In-Situ Bioremediation
Work Plan

CHS Property

33685 Highway 99E
Tangent, Oregon

Agency Information

ODEQ ECSI File No. 5470

Prepared for:

CHS Inc.
5500 Cenex Drive
Inver Grove Heights, Minnesota 55077

Issued on:
May 20, 2024

EVREN Northwest, Inc.
Project No. 160-02001-21

Offices in Portland and Bend, Oregon / San Rafael, California
P.O. Box 14488, Portland, Oregon 97293
T. 503-452-5561 / E. ENW@EVREN-NW.com

This

In-Situ Bioremediation
Work Plan

For the:

CHS Property
33685 Highway 99E
Tangent, Oregon

Has been prepared for the sole benefit and use of our Client:

CHS Inc.
5500 Cenex Drive
Inver Grove Heights, Minnesota 55077

and its assignees

Issued May 20, 2024 *by:*

EVREN NORTHWEST INC.
environmental & natural resource consultants

CERTIFIED
OREGON
LYNN DELAVAN GREEN
E2332
ENGINEERING GEOLOGIST

EXP. 2/1/2025

REGISTERED PROFESSIONAL
OREGON
PAUL M. TRONE
No. G1178
GEOLOGIST

Exp 1-1-25

Paul M. Trone, R.G.
Principal Geologist

Lynn D. Green, Ph.D.
Principal Engineering Geologist

Limitations. This Work Plan (Plan) is reflective of site conditions discovered through environmental site assessments. Required actions described in this Plan are consistent with State of Oregon and Oregon Department of Environmental Quality rules, regulations and guidance enforce and available as of the Plan issue date. The Client is advised to check for any updates that may be applicable to a specific scope of work being conducted under this Plan.

No warranties are expressed or implied concerning potential contaminants or environmental media not addressed through sampling and analysis. EVREN Northwest is not responsible for conditions or consequences arising from information not available at the time of Plan preparation. This Plan was prepared in accordance with generally accepted professional practice in the area at this time for the exclusive use of our client and their agents or authorized third parties. No other warranty, either expressed or implied, is made.

Table of Contents

List of Tables and Figures

Tables (in text)

Figures (after text)

List of Acronyms and Abbreviations

3DMe	3-D Microemulsion
BDI Plus	Bio-Dechlor Inoculum
bgs	below ground surface
BOD	biological oxygen demand
Cascade	Cascade Technical Services of Clackamas, Oregon
Client	CHS Inc.
CO2 or CO_2	carbon dioxide
COD	chemical oxygen demand
cVOCs	chlorinated volatile organic constituents
DCP	1,2-dichloropropane
DHC	*Dehalococcoides sp.*
DO	dissolved oxygen
DPT	direct-push technology
ECSI	Environmental Site Cleanup Information
ENW	EVREN Northwest, Inc.
EPA	US Environmental Protection Agency
ft	feet
gal	gallons
GPR	ground-penetrating radar
H_2	hydrogen
HASP	Health and Safety Plan
HRC	Hydrogen Release Compound
ISCR	in-situ chemical reduction
$IWBU_{UM}$	intermediate water-bearing unit, upper middle portion
$IWBU_L$	intermediate water-bearing unit, lower portion
L	liters
lbs.	pounds
ODEQ	Oregon Department of Environmental Quality
ORP	oxygen-reduction potential
PE	polyethylene
TCP	1,2,3-trichloropropane

1.0 Introduction

EVREN Northwest, Inc. (ENW) has prepared this *In-Situ Bioremediation Full Site Work Plan* (work plan) on behalf of CHS Inc. (Client) for the subject site (CHS Property, 33685 Highway 99E, Tangent, Oregon; see Figures 1 and 2). The results of the in-situ bioremediation pilot study (June 2021 through May 2023)[1] returned positive results demonstrating the effectiveness of the selected product consortia to enhance *in-situ chemical reduction* of 1,2-dichloropropane (DCP) and 1,2,3-trichloropropane (TCP) in the upper portion of the IWBU at a rate that exceeds natural attenuation alone. Therefore, ENW proposes expansion of in-situ bioremediation as a means of reducing the risk to human health associated with these constituents.

Oregon Department of Environmental Quality (ODEQ) is providing oversight through its Voluntary Cleanup Program. ODEQ previously assigned the subject site Environmental Site Cleanup Information (ECSI) site number 5470. The scope of work described in this Work Plan is consistent with prior communications with ODEQ, in which ODEQ said they would prefer more focused remediation.[2] On March 26, 2024, Client authorized ENW to prepare this work plan.

2.0 Background and Goals

ENW discussed options for site closure with ODEQ, including in-situ chemical reduction and long-term monitoring with deepened offsite wells W02 through W04 (see Figure 2). ODEQ has advised ENW that if the higher TCP/DCP concentrations onsite in the $IWBU_{um}$ can be substantially reduced (i.e., by an order of magnitude or so), even if not below drinking water risk-based concentrations they may reduce the long-term ground water monitoring requirements associated with that alternative. Upon consideration of these potential benefits, CHS authorized ENW to proceed with this in-situ bioremediation pilot study, the objectives of which were to:

1. Establish the *effectiveness* of using injections of commercial nutrients, reduction agents, and microbial consortia to promote anaerobic reductive dechlorination of DCP and TCP in the onsite $IWBU_{um}$.
2. Obtain the information needed to estimate the cost of full-scale implementation for use in the evaluation of remedial action alternatives (assuming this is an effective remediation approach and if full-scall implementation is needed).

In accordance with ODEQ's request, ENW prepared a pilot study work plan[3] to test the effectiveness of in-situ bioremediation, i.e., reductive dechlorination, of TCP and DCP in the $IWBU_{um}$ at the subject property. Following discussions with ODEQ, ENW initiated the pilot study in June 2021 with the installation of six temporary injections points upgradient of MW16-I_{UM}, injection at each point of a consortia of 3-D Microemulsion (3DME®), CRS® In-Situ Chemical Reduction (ISCR) Solution (CRS®), and Bio-Dechlor

[1] ENW, July 26, 2023. *In-Situ Bioremediation Pilot Study Summary of Results*, CHS Property, 33685 Highway 99E, Tangent, Oregon, Agency Information ODEQ ECSI File No. 5470, Prepared For: CHS, Inc., 763 Willoughby Lane, Stevensville, Montana 59870.

[2] Meeting with ODEQ, December 12, 2023.

[3] ENW, March 29, 2021. *In-Situ Bioremediation Pilot Study Work Plan*, CHS Property, 33685 Highway 99E, Tangent, Oregon, Agency Information ODEQ ECSI File No. 5470, Prepared for: CHS Inc., 763 Willoughby Lane, Stevensville, Montana 59870.

Inoculum (BDI® Plus),[4] and performance of seven quarters (November 2021 through May 2023) monitoring pursuant to the proposed analytical plan in the pilot study work plan. The pilot study clearly demonstrated the effectiveness of the selected product consortia to enhance in-situ chemical reduction of TCP to DCP in MW16-I_{UM} as compared to MW14-I_{UM}, which was upgradient of the pilot study array.[1] Over the course of 33 months, a 79% decrease in TCP and 57% decrease in DCP was realized at MW16-I_{UM} compared to a 20% decrease in TCP and 18% decrease in DCP at MW14-I_{UM}. Historically, TCP and DCP detections in MW16-I_{UM} were among the highest at the site.

Since the pilot study data suggest that injection of reducing agents and microbial consortia enhance reductive dechlorination of TCP/DCP, ENW initiated follow-up discussions between ODEQ and the client concerning in-site bioremediation as a remedial option to bring the site to closure. ODEQ noted that if we had control over off-site ground water use, monitored natural attenuation alone could be appropriate. Ground water use restrictions could be enacted to achieve that end, however, in the absence of such controls, ODEQ preferred more focused remediation through implementation of in-situ bioremediation as an interim remedial action measure which had proved so effective during the pilot study. The goals of site-wide in-situ bioremediation are to:

1. inject commercial nutrients, reduction agents, and microbial consortia to promote anaerobic reductive dechlorination of TCP and DCP in the $IWBU_{um}$ throughout the impacted area of the site.
2. Reduce TCP and DCP to concentrations that would not require long-term monitoring and would facilitate site closure.

3.0 Proposed Pilot Study Scope of Work

The following general tasks are proposed to complete in-situ bioremediation full site. Details of the tasks are presented in the following sections.

- Pre-field Activities
- Full Site Injections
- Install network of pilot injection points (inject from 30- to 50-ft) in each of the three treatment areas covering the TCP/DCP plume:
    - **Area 1 (6,400-sf)**: central part of the plume having the highest TCP/DCP concentrations, which includes MW14-I_{UM} and MW16-I_{UM}. Requires 14,000 pounds of 3DMe and 98 liters of BDI. Product will be injected into 41 points from 30- to 50-ft below ground surface (bgs) spaced 12.5-ft on center.
    - **Area 2 (9,100-sf)**: northeast part of the plume covered partially by a 5,190-sf building, hydraulically upgradient of Area 1. Neither TCP nor DCP were detected in reconnaissance ground water samples collected in April 2012 from B34 and B35 positioned near the eastern edge of this area. Requires 10,000 pounds of 3DMe and 63 liters of BDI. Product

[4] ENW, June 30, 2021. *Pilot Study – In-Situ Bioremediation, Reductive Dechlorination Pilot Study – Injections and Baseline Monitoring (June 2021)*, CHS Property, 33685 Highway 99E, Tangent, Oregon, Agency Information ODEQ ECSI File No. 5470, Prepared for: CHS Inc., 763 Willoughby Lane, Stevensville, Montana 59870.

will be injected into 16 points from 30- to 50-ft bgs spaced 12-ft on center surrounding the north and east side of the building.

- **Area 3 (44,100-sf)**: east and central parts of the plume in the east-central part of the site, excluding Areas 1 and 2. The former dry fertilizer plant building footprint is in the east-central part of Area 3. Requires 78,000 pounds of 3DMe and 653 liters of BDI. Product will be injected into 114 points from 30- to 50-ft bgs that are 15-ft on center with rows (perpendicular to ground water flow) and 25-ft on center between rows (parallel to ground water flow).

- Apply a one-time dilute suspension of inorganic nutrients, microbial consortia, and chemical reduction agent into the injection points to enhance bioremediation of TCP and DCP via anaerobic reductive dechlorination.
- Monitoring
  - Conduct 12 consecutive quarters (three years) of ground water monitoring and sampling from select monitoring wells.
  - Analyze samples for dissolved DCP, TCP, reductive dechlorination and water chemistry parameters to monitor the effectiveness of in-situ bioremediation treatment.
- Reporting
  - Submit an injection summary report once completed.
  - Submit quarterly ground water monitoring reports.
  - Submit a final report summarizing all in-situ bioremediation monitoring results and presenting an assessment of effectiveness of implementation.

4.0 Pre-Field Activities

The following activities will be completed prior to beginning field work:

- Obtain ODEQ-written approval of this Work Plan.
- A copy of the updated site-specific HASP will be presented to all ENW field personnel and their subcontractors. A tailgate safety meeting will be conducted with all site workers, prior to the start of any onsite work.
- Coordinate access. ENW will coordinate access to the injection area and access to a clean water supply.
- Locate utilities in the area of work. At least 48 hours prior to the start of subsurface activities, proposed work locations will be marked with white paint and One-Call Utility Notification Service will be notified. In addition, a private underground utility locator will be contracted to map subsurface utilities and clear work locations. The injection areas will be scanned with ground penetrating radar (GPR) to locate any underground utilities that may be in the area prior to any tooling being advanced into the subsurface.

- Coordinate subcontractors and ensure all necessary materials are obtained and ready for use during onsite work.

5.0 In-Situ Bioremediation Injection

5.1 Treatment Technology and Rationale

ENW is proposing enhanced anaerobic bioremediation to accelerate the natural attenuation of chlorocarbons in the subsurface. The technology utilizes native microorganisms in addition to introduced acclimated or specialized microorganisms specifically adapted to perform the biotransformation of chlorocarbon compounds through a process called reductive dichlorination. This technology has shown that in microcosms derived from river sediment, TCP can be dechlorinated to DCP, and DCP can be completely dechlorinated to 1-chloropropane, 2-chloropropane, and propene by anaerobic bacteria. [5]

Native and introduced microorganisms have specific nutritional requirements and abilities for mediating transformation of organic compounds. Principal limitations relate to the survival of the introduced bacteria, the distribution and transport of microorganisms within the subsurface environment and ensuring that the microorganisms retain their specific biotransformation abilities. As such, certain geochemical conditions and limiting inorganic nutrients must be maintained to ensure effectiveness of this technology in the subsurface environment.

5.2 Process Description

The process is initiated by injecting a carbon source into the subsurface environment below the water table and positioned within the contaminated zone. This carbon source is fermented by naturally occurring microorganisms (dechlorinating bacteria), which release hydrogen. The dechlorinating bacteria use this hydrogen as their electron donor, ultimately replacing chlorine atoms in the chlorocarbon with hydrogen atoms via hydrogenolytic reductive de-chlorination as shown in Figure 1 below from Löffler and others, 1997.[5]

[5] Löffler, F.E. and others, 1997. Complete Reductive Dechlorination of 1,2 Dichloropropane by Anaerobic Bacteria: In Applied and Environmental Microbiology, v 63, no 7, July 1997, pp 2870-2875.

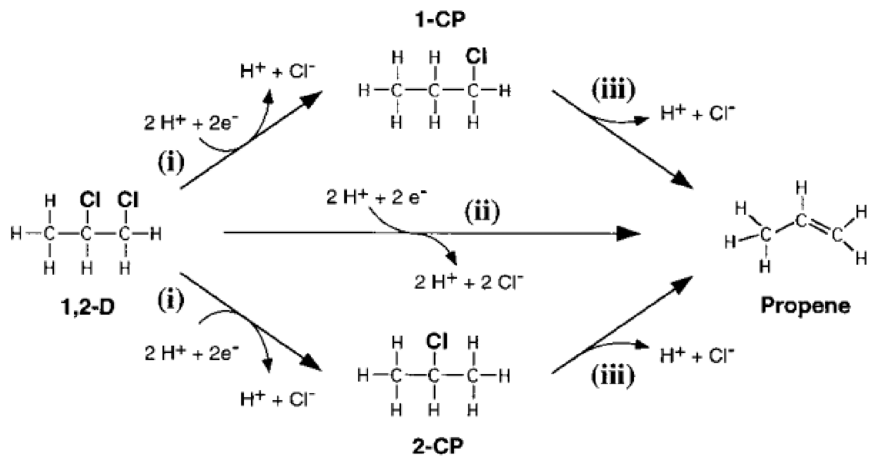


FIG. 1. Anaerobic transformation of 1,2-D detected in microcosms by (i) hydrogenolysis of 1,2-D resulting in the formation of monochlorinated propanes (1-CP and 2-CP), (ii) dichloroelimination (vicinal reduction) of 1,2-D resulting in the formation of propene, the only reaction observed in sediment-free cultures, and (iii) dehydrochlorination of monochlorinated propanes resulting in the formation of propene. Hydrogenolysis of monochlorinated propanes and dehydrochlorination of 1,2-D, a reaction that would result in the formation of monochlorinated propenes, were not observed.

As a follow-up to Loffler and others (1997) initial study,[5] Ritalahti and Löffler (2004)[6] conducted a microcosm study to isolate the bacterial species responsible for reductive dechlorination of DCP. Their findings attributed DCP dechlorination to *Dehalococcoides* populations, thereby expanding the spectrum of chlororganic compounds used by *Dehalococcoides* species as growth-supporting electron acceptors.

5.3 Proposed Product

The remediation design assumes injection of a dilute suspension of 3-D Microemulsion (3DMe), CRS ISCR Solution (CRS) and Bio-Dechlor Inoculum (BDI Plus), all provided by Regenesis of San Clemente, California.

- 3DMe® is comprised of a patented molecular structure containing oleic acids (i.e., oil component) and lactates/polylactates, which are molecularly bound to one another. The 3DMe® molecule contains both a soluble (hydrophilic) and insoluble (lipophilic) region. These two regions of the molecule are designed to be balanced in size and relative strength. The balanced hydrophilic/lipophilic regions of 3DMe® result in an electron donor with physical properties allowing it to initially adsorb to the aquifer material in the area of application, then slowly redistribute via very small 3DMe® "bundles" called micelles. Thus, has been engineered with unique characteristics to facilitate its distribution in the subsurface environment. Once injected and distributed, 3DMe will turn the aquifer anaerobic for an average period of 2-3 years and thereby cause the controlled release of organic acids to the aquifer to stimulate reductive dechlorination. 3DMe® incorporates a Hydrogen Release Compound (HRC®) in addition to a unique molecule (Regenesis, patent pending) that is specifically designed to provide a sequential release of highly efficient electron donors.

[6] Ritalahti, K.M. and Löffler, F.E., 2004. Populations Implicated in Anaerobic Reductive Dechlorination of 1,2-Dichloropropane in Highly Enriched Bacterial Communities: In Applied and Environmental Microbiology®, v 70, no 7, July 2004, pp 4088-4095.

- BDI Plus® is a natural microbial consortium containing species of Dehalococcoides sp. (DHC). This microbial consortium has been enriched to increase its ability to rapidly dechlorinate chlorocarbons (DCP and TCP), during the ISCR processes. 3DMe® will chemically reduce these chlorocarbons, and BDI Plus will provide the *Dehalococcoides* cultures to remediate the chlorocarbons to propene. Addition of BDI Plus will result in the direct application to the subsurface (i.e., seeding) of a bacterial population capable of complete reductive dechlorination to 1-chloropropane and 2-chloropropane, and then to propene. It is proposed here as an enhancement, possibly without the intermediate formation of monochlorinated propanes.

5.4 Methods and Locations

Injections will be performed by a licensed drilling company using an injection platform and direct-push technology (DPT) drill rigs operated by a 40-hour HAZWOPER[7] trained crew.

The injections will be completed in three treatment areas (see Section 3 and Figure 4). Each injection point will contain six (6) five-foot injection intervals at depths of 20 to 25 feet, 25 to 30 feet, 30 to 35 feet, 35 to 40 feet, 40 to 45 feet, and 45 to 50 feet below ground surface (bgs). Injection points in Area 1 will be spaced 12.5-ft on center, injection points in Area 2 will be spaced 12-ft on center, and injection points in Area 3 will be spaced 15-ft on center with rows 25-ft-apart approximately as shown in Figure 4.

The product mixtures and volumes for each injection point are provided on Table 5-1. Actual flow rates and volume totals will be monitored and recorded onto injection logs and overseen by an ENW geologist. The areas surrounding the injection points will be closely monitored for signs of surfacing and spill prevention equipment will be on hand in the event of a spill.

Table 5-1. 3DME® and BDI® Plus Application Design Summary

<table>
<tr><th colspan="2">Treatment Area 1 - Dissolved plume and Saturated Soil</th><th colspan="2">Field Instructions</th></tr>
<tr><td>Application Method</td><td>Direct Push</td><td colspan="2" rowspan="5"></td></tr>
<tr><td>Spacing of points within Rows (ft)</td><td>12.5</td></tr>
<tr><td>Spacing between rows (ft)</td><td>12.5</td></tr>
<tr><td>Application Points</td><td>41</td></tr>
<tr><td>Areal Extent (ft2)</td><td>6,400</td></tr>
<tr><td>Top Application Depth (ft bgs)</td><td>20</td><td colspan="2">Field Mixing Ratios</td></tr>
<tr><td>Bottom Application Depth (ft bgs)</td><td>50</td><td colspan="2" rowspan="2">3DME Concentration per pt (gal)
41</td></tr>
<tr><td>3DME to be applied (lbs.)</td><td>14,000</td></tr>
<tr><td>3DME to be applied (gal)</td><td>1,678</td><td colspan="2" rowspan="2">Mix Water per pt (gal)
777</td></tr>
<tr><td>3DME Mix %</td><td>5%</td></tr>
<tr><td>Volume Water (gal)</td><td>31,875</td><td colspan="2" rowspan="2">3DME Mix Volume per pt (gal)
818</td></tr>
<tr><td>3DME Mix Volume (gal)</td><td>33,553</td></tr>
<tr><td>BDI Plus to be applied (L)</td><td>98</td><td colspan="2" rowspan="2">BDI Volume per pt (L)
2.4</td></tr>
<tr><td>BDI Mix Water Volume (gal)</td><td>980</td></tr>
<tr><td>Total Application Volume (gals)</td><td>34,533</td><td rowspan="2">Vol. per pt (gal)
842</td><td rowspan="2">Vol. per vert. ft
28</td></tr>
<tr><td>Estimated Radius of Injection (ft)</td><td>6.25</td></tr>
</table>

[7] Hazardous Waste Operations and Emergency Response (HAZWOPER).

Treatment Area 2 - Dissolved plume and Saturated Soil		**Field Instructions**	
Application Method	Direct Push		
Spacing of points within Rows (ft)	12		
Spacing between rows (ft)	See Figure 4		
Application Points	16		
Areal Extent (ft2)	9,100		
Top Application Depth (ft bgs)	20	**Field Mixing Ratios**	
Bottom Application Depth (ft bgs)	50	3DME Concentration per pt (gal)	
3DME to be applied (lbs.)	10,000	75	
3DME to be applied (gal)	1,198	Mix Water per pt (gal)	
3DME Mix %	11%	606	
Volume Water (gal)	9,696	3DME Mix Volume per pt (gal)	
3DME Mix Volume (gal)	10,894	681	
BDI Plus to be applied (L)	63	BDI Volume per pt (L)	
BDI Mix Water Volume (gal)	630	3.9	
Total Application Volume (gals)	11,524	Vol. per pt (gal)	Vol. per vert. ft
Estimated Radius of Injection (ft)	6	720	24

Treatment Area 3 - Dissolved plume and Saturated Soil		**Field Instructions**	
Application Method	Direct Push		
Spacing of points within Rows (ft)	15		
Spacing between rows (ft)	25		
Application Points	114		
Areal Extent (ft2)	44,100		
Top Application Depth (ft bgs)	20	**Field Mixing Ratios**	
Bottom Application Depth (ft bgs)	50	3DME Concentration per pt (gal)	
3DME to be applied (lbs.)	78,000	82	
3DME to be applied (gal)	9,347	Mix Water per pt (gal)	
3DME Mix %	8%	1,011	
Volume Water (gal)	115,279	3DME Mix Volume per pt (gal)	
3DME Mix Volume (gal)	124,626	1,093	
BDI Plus to be applied (L)	653	BDI Volume per pt (L)	
BDI Mix Water Volume (gal)	6,530	5.7	
Total Application Volume (gals)	131,156	Vol. per pt (gal)	Vol. per vert. ft
Estimated Radius of Injection (ft)	7.5	1,150	38

The remediation design calls for a total of 12,223 gallons of 3DME® solution and 814 liters of BDI Plus® to be injected across 171 total injection points at an estimated injection rate of 1.8 gallon per minute per point. Water will be supplied from the site. Given the proximity and large number of points, multiple points can be set and injected simultaneously to increase injection efficiency.

Injection will occur through 1.75-inch injection rods equipped with a 5-foot-long multi-port screened injection tool designed to laterally distribute the reagent solution into the desired interval depths. Pressure and flow will be maintained by a manifolded control panel. Each leg has a dedicated port for introducing the BDI® cultures while maintaining an anaerobic atmosphere.

3DME® will be mixed in a high-volume portable mix tank and injected using a progressive cavity pump. Once the volume of solution for an interval has been injected, BDI Plus® bioaugmenation cultures will be injected through a dedicated port. Approximately 20 gallons of anerobic flush water will then be injected to push the culture into the formation. Anerobic water will be created in a separate mix tank using sodium ascorbate (or other oxygen scavenger). Once the volume of reagent solution for an interval is completed, the injection tooling will be pushed to the next interval and the process repeated.

Following fluid injection, each of the temporary injection points will be backfilled with bentonite and completed at the surface to match existing pavement.

6.0 Performance Monitoring

Performance monitoring will be conducted to monitor and evaluate the effectiveness of in-situ bioremediation treatment.

6.1 Ground Water Monitoring and Sampling Collection Methods

Monthly monitoring (field parameters only) and 12 consecutive quarters (three years) of ground water monitoring with sampling will occur at the following existing monitoring wells:

- Nine (9) in the upper portion of the IWBU ($IWBU_{UM}$): MW12-I_{UM}, MW13-I_{UM}, MW14-I_{UM}, MW15-I_{UM}, MW16-I_{UM}, MW17-$_{IUM,}$ MW18-I_{UM}, MW19-I_{UM}, and MW20-I_{UM}.
- Three (3) in the lower portion of the IWBU ($IWBU_L$): MW12-I_L, MW16-I_L and MW18-I_L

The locations of these wells are shown on Figures 3 and 4.

Prior to purging, depth to water and well completion depth will be measured using a water level indicator in the selected ground water monitoring wells. The depth to water will be recorded to the nearest 0.01 foot on a Field Sampling Data Sheet.

The monitoring wells will be purged following low-flow methods using dedicated polyethylene (PE) tubing and a peristaltic pump. During purging, water-quality indicator parameters [pH, temperature, specific conductance, oxygen-reduction potential (ORP), and dissolved oxygen (DO)] will be monitored using a Horiba field instrument equipped with a flow-through cell and recorded on a Field Sampling Data Sheet.

Generally, the following protocol will be followed for collecting ground water samples for each quarterly sampling event:

- Measure the water level and record on the Field Sampling Data Sheet.
- Slowly lower the PE tubing into the monitoring well until the intake end is centered in the screened portion of the monitoring well.
- Connect the discharge line from the peristaltic pump to a flow-through cell. A “T” connector is required prior to the flow cell to allow collection of water for turbidly measurements, if measured. Direct the discharge line from the flow-through cell to a container to contain the purge water during the purging and sampling of the monitoring well.
- Initial pumping at a low flow rate (0.2 to 0.5 liters per minute [L/min]) and slowly increase the pumping rate. Check water level to ensure the total drawdown is less than 10 centimeters (or 0.3 feet), otherwise lower the pumping rate.

- Measure the discharge rate of the pump with a graduated cylinder and a stopwatch. Record both depth to water and flow rate on the Field Sampling Data Sheet every three (3) to five (5) minutes.
- Purge a minimum of one (1) tubing volume (including volume of water in pump and flow cell) prior to recording water-quality indicator parameters (dissolved oxygen, specific electrical conductance, pH, ORP and temperature). Note, ORP may not always be an appropriate stabilization parameter, and will depend on site-specific conditions. However, readings will be recorded as a double check for oxidizing conditions. The stabilization criterion is based on three successive readings of water quality field parameters, as referenced below:
  - pH +/- 0.1
  - Temperature +/-0.1 °C
  - Conductivity +/- 3% µS/cm (microSiemens per centimeter)
  - ORP (oxygen-reduction potential) +/- 10 mV (millivolts)
  - Turbidity +/- 10%
  - DO (dissolved oxygen) +/- 10%

Ground water will be sampled after these parameters have stabilized. Laboratory-supplied containers will be completely filled directly from the effluent tubing with minimal agitation to avoid off-gassing and minimize any void space. Each container will be checked for air bubbles before sealing and refilled if air bubbles are present. Each container will be tightly sealed, labeled, and placed in a cooler for transport to the analytical laboratory under formal chain-of-custody.

6.2 Ground Water Sample Analysis Plan

Ground water samples will be collected on a quarterly basis using low-flow methodology, and field reduction-oxidation (redox) parameters [pH, temperature, DO, ORP and turbidity] will be collected.

Ground water samples will be submitted to the contract laboratory for analysis of select polychlorinated propanes. Additional analysis for parameters specific to monitoring bio-attenuation will also be conducted, such as nitrate, total and dissolved iron and manganese, sulfate, chemical oxygen demand (COD), biological oxygen demand (BOD; 5-day) and dissolved gases [methane, propene, and carbon dioxide (CO_2)]. The proposed analytical plan is provided in Table 6-1 below.

Table 6-1. Proposed Analytical Plan for Monitoring Well Sampling

Analytical Method	Constituents	MW
EPA 5032\5035A\8260B	Select Chlorinated Volatile Organic Constituents (cVOCs)	Ground Water
	• 1,2-Dichloropropane (DCP) • 1,2,3-Trichloropropane (TCP) • 1-Chloropropane (N-Propyl Chloride) • 2-Chloropropane (Isopropyl Chloride)	All
Reductive Dichlorination Parameters	• Nitrate • total and dissolved iron and manganese • sulfate • chemical oxygen demand (COD) • biological oxygen demand (BOD) (5 day) and • dissolved gases [methane, propene, and carbon -dioxide (CO_2)	All

Table 6-2. Analytical Protocol

Analyte(s)	Analytical Method	Container and preservative	Holding time	Preservation
Ground Water:				
Select Chlorinated Volatile Organic Hydrocarbons	EPA Method 5032\8260B	40-ml Teflon cap Volatile Organic Analysis (VOA) containers, no headspace	14-days	Ice & HCl
Nitrate	EPA 300.0	250-ml polyethylene container	48-hours	Ice
Total and Dissolved Iron and Manganese	EPA 6020	250-ml polyethylene container (dissolved will be field-filtered)	6-months	Ice & HNO_3
Sulfate	EPA 300.0	250-ml polyethylene container	28-days	Ice
COD	SM 5220	250-ml polyethylene container	28-days	Ice & H_2SO_4
BOD	EPA 5210	500-ml polyethylene container	48-hours	Ice
Dissolved Gases (methane, propene)	RSK 175	40-ml VOA Vials (3)	1-week	Ice & HCl
CO_2	SM 2320B	250-ml polyethylene container	1-week	Ice
Indicators (data collected during temporary well-point purge)	ORP	per instrument instructions	Field	
	Dissolved Oxygen	per instrument instructions	Field	
	pH	per instrument instructions	Field	
	Temperature	per instrument instructions	Field	
	Specific Conductance	per instrument instructions	Field	

6.3 Investigation-Derived Waste Disposal

Any waste solids from injection point installation and well purge water will be drummed pending characterization for disposal. Within an appropriate time, the drums will be transported off-site to a disposal facility licensed to accept these materials. ENW may request a no-longer contained in determination, depending on the concentrations in the investigation-derived waste.

7.0 Reporting

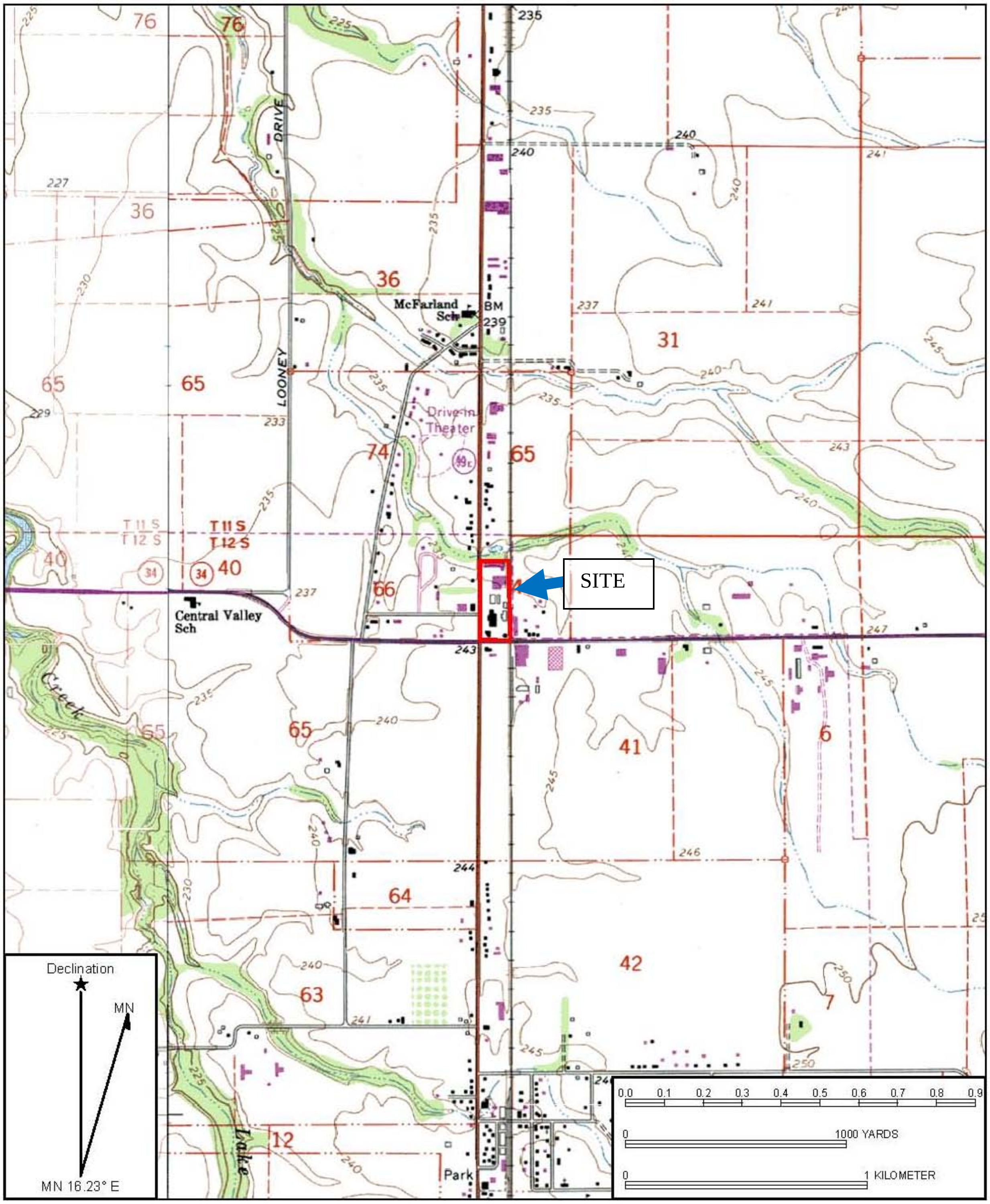
ENW will prepare the following reports for this full site in-situ bioremediation:

- *In-Situ Bioremediation Injection Summary*. This report will document the initial work completed during the full site fluid injection of Regenesis products. This report will describe:
    - Final injection volumes, depth intervals and injection point densities.
    - Site figure showing final injection well point locations.
- *Quarterly Ground Water Monitoring. R*eports will be submitted, one for each quarter of monitoring, which will include:
    a. A summary of monitoring data for specific monitoring event.
    - Potentiometric surface maps and isoconcentration contour maps of ground water sampling data.
    - Appropriate supporting materials such as laboratory reports and disposal receipts.
- Following three years of monitoring, *In-Situ Bioremediation Final IRAM Report*. This report will:
    a. A summary of all monitoring data.
    b. Comparison of initial monitoring from select ground water monitoring wells to monitoring data obtained during the full site in-situ bioremediation as trend charts.
    - Evaluation of the *effectiveness* of in-situ bioremediation.
    - Provide a recommendation for steps to site closure.

8.0 Project Schedule

ENW is prepared to immediately initiate Pre-Field Activities upon ODEQ approval. The start of field activities will depend on subcontractor availability, material delivery time, and client access needs.

Figures



Source: USGS Topographic Map, 7.5-Minute Tangent, Oregon Quadrangle, 1969, photorevised 1986

EVREN NORTHWEST, INC. Environmental and Natural Resource Consulting	Date Drawn: 2/13/2012 CAD File Name: 160-02001-10.fig_1 Drawn By: LDG Approved By: NMW	Cenex Harvest States 33685 Highway 99 East Tangent, Oregon	**Site Vicinity Map**	Project No. 160-02001 Figure **1**

LEGEND:

	SUBJECT SITE PROPERTY BOUNDARY
	BUILDING LOCATION
	OFF-SITE WATER WELLS
	UPPER-MIDDLE IWBU WELL
	LOWER IWBU WELL
	DEEP MONITORING WELL
DWBU	DEEP WATER BEARING UNIT
IWBU	INTERMEDIATE WATER BEARING UNIT
MW9-D(i)	MONITORING WELL (INTERMEDIATE WATER-BEARING UNIT)
MW10D	MONITORING WELL (DEEPER WATER-BEARING UNIT)
MWi	MONITORING WELL (SHALLOW WATER-BEARING UNIT)

NOTES:

1. BASE MAP DEVELOPED FROM AN AERIAL PHOTOGRAPH MAP DATED 2018 AND ENW FIELD NOTES.
2. ALL BUILDING, STREET, AND FEATURE LOCATIONS ARE APPROXIMATE.
3. SYMBOLS REPRESENT LOCATION AND DO NOT ALWAYS REPRESENT EXACT SHAPE, SIZE, OR ORIENTATION.

APPROXIMATE SCALE

0 100 200 FEET

N

EVREN NORTHWEST INC.
environmental natural resource consultants
PO BOX 14488, PORTLAND, OREGON 97293
P: (503)452-5561, E: ENW@EVREN-NW.COM

FIGURE 2

SITE PLAN

FORMER CHS FACILITY
33685 HIGWAY 99E
TANGENT, OREGON

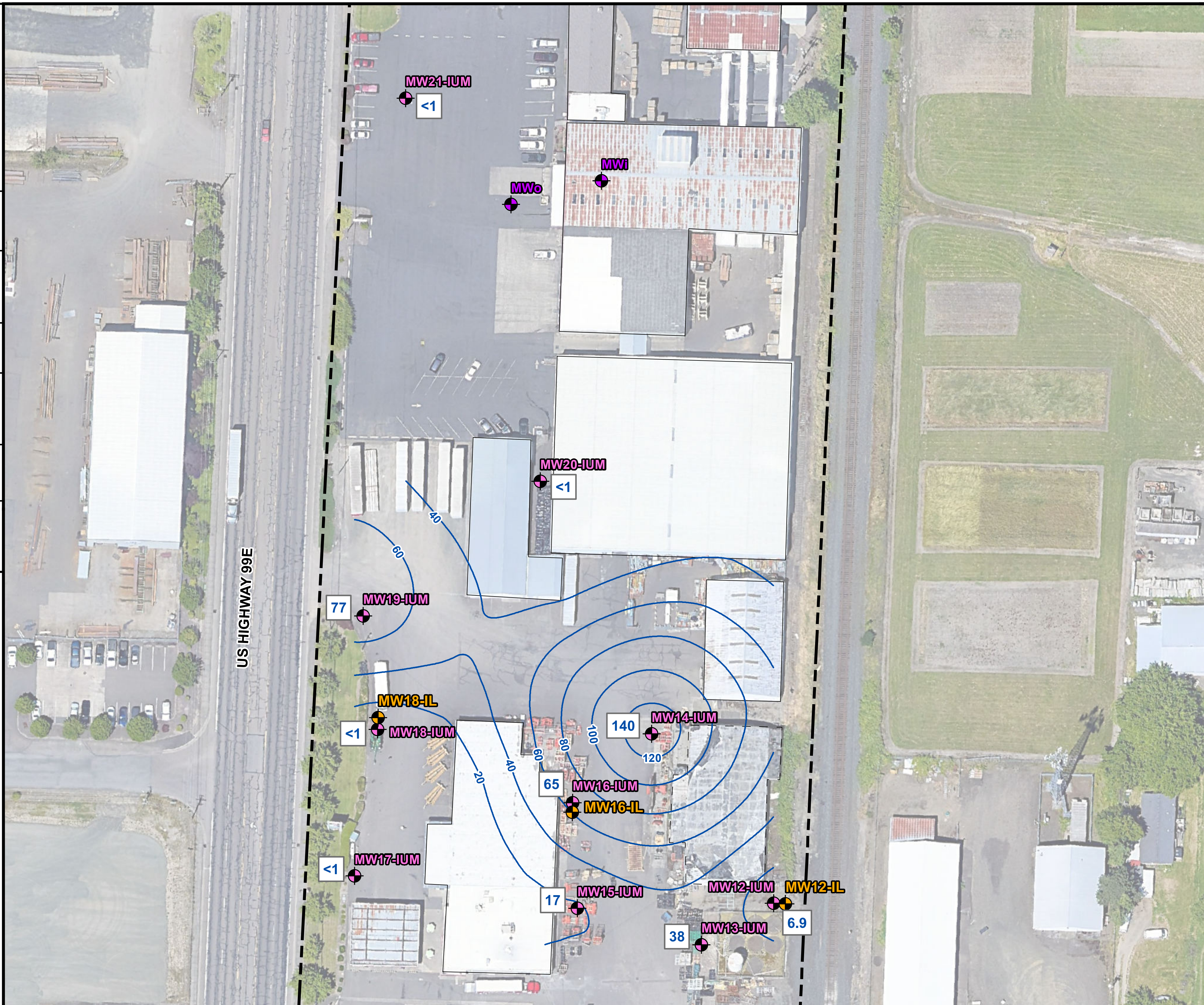
DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
C. ROSEBROOK 07/10/2020	L. GREEN 04/08/2024	P. TRONE 04/08/2024	160-02001(v04)

DRAWING NUMBER 160-02001(V01)

APPROVED BY L. GREEN 2/26/2024

CHECKED BY E. CHAPMAN 2/26/2024

DRAWN BY H. ROMER 2/26/2024



LEGEND:

- SUBJECT PROPERTY BOUNDARY
- SUBJECT BUILDING
- FORMER DRY FERTILIZER PLANT (DEMOLISHED)
- UM WELLS - DCP ISOPLETHS (UG/L)
- EXISTING MONITORING WELLS, SWBU
- LOWER IWBU WELL
- UPPER-MIDDLE IWBU WELL

NOTES:

1. BASE MAP DEVELOPED FROM AN AERIAL PHOTOGRAPH MAP DATED 2022 AND ENW FIELD NOTES.
2. ALL BUILDING, STREET, AND FEATURE LOCATIONS ARE APPROXIMATE.
3. SYMBOLS REPRESENT LOCATION AND DO NOT ALWAYS REPRESENT EXACT SHAPE, SIZE, OR ORIENTATION

0 50 100 200 Feet

N

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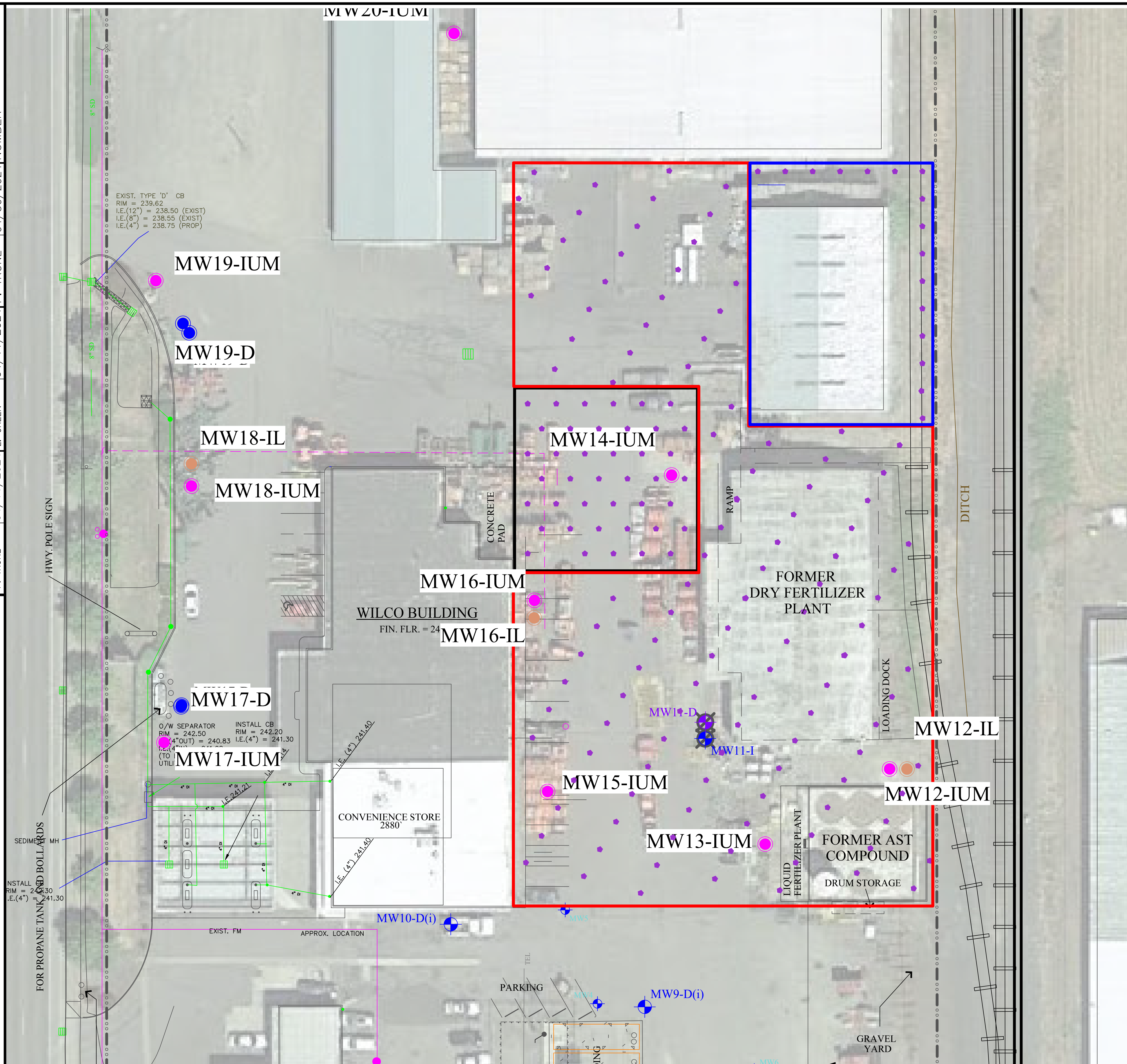
FIGURE 3

DCP - ISOCONCENTRATION PLOT UPPER PORTION OF THE INTERMEDIATE WATER BEARING UNIT FIRST QUARTER 2024

FORMER CHS FACILITY
33685 HIGHWAY 99E
TANGENT, OREGON



DRAWN BY P. TRONE 04/11/2024
CHECKED BY L. GREEN 04/11/2024
APPROVED BY P. TRONE 04/30/2024
DRAWING NUMBER 160-02001(v04)

LEGEND:

- SUBJECT SITE PROPERTY BOUNDARY
- BUILDING LOCATION
- FORMER BUILDING LOCATION
- TREATMENT AREA 1 (41 POINTS)
- TREATMENT AREA 2 (16 POINTS)
- TREATMENT AREA 3 (114 POINTS)
- UPPER-MIDDLE IWBU WELL
- LOWER IWBU WELL
- DEEP MONITORING WELL
- DWBU DEEP WATER BEARING UNIT
- IWBU INTERMEDIATE WATER BEARING UNIT
- INJECTION POINTS FOR REDUCING AGENTS AND MICROBIAL CONSORTIA (20- TO 50-FT BGS)

NOTES:

1. BASE MAP DEVELOPED FROM AN AERIAL PHOTOGRAPH MAP DATED 2018 AND ENW FIELD NOTES.
2. ALL BUILDING, STREET, AND FEATURE LOCATIONS ARE APPROXIMATE.
3. SYMBOLS REPRESENT LOCATION AND DO NOT ALWAYS REPRESENT EXACT SHAPE, SIZE, OR ORIENTATION.

APPROXIMATE SCALE
0 45 90 FEET

N

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environmental natural resource consultants
PO BOX 14488, PORTLAND, OREGON 97293
P: (503)452-5561, E: ENW@EVREN-NW.COM

FIGURE 4
IN-SITU BIOREMEDIATION INJECTION DIAGRAM

FORMER CHS FACILITY
33685 HIGWAY 99E
TANGENT, OREGON