US Army Corps
of Engineers®
New England District

Final
WETLAND & UPLAND HABITAT RESTORATION AND LONG TERM ADAPTIVE MONITORING AND MAINTENANCE PLAN

AREA OF CONTAMINATION (AOC) 57

DEVENS, MASSACHUSETTS

January 2007

PREPARED BY:

DEPARTMENT OF ARMY
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
CONCORD, MASSACHUSETTS 01742

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AREA OF CONTAMINATION (AOC) 57

WETLAND & UPLAND HABITAT RESTORATION AND LONG TERM ADAPTIVE MONITORING AND MAINTENANCE PLAN

1.0 OBJECTIVES

The objectives of the Area of Contamination (AOC) 57 Wetlands and Upland Habitat Restoration and Long Term Adaptive Monitoring and Maintenance Plan are to evaluate the restoration measures implemented in AOC 57 - Areas 2 and 3 during the first three or more growing seasons after site remediation and restoration activities to ensure success and to identify and implement needed corrective actions based on the periodic monitoring. The Record of Decision (ROD) requires monitoring for a period of five years after wetland restoration. The locations of the two restoration sites are provided in Figure 1. The remediation and restoration were completed in October 2003 (Conti Environmental 2004) in accordance with the January 2002 Work Plan (Conti Environmental 2002) and 2003 Work Plan Amendment for Additional Soil Removal (Conti Environmental 2003). Consequently the long term monitoring began in 2004 with annual monitoring inspections scheduled twice a year in the Late Spring/Early Summer and Late Summer/Early Fall time frames. This report plan summarizes the restoration approach and construction measures for the restoration of impacted wetland/upland habitat, and provides the subsequent long term adaptive monitoring and maintenance plan approach that was developed concurrently during implementation of the 2004 program. Results of the annual monitoring program results will be provided in separate annual reports.

2.0 WETLAND & UPLAND HABITAT RESTORATION PLAN AND MONITORING APPROACH

Conti Environmental prepared a wetlands restoration plan in 2002 with assistance from CDM and the Army as summarized herein. This plan addressed activities required to successfully restore wetlands at the site, in compliance with the applicable or relevant and appropriate requirements (ARARs). This plan also contains information related to uplands restoration, as the successful restoration of the AOC57 wetlands is dependent upon, and is integrated with, the adjacent uplands restoration.

2.1 General Restoration Approach

The general restoration approach was to restore habitats disturbed during remediation (including wetland) to an area equal to the disturbed area, and to restore similar slope and transition conditions as surrounding areas representative of the undisturbed natural setting. The approach supports re-establishment of indigenous species within the restoration areas, by providing favorable shading and hydrologic conditions. Several plant species were identified as "invasives" or "exotics" and where practical, were subject to eradication control as reported herein.

This restoration plan was designed to meet the performance standards of the Massachusetts Wetlands Protection Act. Since this task order involved remediation of a contaminated site, it is considered a "limited project" pursuant to the Massachusetts Wetlands Protection Regulations.

2.2 Field Check of Existing Delineations

On Friday November 30, 2001 a site visit was conducted to evaluate both soil excavation areas and previously delineated wetland boundaries.

Area 2: The wetland boundary immediately adjacent to Area 2 was previously delineated and further expanded due to remediation requirements since work was required within the flagged wetland boundary (Figure 2). The general configuration and location of that boundary appeared to be consistent with the boundary observed in the field during this work. However, the prior boundary ended at the southeasterly corner of the presumed extent of contaminated soil. The wetland boundary as observed in the field continues in a northerly direction to about the 222-foot contour and then continues in an easterly direction along that contour. It was determined that the existing delineation and flagging was valid, the wetland boundary was re-staked in the field, and subsequent survey activities demarcated the wetland boundary prior to commencing soils excavation and site restoration. Approximately 1,744 square feet of wetlands was restored at Area 2 as shown in Figure 3.

Area 3: Old wetland flags were observed in the field during the site visit and the wetland boundary was revisited. The wetland boundary observed in the field was just south of and within a few feet of the identified limit of soil excavation as shown in Figure 4. Since cleanup objectives were attained within the planned/final excavation limits, no wetland resource areas were disturbed during remediation of Area 3, and site restoration was consequently performed consistent with the upland areas. The silt fence and hay bales installed immediately downgradient at the edge of the planned/final excavation limit and approximate limit of site restoration may have intruded slightly into the wetland. Since removal of the silt fence may have disturbed the edge of this wetland, this wetland edge will be monitored as part of the long term monitoring plan program.

The elevation of the delineated Bordering Vegetated Wetlands (BVWs) at both Areas 2 and 3 generally follows the 222-foot contour as shown on Figures 2 & 3 for Area 2 and Figure 4 for Area 3. The boundary of the floodplain associated with nearby Cold Spring Brook for Areas 2 and 3 appears to be at an elevation of approximately 224 to 225-feet (Conti Environmental 2002).

2.3 Erosion Control Measures

The installation of sedimentation control barriers and stabilization of exposed soils were needed to prevent the transport of sediment to undisturbed wetlands during soil remediation activities. The following measures were followed:

- Staked silt fence and/or hay bales were installed at the limit of work prior to commencement of work to prevent the transport of sediment to down gradient wetlands during remediation activities. The silt fence/hay bale barrier was inspected weekly and after all storm events of ½ inch or more, and repaired as needed. The barrier was left in place until the area was permanently stabilized. A stockpile of hay bales and/or silt fence was stored on site under a protective cover for routine maintenance and emergency repairs. Hay bales were replaced as necessary due to sediment build-up and degradation.

- Work proceeded as rapidly as possible. Limiting the exposure time of disturbed soils to wind and precipitation minimized soil erosion and subsequent sedimentation.

- All disturbed soils within 100 feet of wetlands were permanently stabilized with a sedimentation/erosion control seed mixture. These areas were maintained and re-seeded to ensure that at least 80 percent ground coverage was achieved.

- The silt fence/hay bale barrier was removed when the work area was stabilized.

Appropriate seed mixes and plantings are presented in Section 2.5 below relative to wetland restoration areas and upland restoration areas.

In addition to the sedimentation control barriers and stabilization of exposed soils, surface water diversion swales and berms were constructed to divert run-on at each excavation area during construction. These swales served to mitigate soil loss from disturbed areas, in addition to helping minimize water within open excavations. The swales and berms were removed when the wetlands restoration work was completed.

2.4 Backfill Materials

Backfill materials were procured from an acceptable source that required prior Army approval of the proposed source based on existing physical and chemical testing data for each material. Backfill material within submerged or unstable wetland areas consisted of clean sand, (e.g., "Septic Sand") so that backfilling could be performed in the wet conditions. The backfill was compacted using a "level of effort" approach to minimize the potential for future subsidence. No compaction testing was required because the backfill will not support structures or roadways. Uplands area backfill material was procured from an approved source and consisted of sand or common borrow with a maximum particle size of 3 inches.

In wetland areas, the clean backfill was placed to one foot below the final target grade (corresponding to the surveyed elevation before excavation of each area). In upland areas, the clean backfill was placed and compacted to approximately 6 inches below the final target grade.

Topsoil placed in the wetlands areas consisted of a one-foot thick layer of organic, rich mixed topsoil. The wetlands topsoil mix was manufactured by mixing locally procured loam and peat in equal amounts by volume to produce a final mix.

Topsoil placed in the upland areas consisted of a screened, organic-rich, silty loam material capable of supporting uplands vegetation.

2.5 Seeding and Planting

Backfilling and temporary seeding was conducted in the winter of 2003, followed by permanent restoration, planting, and seeding in October 2003. The following seed mixes and plantings were used for the temporary and permanent restoration as applicable.

Uplands Tree Plantings. After final grades were restored, the upland restoration areas were planted with red or white oak whips spaced 20 feet on-center.

Uplands Seed Mix. The Massachusetts Highway Department seed mix for slopes and shoulders (i.e. MHD Slope Mix) was used in the upland areas.

Wetlands Plantings. After final grades were restored, the wetland restoration area(s) were planted with red maple (*Acer rubrum*) whips spaced 20 feet on-center.

Wetlands Seed Mix. The wetland restoration area(s) was over seeded with a wetland seed mix after the planting of trees was completed. Bare soil was scarified and raked smooth before seeding. The following seed mixes were used: a combination of the New England Wetlands Plants, Inc. - New England Erosion Control/Restoration Mix and New England Wetmix, or approved equal. The seeding rates and fertilization needs of the soil conformed to the seed supplier's recommendations for this application. Appendix F of Conti Environmental (2002) contains copies of the specifications for each of these seed mixes.

Temporary Seed Mix. A temporary seed mix was applied after the initial backfilling and topsoil placement, since a significant amount of the work occurred at a time of year outside of preferred planting windows. The temporary seed mix consisted of Winter Rye. An evaluation of the addition of a portion of the permanent seed mixes as "dormant" seed depending on conditions at this time of temporary seeding was also performed

2.6 Monitoring During Construction

CDM with assistance from Conti performed monitoring wetlands-related activities on a part-time basis during the fieldwork. A CDM wetlands scientist conducted site visits during layout survey, backfill placement, topsoil placement, and seeding/planting activity. The CDM wetlands scientist recorded all wetlands-related data and observations in a field log book for inclusion in the Remedial Action Completion Report.

2.7 Long-Term Adaptive Monitoring Approach

The restoration of the upland area will be evaluated in terms of degree of establishment of the prescribed cover, such as germination of seed and the appearance of the planted trees, and the establishment of native flora from the surrounding undisturbed habitat as the result of natural recolonization. An enumeration of plant species is not necessary except where they are of specific interest, such as the encroachment of an invasive/exotic plant. The technique for eradication of invasive/exotic plants is the same as that described below for the wetland monitoring. Other conditions of the uplands that will impact the wetlands, such as erosion of unvegetated surfaces, are recorded and mitigated as needed to achieve performance standards.

The wetland restoration area(s) will be monitored to ensure that the restoration area(s) develops at least 75% cover by indigenous wetland plants within the first three or more growing seasons. Habitat monitoring will involve at least semi-annual site visits during the growing season (late spring/early summer) and near the end of peak growing season (late summer/early fall) of each year to observe the plants and soils as described below. The first program semi-annual site visits were conducted in June/July 2004 and September/October 2004 time frames, respectively.

Vegetation including invasive plants along with observations of the structural habitat (e.g. evidence of erosion) will be monitored within each upland and wetland habitat area. The goal is to determine the success of the restoration of the entire wetland community, the ecotone in the transition area between wetland and upland, and the upland community. The wetland community/community type (s) will be classified according to Cowardin et al. (1979). A field observation form will be used to record vegetation data, presence of any invasive plants, habitat stability and any recommended actions in accordance with general ACOE wetland procedures (Appendix A). Vegetation will be evaluated for the herbaceous, shrub and tree layers as appropriate. The classification system and symbols used to describe the vegetation found in the wetland and upland areas is described in Appendix B. It is the frequency of the presence of these plants that determines whether the wetland or upland restoration has attained the stated Performance Standards. The recorded field notes are then summarized electronically by date of observation and provided in chronological order as appendices to the annual reports.

Observations of invasive/exotic plants in the restoration area, either wetland or upland will result in a decision for eradication. This decision will be based on the presence/absence of the invasive/exotic plant of concern in areas contiguous to the restoration site. For example, if the restoration is adjacent to a large area of common reed (*Phragmites australis*), and common reed is also located at the restoration site, no eradication will occur since this action will be futile as the area will be readily re-colonized. However, if the invasive/exotic is absent or minimally present in an adjacent area, eradication will occur. Wherever feasible, the standard and accepted eradication technique of hand-removal will be employed for removal of the specific invasive. Where appropriate and if there is no other practical alternative, the appropriate herbicide will be applied in a minimally effective dose by a MA licensed applicator and the targeted

invasives will be flagged. In subsequent surveys, the success of the eradication efforts will be monitored.

Dominant plant species will be determined using standard dominance measures. From the relative percent cover for each species and the wetland indicator status, it can be determined whether the plant community was dominated by wetland species or upland species. With a compilation of data in this way, one can qualitatively monitor changes in the species community over time based on species presence/absence and changes in relative dominance (e.g. increased cover by upland species over time).

There is no single, correct, indisputable, sound ecological definition of wetlands since wetlands exist as a continuum between wet and dry environments. The prevailing hydrology is the primary factor of whether wetlands and/or upland plants dominate and varies seasonally as well as over time (e.g. year to year and long term trends). Consequently, if increased cover by upland plant species over time is observed, we will consult with the BCT accordingly to determine if any actions are warranted.

Observations of fauna, whose presence or sign is an indication of the success of the restoration values and function, will occur and be recorded during the periodic surveys.

Photographs from set positions will be used to qualitatively assess plant community development (e.g. cover and height). Photographs will be taken concurrently during the monitoring inspections. In addition to the individual photos of areas of interest, permanent photo stations will be established to provide a point of reference for overview photographs of the individual restoration areas to compare over time (i.e. year to year).

2.8 Compliance with Restoration Performance Standards

This was a federal project conducted in accordance with CERCLA and the NCP. CERCLA response actions are exempted by law from the requirement to obtain Federal, State or local permits related to any activities conducted completely on-site. It is the policy of the USEPA (and the Department of the Army) to assure all activities conducted on sites are protective of human health and the environment, and the requirement to meet (or waive) the substantive provisions of permitting regulations that are applicable or relevant and appropriate requirements (ARARs).

Consequently, a review is provided below to show the project complies with the requirements of the Massachusetts Wetlands Protection Act (WPA) and implementing regulations. The remediation of contaminated sites is considered a "limited project" pursuant to the Massachusetts Wetlands Protection Regulations. That status allows certain projects to proceed without strict compliance with the performance standards for the various stated wetland resource areas. Although this project qualifies as a limited project, it has been designed to comply with the more stringent performance standards for the Bordering Vegetated Wetlands (BVW) that were disturbed and restored in Area 2 as described below.

BVWs are considered to be significant to public or private water supply, ground water supply, flood control, storm damage prevention, prevention of pollution, the protection of fisheries, and wildlife habitat [310 CMR 10.55 (1)]. Section 10.55(4) states that a loss of up to 5,000 square feet of BVW requires replacement according to specific performance standards. Greater than 5,000 square feet of wetland alteration is allowed for limited projects. The following sections present each performance standard followed by a response describing how wetland restoration replacement for this project meets the standard.

1. ***The surface of the replacement area to be created ("the replacement area") shall be equal to that of the area that will be lost ("the lost area").***

Wetlands altered as a result of soil remediation were restored in place; therefore, the restoration areas are equal to the altered area. No BVW will be lost as a result of this project.

2. ***The ground water and surface water elevation of the replacement area shall be approximately equal to that of the lost area;***

The wetland restoration area was within the same footprint as the altered BVW, therefore, the post remediation surface and groundwater elevations are expected to be the same to existing conditions.

3. ***The overall horizontal configuration and location of the replacement area with respect to the bank shall be similar to that of the lost area;***

The restoration area was within the same footprint as the altered BVW.

4. ***The replacement area shall have an unrestricted hydraulic connection to the same water body or waterway associated with the lost area;***

The restoration area was within the same footprint as the altered BVW and the post-remediation wetland restoration area has the same hydraulic connectivity to Cold Spring Brook as the existing BVW prior to remediation.

5. ***The replacement area shall be located within the same general area of the water body or reach of the waterway as the lost area;***

See responses provided above.

6. ***At least 75% of the surface of the replacement area shall be reestablished with indigenous wetland plant species within two growing seasons, and prior to said vegetative reestablishment any exposed soil in the replacement area shall be temporarily stabilized to prevent erosion in accordance with standard U.S. Soil Conservation Service methods;***

The wetland restoration plan involved seeding the restoration area with a wetland seed mix comprised of native wetland plants. This seed mixture is expected to provide a dense cover (at least 75%) within two growing seasons. To augment the seeding, red maple whips were planted 20 feet on center to increase plant diversity and more rapidly return the altered areas to wooded wetlands. In addition, natural colonization of wetland plants from the adjacent wetland areas is expected to occur.

7. ***The replacement area shall be provided in a manner which is consistent with all other General Performance Standards for each resource area in Part III of 310 CMR 10.00.***

The project was designed to comply with all performance applicable to the wetland resource areas. Removal of contaminated soils in the BVW was not anticipated to have any long-term negative impacts that would result in loss of wetland area or wetland functions and values since Area 2 was restored in-kind.

2.9 Final Site Restoration Summary

The Army's contractors completed final site restoration at AOC57 Areas 2 and 3 in October 2003. Restoration was completed according to the Work Plan and 2003 Work Plan Amendment for Additional Soil removal, including the following activities:

Uplands/Slope Area Restoration within Areas 2 and 3

- Grading of backfill to produce slopes consistent with surrounding, and pre-excavation grades;
- Placement of topsoil over disturbed areas on the slopes and base of slopes;
- Seeding with seed consistent with the mix specified in the Work Plan (New England Erosion Control/Restoration Mix);
- Planting of White Oak trees at approximately 20 feet on center in Areas 2 and 3;
- Placement of rip rap stone on an eroded channel on the east side of the slope at Area 2;
- Placement of stumps at the perimeter of the Area 3 restoration area;
- Placement of tree trunks from clearing activities at the top of slope at Areas 2 and 3;
- Excavation of a diversion ditch above the Area 2 slope to protect the slope from erosion;
- Re-building of protective casings on monitoring wells disturbed during remediation (57M-03-01X, and 57M-03-06X);
- Placement of boulders to protect monitoring well 57M-03-01X, at the top of the Area 2 slope; and
- Placement of hay mulch, and wood chips generated during site clearing over seeded slope areas and stockpile areas to control erosion.

Restoration within the Area 2 Wetlands Boundary

- Placement of a topsoil/peat mix rich in organic materials to a depth of approximately one foot within and up to approximately 10 feet north of the staked wetland boundary;
- Site visit by a wetland scientist retained by the remediation contractor to observe planting materials, planting areas extent and elevations, and provide guidance on the restoration work;
- Planting of 7 (seven) red maple trees;
- Seeding with the wetlands seed mix specified in the Work Plan (New England Wetmix); and
- Installation of three staff gauges at designated locations corresponding to the surface water sampling stations previously used by CENAE and regulatory agencies.

Silt fence surrounding the work areas left in place was removed following acceptable establishment of permanent vegetation in the restored wetlands and slope areas. Observations made during November 2003 showed that some of the components of the seed mix had germinated, and that the trees planted had dropped their leaves and were dormant for the winter months.

3.0 MONITORING PROGRAM PEFORMANCE STANDARDS & CONTROL OF INVASIVE/EXOTIC PLANTS

This section provides the performance standards for the wetland and upland habitats and the protocol of controlling invasive/exotic plants.

3.1 Long Term Adaptive Monitoring Plan Performance Standards

The objectives of the Devens AOC57 Habitat Long Term Adaptive Monitoring and Maintenance Program are:

1. Measurement of the success of the restoration relative to attainment of the Performance Standards in the restored areas to identify and implement needed corrective actions; and

2. Monitoring of the exotic weeds (the three species of concern are purple loosestrife (*Lythrum salicaria)*, common reed *(Phragmites australis*) and Japanese knotweed (*Polygonum cuspidatum*)) in the restored upland and wetland areas. If present the exotics will be removed by approved methods described below.

The Performance Standards for AOC 57, consistent with those established in the Devens Consolidated Landfill (DCL) Wetland and Upland Habitat Restoration Plan (WUHRP) (Stone & Webster 2002), for wetland areas are:

1. Seeded areas for wetlands shall have an average 75% perennial native obligate/facultative vegetative cover; and

2. Contain no non-vegetated (bare) areas more than 250 square feet.

Performance standards were also established in the WUHRP for uplands. They were based on whether they were considered level or steep slope uplands. The difference between these standards is the single criterion of slope stability.

The standards for level uplands are:

1. Seeded areas shall have an average of 75% perennial native vegetative cover; and
2. Contain no non-vegetated (bare) areas more than 500 square feet.

The standards for steep slope uplands are:

1. Shall be stabilized slope with 75% perennial native vegetative cover; and
2. Contain no non-vegetated bare areas more than 500 square feet.

However, due to the relatively small overall size of the two AOC57 restored sites in comparison to the larger DCL restored sites, the second performance standard will not be used as a measure of success.

The entire restored wetland, upland and ecotone transition areas are systematically observed via the meandering survey methodology coupled with the concept of adaptive monitoring. The meandering survey involves the members of the Team, usually 2-3 individuals, traverse the restored area several times observing and recording the vegetation within about 10 feet of either side of their path. Species are noted and identified according to their wetland status. This observational data is compared relative to the above applicable listed Performance Standards. Wetland status is assigned according to Cowardin's classification (Cowardin et al. 1969).

3.2 Control of Invasive/Exotic Plants

The second objective the adaptive monitoring program is to check for the appearance of the three cited exotics: 1) purple loosestrife; 2) common reed (*Phragmites*); and 3) Japanese knotweed. If these specific varieties of plants were observed, they were removed from the site. The protocol for invasive/exotic plant removal follows.

1. Purple loosestrife is pulled from the ground and if the plant was not in flower or in seed, it is left onsite. If the plant is in flower or seed, it will be pulled, bagged and removed from the site. It is virtually impossible to eradicate purple loosestrife once it is established.

2. *Phragmites* is treated in July-August, later in the growing season, with 25% Rodeo by a licensed MA applicator. Each plant is cut a few inches from the ground between two nodes and 25% Rodeo is injected in the hollow stem. The superior segment of the stem is bagged and disposed in a dumpster offsite. The portion of the site where the *Phragmites* was removed is flagged for future

examination to be certain there was no re-growth. Numbers of plants treated and removed are recorded to maintain qualitative/quantitative information to monitor and document the success of the eradication.

3. Depending on the area of the Japanese knotweed growth, the plants are either cut a few inches from the ground and a mist of 25% Rodeo applied if there is a large plot of plants or 25% Rodeo is injected into the hollow stem if there is only a few plants. As with *Phragmites*, Rodeo is applied by a licensed MA applicator with the proper protective procedures. If the Japanese knotweed is in flower or seed the upper portion of the plant is bagged and removed from the site. Since Japanese knotweed growth habits differs from *Phragmites*, individual shoots are not counted but relative size of the patch is noted to monitor effectiveness of the herbicide treatment. The site of the infestation is flagged and checked during the periodic monitoring to ascertain the removal was successful.

4.0 ANNUAL LONG TERM MONITORING PLAN PROGRAM RESULTS AND RECOMMENDATIONS

An annual long term habitat monitoring plan report based on the results of the several periodic monitoring field inspections conducted in the Late Spring/Early Summer and Late Summer/Early Fall time frames during the first monitoring year in 2004 and in subsequent years will be prepared for five years in accordance with the ROD. A brief description of each of the primary sites, an evaluation of the restored wetlands and/or adjacent uplands relative to meeting performance standards, and recommendations for specific management activities such as exotic plant control and site-specific problems will be provided. A copy of the field data/inspection report for each site visit will be included in the annual reports along with representative photographs of Areas 2 and 3.

Recommendations for the termination or continuation of the long term monitoring at Areas 2 and 3 will be provided in the annual reports based on the monitoring results after three complete growing seasons (i.e. 2006 Annual Report) for discussion with the BCT.

5.0 REFERENCES

Conti Environmental, Inc. 2002. Remedial Action Work Plan, AOC 57, Devens, MA; Prepared for U.S. Army Corps of Engineers, New England District. January 2002.

Conti Environmental, Inc. 2003. Work Plan Amendment for Additional Soil Removal, AOC 57, Devens, MA; prepared for U.S. Army Corps of Engineers, New England District, September 2003.

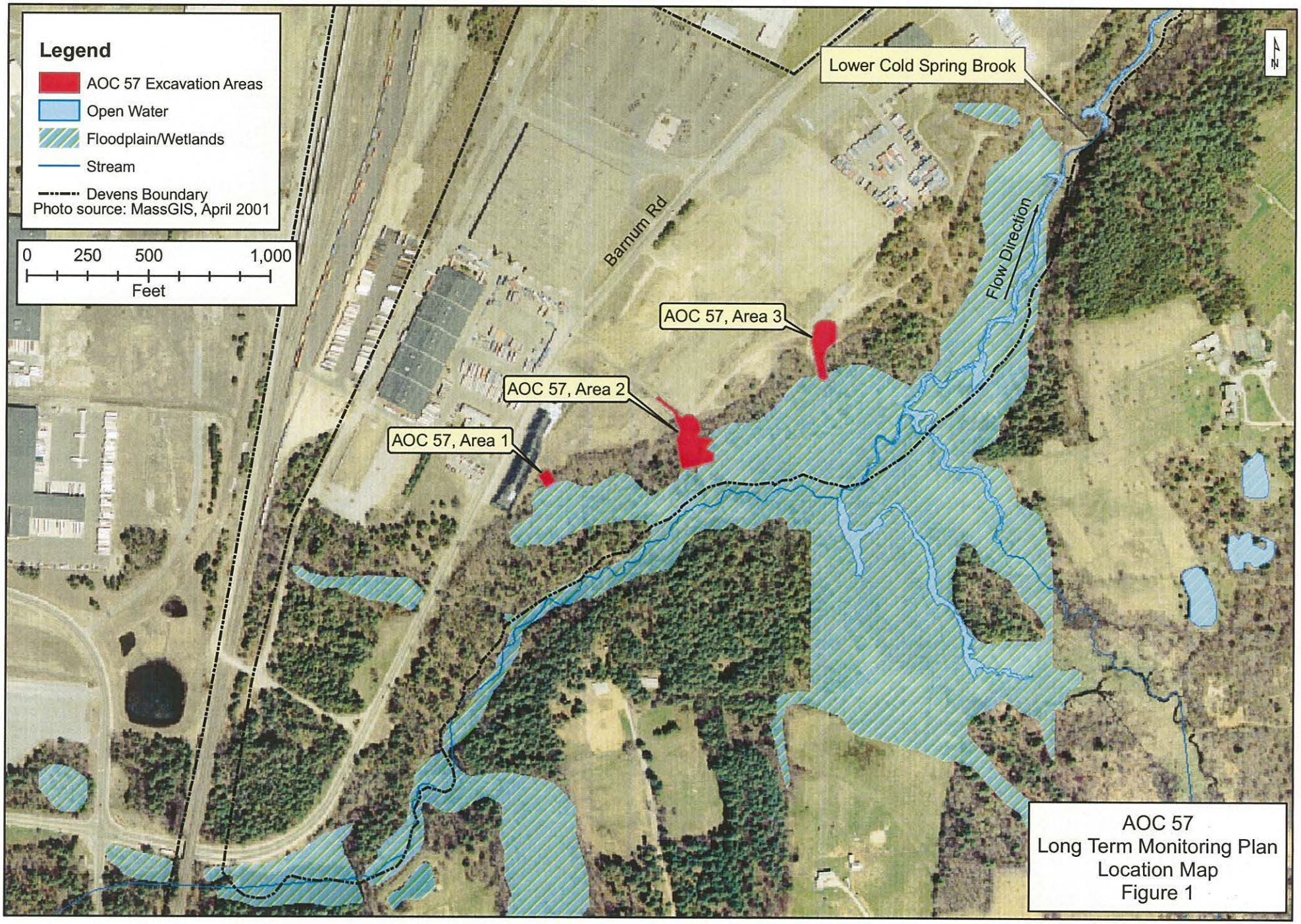
Conti Environmental, Inc. 2004. Final RA Completion Report, Contaminated Soil, AOC 57, Devens, MA; prepared for U.S. Army Corps of Engineers, New England District, Contract DACW33-01D-0003, Task Order 0002.

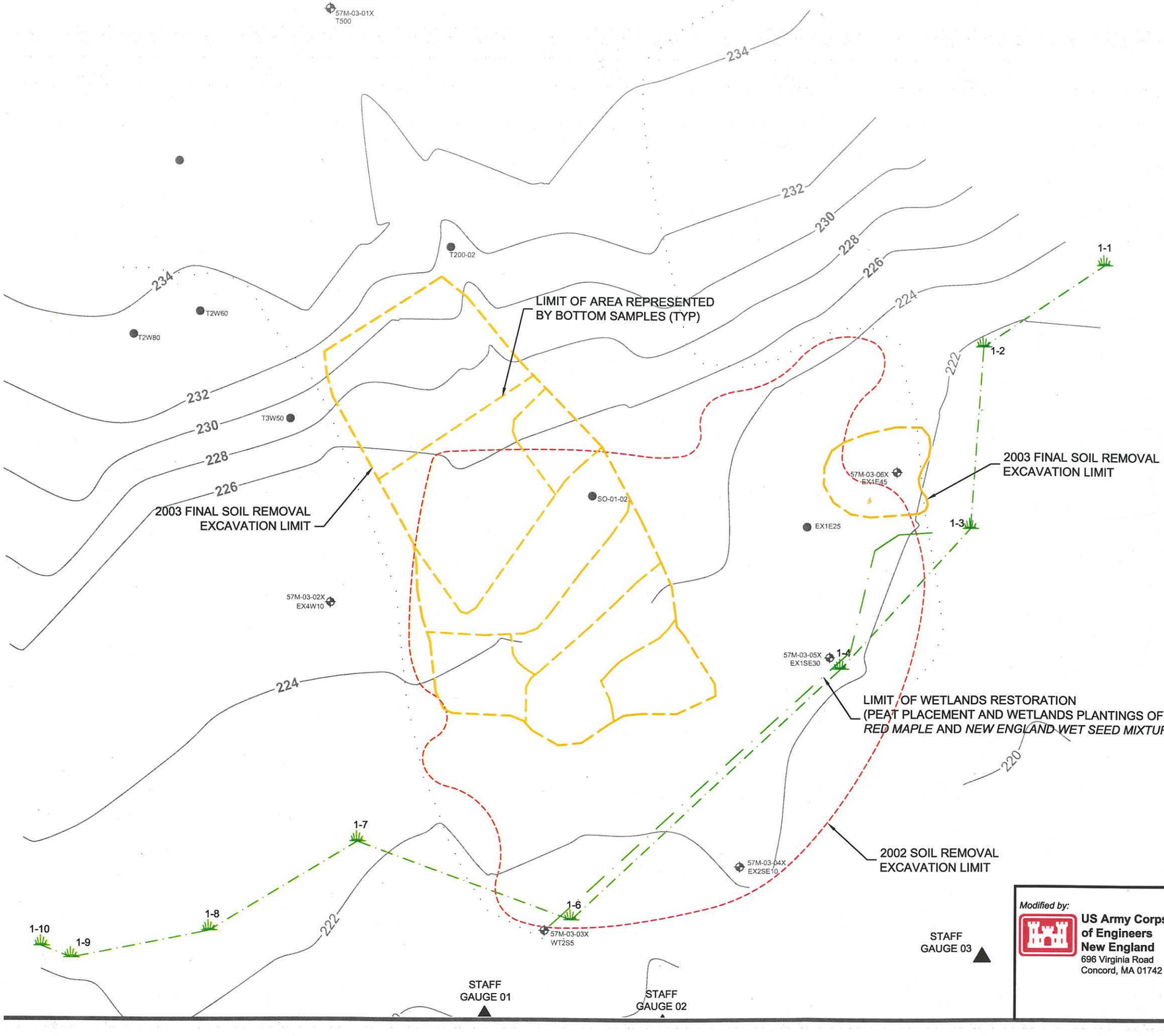
Cowardin et al, 1979, Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, U.S. Dept of the Interior, Washington, D.C.

Reed, P.B., Jr., 1988. National List of Plant Species That Occur in Wetlands: Northeast Region (Region 1). U.S. Fish and Wildlife Service Biological Rep. 88(26.1). 111 pp.

Stone and Webster, 2002. Wetland and Upland Habitat Restoration Plan: Landfill Remediation Project Devens Reserve Training Area Devens, Massachusetts. Prepared for U.S. Army Corps of Engineers, New England District.

Tiner, R.W., JR. 1988. Field Guide to National Nontidal Wetland Identification. Maryland Department of Natural Resources, Annapolis, MD and U.S. Fish and Wildlife Service, Newton Corner, MA. Cooperative Publication. 283 pp. + plates.


Legend
AOC 57 Excavation Areas
Open Water
Floodplain/Wetlands
Stream
Devens Boundary
Photo source: MassGIS, April 2001
0 250 500 1,000
Feet
Lower Cold Spring Brook
Barnum Rd
Flow Direction
AOC 57, Area 3
AOC 57, Area 2
AOC 57, Area 1
N
AOC 57
Long Term Monitoring Plan
Location Map
Figure 1



LEGEND

- SPOT ELEVATION (FINAL GRADE DEC 2003)
- FINAL EXCAVATION LIMIT (2003)
- APPROXIMATE DEPTH OF EXCAVATION FROM ORIGINAL GRADE (FT) (2002 & 2003)
- WETLAND STAFF GAUGE INSTALLED DEC. 2003 (ZERO=220 FT. MSL)
- 12-INCH CMP SUMP INSTALLED DEC 2003
- SIDEWALL COMPOSITE SAMPLE
- TREE LINE
- WT3 — GEOPROBE BORING LOCATION
- 12-In. CORRUGATED METAL PIPE SUMP
- 1-1 — WETLAND FLAG ID
- 228 — SURFACE CONTOURS (PRE-EXCAVATION)
- SO-01-02 — GEOPROBE/HOLLOW STEM AUGER SOIL BORING
- 57M-03-06X EX1E45 — NEW MONITORING WELL
  MONITORING WELL No. IS 57M-XX-XXX
  SOIL BORING No. EX1E45
- LIMIT OF CONTI EXCAVATION (2002)
- LIMIT OF FLAGGED WETLANDS

APPROXIMATE SCALE

20' 10' 0' 10' 20' 40'

NOTES

1. THIS SITE PLAN WAS DEVELOPED FROM A SITE PLAN COMPLETED BY HOWE SURVEYING ASSOCIATES, Inc. AND A SURVEY PERFORMED BY CONTI ENVIRONMENTAL, Inc.
2. CONTI ENVIRONMENTAL Inc. TAPE-MEASURED THE GEOPROBE EXPLORATION LOCATIONS, SUMP LOCATIONS, AND APPROXIMATE EXISTING OPEN EXCAVATION, USING ESTABLISHED WETLAND FLAG LOCATIONS 1-7 AND 1-2 AS BASE POINTS.
3. SPOT AS-BUILT ELEVATIONS AND STAFF GAUGES SURVEYED BY CONTI DECEMBER 2003 (ELEVATIONS IN FT MSL).

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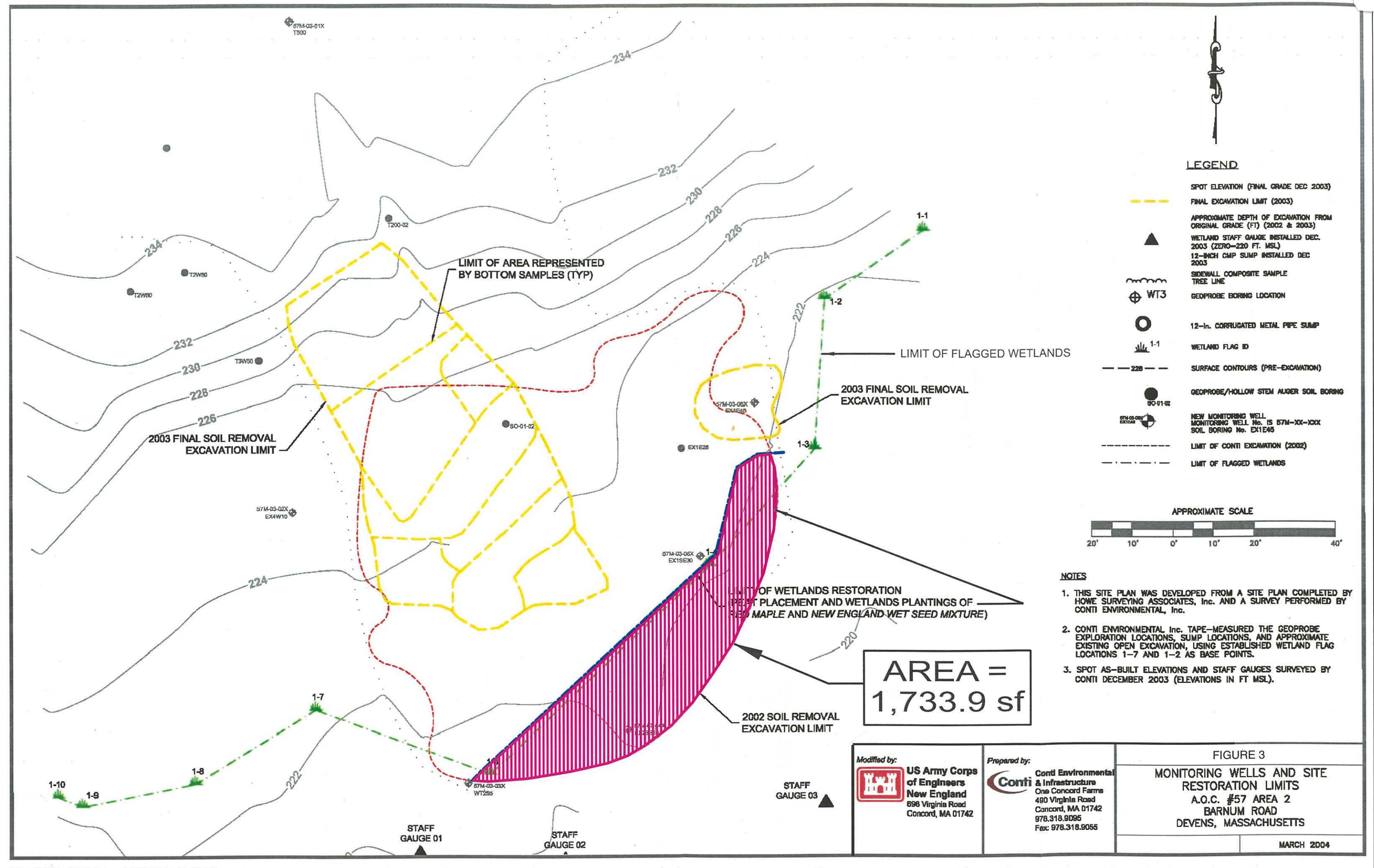
FIGURE 2

MONITORING WELLS AND SITE RESTORATION LIMITS
A.O.C. #57 AREA 2
BARNUM ROAD
DEVENS, MASSACHUSETTS

MARCH 2004



LEGEND

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- 228 — SURFACE CONTOURS (PRE-EXCAVATION)
- SO-01-02 — GEOPROBE/HOLLOW STEM AUGER SOIL BORING
- 57M-03-05X / EX1E45 — NEW MONITORING WELL
  MONITORING WELL No. IS 57M-XX-XXX
  SOIL BORING No. EX1E45
- LIMIT OF CONTI EXCAVATION (2002)
- LIMIT OF FLAGGED WETLANDS

APPROXIMATE SCALE

20' 10' 0' 10' 20' 40'

NOTES

1. THIS SITE PLAN WAS DEVELOPED FROM A SITE PLAN COMPLETED BY HOWE SURVEYING ASSOCIATES, Inc. AND A SURVEY PERFORMED BY CONTI ENVIRONMENTAL, Inc.
2. CONTI ENVIRONMENTAL Inc. TAPE-MEASURED THE GEOPROBE EXPLORATION LOCATIONS, SUMP LOCATIONS, AND APPROXIMATE EXISTING OPEN EXCAVATION, USING ESTABLISHED WETLAND FLAG LOCATIONS 1-7 AND 1-2 AS BASE POINTS.
3. SPOT AS-BUILT ELEVATIONS AND STAFF GAUGES SURVEYED BY CONTI DECEMBER 2003 (ELEVATIONS IN FT MSL).

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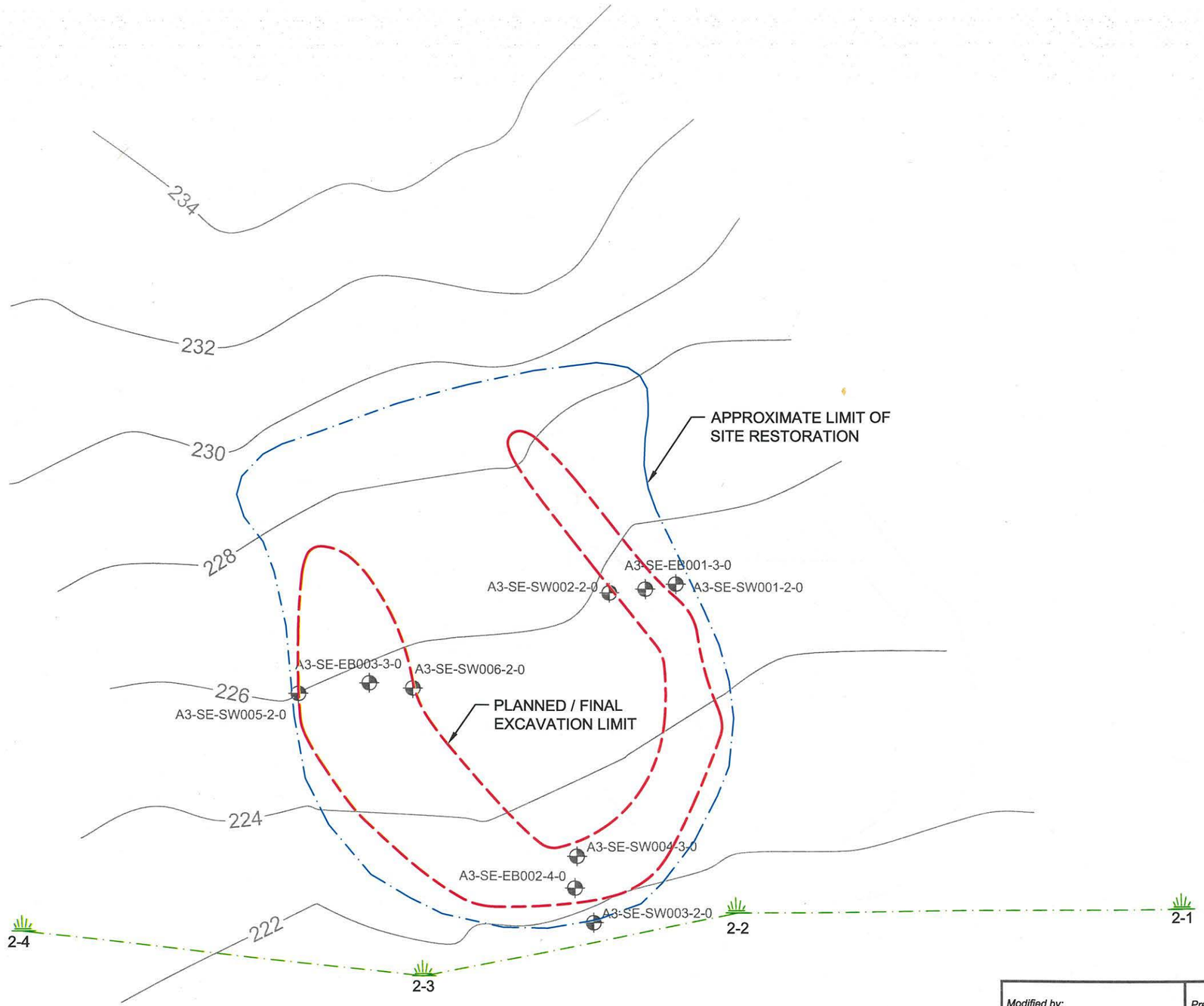
FIGURE 3

MONITORING WELLS AND SITE RESTORATION LIMITS
A.O.C. #57 AREA 2
BARNUM ROAD
DEVENS, MASSACHUSETTS

MARCH 2004



LEGEND

	APPROXIMATE DEPTH OF EXCAVATION FROM ORIGINAL GRADE (FT) (2002 & 2003)
1-1	WETLAND FLAG ID
228	SURFACE CONTOURS (PRE-EXCAVATION)
	LIMIT OF FLAGGED WETLANDS
A3-SE-SW001-2-0	CONFIRMATION SAMPLE LOCATION

APPROXIMATE SCALE

20' 10' 0' 10' 20' 40'

NOTES

1. THIS DRAWING WAS DEVELOPED FROM A SITE PLAN COMPLETED BY HOWE SURVEYING ASSOCIATES, Inc. AND FIELD MEASUREMENTS PERFORMED BY CONTI ENVIRONMENTAL, Inc.

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FIGURE 4

MONITORING WELLS AND SITE RESTORATION LIMITS
A.O.C. #57 AREA 3
BARNUM ROAD
DEVENS, MASSACHUSETTS

MARCH 2004

APPENDIX A

DEVENS BIOLOGICAL HABITAT MONITORING FIELD RECORD

Site:

Date:	Personnel:

Site Description:

General Description of Upland:

Substrate (*organic/cultural debris, erosion, etc*):

Plant Community to be Established:

Plant Community Recorded (*meandering survey*):

Invasive/Noxious Plant Species (*presence/absence/control*):

Evidence of Animal Community:

Indigenous Upland Plant Cover on 75% or more of area: Yes / No
Description:

Problems With Mitigation Area:

APPENDIX A

DEVENS BIOLOGICAL HABITAT MONITORING FIELD RECORD – CONTINUED

Suggested Corrective Measures:

General Description of Wetland:

Standing Water (*presence/absence/description*):

Classification of Wetland Type (*Cowardin Classification*):

Plant Community Recorded (*meandering survey)*:

Indigenous Wetland Plant Cover on 75% or more of area: Yes / No
Description:

Evidence of Animal Community:

Problems Within Wetland Mitigation Area:

Suggested Corrective Measures:

APPENDIX B

Description of Wetland Vegetation Designation Used in Field Notes

"There is no single, correct, indisputable, ecological sound definition for wetlands, primarily because of the diversity of wetlands and because the demarcation between dry and wet environments lies along a continuum" (Cowardin et al. 1979). The prevailing hydrology is the primary factor of whether wetlands and/or upland plants dominate and varies seasonally as well as over time (e.g. year to year). One of the three attributes of a wetland is the particular type of vegetation this wetland is able to support. Plants that are found in the wetland areas where the roots are submerged and the plants can grow are called hydrophytes. The U.S. Fish and Wildlife Service have published a list of more than 2500 species of vascular plants that occur in wetlands, in this case from Maine through Virginia and west to Ohio and Kentucky (Reed 1988). These plants are listed using their scientific name followed by their common name and published in a *National List of Scientific Plant Names*. Each plant is given a regional indicator status along with information on the plant habit, where it lives, and general distribution. This system provides four categories to determine this plant's ability to live in a wetland. These categories according to Tiner (1988) are:

1. Obligate (OBL) greater than 99% occurrence in wetlands;
2. Facultative Wetland (FACW) 66-99% occurrence in wetlands;
3. Facultative (FAC), 33-66% occurrence in wetlands; and
4. Facultative Upland (FACU), 1-33% occurrence in wetlands.

This is the classification system and these are the symbols used in this report to describe the vegetation found in the wetland and upland areas at the various restored wetland and upland sites at Devens. It is the frequency of the presence of these plants that is used to measure whether the wetland and the upland restoration has attained the stated Performance Standards. Obligate and Facultative Wetland plants are almost always found in wetlands and are therefore the best vegetative indicators of wetlands. In addition to the above classification and to better characterize the facultative categories, a positive sign (+) is placed after the FACW to indicate a plant on the wetter side of FACW, and a negative sign (-) for a plant on the drier side of FACW. As a relevant example, wool grass, *Scirpus cyperinus,* a common floral constituent of Devens wetlands is classified as a FACW+, indicating it should be found in a slightly wetter habitat than umbrella sedge, *Cyperus strigosus*, that is classified as FACW. This describes the terminology used to characterize habitat as wetland or upland based on their percent vegetative cover.

Citations are provided in Section 5.0 References.