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23 April 2019

Mr. Josh Cook, P.E.
Environmental Engineer 2
New York State Department of Environmental Conservation
Region 7 - Division of Environmental Remediation
615 Erie Blvd West
Syracuse, New York 13204-2400

RE: Former TRW Union Springs Facility
Site ID No. C706019
Village of Union Springs, Town of Springport, Cayuga Co.
Phytoremediation Pilot Test Work Plan

Dear Mr. Cook:

TRW Automotive U.S. LLC (TRW) received correspondence from the New York State Department of Environmental Conservation (NYSDEC) dated 12 April 2019, approving the Phytoremediation Pilot Study Work Plan (work plan) for the Former TRW Union Springs Facility, pending responses to the comments. On behalf of the TRW, ERM Consulting & Engineering, Inc. (ERM) prepared the following responses to the NYSDEC's comments.

For clarity of review, NYSDEC's comments are repeated below in *italic font* followed by ERM's response in plain font.

1. *Section 2.1 – Additional objectives of the pilot study are to determine the extent to which the contaminants are transferred to and/or concentrated in the trees and to determine the extent to which the contaminants are emitted to the air by the trees in order to support an updated exposure assessment for phytoremediation that would be included in the evaluation of remedial alternatives.*

   The Interstate Technology & Regulatory Council (ITRC) Phytotechnology Technical and Regulatory Guidance and Decision Trees (Phyto 3) indicate there is little or no accumulation of volatile contaminants in plant roots, wood, stems, leaves, or fruit. Volatile organic compounds (VOCs) taken up by a plant are often metabolized through phytodegradation mechanisms, phytophotolysis, and/or phytovolatilized. Sampling has shown

that VOC mass in the transpiration stream exiting the plant through leaf surfaces is minimal (ITRC 2009).

ERM will assess sampling methods to evaluate VOCs transfer to the trees or ambient air to evaluate the potential for exposure. The proposed sampling will be outlined in the monitoring plan requested in comment 8.

2. *Section 3.4.6 – All imported fill will be sampled prior to import, and must not contain contaminants exceeding the lower of the soil cleanup objectives (SCOs) for the protection of groundwater and the SCOs for the protection of public health for the proposed use (commercial use). Fill will be sampled for target compound list (TCL) volatile organic compounds (VOCs) via EPA Method 8260; TCL semivolatile organic compounds via EPA Method 8270; pesticides via EPA Method 8081; polychlorinated biphenyls via EPA Method 8082; target analyte list metals via EPA Methods 6010 and 7471; total cyanide via EPA Method 901x; 1,4-dioxane via EPA Method 8260, 8270or 8270 SIM; and per- and polyfluoroalkyl substances via EPA Method Modified 537. Gravel, rock or stone, consisting of virgin material from a permitted mine or quarry may be imported without testing if it contains less than 10 percent by weight material which would pass through a size 80 sieve.*

   All imported soil will be sampled and analyzed as outlined above. Imported stone will be crushed and screened to a Number 2 stone specification or an equivalent washed gravel from a permitted source. Imported stone/ gravel will contain less than 10 percent fines (i.e. < size 80 sieve) by weight.

3. *Section 3.4.6 – A demarcation layer, such as orange construction fencing, filter fabric or other appropriate material must be placed immediately below the imported fill.*

   In order to place a demarcation barrier between the soil cuttings and imported fill, we will need to have workers in close proximity to a 42-inch-wide borehole that is 20 feet deep. This is a health and safety concern. Alternatively, we are recommending we use an imported sand layer over the soil cuttings for demarcation purposes. ERM has collected and submitted samples to characterize a masonry sand (i.e. a uniform, light brown fine sand) for pre-approval by the NYSDEC. The masonry sand will be used in the

construction of the TreeWells®. We will spread several inches of this sand over the soil cuttings from a safe distance using a skid steer. The transition in color and texture from the silts and clay soil cuttings to a fine sand can mark the transition of imported fill. This will minimize the health and safety risk of working in close proximity to a large, open bore hole and will make an obvious demarcation/ transition between materials.

4. *Section 3.4.7 – If groundwater is found to be discharging from the aeration tubing to the surface at any point, the aeration tube will be removed or sealed.*

   Agreed.

5. *Section 3.4.8 – Water level monitoring will also be conducted outside of the TreeWells to evaluate the radius of influence of each tree. If necessary, additional piezometers will be installed in order to allow this monitoring.*

   We will utilize all wells proximal to the phytoremediation plantation that are screened in the correct hydrogeologic interval to evaluate the radius of influence. This includes the 13 wells and 6 piezometers referenced in Table 5 of the work plan. We will evaluate the need for additional wells or piezometers beyond what was proposed in the work plan during the installation of the TreeWells®.

6. *Section 3.6 – Black locust (Robinia pseudoacacia) is a regulated invasive species as per 6 NYCRR Part 575, and therefore will not be used for the pilot study.*

   Agreed.

7. *Section 3.6 – If multiple tree species are available that would likely be suitable for the pilot study, then more than one species will be used in order to decrease susceptibility to disease or pests. This will also allow for a comparison of the performance of the varying species.*

   Hybrid poplar trees will likely be used for the pilot test due to their prolific growth rates, easy maintenance, and proven success for this application at many remediation sites. These trees are not susceptible to disease. Traditional phytoremediation plantations will often plant hundreds of poplar trees per acre and there is

literature that suggests that these monoculture plantings of this species are not prone to disease. In addition, there is already a mature stand of poplar trees growing in the North Field area of concern (AOC), indicating a healthy growing environment for the species.

8. *Section 3.7 – In order to provide adequate data to fulfill the objectives listed in item 1 of this letter, a monitoring plan will be developed and submitted to the Department within 75 days of completion of backfilling. The monitoring plan will include sampling to assess the potential for ecological exposures and evaluate potential air emissions. Sampling might include tree tissue sampling, which might include sampling roots, leaves, bark/woody tissue, berries, nuts and/or seeds. The monitoring plan will include sampling procedures and quality assurance/quality control requirements for any analytical methods and media which are not already included in the remedial investigation work plan.*

   A monitoring plan will be developed to evaluate the potential for ecological exposure in the phytoremediation plantation.

   ERM will develop a tissue (e.g. sampling roots, leaves, woody tissue, etc.) sampling plan for the third year of the pilot test, when the trees are entering maturity. We would like to minimize sampling of tree tissue that may cause potential damage to the trees within the first two years. In addition, the third growing season is when we are expecting to see accelerated degradation and removal of VOC impacted groundwater due to the maturity of the trees. The objective of this sampling will be to assess the tree's tissue for the potential for ecological exposure.

   ERM will evaluate methods to assess the volatilization from leaves to ambient air within the plantation. For the same reason as stated above, we will recommend completing this evaluation in the third growing season. These data will be used to access the potential for exposure due to transpiration.

   As requested, the monitoring plan will be developed and will include methods/procedures, quality assurance/quality control, and a recommended schedule.

9. *Section 3.7 – Any tree thinning that may be necessary will be done in a way that maintains a maximum spacing of 20 feet between trees.*

   Agreed, however the effectiveness of the plantation to "pump" groundwater is in part based on the tree canopy size and health, and not necessarily a direct relationship to number of trees or tree density. Therefore, if thinning beyond 20-foot spacing is required, it will based on an assessment of the overall plantation health as it relates to tree canopy and capacity to "pump" groundwater versus TreeWells® in-situ phytoremediation effects.

10. *Section 3.7 – Any pest control activities should be conducted in as "green" a way as possible. If application(s) of a pesticide(s) becomes necessary, it must be conducted in accordance with all applicable laws, rules and regulations. It is recognized there is a concern that beavers may damage or destroy the trees. Beavers should not be considered pests for the purposes of this pilot study. Other means of remediation could be considered if fencing is unable to prevent beavers from accessing the stand, and as a result, phytoremediation is found to be unsustainable at the site.*

    It is anticipated the fencing and protective tree collars will prevent beaver damage. If other pest control activities become necessary, we will discuss the approach with the NYSDEC.

11. *Section 3.9 – Investigation-derived waste must be disposed of no later than 90 days after completion of backfilling activities.*

    Investigation-derived waste (IDW) will be disposed of within 90 days of the accumulation start date. Monitoring wells and piezometers that may generate IDW will likely be installed after backfilling activities have been completed.

12. *Section 4.2 – Groundwater sampling must be conducted in accordance with procedures in the approved Remedial Investigation Work Plan.*

    Groundwater sampling will be conducted as outlined in the Remedial Investigation Work Plan. If an alternate sampling method is considered (e.g. passive diffusive bags, etc.) it will be proposed in the monitoring plan requested in comment 8.

13. *Section 4.2 – Groundwater levels must also be recorded in Year 2 and Year 3 in January or February to further assess groundwater flow.*

    Agreed.

In addition, the Department notes the following, which TRW/ERM should consider, though they are not required modifications to the work plan:

A. *Section 3.3 – The proposed spacing of 20 feet between trees creates a treatment area of approximately 310 square feet per tree. The Technical/Regulatory Guidance document "Phytotechnology Technical and Regulatory Guidance and Decision Trees, Revised", dated February 2009, prepared by the Interstate Technology & Regulatory Council (PHYTO-3) recommends a treatment area of 75 square feet per tree, or a spacing of 10 feet between trees. The Department understands the proposed spacing of 20 feet is based on the expected extent of the canopy when the trees are mature. However, it seems it would be worthwhile to consider a closer spacing in the initial planting, and then thinning the stand as necessary as the trees grow.*

B. *Section 3.4.5 – PHYTO-3 suggests the maximum saturated thickness from which plantings will extract water is about 5 feet. For this pilot test, the targeted zone is approximately 12 feet thick. It seems it might be appropriate to consider installing the Root_Sleeve (sleeve) deeper for some of the trees, so as to allow those trees to access the deeper portion of the plume, and then installing other sleeves as indicated in the work plan to allow those trees to access the shallower portion of the plume. It might also be worth considering trying to address the shallower portion of the plume using plantings without a sleeve, though the Department recognizes trees installed without the sleeve might not extend their roots to the contaminated zone at all, depending on the water balance in the stand. If plantings without the sleeve would not reach the plume, it might be worth considering include plantings without a sleeve, probably at the uphill end of the stand, to capture overland flow and reduce the amount of precipitation ultimately captured by the treatment trees.*

   Comments A and B above reference Phyto 3, which is a guidance document for traditional phytoremediation projects. Engineered TreeWells® were developed by Ed Gatliff, Ph.D., who is a referenced contributor and cited throughout Phyto 3, as a means to overcome some of the shortcomings of traditional phytoremediation plantations. TreeWells® were designed to treat much thicker saturated target

treatment zones and to be able to treat much deeper into a saturated zone. The proposed pilot test strategy and spacing was developed in direct consultation with Ed Gatliff, Ph.D. based on his experience at similar sites. Dr. Gatliff applied this technology at another site with remarkably similar site conditions (e.g. target depths, similar depth to groundwater, same contaminants, similar concentrations and groundwater velocities) to the North Field AOC within the last five years. This project used a slightly wider spacing between TreeWells® and is showing very positive results. ERM believes that the Work Plan as proposed is viable. If necessary, your comments will be considered as part of the pilot study performance evaluation.

Thank you for your assistance. Please contact me at 315-233-3038 or Rob.Sents@erm.com if you have any questions or comments.

Sincerely,

Robert Sents
Senior Project Manager

Enclosure

Cc: Harry Warner (NYSDEC)
Joshua Cook (NYSDEC)
Maureen Schuck (NYSDOH)
Jacquelyn Nealon (NYSDOH)
Robert Bleazard (TRW)
Scott Blackhurst (TRW)
Joe Fiacco (ERM)
Robert Sents (ERM)
Wendell Barner (Barner Consulting LLC)

**NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION**

**Division of Environmental Remediation, Region 7**
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April 12, 2019

Robert Bleazard
TRW Automotive U.S., LLC
11202 East Germann Road
Mesa, AZ 85212

Re: Former TRW Union Springs Facility, Site ID No. C706019
Village of Union Springs, Town of Springport, Cayuga Co.
Phytoremediation Pilot Study Work Plan

Dear Mr. Bleazard:

The New York State Department of Environmental Conservation (Department has reviewed the Phytoremediation Pilot Study Work Plan (work plan) for the Former TRW Union Springs Facility (site), dated April 9, 2019, which was prepared by ERM Consulting and Engineering, Inc. (ERM) on behalf of TRW Automotive U.S., LLC (Volunteer). With the modifications listed below in items 1 through 13, the work plan is hereby approved.

1. Section 2.1 – Additional objectives of the pilot study are to determine the extent to which the contaminants are transferred to and/or concentrated in the trees and to determine the extent to which the contaminants are emitted to the air by the trees in order to support an updated exposure assessment for phytoremediation that would be included in the evaluation of remedial alternatives.

2. Section 3.4.6 – All imported fill will be sampled prior to import, and must not contain contaminants exceeding the lower of the soil cleanup objectives (SCOs) for the protection of groundwater and the SCOs for the protection of public health for the proposed use (commercial use). Fill will be sampled for target compound list (TCL) volatile organic compounds (VOCs) via EPA Method 8260; TCL semivolatile organic compounds via EPA Method 8270; pesticides via EPA Method 8081; polychlorinated biphenyls via EPA Method 8082; target analyte list metals via EPA Methods 6010 and 7471; total cyanide via EPA Method 901x; 1,4-dioxane via EPA Method 8260, 8270 or 8270 SIM; and per- and polyfluoroalkyl substances via EPA Method Modified 537. Gravel, rock or stone, consisting of virgin material from a permitted mine or quarry may be imported without testing if it contains less than 10 percent by weight material which would pass through a size 80 sieve.

3. Section 3.4.6 – A demarcation layer, such as orange construction fencing, filter fabric or other appropriate material must be placed immediately below the imported fill.

4. Section 3.4.7 – If groundwater is found to be discharging from the aeration tubing to the surface at any point, the aeration tube will be removed or sealed.

5. Section 3.4.8 – Water level monitoring will also be conducted outside of the TreeWells to evaluate the radius of influence of each tree. If necessary, additional piezometers will be installed in order to allow this monitoring.

6. Section 3.6 – Black locust (*Robinia pseudoacacia*) is a regulated invasive species as per 6 NYCRR Part 575, and therefore will not be used for the pilot study.

7. Section 3.6 – If multiple tree species are available that would likely be suitable for the pilot study, then more than one species will be used in order to decrease susceptibility to disease or pests. This will also allow for a comparison of the performance of the varying species.

8. Section 3.7 – In order to provide adequate data to fulfill the objectives listed in item 1 of this letter, a monitoring plan will be developed and submitted to the Department within 75 days of completion of backfilling. The monitoring plan will include sampling to assess the potential for ecological exposures and evaluate potential air emissions. Sampling might include tree tissue sampling, which might include sampling roots, leaves, bark/woody tissue, berries, nuts and/or seeds. The monitoring plan will include sampling procedures and quality assurance/quality control requirements for any analytical methods and media which are not already included in the remedial investigation work plan.

9. Section 3.7 – Any tree thinning that may be necessary will be done in a way that maintains a maximum spacing of 20 feet between trees.

10. Section 3.7 – Any pest control activities should be conducted in as “green” a way as possible. If application(s) of a pesticide(s) becomes necessary, it must be conducted in accordance with all applicable laws, rules and regulations. It is recognized there is a concern that beavers may damage or destroy the trees. Beavers should not be considered pests for the purposes of this pilot study. Other means of remediation could be considered if fencing is unable to prevent beavers from accessing the stand, and as a result, phytoremediation is found to be unsustainable at the site.

11. Section 3.9 – Investigation-derived waste must be disposed of no later than 90 days after completion of backfilling activities.

12. Section 4.2 – Groundwater sampling must be conducted in accordance with procedures in the approved Remedial Investigation Work Plan.

13. Section 4.2 – Groundwater levels must also be recorded in Year 2 and Year 3 in January or February to further assess groundwater flow.

In addition, the Department notes the following, which TRW/ERM should consider, though they are not required modifications to the work plan:

a. Section 3.3 – The proposed spacing of 20 feet between trees creates a treatment area of approximately 310 square feet per tree. The Technical/Regulatory Guidance document *"Phytotechnology Technical and Regulatory Guidance and Decision Trees, Revised",* dated February 2009, prepared by the Interstate Technology & Regulatory Council (PHYTO-3) recommends a treatment area of 75 square feet per tree, or a spacing of 10 feet between trees. The Department understands the proposed spacing of 20 feet is based on the expected extent of the canopy when the trees are mature. However, it seems it would be worthwhile to consider a closer spacing in the initial planting, and then thinning the stand as necessary as the trees grow.

b. Section 3.4.5 – PHYTO-3 suggests the maximum saturated thickness from which plantings will extract water is about 5 feet. For this pilot test, the targeted zone is approximately 12 feet thick. It seems it might be appropriate to consider installing the Root_Sleeve (sleeve) deeper for some of the trees, so as to allow those trees to access the deeper portion of the plume, and then installing other sleeves as indicated in the work plan to allow those trees to access the shallower portion of the plume. It might also be worth considering trying to address the shallower portion of the plume using plantings without a sleeve, though the Department recognizes trees installed without the sleeve might not extend their roots to the contaminated zone at all, depending on the water balance in the stand. If plantings without the sleeve would not reach the plume, it might be worth considering include plantings without a sleeve, probably at the uphill end of the stand, to capture overland flow and reduce the amount of precipitation ultimately captured by the treatment trees.

Finally, while not a required or recommended modification to the work plan, it is noted that the SCOs for the protection of groundwater are applicable on-site for several contaminants. For the off-site area, the applicable SCOs are the unrestricted SCOs, or at a minimum, the residential use SCOs and protection of groundwater SCOs. The residential use SCOs were not exceeded in off-site samples, but the protection of groundwater SCO was exceeded for trichloroethene and cis-1,2-dichloroethene.

Pursuant to 6 NYCRR 375-1.6(d)(3), the Volunteer must respond in writing within 15 days as to whether the required modifications will be accepted. If accepted, this letter and the Volunteer's acceptance letter must be attached to the front of all copies of the work plan. Please also provide a response to recommendations a. and b.

The Volunteer must obtain and comply with any necessary State, local or federal permits. The Department requires notification at least seven days in advance of field work. If you have any questions, please do not hesitate to contact me at 315-426-7411 or joshua.cook@dec.ny.gov.

Sincerely,

Joshua P. Cook, P.E.
Professional Engineer 1

ec: Harry Warner (NYSDEC)
Joshua Cook (NYSDEC)
Maureen Schuck (NYSDOH)
Jacquelyn Nealon (NYSDOH)
Robert Bleazard (TRW)
Wendell Barner
Rob Sents (ERM)
Pete Marshall (LPW Development, LLC)

# Phytoremediation Pilot Test Work Plan

TRW Automotive U.S. LLC

## Former TRW Union Springs Facility

9 April 2019

Project No.: 0496229

BCP No.: C706019

*The business of sustainability*

ERM

# Phytoremediation Pilot Test Work Plan

## *Former TRW Union Springs Facility*

I, James Ryan, P.E. certify that I am currently a NYS registered professional engineer and that this Report Phytoremediation Pilot Test Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

James Ryan, P.E.
Project Engineer
ERM Consulting & Engineering, Inc.
Date: 9 April 2019

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## List of In-Text Tables



## Acronyms and Abbreviations

| Name | Description |
|---|---|
| AOC | Area of Concern |
| BCP | Brownfield Cleanup Program |
| cDCE | cis-1,2-Dichloroethene |
| COPC | Constitutes of potential concern |
| CVOC | Chlorinated Volatile Organic Compounds |
| ERM | ERM Consulting & engineering, Inc. |
| ft bgs | feet below ground surface |
| ft/ ft | Feet per feet |
| ft/ yr | Feet per year |
| k | Conductivity |
| IDW | investigation derived wastes |
| LPW | LPW Development, LLC |
| NYSDEC | New York State Department of Conservation |
| PPTWP | Phytoremediation Pilot Test Work Plan |
| PVC | polyvinyl chloride |
| R-C | Restricted- Commercial |
| RI | Remedial Investigation |
| SCO | Soil Cleanup Objectives |
| TCE | Trichloroethene |
| tDCE | trans-1,2-Dichloroethene |
| TOGS | Technical and Operational Guidance Series |
| TRW | TRW Automotive U.S. LLC |

| | |
|---|---|
| USEPA | United States Environmental Protection Agency |
| VC | Vinyl Chloride |
| VOC | Volatile Organic Compound |

# 1. INTRODUCTION

ERM Consulting & Engineering, Inc. (ERM) prepared this Phytoremediation Pilot Test Work Plan (PPTWP) on behalf of TRW Automotive U.S. LLC (TRW) for the Former Union Springs Facility, located at 107 Salem Street, Union Springs, New York (Figure 1; hereafter called the "Site"). TRW entered into a Brownfield Cleanup Agreement with the New York State Department of Environmental Conservation (NYSDEC) on 7 January 2016 as a Volunteer. The portion of the properties currently regulated under the Brownfield Cleanup Agreement has been assigned Brownfield Cleanup Program (BCP) Site Number C706019 by the NYSDEC.

From December 2015 to September 2017, ERM conducted a remedial investigation (RI) to satisfy the requirements of the NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10; NYSDEC 2010a). A summary of the RI findings and a remedial alternatives analysis was prepared and a draft report was submitted to the NYSDEC and New York State Department of Health (collectively, Regulators) for a preliminary review on 13 April 2018 (hereafter called the "Report"). The Regulators provided a comment letter to the Report on 17 September 2018. ERM is preparing a response and revising the Report based on comments, follow-up discussions and correspondence with the NYSDEC; revisions will include removing the remedial alternatives analysis section of the Report. TRW intends to manage portions of the Site with interim remedial measures to expedite Site remediation in some areas of concern (AOCs) and to pilot test remedial technologies to support evaluation of proposed remedial strategies for the remaining AOCs identified in the Report.

The purpose of this PPTWP is to document the proposed activities and methods for implementing and evaluating an engineered phytoremediation pilot test within a portion of the North Field AOC (Figure 2) where chlorinated volatile organic compounds (CVOCs) were identified at elevated concentrations in soil and groundwater along the northern BCP boundary. The PPTWP presents the remedial goals and pilot test design.

## 1.1 Site Operational History

The Site was developed in approximately 1790 and has a long industrial history. The oldest building on the Site is the former mill building which was constructed in the 1830s. Beginning in 1932, the Site was used by several companies for manufacturing electrical components for the automotive industry, with TRW operating the facility 1990 through 1997. LPW Development, LLC (LPW) acquired the facility and associated properties from TRW in 1997. Since acquiring the property, LPW has been leasing the facility to various manufacturing and commercial tenants.

## 1.2 Nature and Extent of Contamination

A detailed account of the nature and extent of contamination at the Site is presented in the Report and in the Comprehensive Report: Site Characterization and Remedial Investigation, dated July 2015 (ERM 2015). For the purposes of this PPTWP, a brief summary of the constituents of potential concern (COPC) proximal to the proposed phytoremediation pilot test area is presented below.

### *1.2.1 Constituents of Potential Concern*

The primary COPC identified in overburden soil and groundwater within the target treatment zone (i.e., proximal to the proposed phytoremediation pilot test area shown on Figure 2 to a depth of about 20 feet below ground surface [ft bgs]) are trichloroethene (TCE), cis-1,2-dichloroethene (cDCE), trans-1,2-dichloroethene (tDCE), and vinyl chloride (VC)). These compounds are collectively referred to as CVOCs.

### 1.2.2 Soils

Soils within the proposed pilot test area consist of primarily silt and clay, with some sandy lenses. CVOCs were detected in soil samples at depths ranging from 11 to 25 ft bgs at concentrations below the Restricted-Commercial (R-C) Soil Cleanup Objectives (SCOs), as summarized in Table 1. The depth to groundwater in this area typically ranges from about 5 to 10 ft bgs, so all of the CVOC-impacts identified in soil are below the water table. There were no exceedances of R-C SCOs within the proposed pilot test area and no exceedances of Restricted-Residential SCOs on the abutting property to the north.

**Table 1: Summary of Soil Impacts in the Proposed Phytoremediation Pilot Test Area**

| Compound | Maximum Concentration (µg/Kg) | Restricted-Commercial Soil Cleanup Objectives (µg/Kg) |
|---|---|---|
| 1,1-Dichloroethene | 9.1 | 500,000 |
| cDCE | 8,000 | 500,000 |
| TCE | 160,000 | 200,000 |
| Tetrachloroethene | 15 | 150,000 |
| tDCE | 48 | 500,000 |
| VC | 300 | 13,000 |

*Soil Cleanup Objectives are derived from 6 NYCRR Part 375-6.8(b)*
*µg/Kg: micrograms per kilogram*

The majority of the CVOC mass identified in the pilot test area is present within low permeability geologic media and is therefore relatively immobile.

### 1.2.3 Groundwater

An east–west trending groundwater flow divide transects the pilot test area. Groundwater north of this divide flows generally to the north. Groundwater south of this divide flows generally south-southwest. Shallow groundwater in the northern portion of this AOC discharges to the unnamed stream to the north. The hydraulic conductivity was calculated for the formation in the vicinity of monitoring well MW-105, which is located within the footprint of the pilot test area (Figure 3) and is screened completely within the uniformly very low permeability layer targeted by the pilot test, is 4.86 feet/year (ft/yr) or 4.7 $X10^{-6}$ centimeters/second. Using Darcy's Law with this hydraulic conductivity value, a horizontal hydraulic gradient of 0.04 (Figure 3) and an estimated porosity of 0.4 for silty clay (Freeze and Cherry 1979), both of which are specific to the pilot test area, the resulting groundwater flow velocity is calculated as 0.49 ft/yr.

Table 2 summarizes the most recent groundwater results in the vicinity of the proposed pilot test area. TCE and cDCE concentrations exceed the NYSDEC Division of Water Technical and Operational Guidance Series (TOGS 1.1.1; NYSDEC 1998) ambient groundwater quality standards in monitoring wells MW-301 and MW-302 (Figure 4), which are located off Site between the BCP boundary and the unnamed stream to the north. Trace levels of cDCE were detected in pore water (i.e., groundwater samples collected within soil immediately beneath or adjacent to a surface water body) and surface water samples collected from beneath and within this stream, respectively. No CVOCs were detected in groundwater north of this stream, confirming that this stream represents the hydraulically downgradient extent of CVOC impacts in groundwater in this part of the Site.

There were no exceedances of ambient groundwater quality standards in groundwater samples collected from monitoring wells screened at depths greater than 20 ft bgs off Site between the BCP boundary and the unnamed stream to the north. The focus of the engineered phytoremediation pilot test is shallow groundwater (i.e., depths less than 20 ft bgs); therefore, there is no further discussion of deeper groundwater in the PPTWP.

## Table 2: Summary of CVOC Impacts to Shallow Groundwater Proximal to the Proposed Pilot Test Area

| Compound | Maximum Concentration (µg/L) | TOGS 1.1.1. Ambient Water Quality Standard (µg/L) |
|---|---|---|
| **CVOCs detected in shallow groundwater within the proposed phytoremediation pilot test area** | | |
| 1,1-DCE | 48 | 5 |
| cDCE | 18,000 | 5 |
| tDCE | 99 | 5 |
| TCE | 8,800 | 5 |
| VC | 2,000 | 2 |
| **CVOCs detected in shallow groundwater in hydraulically downgradient monitoring wells on the abutting property to the north** | | |
| cDCE | 810 | 5 |
| TCE | 2,400 | 5 |
| **CVOCs detected in pore water or surface water in the unnamed stream to the north** | | |
| cDCE | 4.2 | 5 |

*µg/L: micrograms per liter*

*TOGS 1.1.1: Technical & Operational Guidance Series (TOGS) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations*

Mass discharge calculations were completed in the Report, including an east-west transect oriented generally perpendicular to groundwater flow through the proposed pilot test area. The mass discharge of CVOCs through this transect toward the north was calculated as 0.00269 gram per day or 0.00098 kilogram per year.

# 2. SUMMARY OF ENGINEERED PHYTOREMEDIATION PILOT TEST STRATEGY

## 2.1 Pilot Test Objectives

The primary objective of the pilot testing is to confirm that engineered phytoremediation along the northern BCP boundary is effective at minimizing further off-Site CVOC migration in groundwater. The pilot test area was selected to coincide with the area where CVOC concentrations in groundwater exceed ambient groundwater quality standards. The remedy is expected to achieve its primary objective through a combination of hydraulic control (i.e., local lowering of the water table during the growing season) and CVOC mass reduction through *in situ* bioremediation. Data collected during the pilot test will be used to evaluate the viability of this remedial technology in this portion of the Site and will be used to design the final remedy, if appropriate.

## 2.2 Estimated Area and Volume of Affected Media Included in the Pilot Test Area

The pilot test will target the volume of saturated soil where CVOC concentrations in groundwater exceed NYSDEC ambient water quality standards and where there is a component of shallow groundwater flow toward the northern BCP boundary, as shown on Figure 4 and summarized in Table 4.

**Table 3: Target Area and Volume of CVOC-Affected Media in Proposed Phytoremediation Pilot Test**

| Estimated Target Treatment Area (square ft [sq ft]) | Estimated Thickness of Saturated Soil in Target Treatment Area (ft) | Estimated Volume of Target Treatment Zone (cubic yards [cu yds]) |
|---|---|---|
| 5,200 | 12 | 2,311 |

## 2.3 Technology—Engineered Phytoremediation

Engineered phytoremediation was selected for pilot testing as a cost effective, readily implementable, and proven remedial alternative to manage CVOC-impacted groundwater. This technology removes mass, controls potential migration of impacted groundwater, and based on the success at sites with similar characteristics has a great potential for long-term effectiveness. Phytoremediation also has the added benefits of being a sustainable and low-energy remediation technology.

Engineered phytoremediation includes not only traditional phytoremediation, but also engineered systems designed to achieve a specific remediation objective. Traditional phytoremediation systems include conventional planting techniques to treat affected soil and groundwater at relatively shallow depths. In an engineered system, the phytoremediation remedy is designed and constructed to control plant growth, manage Site conditions, and target the vertical and horizontal zone of remedial effect.

For this Site, *TreeWell*® technology was selected to achieve the target remediation depth of 20 ft bgs. This technology is a vegetation-based pump-and-treat system developed by Applied Natural Sciences that allows for targeting of specific water-bearing strata. The first *TreeWell*® prototype was installed in 1991 and hundreds of *TreeWell*® units have been installed since then. *TreeWell*® technology enables

access to groundwater up to 150 ft bgs. The engineered phytoremediation system has the ability to remediate and affect the hydraulics of specific horizons and neutralize normally phytotoxic levels of contaminants.

The *TreeWell*® technology typically involves installing a large-diameter borehole down to the impacted horizon of interest. A *Root_Sleeve*™ liner and aeration tubing are added to direct and enhance root growth to the target depth. The borehole is then backfilled with topsoil and selected amendments. Once installed and established, the tree acts like a solar-powered pump: as impacted groundwater uptake through tree roots occurs, water head differential drives replacement water upward through the amended soil column. The *Root_Sleeve*™ liner acts to direct the tree root mass growth and prevent uptake of water entering the system via precipitation infiltration near the tree. This pumping action results in an overall net water loss and localized lowering of the water table.

The *TreeWell*® column also acts as a bioreactor and contaminants are treated through *in situ* biodegradation. Much of the biodegradation is done by microflora in the soil column prior to root uptake, which limits the phytotoxic effects of high contaminant concentrations. The residual contaminants (in the case of CVOCs) are taken up by the plant and are treated within the plant or transpired into the atmosphere where they are photo-oxidized through contact with sunlight.

# 3. PILOT TEST ENGINEERING DESIGN AND INSTALLATION

## 3.1 Pilot Testing Design Summary

The proposed engineered phytoremediation system will be located on Site adjacent to the northern BCP boundary in the area where CVOC concentrations exceed the ambient groundwater quality standards and where shallow groundwater flows to the north (Figure 4). The *TreeWell*® units have been designed to target CVOC-impacted groundwater to a depth of 20 ft bgs within this area.

## 3.2 Tree Spacing and Water Consumption Rates

The proposed engineered phytoremediation system will incorporate the *TreeWell*® technology to force the consumption of groundwater from the targeted zone and to exclude the consumption of groundwater from percolating precipitation. A tree spacing of about 20 ft is expected to result in a full canopy in 3 to 4 years. Water consumption rates for this plantation are primarily a function of total leaf area and solar intensity, rather than the number of trees. In this configuration, an individual tree is expected to consume approximately 10 to 15 gallons of groundwater per day, averaged annually, during the second or third growing season. This groundwater consumption rate is conservatively expected to increase to 30 gallons per day, averaged annually, after 5 years at this spacing. The actual daily removal rates during the active growing season is expected to be much higher.

A total of up to 14 TreeWell® units are planned to be installed in the proposed pilot test area that will cover the entire width of the CVOC-contaminated area (i.e., perpendicular to the groundwater flow direction). Data collected from the uniformly low-permeability layer discussed in Section 1.2.3 was used to calculate the discharge of groundwater along the northern property line and is approximately 5,300 gallons per year. It is estimated the consumption of groundwater by the 14 TreeWell® units will conservatively exceed the groundwater flux along the northern property line within the pilot test area during the growing season (once the trees have matured).

The groundwater flow velocity in this portion of the site is approximately 0.49 ft/yr or about 0.25 ft within the dormant portion of the year. Based on this groundwater flow velocity, CVOC-impacted groundwater will not migrate off site once the plantation has reached maturity. Organic material will be added to the TreeWell® units to help support tree growth. This material will serve as a long-term carbon source that is anticipated to stimulate biological reductive dechlorination of CVOCs throughout the entire year, including when the trees are dormant. Thus, the combination of phytoremediation and *in situ* biological reductive dechlorination will significantly reduce or eliminate off-site migration of CVOCs in groundwater within the pilot test area.

Optimization of the system could require the removal of some trees between 4 and 6 years after planting to favor the better-performing species. Canopy geometry, shading, and competition are other factors that impact water-consumption rates.

## 3.3 Engineered Phytoremediation Layout

The proposed engineered phytoremediation system is intended to:

- Target and remediate CVOC-contaminated groundwater consumption from the targeted groundwater horizons; and
- Control migration of and reduce VOC concentrations over time in the planted area throughout the targeted horizons.

The proposed engineered phytoremediation system will be in an area approximately 35 ft wide by 150 ft long, as shown in plan-view on Figure 4. In general, the trees are spread out at approximately 20-foot

intervals. The presence of existing monitoring wells, existing trees, and the steep slope along the eastern edge of the pilot area may require TreeWell® unit(s) to be offset or excluded.

Actual plot dimensions, numbers and types of trees, spacing, and other design parameters may be altered in the field during installation.

## 3.4 Engineered Phytoremediation Installation

### *3.4.1 Site Access*

ERM met with LPW on 15 March 2019 and reviewed the location and nature of the engineered phytoremediation pilot test documented in this PPTWP. LPW has signed an acknowledgment and approval for TRW to proceed with the pilot test as outlined in this PPTWP (Appendix A).

### *3.4.2 Supporting Documents*

The work will be performed in conformance with the approved supporting documents from the RI Work Plan, such as the Quality Assurance Project Plan and the Community Air Monitoring Plan (ERM 2015). The approved RI Health and Safety Plan will be revised to address potential risks associated with the tasks outlined in this PPTWP. The revised Health and Safety Plan will be reviewed and approved by ERM's senior health and safety team prior to mobilization to the Site.

### *3.4.3 Site Preparation*

The pilot test area is generally grass-covered and relatively flat, with a steep slope toward the unnamed stream to the east. Some minor brush and small tree clearing may be required to prepare the Site for the pilot test. Pruning or removing trees with overhanging (shading) branches may also be required.

### *3.4.4 Erosion and Sediment Control*

During construction activities, erosion and sediment controls will be incorporated to minimize storm water contacting disturbed areas and to control runoff. Silt fences will be installed to the north and east of the plantation area between the construction area and the abutting unnamed stream and wetlands.

### *3.4.5 TreeWell® Unit Construction*

A construction diagram of the tree well unit is presented on Figure 5. Detailed description of the components of the *TreeWell*® units and pilot monitoring wells are presented in the following subsections. Up to 14 *TreeWell*® units will be installed approximately 20 ft apart. To install each unit, an approximately 3.5-foot diameter borehole will be drilled with a caisson rig to a total depth of 20 ft. A *Root_Sleeve*™ liner will be installed from 0.5 ft above ground surface to 8 ft bgs. After installing selected internal infrastructure (e.g., nested well sets, piezometer, nutrient, and/or aeration lines), the borehole will be backfilled both within and below the *Root_Sleeve*™ with a mixture of sandy loam soil (from a source pre-approved by the NYSDEC) amended with organic matter to be approximately flush with the ground surface. The backfilled soil will be hydrated at a rate of approximately 5 gallons per 2 ft of fill placement. The *Root_Sleeve*™ will be finished approximately 0.5 ft above the ground surface to prevent surface water infiltration.

The purpose of the *Root_Sleeve*™ liner is to ensure maximum water usage from the targeted zone by preventing the trees from consuming clean water (percolating precipitation). The liner also functions to direct root growth downward toward the contaminated zone. Following installation of the *Root_Sleeve*™ liner, the soil will be allowed to settle for up to three weeks prior to planting the tree stock. The weather in early spring will determine the timing of the planting activity.

### 3.4.6 Soil Cuttings

Soil cuttings from each *TreeWell*® boring will be used to construct the surface mounding in the planting area as part of the storm water infiltration control design. Cuttings are anticipated to be suitable as clean fill cover, based on current and future intended use. Soil cuttings will be compressed in place around each *TreeWell*® boring. Approximately 8-inches of imported soil from a NYSDEC pre-approved source will be placed as cover over the cuttings. This soil will be covered with a liner to minimize groundwater infiltration. The liner will be covered with 4 inches of gravel to stabilize the soil mound. The placement of imported fill, the liner and gravel cover will result in the surface configuration of the finished *TreeWell*® unit shown on Figure 5. This mound serves as the required 1 foot of clean cover for R-C future intended use and will stop surface water infiltration into the *TreeWell*® unit.

Soil cuttings from the borings observed to be grossly impacted (sheen, elevated field screening concentrations with a photoionization detector, etc.) will be placed in a lined roll-off dumpster. The need to segregate and stage soil will be determined in the field based on observations and field screening with a photoionization detector. Segregated soil will be properly characterized to determine if it can be reused on Site (with NYSDEC approval) or if it must be transported and properly managed off Site. If deemed appropriate based on the analytical data, staged soil will be transported for off-Site disposal at a permitted receiving facility or may be moved to an off-Site facility for temporary staging prior to final disposal in accordance with local, state, and federal laws.

### 3.4.7 Aeration and Fertilizer Tubing

Following the installation of the *Root_Sleeve*™ liner and backfill, aeration and fertilizer tubing will be installed inside the liner. The aeration tubing consists of an approximately 2-inch perforated flexible drainage tube that extends in a U-shaped fashion to a depth of approximately 8 ft bgs. This tube functions to facilitate oxygen availability to the roots in the deeper horizons. A ¾-inch PVC (polyvinyl chloride) fertilizer tube will then be installed into the saturated zone in each *TreeWell*® unit to allow the long-term addition of nutrients.

### 3.4.8 Piezometers

Piezometers will be installed in six of the 14 *TreeWell*® units. The proposed locations of the six piezometers (TW-102 through TW-107) will be selected during installation and selected to provide the widest aerial coverage of the plantation. Each piezometer will be constructed of approximately 18 ft of 1.5-inch diameter PVC riser with 5 ft of 0.010-slot pre-pack well screen set at the approximate midpoint of the saturated zone (11.5 To 16.5 ft bgs). The six piezometers will be used to periodically or continuously measure water levels by manually gauging or with transducers to evaluate the effects of the *TreeWell*® units on the groundwater elevation within the target zone.

### 3.4.9 Nested Monitoring Wells

Nested monitoring wells will be installed in two of the completed *TreeWell*® units. The proposed locations of the two well nests (TW-100a/b/c, and TW-101a/b/c) are depicted on Figure 4. Each nested well set will consist of three individual 1.5-inch diameter PVC wells with 2 ft of 0.010-factory-slot pre-pack screen and riser. The nested well sets will be installed at the top (screened from 10 to 12 ft bgs), middle (screened from 14 to 16 ft bgs), and bottom (screened from 18 to 20 ft bgs) of the saturated treatment interval. Groundwater samples, collected periodically from the nested well sets, will be used to conduct vertical profiling of contaminant mass reduction as part of performance monitoring.

### 3.4.10 Tree Planting

Once all selected subsurface features have been installed and backfill soil has settled, the trees will be planted. The final schedule of planting will require consideration of season, weather, and availability of bare root trees. Typically, a bare root, dormant tree (8 to 10 ft in height) of the selected species will be planted at the top of the *TreeWell*® column.

Following installation of the trees, the aboveground portion of the *Root_Sleeve*™ liner will be closed and sealed with PVC sheeting (or similar material) at the base of the tree to prevent infiltration of precipitation. This will further mitigate confounding water uptake by precipitation. To prevent photodegradation of the liner and preserve the integrity of the *TreeWell*® unit, at least a 3-inch layer of gravel will cover the liner.

### 3.4.11 Perimeter Fencing

Following completion of the plantation installation, the area will be protected by 400 linear ft of 6-foot-high chain-link fencing to protect from deer and beaver damage.

## 3.5 Monitoring Wells

In addition to the nested wells and piezometers installed within the *TreeWell*® units, two additional monitoring wells (MW-500 and MW-501) will be installed on the northern edge of the phytoremediation pilot test area and proximal to the BCP boundary. The approximate location of the proposed wells is presented on Figure 4. These wells will be used to assess the effects of the pilot test on groundwater conditions immediately downgradient of the treatment zone and supplement data collected from within the treatment zone and from other existing monitoring wells in the vicinity.

A NYSDEC-registered driller will be contracted to install the wells for the pilot test. The wells will be installed using means and methods typically used on the Site and be constructed of 2-inch diameter, 5-foot 0.010-slot PVC well screen and riser. The screened interval will be at a depth similar to that of existing monitoring well MW-105 (see Figure 4).

A summary of the proposed wells and piezometers is provided in the following table

**Table 4: Summary of Proposed *TreeWell*® Units, Monitoring Wells and Piezometers**

| Well Type | # of Wells | Well Diameter | Well Material | Well Depth (ft bgs) | Screen Interval (ft bgs) |
|---|---|---|---|---|---|
| TreeWell Units | 14 | 3.5 ft (42 inches) 0 to 10 ft bgs<br>24 inches (10-20) ft bgs | Root Sleeve to 10 ft<br>Amended Soil Borehole from 10 to 20 ft bgs | 20 | N/A |
| Piezometers | 6 | 1.5 inch | PVC | 16.5 | 11.5 to 16.5 |
| Nested* Monitoring Wells | 2 | 1.5-inch | PVC | 20 | 10 to 12<br>14 to 16<br>18 to 20 |
| Monitoring Wells | 2 | 2-inch | PVC | 20 | 15 to 20 |

**Nested Monitoring Well – three 1.5-inch PVC wells installed within two TreeWell Units*

## 3.6 Proposed Tree Species

The following tree species are likely candidates based on their characteristics with respect to water consumption, preferred soil/groundwater conditions, and growth habit. The candidate species have been chosen based on experience at other phytoremediation projects, based on their ability to deal with transplant stress, insect/animal predation, shade tolerance, extremes of weather, and they are not intrusive species:

- Locust (Black) — *Robinia pseudoacacia*
- Locust (Honey) — *Gleditsia triacanthos*
- Weeping Willow — *Salix alba*
- Cottonwood (or Hybrid Poplar) — *Populus deltoides (x nigra)*

Possible alternative species include:

- Sweet Gum — *Liquidambar styraciflua*
- Longleaf pine — *Pinus palustris*

Final selection will be based on plant stock availability, health of the plant materials, and further assessment of local plant material sources at the time of purchase.

## 3.7 Phytoremediation System Operation (Maintenance)

Mortality in the first season following planting stands of trees is possible, but the percentage is usually very low. Any dead or dying trees will be replaced. Once the trees are established, mortality is not expected to be an issue.

The phytoremediation system is expected to operate generally in two phases during the life cycle of the project. The first is a growth phase that generally lasts for the first 5 years of operation when the trees are maturing. Following the initial 5 years of operation, the *TreeWells*® are established and are generally self-sustaining for 6 to 15 more years and require less frequent maintenance and monitoring activities. Maintenance during this period will focus on keeping the trees healthy and minimize competition between trees.

Maintenance is expected to include the following:

- Visual Inspections
- Irrigation (only during first season as needed)
- Perimeter fence maintenance/repair
- Grass cutting
- Weed removal
- Minor pruning
- Downed limb removal
- Growth monitoring
- Tree thinning/removal
- Cover material maintenance

The trees will also be inspected for signs of insect predation, disease, or damage due to other environmental conditions and appropriate steps will be taken to mitigate any problems.

## 3.8 Survey

Following installation of the *TreeWell*® plantation, fencing, and proposed monitoring wells, newly installed features will be surveyed for horizontal location and elevations. The data will be used for subsequent construction completion and performance reporting.

## 3.9 Investigation Derived Waste

Solid and potentially liquid investigation derived waste (IDW) will be generated by the *TreeWell*® installation team and during monitoring well installation. Materials that may become IDW and require proper management include:

- Personnel protective equipment, including disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.;
- Disposable equipment, including plastic ground and equipment covers, aluminum foil, tubing, broken or unused sample containers, sample container boxes, tape, etc.;
- Soil cuttings from drilling;
- Decontamination fluids such as wash water; and
- Well development water.

IDW will be segregated according to waste type. All IDW generated during assessment activities will be placed in Department of Transportation–approved 55-gallon drums or in a lined roll-off dumpster, properly labeled with contents, and stored on Site in a secure area. Characterization, transportation, and disposal of IDW will be conducted by ERM in accordance with NYSDEC guidelines.

# 4. REMEDIATION SYSTEM PERFORMANCE MONTORING AND REPORTING

The primary objective of the proposed monitoring program is to demonstrate the effectiveness of the engineered phytoremediation pilot test in creating an effective hydraulic capture zone to prevent off-Site migration of CVOCs in groundwater and to reduce CVOC concentrations and mass within the target treatment zone over time. This objective can be achieved by monitoring both the hydraulic effects of the engineered phytoremediation system as well as its effectiveness in reducing CVOC concentrations at the target depth. The table below summarizes the performance-monitoring well network. The locations of the wells (except piezometers) are shown on Figure 4.

**Table 5: Summary of Proposed Performance Monitoring Well Network**

| Existing Wells | Proposed Wells | Proposed Piezometers |
|---|---|---|
| JJ-12<br>JJ-17<br>MW-105<br>MW-301<br>MW-302 | MW-500<br>MW-501<br>TW-100a/b/c (nested)<br>TW-101a/b/c (nested) | TW-102<br>TW-103<br>TW-104<br>TW-105<br>TW-106<br>TW-107 |

## 4.1 Groundwater Elevation Gauging

Groundwater elevation gauging will be conducted quarterly in the 13 wells and six piezometers listed in Table 6. Depth to groundwater in each well will be measured using an electronic water level instrument. Quarterly monitoring events will be conducted concurrent with sampling events. In addition, water levels in select piezometers will be continuously monitored using submersible pressure transducers/data loggers.

## 4.2 Groundwater Sampling

Groundwater monitoring will be conducted to evaluate the temporal changes in CVOC concentrations in groundwater in the vicinity of the engineered phytoremediation pilot test. The overall duration of the performance-monitoring period will be at least three years and include a baseline monitoring event. The 13 wells listed above (existing and proposed wells) will be included in each of the performance-monitoring events. For all monitoring events, groundwater samples will be collected along with the collection of field measurements including pH, oxidation reduction potential, conductivity, and dissolved oxygen. Sampling logs will be completed for each monitoring well for each sampling event to document the field parameters. Groundwater samples will be analyzed for CVOCs by United States Environmental Protection Agency (USEPA) Method 8260B. Each event will include the following quality assurance and quality control samples: duplicate, matrix spike & matrix spike duplicate, trip blank, and equipment rinseate blank. Quality assurance and quality control samples will be submitted for VOC analysis by USEPA Method 8260B. Because the effects of the pilot test will advance as the trees become established and mature, sampling event frequency will also increase year-to-year during the pilot testing period. The following summarizes the performance-monitoring sampling schedule.

- Year 1: Baseline sampling (June 2019) will be completed within 2 weeks of completion of construction. A second event will be completed upon conclusion of the growing season (October 2019).
- Year 2: Three monitoring events will be completed in the second year and occur during the growing season (June 2020, August 2020, and October 2020).

- Year 3: Five monitoring events will be completed in the third and final year of the testing period. The events will cover a timeframe extending from immediately before to immediately following the growing season (March 2021, June 2021, July 2021, September 2021, and November 2021). These data will be used to demonstrate seasonal effects to CVOC concentrations within and around the pilot test area.

The frequency of monitoring events and duration of the performance monitoring period will be reviewed and potentially revised, based on interpretation of the results.

## 4.3 Reporting

Data collected during the monitoring events will be included in the monthly progress reports as required by the Brownfield Cleanup Agreement. The results of the pilot testing will be included in a Focused Feasibility Study Report that will be prepared following the proposed pilot testing and interim remedial measures (these will be presented in separate work plans) are completed.

# 5. SCHEDULE

Table 7 presents a general schedule of anticipated events for the duration of the pilot test period. The schedule may be modified based on conditions such as adverse weather, other Site activities, and contractor/equipment availability. NYSDEC will be notified approximately 5 days in advance of any subsurface field or monitoring activities at the Site.

**Table 6: Schedule of Anticipated Events**

| Task | Target Month and Year of Completion |
|---|---|
| Installation of *TreeWell*® units and monitoring wells | May 2019 |
| Planting Trees within *TreeWell*® units | June 2019 |
| Year-1: Baseline Monitoring (Event 1) | June 2019 |
| Year-1: End of Growing Season Monitoring (Event 2) | October 2019 |
| Year 2: Monitoring (Event 3) | June 2020 |
| Year 2: Monitoring (Event 4) | August 2020 |
| Year 2: Monitoring (Event 5) | October 2020 |
| Year 3: Monitoring (Event 6) | March 2021 |
| Year 3: Monitoring (Event 7) | June 2021 |
| Year 3: Monitoring (Event 8) | July 2021 |
| Year 3: Monitoring (Event 9) | September 2021 |
| Year 3: Monitoring (Event 10) | November 2021 |

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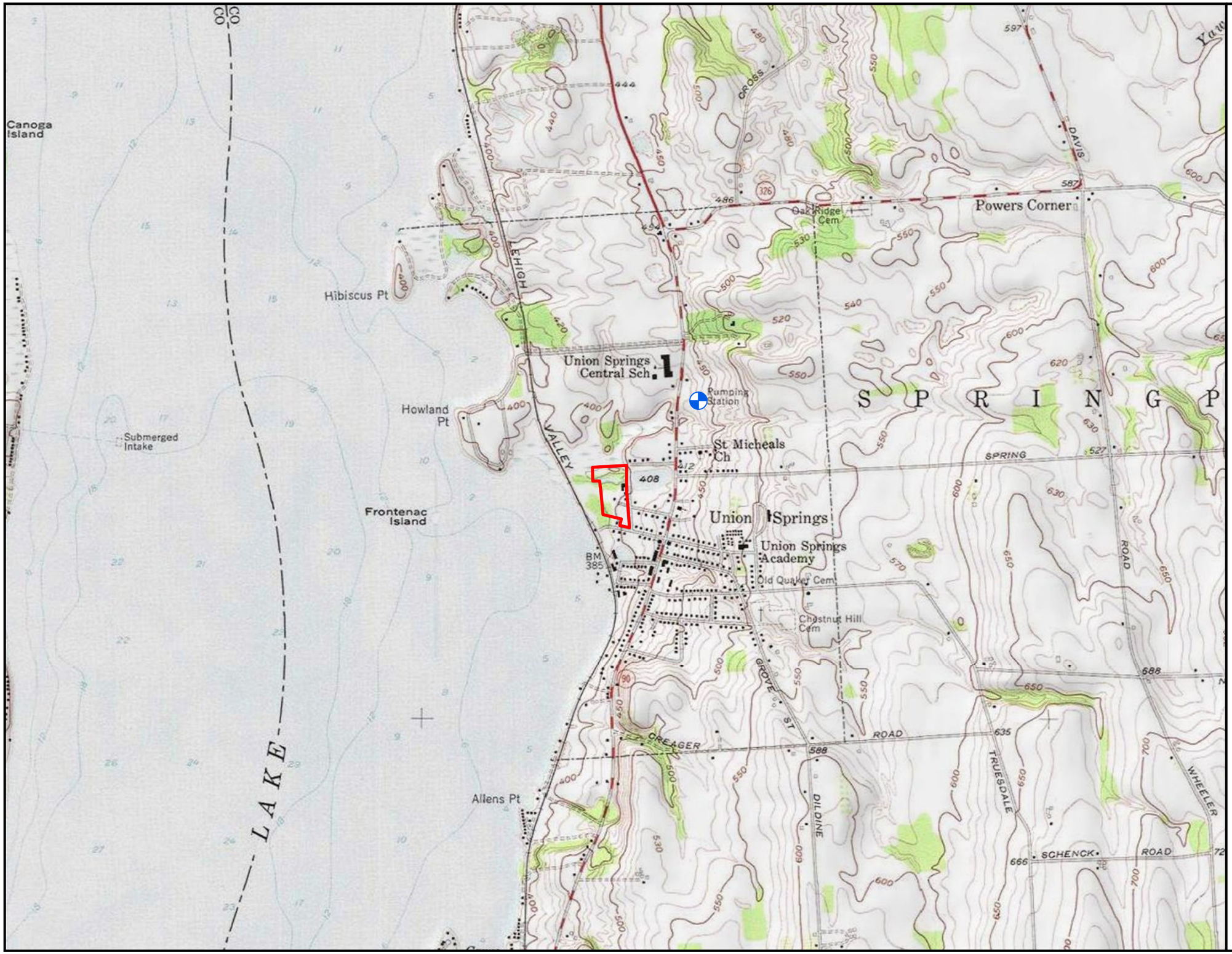
## FIGURES





**Legend**

- Approximate Site Boundary
- Village of Union Springs Water Supply

**NOTES:**

- Location of Former TRW Union Springs Facility was digitized using aerial photography. Locations are approximate.

N

0 1,000 2,000 3,000 4,000

Feet

**Figure 1:** Site Location Map
Former TRW Union Springs Facility
Union Springs, New York

ERM

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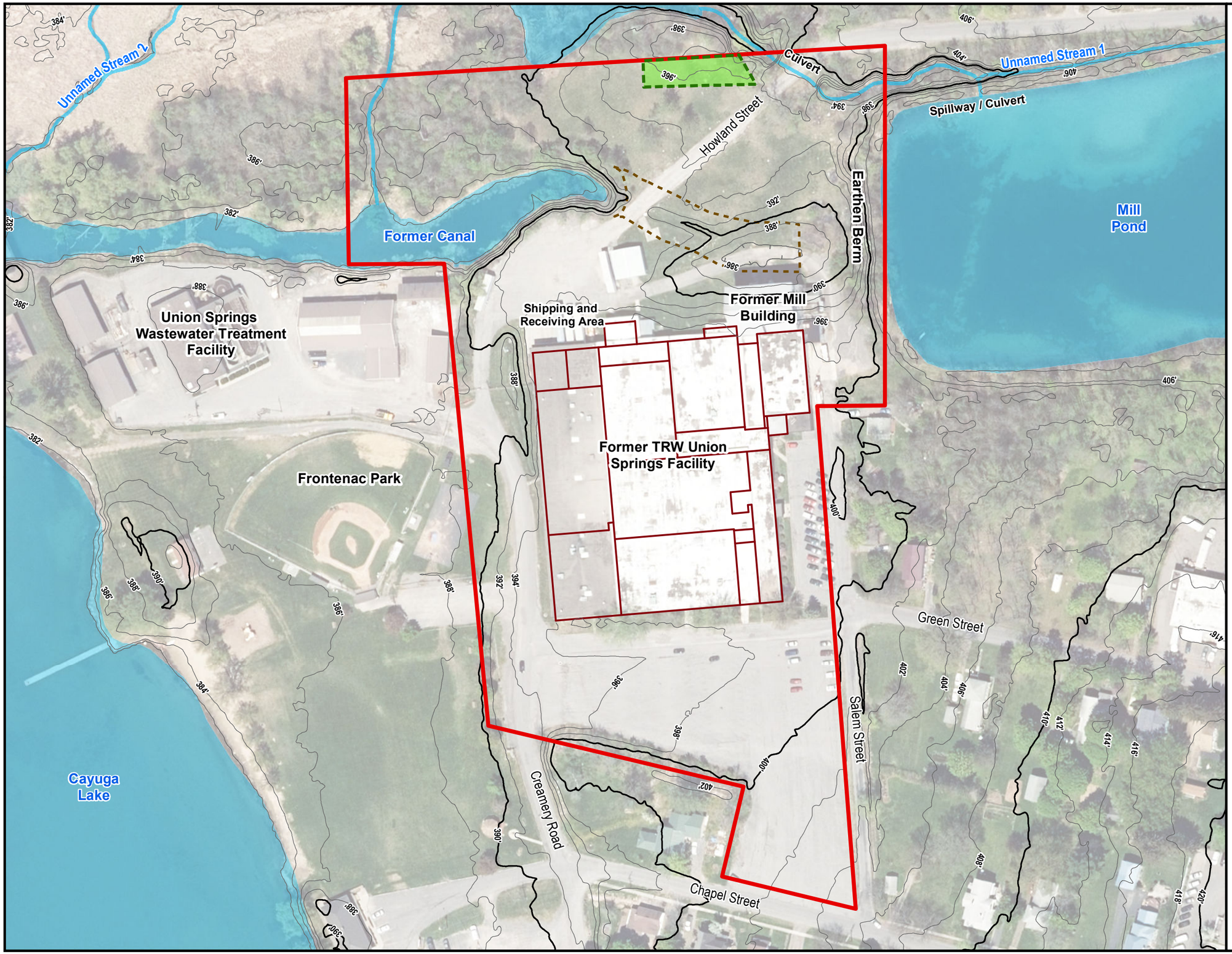


**Legend**

- Building Outline (Approximate)
- Surface Contour - 10 feet
- Surface Contour - 2 feet
- Stream
- Surface Water
- Buried Portion of Former Canal
- Phytoremediation Pilot Study Area
- Approximate Site Boundary

**NOTES:**

- National Wetlands Inventory data provided by the U.S. Fish and Wildlife Service.
- Location of Former TRW Union Springs Facility was digitized using aerial photography. Locations are approximate.
- The buried portion of the former canal was digitized based on historical maps and photographs. Location is approximate.
- Approximate boundary of former canal based on normal high water conditions.
- Aerial imagery captured in 2015 from New York State.

N

0 25 50 100 150 200

Feet

**Figure 2:** Topography and Site Layout
Former TRW Union Springs Facility
Union Springs, New York

ERM

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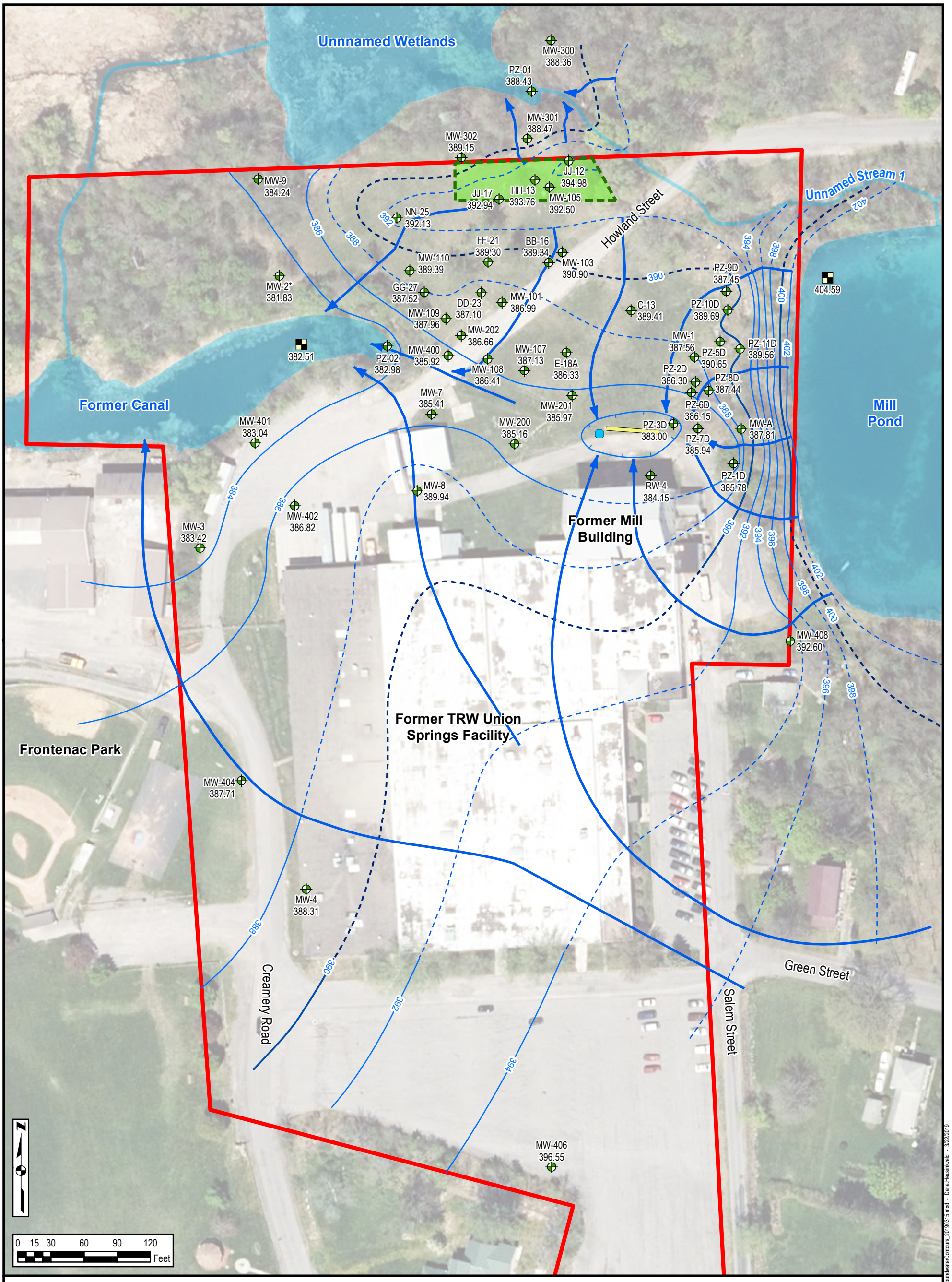



## Legend

- Groundwater Gauging Location and Groundwater Elevation (395.66)
- Staff Gauge
- Catch Basin
- Groundwater Interceptor Trench
- Phytoremediation Pilot Study Area
- Brownfield Cleanup Program Boundary
- Groundwater Flow Lines
- Stream
- Surface Water

**Shallow Groundwater Contours**

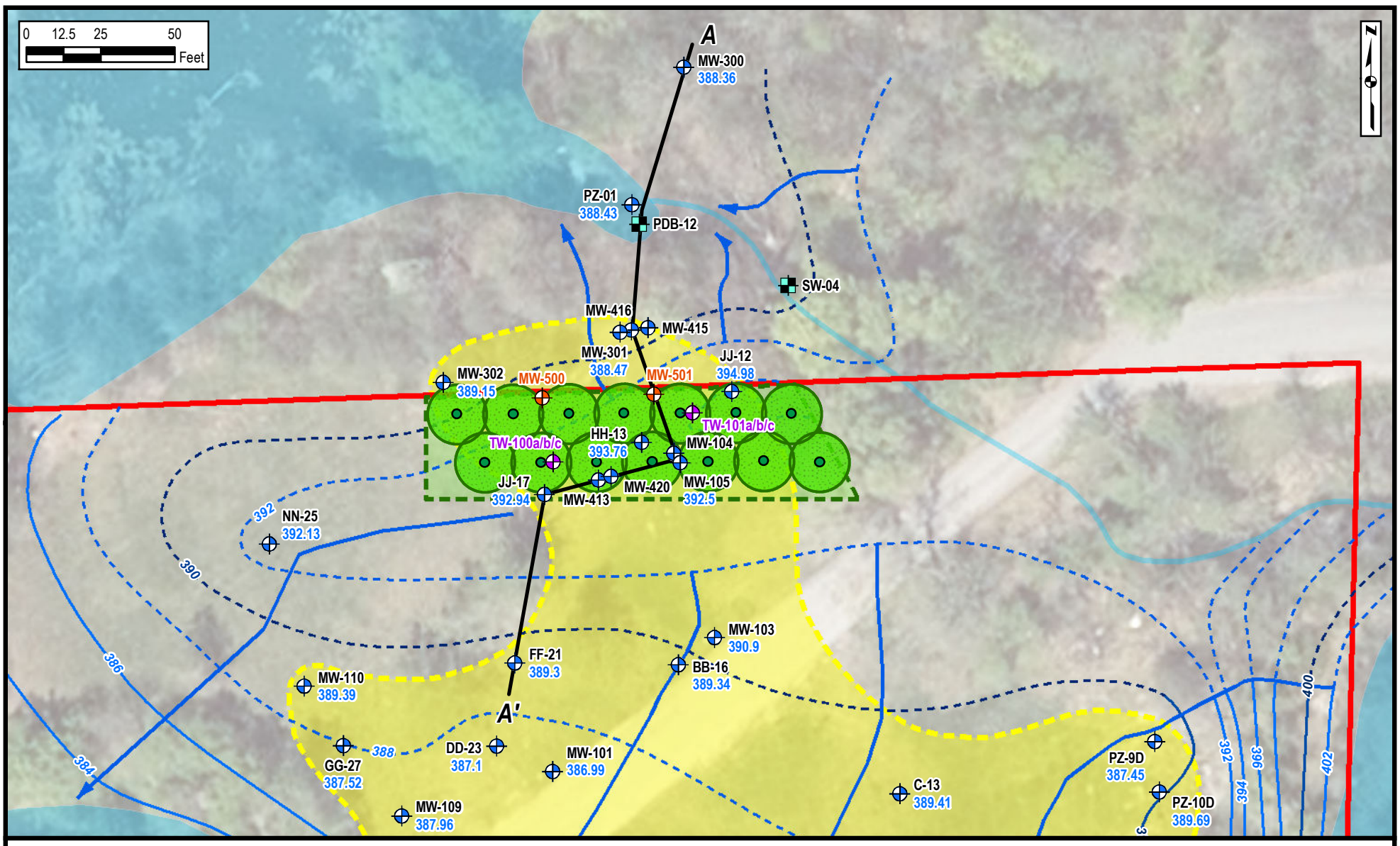
- 10 foot Contours
- 10 foot Contours (Inferred)
- 2 foot Contours
- 2 foot Contours (Inferred)

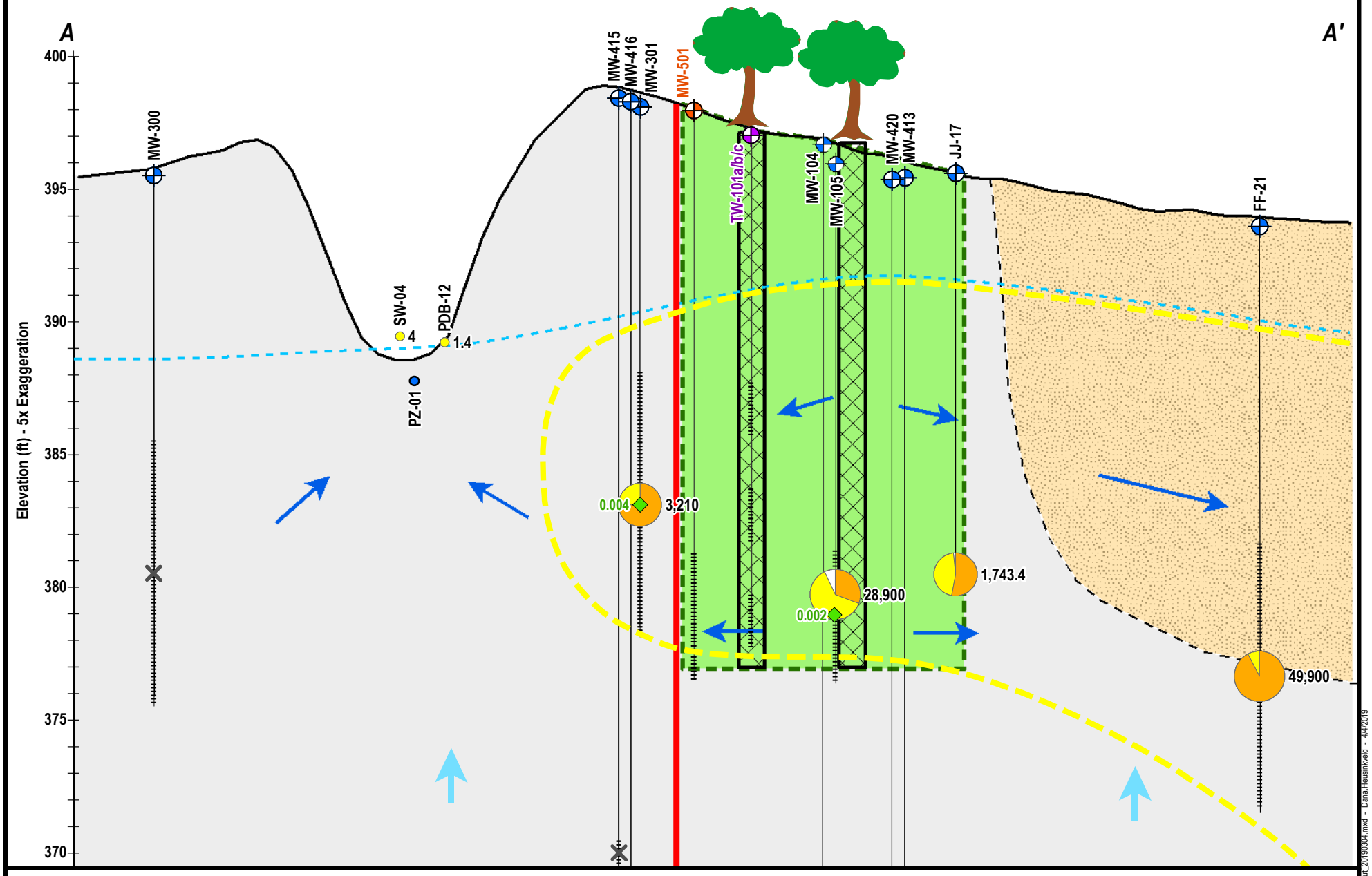
**NOTES:**

- * Denotes anomalous data that was not used in groundwater elevation interpretations.
- Shallow groundwater elevations from wells screened less than 20 feet below surface.
- Groundwater elevations were obtained from the 10 April 2017 gauging event.
- Elevation is reported as feet above mean sea level.
- Aerial imagery captured in 2015 from New York State.

**Figure 3:** Shallow Overburden Groundwater Elevation and Contours
Former TRW Union Springs Facility
Union Springs, New York

ERM




## Legend

- Groundwater Gauging Location
- 395.66 Groundwater Elevation (feet)
- Proposed Well
- Proposed Nested Well
- Approximate Water Table
- Pre-phytoremediation Groundwater Flow Lines

**Shallow Overburden Groundwater Contours**

- 10 foot Contours
- 10 foot Contours (Inferred)
- 2 foot Contours
- 2 foot Contours (Inferred)

- Upward Hydraulic Gradient
- Hydraulic Conductivity (ft/day)
- Monitoring Well Screen
- Borehole
- Cross Section Transect
- Engineered Tree Well
- Tree Well
- Approximate Phytoremediation Pilot Study Area
- Inferred CVOC in Groundwater in Excess of Ambient Groundwater Standards
- Silt and Clay
- Fine Sand and Silt

- Brownfield Cleanup Program Boundary

**Pie Chart Total VOCs (µg/L)**

- Trichloroethene
- cis-1,2-Dichloroethene
- Vinyl Chloride
- Non-detect

**Figure 4:** Proposed Engineered Phytoremediation Layout
Former TRW Union Springs Facility
Union Springs, New York

**NOTES:**

- Shallow overburden groundwater contours (<20 ft bgs) based on groundwater elevations (ft amsl) from 10 April 2017 gauging event.
- Proposed piezometers (up to 6) installed within selected *TreeWells*® will be field selected (not shown)
- Aerial imagery captured in 2015 from New York State.

ERM

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Tree planting

Nested monitoring wells collocated with up to 2 *TreeWells* ®

3.5 ft

Piezometer collocated with up to 6 *TreeWells* ®

1 ft

8 ft

~8 ft bgs

~8 ft bgs

20 ft

2-foot well screen approx. 10-12 feet bgs

2-foot well screen approx. 14-16 feet bgs.

12 ft

5-foot well screen approx. 11.5-16.5 feet bgs.

2-foot well screen approx. 18-20 feet bgs.

3.5 ft

## Legend

- Static Water Table
- Well Screen (pre-pack)
- *Root_Sleeve*™ Liner
- PVC Aeration Tube
- Tree Roots
- Gravel
- Liner
- Imported Clean Soil
- Soil Cuttings
- High Permeability Amended Soil
- Native Soil

**Figure 5:** Proposed *TreeWell* ® Construction Detail
Former TRW Union Springs Facility
Union Springs, New York

**NOTES:**
- Scale is approximate.
- bgs = below ground surface.
- All montioring wells shown are 1.5-inch diameter wells installed as pre-pack type wells placed in *TreeWell* ® boring prior to amended soil backfill.
- Some *TreeWell*® installations will include nested monitoring wells or piezometers, but not both; both are shown on the figure for purposes of efficiency.
- Aeration and nutrient addition tubing will be installed in each *TreeWell* ® (not shown)

ERM

# APPENDIX A LPW DEVELOPMENT LLC ACKNOWLEDGMENT AND APPROVAL

ERM

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April 4, 2018

Mr. Marshall
LPW Development LLC,
15 Garfield Street
Auburn, New York 13021-009

Subject: Proposed Engineered Phytoremediation Pilot Study Approval – Former TRW Automotive Facility, 107 Salem St, Village of Union Springs, NY.

Dear Mr. Marshall

ERM Consulting & Engineering, Inc. (ERM), on behalf of TRW Automotive U.S. LLC (TRW) is planning to implement the proposed Engineered Phytoremediation Pilot Study (Project) on the referenced property as discussed in detail during our meeting with you on 15 March 2019. During the meeting, the details of the Project were discussed as outlined below:

- ERM is proposing to install 14 engineered phytoremediation TreeWells north of the Howland Street access road. The pilot testing area is shown on the attached figure. Soil removed from the TreeWells will be mounded around each TreeWell structure, covered with plastic and stone for long-term maintenance. The mounded soil and stone will have a minimum of 1 foot of clean cover following the guidance for current and future intended use of the property (i.e., restricted-commercial) in the New York State Department of Environmental Conservation's Division of Environmental Remediation 6 NYCRR Part 375 Environmental Remediation Programs. Disturbed soil around the TreeWells will be graded and grass will be planted for ease of maintenance. ERM, on behalf of TRW, will conduct maintenance on the TreeWells, as needed.

- The proposed pilot study area will be surrounded with chain-link fencing to protect the trees from wildlife in the area. A large gate will be added to the fence to allow LPW access for mowing or other maintenance purposes.

- Several flush-mounted monitoring wells and piezometers already exist or will be installed in and around the proposed pilot testing area for monitoring of subsurface conditions.

- The installation of the TreeWells is currently proposed for May 2019. If the schedule changes based on the regulatory approval process or other unforeseen circumstances, LPW will be notified in writing.

- The proposed pilot test is a long-term remedial approach. The TreeWells are anticipated to be in place for at least a decade.

This signed letter serves as documentation of the 15 March meeting and LPW's acknowledgement and approval for the Project.

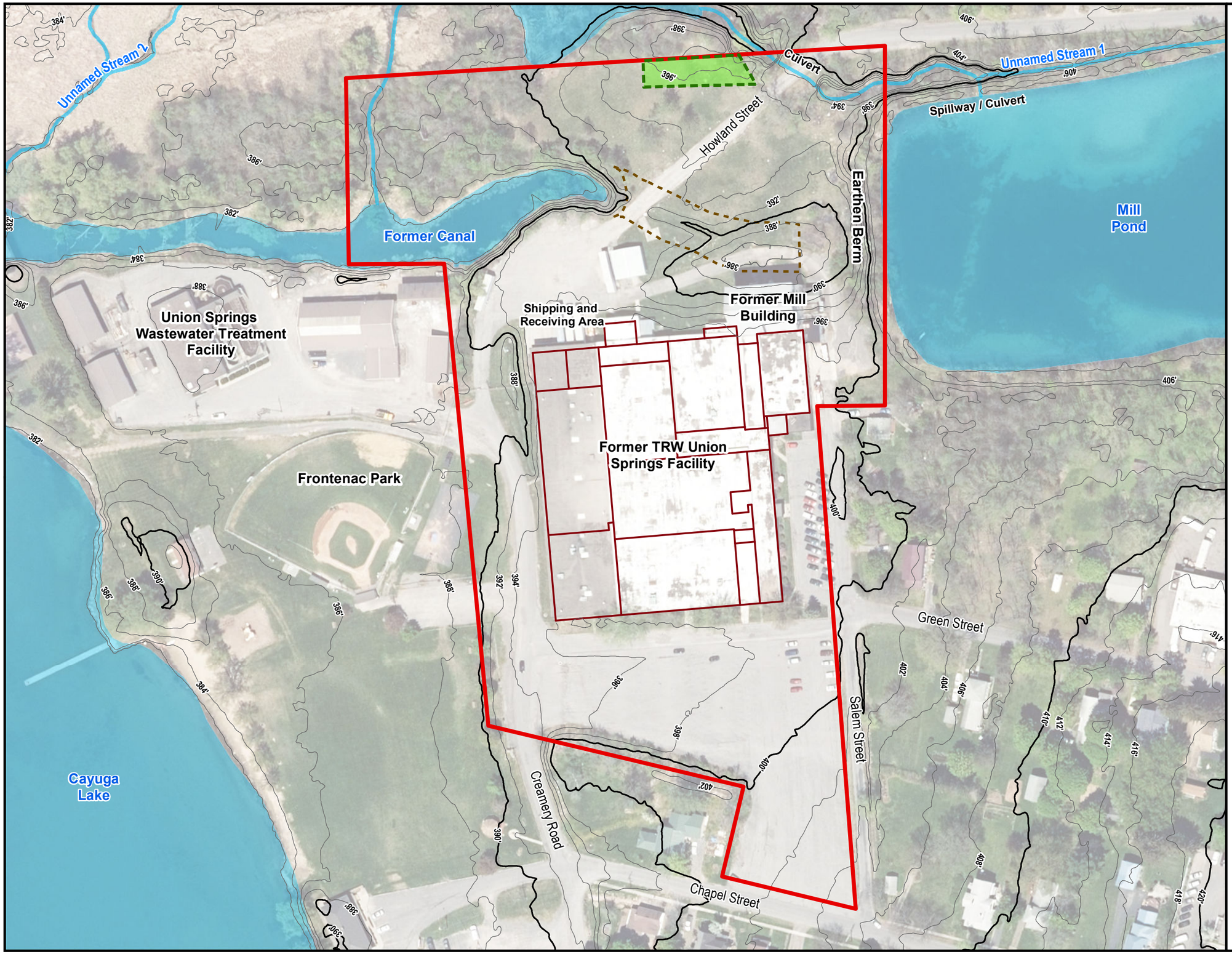
Yours sincerely

Rob Sents
ERM Project Manager

Name: _____

Title: Member

Date: 4-8-19




**Legend**

- Building Outline (Approximate)
- Surface Contour - 10 feet
- Surface Contour - 2 feet
- Stream
- Surface Water
- Buried Portion of Former Canal
- Phytoremediation Pilot Study Area
- Approximate Site Boundary

**NOTES:**

- National Wetlands Inventory data provided by the U.S. Fish and Wildlife Service.
- Location of Former TRW Union Springs Facility was digitized using aerial photography. Locations are approximate.
- The buried portion of the former canal was digitized based on historical maps and photographs. Location is approximate.
- Approximate boundary of former canal based on normal high water conditions.
- Aerial imagery captured in 2015 from New York State.

N

0 25 50 100 150 200

Feet

**Figure 2:** Topography and Site Layout
Former TRW Union Springs Facility
Union Springs, New York

ERM

Q:\Team\DMM\Clients_Q_U\TRW\Union_Springs\MXD\2019_Workplan\Figure2_TopoLayout_20190315.mxd - Dana.Heusinkveld - 3/15/2019