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GROUNDWATER MONITORING SAMPLING AND ANALYSIS PLAN FOR OPEN BURN/OPEN DETONATION (OB/OD) UNIT NWS EARLE NJ

7/1/2012

TETRA TECH

NAVFAC Atlantic Biological Resource Services

Contract: N62470-08-D-1008; Task Order: WE08, Task 02

July 2012

Groundwater Monitoring Sampling and Analysis Plan

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1.0 INTRODUCTION

This groundwater monitoring sampling and analysis plan (SAP) for the Open Burning and Open Detonation (OB/OD) Unit at the Naval Weapons Station (NWS) Earle, Colts Neck, New Jersey is based on the recommendations made in "The Phase IV Sampling Field Investigation Report for Open Burning/Open Detonation Unit (Site 2) Naval Weapons Station Earle" (Tetra Tech, 2012). The Baseline Environmental Monitoring Plan (BEMP) for the OB/OD Unit at NWS Earle was prepared and issued by Tetra Tech, Inc. (Tetra Tech) in April 2003. The BEMP established the methods and technical approaches for the collection of groundwater, soil, surface water, and sediment samples in the OB/OD Unit to characterize the local environmental conditions. The results of the Phase I (2003) and Phase II (2005/2006) monitoring were presented in the Baseline Monitoring Phases I and II Data Report (Tetra Tech, 2008). The results of the Phase III monitoring were presented in the Phase III Field Investigation 2010 (Tetra Tech, 2010). The results of the Phase IV sampling event were presented in the Phase IV Sampling Field Investigation Report (Tetra Tech, 2012).

The data produced by the Phase IV Field Investigation were evaluated with the previously collected data to better characterize the horizontal and vertical extent of groundwater contamination in the vicinity of the OB/OD Unit and evaluate the potential for migration beyond the Explosive Ordnance Disposal (EOD) Area boundary.

2.0 BACKGROUND AND PHYSICAL SETTING

The OB/OD Unit is located in the EOD Area at NWS Earle (Figure 1). The EOD Area covers approximately 15.5 acres and consists of a slightly sloping (downward to the north), non-vegetated sandy area surrounded by a berm ranging from approximately 2 to 10 feet (ft) in height. The EOD area is non-vegetated and is surrounded by mixed pine and deciduous forest. Surface water runoff from the EOD Area is generally limited by the berm, which surrounds the outer edge of EOD Area. Several low-lying areas are present in the northeast corner of the OB/OD Unit where surface water collects on the surface (Figure 2).

Two undeveloped and unpaved roads provide access to the EOD Area, one from the east and one from the west. A more developed, but unpaved road provides access to the site from the south.

The OB/OD Unit contains two bermed operational areas used to contain the actual sites for OB and OD operations. EOD training activities may be conducted in areas outside the bermed OB and OD treatment areas but within the bermed EOD Area. The local groundwater is generally within about 10 ft of the ground surface.

3.0 SUMMARY OF PREVIOUS ENVIRONMENTAL ACTIVITIES

The field activities completed at the OB/OD Unit during previous activities (Phase I through Phase III) included the following.

3.1 PHASE I SAMPLING

The Phase I field activities began in December 2003; however, due to adverse weather conditions, the work was postponed. Field activities took place from February 3 through February 12, 2004. All work was performed in accordance with the procedures and methodologies described in the BEMP (Tetra Tech, 2003), as well as modifications to the plan as agreed upon during meetings between the Navy, the New Jersey Department of Environmental Protection (NJDEP), and Tetra Tech personnel on October 21, 2003 and November 20, 2003.

3.2 PHASE II SAMPLING

The Phase II field activities were conducted in November and December 2005, and January 2006. All work was performed in accordance with the procedures and methodologies described in the BEMP (Tetra Tech, 2003), as well as modifications to the plan as agreed upon during meetings between the Navy, NJDEP, and Tetra Tech personnel on July 14 and September 14, 2005.

3.3 PHASE III SAMPLING

The Phase III field activities were conducted from January 2010 through February 2010 (Round 1), and May 2010 (Round 2). The installation of the permanent monitoring wells was conducted from January 19 through 29, 2010. The Round 1 surface water and groundwater sampling was conducted in two mobilizations (February 8 and 9, 2010, and February 22 through 24, 2010) due to inclement weather. The Round 2 surface water and groundwater sampling was conducted from May 3 through 7, 2010.

3.4 PHASE IV SAMPLING

The Phase IV field activities were conducted from December 19, 2011 through February 14, 2012. Monitoring well clusters upgradient (02MW01) and downgradient (02MW13) of the OB/OD unit were installed and developed from December 19 through December 23, 2011. The surface water and groundwater sampling was conducted January 17 through January 19, 2012. The synoptic water level round and well survey were conducted on February 14, 2012.

All work was performed in accordance with the procedures and methodologies described in the BEMP (Tetra Tech, 2003), as well as the BEMP Addendum (Tetra Tech, 2011).

3.5 PREVIOUS SAMPLING RESULTS

This section summarizes the Phase I through Phase IV groundwater sampling results.

The following presents the conclusions based on the Phase IV data.

Hydrogeologic and Hydrologic Data: Local groundwater generally flows from the south through the silty sandy soil of the OB/OD Unit and continues to the north towards surface water discharge locations north and northeast of the OB/OD Unit at a horizontal gradient of

approximately 0.005 (Figure 3). The groundwater elevations measured in the monitoring well clusters indicate a downward flow gradient of approximately 0.004 to 0.007. The conceptual site model (CSM) for the OB/OD Unit with the existing well network is provided on Figure 4.

Explosives and Perchlorate Data*:* The analytical results from the previous investigation phases indicated that the highest concentrations of explosives are present near the OB/OD Unit. The concentrations decrease along the prevailing groundwater flow directions and decrease with depth in the saturated zone. The Phase III analytical results indicated that detected concentrations of explosives and perchlorate, and exceedances of the groundwater quality standards (GWQS) are generally limited to the shallow saturated zone (5 ft to 15 ft below ground surface [bgs]). Detected concentrations of explosives and perchlorate in the intermediate groundwater interval (15 ft to 35 ft bgs) appear to be limited to the central (active) portion the OB/OD Unit. The vertically downward flow gradient suggests that explosives may move vertically deeper into the aquifer; however, the Phase III analytical results did not indicate any exceedance of the GWQS for explosives or perchlorate in the deeper saturated zone (35 ft to 55 ft bgs).

The groundwater analytical results (explosives and perchlorate either not detected or at concentrations below project screening criteria) from the Phase IV sampling better defined the down-gradient extent of the plume as being between monitoring well 02MW03 and well cluster 02MW13. Up-gradient detection of perchlorate, only in estimated low concentrations (below the GWQS) in monitoring wells 02MW01A and 02MW01B suggests that the plume does not extend beyond that well cluster.

The Phase IV analytical data indicate that shallow groundwater is discharging to surface water, as seen by detection of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) (below the GWQS) in one down-gradient surface water sample (02SW101). The surface water locations have had consistently low detections (below drinking water standards) when detected at all.

Metals Data: The Phase III analytical results indicated that there were numerous exceedances of metals throughout the OB/OD Unit (Tetra Tech, 2010). However, there was no definitive pattern associating the exceedances with OB/OD treatment activities. Comparison of maximum metals concentrations to the 95 percent upper tolerance limit (UTL) for the NWS Earle Facility indicates that although there are exceedances of project screening criteria, the concentrations of metals in groundwater is within background levels; and no wells, which are located outside of the OB/OD Unit, had concentrations in excess of facility-wide background concentrations.

The Phase IV analytical results indicate that the only exceedance of the GWQS was iron in the groundwater and surface water samples, and lead in one surface water sample. The available literature documents elevated iron concentrations as a regional condition. The lead exceedance has a similar concentration to previous surface water results, which also exceeded the GWQS and surface water standards.

The Phase IV analytical results indicate that the arsenic concentration in surface water sample 02SW102 exceeded the NJDEP Fresh Water Criteria, but not the GWQS. Arsenic was not detected in the down-gradient surface water samples during the Phase III sampling (Tetra Tech, 2010).

4.0 RECOMMENDATIONS

Based on the results of the Phases I through IV investigations, the horizontal and vertical extents of the explosives/perchlorate/metals plume exceeding NJDEP GWQS have been defined. Additional sampling is needed to confirm the concentrations detected in previous sampling rounds. The Phase IV Sampling Field Investigation Report for the OB/OD Unit (Tetra Tech, 2012) recommended that:

- The monitoring wells at the OB/OD Unit should be sampled quarterly for four quarters to identify any trends in contaminant distribution.
- Analytes should include the explosives compounds, perchlorate and metals (lead, arsenic, antimony, copper, zinc, iron, and chromium) analyzed for in the previous investigations.
- The monitoring wells should be inspected monthly for damage due to site operations. Any damage observed, such as punctured casings or missing lids should be repaired prior to quarterly sampling.
- The flush-mount monitoring wells within the center of the EOD range (02MW11A, B, C and 02MW12B) are more likely to be impacted by surface water runoff. Therefore, abandonment of these four wells is recommended.

5.0 WORK PLAN ACTIVITIES

5.1 GROUNDWATER SAMPLING

Groundwater samples will be collected quarterly for four quarters from the following monitoring wells:

- 02MW01A
- 02MW01B
- 02MW01C
- 02MW06B
- 02MW06C
- 02MW07
- 02MW09B
- 02MW10C
- 02MW013
- 02MW013B
- 02MW13C

Table 1 contains the monitoring well construction details. Table 2 lists the samples to be collected. The sample identifier will contain the quarterly sampling date. Table 3 contains the analyte list and project screening criteria. Table 4 contains the quality control summary for each quarter.

The parameters to be monitored include the explosives TNT, RDX, and degradation products (1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-

dinitrotoluene, 4-amino-2,6-dinitrotoluene, 1,3,5-trinitroso-1,3,5-hexahydrotriazine (TNX), and 1-nitro-3,5-dinitro-1,3,5-hexahydrotriazine (MNX); perchlorate; and select total metals (antimony, arsenic, chromium, copper, iron, lead, and zinc) as requested by NJDEP. Analyses will be performed by Department of Defense and NJDEP-certified laboratories.

NJDEP requires metals analyses to be performed on unfiltered groundwater in order to ensure that the collected samples are representative of the conditions in the aquifer. Low-flow/low-volume sampling will be used to control turbidity and minimize sample chemistry alteration by pumping at very low flow rates from the well screen zone, avoiding disturbance to the water column in the well, and minimizing stress on the surrounding formation. Samples obtained in this manner typically reflect the groundwater chemistry at ambient flow conditions and characterize the true mobile load of contaminants in the groundwater. Purged groundwater will be discharged to the ground surface as per NJDEP Field Sampling Procedures Manual Section 2.4.5.7.

Field parameters such as temperature, pH, specific conductance, and dissolved oxygen will be monitored to confirm stable groundwater conditions prior to sampling. Every effort will be made to minimize turbidity in the samples. Purging will continue until turbidity is below 10 nephelometric turbidity units (NTUs) or until 4 hours have passed, whichever happens first. If sample turbidity cannot be reduced below 10 NTUs, then field filtering of the sample will be performed and both a filtered (dissolved) and an unfiltered (total) metals sample from the well will be submitted to the laboratory for metals analyses. If the final sampling turbidity is greater than 25 NTUs, the well will be re-developed and re-sampled for metals only. When sampling surface water, adequate sample volume will be collected to permit analysis for both filtered (dissolved) and, if necessary, unfiltered (total) metals.

The methods and technical approaches for the collection of groundwater samples in the OB/OD Unit, including quality control and field documentation, are described in Standard Operating Procedure 10-154 of the BEMP. A synoptic water level round of all existing monitoring wells will also be conducted each quarter.

5.2 WELL ABANDONMENT

As recommended in the Phase IV Sampling Field Investigation Report, monitoring wells 02MW11A, 02MW11B, 02MW11C, and 02MW12B will be abandoned because their groundwater quality may be compromised by surface water runoff entering the wells. The monitoring will be abandoned in accordance with NJDEP guidelines (N.J.A.C. 7:9D). All efforts will be made to remove as much of the polyvinyl chloride (PVC) screen and riser as possible. After screen/riser removal, the borehole will be backfilled with cement-bentonite grout. The protective casing, concrete pad, and PVC will require removal by a licensed drilling subcontractor.

5.3 INVESTIGATION-DERIVED WASTE

Environmental media will be collected in drums during active investigation, e.g., during water collection. Soil or groundwater that is not contaminated, based on field observations, will be released to the ground. Soil will be spread in the area of origin and groundwater will be released

to the ground in a manner that will allow it to absorb into the subsurface and not run into any surface water.

Any soil or groundwater that is determined to be potentially contaminated based on field observations will be kept in the drums for later disposal. Groundwater will be treated at the NWS Earle water treatment plant, and the soils will be sent off-site for appropriate disposal.

5.4 REPORTING

Quarterly reports documenting the analytical results, groundwater flow directions, monitoring well conditions, and any recommendations will be produced according to the schedule provided in Section 5.5.

5.5 SCHEDULE

The quarterly sampling is scheduled for the weeks of July 16, 2012; October 14, 2012; January 14, 2013, and April 15, 2013. Draft quarterly reports will be provided 45 days after receipt of laboratory analytical results, and final quarterly reports will be provided 14 days after client comments have been received.

6.0 REFERENCES

Tetra Tech, 2003. Baseline Environmental Monitoring Plan for Open Burning/Open Detonation Treatment Unit, Naval Weapons Station Earle, Colts Neck, New Jersey. April.

Tetra Tech, 2008. Baseline Monitoring Phases I and II Data Report for Site 2 - Open Burning/Open Detonation Unit, Naval Weapons Station Earle, Colts Neck, New Jersey. June.

Tetra Tech, 2010. Phase Ill Sampling – Field Investigation Report for Open Burning/Open Detonation (OB/OD) Unit, Naval Weapons Station Earle, Colts Neck, New Jersey. June.

Tetra Tech, 2011. Baseline Environmental Monitoring Plan Addendum for Open Burning/Open Detonation (OB/OD) Unit, Naval Weapons Station Earle, Colts Neck, New Jersey. October.

Tetra Tech, 2012. Phase IV Sampling Field Investigation Report for Open Burning/Open Detonation Unit, (Site 2) Naval Weapons Station Earle, Colts Neck, New Jersey. June.

Table 1: Proposed Supplemental Groundwater Monitoring Well Program

Well Number	Groundwater Elevation (ft amsl)	Top of Riser Elevation (ft amsl)	Total Depth (ft bgs)	Screen Interval (ft bgs)	Screen Length (ft)	Top of Screen Elevation (ft amsl)	Bottom of Screen Elevation (ft amsl)	Well Diameter (in)	Year Installed
02MW01A	102.48	104.76	19	9 - 19	10	93.48	83.48	2	2011
02MW01B	102.01	104.20	35	25 - 35	10	77.01	67.01	2	2011
02MW01C	101.68	103.67	55	45 - 55	10	56.68	46.68	2	2011
02MW06B	91.263	93.08	35	25 - 35	10	66.26	56.26	2	2010
02MW06C	91.624	94.00	55	45 - 55	10	46.62	36.62	2	2010
02MW07	91.697	93.65	20.5	5- 20	15	86.70	71.70	4	1991
02MW09B	88.414	90.34	34.7	25- 35	10	63.71	53.71	2	2010
02MW10C	88.08	90.35	55	45 - 55	10	43.08	33.08	2	2010
02MW13A	79.46	82.09	14	4 - 14	10	75.46	65.46	2	2011
02MW13B	79.35	81.68	35	25 - 35	10	54.35	44.35	2	2011
02MW13C	79.09	81.63	55	45 - 55	10	34.09	24.09	2	2011

amsl = above mean sea level
bgs = below ground surface
ft = feet
in = inches

Table 2: Summary of Quarterly Groundwater Samples

Well Number	Sample Number	Depth (ft bgs)	Analyses		
			Explosives SW-846 8330	TAL Metals SW-846 6020	Perchlorate SW-846 6850
02MW01A	02MW01A-MMDDYY	9 - 19	•	•	•
02MW01B	02MW01B-MMDDYY	25 - 35	•	•	•
02MW01C	02MW01C-MMDDYY	45 - 55	•	•	•
02MW06B	02MW06B-MMDDYY	25 - 35	•	•	•
02MW06C	02MW06C-MMDDYY	45 - 55	•	•	•
02MW07	02MW07-MMDDYY	5- 20	•	•	•
02MW09B	02MW09B-MMDDYY	25- 35	•	•	•
02MW10C	02MW10C-MMDDYY	45 - 55	•	•	•
02MW13A	02MW13A-MMDDYY	4 - 14	•	•	•
02MW13B	02MW13B-MMDDYY	25 - 35	•	•	•
02MW13C	02MW13C-MMDDYY	45 - 55	•	•	•

bgs = below ground surface
ft = feet

Table 3: Analyte List and Project Screening Criteria

Chemicals of Concern[1]	CAS Number	NJDEP Groundwater Remediation Standards		ORNL Regional Screening Level (RSL)[4]		NJDEP Surface Water Quality Criteria
		Specific GW Quality Criteria (µg/L)	Interim GW Quality Criteria[2] (µg/L)	Tap Water (µg/L)	MCL (µg/L)	Human Health (µg/L)
Explosives						
2,4,6-Trinitrotoluene (TNT)	118-96-7	NA	**1**	2.2	NA	NA
1,3,5-Trinitrobenzene	99-35-4	NA	NA	**1,100**	NA	NA
1,3-Dinitrobenzene	99-65-0	NA	NA	**3.7**	NA	NA
2,4-Dinitrotoluene	121-14-2	0.05 (mixture)	NA	**0.22**	NA	**0.11**
2,6-Dinitrotoluene	606-20-2		NA	**37**	NA	NA
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	NA	**0.22**	NA	NA
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	NA	**73**	NA	NA
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	NA	**0.5**[3]	0.61	NA	NA
1,3,5-Trinitroso-1,3,5-hexahydrotriazine (TNX)	13980-04-6	NA	NA	NA	NA	NA
1-Nitroso-3,5-dinitro-1,3,5-hexahydrotriazine (MNX)	5755-27-1	NA	NA	NA	NA	NA
Metals						
Antimony	007440-36-0	**6**	NA	15	6	**5.6**
Arsenic	7440-38-2	**3**	NA	0.05	10	**0.017**
Chromium (Total)	7440-47-3	**70**	NA	NA	100	**92**
Copper	7440-50-8	**1300**	NA	1500	1300[4]	**1300**
Iron	7439-89-6	**300**	NA	26,000	NA[3]	NA
Lead	7439-92-1	**5**	NA	NA	15[4]	**5**
Zinc	7440-66-6	**2000**	NA	11000	NA[3]	**7400**
Other						
Perchlorate	014797-73-0	NA	**5**	26	15	NA

Shaded cells indicate the parameter criterion selected for preliminary screening of environmental data.

1. **Bold** Chemicals indicate primary COCs and *italic* compounds are secondary degradation products.
2. The Interim Groundwater Quality Standard (0.3 µg/L) is less than the Practical Quantitation Level (PQL) of 0.5 µg/L, which is the numerical standard to be applied for each constituent in Class II-A aquifers, according to the New Jersey Administrative Code (NJAC) 7:9C-1.9(c)).
3. MCL for zinc and iron based on secondary criteria (SMCL).
4. MCL for copper and lead are the MCLG.

CAS = Chemical Abstract Service
GW = Groundwater

MCL = Maximum Contaminant Level

NA = Not Available
ORNL = Oak Ridge National Laboratory
µg/L = Micrograms per liter

Table 4: Sample Quality Control Summary

Analyte Group	Analytical Method	Matrix	No. of Environmental Samples/Quarter	No. of Field Duplicates	No. of MS/MSDs	No. of Equipment Blanks	Total No. of Samples to Laboratory
Metals (total)	**SW-846 6020A**	**GW**	**11**	**2**	**1**	**1**	**14**
Metals (dissolved)[1]	**SW-846 6020A**	**GW**	**4**	**1**	**1**	**1**	**6**
Perchlorate	**SW-846 6850**	**GW**	**11**	**2**	**1**	**1**	**14**
Explosives and byproducts	**SW-846 8330A**	**GW**	**11**	**2**	**1**	**1**	**14**

1. Dissolved metals to be collected based on turbidity as described in the text.
MS = Matrix Spike
MSD = Matrix Spike Duplicate

Figure 1: Site Location

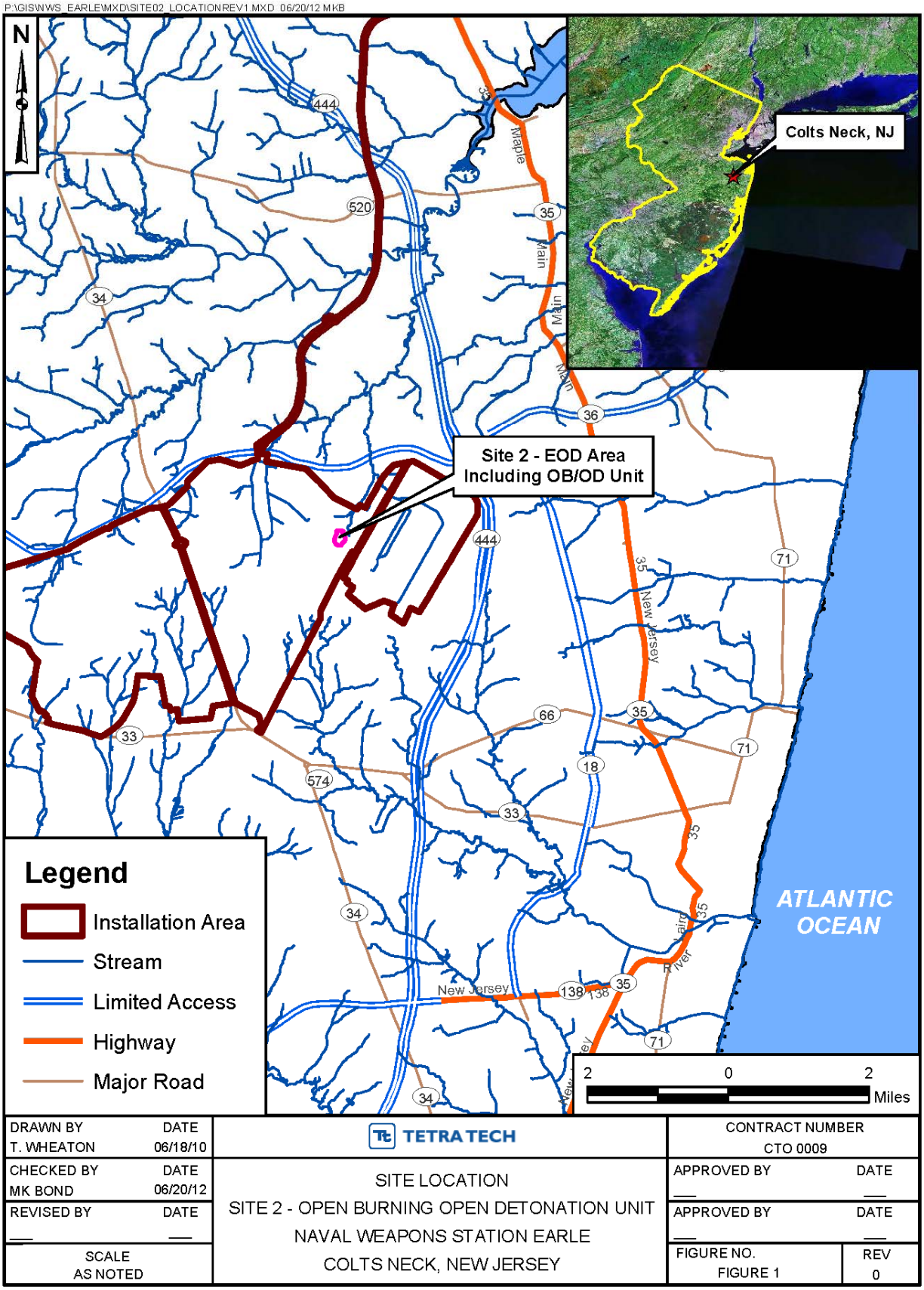


Figure 2: Site Layout

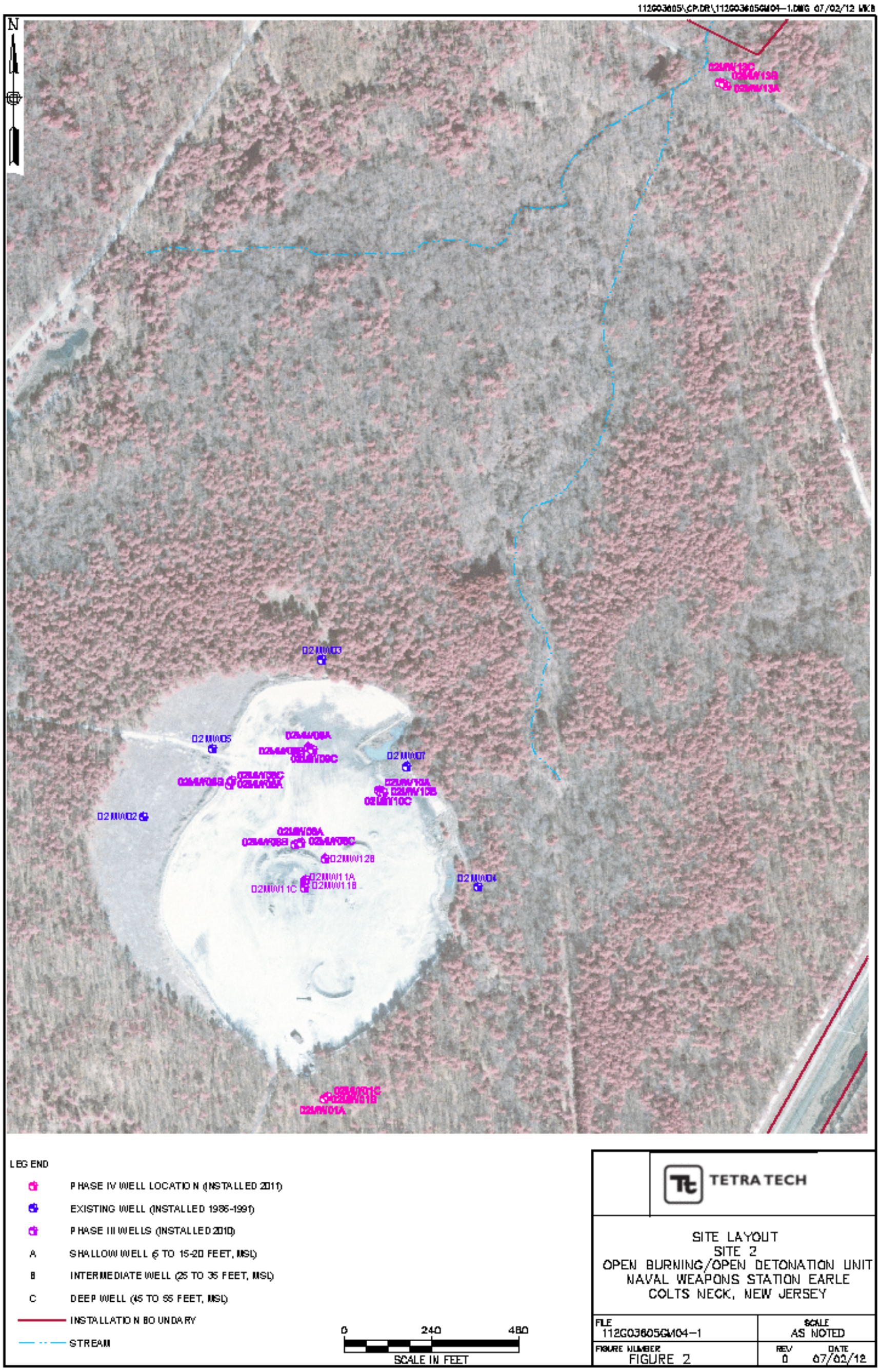


Figure 3: Groundwater Elevation Contours

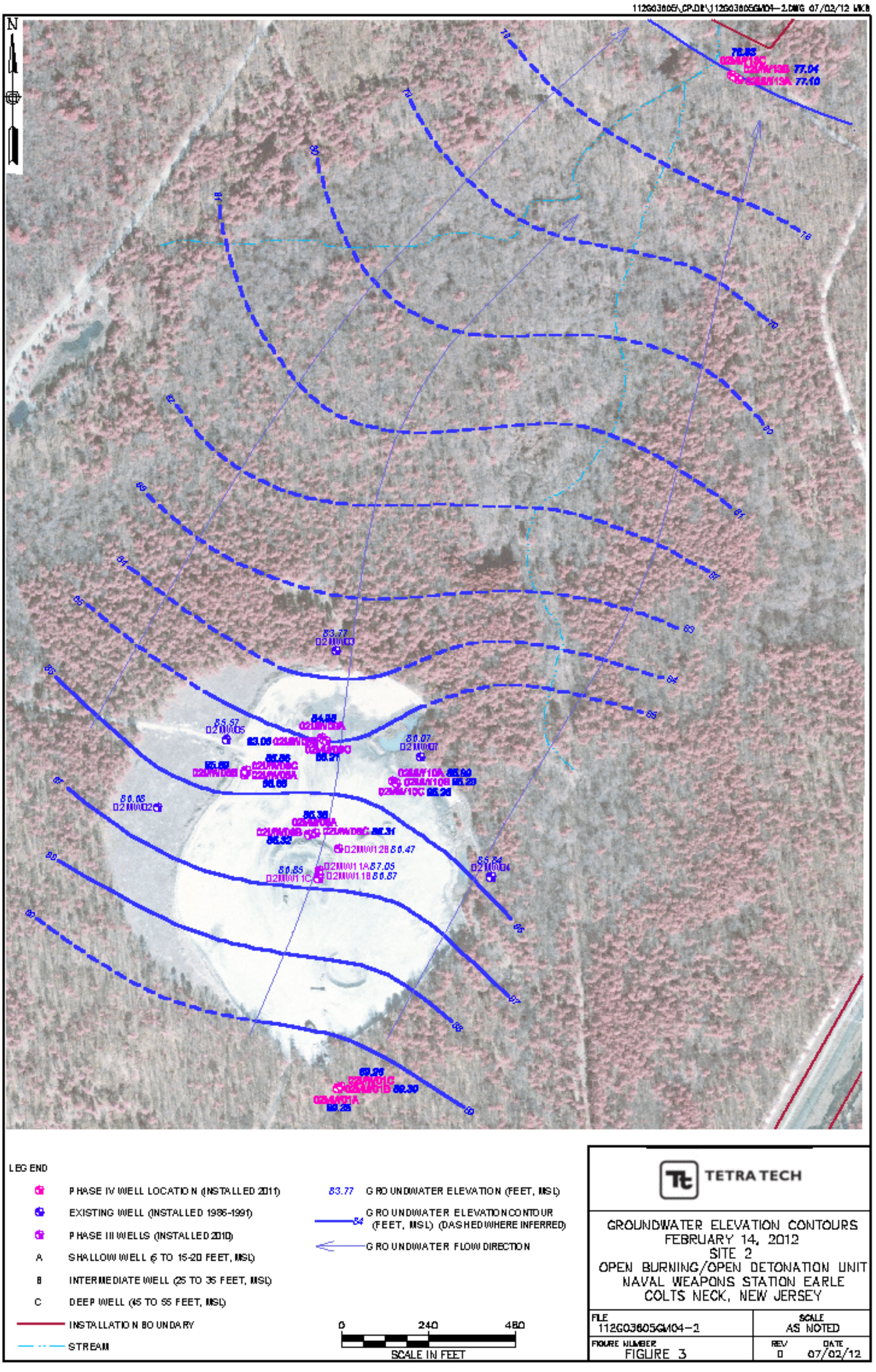
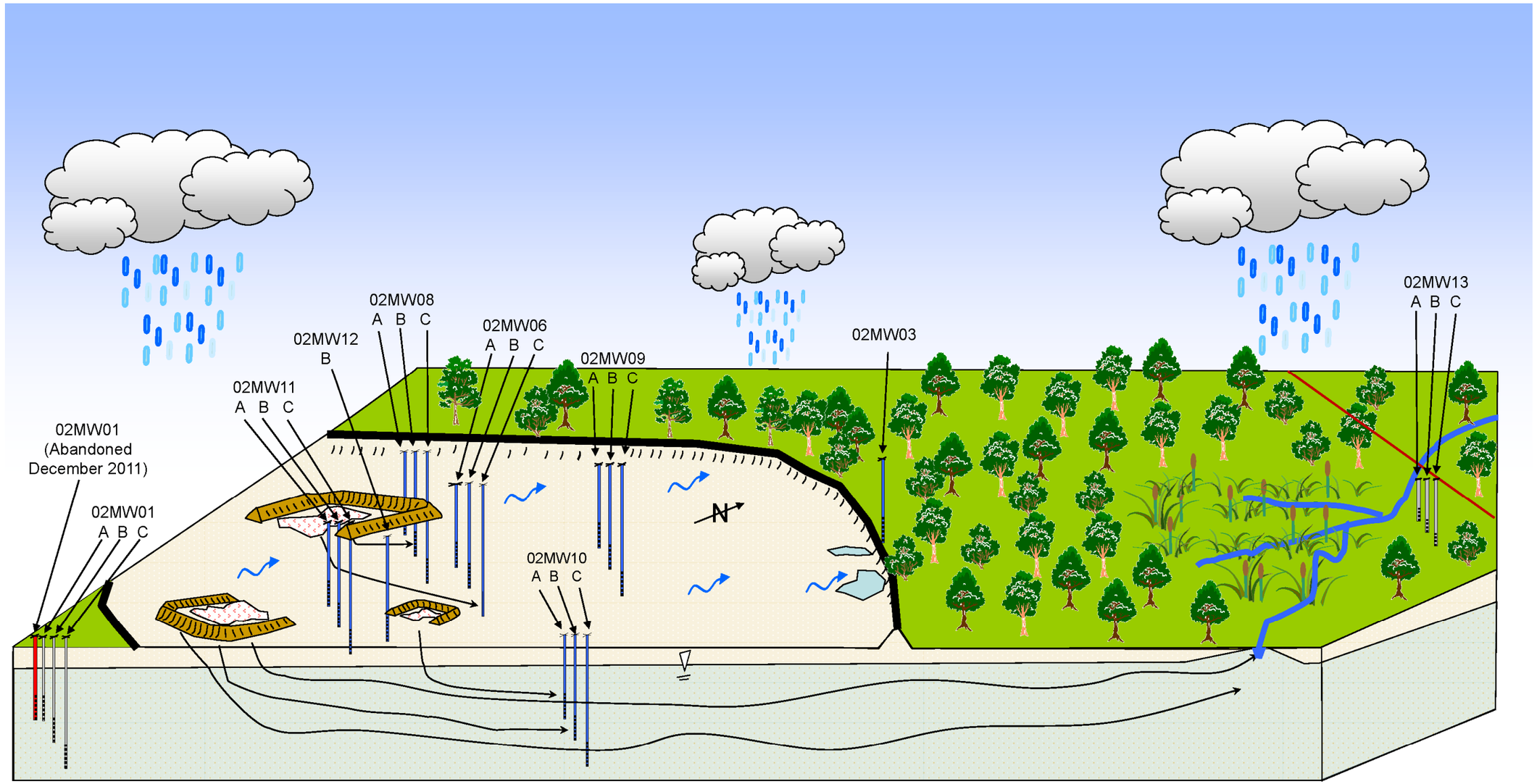


Figure 4: Groundwater Monitoring Plan Regional Conceptual Site Model



Feature Key

Overland Flow

Groundwater Flow

Installation Area

A =shallow water table well
B = 20 feet below water table
C = 40 feet below water table

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