidence are as follows:

- Slug tests in wells and piezometers show that hydraulic conductivity within the sand units ranges from less than 10 feet per day (ft/day) to approximately 100 ft/day. The hydraulic conductivity within the aquitards ranges from less than 0.1 ft/day to approximately 0.5 ft/day.
- HPT borings illustrate the heterogeneity of the overburden deposits and help define the vertical and lateral bounds of the hydrostratigraphic units. HPT estimates of hydraulic conductivity are generally consistent with slug test results, with sand-unit permeability most commonly in the range of 20 to 50 ft/day, and middle aquitard permeability at or below about 0.1 ft/day. Note that the HPT borings were not able to penetrate the deeper till.

- Grain-size analysis data support field observations of soil type described in boring logs, in particular the heterogeneous composition of the till layers, and the well-sorted composition of the sand units. The grain size data support the hydraulic conductivity data.

Soil descriptions recorded in boring logs and HPT data also highlight the fine-scale heterogeneity within the larger hydrostratigraphic units. It is not uncommon for thin sand beds to be interbedded within a thicker silt deposit, or for thin beds of silt to occur within a package of sands. These fine-scale heterogeneities impart vertical anisotropy within the deposits, favoring lateral flow along more permeable beds. The heterogeneities also suggest that limited flow can occur within the aquitards.

A narrow horizon of fractures in the upper 5 to 10 feet of the bedrock appears to form a thin groundwater transport zone underlying the deep aquitard. This zone is screened by two on-site monitoring wells (PZ-1D and PZ-4D). Deep vertical aquifer profile (VAP) sampling also encountered this bedrock interface zone at two locations (VAP-28 and VAP-29). Deeper below the bedrock surface, however, bedrock was found to have negligible transmissivity. As reported in the Interim SIR, packer testing and geophysical logging found negligible yield in deeper bedrock at four locations (MW-100B, MW-101B, and MW-102B, each completed to 205 feet below ground surface [bgs], and former FTC production well PW-1, open to approximately 147 feet bgs). Deeper bedrock formations (e.g., greater than 200 feet) do serve as productive aquifers. In particular, the Cambrian Sandstone Aquifer, the top of which is estimated to be approximately 400 feet bgs, serves as a productive aquifer within the investigation area. Shallow groundwater in the Marinette area will not migrate down to this deeper aquifer, because the shallower dolomite forms a competent aquitard, and because regional gradients from the deep sandstone aquifer are expected to be upward toward Green Bay.

2.5.2 Groundwater Recharge

The primary recharge mechanism within the investigation area is precipitation (natural recharge). Natural recharge is variable from year to year, changing with annual precipitation. The precipitation amount is discussed in Section 2.3. A comparison of annual average precipitation in the past 2, 20, and 100 years indicates a trend of higher average precipitation in recent years. Recharge from precipitation typically ranges from 5 to 25 percent of annual precipitation.

Several factors influence the rate and spatial distribution of recharge:

- Recharge may be significantly reduced in winters, after the ground has frozen and precipitation occurs as snow. Snowmelt and early spring rains may restrict ability to infiltrate and preferentially drain as surface runoff.
- Significant portions of the investigation area are wetlands, where the water table is expressed at the ground surface (**Figure 5**). Wetland areas may be groundwater discharge locations, thus precipitation and snowmelt occurring in them during seasonally wet conditions may not result in recharge to the aquifer, but rather add to the surface storage and move laterally toward surface drainages.
- Because the water table within the investigation areas is shallow (often less than 5 feet bgs), areas of deep-rooted vegetation such as forested areas may directly uptake groundwater. This process effectively intercepts additional recharge in excess of normal evapotranspiration.

- The developed portions of Marinette are drained by storm sewers, designed to intercept and remove runoff that might otherwise infiltrate to groundwater.

Groundwater recharge also occurs from a segment of Ditch A that has been identified as losing. Groundwater-surface water interactions are discussed further in Section 2.5.3.1.

2.5.3 Groundwater Occurrence and Flow

The water table throughout the investigation area is shallow, generally less than 5 feet deep. The saturated thickness of the overburden varies from as little as 12 feet to more than 100 feet, depending on the thickness of the overburden and the depth of the bedrock surface. Within the saturated overburden, groundwater flow occurs primarily in the more permeable sediments in the shallow and deep sand hydrostratigraphic units, as defined in Section 2.5.1. Groundwater in both zones is interpreted to flow generally east, with flow paths radiating along an arc from southeast to northeast, discharging to Green Bay and the Menominee River. **Figures 11 and 12** illustrate the potentiometric surfaces of the shallow and deep sand units, respectively, based on an area-wide gauging event completed in October 2019. Patterns of groundwater flow in the shallow and deep sand units are discussed below.

2.5.3.1 Shallow Sand Hydrostratigraphic Unit

The potentiometric surface in the shallow sand unit (**Figure 11**) is an approximate reflection of the topography. Groundwater in the shallow sand flows generally toward the primary discharges at Green Bay and the Menomonee River, but also interacts with surface water in the ditches, ponds, and wetlands within the investigation area. Most ponds are interpreted to be groundwater flow-through features. Wetlands likely receive groundwater discharge and allow water to flow through until reaching a ditch, river, or lake.

The ditches in the investigation area are predominantly gaining (i.e., groundwater discharge locations), reflected in the shape of the water table, where potentiometric contours bend toward ditches (e.g., forming upstream “V”s). **Figure 11** also denotes gaining and losing conditions measured at points on Ditches A and B, based on comparison of water levels at stream gauges and ditch-bed mini-piezometers. During the October 2019 monitoring event, all locations on Ditches A and B were observed to be gaining except for a reach of Ditch A approximately from University Drive to Madsen Road. This section of the ditch was constructed over very flat ground with a minimal stream gradient. South of this section, Ditch A descends into a naturally eroded channel, and the ditch returns to a gaining condition.

The patterns of gaining and losing conditions shown on the October 2019 water table (**Figure 11**) remain generally consistent across a range of seasonal conditions measured in 2018 and 2019. As reported in the Interim SIR, transducers were deployed at six ditch monitoring points (stilling well and mini-piezometer pairs) to evaluate gradients between shallow groundwater and surface water along Ditch A and Ditch B. Water levels were recorded during four multi-week monitoring periods occurring in the spring, summer, and fall, and including a range of large and small precipitation events. (Note that gauging in winter is infeasible because most surface water in Marinette freezes.) The findings of this study are summarized on **Figure 13**. The data indicate the following:

- Ditch A shifts from being predominantly gaining within the Site to predominantly losing from near University Drive to Madsen Road, where the ditch then enters a natural channel flowing in from the west. South of this point, Ditch A is consistently gaining.
- Ditch B is predominantly gaining from north of the Site to its outlet into Green Bay.
- Minor seasonal variation and short gradient reversals appear to reflect periods of heavy recharge, when surface water bodies have higher surface water elevations than typical.

Groundwater flow within the shallow sand unit is interpreted to move slowly. The linear velocities of groundwater in the more permeable sands are calculated to be several hundred feet per year. For example, estimates of typical investigation area hydraulic parameters (gradient of 0.003, hydraulic conductivity of 50 ft/day, and effective porosity of 15 percent) predict a linear groundwater velocity of 400 ft/year. Groundwater flow in less permeable sands would be as much as 10 times slower. In this context, short-term variability between gaining and losing is much less meaningful than the predominant condition at a ditch segment. A short losing period for a ditch segment that is normally gaining, for instance, will not result in water escaping the ditch's catchment. Instead, lost surface water will migrate a short distance from the ditch but flow back into the ditch when ditch and groundwater levels revert to normal conditions.

2.5.3.2 Deep Sand Hydrostratigraphic Unit

The horizontal patterns of groundwater flow in the deep sand hydrostratigraphic unit follow patterns similar to the shallow sand unit. The key distinctions between shallow sand and deep sand unit flow patterns are in vertical flow. The deep sand unit potentiometric surface (**Figure 12**) illustrates several of these differences:

- Unlike the shallow sand, the deep sand unit is not laterally extensive. It exists only where bedrock surface descends below approximately 560 ft amsl. West and north of the OTA where the overburden thins to less than about 50 feet, the deep sand is effectively absent.
- Where the middle aquitard exists, it provides a clear separation between the shallow and deep sands. However, in areas where the aquitard is absent, the two units are connected and the boundary between the shallow and deep units is indistinct.
- Like the shallow sand unit, gradients in the deep sand unit trend generally toward Green Bay and the Menominee River. Unlike the shallow unit, the deep unit does not directly interact with surface water, and potentiometric contours show little influence associated with the ditches.
- While groundwater in the shallow unit discharges directly to ditches, to wetlands, or to Green Bay and the Menominee River, groundwater in the deep zone may only discharge by moving upward through the overlying units. As discussed below, upwelling is interpreted to occur to the shallow sand in several areas where the middle aquitard is absent. Flow paths trending toward Green Bay beneath the middle aquitard are interpreted to continue below the lake and gradually migrate upward through the overlying sediments.

Groundwater in the deep sand unit is recharged by downward flow from the shallow sand unit on the western side of the investigation area where the middle aquitard is absent. **Figure 12** denotes the vertical gradient direction based on measurements at adjacent shallow and deep wells. Note that except for locations close to Green Bay or the Menominee River, the predominant gradient direction between the shallow and deep sand units is downward. This reflects the wedge shape of the overburden and the absence of significant upward discharge from the underlying bedrock. Shallow groundwater recharged in the thin upgradient side of the wedge must fan out vertically to fill the thicker eastern side of the wedge. The predominantly downward vertical gradients observed between the shallow and deep sand units, and the predominantly gaining conditions of the ditches (as discussed in Section 2.5.3.1) show that, with localized exceptions, groundwater diverges vertically into a shallow pathway that discharges to the ditches, and deeper pathways that diverge between the shallow and deep sands.

The vertical gradient directions illustrated on **Figure 12** include both areas where vertical flow is occurring, and where flow would occur if the middle aquitard were absent. Most vertical flow between the units occurs where the sand bodies lie in direct contact. Where the aquitard separates the units, flow between the sand units is negligible. Because the aquitard controls where vertical flow occurs, the edges of the aquitard appears to create several areas of focused upwelling, which are the exception to the predominant downward gradient direction between the shallow and deep sand units. These include:

- Ditch B, in the ditch segment from near the crossing at Pierce Avenue downstream to Edwin Street (note the 5-foot head difference between deep-unit PZ-23 and ditch-bed mini-piezometer PZ-06).
- Near the head of Ditch E on Green Gable Road. Note that no paired shallow/deep water-level measurements are available for this location; however, the location is geologically similar to Ditch B near Pierce Avenue.

In both locations noted above, the expected physical process of upward groundwater flow is supported by observations of PFAS concentrations in groundwater and surface water (e.g., VAP-21 on Green Gable Road and surface water sample SW-17 on Ditch B). PFAS transport in groundwater is discussed further in Section 4.5.

3 POTENTIAL SOURCES AND RELEASE MECHANISMS

This section discusses potential sources of PFAS and release mechanisms to the environment relating to historical practices at the FTC.

3.1 Indoor Facility Operations

PFAS-containing products are handled in four buildings on the Site as discussed below. PFAS-containing products are not handled in the remaining buildings on Site. The remaining buildings are used for manufacturing fire suppression hardware, warehousing, office, or classroom activities. Building numbers are labeled on **Figure 3**.

3.1.1 Engineering Laboratory

The Engineering Laboratory (Building 102) was constructed in approximately 1962, with various additions over time. A range of laboratory-scale research, development, and quality control activities on AFFF products have occurred inside this building including laboratory-scale formulation, fire testing, physical and chemical parameter testing, and equipment testing and calibration (Tyco 2018). The products tested are primarily Tyco products, although in approximately 1988, Tyco began providing third-party laboratory-scale testing services for its foam products as well as foam agents manufactured by others. There are no significant air emissions, including potential PFAS air emissions, from this building. Process discharge water from this building was conveyed to the sanitary sewer until March 2019 and is now stored in an on-site tank prior to treatment and off-site disposal (Section 3.3).

3.1.2 Fire Test Houses

The first Fire Test House (Building 107) was constructed in approximately 1967 and has been used for indoor fire testing including, but not limited to, foam and foam sprinkler testing. A second Fire Test House (Building 127) was added in approximately 2016 for the same activities. Up to six fires per day per test house for 50 weeks a year are conducted with common application rates of 2 to 3 gpm for 3 to 5 minutes. Based on facility testing data, maximum temperatures in the range of 140 to 300 degrees centigrade are reached during test fires prior to application of AFFF, and temperatures remain above 100 degrees centigrade for two to six minutes. Ceiling and wall temperatures peak at approximately 150 degrees centigrade. The fires rapidly cool and are quenched rapidly once AFFF is applied. Smoke from test fires exits the building through a chimney and likely consists mainly of the decomposition products of the material burned prior to the application of AFFF. The fire test houses are not believed to be a source of PFAS air emissions. Process discharge water from this building was conveyed to the sanitary sewer until March and is now stored in an on-site tank prior to treatment and off-site disposal (Section 3.3).

3.1.3 Cold Storage

The Cold Storage Building (Building 115) was constructed in approximately 1976 and has been used for foam testing activities, including test enclosure extinguishment testing and nozzle testing (Tyco 2018). All AFFF releases were confined indoors. There are no air emissions, including potential PFAS air emissions, from this building. Process discharge water from this building was conveyed to the sanitary sewer until March 2019 and is now stored in an on-site tank prior to treatment and off-site disposal (Section 3.3).

3.1.4 Analytical Laboratory

Building 130 contains an analytical laboratory. Glassware from the laboratory may have been rinsed in the sink in the past. Process discharge water from this building was conveyed to the sanitary sewer until March 2019 and is now stored in an on-site tank prior to treatment and off-site disposal (Section 3.3).

3.2 Outdoor Facility Operations

The outdoor facility operations are surrounded by trees and wetlands which limit the potential for aerial foam migration.

3.2.1 Outdoor Testing/Training Area

The OTA was constructed in approximately 1961 and has been used to conduct testing, demonstrations, and training on a range of fire suppressants (both dry chemical and foam-containing products).

The OTA consists of various concrete and clay pads and steel pans, some with “props” where a contained fire would be started and extinguished to test the performance of the fire suppression products. The testing of foam products began in the early 1960s.

Training and demonstration activities also occur at the OTA. Fire schools and foam schools are hosted during the summer months to train employees and customers on fire suppression techniques. Based on current practices, approximately 10 to 20 fire schools are scheduled per year with one foam demonstration per school. For the foam schools, approximately two are scheduled per year with two foam demonstrations per school, and an additional three to four foam schools with two foam demonstrations are also conducted for specific applications (Tyco 2018). The fire schools appear to have occurred prior to the 1980s, and it is believed that the foam schools may have started at the Site after the late 1990s (Tyco 2018).

Anecdotal observations from Tyco employees indicate that basketball-sized pieces of foam occasionally drifted away from the OTA during fire training exercises.

Another outdoor testing area, referred to as the Marine testing area, is believed to have been located between Buildings 110 and 115 and has been dismantled (Tyco 2018). This area is approximately 300 feet west of the current OTA. After a reasonable and good faith inquiry, information to document the time period and uses of the Marine testing area was not found (Tyco 2018).

3.2.2 Hydraulics Laboratory

The Hydraulics Laboratory (Building 105) (**Figure 3**) was constructed in approximately 1985 and is in the northeast corner of the OTA. It consists of a building with various tanks, pumps, and nozzles where foam concentrate is mixed with water and used to conduct performance testing of foam systems (proportioning and hardware). It has an outdoor paved foam monitor pad, which is sloped to promote drainage of water/foam mixture back into the building into a collection system. Process discharge water from this building was conveyed to the sanitary sewer until March 2019 and is now stored in an underground concrete storage tank prior to treatment and/or off-site disposal (Section 3.3).

3.3 Wastewater Conveyance

Historically, Tyco discharged, under permit, foam-containing wastewater produced at the FTC to the sanitary sewer system. Due to foaming issues reported by personnel from the City of Marinette's Publicly Owned Treatment Works, Tyco limited its output to approximately 2 gpm. In March 2019, Tyco ceased discharging foam-containing wastewater into the sanitary sewer system. The buildings described in Section 3 where PFAS-containing products are handled currently collect foam waste in tanks. Each building has a waste foam tank. The tanks are periodically pumped out for treatment and proper off-site disposal of the waste foam.

In 2018, the City of Marinette collected a sanitary sewer sample at the Site's outfall (MH-120) for analysis of PFOS and PFOA. The PFOS and PFOA concentrations were found to be 3,670 nanograms per liter (ng/L) and 253 ng/L, respectively. In response, a site-wide sanitary sewer investigation was performed in early 2019. The investigation consisted of cleaning and televising sanitary sewer mains, laterals, and manholes. The sewer mains and laterals were inspected with closed-circuit television or push cameras. Visual review of the footage identified groundwater infiltration at multiple locations due to structural defects in the pipes and/or manholes. More than 2,400 feet of sanitary sewer pipe was inspected.

The following five rehabilitation techniques were completed:

- Test and Seal. This entailed sealing polyvinyl chloride joints with grout via specialized equipment placed in the pipes with manhole access. Six joints required grouting.
- Cured-in-Place Pipe Lining (CIPPL). CIPPL is the lining of a pipe to seal off infiltration. Approximately 1,400 feet of pipe was lined via CIPPL.
- Excavation Point Repair. This consisted of excavating to the damaged pipe to remove it and replacing the damaged section of pipe.
- Lateral Abandonment. Five unused laterals were abandoned to prevent future infiltration issues.
- Manhole Rehabilitation. Grout was injected under pressure around leaking points to seal areas of infiltration. Fourteen of 20 manholes inspected require rehabilitation.

4 POTENTIALLY AFFECTED MEDIA AND PFAS MIGRATION PATHWAYS

Investigations completed by Tyco and others have evaluated multiple environmental media for the potential presence of PFAS. The Interim SIR (Arcadis 2020a) describes the completed scope of investigations and analytical results for each media directly evaluated to date. These media include soil, stormwater, surface water, sediment, and groundwater. This section reviews the current understanding of the nature and extent of migration pathways for PFAS in each of these media.

This section also reviews the current understanding of the potential for PFAS occurrence and transport in media not addressed in the Interim SIR. These include air, fish tissue, and deer tissue.

WDNR has calculated direct contact (DC) residual contaminant levels (RCLs) in soil for PFOA and PFOS protective of human health. WDNR established the non-industrial DC RCLs for both PFOA and PFOS at 1,260 micrograms per kilogram (µg/kg). WDNR also established the industrial DC RCLs for both PFOA and PFOS at 16,400 µg/kg. The current WDNR surface water quality guidelines are a maximum of 420 ng/L for PFOA and 11 ng/L for PFOS. In May 2016, the USEPA issued a drinking water Lifetime Health Advisory Level (HAL) for two PFAS, specifically the individual and combined values for PFOA and PFOS of 70 ng/L, or parts per trillion. In June 2019, the Wisconsin Department of Health Services (WDHS) recommended a groundwater enforcement standard of 20 ng/L for PFOA and PFOS, individually and combined.

4.1 Soil

4.1.1 Nature and Extent of PFAS in Soil

Soil was sampled at 47 locations at the Site and analyzed for PFAS between October 2013 and July 2019 (**Figure 14**). Soil excavation at the OTA occurred in 2006 to remove petroleum impacts. The 2013 to 2019 PFAS soil sampling did not occur in locations where the 2006 soil excavation occurred. PFAS soil results from soil collected within the top 2 feet at the Site are presented on **Figure 15**. Soil samples were bracketed into groups based on combined PFOS and PFOA detections. The groupings are not based on any regulatory targets. Grouping are approximately by order of magnitude of concentration.

The following summarizes the PFAS soil data:

- Combined PFOS and PFOA concentrations greater than 100 µg/kg (i.e., the highest detections) are concentrated in the following locations that are associated with historical AFFF outdoor releases or their surface water runoff pathways (blue and yellow circles within **Figure 15**):
  - Within the fire training area (e.g., locations SS-135 and SS-105)
  - Along the Hydraulics Laboratory paved foam monitoring pad (near samples locations FTC-71, FTC-72, FTC-77)
  - Along depressions that convey surface water runoff to the southwest of the OTA (near sample SS-133) and the northeast of the OTA (SS-122, SS-139).

- In many locations within 150 feet or less of the OTA, where foam would have most likely deposited if it migrated aerially, combined PFOS and PFOA concentrations are below 10 µg/kg (e.g., samples located at SS-123, SS-124, SS-130, SS-134, SS-115, SS-116, SS-119 represented by green and purple dots on **Figure 15**).

Less than 150 feet outside of the OTA in multiple directions (i.e., SS-123, SS-124, SS-138 and SS-127 to the north/northwest, SS-119 and SS-120 to the north/northeast, SS-130 to the west, SS-115 and SS-116 to the east, and SS-134 to the southeast) there are soil samples that contain no more than an order of magnitude greater PFAS than the background levels cited in peer-reviewed studies of soil concentrations in background soils (**Table 1**). These data provide strong evidence that foam migration will not cause substantial PFAS impacts to soil outside of the Site.

In results from a total of 66 soil samples collected with in and near the OTA, none exceeded the industrial DC RCLs for PFOA or PFOS.

At locations where samples were collected at multiple depths, concentrations were generally greatest at the shallowest sample interval.

As part of the July 2019 soil sampling event, soil from eight of the ten sample locations was used to conduct leaching tests on soil to evaluate soil leaching to groundwater potential. The results of the leaching tests are presented in the Interim Site Investigation Report. An evaluation of the leachate results is presented in Section 4.1.2.

4.1.2 PFAS Migration Pathways in Soil

PFAS sorption onto soils occurs via hydrophobic and electrostatic interactions that can result in multiple PFAS layers on the soil surface. Since PFAS sorption onto soils involves reversible mechanisms, PFAS-enriched soil can become a source of elevated surficial groundwater concentrations as surface water infiltrates the soil mass and PFAS desorb. The rate of PFAS leaching from soil to groundwater depends on multiple variables including water chemistry, PFAS type, soil type, soil organic content, soil charge, and site topography.

To evaluate soil leaching potential, eight soil samples were collected within the OTA and analyzed using a modified Synthetic Precipitation Leaching Procedure (SPLP) as described in the 2019 Data Summary Report (Arcadis 2019). The results for the leachate and the soil are presented in **Tables 2 and 3**, respectively.

In accordance with WDNR Guidance on the Use of Leaching Tests for Unsaturated Contaminated Soils to Determine Groundwater Contamination Potential (Soil Leaching Guidance; WDNR 2003), the initial evaluation of the SPLP data involved a comparison of the 95% upper confidence limit (UCL) of the set of eight leachate PFAS concentrations to the groundwater screening levels. The WDNR guidance indicates SPLP data may be used to establish site-specific soil screening levels following completion of a full site characterization and preliminary groundwater remediation. The screening levels calculated using the current SPLP data set are considered preliminary estimates and may be updated.

The 95% UCL of PFOA and PFOS leachate concentrations from the SPLP testing were both individually estimated to exceed the USEPA HAL of 70 ng/L and the WDHS recommended groundwater enforcement standard of 20 ng/L (**Table 2**). This is a conservative evaluation as it assumes there is no mixing of soil leachate with groundwater. The comparison indicates the potential for PFAS leaching from Site soil within the OTA to result in PFOS and PFOA levels above 20 ng/L.

To further evaluate the potential for PFAS in soil to leach to groundwater, the next step in the WDNR Soil Leaching Guidance (2003) was performed. Soil concentrations and leachate concentrations were used to estimate site-specific residual contaminant levels (SSRCLs). The WDNR Soil Leaching Guidance (2003) provides an equation using a simple ratio to estimate the SSRCL:

$$SSRCL = \frac{C_s}{C_l}\,(PAL)$$

Where:

SSRCL = site-specific residual contaminant level

Cs = total concentration in soil

Cl = concentration leached from soil

PAL = preventive action limit

This equation was modified by replacing the PAL with the enforcement standard, based on WDNR approach for PFAS. The WDHS recommended groundwater enforcement standard was used. This is consistent with WDNR Soil Residual Contaminant Level Determinations Using the USEPA Regional Screening Level Web Calculator (WDNR 2014), which uses the enforcement standard rather than the PAL. To calculate soil SSRCLs using the WDNR Soil Leaching Guidance, the mean ratio of soil concentration to leachate concentration was multiplied by the WDHS recommended groundwater enforcement standard of 20 ng/L for both PFOA and PFOS (**Tables 4 and 5**). This approach for estimating the SSRCL only evaluates soil leaching. It does not account for soil physical properties (e.g., dry bulk density, porosity, water content).

A third step was taken to further refine the SSRCLs, using WDNR Soil Residual Contaminant Level Determinations Using the USEPA Regional Screening Level Web Calculator (WDNR 2014). The web calculator includes specific compounds for which SSRCLs can be estimated. The web calculator does not include PFAS. The equations in the web calculator were used to prepare a spreadsheet to estimate the SSRCLs. The web calculator equations are based on USEPA calculations which use New Jersey Department of Environmental Protection equations (New Jersey Department of Environmental Protection 2013a and 2013b). The SSRCLs were calculated with the equations in the web calculator (**Table 5**) utilizing site-specific physical parameters (**Table 6**), the soil water partitioning coefficients (K_D) calculated from SPLP measurements (**Table 7**), and the Wisconsin default dilution factor of 2. A comparison of the two SSRCL methods is presented in **Table 5**. The WDNR Soil Leaching Guidance method and the USEPA soil water partitioning coefficient method produce similar SSRCLs for PFOS. The WDNR (2014) method, using the USEPA partition coefficient method, produces a slightly higher PFOA SSRCL compared to the WDNR (2003) method.

The following uncertainties are associated with the SSRCL calculations:

- PFOS was not detected in soil sample SS-139. Therefore, this result was not used in the SSRCL calculations.

- The mass of PFOS detected in SS-132 and SS-139 leachate results was larger than the mass of PFOS in the respective soil samples. This is likely the result of soil heterogeneity. These results were not used in the SSRCL calculations.
- In literature values, the PFOS partition coefficient is typically larger than the PFOA partition coefficient. The site-specific partition coefficient for PFOA was larger than the PFOS partition coefficient.

The SSRCLs indicate the potential for PFAS leaching from Site soil within the OTA to result in PFOS and PFOA levels above 20 ng/L.

4.2 Stormwater

4.2.1 Nature and Extent of PFAS in Stormwater

Stormwater runoff samples for the site investigation were collected at four locations downgradient from the OTA throughout 2019 to evaluate season variations of PFAS concentrations (locations designated as SW-FTC-01 through SW-FTC-04 on **Figure 16**). A total of 10 samples were collected across four locations and analyzed for PFAS and total suspended solids (TSS).

Sampling occurred during three separate field events to capture runoff conditions related to snowmelt, spring rainfall, and fall rainfall at each of the four locations. Locations were spaced along the northern, eastern, and southern portions of the OTA in low areas prone to surface runoff (**Figure 16**). Drainage at the OTA flows radially along the eastern-southeastern side of the pad. The highest concentrations of combined PFOA and PFOS during each sampling event were detected at the southernmost location, SW-FTC-03, ranging from 3,300 ng/L to 11,500 ng/L. This location is at the beginning of a small drainage pathway from the OTA into Ditch A, where combined PFOA and PFOS concentrations downstream varied between 680 ng/L and 4,900 ng/L seasonally. PFOS and PFOA concentrations at SW-FTC-03 increased over time throughout the sampling events. SW-FTC-04, located slightly upgradient and northeast of SW-FTC-03 (**Figure 16**), was only sampled during the spring rainfall event, which was the only event with stormwater flow at this location. The combined concentration of PFOS and PFOA at SW-FTC-04 was 345 ng/L, which was the lowest detection of the four locations during the sampling event. Runoff does not pool in this area but continues to flow south-southeast from the pad.

At SW-FTC-01 and SW-FTC-02, located along the northeast edge of the OTA (**Figure 16**), combined PFOS and PFOA concentrations ranged from 61 ng/L to 1,419 ng/L. Combined concentrations were consistently slightly higher at STW-FTC-01 than STW-FTC-02 during each sampling event. SW-FTC-01 is the northernmost location and is located within a northwest-southeast trending drainage area where runoff pools before flowing into the surrounding wetlands. STW-FTC-02 is southeast of SW-FTC-01 and located along the eastern edge of the OTA near a small low point where runoff from the pad appears more concentrated.

In November 2019, stormwater runoff samples (designated as OS-01 through OS-04) were collected from four outfall locations at the OTA, shown on **Figure 16**, pursuant to Wisconsin Pollutant Discharge Elimination System annual discharge compliance requirements. Samples were analyzed for PFAS, metals, cyanide, phenols, oil and grease, pH, biological oxygen demand, chemical oxygen demand, phosphorous, and TSS. Combined concentrations of PFOA and PFOS observed at three of the locations

(OS-01, OS-03, OS-04) ranged from 2.01 ng/L to 8.4 ng/L. The highest concentrations were observed at OS-02, with a combined concentration of PFOA and PFOS of 139.5 ng/L in the parent sample and 139.8 the field duplicate.

4.2.2 Stormwater Discharge to Surface Water

Migration of PFAS to surface waters is known to occur through stormwater discharges from the OTA. Stormwater that falls on the surface of the OTA flows radially in a southeasterly direction via sheet flow, where it channelizes and flows into a stormwater ditch that flows toward the southwest, discharging into Ditch A. Based on site topography, most of the OTA drains toward the drainage ditch that discharges into Ditch A. A portion of the OTA surface water pools and appears to discharge into surrounding wetlands located northeast of the OTA (stormwater runoff location OS-04 on **Figure 16**).

Additionally, a stormwater basin is located north of Building 112 and the associated parking lot and outdoor storage area (location SW-23 on **Figure 17**). The pond collects surface runoff from Building 112 and surrounding parking and storage areas. The pond discharges through an outlet structure to the northern portion of Ditch A, which is believed to have historically flowed to the north toward Woleske Road and then to Ditch B. The connection to Ditch B was eliminated at an unknown time and Ditch A flow was directed to the south, its current flow direction. However, under certain flow conditions, it is possible that the northern part of Ditch A, in the vicinity of location OS-2 (**Figure 16**), still flows north to Woleske Road and then infiltrates into the soil. The reversal of flow may be the reason for the detected concentrations of PFAS in stormwater sample OS-2. PFAS has been detected in surface water at location SW-22, which is located south of the pond and Building 112, and there is potential for migration of PFAS via stormwater discharges to surface water discharge point OS-02. AFFF is not stored or used in Building 112. Manufacturing of fire suppression hardware occurs in Building 112.

Stormwater from Building 114 and the surrounding parking and storage areas discharge to a roadside ditch along Edwin Street (location OS-03 on **Figure 16**) and is believed to flow west, eventually discharging to Ditch B near the intersection of Edwin Street and Aerial Drive. PFOS and PFOA were present in the 2019 stormwater sample (OS-3) from this location at concentrations at or below 2.0 ng/L.

In summary, stormwater data indicate there is stormwater transport of PFAS from the OTA to Ditch A and then to the Ditch A treatment system. There may be stormwater transport of PFAS in the northern part of Ditch A and infiltration at the northern end of Ditch A.

4.3 Surface Water

4.3.1 Nature and Extent of PFAS in Surface Water

Surface water was monitored throughout 2018 and 2019 to evaluate PFAS concentration, off-site transport, and interactions with groundwater throughout the investigation area. Data collection field events were completed seasonally based on precipitation events of spring snow melt, spring rain, summer dry period, and fall rain. Surface water samples were collected from Ditches A, B, C, D, and E and five ponds (**Figure 17**). A total of 105 samples were collected across 29 locations and analyzed for PFAS and TSS.

Ditch A trends north-south through the OTA and continues south of the investigation area. Ten sampling locations along the entire length of Ditch A and two tributaries were sampled over five seasonal events. A comparison of combined PFOA and PFOS concentrations at locations on Site and locations that continue downgradient shows a linear decreasing trend (**Figure 18**). The average combined concentration of PFOA and PFOS observed at the on-site locations (SW-22, SW-24, SW-25, SW-27) was 1,967 ng/L whereas the combined concentrations observed at downgradient locations (SW-10, SW-11, SW-13, SW-34) was 21.5 ng/L during the 2018 sampling events, prior to the installation and operation of the Ditch A treatment system. Two intermittent locations after the ditch first flows off- site (SW-12 and SW-26) averaged a combined concentration of 1,184 ng/L across during the 2018 sampling events. Seasonal variability can be observed throughout the sample locations and is greatest at locations where higher concentrations were detected. Although there is variation in detections across samples at each location, the general trend is of higher upgradient concentrations and linear decreasing detections as the flow moves south from the OTA.

Since the site investigation began, a water treatment system has been installed in Ditch A, north of the southern boundary of the FTC and SW-27. The Ditch A treatment system began operation in January 2019. Since then, a decrease in average detections was observed at the three downgradient sample locations, SW-27, SW-26, and SW-12, in respective order of north to south. The average detections of combined PFOA and PFOS observed at SW-27 were 1,660 ng/L in the three sampling events prior to the operation of the treatment system and 490 ng/L after operations began. Average combined concentrations changes observed at SW-26 decreased from 1,660 ng/L to 490 ng/L at SW-26 and at SW-12 decreased from 860 ng/L to 196 ng/L at SW-12.

Average detections of combined PFOA and PFOS concentrations at the three upgradient on-site locations have remained relatively stable since the installation of the Ditch A treatment system. The average detections of combined PFOA and PFOS concentrations observed at the three upgradient on-site locations (SW-22, SW-24, SW-25) were observed average combined PFOA and PFOS concentrations slightly above 2,000 ng/L prior to the installation and averaged 2,311 ng/L after operation began. The minimum detection observed was 78.9 ng/L at SW-22 and the maximum detection observed was 6,180 ng/L at SW-24.

Seven locations along the length of Ditch B were sampled over five seasonal events. Surface water samples located upgradient of the Site-related impacts contained minimal seasonal variations and concentrations (SW-20, SW-21, and SW-32), averaging combined concentrations of 18.2 ng/L (**Figure 19**). At the confluence of Ditch B with a northern tributary and slightly northeast of the OTA (SW-18), combined detections of PFOA and PFOS increased to an average of 309 ng/L. Downgradient of this location, increases in concentrations and seasonal variations are were observed. These downgradient locations along Ditch B (SW-15, SW-16, SW-17) are due east of the OTA. The average PFOA and PFOS combined concentrations observed seasonally across the three locations were 3,523 ng/L during the spring event, 1,587 ng/L during the summer event, 1,139 ng/L during the fall event, and 2,258 ng/L during the winter snowmelt event . Samples were collected prior to the installation and operation of a water treatment system installed in Ditch B, southeast and downgradient of SW-16. The treatment system began operation in October 2019.

During three sampling events along Ditch D, relatively stable seasonal concentrations were observed, with an average result of combined PFOA and PFOS concentrations of 120 ng/L (**Figure 20**). Ditch D is located southeast of the Site, east of Ditch A, and south of Ditch B, with the channel feeding into Green Bay.

The average combined concentration observed was 27.7 ng/L within Ditch C and 22.9 ng/L within Ditch E (**Figure 20**). Ditch C is located towards the northern extent of the investigation area and Ditch E is located along the southern extent of the investigation area.

The five ponds sampled during field events exhibited limited seasonal variability of concentrations. The average PFOA and PFOS combined concentrations across all pond samples was 173 ng/L, with a maximum average concentration of 272 ng/L observed at SW-14 and a minimum average concentration of 8.2 ng/L observed at SW-37.

Based on 2018 and 2019 sampling data, PFOA and PFOS concentrations were present in surface water above WDNR surface water quality guidelines in portions of Ditches A, B, and D. The ditch segments where PFOA and PFOS concentrations exceeded the WDNR surface water quality guidelines include:

- Ditch A, PFOA and PFOS concentrations in surface water samples were above the guidelines in sample locations extending from the Site to approximately where the ditch crosses Rader Road.
- Ditch B, PFOA and PFOS concentrations in surface water samples were above the guidelines in sample locations approximately from where the ditch crosses Pierce Avenue to Green Bay.
- Ditch D, PFOS concentrations intermittently in both surface water sample locations.

The two ponds just south of the Site contain PFOS surface water concentrations above WDNR surface water quality guidelines.

Detections of PFOS and PFOA in surface water samples at two additional ditches evaluated (Ditches C and E) were all are below WDNR surface water quality guidelines. Note that Tyco has installed surface water treatment systems as interim actions to reduce PFAS concentrations in both Ditches A and B. Those systems went on-line in January and October 2019, respectively. Results from the Green Bay surface water investigation (tentatively planned for summer 2020) will be used to further delineate the lateral extent of PFAS concentrations.

Independent of the Site investigation and as part of a state-wide evaluation of PFAS in surface water, in 2019, the WDNR collected surface water samples at five locations on the Menominee River. Four samples were collected just north of the City of Marinette, one at the confluence of the Menominee River and Green Bay, one approximately 1.5 miles up river from the mouth, one approximately 2.7 miles up river from the mouth, and one approximately 3.5 miles up river from the mouth. The average combined concentrations of PFOA and PFOS from all four locations during three sampling events ranged from non-detect to 1.22 ng/L. One sample was collected from a location approximately 50 miles up river of the City of Marinette in May 2019. Combined concentrations of PFOA and PFOS was observed at 0.63 ng/L (WDNR 2019).

4.3.2 PFAS Migration in Surface Water

Surface water velocities were measured seasonally in the ditches at transects collocated with sampling locations (**Figure 6**). Flow was calculated using these velocity measurements to determine the off-site transport potential from surface water. Flow is discussed in Section 2.1. Surface water infiltration to groundwater and groundwater discharge to surface water are discussed in Section 2.5.2. Potential groundwater discharge to the Menominee River results in minimal PFAS mass loading to the river, based on WDNR surface water samples from the river, which had PFOS and PFOA concentrations below

WDNR surface water quality guidelines. Surface water sampling in Green Bay is scheduled for later in 2020.

4.4 Sediment

4.4.1 Nature and Extent of PFAS in Sediment

Sediment samples were collected in June 2018 from Ditches A and B to evaluate sediment quality and determine if the ditch sediments are a potential source of PFAS to ditch surface water or groundwater. A total of 27 sediment samples were collected from 18 locations: seven locations on the Site, six locations north of the Site, and five locations south of the Site (**Figures 21 to 23**). Samples were collected from the top 6 inches at each location and submitted for PFAS analysis, total organic carbon analysis, and grain size testing. Sediment results are presented on **Figures 21 through 23**.

Concentrations of PFOS in sediment ranged from non-detect to 100 µg/kg, and PFOA concentrations ranged from non-detect to 550 µg/kg. The highest PFOA and PFOS concentrations detected in sediment on Site and off Site are in Ditch A. On the Site, the highest concentrations are adjacent to the OTA down to University Drive. Off Site, the highest concentrations in sediment are in Ditch A from University Drive to Madsen Drive, where combined PFOS and PFOA concentrations ranged from 25 to 93 µg/kg. Concentrations for combined PFOA and PFOS identified in the remaining sediment samples from Ditches A and B ranged from non-detect to 8.4 µg/kg. There was not significant variability in grain size between sediment sample locations with higher PFAS concentrations and lower PFAS concentrations.

PFAS in the sediment is likely a result of OTA runoff, groundwater discharge to surface water, and surface water transport.

4.4.2 Sediment Leaching to Groundwater

PFOA and PFOS leaching from sediment does not appear to be a source of PFAS to groundwater as the ditches are primarily gaining (groundwater discharging to the ditches) as discussed in Section 2.5.3.1.

4.4.3 Sediment Leaching to Surface Water

While the predominant mass transport of PFAS to surface water is from groundwater discharge to surface water, there is the potential for PFAS to leach from sediment to surface water. However, if PFAS is leaching from sediment to surface water, it is likely a small mass contributor compared to the mass of PFAS in the groundwater.

4.4.4 Sediment Transport

PFAS sorbed to sediment may be transported downstream in the ditches if sediment is eroded. As discussed in Section 4.4.1, sediment samples from on Site in Ditch A have the highest PFAS concentration but it is unlikely to be sediment transport off Site because Ditch A is heavily vegetated. As surface water flows through the vegetation in Ditch A, potential suspended solids (i.e., eroded sediment) will be deposited.

4.5 Groundwater

PFAS are present in groundwater beneath the Site and extending off Site to the northeast, east, and southeast within portions of Marinette and Peshtigo. As described in the Interim SIR (Arcadis 2020a), investigations to delineate the extent of PFAS in groundwater have primarily relied on two approaches:

- Completion of VAP borings, an investigation approach in which groundwater samples are collected from multiple depths in temporary borings. In total, 65 VAP borings were completed with multiple groundwater samples analyzed for PFAS. VAP results are summarized on **Figure 24** (on-site locations) and **Figure 25** (off-site locations).
- Sampling of 35 monitoring wells and piezometers. Sampling for PFAS was completed at existing on-site wells and at four new off-site wells completed in 2018. Analytical results for groundwater collected at monitoring wells are summarized on **Figure 26**.

The results presented in the Interim SIR define the extent of PFAS in groundwater related to the Site sources above the USEPA HAL of 70 ng/L for PFOA and PFOS (individual or combined) and the WDHS recommended groundwater enforcement standard of 20 ng/L for PFOA and PFOS, individually and combined.

The lateral extent of PFOA and PFOS detected in groundwater above the 70 ng/L HAL and the 20 ng/L recommended enforcement standard is shown on **Figure 27**. The mapped plume extent is based on the maximum concentration observed at any depth within the overburden, integrating data collected at both VAP borings and monitoring wells.

Based on the cumulative groundwater investigation results, the nature and extent of PFAS and transport patterns of groundwater may be described as follows:

- The groundwater on Site and potentially associated with the Site contain a consistent PFAS mixture that is mostly dominated by PFOA or in some samples perfluorohexanoic acid (PFHxA). Where the PFAS mixture deviates from the characteristic mixture of PFAS associated with the Site, the combined PFOS and PFOA concentration is less than 20 ng/L PFOS and PFOA, in the majority of samples.
- The highest detected concentrations of PFAS in groundwater in the investigation area occur at the Site, in an area between the OTA and the eastern site boundary. Samples collected adjacent the OTA contained PFOA as high as 254,000 ng/L at FTC-60S and PFOS as high as 64,000 ng/L (exceeded laboratory detection range) at FTC-82. PFOA was detected at greater than 100,000 ng/L in two VAP borings on the eastern property boundary (SB-9 and SB-5).
- The highest PFAS concentrations observed off Site occur in the deep sand unit between the Site and Ditch B (i.e., PZ-23, SB-49, and SB-50). The maximum concentration of PFOA detected offsite was 33,000 ng/L in SB-50 in a sample from 35 to 40 feet bgs.
- PFAS detections in groundwater off Site form two distinct lobes:
  - A northern lobe trends northeast from the OTA. A component of the northern lobe discharges to Ditch B, while a deeper component extends farther northeast toward the Menominee River.

- o The southern lobe extends southeast from the Site into the Town of Peshtigo. The PFAS in the southern lobe is interpreted to enter groundwater from the losing segment of Ditch A (as described in Section 2.5.3). The lobe extends southeast toward Green Bay with components discharging to Ditches D and E.
- The vertical distribution of PFAS varies within the plume extent, based on vertical circulation within the shallow and deep sand units and pattern of recharge and discharge to surface water.

The distribution of PFAS observed in groundwater within the plume extent shown on **Figure 27** is consistent with the known sources at the Site, release pathways via direct leaching to groundwater and from infiltration from surface water, and patterns of groundwater flow controlled by the hydrostratigraphy and observed gradients. As described in Section 2.5.3, most groundwater flow occurs in the more permeable sand units, but the pathways of flow within the sand are shaped by the presence and absence of aquitards.

As shown on **Figure 27**, isolated detections of PFOS and PFOA above a combined 20 ng/L are found to the south of the Site plume extent. These detections represent local point sources unrelated to the Site. The Southern Area Groundwater Evaluation Report (Arcadis 2020b) provides additional analyses supporting the attribution of those outlier detections to unrelated sources.

The northeastern extent of the mapped plume extent includes the Tyco Stanton Street Facility, located adjacent to the Menominee River. Groundwater investigation completed for the Site suggests that a component of the Site-related plume may reach the Stanton Street site. However, because the Stanton Street site is known to have separate PFAS sources impacting groundwater, there is potential for comingling of PFAS in groundwater associated with the two facilities. Additional investigation to evaluate groundwater quality at the Stanton Street site is planned for 2020.

Interpretations of the plume geometry are undergoing refinement as a component of a groundwater modeling effort now in progress and scheduled for completion at a later date. Interpretations of groundwater flow and transport presented in this CSM will be tested and refined through simulations using a three-dimensional groundwater flow and transport model.

4.6 Air

No ambient air samples have been collected or analyzed for PFAS to date because air is not expected to contain significant PFAS concentrations due to the lack of aerial emissions at the Site. Air was evaluated as a media of concern in an Aerial Deposition Evaluation Report which is in preparation, which concluded that aerial deposition of PFAS does not constitute an important transport mechanism for the Site.

PFAS is not manufactured at the Site, and there are no stack emissions at the Site from indoor facility operations. Outdoor firefighter training and product testing occurred at the Site (Section 3.2) and historical anecdotal observations from Tyco employees note that basketball-sized pieces of foam occasionally drifted away from the OTA during outdoor fire training and foam testing exercises, which have not occurred since 2017. Thus, the only potential air release mechanism of PFAS from the facility is occasional/rare historical foam migration from the OTA.

The PFAS found in AFFF contain charged functional groups (e.g., negatively charged functional groups like sulfonate), which are integral to their functionality as surfactants in AFFF. The charged nature of these chemicals inhibits their volatilization out of solution. The PFAS found in AFFF have a tendency to remain in the aqueous phase or at the air- water interface of bubbles and follow the same migration pathways as water. Because of these chemical characteristics, aerial migration of PFAS relevant to AFFF would occur in association with aerosol particles, not in the gas phase.

Soil samples collected from the Site in and around the OTA (Section 4.1) provide evidence that significant aerial migration of foam has not occurred.

The highest detections of PFAS in surficial soil occur within the fire training portion of the OTA, near known discharge and testing points, and along surface water runoff routes. Soil detections are variable with direction and do not follow the pattern of predominant wind directions indicated by the wind rose collected from the nearby Menominee-Marinette Twin County Airport. Multiple soil samples collected within 150 feet of the OTA and the R&D testing facility contained PFOS and PFOA concentrations within an order of magnitude or less of the concentrations observed in literature reported background soils. The decrease in PFAS concentrations from the source of foam application to concentrations within an order of magnitude of background in a short distance from the OTA support that AFFF application of foam on the OTA is the primary source and surface runoff is the primary transport pathway of PFAS. These data provide strong evidence that foam migration will not cause substantial PFAS impacts to soil outside of the Site.

The PFAS mixture observed in groundwater samples collected from the Site and in the downgradient plume is consistently PFOA or PFHxA dominant (Section 4.4). Where the PFAS mixture in groundwater deviated from the characteristic site signature, PFAS impacts were lower than 20 ng/L. Groundwater samples collected at the perimeter of the Site from locations that are not downgradient of the OTA and are not connected by surface water features did not contain PFOS or PFOA concentrations above 20 ng/L. These sampling results suggest that in the absence of hydraulic connectivity within the Site, other PFAS transport mechanisms such as aerial deposition is insufficient to result in impacts above 20 ng/L. The distribution of PFAS in groundwater that is so far understood to be connected to the Site is consistent with hydraulically driven transport pathways, not aerial deposition.

These lines of evidence do not support that an aerial transport pathway has carried sufficient quantities of PFAS off the Site to cause PFAS concentrations in groundwater that exceed 20 ng/L.

4.7 Biota

Fish tissue samples will be collected from a number of ponds located on private properties near the Site in 2020 to evaluate the nature, extent, and potential transport of PFAS into fish tissue of edible size fish. WDNR and USEPA collected fish tissue samples from the Menominee River and Green Bay in 2019 (Stahl et al. 2014; Williams and Schrank 2016). WDNR has not published the results of the 2019 fish tissue sampling. These data will be used in comparison to the fish tissue results collected from the ponds.

WDNR collected deer tissue on Site in February 2020. WDNR has not yet provided the results of the deer tissue sampling and analysis.

5 POTENTIAL RECEPTORS

Humans that may be exposed to PFAS via ingestion of PFAS-containing groundwater at concentrations greater than 20 ng/L are the primary receptors of concern. Human exposure may also occur via direct contact exposure of PFAS-containing media and via ingestion of PFAS-containing tissue. Based on the findings of PFAS groundwater investigation activities completed to date, Tyco is performing the following voluntary interim remedial actions with WDNR’s approval:

- Providing ongoing bottle water service to private drinking water well owners/users in the private well sampling area.
- Maintaining and monitoring 40 point-of-entry treatment (POET) systems of private well owners/users in the private well sampling area installed for wells with PFAS detections.
- Developing and designing a municipal water line extension to service businesses and residences in the portions of the private well sampling area and pursuing regulatory approval for same.

Ecological receptors may be exposed to PFAS via ingestion of PFAS-containing media. Ecological receptors will be evaluated based on fish and deer tissue data.

6 SUMMARY

AFFF application on the OTA is the primary PFAS source at the Site. PFAS migrated into soil and groundwater at the OTA via infiltration. The highest PFOS and PFOA concentrations in soil are concentrated in the OTA, the foam monitoring pad, and depressions that convey stormwater runoff to Ditch A, following locations that are associated with historical AFFF outdoor releases and their stormwater runoff pathways. PFOA and PFOS concentrations in soil are below the WDNR industrial direct contact residual contaminant levels based on analytical testing results. Data indicate there is stormwater transport of PFAS from the OTA to Ditch A.

Groundwater is present at shallow depths (typically less than 5 feet) within an unconsolidated aquifer. The unconsolidated zone is predominantly sand but includes two major aquitards comprising a combination of silt, clay, and till. A middle aquitard that is present through most of the eastern and southern portions of the investigation area separates the sand into shallow and deep units. A deep aquitard separates the sand units from the underlying bedrock.

Groundwater from the Site flows generally east, with flow paths radiating along an arc from southeast to northeast, discharging to Green Bay and the Menominee River. Groundwater in the shallow sand unit interacts with surface water in the ditches, ponds, and wetlands within the investigation area. The ditches in the investigation area are predominantly gaining (i.e., groundwater discharge locations), with the exception of a segment of Ditch A approximately from University Drive to Madsen Road.

PFAS migrated into groundwater via infiltration through soil at the OTA and from surface water in the losing segment of Ditch A. PFAS detections in groundwater form two lobes: one trending to the northeast, and one trending to the southeast. The highest concentrations of PFAS in groundwater were detected in the northern lobe in an area between the OTA and the eastern site boundary. A component of the northern lobe discharges to Ditch B east of the Site, while a deeper component extends farther northeast toward the Menominee River. The southern lobe extends southeast from the Site into the Town of Peshtigo. A component of PFAS in the southern lobe is interpreted to have entered groundwater from the losing segment of Ditch A. The lobe extends southeast toward Green Bay with components potentially discharging to Ditch D.

The groundwater investigations completed to date have defined the lateral extent of PFAS relative to the WDHS recommended groundwater enforcement standard of 20 ng/L for PFOA and PFOS, individually and combined. The plume extent encompasses a region that extends generally east from the Site and radiates northeast toward the Menominee River and southeast toward Green Bay, extending approximately as far south as Rader Road in Peshtigo.

The ditch segments where PFOA and PFOS concentrations in surface water exceeded the guidelines include:

- Ditch A, PFOA and PFOS concentrations in surface water samples were above the guidelines in sample locations extending from the Site to approximately where the ditch crosses Rader Road.
- Ditch B, PFOA and PFOS concentrations in surface water samples were above the guidelines in sample locations approximately from where the ditch crosses Pierce Avenue to Green Bay.
- Ditch D, PFOS concentrations intermittently in both surface water sample locations.

The two ponds just south of the Site contain PFOS concentrations above WDNR surface water quality guidelines, likely a result of groundwater discharge to surface water.

Combined PFOA and PFOS concentrations in surface water in Ditch A at on-site locations and locations downgradient of the Site show a linear decreasing trend. As of January 2019, the majority of on-site flow in Ditch A is intercepted and treated to remove PFAS before exiting the site boundary. In Ditch B where a northern tributary flows into Ditch B and slightly northeast of the Site, combined detections of PFOA and PFOS in surface water increase. Downgradient of this location, increases in PFAS concentrations and seasonal variations are observed. This portion of the ditch appears to receive groundwater discharge from the groundwater plume originating from the Site. A treatment system is installed and operating in Ditch B to treat surface water. PFOA and PFOS concentrations in surface water and variability along Ditch C and Ditch E are relatively low, and concentrations remained below the WDNR surface water quality guidelines during three 2018 and 2019 sampling events. Surface water samples from Ditch D had relatively stable seasonal concentrations with occasional concentrations exceeding the WDNR surface water quality guidelines. The five ponds sampled during field events exhibit limited seasonal variability of concentrations.

The highest PFOA and PFOS concentrations detected in sediment on Site and off Site are in Ditch A. On the Site, the highest concentrations are adjacent to the OTA down to University Drive. Off Site, the highest concentrations in sediment are in Ditch A from University Drive to Madsen Drive. Concentrations identified in the remaining sediment samples from Ditches A and B were low and ranged from non-detect to 8.4 µg/kg for combined PFOS and PFOA. PFAS in the sediment is likely a result of OTA runoff, groundwater discharge to surface water, and surface water transport. The PFOA and PFOS in sediment do not appear to be a source of PFAS to groundwater as the ditches are primarily gaining (groundwater discharging to the ditches). While the predominant mass transport of PFAS to surface water is from groundwater discharge to surface water, there is the potential for PFAS to leach from sediment to surface water. However, if PFAS is leaching from sediment to surface water, it is likely a small mass contributor compared to the mass of PFAS in the groundwater. PFAS sorbed to sediment may be transported downstream in the ditches if sediment is eroded but it is unlikely to be sediment transport off Site because Ditch A is heavily vegetated. As surface water flows through the vegetation in Ditch A, potential suspended solids (i.e., eroded sediment) will be deposited.

The only potential aerial release mechanism of PFAS at the Site is historical migration of foam from outdoor AFFF testing and training activities. An evaluation of site soil and groundwater data did not find evidence that aerial deposition of PFAS was either common enough or carried sufficient mass when it occurred to constitute an important transport mechanism within or outside of the Site.

Humans that may be exposed to PFAS via ingestion of PFAS-containing groundwater at concentrations greater than 20 ng/L are the primary receptors of concern. Based on the findings of PFAS groundwater investigation activities completed to date, Tyco is performing the following voluntary interim remedial actions with WDNR’s approval:

- Provide ongoing bottle water service to private drinking water well owners/users in the private well sampling area.
- Maintaining and monitoring 40 POET systems of private well owners/users in the private well sampling area installed for wells with PFAS detections.

- Developing, designing, and pursuing regulatory approval for a municipal water line extension to service businesses and residences in the portions of the private well sampling area.

Ecological receptors may be exposed to PFAS via ingestion of PFAS-containing media. Ecological receptors will be evaluated based on fish and deer tissue data.

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NR 712.09 CERTIFICATION

I, Benjamin J. Verburg, 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.

Signature, title and P.E. number

P.E. stamp

I, Christopher S. Peters, 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.

WI PG 1054-013

Signature, title and P.E. number

P.E. stamp

TABLES

Table 1
Soil Background Concentrations
Conceptual Site Model
Marinette, Wisconsin

Compound	Pristine North America Soils (µg/kg) (Rankin et al. 2016)	Global Urban Soils (µg/kg) (Strynar et al. 2012)	Statewide Survey of Vermont Soils (µg/kg) (Zhu et al. 2019)
PFOS	0.39	1.88	0.4
PFOA	0.54	2.42	0.68

Table 2
Soil Leachate Analytical Results
Conceptual Site Model
Marinette, Wisconsin

	Location	SS-130		SS-132		SS-134		SS-135		SS-136		SS-137		SS-138		SS-139	
	Sample Date	7/17/2019		7/16/2019		7/17/2019		7/17/2019		7/17/2019		7/16/2019		7/16/2019		7/16/2019	
	Sample Depth (feet)	0.5-1.5		0.75-1		0.8-1.7		0.7-1.6		0.6-2		0.5-1.2		0.5-1.5		0.5-1.2	
Chemical Name	Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
EtFOSAA	ng/L	<1.7	U	<1.8	U	**3.50**	J	**4,600**	D	**15.00**	J	<1.7	U	<1.7	U	<1.7	U
MeFOSAA	ng/L	<2.8	U	<2.9	U	<2.8	U	**91**		<2.7	U	<2.8	U	<2.8	U	**15**	J
PFBS	ng/L	<0.18	U	<0.19	U	<0.18	U	<0.17	U	<0.17	U	<0.18	U	<0.18	U	**0.5**	J
PFDA	ng/L	**1.1**	J	**37**		**4.9**		**1,200**	D	**29**		**150**		**1.3**	J	**1,100**	D
PFDoA	ng/L	<0.49	U	<0.51	U	<0.49	U	**0.49**	J	**3.3**		**1.3**	J	<0.50	U	**12**	
PFHpA	ng/L	**8.8**		<1.9	UB	**11**		**8**		**3.7**		**24**		**33**		**630**	D
PFHxS	ng/L	<1.8	UB	**1.5**	JB	**2.8**		<1.7	UB	<1.7	UB	**3.4**		<1.8	UB	**61**	
PFHxA	ng/L	**9**		**8.4**		**12**		**43**		**5.9**		**63**		**18**		**260**	
PFNA	ng/L	**22**		**15**		**49**		**41**		**18**		**160**		**20**		**2,900**	D
PFOS	ng/L	**37**		**1,300**	D	**330**		**6,900**	D	**210**		**180**		**18**		**1,000**	D
PFOA	ng/L	**11**		**34**		**33**		**180**		**10**		**20**		**30**		**2,900**	D
PFTeA	ng/L	<1.8	UB	<0.27	U	<0.26	U	<1.7	UB	<0.25	U	<0.26	U	<0.27	U	<0.27	U
PFTrDA	ng/L	<1.2	U	<1.2	U	<1.2	U	<1.1	U	<1.1	U	<1.2	U	<1.2	U	<1.2	U
PFUdA	ng/L	<0.98	U	**2.4**		<0.98	U	**2.7**		**72**		**22**		<1.0	U	**1,500**	D

Notes:
Detections are boldfaced.
ng/L = nanograms per liter
D = Dilution required for sample analysis.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UB = The compound is considered non-detect at the listed value due to associated blank contamination.
Samples below the reporting limit were omitted from calculation of the mean.
N/A = Not calculated because less than two samples were above the detection limit

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Table 3
Soil Analytical Results from Leachate Test
Conceptual Site Model
Marinette, Wisconsin

Location		SS-130		SS-132		SS-134		SS-135		SS-136		SS-137		SS-138		SS-139	
Sample Date		7/17/2019		7/16/2019		7/17/2019		7/17/2019		7/17/2019		7/16/2019		7/16/2019		7/16/2019	
Sample Depth (feet)		0.5-1.5		0.75-1		0.8-1.7		0.69-1.6		0.6-2		0.5-1.2		0.5-1.5		0.5-1.2	
Chemical Name	Unit	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier	Result	Qualifier
EtFOSAA	µg/kg	<0.48	U	**1.3**	J	<0.41	U	**190**	DJ	<0.47	U	<0.48	U	<0.44	U	<44	U
MeFOSAA	µg/kg	<0.51	U	<0.45	U	<0.43	U	**1**	J	<0.50	U	<0.51	U	<0.46	U	<46	U
PFBS	µg/kg	<0.033	U	<0.029	U	<0.028	U	<0.026	U	<0.032	U	<0.033	U	<0.029	U	<3.0	U
PFDA	µg/kg	**0.12**	J	**0.54**		**0.14**	J	**42**		**1.8**		**3.3**		**0.045**	J	**42**	
PFDoA	µg/kg	<0.088	U	**0.27**		<0.075	U	**0.077**	J	**0.39**		**0.14**	J	<0.079	U	<8.0	U
PFHpA	µg/kg	**0.38**		**0.3**		**0.24**		**1.4**		**0.14**	J	**0.66**		**0.85**		**25**	
PFHxS	µg/kg	**0.081**	J	**0.053**	J	**0.078**	J	**0.49**		**0.12**	J	**0.13**	J	<0.036	U	<3.7	U
PFHxA	µg/kg	**0.37**		**0.33**		**0.27**		**2.5**		**0.46**		**1.8**		**0.46**		**33**	
PFNA	µg/kg	**1.4**		**0.44**		**1.1**		**1.2**		**0.83**		**3.7**		**0.52**		**63**	
PFOS	µg/kg	**3.1**		**17**		**8.3**		**210**	D	**14**		**5.2**		**0.59**		<24	U
PFOA	µg/kg	**0.56**		**10**	J	**0.88**		**110**		**3.7**		**2**		**0.82**		**1100**	
PFTeA	µg/kg	<0.071	U	<0.062	U	<0.060	U	<0.056	U	<0.069	U	<0.071	U	<0.064	U	<6.4	U
PFTrDA	µg/kg	<0.067	U	**0.096**	J	<0.057	U	<0.053	U	**0.33**		<0.067	U	<0.060	U	<6.1	U
PFUdA	µg/kg	**0.086**	J	**0.91**		<0.040	U	**0.14**	J	**5**		**0.75**		<0.042	U	**83**	

Notes:
Detections are boldfaced.
µg/kg = micrograms per kilogram
D = Dilution required for sample analysis.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

Table 4
Soil Concentration to Leachate Concentration Ratio
Conceptual Site Model
Marinette, Wisconsin

	Location	SS-130	SS-132	SS-134	SS-135	SS-136	SS-137	SS-138	SS-139
	Sample Date	7/17/2019	7/16/2019	7/17/2019	7/17/2019	7/17/2019	7/16/2019	7/16/2019	7/16/2019
	Depth (feet)	0.5-1.5	0.75-1	0.8-1.7	0.69-1.6	0.6-2	0.5-1.2	0.5-1.5	0.5-1.2
Chemical Name	Unit	Ratio Soil:Leachate							
PFOS	L/kg	83.8	N/A	25.2	30.4	66.7	20.6	32.8	N/A
PFOA	L/kg	50.9	294.1	26.7	611.1	370.0	260.0	27.3	379.3

Notes:

Cl = confidence limit

L/kg = liters per kilogram

N/A = ratio not calculated because the total measured PFAS in the soil was less than the mass leached.

Table 5
Site-Specific Residual Contaminant Levels
Conceptual Site Model
Marinette, Wisconsin

Chemical Name	Unit	SSRCLs	
		Wisconsin Guidance Document[1]	EPA Partition Coefficient Methods[2]
PFOS	µg/kg	0.9	1.0
PFOA	µg/kg	5.0	8.5

Notes:

[1] SSRCLs calculated using methods presented in Wisconsin Department of Natural Resources (WDNR) 2003*;* RCLs calculated as mean ratio of total contaminant in the soil to the leached concentration multiplied by the preventive action limit for groundwater (20 parts oer trillion [ppt] for PFOA and 20 ppt PFOS); mean ratios were used instead of the lower 95% confidence interval because the calculated lower confidence interval is a negative number.

[2] SSRCLs calculated using methods presented in NJDEP 2013; RSLs calculated using the preventive action limit for groundwater of 20 ppt for PFOA and PFOS, soil water partitioning coefficients calculated from measured SPLP concentrations, measured dry soil density and soil porosity measured in this study, and dilution attenuation factor of 2; assume $\theta aH' \ll \theta w$ for PFOS and PFOS because all pore space is water filled.

µg/kg = micrograms per kilogram

Table 6
Soil Physical Parameters
Conceptual Site Model
Marinette, Wisconsin

Location		SS-130	SS-132	SS-134	SS-135	SS-136	SS-137	SS-138	SS-139
Sample Date		7/17/2019	7/16/2019	7/17/2019	7/17/2019	7/17/2019	7/16/2019	7/16/2019	7/16/2019
Depth (feet)		0.5-1.5	0.75-1	0.8-1.7	0.69-1.6	0.6-2	0.5-1.2	0.5-1.5	0.5-1.2
Parameter	**Unit**								
Dry Bulk Density	kg/L	1.362	1.123	1.328	1.307	1.661	1.610	1.566	1.614
Porosity	unitless	0.490	0.580	0.500	0.440	0.380	0.390	0.410	0.390
Water Content	unitless	0.234	0.438	0.172	0.195	0.176	0.167	0.180	0.178
Specific Gravity	unitless	2.668	2.655	2.635	2.735	2.684	2.661	2.655	2.637
Total Organic Carbon	mg/kg	4000	3000	<600	<600	<600	<600	1400	5400

Notes:

Cl = confidence limit

kg/L = kilograms per liter

mg/kg = milligrams per kilogram

Table 7
Soil Partition Coefficients
Conceptual Site Model
Marinette, Wisconsin

	Location	SS-130	SS-132	SS-134	SS-135	SS-136	SS-137	SS-138	SS-139
	Sample Date	7/17/2019	7/16/2019	7/17/2019	7/17/2019	7/17/2019	7/16/2019	7/16/2019	7/16/2019
	Depth (feet)	0.5-1.5	0.75-1	0.8-1.7	0.69-1.6	0.6-2	0.5-1.2	0.5-1.5	0.5-1.2
Chemical Name	Unit	K_D[1]							
PFOS	L/kg	63.8	N/A	5.2	10.4	46.7	8.9	12.8	N/A
PFOA	L/kg	30.9	274.1	6.7	591.1	350.0	80.0	7.3	359.3

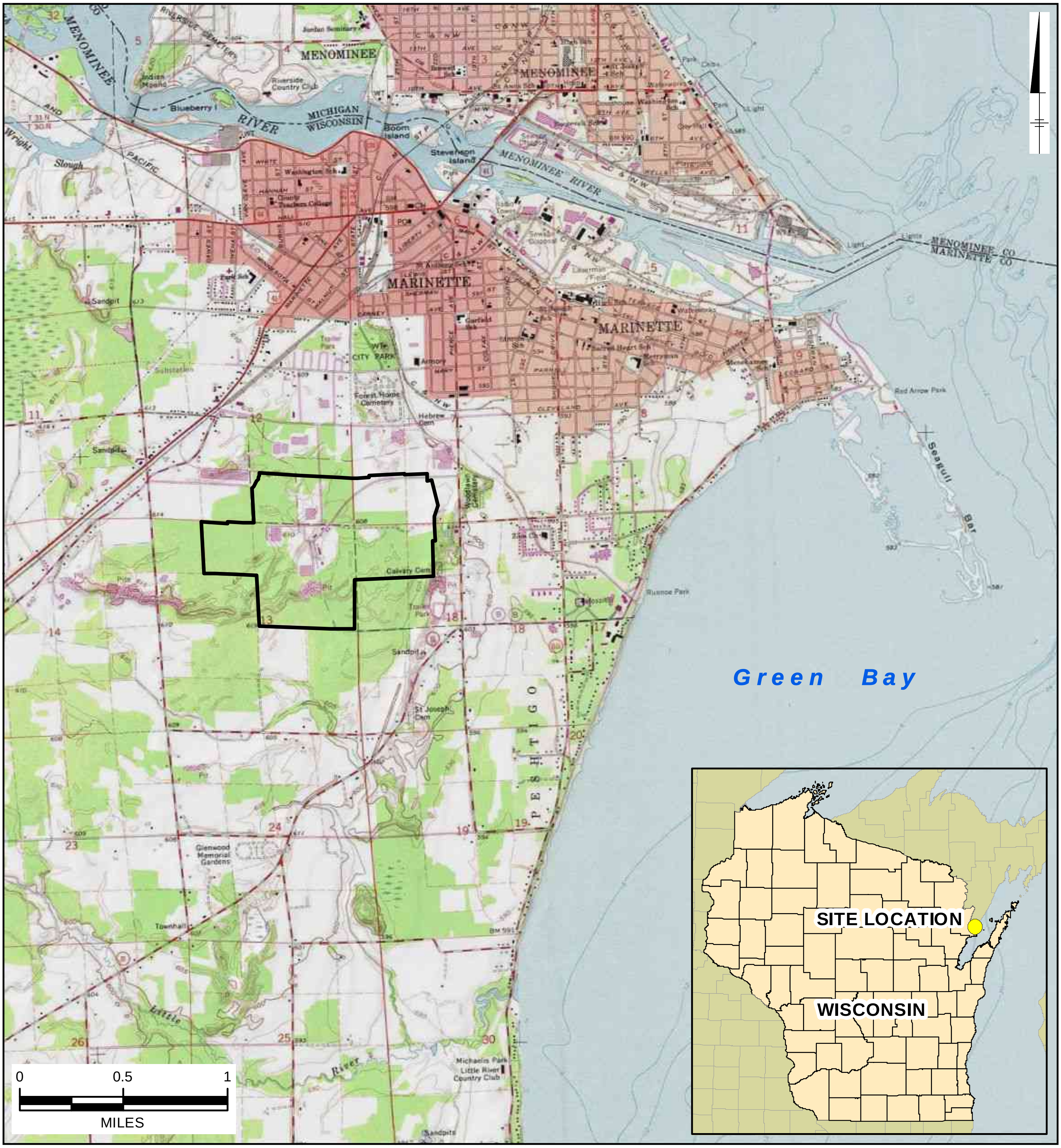
Notes:

1 K_D calculated using the equation presented in the New Jersey Department of Environmental Protection Guidance Document, which calculates K_D as the ratio of the final concentration in the soil (calculated from the initial mass in the soil and the leached mass) to the leached concentration.

L/kg = liters per kilogram

N/A = Partition coefficient not calculated because the total measured PFAS in the soil was less than the mass leached.

FIGURES



LEGEND:

APPROXIMATE SITE PROPERTY BOUNDARY

NOTES:

1. TOPOGRAPHIC MAP SOURCE: COPYRIGHT:© 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED, ACCESSED APRIL, 2020.

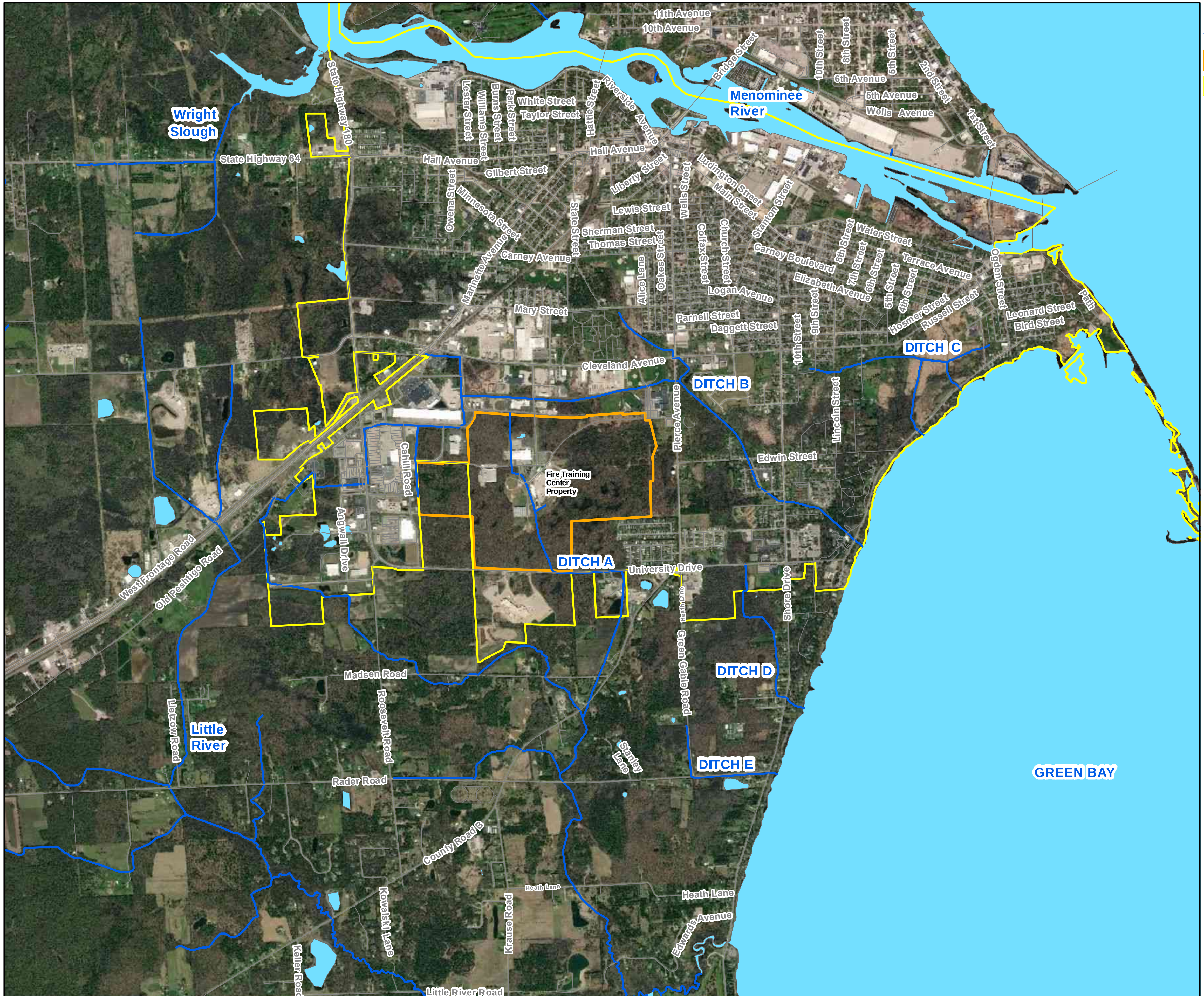
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN

CONCEPTUAL SITE MODEL

SITE LOCATION

ARCADIS

FIGURE
1



LEGEND:

- DITCH/STREAM
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- WATERBODY

NOTES:

1. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
2. DITCH/STREAM DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
3. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
4. AERIAL IMAGERY: 4/27/2016 DIGITALGLOBE, VIVID-USA

0 1,100 2,200

GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

INVESTIGATION AREA

ARCADIS

FIGURE
2

LEGEND:

DITCH

NOTES:

1. IMAGERY SOURCE: 4/27/2016, DIGITALGLOBE, VIVID - USA.

0 225 450

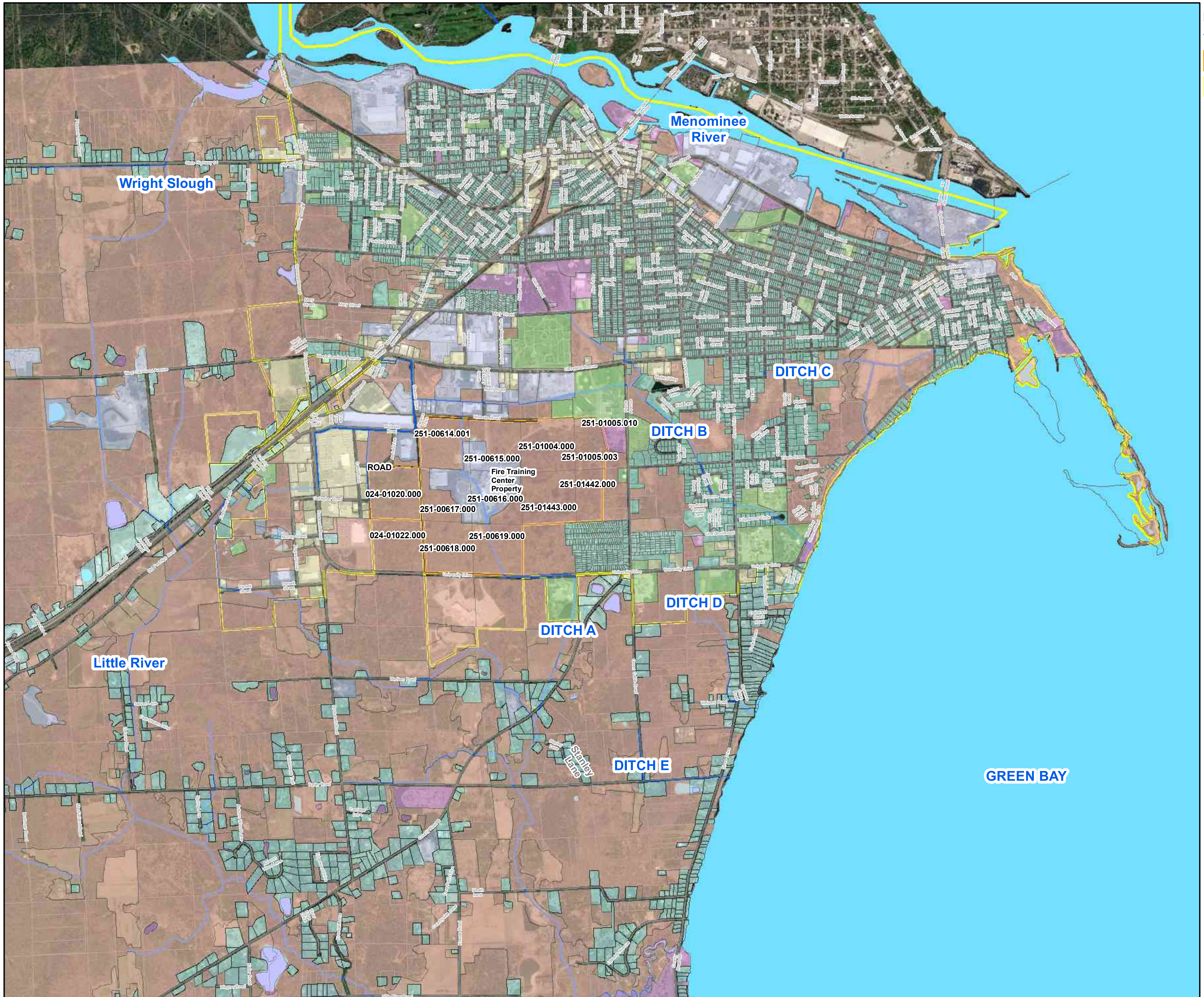
GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

FTC OPERATIONS AREA LAYOUT

ARCADIS

FIGURE
3



LEGEND:
- DITCH/STREAM
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- WATERBODY

MARINETTE LANDUSE
- INDUSTRIAL
- MUNICIPAL
- OPEN SPACE
- PARKS AND RECREATION
- RESISDENTIAL
- RETAIL/COMMERCIAL

NOTES:

1. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
2. DITCH/STREAM DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
3. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
4. AERIAL IMAGERY: 4/27/2016 DIGITALGLOBE, VIVID-USA

0 1,100 2,200

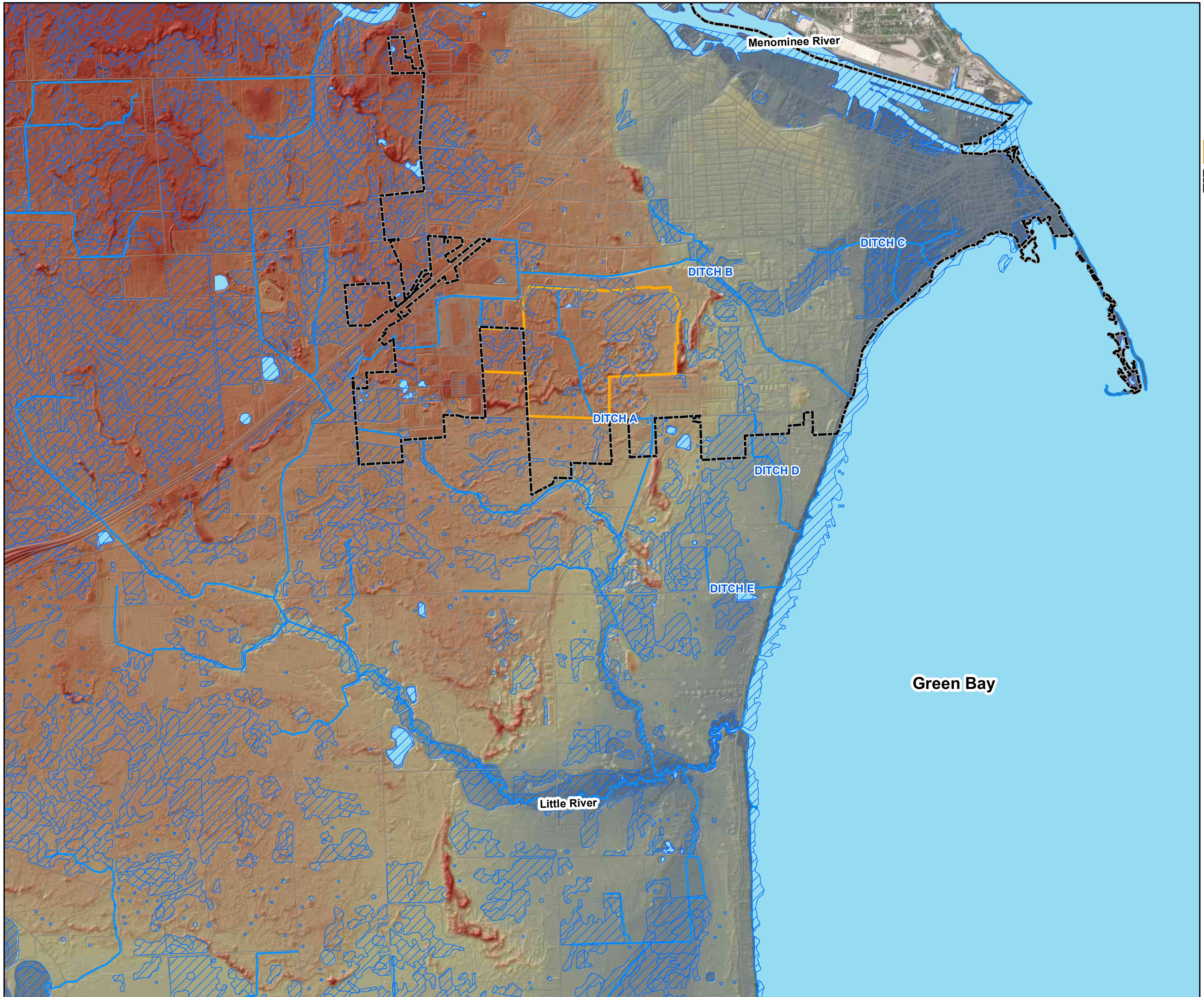
GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

LAND AREA USE

ARCADIS

FIGURE
4



LEGEND:

- DITCH
- WETLAND
- WATERBODY
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE_MARINETTE_CITY_BOUNDARY

GROUND SURFACE ELEVATION (FEET AMSL)

High
625
620
615
610
605
600
595
590
585
580
575
Low

NOTE:

1. AERIAL IMAGERY: USDA FSA NAIP 2015
2. DEM SOURCE: ARCGIS ONLINE.

0 3,000 6,000 Feet

GRAPHIC SCALE

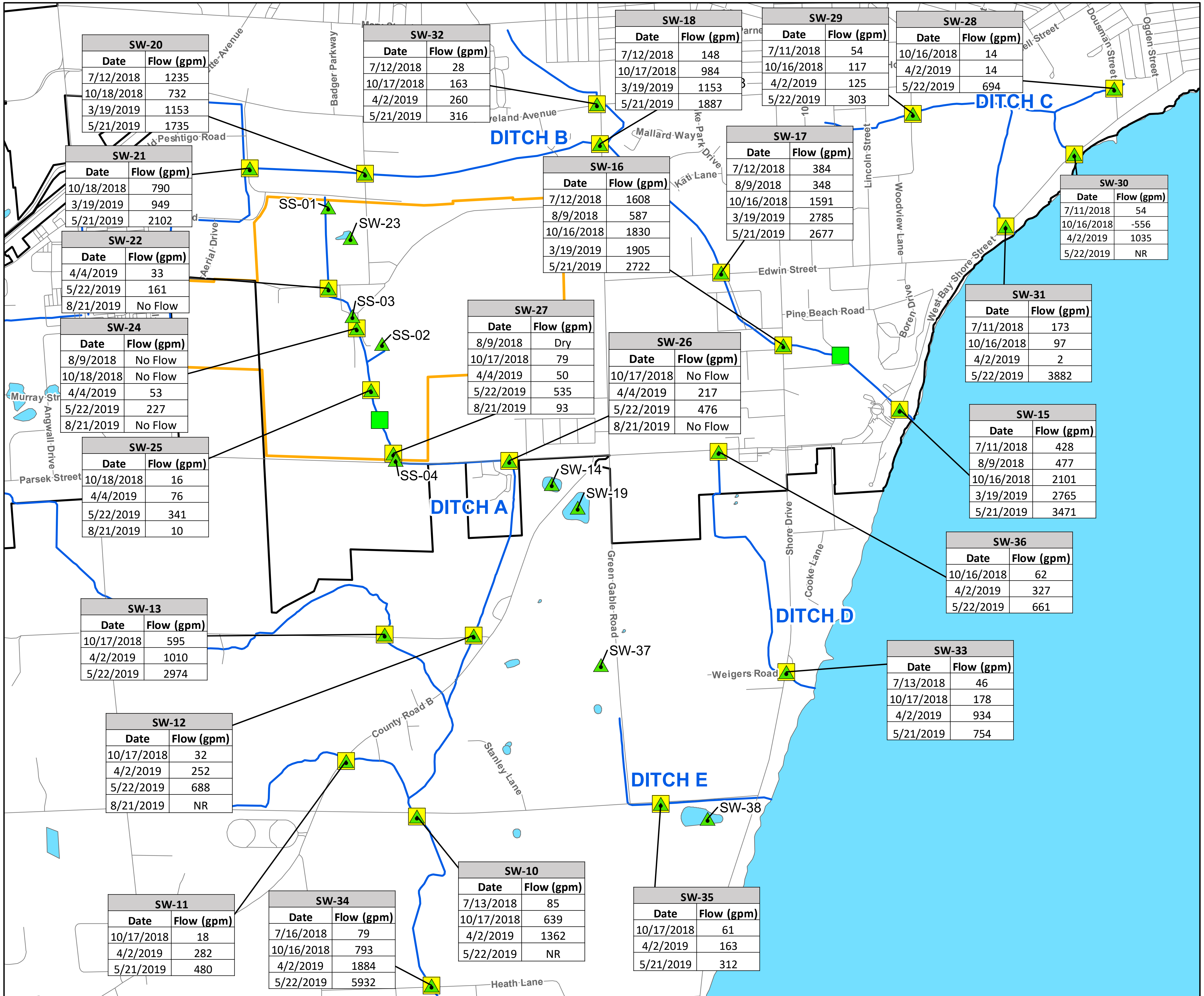
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

TOPOGRAPHY AND WETLANDS

ARCADIS

FIGURE 5

City: Minneapolis/Citrix Div/Group: IMDVC Created By: Last Saved By: MSMiller
TYCO Marinette, WI
D:\Tyco_Marinette\MXD\2020-05\10pt3_MXDs\Topography.mxd 5/26/2020 8:17:55 AM



SW-20

Date	Flow (gpm)
7/12/2018	1235
10/18/2018	732
3/19/2019	1153
5/21/2019	1735

SW-32

Date	Flow (gpm)
7/12/2018	28
10/17/2018	163
4/2/2019	260
5/21/2019	316

SW-18

Date	Flow (gpm)
7/12/2018	148
10/17/2018	984
3/19/2019	1153
5/21/2019	1887

SW-29

Date	Flow (gpm)
7/11/2018	54
10/16/2018	117
4/2/2019	125
5/22/2019	303

SW-28

Date	Flow (gpm)
10/16/2018	14
4/2/2019	14
5/22/2019	694

SW-21

Date	Flow (gpm)
10/18/2018	790
3/19/2019	949
5/21/2019	2102

SW-16

Date	Flow (gpm)
7/12/2018	1608
8/9/2018	587
10/16/2018	1830
3/19/2019	1905
5/21/2019	2722

SW-17

Date	Flow (gpm)
7/12/2018	384
8/9/2018	348
10/16/2018	1591
3/19/2019	2785
5/21/2019	2677

SW-30

Date	Flow (gpm)
7/11/2018	54
10/16/2018	-556
4/2/2019	1035
5/22/2019	NR

SW-22

Date	Flow (gpm)
4/4/2019	33
5/22/2019	161
8/21/2019	No Flow

SW-31

Date	Flow (gpm)
7/11/2018	173
10/16/2018	97
4/2/2019	2
5/22/2019	3882

SW-27

Date	Flow (gpm)
8/9/2018	Dry
10/17/2018	79
4/4/2019	50
5/22/2019	535
8/21/2019	93

SW-24

Date	Flow (gpm)
8/9/2018	No Flow
10/18/2018	No Flow
4/4/2019	53
5/22/2019	227
8/21/2019	No Flow

SW-26

Date	Flow (gpm)
10/17/2018	No Flow
4/4/2019	217
5/22/2019	476
8/21/2019	No Flow

SW-15

Date	Flow (gpm)
7/11/2018	428
8/9/2018	477
10/16/2018	2101
3/19/2019	2765
5/21/2019	3471

SW-25

Date	Flow (gpm)
10/18/2018	16
4/4/2019	76
5/22/2019	341
8/21/2019	10

SW-36

Date	Flow (gpm)
10/16/2018	62
4/2/2019	327
5/22/2019	661

SW-13

Date	Flow (gpm)
10/17/2018	595
4/2/2019	1010
5/22/2019	2974

SW-33

Date	Flow (gpm)
7/13/2018	46
10/17/2018	178
4/2/2019	934
5/21/2019	754

SW-12

Date	Flow (gpm)
10/17/2018	32
4/2/2019	252
5/22/2019	688
8/21/2019	NR

SW-10

Date	Flow (gpm)
7/13/2018	85
10/17/2018	639
4/2/2019	1362
5/22/2019	NR

SW-35

Date	Flow (gpm)
10/17/2018	61
4/2/2019	163
5/21/2019	312

SW-11

Date	Flow (gpm)
10/17/2018	18
4/2/2019	282
5/21/2019	480

SW-34

Date	Flow (gpm)
7/16/2018	79
10/16/2018	793
4/2/2019	1884
5/22/2019	5932

LEGEND:

- SURFACE WATER SAMPLE
- DITCHTREATMENT SYSTEM
- VELOCITY MEASUREMENT LOCATION
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:

1. THE MAY 2018 VELOCITY MEASUREMENTS WERE NOT USED FOR CALCULATING FLOW.
2. NR = DATA NOT RECORDED DURING FIELD EVENT.
3. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
4. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
5. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
6. GPM = GALLONS PER MINUTE
7. NO FLOW = STANDING WATER WAS OBSERVED AT THE LOCATION BUT VELOCITY MEASUREMENTS WERE RECORDED AS 0 IN ALL DIRECTIONS.
8. THE DITCH A SURFACE WATER TREATMENT SYSTEM WAS INSTALLED IN DECEMBER 2018, THE DITCH B SURFACE WATER TREATMENT SYSTEM WAS INSTALLED IN NOVEMBER 2019.

0 1,500 3,000

GRAPHIC SCALE IN FEET

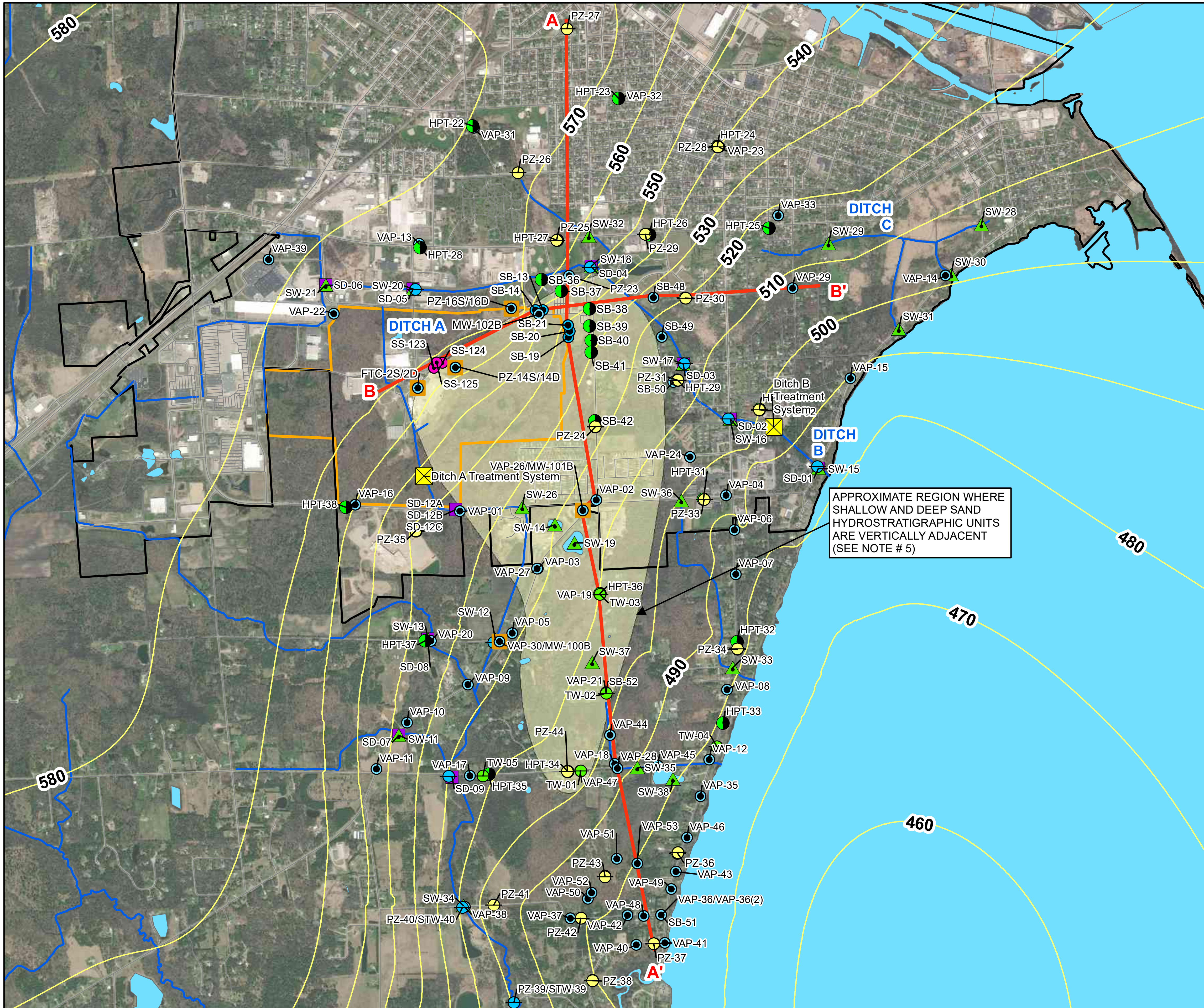
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN

CONCEPTUAL SITE MODEL

HISTORIC CALCULATED SURFACE WATER FLOW RATES

ARCADIS

FIGURE **6**



LEGEND:

- BEDROCK SURFACE ELEVATION CONTOUR (FT AMSL)
- CROSS-SECTION LOCATION
- CLUSTERED MONITORING WELLS
- CLUSTERED PIEZOMETER LOCATION
- PZ/STW PAIRS
- TEMPORARY PIEZOMETER
- HPT LOCATIONS
- SEDIMENT SAMPLE
- VAP LOCATION
- SURFACE WATER SAMPLE AND VELOCITY MEASUREMENT
- SOIL SAMPLING LOCATION
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:
1. HPT-25 AND HPT-35 ALSO HAD A SOIL BORING COMPLETED AT THE LOCATION.
2. CLUSTERED PIEZOMETERS AND MONITORING WELLS IDS ARE SHOWN SEPARATELY.
3. ONLY LOCATIONS THAT WERE USED FOR THE GEOLOGIC CROSS-SECTION INSIDE THE SITE BOUNDARY ARE SHOWN, ALL OTHER ON-SITE LOCATIONS ARE SHOWN SEPARATELY.
4. BEDROCK CONTOURS BASED ON SITE SPECIFIC DATA AND REGIONAL MAPPING IN TROLLA ET AL. (1973), WDNR (2011, AND SOLLER ET AL. (2018).
5. REGION SHOWS WHERE HYDRYDRAULIC COMMUNICATION BETWEEN SHALLOW AND DEEP HYDROSTRATIGRAPHIC UNITS IS MOST PROBABLE. TO EAST AND SOUTH, UNITS ARE SEPARATED BY MIDDLE AQUITARD. TO WEST AND NORTH, DEEP SAND UNIT NOT PRESENT.

0 2,000 4,000

GRAPHIC SCALE IN FEET

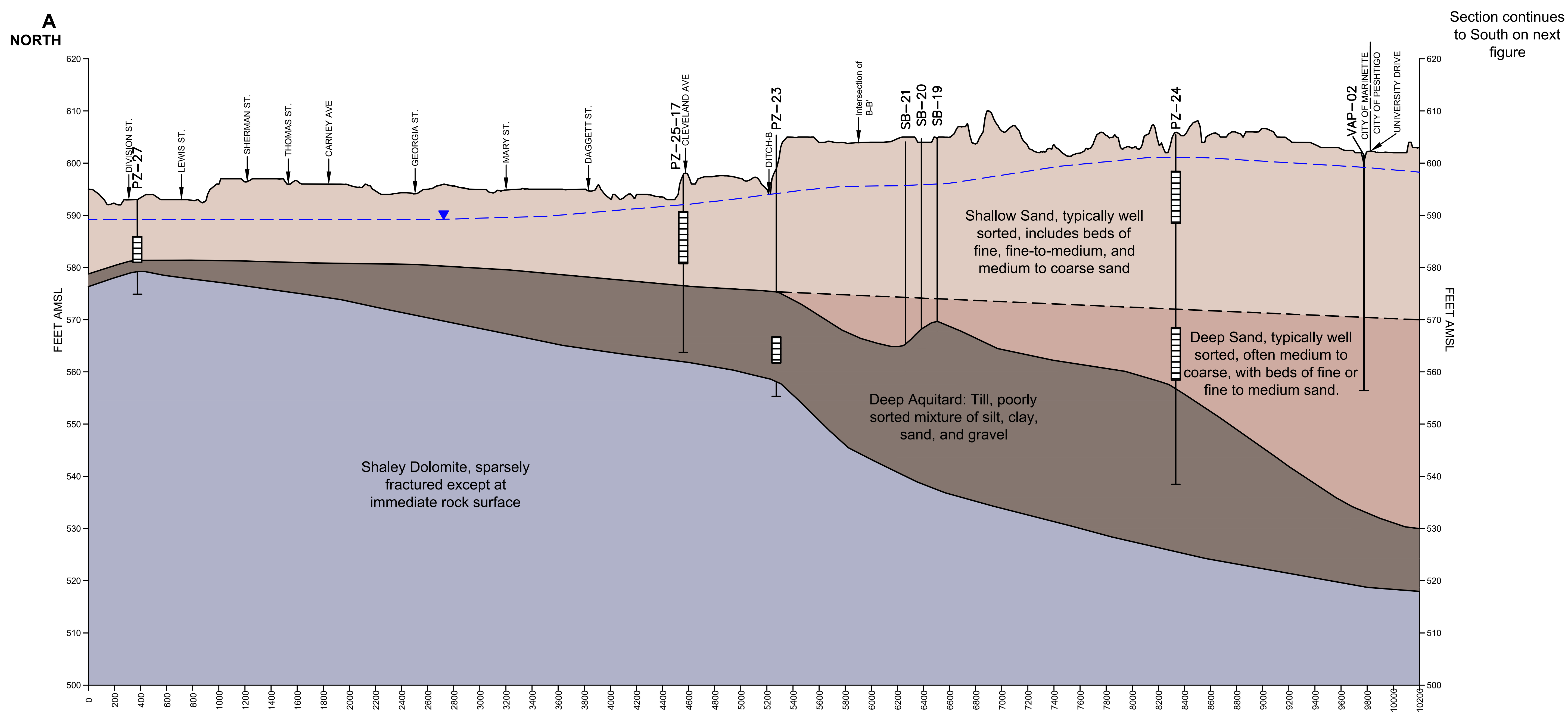
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

BEDROCK SURFACE AND CROSS-SECTION LOCATIONS

ARCADIS

FIGURE
7

City: Minneapolis/Citrix Div/Group: IMDVC Created By: Last Saved By: MSMiller
TYCO Marinette, WI
D:\Tyco_Marinette\MXD\2020-05\10pt3_MXDs\BedrockSurface_05262020.mxd 5/26/2020 11:26:53 AM



LEGEND

PZ-30 = WELL/BORING ID

WATER TABLE

SCREEN INTERVAL

BOREHOLE

NOTES:

1. GEOLOGY GENERALIZED INTO MAJOR HYDROSTRATIGRAPHIC UNITS; EACH UNIT MAY INCLUDE HETEROGENEITIES NOT SHOWN. WHERE MIDDLE AQUITARD NOT PRESENT, CONTACT BETWEEN UPPER AND LOWER SAND UNITS IS ASSUMED WHERE COMBINED THICKNESS EXCEEDS ABOUT 30 FEET.
2. ABBREVIATIONS: AMSL – ABOVE MEAN SEA LEVEL; VAP – VERTICAL AQUIFER PROFILE
3. WATER TABLE APPROXIMATE, BASED ON OCTOBER 2019 WATER-LEVELS.

0 20 40
VERTICAL SCALE IN FEET

0 800 1600
HORIZONTAL SCALE IN FEET

VERICAL EXAGGERATION = 40X

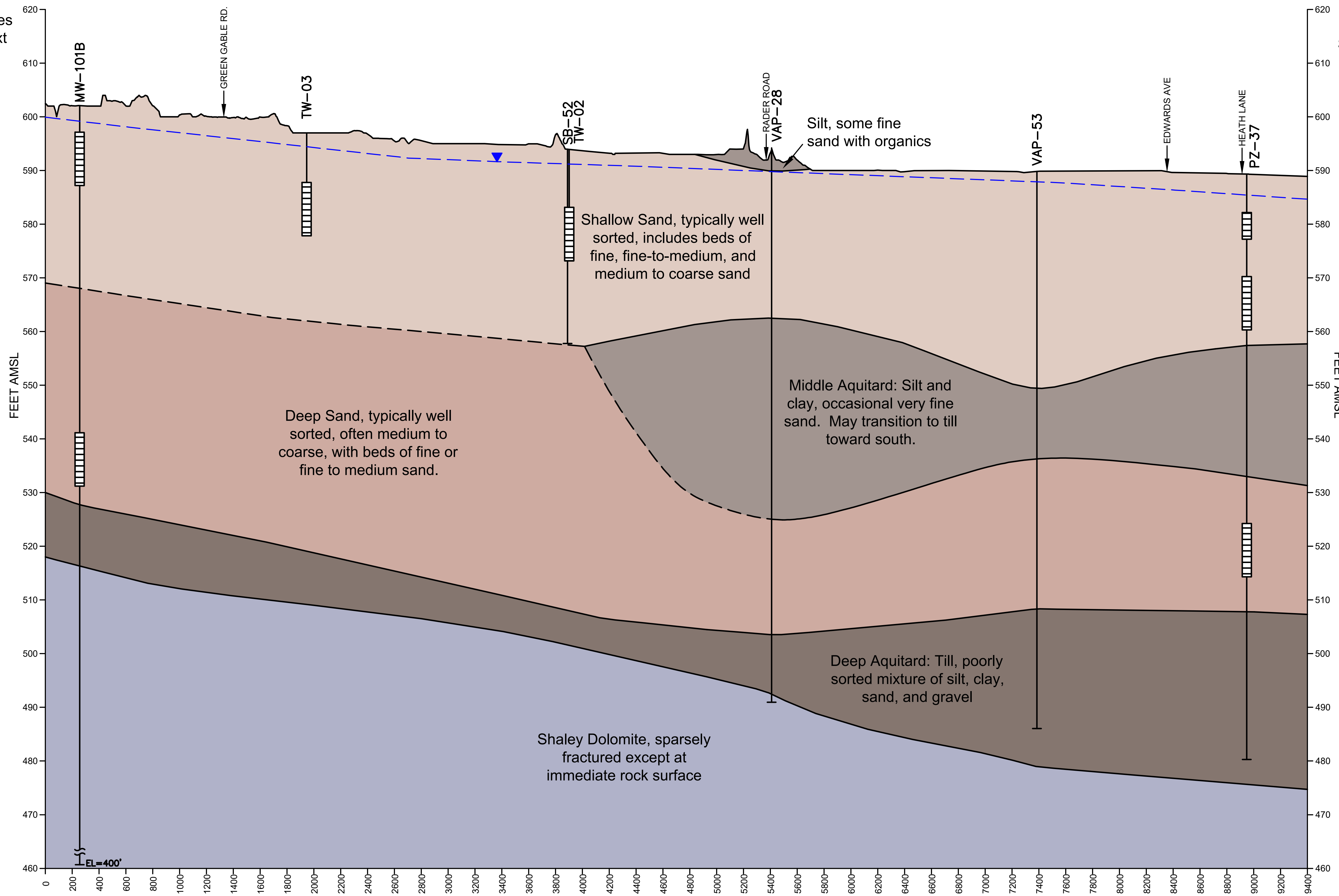
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

CROSS SECTION A-A' (NORTH HALF)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8

Section continues to North on next figure



LEGEND

PZ-30 = WELL/BORING ID

WATER TABLE

SCREEN INTERVAL

BOREHOLE

NOTES:

1. GEOLOGY GENERALIZED INTO MAJOR HYDROSTRATIGRAPHIC UNITS; EACH UNIT MAY INCLUDE HETEROGENEITIES NOT SHOWN. WHERE MIDDLE AQUITARD NOT PRESENT, CONTACT BETWEEN UPPER AND LOWER SAND UNITS IS ASSUMED WHERE COMBINED THICKNESS EXCEEDS ABOUT 30 FEET.

2. ABBREVIATIONS: AMSL – ABOVE MEAN SEA LEVEL; VAP – VERTICAL AQUIFER PROFILE

3. WATER TABLE APPROXIMATE, BASED ON OCTOBER 2019 WATER-LEVELS.

0 20 40
VERTICAL SCALE IN FEET

0 800 1600
HORIZONTAL SCALE IN FEET

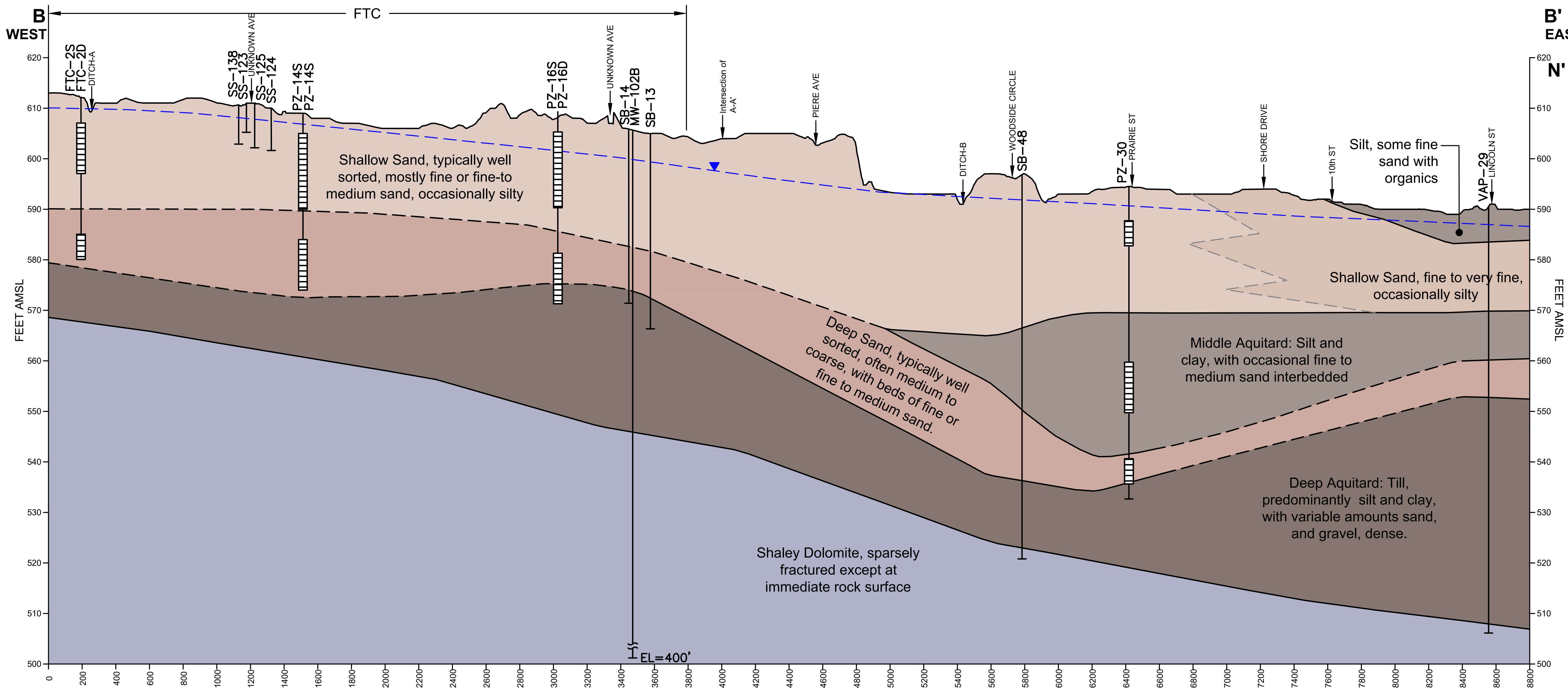
VERICAL EXAGGERATION = 40X

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

CROSS SECTION A-A' (SOUTH HALF)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
9



LEGEND

PZ-30 = WELL/BORING ID

WATER TABLE

SCREEN INTERVAL

BOREHOLE

NOTES:

1. GEOLOGY GENERALIZED INTO MAJOR HYDROSTRATIGRAPHIC UNITS; EACH UNIT MAY INCLUDE HETEROGENEITIES NOT SHOWN. WHERE MIDDLE AQUITARD NOT PRESENT, CONTACT BETWEEN UPPER AND LOWER SAND UNITS IS ASSUMED WHERE COMBINED THICKNESS EXCEEDS ABOUT 30 FEET.
2. ABBREVIATIONS: AMSL – ABOVE MEAN SEA LEVEL; VAP – VERTICAL AQUIFER PROFILE
3. WATER TABLE APPROXIMATE, BASED ON OCTOBER 2019 WATER-LEVELS.

0 20 40
VERTICAL SCALE IN FEET

0 600 1200
HORIZONTAL SCALE IN FEET

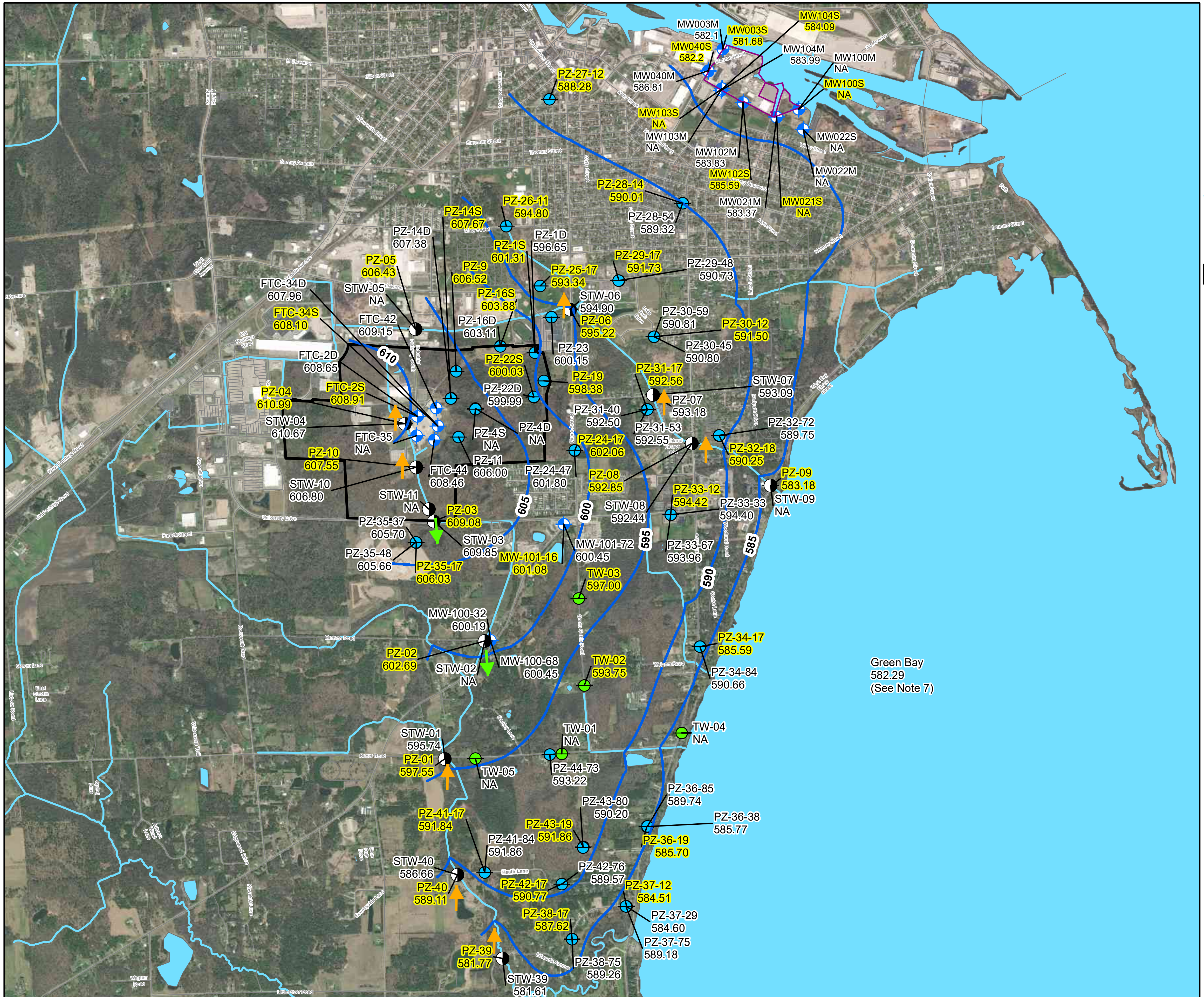
VERICAL EXAGGERATION = 30X

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

CROSS SECTION B-B'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
10



LEGEND:

- MONITORING WELL
- PIEZOMETER
- IN-STREAM PIEZOMETER AND STILLING WELL PAIR
- TEMPORARY PIEZOMETER
- ROAD
- HYDRAULIC CONTAINMENT WALL
- DITCH/STREAM
- WATERBODY
- SHALLOW SAND POTENTIOMETRIC SURFACE (AMSL)
- APPROXIMATE SITE PROPERTY BOUNDARY
- GAINING CONDITION AT STREAM GAUGE
- LOSING CONDITION AT STREAM GAUGE

NOTES:

1. WELLS AND PIEZOMETERS WERE USED FOR CONTOURING THE GROUNDWATER POTENTIOMETRIC SURFACE.
2. WATER LEVELS POSTED FOR PIEZOMETER/STILLING WELL PAIRS ARE FOR THE PIEZOMETERS. STILLING WELL MEASUREMENTS NOT AVAILABLE.
3. DITCH/STREAM DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
4. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
5. AERIAL IMAGERY: 5/14/2017 DIGITALGLOBE, VIVID-USA
6. POSTED WATER- EVEL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL), BASED ON MEASUREMENTS COMPLETED 10/16/2019 - 10/17/2019.
7. BAY OF GREEN BAY SURFACE ELEVATION (582.29) AS REPORTED BY NOAA/NOS MENOMINEE, MI, STATION #9087088 FOR 10/16/2019.
8. NA = LOCATION DATA NOT AVAILABLE FOR GROUNDWATER

0 2,000 4,000

GRAPHIC SCALE IN FEET

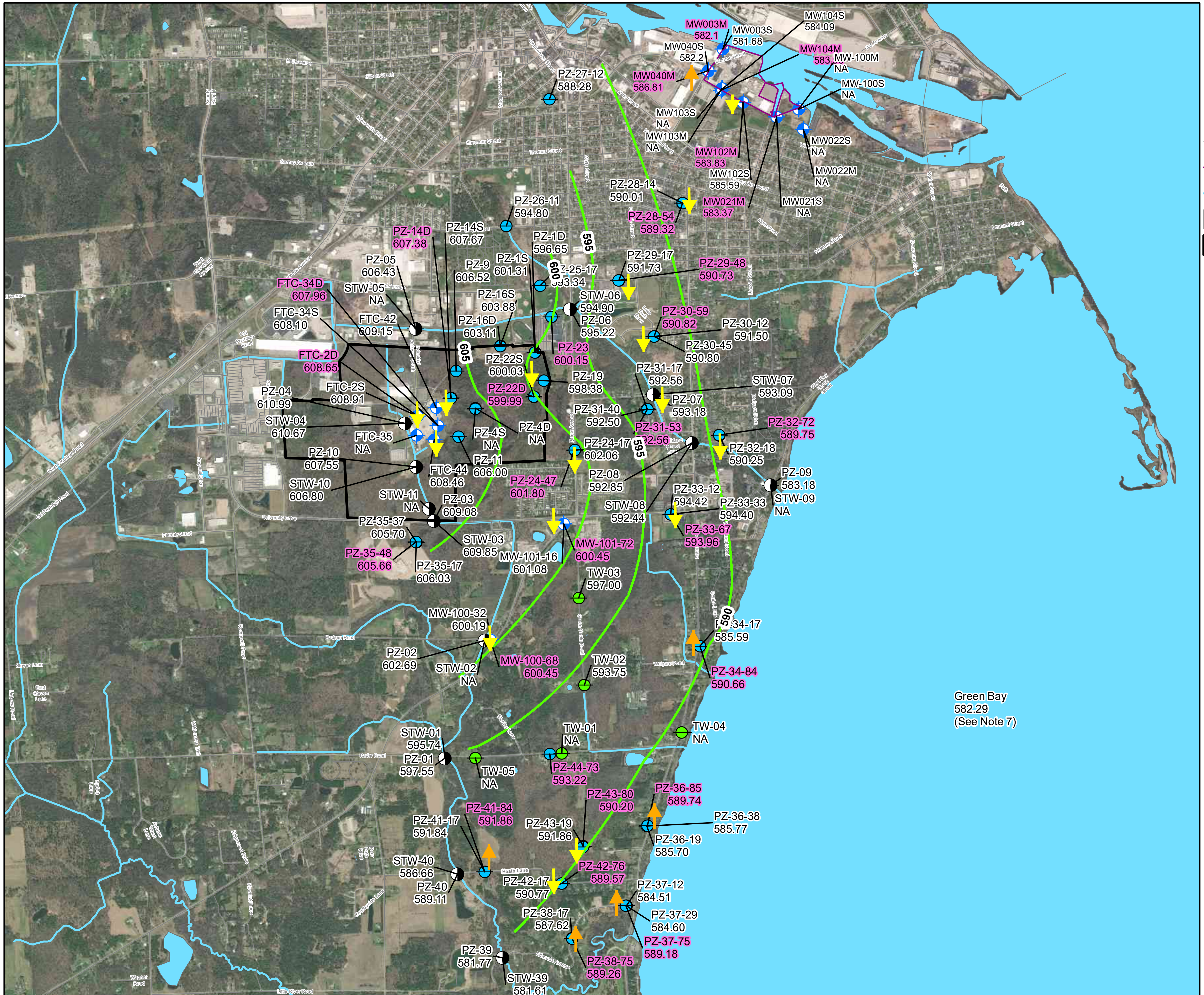
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN

CONCEPTUAL SITE MODEL

SHALLOW SAND POTENTIOMETRIC SURFACE - OCTOBER 2019

ARCADIS

FIGURE
11



LEGEND:

- MONITORING WELL
- PIEZOMETER
- IN-STREAM PIEZOMETER AND STILLING WELL PAIR
- TEMPORARY PIEZOMETER
- ROAD
- HYDRAULIC CONTAINMENT WALL
- DITCH/STREAM
- WATERBODY
- APPROXIMATE SITE PROPERTY BOUNDARY
- DEEP SAND POTENTIOMETRIC SURFACE
- UPWARD GRADIENT FROM DEEP TO SHALLOW SAND
- DOWNWARD GRADIENT FROM SHALLOW TO DEEP SAND

NOTES:

1. WELLS AND PIEZOMETERS WERE USED FOR CONTOURING THE GROUNDWATER POTENTIOMETRIC SURFACE.
2. WATER LEVELS POSTED FOR PIEZOMETER/STILLING WELL PAIRS ARE FOR THE PIEZOMETERS. STILLING WELL MEASUREMENTS NOT AVAILABLE.
3. DITCH/STREAM DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
4. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
5. AERIAL IMAGERY: 5/14/2017 DIGITALGLOBE, VIVID-USA
6. POSTED WATER LEVEL ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (AMSL), BASED ON MEASUREMENTS COMPLETED 10/16/2019 - 10/17/2019.
7. BAY OF GREEN BAY SURFACE ELEVATION (582.29) AS REPORTED BY NOAA/NOS MENOMINEE, MI, STATION #9087088 FOR 10/16/2019.
8. NA = LOCATION DATA NOT AVAILABLE FOR GROUNDWATER

0 2,000 4,000

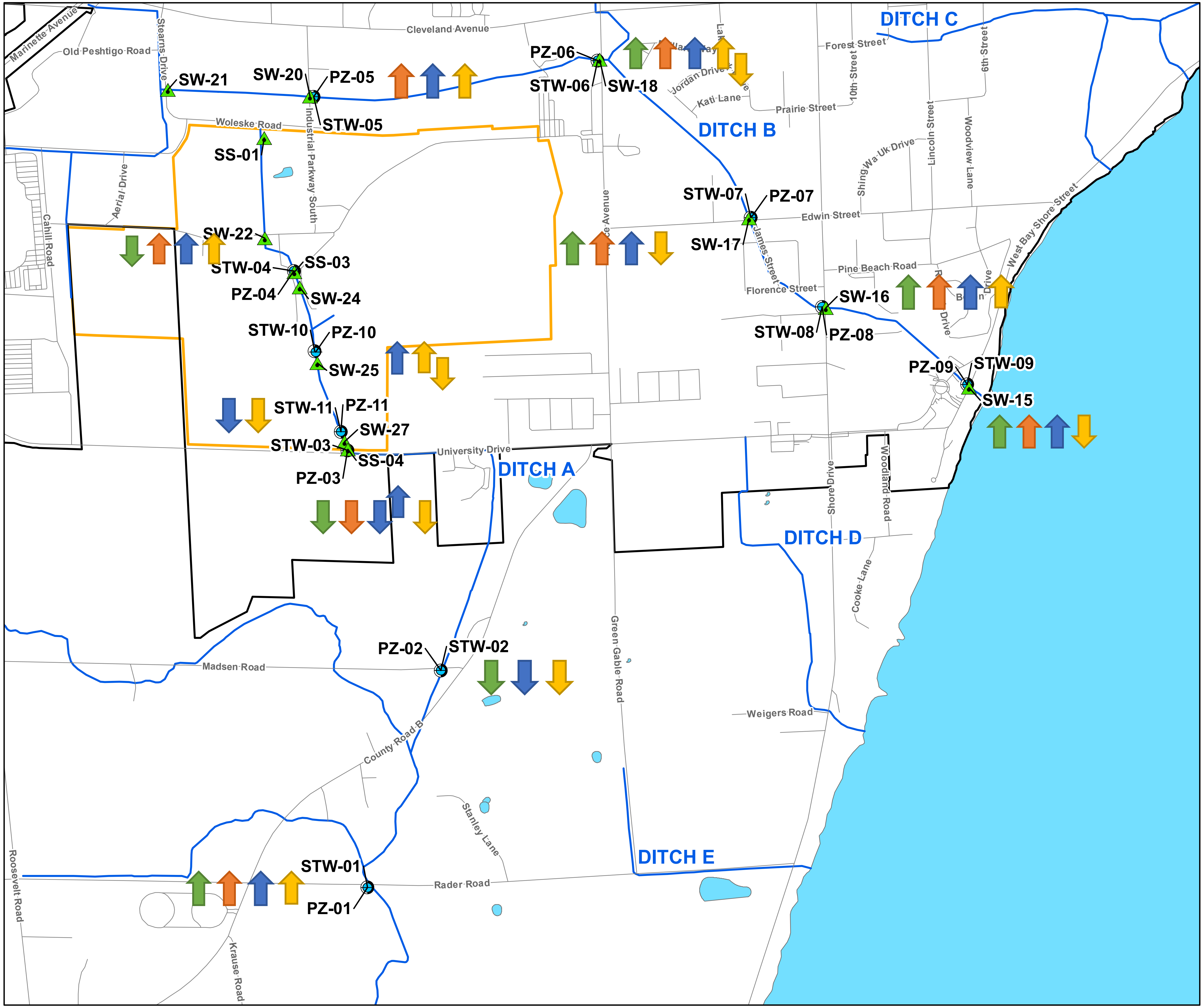
GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

DEEP SAND POTENTIOMETRIC SURFACE - OCTOBER 2019

ARCADIS

FIGURE 12



LEGEND:

- SURFACE WATER SAMPLE
- PIEZOMETER
- STILLING WELL
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY
- AUGUST 2018
- OCTOBER/NOVEMBER 2018
- MARCH THROUGH MAY 2019
- MAY/JUNE 2019
- GAINING STREAM: GROUNDWATER ELEVATION IS HIGHER THAN SURFACE WATER ELEVATION
- LOSING STREAM: GROUNDWATER ELEVATION IS LOWER THAN SURFACE WATER ELEVATION
- CHANGED FROM LOSING TO GAINING MID-EVENT
- CHANGED FROM GAINING TO LOSING MID-EVENT

NOTES:

1. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
2. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
3. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.

0 1,500 3,000

GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN

CONCEPTUAL SITE MODEL

SURFACE WATER-GROUNDWATER INTERACTIONS

ARCADIS

FIGURE **13**

LEGEND:

SOIL SAMPLE LOCATION

NOTE:

1. AERIAL IMAGERY: USDA FSA NAIP 2015

0 300 600
Feet

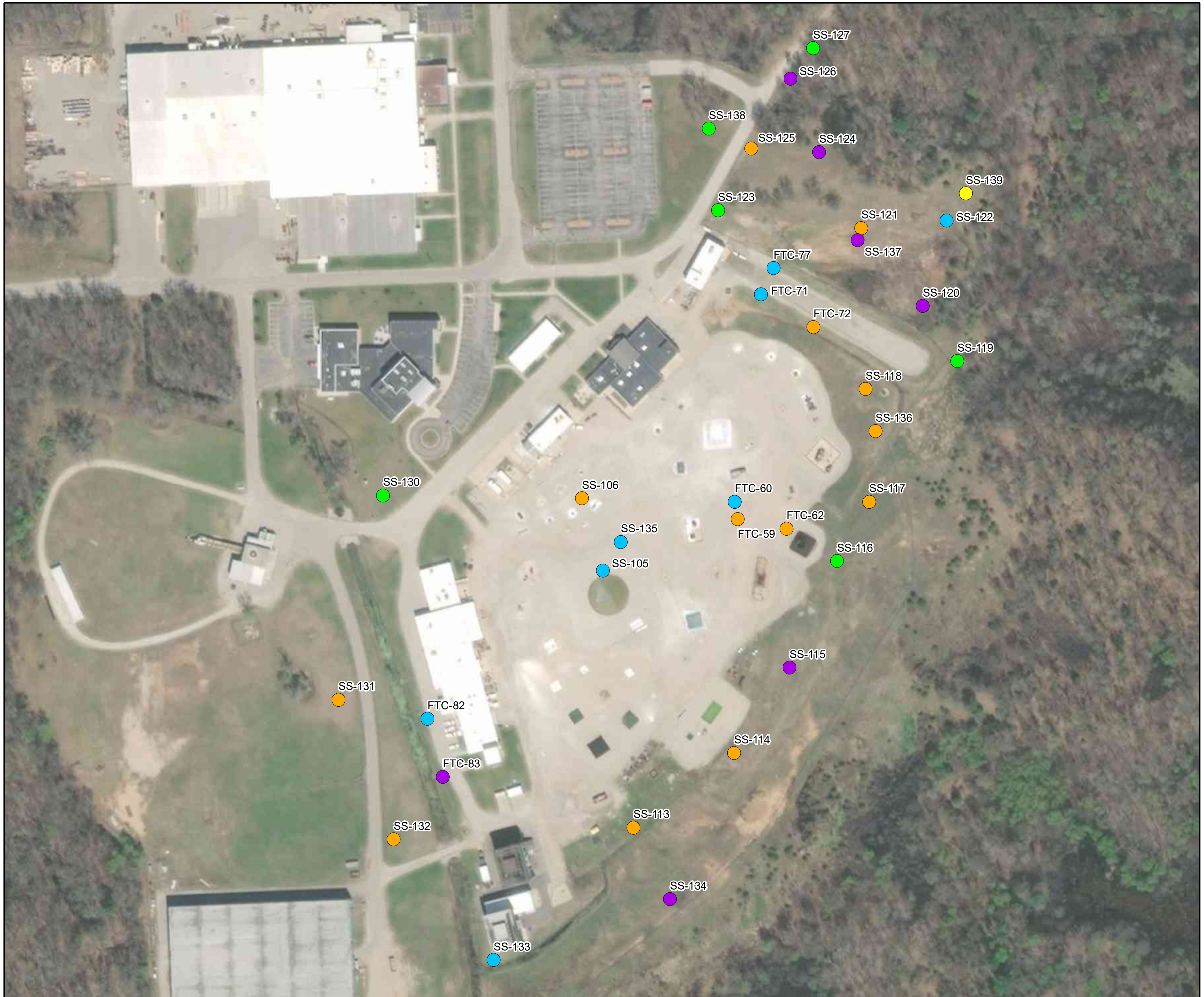
GRAPHIC SCALE

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONSEPTUAL SITE MODEL

SOIL SAMPLE LOCATIONS

ARCADIS

FIGURE
14



Legend

COMBINED PFOS AND PFOA IN SHALLOW SOIL SAMPLE LOCATIONS

- ND - 5 µg/kg
- 5 - 10 µg/kg
- 10 - 100 µg/kg
- 100 - 1,000 µg/kg
- >1,000 µg/kg

NOTES:

1. IMAGERY SOURCE: 4/27/2016, DIGITALGLOBE, VIVID - USA.
2. PFOA (PERFLUOROCTANOIC ACID) AND PFOS (PERFLUOROOCTANE SULFONIC ACID)
3. ug/kg = MICROGRAMS PER KILOGRAM
4. ND = NON-DETECT

0 150 300

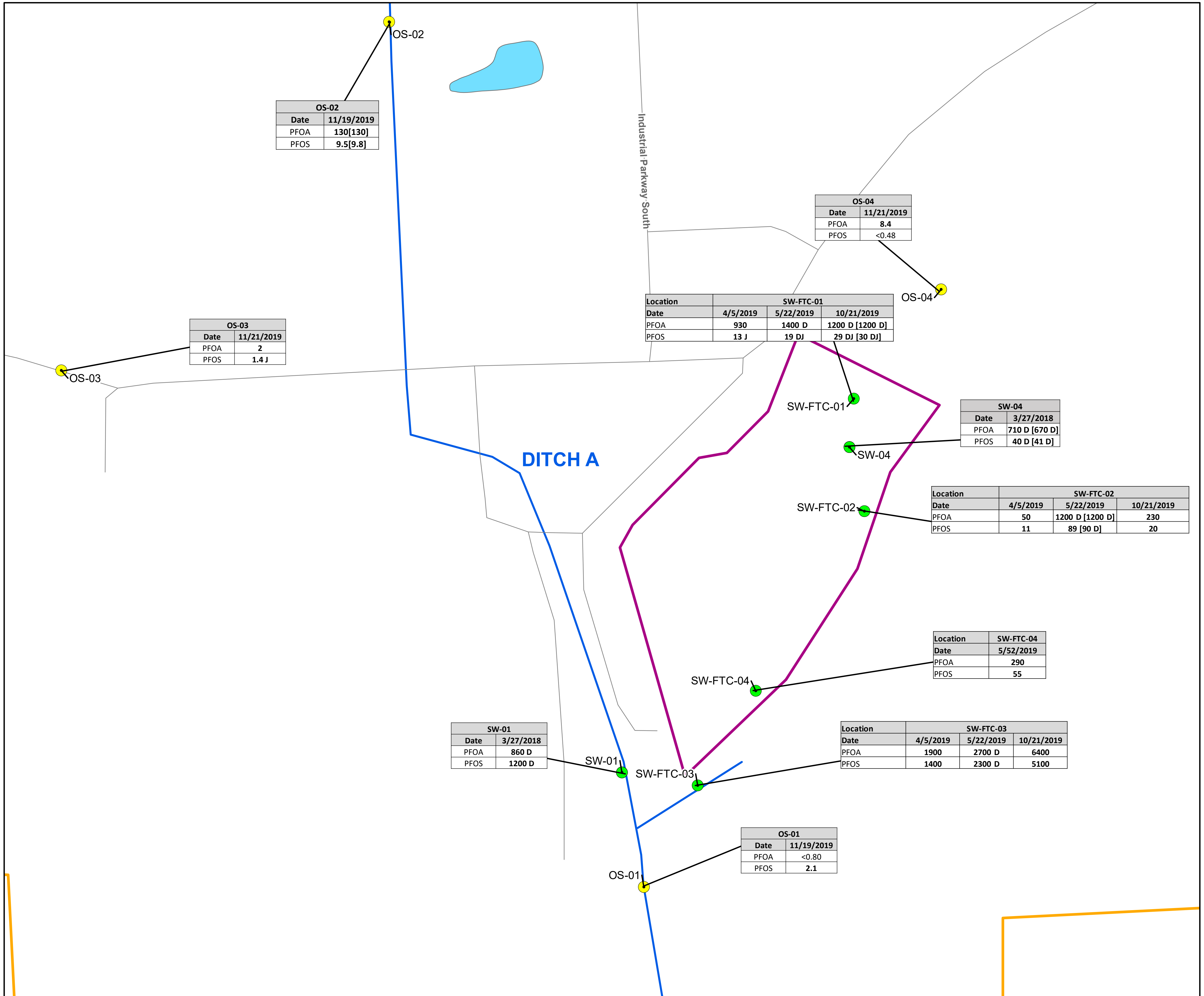
GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

SHALLOW SOIL INVESTIGATION LOCATIONS

ARCADIS

FIGURE
15



OS-02	
Date	11/19/2019
PFOA	130[130]
PFOS	9.5[9.8]

OS-03	
Date	11/21/2019
PFOA	2
PFOS	1.4 J

OS-04	
Date	11/21/2019
PFOA	8.4
PFOS	<0.48

Location	SW-FTC-01		
Date	4/5/2019	5/22/2019	10/21/2019
PFOA	930	1400 D	1200 D [1200 D]
PFOS	13 J	19 DJ	29 DJ [30 DJ]

SW-04	
Date	3/27/2018
PFOA	710 D [670 D]
PFOS	40 D [41 D]

Location	SW-FTC-02		
Date	4/5/2019	5/22/2019	10/21/2019
PFOA	50	1200 D [1200 D]	230
PFOS	11	89 [90 D]	20

Location	SW-FTC-04
Date	5/52/2019
PFOA	290
PFOS	55

SW-01	
Date	3/27/2018
PFOA	860 D
PFOS	1200 D

Location	SW-FTC-03		
Date	4/5/2019	5/22/2019	10/21/2019
PFOA	1900	2700 D	6400
PFOS	1400	2300 D	5100

OS-01	
Date	11/19/2019
PFOA	<0.80
PFOS	2.1

LEGEND:

- OUTFALL SAMPLE LOCATION
- STORMWATER RUNOFF LOCATION
- APPROXIMATE SITE PROPERTY BOUNDARY
- OUTDOOR TRAINING/TESTING AREA
- ROAD
- DITCH/STREAM
- WATERBODY

ABBREVIATIONS:

PFOA = PERFLUOROOCTANOIC ACID
PFOS = PERFLUOROOCTANESULFONIC ACID
ALL CONCENTRATIONS REPORTED IN UNITS OF NANOGRAM PER LITER (ng/L)
BOLD = DETECTIONS
D = DILUTION
J = THE ANALYTE WAS POSITIVELY IDENTIFIED; HOWEVER, THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY.
ng/L
<; = THE ANALYTE WAS NOT DETECTED ABOVE THE LIMIT OF DETECTION = NANOGRAMS PER LITER

NOTES:

1. FIELD DUPLICATE RESULTS ARE INCLUDED IN BRACKETS.
2. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
3. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
4. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
5. SW-01 AND SW-04 ARE APPROXIMATE LOCATIONS, EXACT LOCATIONS WERE NOT RECORDED DURING SAMPLE COLLECTION.

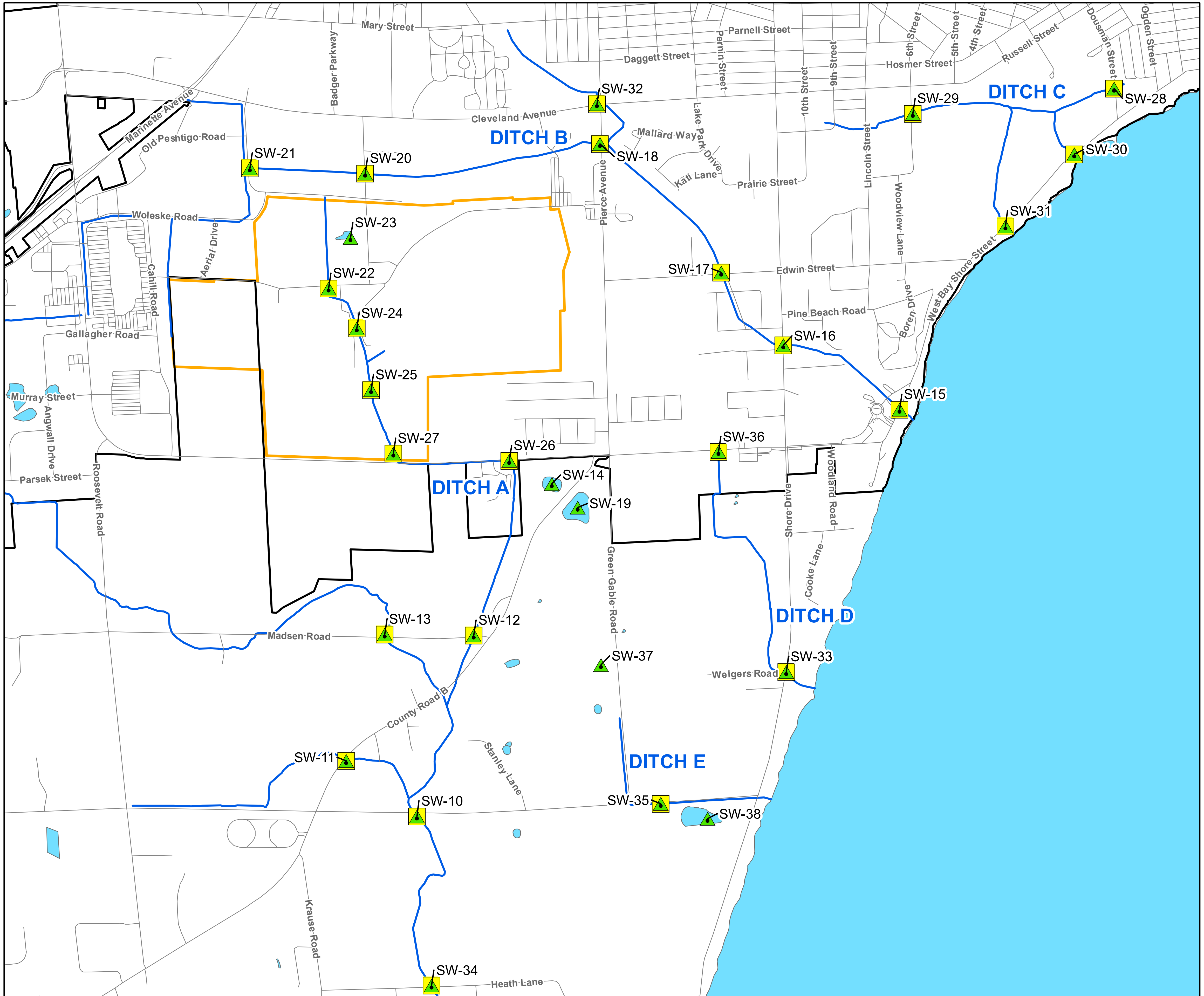
0 250 500
GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

STORMWATER RUNOFF ANALYTICAL RESULTS

ARCADIS

FIGURE **16**



LEGEND:

- SURFACE WATER SAMPLE
- VELOCITY MEARUREMENT LOCATION
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:

1. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
2. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
3. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.

0 1,500 3,000

GRAPHIC SCALE IN FEET

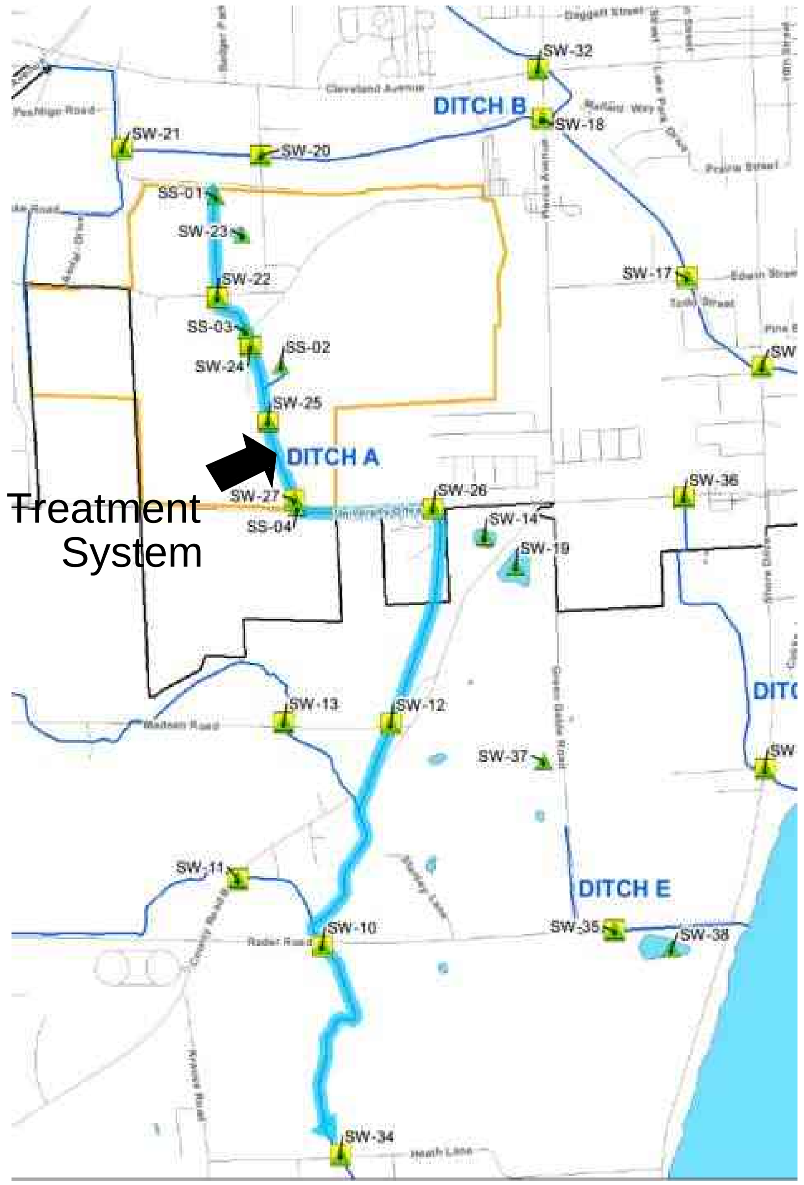
TYCO FIRE PRODUCTS, LP
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

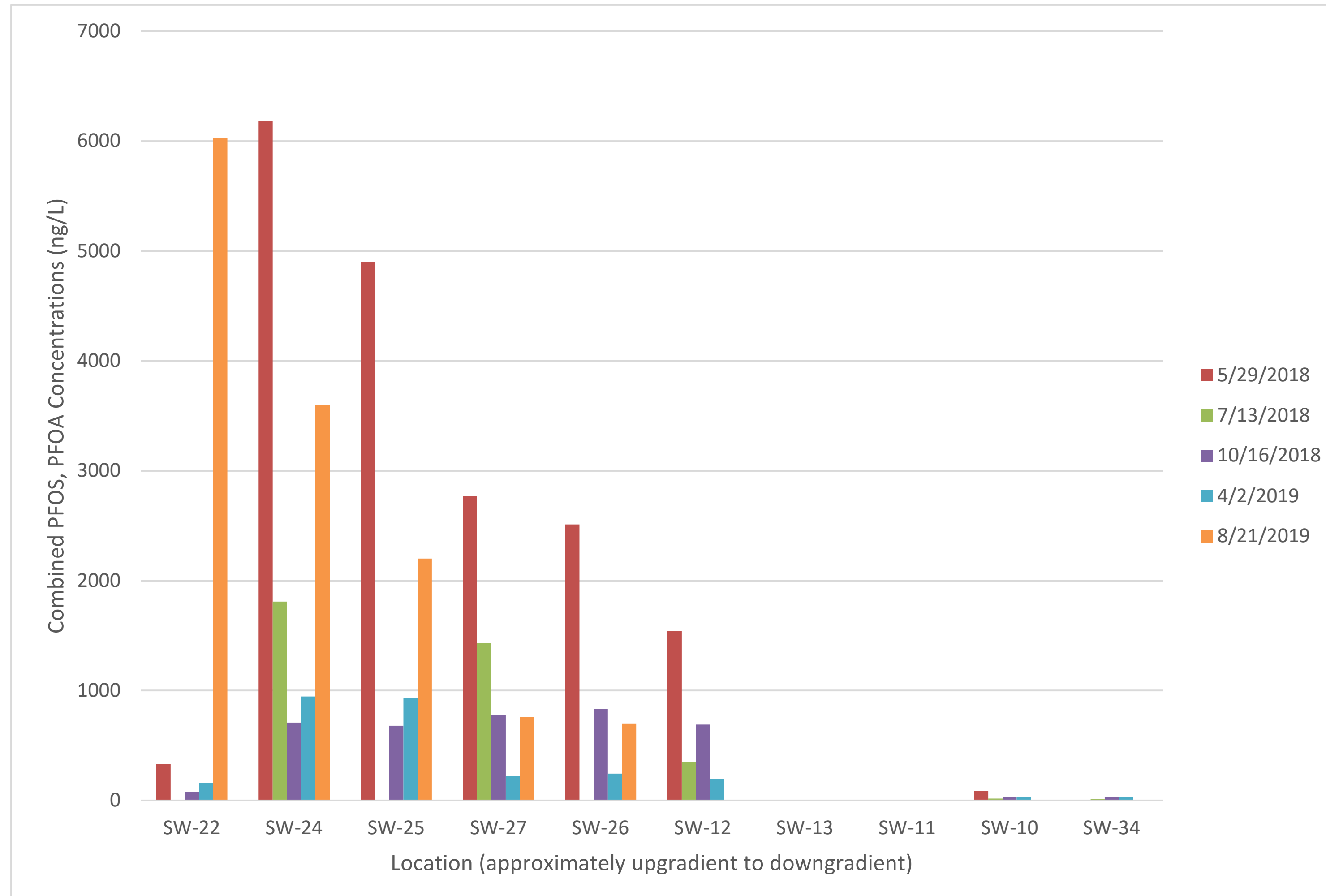
SURFACE WATER SAMPLING LOCATIONS

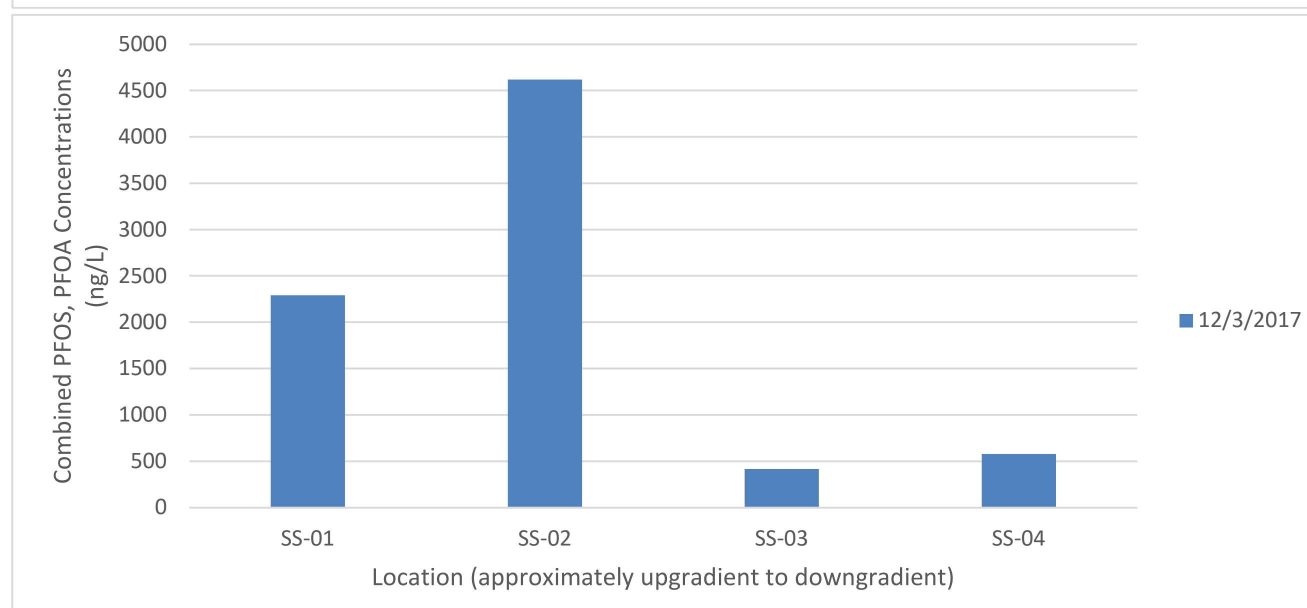
ARCADIS

FIGURE
17

PFOS + PFOA in Surface Water (2017 - 2019)







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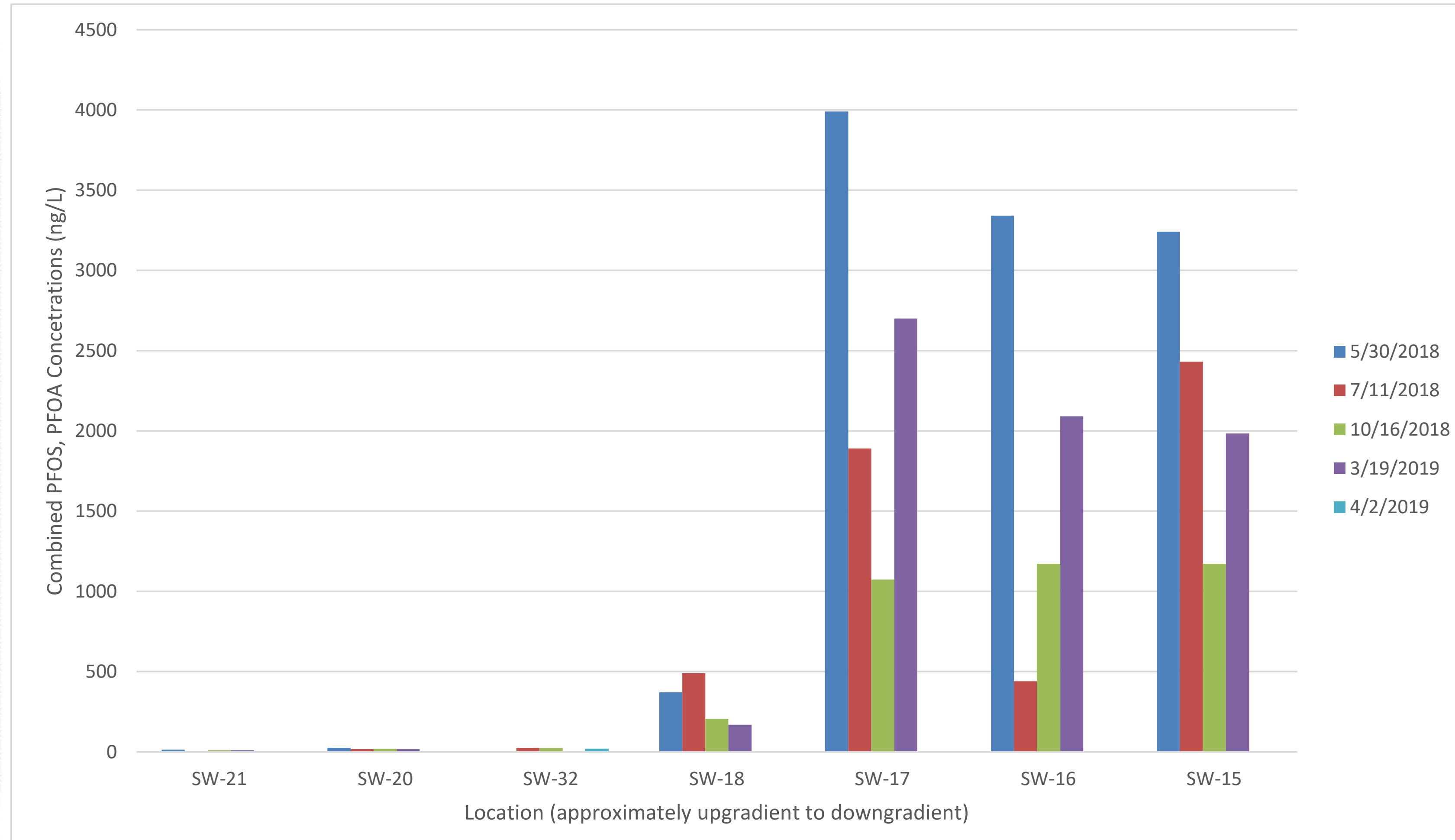
TYCO FIRE TECHOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

DITCH A
SURFACE WATER
ANALYTICAL RESULTS

FIGURE

18

PFOS + PFOA in Surface Water (2018 - 2019)



NOTE: 1. DATA PRESENTED ON THIS FIGURE WERE COLLECTED BEFORE THE DITCH B TREATMENT SYSTEM BEGAN OPERATION IN OCTOBER 2019.

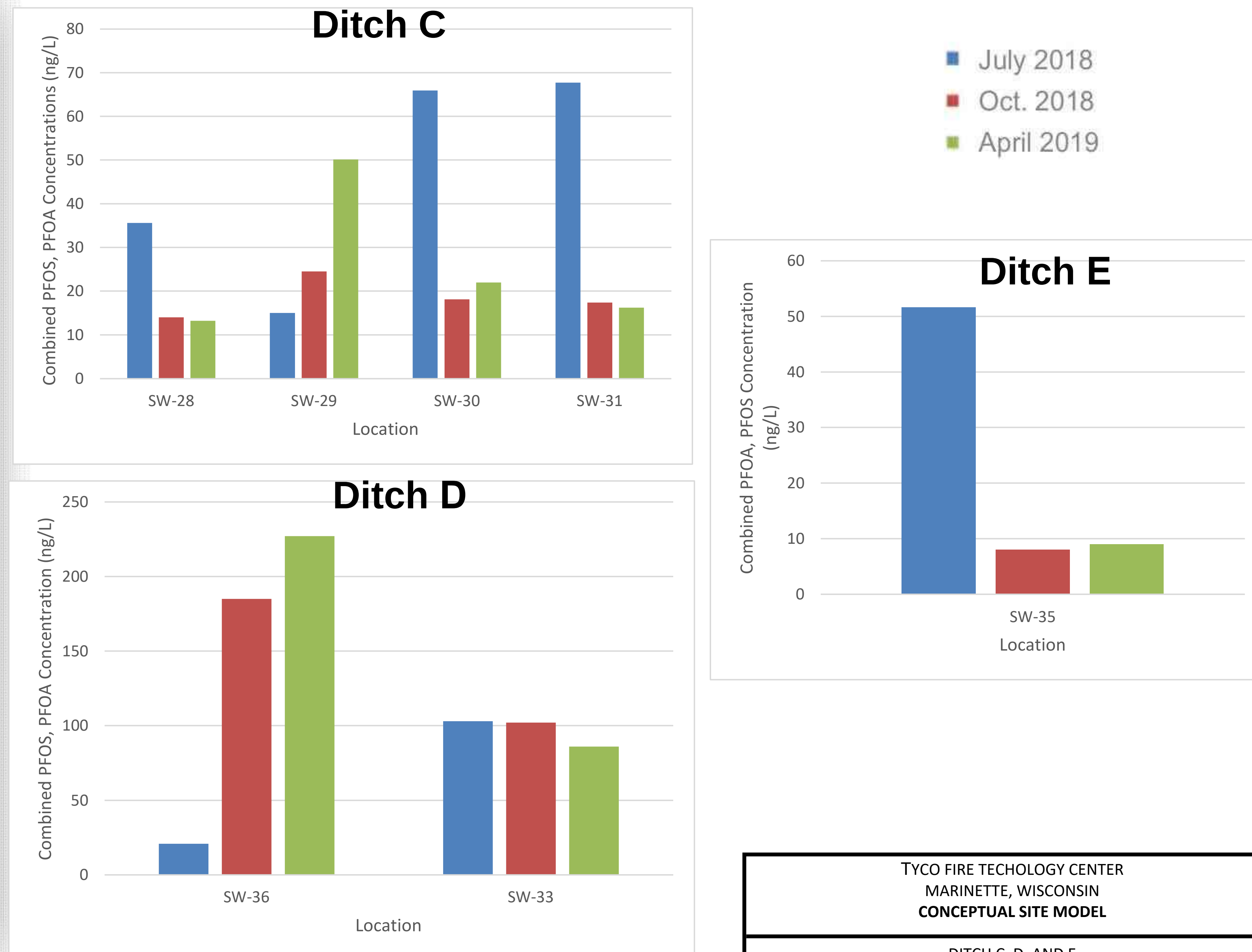
TYCO FIRE TECHOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

DITCH B
SURFACE WATER ANALYTICAL RESULTS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
19

PFOS + PFOA in Surface Water (2018 - 2019)



TYCO FIRE TECHOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

DITCH C, D, AND E
SURFACE WATER ANALYTICAL RESULTS

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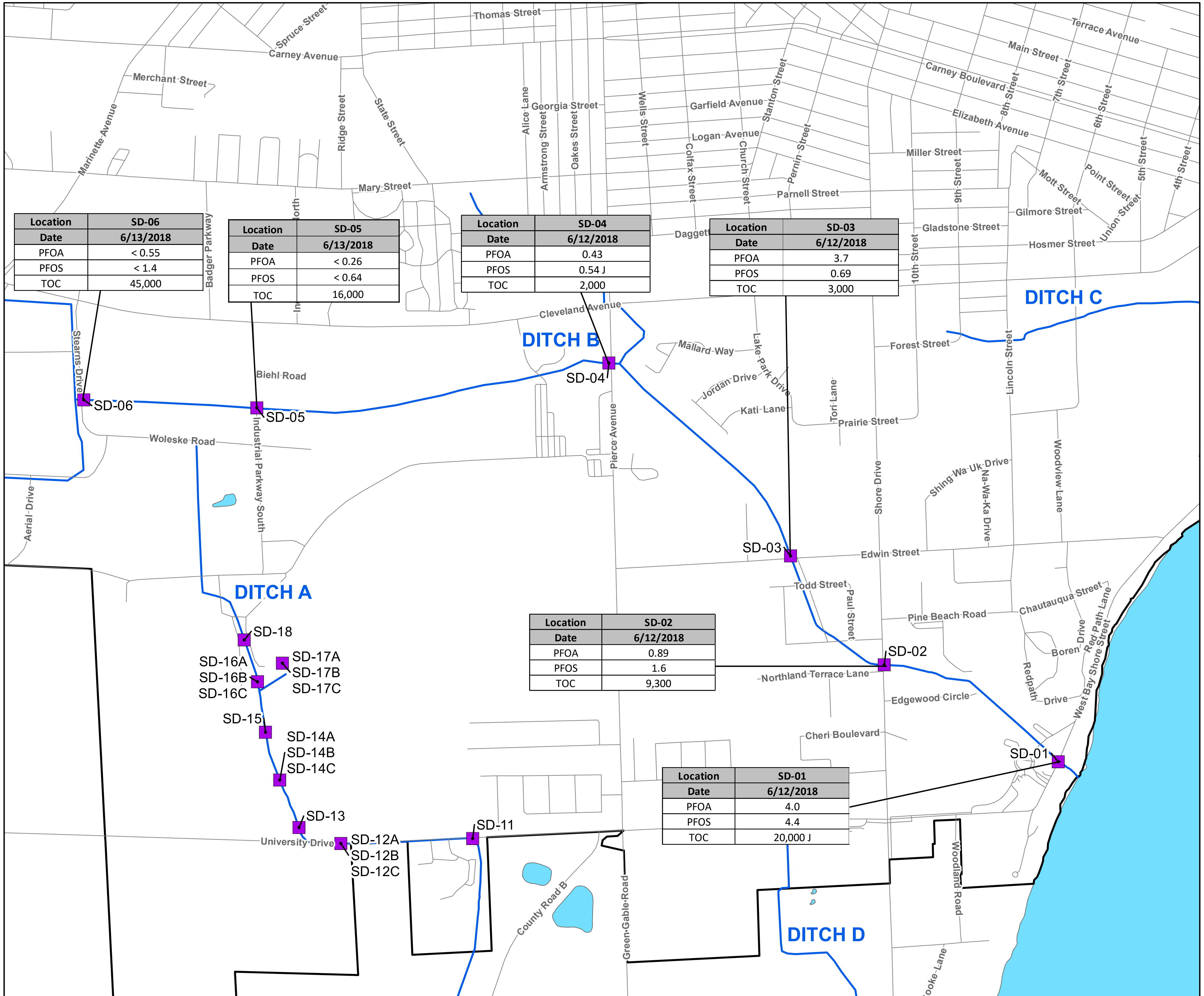
FIGURE
20



Location	SD-06
Date	6/13/2018
PFOA	< 0.55
PFOS	< 1.4
TOC	45,000

Location	SD-05
Date	6/13/2018
PFOA	< 0.26
PFOS	< 0.64
TOC	16,000

Location	SD-04
Date	6/12/2018
PFOA	0.43
PFOS	0.54 J
TOC	2,000

Location	SD-03
Date	6/12/2018
PFOA	3.7
PFOS	0.69
TOC	3,000

Location	SD-02
Date	6/12/2018
PFOA	0.89
PFOS	1.6
TOC	9,300

Location	SD-01
Date	6/12/2018
PFOA	4.0
PFOS	4.4
TOC	20,000 J

LEGEND:

- SEDIMENT SAMPLE
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:

1. PFOA = PERFLUOROOCTANOIC ACID
2. PFOS = PERFLUOROOCTANESULFONIC ACID
3. TOC = TOTAL ORGANIC CARBON
4. TOC REPORTED IN UNITS OF MILLIGRAM PER KILOGRAM (mg/kg). PFOA AND PFOS REPORTED IN UNITS OF MICROGRAM PER KILOGRAM (µg/kg).
5. QUALIFIERS ARE DEFINED AS:
< = COMPOUND NOT DETECTED AT METHOD DETECTION LIMIT.
J = THE COMPOUND WAS POSITIVELY IDENTIFIED; HOWEVER, THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY.
6. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
7. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
8. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.

0 1,000 2,000

GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN

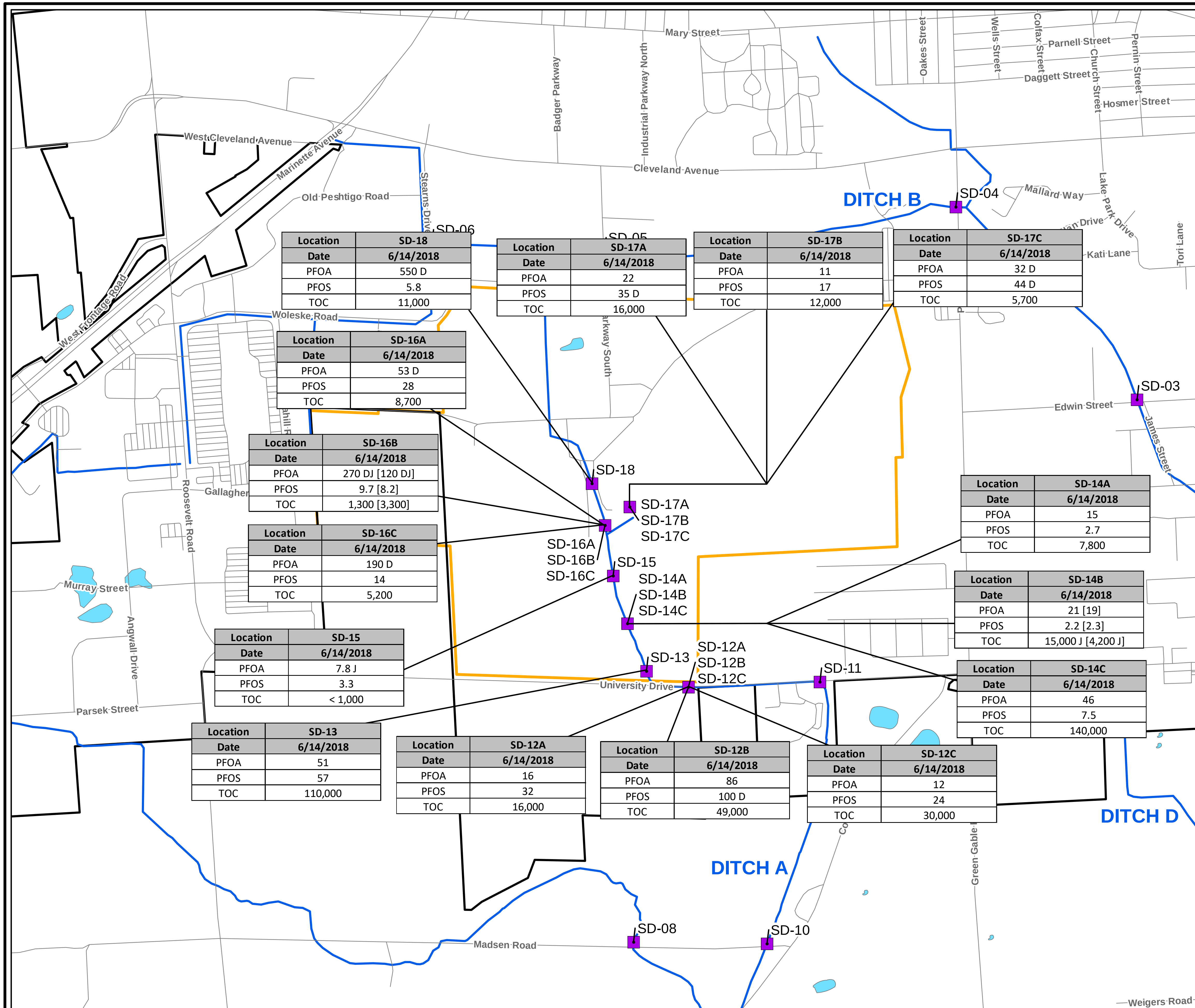
CONCEPTUAL SITE MODEL

JUNE 2018 SEDIMENTANALYTICAL RESULTS - NORTH

ARCADIS

FIGURE

21



Location	SD-18
Date	6/14/2018
PFOA	550 D
PFOS	5.8
TOC	11,000

Location	SD-17A
Date	6/14/2018
PFOA	22
PFOS	35 D
TOC	16,000

Location	SD-17B
Date	6/14/2018
PFOA	11
PFOS	17
TOC	12,000

Location	SD-17C
Date	6/14/2018
PFOA	32 D
PFOS	44 D
TOC	5,700

Location	SD-16A
Date	6/14/2018
PFOA	53 D
PFOS	28
TOC	8,700

Location	SD-16B
Date	6/14/2018
PFOA	270 DJ [120 DJ]
PFOS	9.7 [8.2]
TOC	1,300 [3,300]

Location	SD-16C
Date	6/14/2018
PFOA	190 D
PFOS	14
TOC	5,200

Location	SD-15
Date	6/14/2018
PFOA	7.8 J
PFOS	3.3
TOC	< 1,000

Location	SD-14A
Date	6/14/2018
PFOA	15
PFOS	2.7
TOC	7,800

Location	SD-14B
Date	6/14/2018
PFOA	21 [19]
PFOS	2.2 [2.3]
TOC	15,000 J [4,200 J]

Location	SD-14C
Date	6/14/2018
PFOA	46
PFOS	7.5
TOC	140,000

Location	SD-13
Date	6/14/2018
PFOA	51
PFOS	57
TOC	110,000

Location	SD-12A
Date	6/14/2018
PFOA	16
PFOS	32
TOC	16,000

Location	SD-12B
Date	6/14/2018
PFOA	86
PFOS	100 D
TOC	49,000

Location	SD-12C
Date	6/14/2018
PFOA	12
PFOS	24
TOC	30,000

LEGEND:

- SEDIMENT SAMPLE
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:

1. PFOA = PERFLUOROOCTANOIC ACID
2. PFOS = PERFLUOROOCTANESULFONIC ACID
3. TOC = TOTAL ORGANIC CARBON
4. TOC REPORTED IN UNITS OF MILLIGRAM PER KILOGRAM (mg/kg). PFOA AND PFOS REPORTED IN UNITS OF MICROGRAM PER KILOGRAM (µg/kg).
5. QUALIFIERS ARE DEFINED AS:
< = COMPOUND NOT DETECTED AT METHOD DETECTION LIMIT.
J = THE COMPOUND WAS POSITIVELY IDENTIFIED; HOWEVER, THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY.
D = DILUTION REQUIRED FOR SAMPLE ANALYSIS.
6. FIELD DUPLICATE RESULTS ARE INCLUDED IN BRACKETS.
7. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
8. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
9. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.

0 1,000 2,000

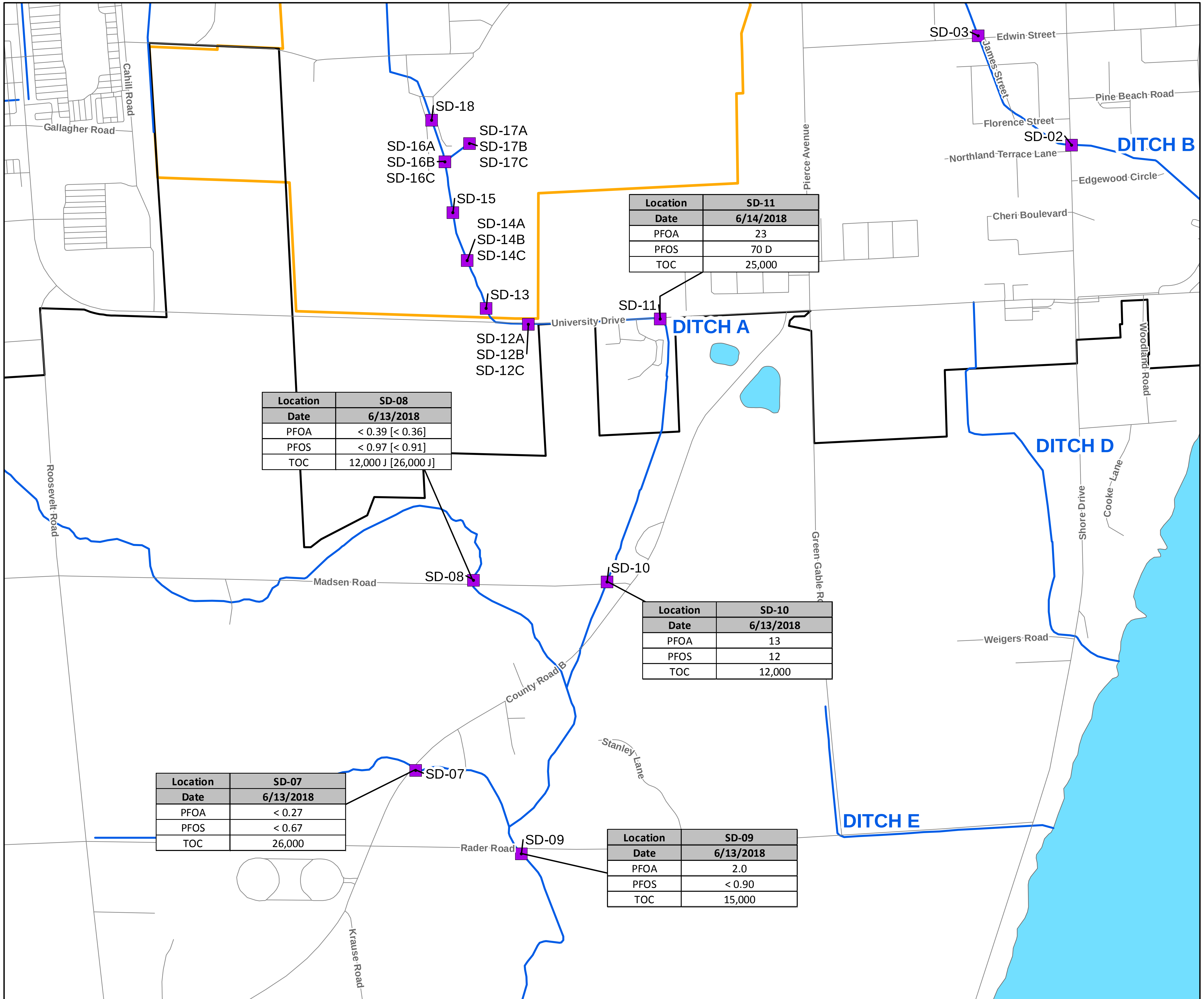
GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

JUNE 2018
SEDIMENT ANALYTICAL RESULTS - FTC

ARCADIS

FIGURE
22



Location	SD-11
Date	6/14/2018
PFOA	23
PFOS	70 D
TOC	25,000

Location	SD-08
Date	6/13/2018
PFOA	< 0.39 [< 0.36]
PFOS	< 0.97 [< 0.91]
TOC	12,000 J [26,000 J]

Location	SD-10
Date	6/13/2018
PFOA	13
PFOS	12
TOC	12,000

Location	SD-07
Date	6/13/2018
PFOA	< 0.27
PFOS	< 0.67
TOC	26,000

Location	SD-09
Date	6/13/2018
PFOA	2.0
PFOS	< 0.90
TOC	15,000

LEGEND:

- SEDIMENT SAMPLE
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:

1. PFOA = PERFLUOROOCTANOIC ACID
2. PFOS = PERFLUOROOCTANESULFONIC ACID
3. TOC = TOTAL ORGANIC CARBON
4. TOC REPORTED IN UNITS OF MILLIGRAM PER KILOGRAM (mg/kg). PFOA AND PFOS REPORTED IN UNITS OF MICROGRAM PER KILOGRAM (µg/kg).
5. QUALIFIERS ARE DEFINED AS:
< = COMPOUND NOT DETECTED AT THE REPORTING LIMIT.
D = DILUTION REQUIRED FOR SAMPLE ANALYSIS.
6. FIELD DUPLICATE RESULTS ARE INCLUDED IN BRACKETS.
7. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
8. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
9. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.

0 1,000 2,000

GRAPHIC SCALE IN FEET

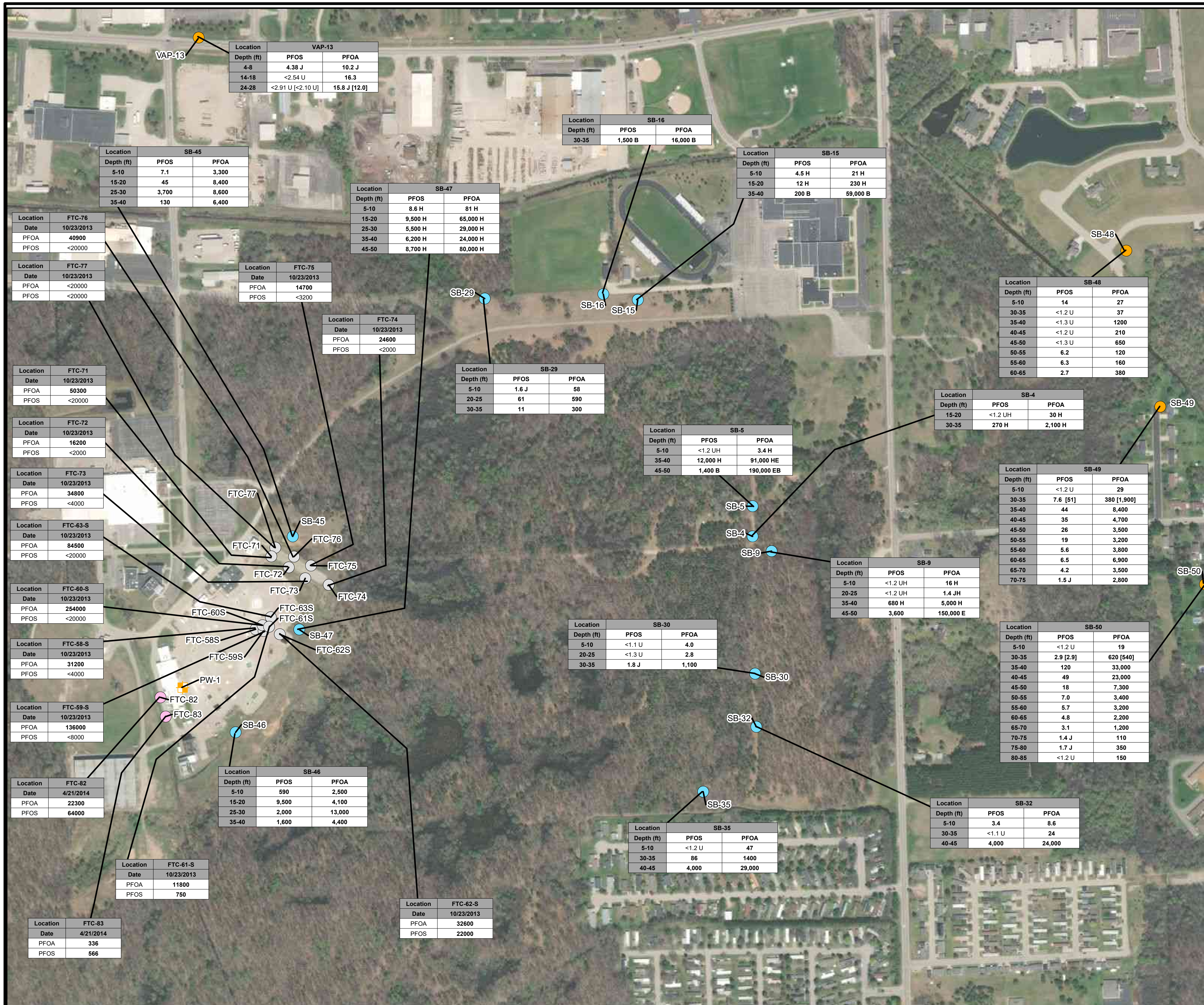
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

JUNE 2018
SEDIMENT ANALYTICAL
RESULTS - SOUTH

ARCADIS

FIGURE
23

City: Minneapolis/Citrix Div/Group: IMDVC Created By: Last Saved By: msmiller
TYCO Marinette, WI
Z:\GISProjects_ENV\TYCO_Marinette_WI\MXD\2018-09\June2018_SED_Data_South_20180906.mxd 9/28/2018 1:50:58 PM



Location	VAP-13	
Depth (ft)	PFOS	PFOA
4-8	4.38 J	10.2 J
14-18	<2.54 U	16.3
24-28	<2.91 U [<2.10 U]	15.8 J [12.0]

Location	SB-45	
Depth (ft)	PFOS	PFOA
5-10	7.1	3,300
15-20	45	8,400
25-30	3,700	8,600
35-40	130	6,400

Location	SB-16	
Depth (ft)	PFOS	PFOA
30-35	1,500 B	16,000 B

Location	SB-15	
Depth (ft)	PFOS	PFOA
5-10	4.5 H	21 H
15-20	12 H	230 H
35-40	200 B	59,000 B

Location	SB-47	
Depth (ft)	PFOS	PFOA
5-10	8.6 H	81 H
15-20	9,500 H	65,000 H
25-30	5,500 H	29,000 H
35-40	6,200 H	24,000 H
45-50	8,700 H	80,000 H

Location	FTC-76
Date	10/23/2013
PFOA	40900
PFOS	<20000

Location	FTC-77
Date	10/23/2013
PFOA	<20000
PFOS	<20000

Location	FTC-75
Date	10/23/2013
PFOA	14700
PFOS	<3200

Location	FTC-74
Date	10/23/2013
PFOA	24600
PFOS	<2000

Location	SB-48	
Depth (ft)	PFOS	PFOA
5-10	14	27
30-35	<1.2 U	37
35-40	<1.3 U	1200
40-45	<1.2 U	210
45-50	<1.3 U	650
50-55	6.2	120
55-60	6.3	160
60-65	2.7	380

Location	SB-29	
Depth (ft)	PFOS	PFOA
5-10	1.6 J	58
20-25	61	590
30-35	11	300

Location	FTC-71
Date	10/23/2013
PFOA	50300
PFOS	<20000

Location	SB-4	
Depth (ft)	PFOS	PFOA
15-20	<1.2 UH	30 H
30-35	270 H	2,100 H

Location	FTC-72
Date	10/23/2013
PFOA	16200
PFOS	<2000

Location	SB-5	
Depth (ft)	PFOS	PFOA
5-10	<1.2 UH	3.4 H
35-40	12,000 H	91,000 HE
45-50	1,400 B	190,000 EB

Location	SB-49	
Depth (ft)	PFOS	PFOA
5-10	<1.2 U	29
30-35	7.6 [51]	380 [1,900]
35-40	44	8,400
40-45	35	4,700
45-50	26	3,500
50-55	19	3,200
55-60	5.6	3,800
60-65	6.5	6,900
65-70	4.2	3,500
70-75	1.5 J	2,800

Location	FTC-73
Date	10/23/2013
PFOA	34800
PFOS	<4000

Location	FTC-63-S
Date	10/23/2013
PFOA	84500
PFOS	<20000

Location	SB-9	
Depth (ft)	PFOS	PFOA
5-10	<1.2 UH	16 H
20-25	<1.2 UH	1.4 JH
35-40	680 H	5,000 H
45-50	3,600	150,000 E

Location	FTC-60-S
Date	10/23/2013
PFOA	254000
PFOS	<20000

Location	SB-30	
Depth (ft)	PFOS	PFOA
5-10	<1.1 U	4.0
20-25	<1.3 U	2.8
30-35	1.8 J	1,100

Location	SB-50	
Depth (ft)	PFOS	PFOA
5-10	<1.2 U	19
30-35	2.9 [2.9]	620 [540]
35-40	120	33,000
40-45	49	23,000
45-50	18	7,300
50-55	7.0	3,400
55-60	5.7	3,200
60-65	4.8	2,200
65-70	3.1	1,200
70-75	1.4 J	110
75-80	1.7 J	350
80-85	<1.2 U	150

Location	FTC-58-S
Date	10/23/2013
PFOA	31200
PFOS	<4000

Location	FTC-59-S
Date	10/23/2013
PFOA	136000
PFOS	<8000

Location	SB-46	
Depth (ft)	PFOS	PFOA
5-10	590	2,500
15-20	9,500	4,100
25-30	2,000	13,000
35-40	1,600	4,400

Location	FTC-82
Date	4/21/2014
PFOA	22300
PFOS	64000

Location	SB-32	
Depth (ft)	PFOS	PFOA
5-10	3.4	8.6
30-35	<1.1 U	24
40-45	4,000	24,000

Location	SB-35	
Depth (ft)	PFOS	PFOA
5-10	<1.2 U	47
30-35	86	1400
40-45	4,000	29,000

Location	FTC-61-S
Date	10/23/2013
PFOA	11800
PFOS	750

Location	FTC-62-S
Date	10/23/2013
PFOA	32600
PFOS	22000

Location	FTC-83
Date	4/21/2014
PFOA	336
PFOS	566

LEGEND:

- 2013 VAP BORING LOCATIONS
- 2014 VAP BORING LOCATIONS
- 2016 VAP BORING LOCATIONS
- 2017 VAP BORING LOCATIONS
- PRODUCTION WELL (ABANDONED 2019)

NOTES:

1. VAP = VERTICAL AQUIFER PROFILING
2. PFOA = PERFLUOROOCTANOIC ACID
3. PFOS = PERFLUOROOCTANESULFONIC ACID
4. PFOA/PFOS REPORTED IN UNITS OF NANOGRAM PER LITER (ng/L)
5. QUALIFIERS ARE DEFINED AS:
< = COMPOUND NOT DETECTED AT METHOD DETECTION LIMIT.
B = ANALYTE DETECTED IN SAMPLE AND ASSOCIATED BLANK SAMPLE.
E = CONCENTRATION EXCEEDS CALIBRATION RANGE OF LABORATORY SAMPLE
H = EXCEEDED HOLDING TIME.
J = THE COMPOUND WAS POSITIVELY IDENTIFIED; HOWEVER, THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY
U = THE COMPOUND WAS ANALYZED FOR BUT NOT DETECTED.
6. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
7. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
8. BOLD = DETECTION
9. FIELD DUPLICATES ARE SHOWIN BRACKETS []

0 500 1,000 Feet

GRAPHIC SCALE

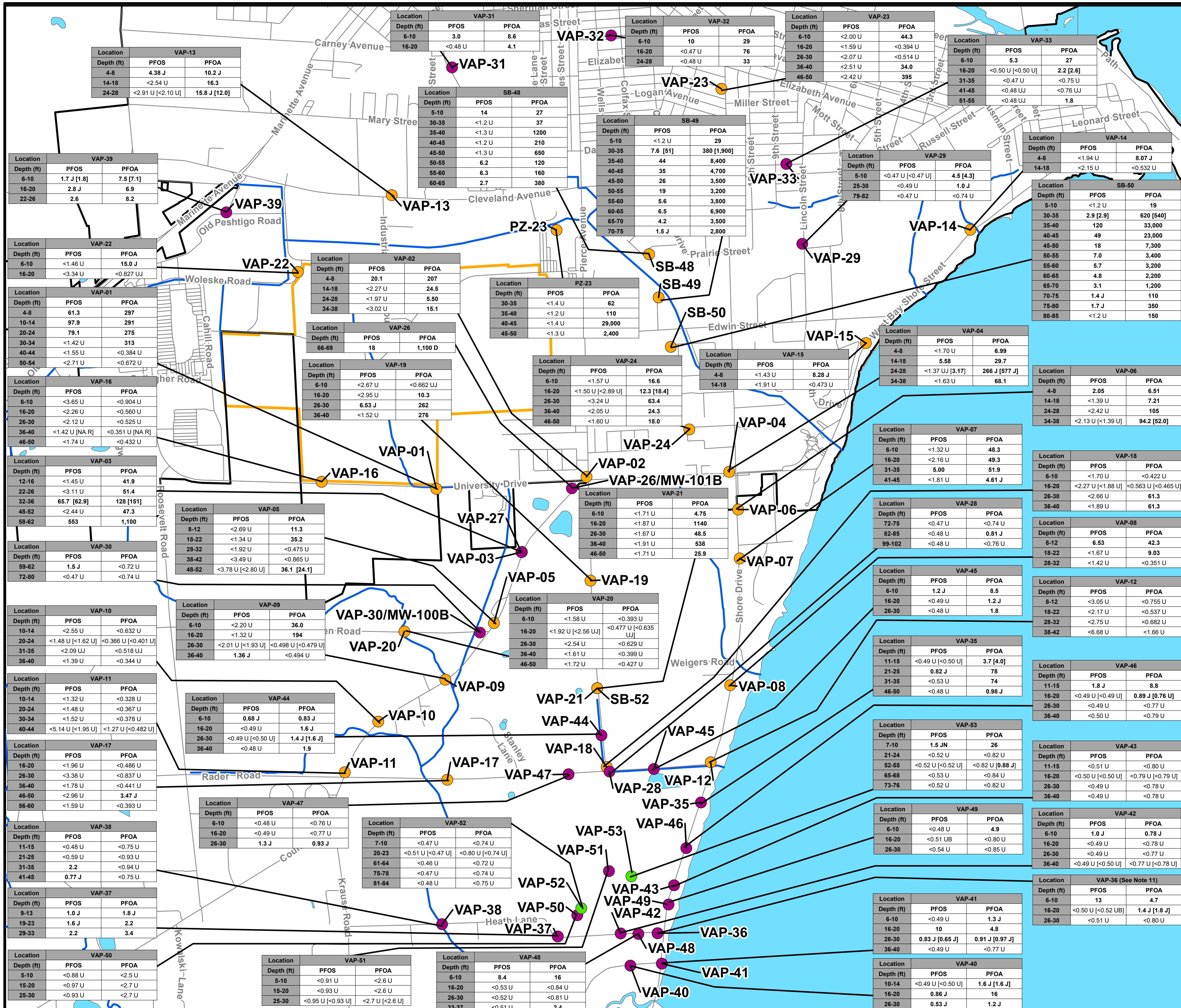
TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN

CONCEPTUAL SITE MODEL

VAP ANALYTICAL RESULTS - ON-SITE

ARCADIS

FIGURE 24



Location	VAP-13	
Depth (ft)	PFOS	PFOA
4-8	**4.38 J**	**10.2 J**
14-18	<2.54 U	**16.3**
24-28	<2.91 U [<2.10 U]	**15.8 J [12.0]**

Location	VAP-31	
Depth (ft)	PFOS	PFOA
6-10	**3.0**	**8.6**
16-20	<0.48 U	**4.1**

Location	SB-48	
Depth (ft)	PFOS	PFOA
5-10	**14**	**27**
30-35	<1.2 U	**37**
35-40	<1.3 U	**1200**
40-45	<1.2 U	**210**
45-50	<1.3 U	**650**
50-55	**6.2**	**120**
55-60	**6.3**	**160**
60-65	**2.7**	**380**

Location	VAP-32	
Depth (ft)	PFOS	PFOA
6-10	**10**	**29**
16-20	<0.47 U	**76**
24-28	<0.48 U	**33**

Location	VAP-23	
Depth (ft)	PFOS	PFOA
6-10	<2.00 U	**44.3**
16-20	<1.59 U	<0.394 U
26-30	<2.07 U	<0.514 U
36-40	<2.51 U	**34.0**
46-50	<2.42 U	**395**

Location	VAP-33	
Depth (ft)	PFOS	PFOA
6-10	**5.3**	**27**
16-20	<0.50 U [<0.50 U]	**2.2 [2.6]**
31-35	<0.47 U	<0.75 U
41-45	<0.48 UJ	<0.76 UJ
51-55	<0.48 UJ	**1.8**

Location	SB-49	
Depth (ft)	PFOS	PFOA
5-10	<1.2 U	**29**
30-35	**7.6 [51]**	**380 [1,900]**
35-40	**44**	**8,400**
40-45	**35**	**4,700**
45-50	**26**	**3,500**
50-55	**19**	**3,200**
55-60	**5.6**	**3,800**
60-65	**6.5**	**6,900**
65-70	**4.2**	**3,500**
70-75	**1.5 J**	**2,800**

Location	VAP-29	
Depth (ft)	PFOS	PFOA
5-10	<0.47 U [<0.47 U]	**4.5 [4.3]**
25-30	<0.49 U	**1.0 J**
79-82	<0.47 U	<0.74 U

Location	VAP-14	
Depth (ft)	PFOS	PFOA
4-8	<1.94 U	**8.07 J**
14-18	<2.15 U	<0.532 U

Location	SB-50	
Depth (ft)	PFOS	PFOA
5-10	<1.2 U	**19**
30-35	**2.9 [2.9]**	**620 [540]**
35-40	**120**	**33,000**
40-45	**49**	**23,000**
45-50	**18**	**7,300**
50-55	**7.0**	**3,400**
55-60	**5.7**	**3,200**
60-65	**4.8**	**2,200**
65-70	**3.1**	**1,200**
70-75	**1.4 J**	**110**
75-80	**1.7 J**	**350**
80-85	<1.2 U	**150**

Location	VAP-39	
Depth (ft)	PFOS	PFOA
6-10	**1.7 J [1.8]**	**7.5 [7.1]**
16-20	**2.8 J**	**6.9**
22-26	**2.6**	**8.2**

Location	VAP-22	
Depth (ft)	PFOS	PFOA
6-10	<1.46 U	**15.0 J**
16-20	<3.34 U	<0.827 UJ

Location	VAP-01	
Depth (ft)	PFOS	PFOA
4-8	**61.3**	**297**
10-14	**97.9**	**291**
20-24	**79.1**	**275**
30-34	<1.42 U	**313**
40-44	<1.55 U	<0.384 U
50-54	<2.71 U	<0.672 U

Location	VAP-16	
Depth (ft)	PFOS	PFOA
6-10	<3.65 U	<0.904 U
16-20	<2.26 U	<0.560 U
26-30	<2.12 U	<0.525 U
36-40	<1.42 U [NA R]	<0.351 U [NA R]
46-50	<1.74 U	<0.432 U

Location	VAP-03	
Depth (ft)	PFOS	PFOA
12-16	<1.45 U	**41.9**
22-26	<3.11 U	**51.4**
32-36	**65.7 [62.9]**	**128 [151]**
48-52	<2.44 U	**47.3**
58-62	**553**	**1,100**

Location	VAP-30	
Depth (ft)	PFOS	PFOA
59-62	**1.5 J**	<0.72 U
72-80	<0.47 U	<0.74 U

Location	VAP-02	
Depth (ft)	PFOS	PFOA
4-8	**20.1**	**207**
14-18	<2.27 U	**24.5**
24-28	<1.97 U	**5.50**
34-38	<3.02 U	**15.1**

Location	VAP-26	
Depth (ft)	PFOS	PFOA
66-69	**18**	**1,100 D**

Location	VAP-19	
Depth (ft)	PFOS	PFOA
6-10	<2.67 U	<0.662 UJ
16-20	<2.95 U	**10.3**
26-30	**6.53 J**	**262**
36-40	<1.52 U	**276**

Location	PZ-23	
Depth (ft)	PFOS	PFOA
30-35	<1.4 U	**62**
35-40	<1.2 U	**110**
40-45	<1.4 U	**29,000**
45-50	<1.3 U	**2,400**

Location	VAP-24	
Depth (ft)	PFOS	PFOA
6-10	<1.57 U	**16.6**
16-20	<1.50 U [<2.89 U]	**12.3 [18.4]**
26-30	<3.24 U	**63.4**
36-40	<2.05 U	**24.3**
46-50	<1.60 U	**18.0**

Location	VAP-15	
Depth (ft)	PFOS	PFOA
4-8	<1.43 U	**8.28 J**
14-18	<1.91 U	<0.473 U

Location	VAP-04	
Depth (ft)	PFOS	PFOA
4-8	<1.70 U	**6.99**
14-18	**5.58**	**29.7**
24-28	<1.37 UJ [3.17]	**266 J [577 J]**
34-38	<1.63 U	**68.1**

Location	VAP-06	
Depth (ft)	PFOS	PFOA
4-8	**2.05**	**6.51**
14-18	<1.39 U	**7.21**
24-28	<2.42 U	**105**
34-38	<2.13 U [<1.39 U]	**94.2 [52.0]**

Location	VAP-05	
Depth (ft)	PFOS	PFOA
8-12	<2.69 U	**11.3**
18-22	<1.34 U	**35.2**
28-32	<1.92 U	<0.475 U
38-42	<3.49 U	<0.865 U
48-52	<3.78 U [<2.80 U]	**36.1 [24.1]**

Location	VAP-21	
Depth (ft)	PFOS	PFOA
6-10	<1.71 U	**4.75**
16-20	<1.87 U	**1140**
26-30	<1.67 U	**48.5**
36-40	<1.91 U	**538**
46-50	<1.71 U	**25.9**

Location	VAP-07	
Depth (ft)	PFOS	PFOA
6-10	<1.32 U	**48.3**
16-20	<2.16 U	**49.3**
31-35	**5.00**	**51.9**
41-45	<1.81 U	**4.61 J**

Location	VAP-18	
Depth (ft)	PFOS	PFOA
6-10	<1.70 U	<0.422 U
16-20	<2.27 U [<1.88 U]	<0.563 U [<0.465 U]
26-30	<2.66 U	**61.3**
36-40	<1.89 U	**61.3**

Location	VAP-28	
Depth (ft)	PFOS	PFOA
72-75	<0.47 U	<0.74 U
82-85	<0.48 U	**0.81 J**
99-102	<0.48 U	<0.76 U

Location	VAP-08	
Depth (ft)	PFOS	PFOA
8-12	**6.53**	**42.3**
18-22	<1.67 U	**9.03**
28-32	<1.42 U	<0.351 U

Location	VAP-45	
Depth (ft)	PFOS	PFOA
6-10	**1.2 J**	**8.5**
16-20	<0.49 U	**1.2 J**
26-30	<0.48 U	**1.8**

Location	VAP-12	
Depth (ft)	PFOS	PFOA
8-12	<3.05 U	<0.755 U
18-22	<2.17 U	<0.537 U
28-32	<2.75 U	<0.682 U
38-42	<6.68 U	<1.66 U

Location	VAP-35	
Depth (ft)	PFOS	PFOA
11-15	<0.49 U [<0.50 U]	**3.7 [4.0]**
21-25	**0.82 J**	**78**
31-35	<0.53 U	**74**
46-50	<0.48 U	**0.98 J**

Location	VAP-46	
Depth (ft)	PFOS	PFOA
11-15	**1.8 J**	**8.8**
16-20	<0.49 U [<0.49 U]	**0.89 J [0.76 U]**
26-30	<0.49 U	<0.77 U
36-40	<0.50 U	<0.79 U

Location	VAP-53	
Depth (ft)	PFOS	PFOA
7-10	**1.5 JN**	**26**
21-24	<0.52 U	<0.82 U
52-55	<0.52 U [<0.52 U]	<0.82 U [**0.88 J**]
65-68	<0.53 U	<0.84 U
73-76	<0.52 U	<0.82 U

Location	VAP-43	
Depth (ft)	PFOS	PFOA
11-15	<0.51 U	<0.80 U
16-20	<0.50 U [<0.50 U]	<0.79 U [<0.79 U]
26-30	<0.49 U	<0.78 U
36-40	<0.49 U	<0.78 U

Location	VAP-49	
Depth (ft)	PFOS	PFOA
6-10	<0.48 U	**4.9**
16-20	<0.51 UB	<0.80 U
26-30	<0.54 U	<0.85 U

Location	VAP-42	
Depth (ft)	PFOS	PFOA
6-10	**1.0 J**	**0.78 J**
16-20	<0.49 U	<0.78 U
26-30	<0.49 U	<0.77 U
36-40	<0.49 U [<0.50 U]	<0.77 U [<0.78 U]

Location	VAP-36 (See Note 11)	
Depth (ft)	PFOS	PFOA
6-10	**13**	**4.7**
16-20	<0.50 U [<0.52 UB]	**1.4 J [1.8 J]**
26-30	<0.51 U	<0.80 U

Location	VAP-41	
Depth (ft)	PFOS	PFOA
6-10	<0.49 U	**1.3 J**
16-20	**10**	**4.8**
26-30	**0.83 J [0.65 J]**	**0.91 J [0.97 J]**
36-40	<0.49 U	<0.77 U

Location	VAP-40	
Depth (ft)	PFOS	PFOA
10-14	<0.49 U [<0.50 U]	**1.6 J [1.6 J]**
16-20	**0.86 J**	**16**
26-30	**0.53 J**	**1.2 J**

Location	VAP-10	
Depth (ft)	PFOS	PFOA
10-14	<2.55 U	<0.632 U
20-24	<1.48 U [<1.62 U]	<0.366 U [<0.401 U]
31-35	<2.09 UJ	<0.518 UJ
36-40	<1.39 U	<0.344 U

Location	VAP-09	
Depth (ft)	PFOS	PFOA
6-10	<2.20 U	**36.0**
16-20	<1.32 U	**194**
26-30	<2.01 U [<1.93 U]	<0.498 U [<0.479 U]
36-40	**1.36 J**	<0.494 U

Location	VAP-20	
Depth (ft)	PFOS	PFOA
6-10	<1.58 U	<0.393 U
16-20	<1.92 U [<2.56 UJ]	<0.477 U [<0.635 UJ]
26-30	<2.54 U	<0.629 U
36-40	<1.61 U	<0.399 U
46-50	<1.72 U	<0.427 U

Location	VAP-11	
Depth (ft)	PFOS	PFOA
10-14	<1.32 U	<0.328 U
20-24	<1.48 U	<0.367 U
30-34	<1.52 U	<0.378 U
40-44	<5.14 U [<1.95 U]	<1.27 U [<0.482 U]

Location	VAP-44	
Depth (ft)	PFOS	PFOA
6-10	**0.68 J**	**0.83 J**
16-20	<0.49 U	**1.6 J**
26-30	<0.49 U [<0.50 U]	**1.4 J [1.6 J]**
36-40	<0.48 U	**1.9**

Location	VAP-17	
Depth (ft)	PFOS	PFOA
16-20	<1.96 U	<0.486 U
26-30	<3.38 U	<0.837 U
36-40	<1.78 U	<0.441 U
46-50	<2.96 U	**3.47 J**
56-60	<1.59 U	<0.393 U

Location	VAP-47	
Depth (ft)	PFOS	PFOA
6-10	<0.48 U	<0.76 U
16-20	<0.49 U	<0.77 U
26-30	**1.3 J**	**0.93 J**

Location	VAP-52	
Depth (ft)	PFOS	PFOA
7-10	<0.47 U	<0.74 U
20-23	<0.51 U [<0.47 U]	<0.80 U [<0.74 U]
61-64	<0.46 U	<0.72 U
75-78	<0.47 U	<0.74 U
81-84	<0.48 U	<0.75 U

Location	VAP-38	
Depth (ft)	PFOS	PFOA
11-15	<0.48 U	<0.75 U
21-25	<0.59 U	<0.93 U
31-35	**2.2**	<0.94 U
41-45	**0.77 J**	<0.75 U

Location	VAP-37	
Depth (ft)	PFOS	PFOA
9-13	**1.0 J**	**1.8 J**
19-23	**1.6 J**	**2.2**
29-33	**2.2**	**3.4**

Location	VAP-50	
Depth (ft)	PFOS	PFOA
5-10	<0.88 U	<2.5 U
15-20	<0.97 U	<2.7 U
25-30	<0.93 U	<2.7 U

Location	VAP-51	
Depth (ft)	PFOS	PFOA
5-10	<0.91 U	<2.6 U
15-20	<0.93 U	<2.6 U
25-30	<0.95 U [<0.93 U]	<2.7 U [<2.6 U]

Location	VAP-48	
Depth (ft)	PFOS	PFOA
6-10	**8.4**	**16**
16-20	<0.53 U	<0.84 U
26-30	<0.52 U	<0.81 U
33-37	<0.51 U	**2.4**

LEGEND:

- 2017 VAP BORING LOCATION
- 2018 VAP BORING LOCATION
- 2019 VAP BORING LOCATION
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:

1. VAP = VERTICAL AQUIFER PROFILING
2. PFOA = PERFLUOROOCTANOIC ACID
3. PFOS = PERFLUOROOCTANESULFONIC ACID
4. PFOA/PFOS REPORTED IN UNITS OF NANOGRAM PER LITER (ng/L).
6. QUALIFIERS ARE DEFINED AS:
< = COMPOUND NOT DETECTED AT METHOD DETECTION LIMIT.
B = ANALYTE DETECTED IN SAMPLE AND ASSOCIATED BLANK SAMPLE.
H = EXCEEDED HOLDING TIME.
J = THE COMPOUND WAS POSITIVELY IDENTIFIED; HOWEVER, THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY
NA = NOT ANALYZED
R = REJECTED ANALYTE
U = THE COMPOUND WAS ANALYZED FOR BUT NOT DETECTED.
6. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
7. DITCH/STREAM AND WATERBODY DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
8. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
9. BOLD = DETECTION.
10. FIELD DUPLICATES ARE SHOWN IN BRACKETS [].
11. VAP-36 WAS SAMPLED 6/26/2018 AND THEN RESAMPLED 10/26/2018 AT ADJACENT LOCATION VAP-36(2) TO EVALUATE SUSPECTED ERRONEOUS RESULTS. RESULTS OF RESAMPLING ARE SHOWN.

0 1,800 3,600
GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

VAP ANALYTICAL RESULTS - OFF-SITE

ARCADIS

FIGURE
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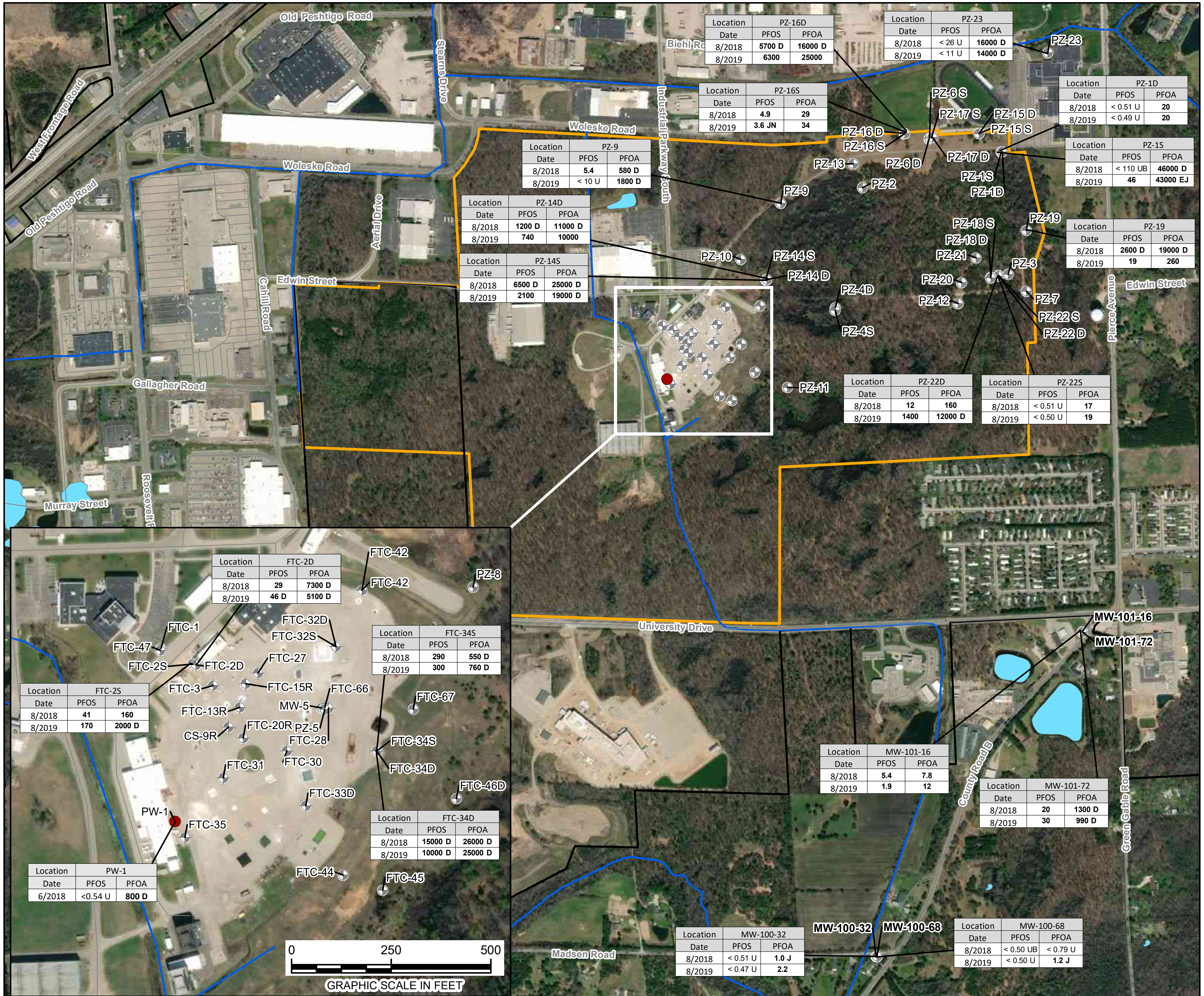


Location	PZ-16D	
Date	PFOS	PFOA
8/2018	**5700 D**	**16000 D**
8/2019	**6300**	**25000**

Location	PZ-23	
Date	PFOS	PFOA
8/2018	< 26 U	**16000 D**
8/2019	< 11 U	**14000 D**

Location	PZ-16S	
Date	PFOS	PFOA
8/2018	**4.9**	**29**
8/2019	**3.6 JN**	**34**

Location	PZ-1D	
Date	PFOS	PFOA
8/2018	< 0.51 U	**20**
8/2019	< 0.49 U	**20**

Location	PZ-9	
Date	PFOS	PFOA
8/2018	**5.4**	**580 D**
8/2019	< 10 U	**1800 D**

Location	PZ-1S	
Date	PFOS	PFOA
8/2018	< 110 UB	**46000 D**
8/2019	**46**	**43000 EJ**

Location	PZ-14D	
Date	PFOS	PFOA
8/2018	**1200 D**	**11000 D**
8/2019	**740**	**10000**

Location	PZ-19	
Date	PFOS	PFOA
8/2018	**2600 D**	**19000 D**
8/2019	**19**	**260**

Location	PZ-14S	
Date	PFOS	PFOA
8/2018	**6500 D**	**25000 D**
8/2019	**2100**	**19000 D**

Location	PZ-22D	
Date	PFOS	PFOA
8/2018	**12**	**160**
8/2019	**1400**	**12000 D**

Location	PZ-22S	
Date	PFOS	PFOA
8/2018	< 0.51 U	**17**
8/2019	< 0.50 U	**19**

Location	FTC-2D	
Date	PFOS	PFOA
8/2018	**29**	**7300 D**
8/2019	**46 D**	**5100 D**

Location	FTC-34S	
Date	PFOS	PFOA
8/2018	**290**	**550 D**
8/2019	**300**	**760 D**

Location	FTC-2S	
Date	PFOS	PFOA
8/2018	**41**	**160**
8/2019	**170**	**2000 D**

Location	FTC-34D	
Date	PFOS	PFOA
8/2018	**15000 D**	**26000 D**
8/2019	**10000 D**	**25000 D**

Location	PW-1	
Date	PFOS	PFOA
6/2018	<0.54 U	**800 D**

Location	MW-101-16	
Date	PFOS	PFOA
8/2018	**5.4**	**7.8**
8/2019	**1.9**	**12**

Location	MW-101-72	
Date	PFOS	PFOA
8/2018	**20**	**1300 D**
8/2019	**30**	**990 D**

Location	MW-100-32	
Date	PFOS	PFOA
8/2018	< 0.51 U	**1.0 J**
8/2019	< 0.47 U	**2.2**

Location	MW-100-68	
Date	PFOS	PFOA
8/2018	< 0.50 UB	< 0.79 U
8/2019	< 0.50 U	**1.2 J**

LEGEND:

- MONITORING WELLS
- SITE PRODUCTION WELL
- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- ROAD
- DITCH/STREAM
- WATERBODY

NOTES:

1. CITY BOUNDARY DATA SOURCE: WISCONSIN LEGISLATIVE TECHNOLOGY SERVICES BUREAU, WISCONSIN COUNTY CLERKS AND LAND INFORMATION OFFICES, ACCESSED FALL 2017.
2. DITCH/STREAM DATA SOURCE: U.S. GEOLOGICAL SURVEY NATIONAL HYDROGRAPHY DATASET, ACCESSED FALL 2017.
3. ROAD DATA SOURCE: OPEN STREET MAP, ACCESSED FALL 2017.
4. AERIAL IMAGERY: 4/27/2016 DIGITALGLOBE, VIVID-USA.
5. PFOS = PERFLUOROOCTANE SULFONIC ACID.
6. PFOA = PERFLUOROOCTANOIC ACID.
7. D = DILUTION REQUIRED FOR SAMPLE ANALYSIS.
8. U = INDICATES THE ANALYTE WAS ANALYZED FOR BUT NOT DETECTED.
9. J = THE RESULT IS AN ESTIMATED QUANTITY. THE ASSOCIATED NUMERICAL VALUE IS THE APPROXIMATE CONCENTRATION OF THE ANALYTE IN THE SAMPLE.
10. B = THE COMPOUND HAS BEEN FOUND IN THE SAMPLE AS WELL AS ITS ASSOCIATED BLANK, ITS PRESENCE IN THE SAMPLE MAY BE SUSPECT.
11. E = CONCENTRATION EXCEEDS CALIBRATION RANGE OF LABORATORY INSTRUMENT.
12. N = NORMAL SAMPLE TYPE.
13. UNIT OF MEASUREMENT USED IS NANOGRAMS PER LITER (NG/L).
14. DETECTIONS ARE IN BOLD.
15. FIELD DUPLICATE VALUES HAVE NOT BEEN REPORTED, THE HIGHER VALUE HAS BEEN REPORTED

0 800 1,600

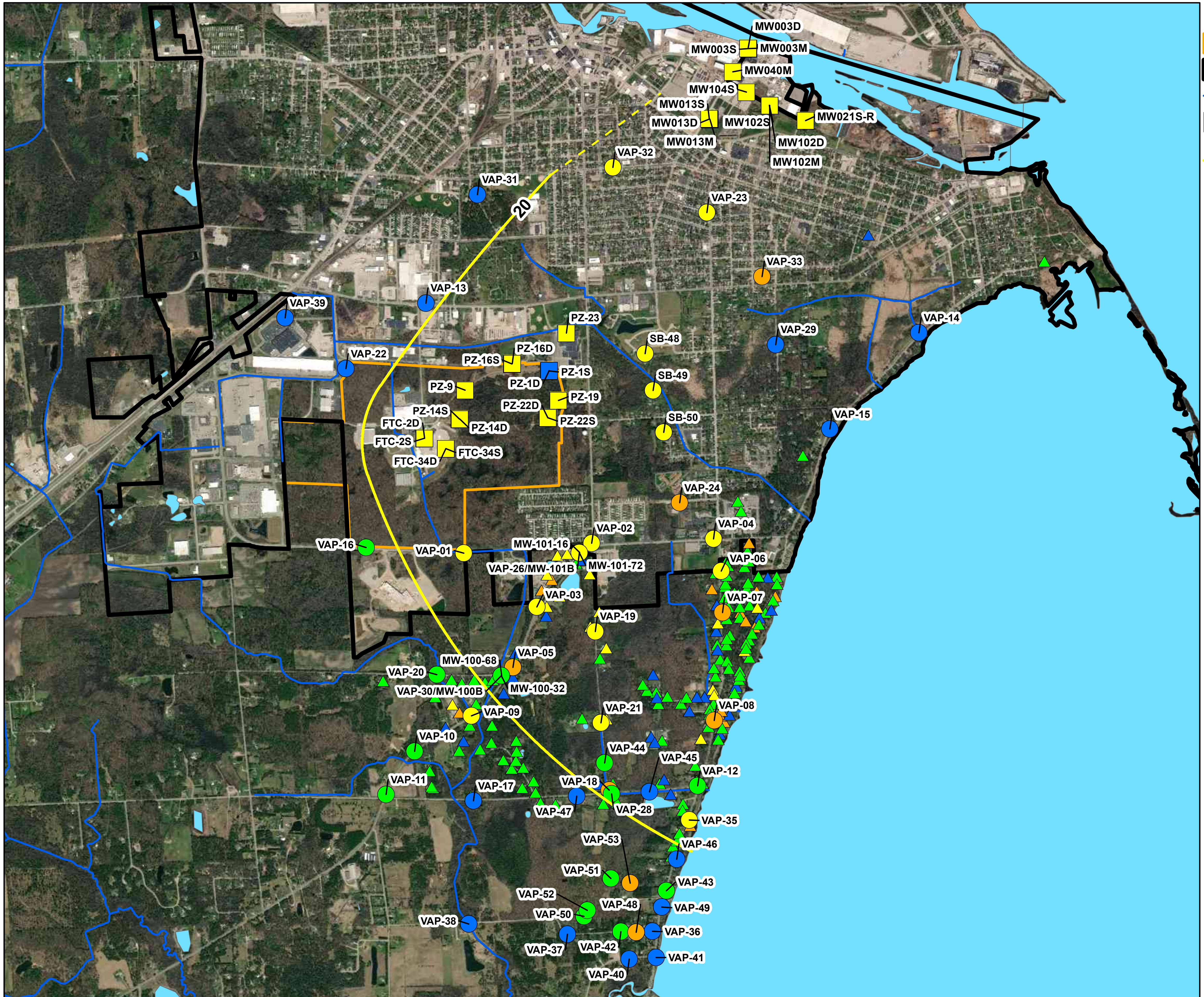
GRAPHIC SCALE IN FEET

TYCO TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

ANALYTICAL MONITORING WELL DATA

ARCADIS

FIGURE
26



LEGEND:

- APPROXIMATE SITE PROPERTY BOUNDARY
- APPROXIMATE MARINETTE CITY BOUNDARY
- DITCH/STREAM
- WATERBODY
- APPROXIMATE WESTERN EXTENT OF GROUNDWATER WHERE COMBINED PFOS AND PFOA DETECTED ABOVE 20 ppt AND POTENTIALLY ASSOCIATED WITH THE FTC OR STANTON STREET SITES (DASHED WHERE INFERRED)

TOTAL PFOS AND PFOA IN GROUNDWATER

VAP BORING (MAX RESULT AT ANY SAMPLE DEPTH)

- ND - 2 ppt
- 2 - 20 ppt
- 20 - 70 ppt
- >70 ppt

MONITORING WELL SAMPLE RESULT (AUGUST 2019)

- ND - 2 ppt
- 2 - 20 ppt
- 20 - 70 ppt
- >70 ppt

RESIDENTIAL WELL SAMPLING RESULT (SPRING 2019)

- ND - 2 ppt
- 2 - 20 ppt
- 20 - 70 ppt
- >70 ppt

NOTES:

1. FIGURE PROVIDES REPRESENTATIVE ONSITE DATA AND DOES NOT REFLECT A COMPREHENSIVE DATASET FOR THE FTC SITE
2. RESIDENTIAL WELL LOCATIONS ARE APPROXIMATE
3. ppt = PARTS PER TRILLION
   PFOA = PERFLUOROOCTANOIC ACID
   PFOS = PERFLUOROOCTANESULFONIC ACID
   VAP = VERTICAL AQUIFER PROFILE
   FTC = FIRE TRAINING CENTER
4. SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

0 1,200 2,400

GRAPHIC SCALE IN FEET

TYCO FIRE TECHNOLOGY CENTER
MARINETTE, WISCONSIN
CONCEPTUAL SITE MODEL

DETECTIONS OF PFOA AND PFOS IN GROUNDWATER

ARCADIS

FIGURE
27

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