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March 30, 2016

Mr. Ron Pauer
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Dear Mr. Pauer:

The Department of Toxic Substances Control (DTSC) has completed its review of the revised Explanation of Significant Differences for Modification of the Building 25A In Situ Soil Flushing System, dated March 18, 2016. DTSC has no additional comments and hereby approves modification of the Building 25A In Situ Soil Flushing system, which consists of converting the injection trench to one that will be used to extract contaminated groundwater. Please coordinate with DTSC for publication of a notice of availability of the ESD in a major local newspaper and put it in the LBNL Information Repository at the Berkeley Public Library main branch.

If you have any questions, please contact me at (510) 540-3842 or via e-mail at Jacinto.Soto@dtsc.ca.gov.

Sincerely,

Jacinto Soto
Project Manager
Brownfields and Environmental Restoration Program

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EXPLANATION OF SIGNIFICANT DIFFERENCES

BUILDING 25A IN SITU SOIL FLUSHING SYSTEM MODIFICATION

March 2016

Lawrence Berkeley National Laboratory
Environmental Services Group
Environmental Restoration Program

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March 2016

Lawrence Berkeley National Laboratory
Environmental Services Group
Environmental Restoration Program

Prepared by:

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Ron Pauer
LBNL Environmental Services Group Manager

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LIST OF ABBREVIATIONS

Cal/EPA	California Environmental Protection Agency
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
DCE	Dichloroethene
DTSC	Department of Toxic Substances Control
EBMUD	East Bay Municipal Utility District
ESD	Explanation of Significant Differences
GAC	Granular Activated Carbon
ICM	Interim Corrective Measure
LBNL	Lawrence Berkeley National Laboratory
MCL	Maximum Contaminant Level for drinking water
MCS	Media Cleanup Standard
µg/L	micrograms per liter (10^{-6} grams per liter)
RCRA	Resource, Conservation and Recovery Act
SWRCB	State Water Resources Control Board
TCE	Trichloroethylene
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

This Explanation of Significant Differences (ESD) has been prepared to provide the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) with a description of, and rationale for, Lawrence Berkeley National Laboratory's (LBNL's) proposed modification of the Building 25A *In Situ* Soil Flushing System, the DTSC approved corrective measure for the Building 25A Lobe of the Old Town Groundwater Plume. The system currently consists of injecting treated groundwater into a trench on the west side of Building 30 (Chu Hall) and extracting groundwater from wells south of the building. The proposed modification will convert the injection trench to one that can also be used to extract contaminated groundwater. This request complies with DTSC's requirement that LBNL submit the request in an ESD-equivalent format for review and approval.

Recent heavy rains have caused the groundwater elevation to rise into the gravel backfill below the Chu Hall basement. The purpose of the proposed modification is to prevent the potential migration of contaminated groundwater through the clean gravel below the basement. LBNL proposes to extract groundwater only when necessary to limit the groundwater elevation to approximately 916 feet, which is approximately 2 feet beneath the base of the backfill. Limiting the groundwater elevation to the elevation of 916 feet will not reverse the groundwater gradient and pull contaminated water back toward the clean area near the trench location since the groundwater elevations in the three extraction wells south of the building are maintained at an elevation of approximately 900 feet. The direction of soil flushing would therefore remain the same –that is, away from the trench and toward the extraction wells.

2.0 SITE HISTORY, CONTAMINATION, AND REMEDIES SELECTED

2.1 Site History and Contamination

LBNL's Hazardous Waste Handling Facility operates under a DTSC-issued Resource Conservation and Recovery Act (RCRA) Part B Hazardous Waste Facility Permit. The Permit issued in 1993 required LBNL to investigate and address all releases of hazardous waste and hazardous constituents that may have occurred at the site, in accordance with RCRA Corrective Action Program (CAP) requirements. These activities were carried out by the LBNL

Environmental Restoration Program (ERP), which is a program of the Environmental Services Group within LBNL's Environment/Health/Safety Division.

In 2005, LBNL submitted its *Corrective Measure Study Report* (CMS) (LBNL, 2005) to DTSC for review and approval. The CMS provided recommendations for the specific corrective measures that should be implemented to eliminate or reduce potential risks to human health from contaminants in the soil and groundwater at LBNL and protect the potential beneficial uses of the groundwater. On August 31, 2005 DTSC issued its *Approval of Final Corrective Measures Study Report and Remedy Selection, Lawrence Berkeley National Laboratory* (DTSC, 2005).

On April 2, 2007 LBNL submitted its *RCRA Corrective Measures Implementation (CMI) Report* to the DTSC (LBNL, 2007). The CMI Report provided a consolidated record of the construction and implementation of the DTSC-approved corrective measures. The corrective measures approved for contaminated soil were all completed by the end of 2006. The corrective measures approved for groundwater are currently in the long-term operation, maintenance, and monitoring stage. These measures consist primarily of *in situ* soil flushing and groundwater capture systems but also include subsurface injection of Hydrogen Release Compound® (HRC), Soil Vapor Extraction (SVE), and Monitored Natural Attenuation (MNA) at some locations.

One of the areas of groundwater contamination that the DTSC determined required corrective action is the Building 25A lobe of the Old Town Groundwater Solvent Plume (DTSC, 2005). The Building 25A lobe extends westwards from the western portion of Building 30 (former Building 25A location) to the eastern edge of Building 6 (Figure 1). Based on the concentrations of contaminants in the groundwater, the source area for the Building 25A lobe was located near the west end of Building 25A (beneath current Building 30). The principal constituents of the Building 25A lobe are halogenated volatile organic compounds (VOCs), primarily trichloroethene (TCE) and its degradation products (*e.g.* 1,1-dichloroethene [DCE] and cis-1,2-DCE). An isoconcentration contour map of total halogenated VOCs detected in Building 25A lobe groundwater during the fourth

quarter of fiscal year 2015 (July to September 2015) is shown on Figure 1. Concentrations of the individual VOCs detected are provided in Table 1.

2.2 Initial Remedy Approved for Building 25A Lobe in 2005

In 2002, an *in situ* soil flushing system was installed in the source area for the Building 25A lobe groundwater contamination as an Interim Corrective Measure (ICM) to remove contamination from the soil and groundwater near the western end of Building 25A (current Building 30 location) and to control plume migration. The system consisted of a groundwater extraction trench approximately 80 feet northwest of Building 25A (currently located partially under the western edge of Building 30), an infiltration bed located upgradient from the trench adjacent to the northwest edge of Building 25A, and groundwater extraction well MW25A-98-3 located north of Building 25A. Contaminated groundwater was extracted from both extraction well EW25A-02-1 installed at the northern end of the collection trench and from well MW25A-98-3. The extracted groundwater was treated to non-detectable levels of contaminants at the Building 25A Groundwater Treatment System and then recirculated into the infiltration bed.

Table 1. Concentrations of VOCs Detected in Groundwater Building 25A Lobe.

Date	Location	Approved MCS for Well Location	Concentrations in Micrograms per Liter (µg/L)			
			Chloroform	1,1-DCE	Cis-1,2-DCE	TCE
Target Risk-Based MCS			1,206	28,873	98,405	1,594
	MCL		80	6	6	5
9/15	MW5-93-10	MCL	ND	ND	ND	ND
7/15	MW6-92-17	risk-based	5.9*	ND	ND	3.7
2/14	MW16-95-3	risk-based	1.8*	ND	ND	8.8
8/15	MW30-13-1	risk-based	ND	2.3	1.4	7
8/15	MW30-13-2	risk-based	ND	5	5.5	41
9/15	SB16-98-1	risk-based	ND	ND	ND	0.73
9/15	SB25-10-1	risk-based	ND	1.5	0.78	38
9/15	SB25-10-2	risk-based	0.77	2.0	1.4	74
9/15	SB44-98-1	MCL	ND	0.50	ND	3.2
9/15	EW30-12-1	risk-based	ND	0.52	ND	7.6
9/15	EW30-12-2	risk-based	ND	ND	1.8	14
9/15	EW30-12-3	risk-based	ND	0.70	2.0	1.4

*Source of chloroform East Bay Municipal Utility District water supply line break.
ND: No VOCs detected (<0.5 µg/L)
MCL: Maximum Contaminant Level for Drinking Water
MCS: Media Cleanup Standard

The groundwater collection trench was approximately 40 feet long by 40 feet deep and was backfilled with gravel. Submersible pumps controlled by float switches were used to pump groundwater from the two extraction wells. The treatment system, which is still in use, consists of a primary 1000-pound Granular Activated Carbon (GAC) canister and a secondary 55-gallon GAC drum in series.

The *in situ* soil flushing system that was implemented as an ICM was approved as the required corrective measure for the Building 25A lobe of the Old Town Groundwater Solvent Plume by the DTSC in 2005 (DTSC, 2005).

2.3 Modified Remedy Approved for Building 25A Lobe in 2011

In June 2011 LBNL submitted a *Workplan for Proposed Modification of the Building 25A In Situ Soil Flushing System* (LBNL, 2011) to the DTSC. The proposed modifications were necessary due to the demolition of Building 25A and the construction of Building 30 (the Solar Energy Research Center [subsequently renamed Chu Hall]) over most of the soil flushing area at the same site. Modifications included:

1) Removal of the infiltration bed;
2) Reconfiguration of the groundwater extraction trench to a groundwater injection trench;
3) Construction of three new groundwater extraction wells near the southern end of Building 30 (EW30-12-1, EW30-12-2, and EW30-12-3);
4) Decommissioning six wells;
5) Installation of two replacement groundwater monitoring wells under the building (MW30-13-1 and MW30-13-2 for decommissioned wells MW25A-99-2 and MW25A-98-3).

DTSC provided comments on the workplan, and following LBNL's response to comments, the workplan was approved by DTSC in September 2011 (DTSC, 2011). The location and configuration of the modified Building 25A lobe *in situ* soil flushing system, which is the currently approved operating system, is shown on Figure 2.

2.4 Media Cleanup Standards and Goals

Cleanup levels (*i.e.* media cleanup standard [MCS]) based on both human health risk and regulatory requirements were developed in the CMS (LBNL, 2005) and approved by the DTSC. The risk-based MCSs, which are applicable to all areas of LBNL, were based on the more conservative of two criteria: 1) the United States Environmental Protection Agency (USEPA) recommended target cancer-risk range for risk managers (*i.e.*, a theoretical Incremental Lifetime Cancer Risk [ILCR] between 10^{-6} and 10^{-4}) and 2) a non-cancer hazard quotient (HQ) of 1.0. An ILCR in the range of 10^{-4} to 10^{-6} is considered by the USEPA to be safe and protective of public health (Federal Register 56 [20]: 3535, Wednesday, January 30, 1991). Exposure to chemicals with a Hazard Index (HI) (sum of HQs) below 1.0 is considered unlikely to result in adverse non-cancer health effects over a lifetime of exposure.

Two sets of risk-based MCSs were developed: 1) target risk-based MCSs, which were set conservatively at the lower bound of the risk management range (theoretical ILCR of 10^{-6}) and an HQ of 1.0 and 2) upper-limit risked-based MCSs that represent the upper bound of the risk management range (theoretical ILCR of 10^{-4}) and an HQ of 1.0. The corrective measures were designed to meet the target risk-based MCSs. However, since it may not be feasible to achieve the target risk-based MCSs in all areas of the LBNL site, upper-limit risk-based MCSs were established as an alternative cleanup level applicable to those areas.

Regulatory-based MCSs are the DTSC-required MCSs that are applicable only to areas of LBNL that are considered potential sources of drinking water as defined by State Water Resources Control Board (SWRCB) Resolution 88-63 (*i.e.* areas with sufficient well yields), and are based on Maximum Contaminant Levels [MCLs] for drinking water. The areas where the regulatory-based MCSs are applicable are defined in the CMS Report (LBNL, 2005). Regulatory-based MCSs are more stringent than, and therefore supersede, the risk-based MCSs in these areas. Although the regulatory-based MCSs are not applicable in areas with insufficient well yields, since the SWRCB designates all groundwater in California potentially suitable for domestic supply unless it has been formally de-designated, LBNL has established a long-term goal to reduce contaminant concentrations in all groundwater at LBNL to MCLs for drinking water, if practicable (LBNL, 2005). The groundwater at LBNL is not used for domestic, irrigation, or industrial purposes; drinking water is supplied by the East Bay Municipal Utility District (EBMUD).

Risk-based MCSs are the required cleanup level for most parts of the Building 25A lobe, while regulatory-based MCSs (MCLs) are the required cleanup level for the northern part of the lobe in the vicinity of wells MW5-93-10 and SB44-98-11 (Figure 1). As indicated in Table 1, concentrations of all VOCs have declined during operation of the Building 25A lobe *in situ* soil flushing system to below the DTSC-required cleanup levels in all areas of the lobe.

2.5 Groundwater Elevations

Approximately 10 to 15 feet of soil/rock was excavated at the former Building 25A site for the construction of Building 30, which included a basement level at an elevation of 923 feet (top of the basement slab). A gravel bed with subdrains was installed beneath the basement slab. Groundwater elevations in two decommissioned groundwater monitoring wells located in the area of the basement prior to Building 30 construction (MW25A-99-2 and MW25A-98-3) varied from approximately 916 to 925 feet prior to the start of *in situ* soil flushing, and represent the normal range of groundwater elevations under much of Building 30 in the absence of soil flushing. Additional decommissioned wells that were located in the flushing area adjacent to the current location of Building 30 had minimum water levels several feet lower including MW25A-95-15, which was located adjacent to the trench and had a minimum level of 905 feet.

Groundwater elevations measured in groundwater monitoring wells MW30-13-1 and MW30-13-2, which were installed in the basement of Building 30 following its construction in 2013, have varied from approximately 916 to 919 feet since monitoring began in July 2014. The locations of both decommissioned wells MW25A-99-2 and MW25A-98-3 and the wells installed in 2013 are shown on Figure 2. A schematic diagram showing a cross section of the Building 30 foundation, subdrain, injection trench, and range of water table elevations is shown on Figure 3.

3.0 THE BASIS FOR AND DESCRIPTION OF THE SIGNIFICANT DIFFERENCES

3.1 Basis

Based on the water level information described above and Chu Hall construction details, LBNL requests that DTSC approve the modification of the Building 25A *In Situ* Soil Flushing System to allow extraction from the Building 30 injection trench when there is the potential for the migration of contaminated groundwater through the backfill beneath the basement. This would be

accomplished by limiting the groundwater elevation to approximately 916 feet, which is approximately 2 feet below the base of the backfill beneath the building's floor slab.

This proposed modification would not change the operation of remedy or its effectiveness for the following reasons:

1. The purpose of injection in a soil flushing remedy is to raise the hydrostatic head in order to increase the flow of water through the contaminated zone. The normal water table elevation under Building 30 is within, or above, the gravel bed under Building 30 from approximately January until July. The minimum historical water table elevation (916 feet) measured during the August through December period is within approximately 2 feet of the bottom of the gravel bed (918 feet).
2. Maintaining the groundwater elevation at approximately 916 feet will not reverse the groundwater gradient and pull contaminated water back toward the clean area near the trench location since the groundwater elevations in the three extraction wells south of the building are maintained at an elevation of approximately 900 feet. The direction of soil flushing would therefore remain the same –that is, away from the trench and toward the extraction wells.

Also, if significant rainfall occurs the natural rise in the water table combined with the injection of water could potentially raise the water table under the building to the basement slab height. This increase in the water table elevation could potentially have an adverse effect on the integrity of the foundation slab due to hydrostatic uplift pressure and could also result in seepage into the basement. Extracting rather than injecting water would lower the water table, thereby mitigating these potentially adverse impacts.

3.2 Description of Difference

The proposed configuration of the modified B25A lobe *in situ* soil flushing system is shown on Figure 4. The Building 25A trench will be reconfigured to operate both as a groundwater extraction and injection trench. A submersible pump controlled by float switches will be placed in injection well IW30-12-1 to allow extraction of groundwater from the trench when needed. The extracted groundwater will be routed to the existing Building 25A Groundwater Treatment System where the groundwater will be treated to non-detectable levels of VOCs and then discharged to

the sanitary sewer in accordance with provisions of LBNL's wastewater discharge permit (No. 5034789 1) issued by EBMUD.

4.0 PUBLIC PARTICIPATION

If requested by DTSC, LBNL will arrange for publication of a notice of availability of the ESD and brief description in a major local newspaper. The ESD will be available for public review online at http://www.lbl.gov/ehs/erp/html/documents.shtml and at the LBNL Information Repository at the Berkeley Public Library main branch: Berkeley Public Library, 2090 Kittredge St. Berkeley, CA. Contact information: (510) 981-6100.

5.0 STATUTORY DETERMINATIONS

With incorporation of the system modification described in this ESD, the corrective action remains protective of human health and the environment, complies with the requirements that were identified in the RCRA Corrective Measures Study Report, and is cost effective. In addition, concentrations of contaminants in groundwater are all less than the DTSC-approved cleanup levels.

6.0 REFERENCES

DTSC, 2005. *Approval of Final Corrective Measures Study Report and Remedy Selection Lawrence Berkeley National Laboratory,* 1 Cyclotron Road Berkeley, California, EPA ID No. CA489008986. Letter from Mohinder Sandhu (DTSC) Chief Standardized Permitting and Corrective Action Branch to Iraj Javandel (LBNL), August 31, 2005.

DTSC, 2011. Letter from Jacinto Soto (DTSC) Project Manager Brownfields and Environmental Restoration Program-Berkeley Office to Iraj Javandel (LBNL), September 28, 2011.

LBNL, 2005. *RCRA Corrective Measures Study Report,* Environmental Restoration Program, Lawrence Berkeley National Laboratory, Berkeley, California, February 2005.

LBNL, 2007. RCRA *Corrective Measures Implementation (CMI) Report*, Environmental Restoration Program, Lawrence Berkeley National Laboratory, April 2007.

LBNL, 2011. *Workplan for Proposed Modification of the Building 25A In Situ Soil Flushing System*, Environmental Restoration Program, Lawrence Berkeley National Laboratory, Berkeley, California, September 2011.

7.0 LIST OF FIGURES

Figure 1. Isoconcentration Contour map, Total Halogenated Hydrocarbons in Groundwater (µg/L), Building 25A Lobe, Fourth Quarter Fiscal Year 2015.

Figure2. Current Configuration of the Building 25A In Situ Soil Flushing System.

Figure 3. Schematic Cross Section Building 30 Foundation and Injection Trench.

Figure 4. Proposed Configuration of the Building 25A In Situ Soil Flushing System.

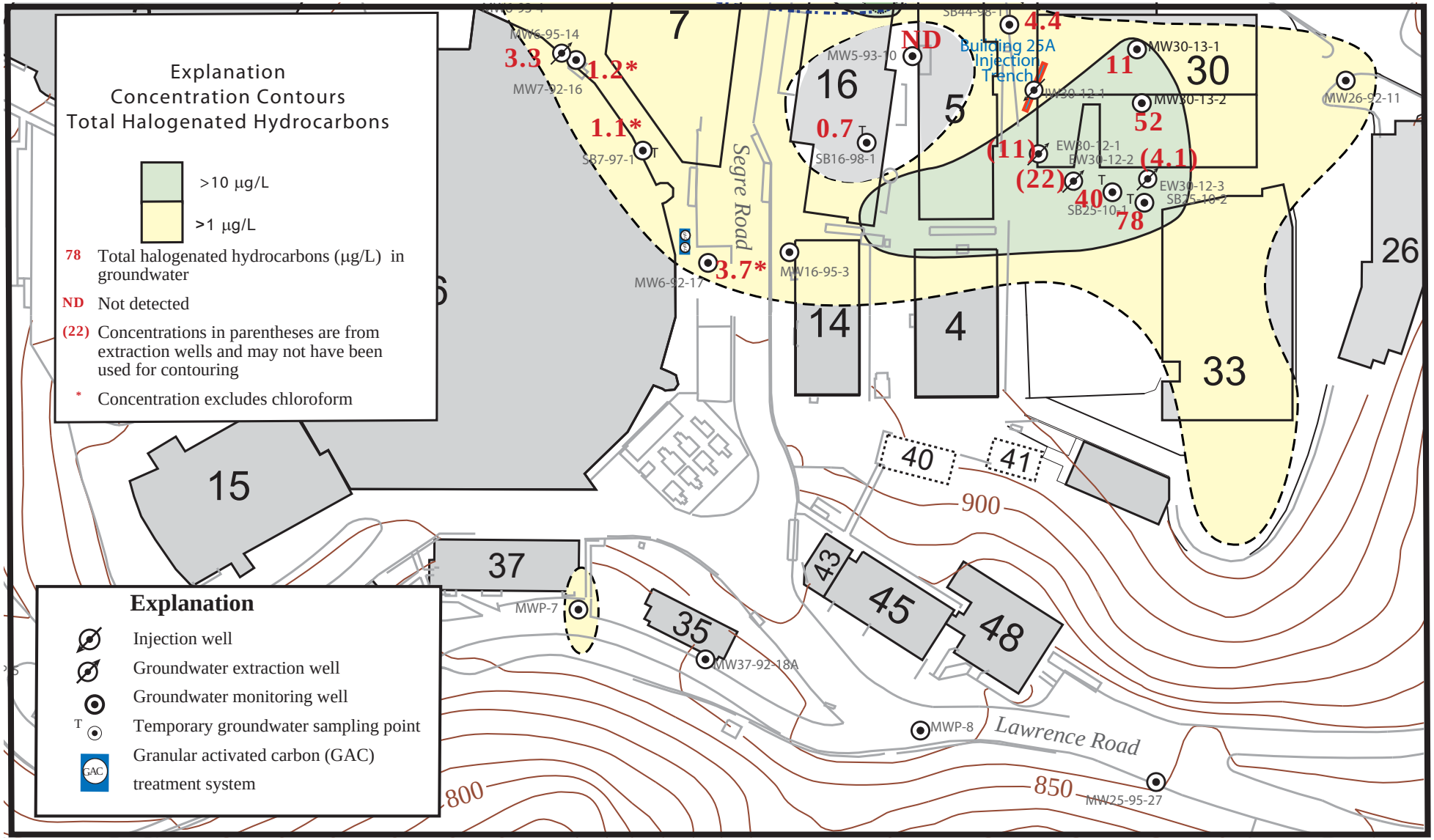

Figure 1. Isoconcentration Contour Map, Total Halogenated Hydrocarbons in Groundwater (µg/L), Building 25A Lobe, Fourth Quarter FY15.

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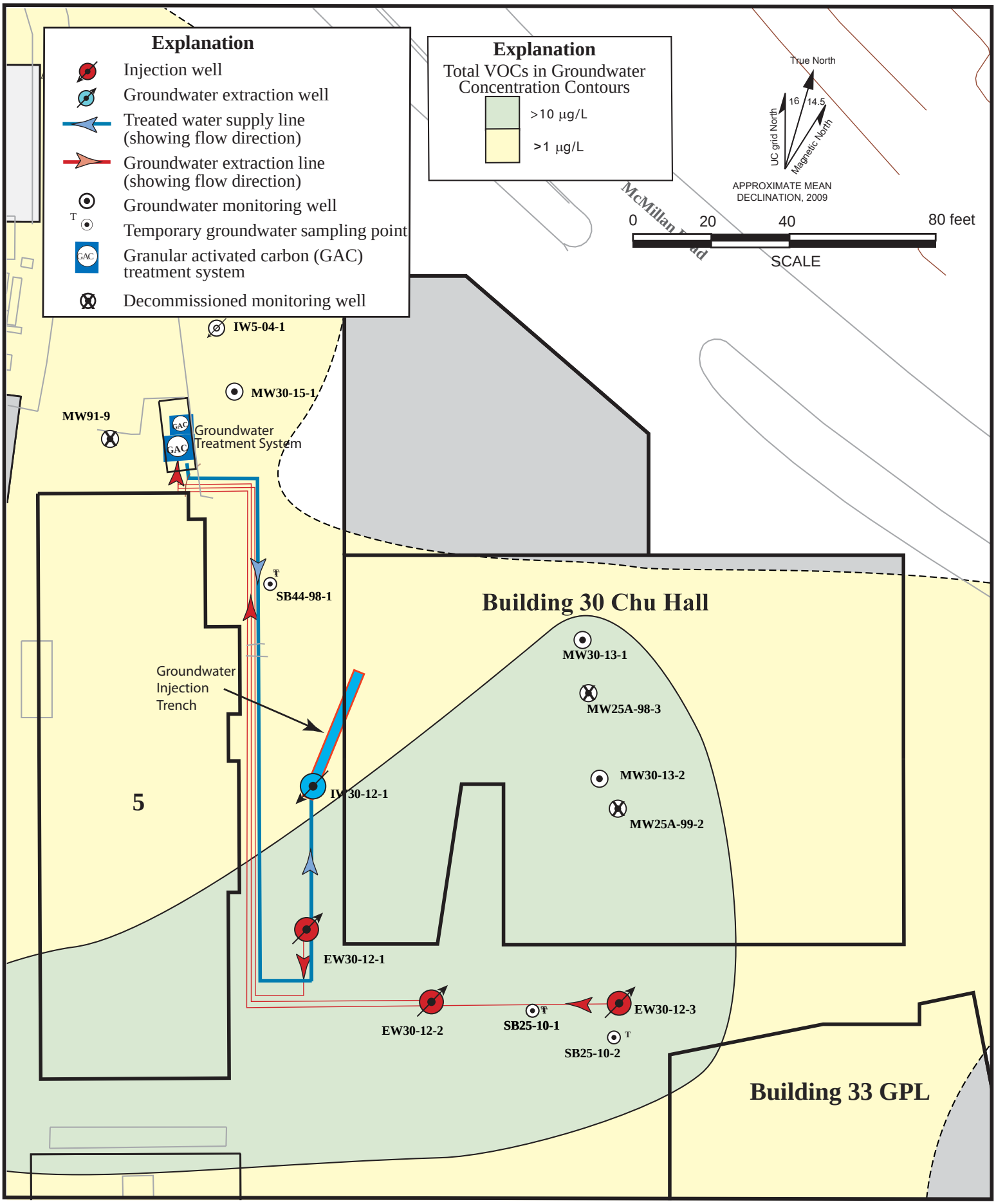

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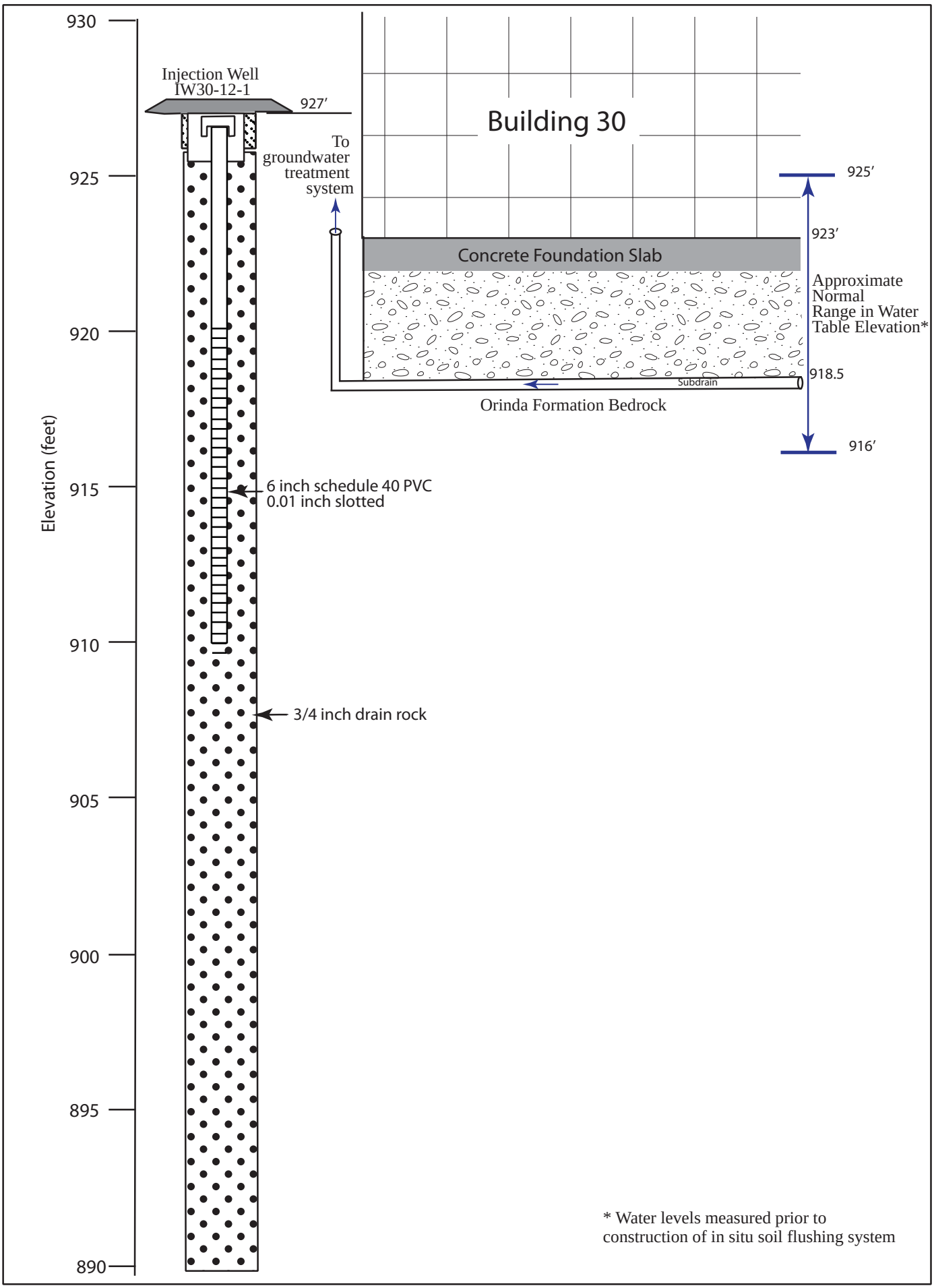

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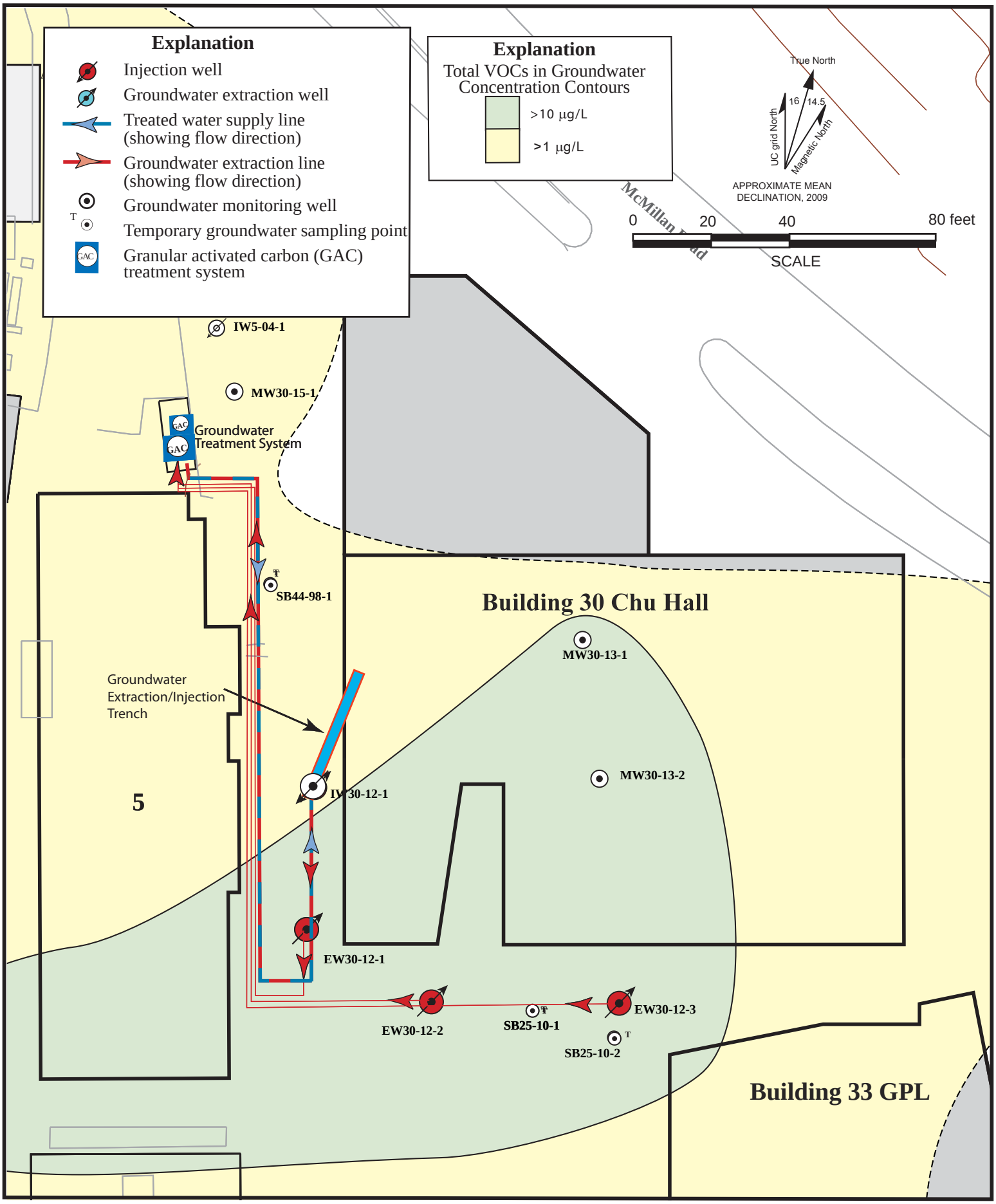

Figure 4. Proposed Configuration of the Building 25A In Situ Soil Flushing System.