

EXPLANATION OF SIGNIFICANT DIFFERENCES
OPERABLE UNIT 12
LORING AIR FORCE BASE
LIMESTONE, MAINE

**INTRODUCTION AND
STATEMENT OF PURPOSE**

This Explanation of Significant Differences (ESD) identifies a change to the Record of Decision (ROD) for Operable Unit (OU) 12 for contaminated base-wide groundwater at the former Loring Air Force Base (AFB) National Priorities List site in Limestone, Maine. This ESD identifies enhancements to the remedies selected in the Record of Decision (ROD) (Harding Lawson Associates, Inc. [HLA], 1999) for certain portions of OU12. It also replaces the remediation goal (RG) for total petroleum hydrocarbons (TPH) with RGs for petroleum fractions to reflect recent changes to Maine Department of Environmental Protection (MEDEP) guidance.

The United States (U.S.) Air Force is the lead agency, with oversight from the U.S. Environmental Protection Agency (EPA) and the MEDEP, for cleanup of sites at the former Loring AFB under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as modified by the Superfund Amendments and Reauthorization Act. The U.S. Air Force is issuing this ESD as part of the public participation requirements under Section 117(c) of CERCLA, Section 300.435(c)(2)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and the Air Force Installation Restoration Program (IRP). In accordance with Section 300.825(a)(2) of the NCP, this ESD will become part of the administrative record for the facility. The administrative record also contains background information that was used to determine the original remedy, as documented in

the OU12 ROD (HLA, 1999). The administrative record for the former Loring AFB is available for review online at <http://afcec.publicadmin-record.us.af.mil/Search.aspx> or at the following location:

Air Force Civil Engineer Center
154 Development Drive, Suite G
Limestone, Maine 04750-9743
(207) 328-7109
Hours: 8:00 a.m. to 4:30 p.m.
Monday through Friday

In addition, a notice that briefly summarizes this ESD will be published in the *Aroostook Republican* and the *Bangor Daily News*.

This ESD documents enhancements to the remedies for certain portions of OU12, as well as incorporates new RGs for petroleum contamination in OU12 groundwater.

An ESD, rather than a ROD amendment, is appropriate to document this change, as it does not fundamentally change the remedy. The ESD documents the remedy enhancement efforts the U.S. Air Force is implementing to improve the performance of the current remedy.

**SITE HISTORY, CONTAMINATION,
AND SELECTED REMEDY**

Site Description and History

The former Loring AFB is located in northeastern Maine and is bordered on the south and east by the town of Limestone, on the north by the towns of Caswell and Connor, and on the west by the city of Caribou (Figure 1). The

former Loring AFB is approximately 3 miles west of the U.S.-Canada border and covers approximately 9,000 acres.

The former Loring AFB was constructed in the late 1940s. Its primary mission was to support long-range bomber aircraft for the Strategic Air Command. Principal base operations included aircraft maintenance, refueling, munitions storage and maintenance, and flight line operations. These operations required the use, handling, storage, or disposal of materials and compounds containing hazardous substances. In the past, these hazardous substances entered the environment through accidental spills, leaks in supply piping, landfilling operations, burning of liquid wastes during fire training exercises, and the cumulative effects of operations conducted at the former Loring AFB flight line and industrial areas.

Under the U.S. Department of Defense's IRP, the U.S. Air Force initiated activities to identify, evaluate, and remediate sites contaminated with hazardous substances. The site has been organized into OUs to facilitate investigative and remedial activities. Because of the contamination discovered under the IRP, the former Loring AFB was placed on the National Priorities List in 1990, and the U.S. Air Force, EPA, and MEDEP agreed to remediate it in accordance with the Federal Facility Agreement (FFA) signed in 1991 (FFA, 1991). Following the signing of the FFA, the former Loring AFB was placed on the Base Closure List by the U.S. Congress and was closed in September 1994.

OU12 is comprised of site-wide groundwater. A site-specific description and history are provided below for the areas of contamination relevant to this ESD.

OU12—Contaminated Base-wide Groundwater

The OU12 ROD selected the Limited Action alternative as the remedy for 6 groundwater plumes and the Groundwater Management Zone (GMZ) alternative for 12 groundwater plumes. The Limited Action alternative was selected for plumes where chlorinated degradation products

were not present or contaminants of concern (COCs) were present only at low concentrations and were not widely distributed. The GMZ alternative was selected for plumes where there was evidence of natural attenuation processes and higher concentrations and/or greater distribution of COCs were present (HLA, 1999). The two alternatives have similar components; however, the GMZ alternative includes natural attenuation processes as one of the components, and thus has a more complex monitoring program. The establishment of GMZs is common to both of these alternatives, and the OU12 ROD established six GMZs (see **Figure 1**). Each GMZ includes a contaminated groundwater area (i.e., an area of contaminated groundwater consisting of one or more of the delineated OU12 plumes), outside of which was the zone's compliance boundary; the compliance boundary for each zone was established at a distance of approximately 100 to 500 feet from the edge of the contaminated groundwater area (i.e., from the edge of the plume[s]).

The remedial action objectives established by the OU12 ROD include the following:

- Preventing residential use of groundwater containing COCs in excess of RGs;
- Preventing COCs in excess of RGs from migrating off site (past the compliance boundary); and
- If feasible, reducing COC concentrations to RG concentrations.

The OU12 ROD also specified RGs for each GMZ in order to meet the above objectives. This ESD applies to GMZs 1, 3, 4, 5, and 6. GMZ-2 is not included in this ESD because it was closed in 2003 when it was demonstrated that all remedial action objectives had been met (MWH Americas, Inc, 2002). A description of the five GMZs covered by this ESD follows.

GMZ-1 is located in the central portion of the former Loring AFB adjacent to the flight line area. GMZ-1 includes 11 groundwater plumes, 9 of which are related to defined source areas and 2 of which are formed by the commingling of source area plumes. Source area plumes in the

northern and central portions of GMZ-1 include the Central Nose Dock Area (CNDA), Pump House (PH) 8210, the Former Solvent Storage Building (FSSB), the Jet Engine Build-up Shop (JEBS) North, the Entomology Shop (ES)/JEBS South, and the Contractor Storage Shed (CSS). These plumes discharge in the Flight Line Drainage Ditch (FLDD) area and commingle to form the FLDD North Plume. Source area plumes in the southern portion of GMZ-1 include the Base Laundry (BL), the Vehicle Maintenance Building (VMB), and the Refueling Maintenance Shop Area (RMSA). These plumes discharge and commingle to form the FLDD South Plume.

Former activities in GMZ-1 included aircraft storage, maintenance, fueling, and defueling in the CNDA; aircraft fueling at PH 8210; storage of thinner and solvents for aircraft maintenance at the FSSB; repair, teardown, and modification of jet engines at the JEBS; treatment of JEBS wastewater and pesticide storage and preparation at the ES; storage of waste oil, waste chemical drums, and electrical transformers at the CSS; dry cleaning at the BL; vehicle maintenance and refueling at the VMB; and maintenance operations for fuel bowser trucks at the RMSA.

Source areas in GMZ-1 have been addressed through numerous remedial actions dating from the 1980s. Remedial actions include building demolition at PH 8210, the FSSB, the ES/JEBS South, and the CSS; removal of aboveground and underground storage tanks (USTs) at the CNDA, PH 8210, and the RMSA; excavation of contaminated soil at the CNDA, PH 8210, the FSSB, the ES/JEBS South, the BL, the VMB, and the RMSA; installation of soil vapor extraction systems at the JEBS North, ES/JEBS South, and BL; and installation of bioventing systems at the CNDA, the ES/JEBS South, and the VMB. In addition, a potassium permanganate treatability study was completed for soil at the BL. Approximately 30,000 cubic yards of the soil excavated at the CNDA was remediated by landspreading and reused to backfill the excavations. Some of the soil excavated at the VMB was treated ex situ with soil vapor extraction.

The OU12 ROD selected the limited action alternative for three of the GMZ-1 plumes (RMSA, FSSB, and CSS) and the GMZ alternative for the other eight GMZ-1 plumes. The OU12 ROD also included a technical impracticability (TI) waiver for the ES/JEBS plume based on an estimated cleanup time of 320 years (HLA, 1999). The EPA and MEDEP requested that the U.S. Air Force subsequently review and consider implementing technologies applicable to any portion of OU12 where the TI waiver was granted.

GMZ-3 is located in the west-central portion of the former Loring AFB. GMZ-3 consists of three groundwater plumes associated with Buildings 8710 and 8711, which were a source of chlorinated volatile organic compounds (VOCs), and the Base Exchange Service Station (BXSS), which was a source of petroleum-related compounds. The plumes are named based on location and include Upgradient BXSS, Building 8711, and BXSS Plume.

Building 8710 was used for equipment maintenance, weapon loading, and weapon storage. Building 8711 has a former drum storage area/equipment degreasing area, a former engine testing area, and a fuel bowser storage area (HLA, 1999). The BXSS was built in 1955 and closed in September 1994. The station was used to dispense leaded and unleaded gasoline and to perform vehicle maintenance for military personnel stationed at the former Loring AFB.

Contaminated soil associated with the Building 8711 plume was excavated in a removal action from the area west of the Building 8711 parking lot in 1996 and from the north side of Building 8710 in 1998. All USTs, gasoline pumps, and associated piping were removed and replaced at the BXSS in 1991. Free product was encountered during the excavations, and it was recovered, containerized, and disposed. A bioventing pilot study was initiated in 1992 and expanded in 1996. Contaminated soil and sediment were excavated in a removal action from the drainage ditch west of the BXSS in 1997.

The OU12 ROD selected the limited action alternative for two of the GMZ-3 plumes (Upgradient BXSS and Building 8711) and the GMZ alternative for the BXSS Plume.

GMZ-4 is located near the northwestern boundary of the former Loring AFB, adjacent to the Nose Dock Area. GMZ-4 consists of a plume of chlorinated VOCs in bedrock in the area of the Quarry. Rock quarrying activities started with the construction of the former Loring AFB in 1947, and operations continued until 1985. The former quarrying activities removed most of the vegetative and soil cover along with a large volume of rock, resulting in two levels, the upper and lower tiers, which open to the west (EPA and MEDEP, 2005). The lower tier is seasonally flooded and drains through an excavated ditch into the Greenlaw Brook wetland. The lower tier rises approximately 30 feet to the upper tier, which rises approximately 30 feet more to the Nose Dock Area.

Waste materials from construction projects, industrial and maintenance shops, and other base activities were stored and disposed of at the Quarry. Soil, sediment, and construction debris were excavated from the Quarry in a 1994 removal action. Approximately 300 drums and associated contaminated soil were excavated from an area northeast of the Quarry in a 1998 removal action. The EPA and MEDEP conducted a steam-enhanced remediation pilot study in 2002 to recover VOCs from the fractured bedrock. The pilot study included additional characterization activities in 2001 followed by construction of the remediation system in 2002.

The OU12 ROD selected the GMZ alternative for GMZ-4. The OU12 ROD also included a TI waiver for GMZ-4 based on an estimated cleanup time of between 168 and 1,152 years (HLA, 1999). The EPA and MEDEP requested that the Air Force subsequently review and consider implementing technologies applicable to any portion of OU12 where the TI waiver was granted.

GMZ-5 is located on the west side of the runway area north of the CNDA and consists of

a plume of chlorinated VOCs resulting from former activities at the Former Jet Engine Test Cell (FJETC) site. The FJETC included two small buildings and a concrete pad that were used for stationary tests of aircraft engines upon concrete pedestals. The buildings were decommissioned in 1976 and demolished in 1986. The site currently consists of a 40- by 50-foot concrete pad, asphalt pavement, and a cobble-lined (riprap) blast zone.

Source area soil at the FJETC, addressed under OU5, has been treated by a bioventing system that was installed in 1995 as recommended by an engineering evaluation/cost analysis (EE/CA). The bioventing system has been in operation since the 1990s, but cleanup goals have not been met throughout the treatment area. Remaining soil contamination will be addressed by excavation as documented in a separate ESD for OU5.

The OU12 ROD identified the GMZ alternative for GMZ-5.

GMZ-6, East Base, is located along the northeastern side of the former Loring AFB, south-southwest of Oklahoma Road and consists of a plume of primarily fuel-related VOCs resulting from activities at the former Fire Training Area. The Fire Training Area was used from 1952 to 1988 and consisted of a mock aircraft located in a bermed circular pit. A UST and associated piping were removed in 1994. An EE/CA, prepared in 1995, recommended excavation of contaminated soil and bioventing, and 4,510 cubic yards of soil were excavated. A bioventing system was installed in 1995 and started operation in 1996. The bioventing system was decommissioned in 1998 after soil confirmation sampling indicated that xylene, naphthalene, and 2-methylnaphthalene remained at concentrations above RGs. In conjunction with the decommissioning, an additional 23,100 cubic yards of contaminated soil were excavated.

The OU12 ROD identified the GMZ alternative for GMZ-6.

BASIS AND DESCRIPTION OF SIGNIFICANT DIFFERENCES

As discussed above, the OU12 ROD established the limited action alternative as the remedy for 6 groundwater plumes and the GMZ alternative for 12 groundwater plumes. Each of these remedies relied on natural degradation processes monitored over time. During 2012, groundwater sampling was conducted according to the OU12 Long-Term Monitoring Plan, and was supplemented by additional groundwater sampling and investigation activities. The objectives of this effort were to fulfill the U.S. Air Force's long-term monitoring commitment and also to assess the current status of the various OU12 plumes to determine whether additional activities could be conducted to improve remedy performance and potentially reduce the length of time projected to achieve the RGs. The methods and results of this investigation effort are presented in the 2012 OU12 Long-Term Monitoring Report (Shaw, 2013). Based on the results obtained, the following modifications to the selected remedies for GMZ-1, GMZ-3, and GMZ-5 will be implemented. A separate ESD documenting modifications to the remedies for GMZ-4 and GMZ-6 will be submitted at a later time, if necessary. Additionally, a proposal to enhance the groundwater remedy at the JEBS South Plume (GMZ-1) may be submitted at a later time.

GMZ-1

- The OU12 ROD specified the GMZ alternative for the JEBS South Plume including a TI waiver of the requirement to achieve groundwater RGs in a reasonable timeframe. In order to reduce the potential for trichloroethene (TCE) in deep soils to be a continuing source of groundwater contamination, the U.S. Air Force will excavate TCE contaminated soil located below the shallow water soil table at the South JEBS and treat the soil by landspreading. In addition, a carbon source and microbes will be applied to the bottom of the excavation. Refer to **Figure 2** for the excavation and treatment area. Excavation

and treatment of soil above the shallow water table will be conducted under OU10. The option to excavate soil was considered in the Feasibility Study which supported the original remedy selection for the JEBS site.

GMZ-3

- The U.S. Air Force will implement In-Situ Enhanced Bioremediation (ISEB) to enhance groundwater contamination remediation at the Building 8711 Plume in the vicinity of source area well JMW6105. ISEB will be implemented by adding emulsified vegetable oil and SDC-9 microbe cultures into bedrock injection wells. Refer to **Figure 3** for the location of the proposed treatment. The ROD specified the Limited Action alternative for this plume.

GMZ-5

- Conduct soil excavation of FJETC soil to address the TCE- and petroleum-contaminated soil below the shallow water table. Soil will be excavated and treated on site by landspreading. Refer to **Figure 4** for the proposed excavation area. Excavation of soil above the shallow water table will be conducted under OU5. The ROD specified the GMZ alternative for this plume. The option to excavate soil was considered in the Feasibility Study which supported the original remedy selection for the FJETC site.

The OU12 ROD established RGs for each plume and the compliance boundary for each GMZ in Tables 11-1 and 11-2 of that document. These RGs were based on applicable or relevant and appropriate requirements (ARARs) and risk considerations. At the time of the ROD, a risk-based concentration of 361 micrograms per liter ($\mu\text{g/L}$) TPH was established as a screening value for use at the compliance boundary.

Analytical methods for diesel-range organics and gasoline-range organics have historically been used for characterizing petroleum-contaminated groundwater at the former Loring AFB. These methods do not quantify aliphatic

and aromatic hydrocarbon fractions, and therefore, do not provide adequate information regarding the contaminant composition or toxicity needed to support risk-based decisions. The MEDEP recently adopted extractable petroleum hydrocarbon (EPH)/volatile petroleum hydrocarbon (VPH) analytical methods and risk-based cleanup guidelines for use at petroleum-contaminated sites (MEDEP, 2009). The EPH/VPH methods measure the collective concentrations of aliphatic and aromatic hydrocarbon fractions needed to assess risk (MEDEP, 2009).

Since there are now risk-based State guidelines for petroleum hydrocarbons applicable to sites within OU12, this ESD incorporates them as compliance boundary RGs for petroleum hydrocarbons, expressed as hydrocarbon fractions, as follows:

	Existing Compliance Boundary RG (µg/L)	New Compliance Boundary RG (µg/L)
TPH	361*	Replaced by EPH/VPH RGs
VPH		
C5-C8 Aliphatics	None	300
C9-C12 Aliphatics	None	700
C9-C10 Aromatics	None	200
EPH		
C9-C18 Aliphatics	None	700
C19-C36 Aliphatics	None	10,000
C11-C22 Aromatics	None	200

* Screening value for Compliance Boundary.

µg/L denotes micrograms per liter.

EPH denotes extractable petroleum hydrocarbon.

RG denotes remediation goal.

VPH denotes volatile petroleum hydrocarbon.

This change will result in the need to incorporate EPH/VPH analytical methods into the long-term groundwater monitoring plan for the site. It

should not result in significant changes to the selected remedies or increase time to achieve cleanup objectives.

SUPPORT AGENCY COMMENTS

EPA and MEDEP representatives, as part of the Loring AFB team, have had ongoing involvement in the decision-making process associated with the changes in the OU12 remedies. The U.S. Air Force has obtained concurrence from the EPA and MEDEP on the modification to the cleanup remedies and confirms that they address the concerns of the community and protects human health and the environment.

STATUTORY DETERMINATIONS

The proposed change to the selected remedy will continue to satisfy the statutory requirements of CERCLA, Section 121, and the modified remedy will remain protective of human health and the environment and will continue to comply with federal and state ARARs and be cost-effective.

PUBLIC PARTICIPATION

Public participation requirements as outlined in the NCP, Section 300.435(c)(2)(i) have been met.

FOR MORE INFORMATION

If you have questions or would like further information about this ESD for OU12 at the former Loring AFB, please contact:

David Strainge
 Air Force Center for Engineering and the Environment
 154 Development Drive
 Limestone, Maine 04750-9743
 (207) 328-7109

DECLARATION

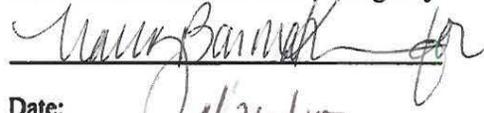
The issuance of the ESD for OU12 at the former Loring AFB is concurred with.

Department of the Air Force


Date: 14 JUN 15

Robert E. Moriarty, P.E.
Director, Installations Directorate
Air Force Civil Engineer Center

U.S. Environmental Protection Agency


Date: 01/26/15

James T. Owens
Director, Office of Site Remediation and Restoration
U.S. EPA Region 1

REFERENCES

Federal Facilities Agreement (FFA) Under CERCLA Section 120, *The Matter of Loring Air Force Base* by U.S. Environmental Protection Agency Region 1, State of Maine, and the U.S. Department of the Air Force, 30 January 1991.

Harding Lawson Associates, Inc. (HLA), 1999. *Operable Unit (OU) 12 Record of Decision Installation Restoration Program Loring Air Force Base*, September.

Maine Department of Environmental Protection (MEDEP), 2009. *Remediation Guidelines for Petroleum-Contaminated Sites in Maine*, December.

MWH Americas, Inc., 2002. *Remedial Action Completion Report for GMW-2*, November.

Shaw, 2013. *Draft Operable Unit 12 Long Term Monitoring Program, 2012 Annual Report, Groundwater Monitoring Zones 1-6 Former Loring Air Force Base*, Limestone, Maine, July.

U.S. Environmental Protection Agency (EPA), and MEDEP, 2005. *Steam Enhanced Remediation Research for DNAPL in Fractured Rock Loring Air Force Base, Limestone, Maine*, August.

ACRONYMS

CERCLA – Comprehensive Environmental Response, Compensation, and Liabilities Act

COC – Contaminant of Concern

EE/CA -- Engineering Evaluation/Cost Analyses

EPA – Environmental Protection Agency

EPH – Extractable Petroleum Hydrocarbons

ESD – Explanation of Significant Differences

FFA – Federal Facilities Agreement

GMZ – Groundwater Management Zone

IRP – Installation Restoration Program

ISEB – In-Situ Enhanced Bioremediation

MEDEP – Maine Department of Environmental Protection

NCP – National Contingency Plan

OU – Operable Unit

RG – Remediation Goal

ROD – Record of Decision

TCE -- Trichloroethene

TI – Technical Impracticability

TPH – Total Petroleum Hydrocarbons

UST – Underground Storage Tank

VOC – Volatile Organic Carbon

VPH – Volatile Petroleum Hydrocarbons



-  Former Base Boundary
-  Plume Definition
-  Groundwater Management Zone Compliance Boundary

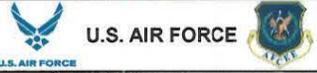
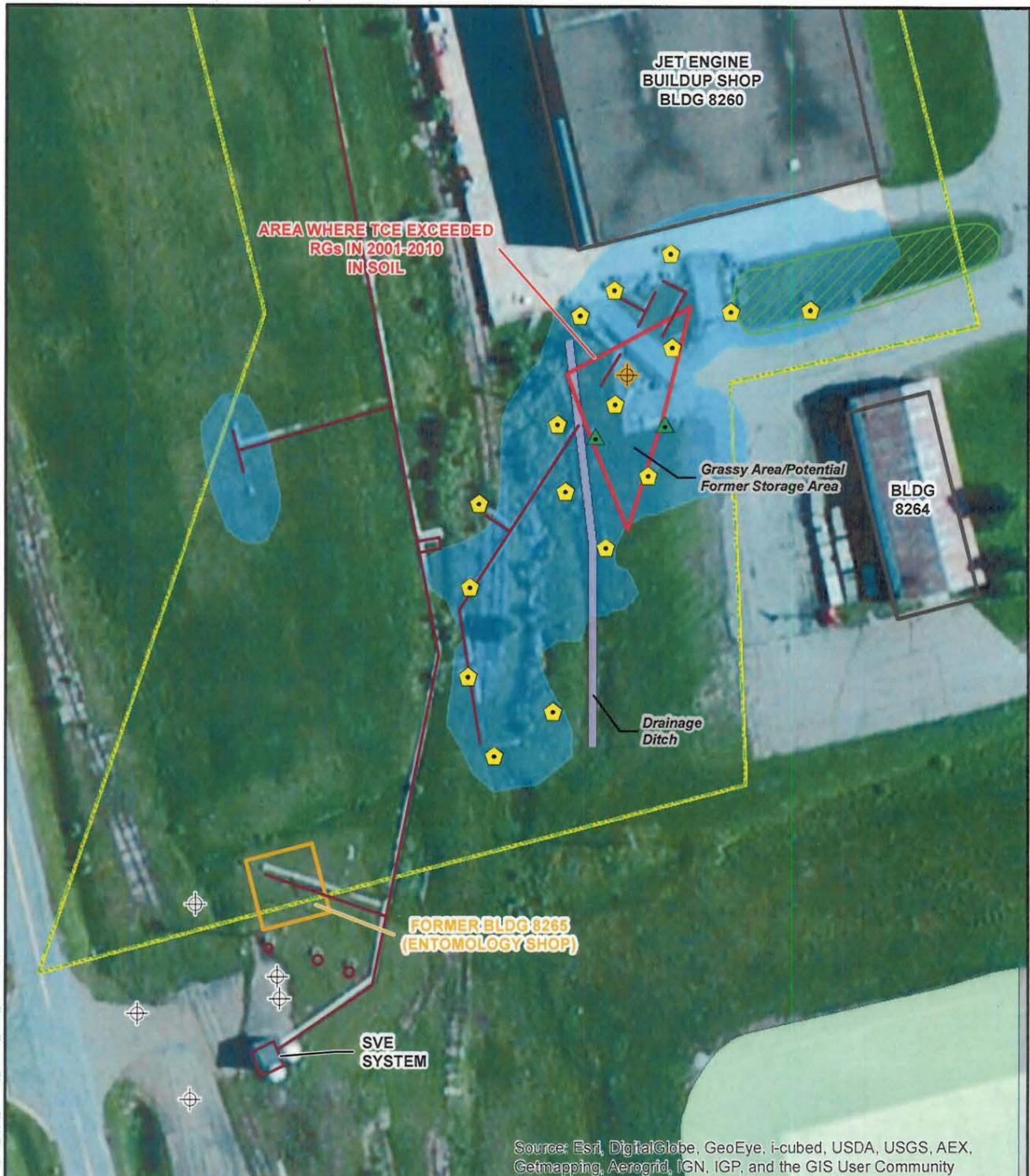


FIGURE NUMBER 1 LOCATIONS OF GROUNDWATER MANAGEMENT ZONES AND PLUMES WITHIN OU 12 FORMER LORING AIR FORCE BASE LIMESTONE, MAINE





Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community

- Bedrock Monitoring Well
- Overburden Monitoring Well
- Air Extraction Well
- Passive Air Vent
- Potential Biopiling Treatment Area
- Compliance Boundary
- JEBs Plume (1997)
- Area of Contaminated Soil Based on 2001-2010 Soil Borings
- Former Drainage Swale



PROJECTION: NAD83 UTM Zone 13N

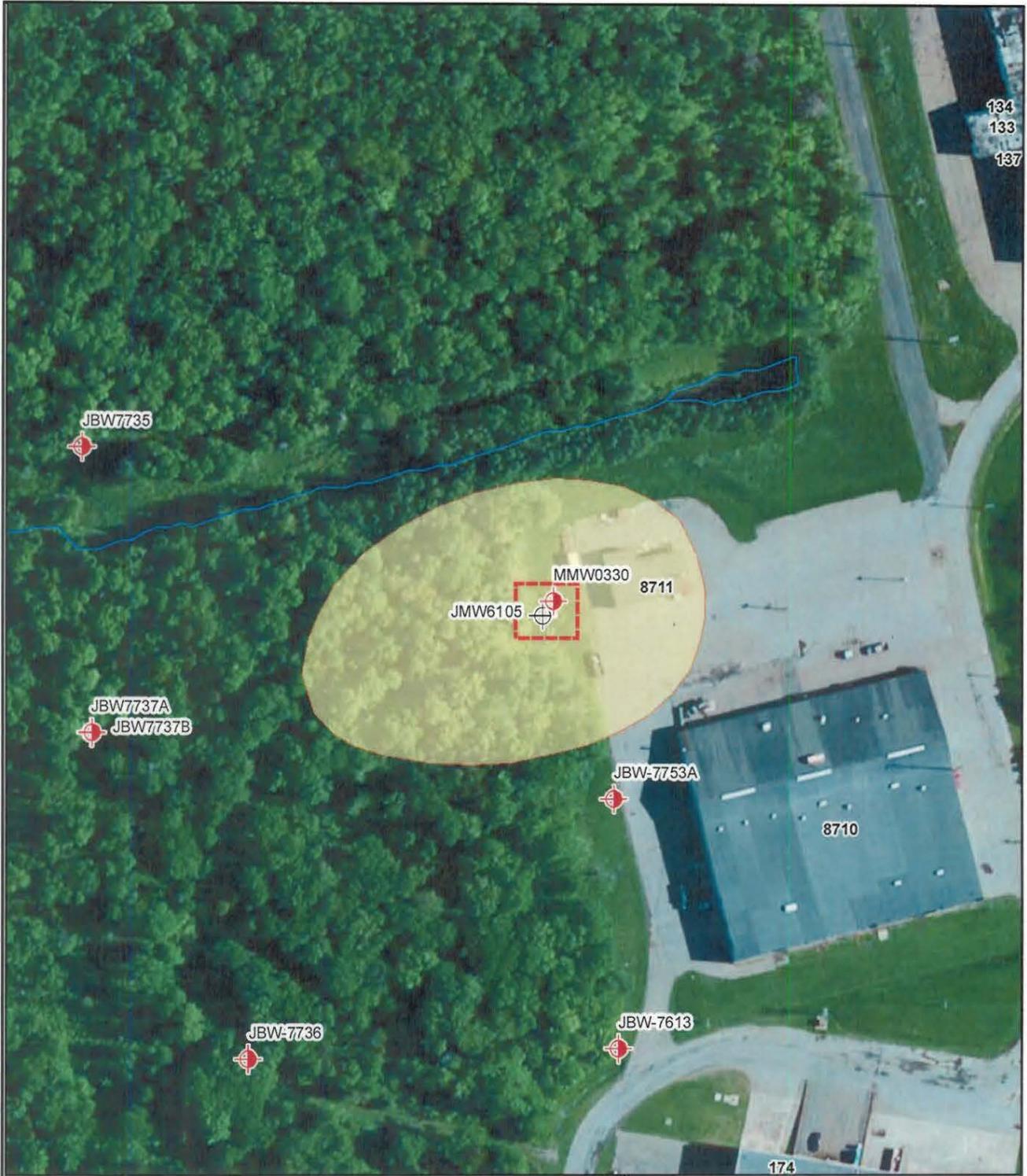
U.S. AIR FORCE

Explanation of Significant Differences
Operable Unit 12

FIGURE NUMBER	2
EXCAVATION AREA SOUTH JEBs - JET ENGINE BUILDUP SHOP (WP040) FORMER LORING AIR FORCE BASE LIMESTONE, MAINE	

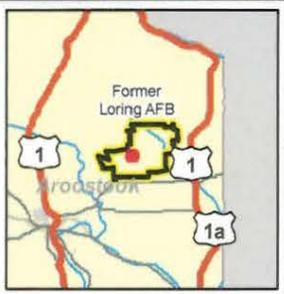
Shaw Environmental & Infrastructure, Inc.
(A CB&I Company)
150 Royall Street
Canton, MA 02021

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-  Hybrid (Overburden/Bedrock) Monitoring Wells
-  Bedrock Monitoring Wells
-  Groundwater Treatment Area
-  Pre-2012 Baseline Sampling Plume Definition

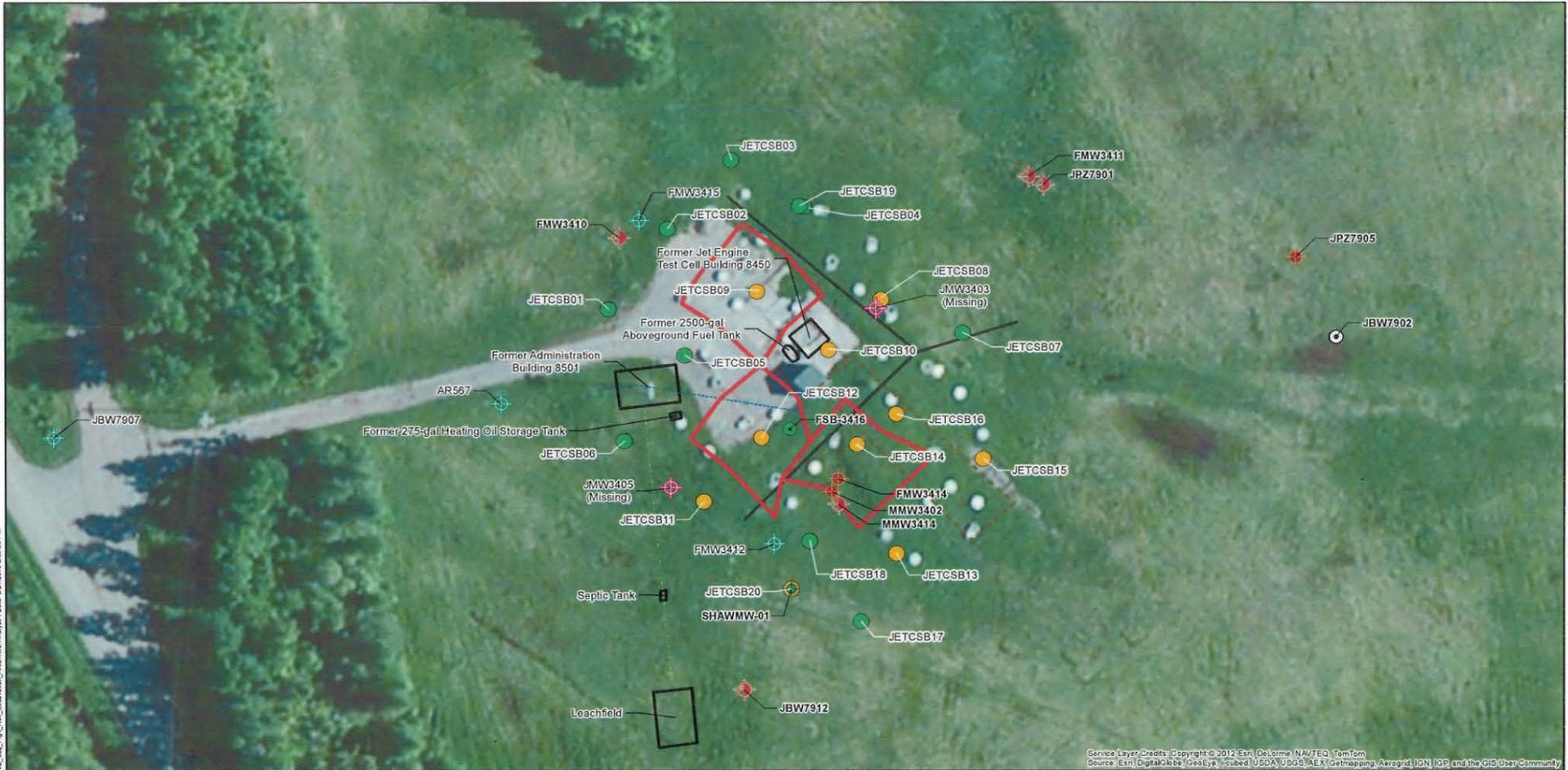
Note:
Depending on the results of Phase I,
proposed injection well locations
may be converted to monitoring wells



PROJECTION: NAD 1983 StatePlane Maine East FIPS 1801 Feet

 U.S. AIR FORCE 	
Explanation of Significant Differences Groundwater Management Zone 3 (SS056)	
FIGURE NUMBER 3	GROUNDWATER TREATMENT AREA, GMZ-3 FORMER LORING AIR FORCE BASE LIMESTONE, MAINE
 Shaw Environmental & Infrastructure, Inc. (A CBI Company) 150 Royall Street Canton, MA 02021	

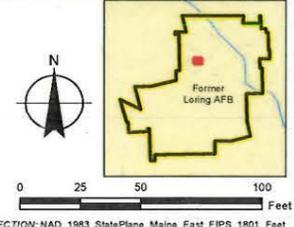
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Service Layer Credits: Copyright © 2012 Esri | DeLorme | NAVTEQ | TomTom
 Source: Esri | DigitalGlobe | GeoEye | USDA | USGS | AEX | Getmapping | Aergrid | IGN | IGP and the GIS User Community

- Rip Rap Blast Zone Trough
- Excavation Area
- Subsurface Drainage Trench
- Septic Line
- Underground Electric
- New Monitoring Well
- Soil Boring Location
- Bedrock Monitoring Well
- Overburden Monitoring Well
- Overburden - Screened Auger Boring
- Abandoned Monitoring Well
- Missing Monitoring Well
- Shallow Soil Boring Samples
- Deep Soil Boring Samples

Notes:
 1) Location of FSB-3416 from RI (CDM, 1996).



U.S. AIR FORCE	
Explanation of Significant Differences Operable Unit 12	
FIGURE NUMBER 4	REVISED EXCAVATION AREA FORMER JET ENGINE TEST CELL - SS035 FORMER LORING AIR FORCE BASE LESTER, MAINE
Shaw Environmental & Infrastructure, Inc. (A CBI Company) 150 Royal Street Canton, MA 02021	

PROJECTION: NAD, 1983 StatePlane Maine_East FIPS 1801 Feet