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EPA Superfund Record of Decision:

Langley Air Force Base
NASA Langley Center OU 2
Hampton, VA
9/2/1999

RECORD OF DECISION

NASA LANGLEY RESEARCH CENTER

STRATTON SUBSTATION OU

August 1999

RECORD OF DECISION
NASA LANGLEY RESEARCH CENTER

DECLARATION

SITE NAME AND LOCATION

NASA Langley Research Center (NASA LaRC)
Stratton Substation Operable Unit
Hampton, Virginia

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the selected remedial action for the Stratton Substation Operable Unit (OU) at the NASA Langley Research Center (LaRC) in Hampton, Virginia (the "Site"), chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, 42 U.S.C. §9601 et seq. and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision is based on the Administrative Record for this Site.

The Virginia Department of Environmental Quality (VDEQ) concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this OU, if not addressed by implementing the response actions selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Stratton Substation OU cleanup is part of a comprehensive environmental investigation and cleanup currently being performed at the NASA LaRC under the CERCLA program. This ROD addresses only the Stratton Substation OU; the other OUs located at NASA LaRC will be addressed in future RODs. Also, this ROD addresses only soil at the OU. The groundwater is being addressed as a separate OU and will be addressed in a future ROD.

This action addresses the principle threat at the Stratton Substation OU by excavating and disposing of contaminated soil off-site and by imposing land use restrictions that will prevent any non-industrial activities to take place on the OU.

The selected remedy is the excavation and off-site disposal of contaminated soil and the implementation of institutional controls, which include:

1) excavation of soils with PCB concentrations greater than 10 parts per million (ppm), estimated at 212 cubic yards;
2) transporting and disposing of the soils off-site to a Toxics Substances Control Act (TSCA) - approved chemical waste landfill;
3) backfilling excavated areas with clean fill material;
4) the prohibition of use of the property for purposes other than industrial (e.g., residential, child care or recreational use);
5) inputting these restrictions in the NASA LaRC Master Plan;
6) within 90 days of ROD signature, NASA shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of the Stratton Substation Operable Unit and the extent of the soil contamination. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict the land use of the property. The plat shall be submitted to the local recording authority;

7) NASA shall incorporate these restrictions and submit a copy of the plat into any real property documents necessary for transferring ownership from NASA, in the unlikely event that NASA sells the property. The real property document would also include a discussion of the National Priorities List (NPL) status of this Site, as well as a description of the soil contamination;
8) The NASA LaRC Environmental Engineering Office Head will certify to USEPA on an annual basis that there have been no violations of these prohibitions. If a violation has occurred, a description of the violation and corrective actions to be taken will be provided.

DECLARATION OF STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this OU.

Because this remedy may result in hazardous substances remaining onsite, a review will be conducted every 5 years after the commencement of the remedial action, to ensure that the remedy continues to provide adequate protection of human health and the environment.

for Lena M Couch
Dr. Jeremiah F. Creedon
Director
NASA Langley Research Center

8/25/99
Date

[signature] for
Abraham Ferdas
Director
Hazardous Site Cleanup Division
U.S. Environmental Protection Agency, Region III

9/2/99
Date

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RECORD OF DECISION

NASA LANGLEY RESEARCH CENTER
STRATTON SUBSTATION OPERABLE UNIT

DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

NASA LaRC is a 787-acre NASA research center located in southeastern Virginia in the Hampton Roads area. NASA LaRC is bounded by State Route 172 on the West, by Brick Kiln Creek to the North and by Langley Air Force Base to the South and East (Figure 1, Appendix A). NASA LaRC together with Langley Air Force Base was proposed to the National Priorities List (NPL) in 1993. NPL listing was finalized in 1994.

The Stratton Substation OU is a major active electrical switchyard for the West Area of NASA LaRC and is located on approximately 2.5 acres of land. The Stratton Substation OU is designated as Building 1233 and the fenced-in area surrounding it, which lies on the northeast side of Stratton Road between Taylor Road and Warner Road (Figure 2, Appendix A), and comprises switch gear structures, a control house, and a pump house (Figure 3, Appendix A).

The site is located within the Atlantic Coastal Plain physiographic province. The geology of the area, primarily flat lying marine sediments, consists of the Norfolk Formation and the Yorktown Formation. The uppermost soil unit at the site consists of varying sequences of silt, clay, and silty to clayey sands belonging to the Norfolk Formation. In the boring drilled for the Site Inspection, this unit occurs from 0 to 9 feet in depth and consists of brown, mottled orange and gray soils. They are typically dry to moist and slightly to moderately plastic. The underlying Yorktown Formation consists of gray silty clay and clayey silt with abundant shells and shell fragments. It is typically wet to saturated, moderately to highly plastic and occasionally mottled. Local sand lenses are common, as are partially hardened shelly layers (coquina). The Yorktown Formation extends to approximately 400 feet below grade at the site.

Groundwater in the area can be found at a depth of 5 to 50 feet below the land surface. This aquifer, known as the Columbia aquifer, is brackish and is limited to lawn and garden watering. Both the Yorktown and the Yorktown-Eastover aquifers underlie the Columbia aquifer. The Yorktown-Eastover aquifer is confined and is used as a source of domestic potable water.

II. SITE HISTORY

This section describes the Site history, history of waste disposal, and CERCLA investigations response actions at the Site.

A. HISTORY OF THE SITE

NASA LaRC was the first national research laboratory dedicated to aviation. Groundbreaking took place on June 7, 1917 under the authority of the National Advisory Committee for Aeronautics (NACA), created by Congress in 1915. Prior to 1917, the property was used for agriculture.

In 1920, NASA LaRC was dedicated and the world's first wind tunnel was completed at the facility. The goal of NASA LaRC was to advance the understanding of aerodynamics. During World War II, NASA LaRC began studying space travel in response to German rocket testing. In the 1960's the Mercury Astronauts were trained at NASA LaRC. This ended in 1962 when the manned space center in Houston was opened. Since the 1970's, NASA LaRC has focused on testing Space Shuttle Systems and unmanned Viking probes.

B. HISTORY OF WASTE DISPOSAL

The primary function of NASA LaRC is the research and development of advanced technologies for aircraft and spacecraft. Specific studies center on instrumentation, materials fatigue, acoustics, aerodynamics, and guidance control. In conducting its research and development mission, NASA LaRC requires many support facilities including Underground Storage Tanks (USTs) for fuel and other raw products, power plants, wind tunnels, laboratories and administrative buildings. All of these facilities have the potential to impact the environment through disposal activities, material(s) transportation and inadvertent releases such as spills or mechanical malfunctions.

There are currently 6 Operable Units being investigated under CERCLA at NASA LaRC. They include: the Construction Debris Landfill, the Chemical Waste Pit, Area E Warehouse, Tabbs Creek, Stratton Substation Groundwater, and Stratton Substation (soils). A brief summary of these areas is provided on Table 1. Figure 2 (Appendix A) provides the location of these areas. Records of Decision have been signed by NASA and EPA for the Area E Warehouse OU and the Tabbs Creek OU. The Construction Debris Landfill, Chemical Waste Pit and Stratton Substation Groundwater will be addressed in future RODs.

Table 1. Summary of Operable Units Under CERCLA Investigations

OU Name	Findings	Current Status
Construction Debris Landfill	Organic and inorganic contaminants found in groundwater, surface water, sediment, and soil.	NASA preparing response to regulator comments on the draft Remedial Investigation/Feasibility Study
Chemical Waste Pit	Chemical wastes reportedly buried at the site.	Chemical Waste Pit was found to be located within the boundaries of the Construction Debris Landfill (CDL) OU and is addressed in the CDL RI/FS.
Area E Warehouse	Low levels of Polychlorinated Biphenyls (PCBs) and metals contaminated soils.	Record of Decision was signed on 30 September 1998. Remedy is the implementation of institutional controls (land use restrictions). The survey plat required as part of the remedy has been prepared.
Tabbs Creek	PCB/PCT contaminated sediment.	Record of Decision signed on 30 September 1998. Remedy involves dredging and off-site disposal of contaminated sediment. NASA is currently preparing responses to regulator comments on the draft Remediation Work Plan.
Stratton Substation Groundwater	PCB contaminated groundwater	Monitoring wells will be sampled upon completion of the Stratton Substation soil remedial action. A focused RI/FS report will be prepared based on the groundwater sampling effort.

C. CERCLA INVESTIGATIONS

NASA completed CERCLA Preliminary Assessment (PA) and Site Inspection (SI) Reports in 1988 and 1989, respectively. In 1993, NASA LaRC, together with Langley Air Force Base (LAFB), was proposed for inclusion on the National Priorities List (NPL) and included on the NPL in 1994. A Federal Facilities Agreement (FFA) was signed by EPA, NASA and the Virginia Department of Environmental Quality (VDEQ) in 1994. The FFA establishes a procedural framework and schedule for implementing site cleanups at NASA LaRC (the Site).

PCBs were detected in 1984 in two areas (Areas 1 and 2; Figure 5, Appendix A) in the soil adjacent to the pump house at the Stratton Substation OU. Between 1984 and February 1987, the focus of site investigations was directed primarily toward soil contamination; a total of three removal actions were completed.

A Focused Feasibility Study was performed by NASA in 1996 and 1997. The investigation consisted of sampling and analysis of surface and subsurface soils. The on-site screening analysis indicated the presence of PCB 1260 only in isolated pockets, in both areas and at two locations near the control room, within the limits of the Stratton Substation OU. The detected PCB concentration ranged from non-detect to a maximum of 1100 ppm in Area 1, from non-detect to a maximum of 49 ppm in Area 2, and from non-detect to a maximum of 333 ppm in other areas within the limits of the yard. The results were used to conduct a human health risk assessment.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

In accordance with Sections 113 and 117 of CERCLA, 42 U.S.C. Sections 9613 and 9617, NASA, in conjunction with EPA, issued a Proposed Plan on March 1, 1999, presenting the preferred remedial alternative for the Stratton Substation OU. The Proposed Plan and the supporting documentation became available for review at that time and are among the documents which comprise the CERCLA Administrative Record for NASA LaRC.

The Administrative Record is available for review by the public at the following information repositories:

Poquoson Public Library
800 City Hall Avenue
Poquoson, Virginia

Floyd L. Thompson Library
NASA LaRC
Hampton, Virginia

An announcement for a public meeting, the comment period, and the availability of the Administrative Record for the remedy for the Stratton Substation OU was published in the *Daily Press* on February 28, 1999. Additionally, the Notice of Availability was mailed to local municipal and government agencies and residents in the vicinity of the Site. The public comment period for the Proposed Plan was from March 1, 1999 to April 14, 1999. A public availability session was held at the Virginia Air and Space museum in Hampton, Virginia on March 17, 1999 to inform the public of all the remedial alternatives and to seek public comments. At this meeting, representatives from NASA, USEPA, VDEQ and Foster Wheeler (an environmental consultant) were available to answer questions about conditions at the site and the remedial alternatives under consideration. Responses to the comments received during this period are included in the Responsiveness Summary section of this ROD.

All documents considered or relied upon in reaching the remedy selection decision contained in this ROD are included in the Administrative Record for the Site and can be reviewed at the information repositories.

IV. SCOPE AND ROLE OF THIS REMEDIAL ACTION

Discrete portions of an NPL site are often managed more effectively as Operable Units. NASA has organized work to date into six operable units. This ROD for the Stratton Substation OU addresses PCB contaminated soil. The remaining Operable Units are:

- Construction Debris Landfill
- Chemical Waste Pit
- Area E Warehouse
- Tabbs Creek
- Stratton Substation Groundwater

These five remaining Operable Units are currently being independently investigated under CERCLA and either have been or will be addressed in separate Records of Decision. See Table 1 discussion.

V. SUMMARY OF SITE CHARACTERISTICS AND EXTENT OF CONTAMINATION

Summarized below are the relevant findings of the work to date with regard to Site characteristics and contaminated soil located within the boundaries of the NASA LaRC including the Stratton Substation OU.

A. SITE CHARACTERISTICS

1. Geology

LaRC is situated within the Atlantic Coastal Plain physiographic province, which consists of an eastward thickening sedimentary wedge composed of unconsolidated gravels, sands, silts, and clays, with variable amounts of marine fossils. LaRC is underlain by approximately 2,000 feet of unconsolidated sediments.

The uppermost soil units (excluding fill material) are Holocene age deposits and Pleistocene deposits of the Norfolk Formation. Holocene deposits, consisting of organic clays, silts, and silty clays, are encountered in proximity to the margins of tidal estuaries that border LaRC. These deposits are up to 30 feet thick along the northern border of the facility. Away from the tidal estuaries, surface soils consist of the Norfolk Formation, a member of the Pleistocene Age Columbia Group. Soils of the Norfolk Formation consist of sequences of silt, clay, and silty to clayey sands that are typically dry to moist and slightly to moderately plastic. An erosional surface separates this unit from the underlying Bacons Castle Formation.

The Pliocene Age Bacon Castle Formation, composed of the Moore House Member, occurs at depths of 50 to 60 feet at LaRC. The Moore House Member consists of sequences of silty sands containing marl and shell hash lenses. These marl and hash lenses are absent at some locations. The Mogarts Beach Member of the Yorktown Formation is encountered at depths of 70 to 80 feet. The Mogarts Beach Member is a distinctive hydrologic unit consisting of blue clay of up to 15 feet in thickness; however, it is absent at some locations.

2. Hydrogeology

Groundwater in the area can be found at a depth of 5 to 50 feet below the land surface. This aquifer, known as the Columbia aquifer, is brackish and, its use is limited to lawn and garden watering. Both the Yorktown and the Yorktown-Eastover aquifers underlie the Columbia aquifer. The Yorktown-Eastover aquifer is confined and is used as a source of domestic potable water. Groundwater is not being addressed as part of this remedial action.

3. Meteorology

The climate at the Site is characterized by mild winters and warm and humid summers. The climate is affected by the Chesapeake Bay and Atlantic Ocean to the east and mountains to the west. During the winter, temperatures reach a high of near 50 with lows in the 30s. In the summer, the highs are generally in the 80s with lows around 70.

The mean annual precipitation at the Site is 44.15 inches. Maximum precipitation occurs in July and August, while the minimum occurs in November and April. However, precipitation is distributed throughout the year. The average number of days with precipitation ranges from 7 to 11 days per month and 110 days per year. Snowfall in the winter averages 10 inches per year, however, it is extremely variable, ranging annually from 0 to 45 inches.

The prevailing wind direction is south-southwest in April and May, southwest in June to September, and north in October to March. The average wind speed is 5 to 8 knots.

4. Ecology

Open land, woodland, wetland and aquatic habitats are all found within or near NASA LaRC. These include mowed fields and lawns, nonforested overgrown land, wooded areas, forested wetlands, scrub/shrub wetlands, creeks, tributaries and steams.

5. Soils

Soil at the Stratton Substation OU consist of a thin (3 feet) surface layer of fine sandy and silty clays, typical of the Columbia Group.

B. NATURE AND EXTENT OF CONTAMINATION

Polychlorinated biphenyls (PCBs) were detected in 1984 in two areas (Areas 1 and 2, Figure 5, Appendix A) in the soil adjacent to the pump house. Between 1984 and February 1997, a total of three removal actions were completed. Residual soil contamination (less than 50 ppm) remained at the site.

As part of the Focused Feasibility Study (FFS) two investigations were conducted on the soils at the Stratton Substation OU. The initial investigation was concentrated only to the two areas (Areas 1 and 2, Figure 5, Appendix A) adjacent to the Pump House. Following the initial investigation, a supplemental investigation was concentrated outside the two areas (Areas 1 and 2) within and just outside the fenced-in limits of the yard.

The following is a summary of the sampling results of the FFS.

Within the fenced-in area of the Stratton Substation OU a gravel layer is present, especially at Area 1. The thickness of the gravel varied within each area and the thickness ranges from 3- to 8- inches in Area 1 and from 1- to 5- inches in Area 2.

The on-site screening analysis indicated the presence of PCB 1260 only in isolated pockets, in both areas and at two locations near the control room, within the limits of the Stratton Substation OU. The detected PCB concentration ranged from non-detect to a maximum of 1100 ppm in Area 1, from non-detect to a maximum of 49 ppm in Area 2, and from non-detect to a maximum of 333 ppm in other areas within the limits of the yard.

1. Area 1

The surface soil (0.0 to 0.5 foot interval) samples indicated presence of PCB contamination within this Area (Figure 6, Appendix A). Within Area 1 the extent of contamination is isolated to three subareas (Figure 6, Appendix A). Subarea 1 included soil sample locations 3, 8 and 14. The detected PCB concentrations ranged from 71.1 to 1100 ppm. Subarea

2 included soil sample locations 10, 11, and 22. The detected PCB concentrations ranged from 120 to 1000 ppm. Subarea 3 included soil sample location 33. The detected concentration at this location was 60 ppm. PCBs were not detected from the sample located underneath the driveway.

The subsurface soil samples also indicated presence of PCB contamination in isolated spots, especially in two of the three subareas (Figure 7, Appendix A). For the 0.5 to 1.0 foot interval, sample location 8 in Subarea 1 indicated a PCB concentration of 470 ppm; whereas sample location 11 in Subarea 2 indicated a PCB concentration of 93.4 ppm. At 1.0 to 2.0 foot interval, sample location 11 in Subarea 2, indicated the presence of PCB at 40 to 67.4 ppm (Figure 8, Appendix A). At the 2.0 to 3.0 foot interval, sample locations 10 and 11 in Subarea 2 (Figure 9, Appendix A), indicated presence of PCBs at 27.3 and 25.9 ppm, respectively. At the 3.0 to 4.0 foot interval, sample locations 10 and 11 in Subarea 2 (Figure 10, Appendix A) indicated presence of PCB at 144.5 and 24.2 ppm, respectively.

During the supplemental investigation, two subsurface soil samples from the 1 to 2 foot and 2 to 3 foot intervals were collected and analyzed for PCBs at sample location SRS1-08. Both samples indicated presence of PCBs at 36.9 and 17.2 ppm, respectively (Figures 8 and 9, Appendix A). Also at Sample location SRS1-22, two subsurface soil samples were collected and analyzed. Samples collected from 0.5 to 1 foot and 1 to 2 foot intervals indicated presence of Aroclor 1260 at 284.9 and 136 ppm, respectively (Figures 7 and 8, Appendix A).

An additional soil sample was added, SRS1-54, to further delineate the extent of contamination from sample point SRS1-33 (Figure 6, Appendix A). Both surface and subsurface samples were collected and subjected to on-site screening analysis. None of the samples indicated presence of PCBs at levels exceeding 10 ppm.

2. Area 2

The surface soil (0.0 to 0.5 foot interval) samples had the most contamination within this area (Figure 11, Appendix A). Within Area 2 the extent of contamination is isolated to two Subareas (Figure 11, Appendix A). Subarea 1, includes soil sample location 11. The detected PCB concentration was at 44.8 ppm. Subarea 2 includes soil sample locations 4 and 9. The detected concentration ranged from 20.6 ppm to 35.5 ppm.

The subsurface soils also indicated presence of PCB contamination in an isolated spot in one of the two Subareas. At 0.5 to 1.0 foot interval, sample location 11 in Subarea 1 (Figure 12, Appendix A) indicated a PCB concentration of 28 ppm to 48.8 ppm.

3. Other Areas - North of Concrete Driveway

None of the samples collected from the northern half of the site indicated the presence of PCBs at significant levels. The detected concentrations ranged from non-detect to a maximum of 2.2 ppm in the surface soil (0.0 to 0.5 foot) samples from 14 different locations (SRS1-40 through SRS1-53; Figure 13, Appendix A). At five of the fourteen locations, based on surficial discoloration of the soil, a subsurface soil (0.5 to 1 feet) sample was also collected for on-site analysis. The Aroclor 1260 was detected at concentrations from non-detect to 0.4 ppm in these subsurface soil samples.

4. Other Areas - South of Concrete Driveway

Thirteen sample locations were selected to represent the southern half of the site (SRS2-25 through SRS2-37 in Figure 13, Appendix A). The majority of the surface soil samples (11 of 13) indicated presence of PCBs at trace levels from non-detect to 0.4 ppm. PCBs were detected in two of the 13 surface samples at 16 ppm at SRS2-28 (0-0.5 foot interval) and at 21.7 ppm at SRS2-34 (0 to 0.5 foot interval). The area surrounding these two sample locations is identified as Contaminated Areas F and G (Figure14, Appendix A).

VI. SUMMARY OF SITE RISKS

Human Health Risk Assessment

Health risks are based on a conservative estimate of the potential carcinogenic risk or potential to cause other health effects not related to cancer. Carcinogenic risks and noncarcinogenic risks were evaluated as part of the risk assessment; three factors were considered:

1. nature and extent of contaminants at the OU,
2. the pathways through which human receptors are or may be exposed to those contaminants at the OU, and
3. potential toxic effects of those contaminants.

For this OU, the human health risk assessment was based on exposure to soil under industrial land use scenarios. Surface water and sediment were not evaluated because human receptors are not exposed to this medium at this OU. Groundwater for this OU will be investigated upon the completion of this remedial action and addressed in a separate ROD.

Cancer risks are expressed as a number reflecting the increased chance that a person will develop cancer, if he/she is directly exposed (i.e., through working at the OU) to the contaminants found in the soil at the OU for 30 years. For example, EPA's acceptable risk range for cancer is 1×10^{-4} to 1×10^{-6}, meaning there is one additional chance in ten thousand (1×10^{-4}) to one additional chance in one million (1×10^{-6}) that a person will develop cancer if exposed to a hazardous waste site.

Direct contact, including oral and dermal exposures of contaminated soils for LaRC workers was calculated for the risk assessment. The lifetime cancer risk from PCB exposure for the worker at the Stratton Substation OU is calculated at 1.5×10^{-4}. This lifetime cancer risk exceeds EPA's acceptable risk range of 1×10^{-4} to 1×10^{-6}.

Ecological Risk Assessment

Due to the characteristics of the OU (i.e., fenced-in gravel covered area, no surface water bodies in the immediate vicinity of the OU), exposure to ecological receptors, including aquatic and terrestrial receptors, to contaminated soil is unlikely; the exposure pathway is incomplete. Therefore, an ecological risk assessment was not performed.

C. CONCLUSIONS

The remedial objective for the Stratton Substation OU is to protect human health and the environment. As indicated above, the risk posed to the worker exceeds EPA's acceptable risk range. Based on available information, and standards such as applicable or relevant and appropriate requirements of federal and state law (ARARs), and risk-based levels established in the risk assessments, the specific remedial objectives for the Stratton Substation OU are presented as follows:

Soil

The human health risk assessment concluded that direct exposure to contaminated soil would pose a cancer risk which exceeds the EPA's acceptable risk range of 10^{-6} to 10^{-4}. In view of the results of the human health risk assessment, the remedial action objective for the soil would be to remediate PCBs in the soil to a level that is protective of human health. An additional objective is to assure that the property use does not allow non-industrial exposure to soils. A cleanup level of 10 ppm of PCBs is recommended for the Stratton Substation OU and is based on the protection of human health.

Contaminated Soil Areas and Volumes

The soil sampling results indicated that the surface and subsurface soils in four separate areas, southwest (Area I) and southeast (Area II) corner areas of the pump house and northwest and northeast corner areas of the control room, were contaminated with elevated concentrations of PCBs.

By comparing the sampling data to the cleanup level of 10 ppm, three small isolated contamination areas were identified in Area I. Two of the areas are adjacent to the previous excavated area along the concrete driveway. The total contaminated area in Area I is estimated at 1280 square feet and 480 square feet and is depicted in layers in Figures 15 through 19 (Appendix A). The aerial extent of contamination was estimated based on the assumption that the PCB concentration of a sample point represented an area concentration within a 12 foot radius from the sample point. The physical barriers, i.e., building and concrete driveway, and the extent of the previous excavated area were also taken into account. By using the same method, two isolated contamination areas were identified in Area II, and two areas near the control room exceeding the cleanup level. The total contaminated area of Area II was estimated at 480 square feet and is depicted in layers in Figures 20 and 21 (Appendix A). The total contaminated areas in the control room were estimated at 500 square feet and are depicted in Figures 22 through 24.

As seen in Figure19, PCB contamination has extended to a three to four foot range below ground surface at subareas B1 and B2 located in Area I. Since no subsurface samples were collected beyond 4 feet deep from the ground surface, six feet of PCB contamination is assumed; however, the limits of excavation will be determined through confirmation samples. Similarly, there were no samples collected beyond three feet at Subarea A2 and two feet at Subarea G2. Four feet of excavation was assumed for both areas. Consequently, the contaminated soil volume was estimated at 212 cubic yards. Table 2 (Appendix B) provides detailed calculation of contaminated soil areas and volumes.

VII. DESCRIPTION OF ALTERNATIVES

The soil remediation technologies were identified and screened using effectiveness and implementability as the criteria. The screening process is described in Table 3 (Appendix B). Table 4 (Appendix B) summarizes the process options that were retained to form alternatives. Using these retained process options, three alternatives: 1) no-action; 2) excavation/off-site incineration; and 3) excavation/off-site disposal in a TSCA landfill were developed for detailed analysis as follows.

Alternative 1 - No Action

The NCP requires that a no action alternative be considered to provide a baseline for comparison with action alternatives. Under this alternative, no remedial action would be undertaken at this time to address contaminated soil at the Stratton Substation OU.

Capital Cost: $0
Operations and maintenance (O & M) cost: $0
Net Present Worth: $0

Alternative 2: Excavation/Off-Site Incineration

This alternative involves the excavation of soil with concentrations greater than 10 ppm, estimated at 190 cubic yards. The contaminated soil would be hauled to a permitted off-site facility for incineration. The excavated areas would be backfilled with clean fill material and regraded as needed to existing conditions. Use restrictions will be imposed to limit the site use to industrial purposes only. This will include the preparation of a survey plat which will state the land use restrictions that have been placed on the property and will indicate the boundaries of the OU. This plat will be submitted to the local recording authority. These use restrictions will also be incorporated into the NASA LaRC Base Master Plan.

In addition, the presence of the existing security fence around the OU serves to limit access to the OU. Although the purpose of the fence around the OU is for providing security (its presence and maintenance is not part of this alternative) it also limits the individuals who may be exposed to the contaminated soils by preventing unauthorized access.

Capital Cost	$ 445,000
Annual O&M Cost	$ 500
Present Worth	$ 461,000

It is anticipated that the time required to achieve remedial action objectives for this alternative is approximately 3 months; 2 months for the preparation and approval of the design; 1 week for site preparation; 1 week for excavation; and 1 week for demobilization.

Alternative 3: Excavation/Off-Site Disposal

This alternative is identical to Alternative 2 except excavated soil will be disposed in a TSCA permitted landfill.

Capital Cost	$294,000
Annual O&M Cost	$500
Present Worth	$301,000

As with Alternative 2, it is anticipated that the time required to achieve remedial action objectives is approximately 3 months.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

During the detailed evaluation of remedial alternatives, each alternative is assessed against the following nine evaluation criteria: overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements (ARARs); long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; regulatory acceptance; and community acceptance.

A comparative analysis for the three alternatives based on these evaluation criteria is presented in the following sections. In addition, Table 5 (Appendix B) provides a summary of contaminated soil remedial alternatives evaluation.

A. OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 provides no remedial action and the soils at the Stratton Substation OU continue to be contaminated. Alternatives 2 and 3 would provide protection to human health and the environment from exposure to the contaminated soil since soils with contamination above the cleanup levels for PCBs would be removed from the site. With off-site disposal of contaminated soil, Alternative 3 would contain contaminants in a controlled environment (i.e., TSCA landfill). With off-site incineration, Alternative 2 would destroy the contaminants. Alternative 2 would be most effective because the destruction process is not reversible. However, Alternative 3 also meets this criteria because it provides protection of human health and the environment and is more cost effective than Alternative 2.

B. COMPLIANCE WITH ARARS

TSCA requirements for disposal of PCB contaminated soils is applicable and therefore an action-specific ARAR for contaminated soil. The cleanup level was derived to protect the workers at the OU. Alternatives 2 and 3 would meet the cleanup level by removing the soil with contamination exceeding the level and treating/disposing the soil at an offsite facility. These alternatives would meet the remedial action objectives. For Alternative 1, the cleanup level would not be attained. (Specific ARARs for the remedy in this case are identified in Tables 6 and 7 in Appendix B of this ROD).

C. LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternatives 2 and 3 would be effective in addressing the site contaminants since the soil with contamination above the cleanup level would be completely removed from the site. Alternative 2 would be most effective in the long term since incineration of contaminated soil is not reversible and does not require long-term maintenance. Alternative 3 would provide off-site containment of PCBs which would be less effective than the treatment processes. A landfill will require long-term proper maintenance.

Alternative 1 would not provide any type of remedy for the contaminated soil; therefore, future remedial actions would probably be required.

D. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternative 2 would reduce the toxicity, mobility, and volume of contaminated soil at the Stratton Substation OU through treatment. Alternative 3 does not involve treatment. Alternative 1 would not reduce the toxicity, mobility, or volume of the contaminants. The treatment process under Alternative 2 is irreversible. Although Alternative 3 does not reduce toxicity mobility or volume through treatment, it is protective of human health and the environment and more cost-effective than Alternative 2. In addition, principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials. Conditions at the Stratton Substation OU do not meet these criteria to warrant treatment, but do warrant removal of contaminated soil.

E. SHORT-TERM EFFECTIVENESS

Alternative 1 would not involve any construction activities; therefore, it would provide the least short-term risks to the community, workers, and the environment.

Alternatives 2 and 3 would require excavating and handling of contaminated soil, posing some risk of contact to workers and residents. Engineering measures would be implemented to protect the workers and the community. They may also cause a traffic inconvenience to neighboring communities.

Once on-site work begins, Alternatives 2 and 3 would require approximately 3 weeks to complete. Alternative 1 does not involve any on-site work and does not meet remedial action objectives.

F. IMPLEMENTABILITY

Alternative 1 would be the easiest alternative to implement since no construction activities would be performed at the Stratton Substation OU.

Alternatives 2 and 3 would involve removal of the contaminated soil from the area. Excavating and waste transporting would use common equipment and procedures. Incineration and landfilling in Alternatives 2 and 3 are also common and proven technologies utilized in PCB remediation. After removal of contaminated soil, clean material would be used to backfill the excavated area.

G. COST

Alternative 1 has no cost associated with implementation. Alternative 2 would eliminate long-term maintenance costs and reduce toxicity, mobility, and volume at a significant increase in cost over the other alternatives. Alternative 3 would provide similar protection to Alternative 2, but at one third the cost. Alternative 3 is the more cost-effective alternative. It will meet all remediation goals (in contrast to Alternative 1) with significantly less cost than Alternative 2.

H. STATE ACCEPTANCE

The Virginia Department of Environmental Quality concurs with the selection of Alternative 3, Excavation and Off-Site Disposal and Institutional Controls as the selected remedy for this OU.

I. COMMUNITY ACCEPTANCE

An availability session on the Proposed Plan was held on March 17, 1999 in Hampton, Virginia. Comments received orally and/or in writing at the availability session are referenced in the Responsiveness Summary (Section XII of this ROD). There was no public opposition to proposed remedy.

IX. SELECTED REMEDY

Following review and consideration of the information in the Administrative Record file, requirements of CERCLA and the NCP, and the public comments reviewed on the Proposed Remedial Action Plan, NASA and EPA, in consultation with VDEQ, have selected Alternative 3: Excavation/Off-Site Disposal and Institutional Controls as the remedy for the Stratton Substation Operable Unit. This remedy would prevent unacceptable exposure to contaminated soil.

Based on available information, NASA and EPA believe that the selected remedy would be protective of human health and the environment, would be cost effective, and would provide the best balance of trade-offs among the alternatives with respect to the evaluation criteria.

The selected remedy for the Stratton Substation OU includes the following major components:

1) excavation of soils with concentrations greater than 10 parts per million (ppm), estimated at 212 cubic yards;
2) transporting and disposing of the soils off-site to a Toxics Substances Control Act (TSCA) - approved chemical waste landfill;
3) backfilling excavated areas with clean fill material;
4) the prohibition of use of the property for purposes other than industrial (e.g., residential, child care or recreational use);
5) inputting these restrictions in the NASA LaRC Master Plan;
6) within 90 days of ROD signature, NASA shall produce a survey plat prepared by a professional land surveyor registered by the Commonwealth of Virginia indicating the location and dimensions of the Stratton Substation Operable Unit and the extent of the soil contamination. The plat shall contain a note, prominently displayed, which states the owner's future obligation to restrict the land use of the property. The plat shall be submitted to the local recording authority;
7) NASA shall incorporate these restrictions and supply a copy of the plat into any real property documents necessary for transferring ownership from NASA, in the unlikely event that NASA sells the property. The real property document would also include a discussion of the National Priorities List (NPL) status of this Site, as well as a description of the soil contamination;
8) The NASA LaRC Environmental Engineering Office Head will certify to USEPA on an annual basis that there have been no violations of these prohibitions. If a violation has occurred, a description of the violation and corrective actions to be taken will be provided.

The present worth of this remedy is $301, 000.

PERFORMANCE STANDARDS

Excavation/Off-Site disposal shall remove all soils with concentrations greater than 10 ppm. This includes excavating to a depth of 6 feet in certain areas.

X. STATUTORY DETERMINATIONS

A. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy, Alternative 3, would protect human health and the environment by preventing exposure through the removal (excavation) of the contaminated soils and containment in a landfill designed to store PCBs.

B. COMPLIANCE WITH ARARS

The selected remedy will comply with all ARARs including TSCA (see Tables 6 and 7, Appendix B). The remedial action objectives will be met by the selected alternative since the contaminated soil in excess of the cleanup level will be removed.

The selected alternative will comply with action-specific ARARs which include OSHA, transportation and disposal regulations (see Table 7, Appendix B).

C. COST EFFECTIVENESS

The selected remedy is cost-effective. The present worth cost is $301,000.

D. UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The removal of contaminated soil in the selected alternative would permanently reduce the volume of contaminants at the Stratton Substation OU. After the remedial action is completed, residual risks around the site would be within an acceptable level. Off-site disposal of contaminated soil in a landfill would control the mobility of the contaminants.

The selected remedy does not utilize permanent treatment technologies for this site due to cost and other considerations. Although this action does not fully address the statutory mandate for treatment, this action provides for a permanent remedy and thus partially satisfies this mandate.

E. PREFERENCE FOR TREATMENT AS A PRINCIPLE ELEMENT

The selected alternative does not treat the contaminants. However, excavation and off-site disposal are proven and reliable technologies, and would achieve the remedial action objectives as effectively as the treatment alternative at the site.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan for the Stratton Substation OU was released for public comment on March 1, 1999. The Proposed Plan identified Alternative 3, Excavation/Off-Site Disposal and Institutional Controls, as the preferred alternative. NASA, EPA and VDEQ reviewed and considered all comments received during the public meeting and during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, are necessary.

XII. RESPONSIVENESS SUMMARY

OVERVIEW

In a Proposed Plan released for public comment on March 1, 1999, NASA, with the support of EPA, identified Alternative 3 as the preferred remedial alternative for the Stratton Substation OU at the Site. Alternative 3 in the Proposed Plan was described in Section VIII; there was no public opposition to the proposed remedy.

COMMUNITY INVOLVEMENT TO DATE

NASA and EPA established a public comment period from March 1, 1999 to April 14, 1999 for interested parties to comment on the Proposed Plan for the Stratton Substation OU. These and all other documents considered or relied upon during the remedial selection process for the Stratton Substation OU are included in the Administrative Record, which has been in two information repositories accessible to the public since the beginning of the public comment period for the Stratton Substation OU.

A public meeting was held at the Virginia Air and Space Center on March 17, 1999 to present the Proposed Plan, answer questions, and accept both oral and written comments on the Stratton Substation OU remedial alternatives. No one attended this session.

C. SUMMARY OF RESPONSES RECEIVED DURING THE PUBLIC COMMENT PERIOD AND COMMENT RESPONSES

Although no one attended the public meeting, prior to the start of the public meeting, a Technical Review Committee (TRC) meeting was held at which time the Stratton Substation Proposed Plan was discussed. The following comments were raised during the TRC meeting:

Comment 1: What is the difference between Alternative 2 and Alternative 3?

Response 1: Both alternatives excavate the contaminated soil. Alternative 2 involves incineration in an off-site facility. Alternative 3 involves disposal in an off-site landfill.

Comment 2: What is the cost difference?

Response 2: Alternative 2 costs $461,000 and Alternative 3 costs $301,000.

Comment 3: Where will the contaminated soil be disposed?

Response 3: In a TSCA-approved landfill. The exact location has not yet been determined, however, there are no TSCA-approved landfills in Virginia, so it would be transported out of state.

XIII. REFERENCES

Foster Wheeler Environmental, 1996. Final Field Sampling and Analysis Plan, Focused Feasibility Study Investigation for Stratton Substation Site, NASA Langley Research Center, Hampton, Virginia.

Foster Wheeler Environmental, 1998. Final Focused Feasibility Study Report for Stratton Substation Site, NASA Langley Research Center, Hampton, Virginia.

APPENDIX A

FIGURES

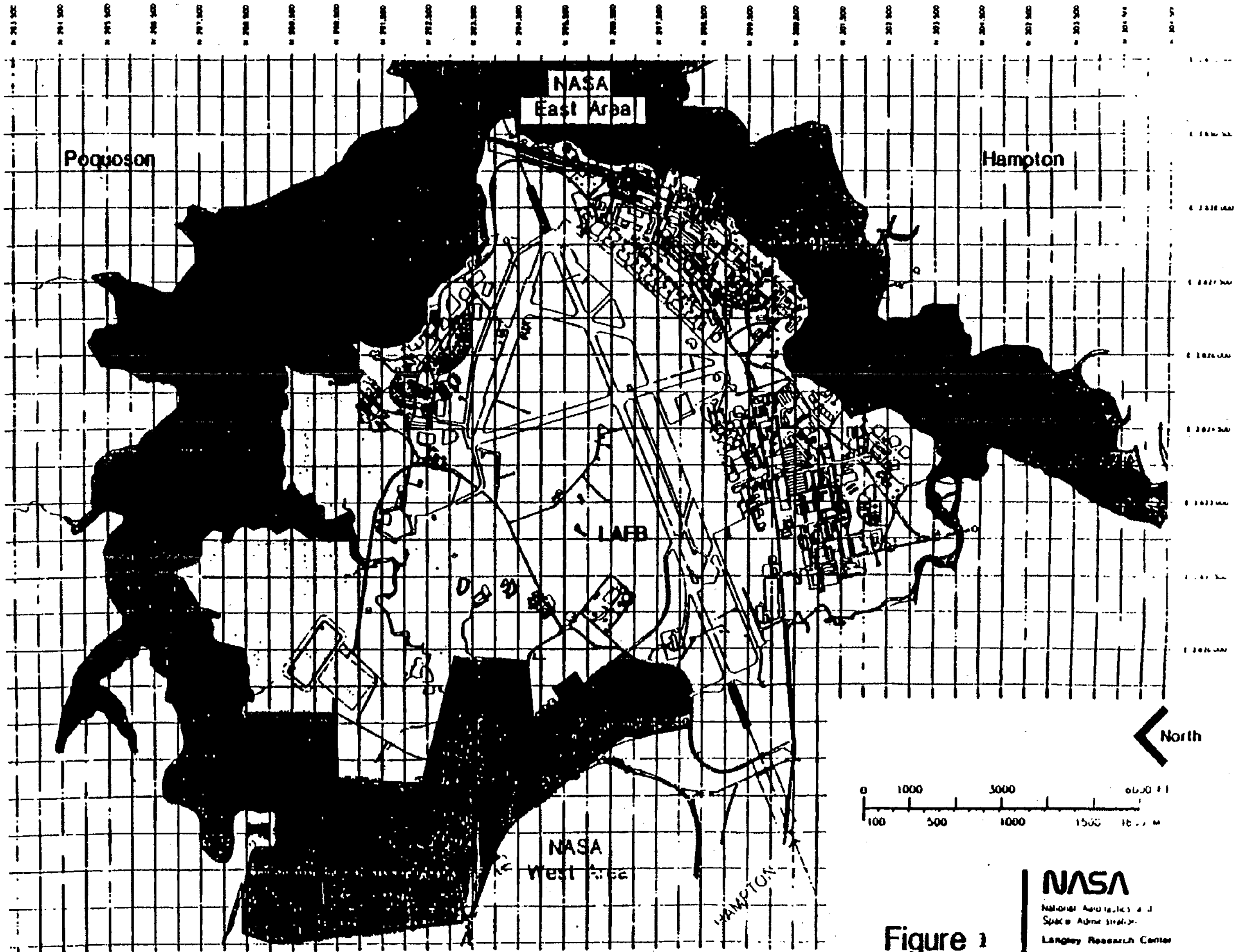


Figure 1
Vicinity Map

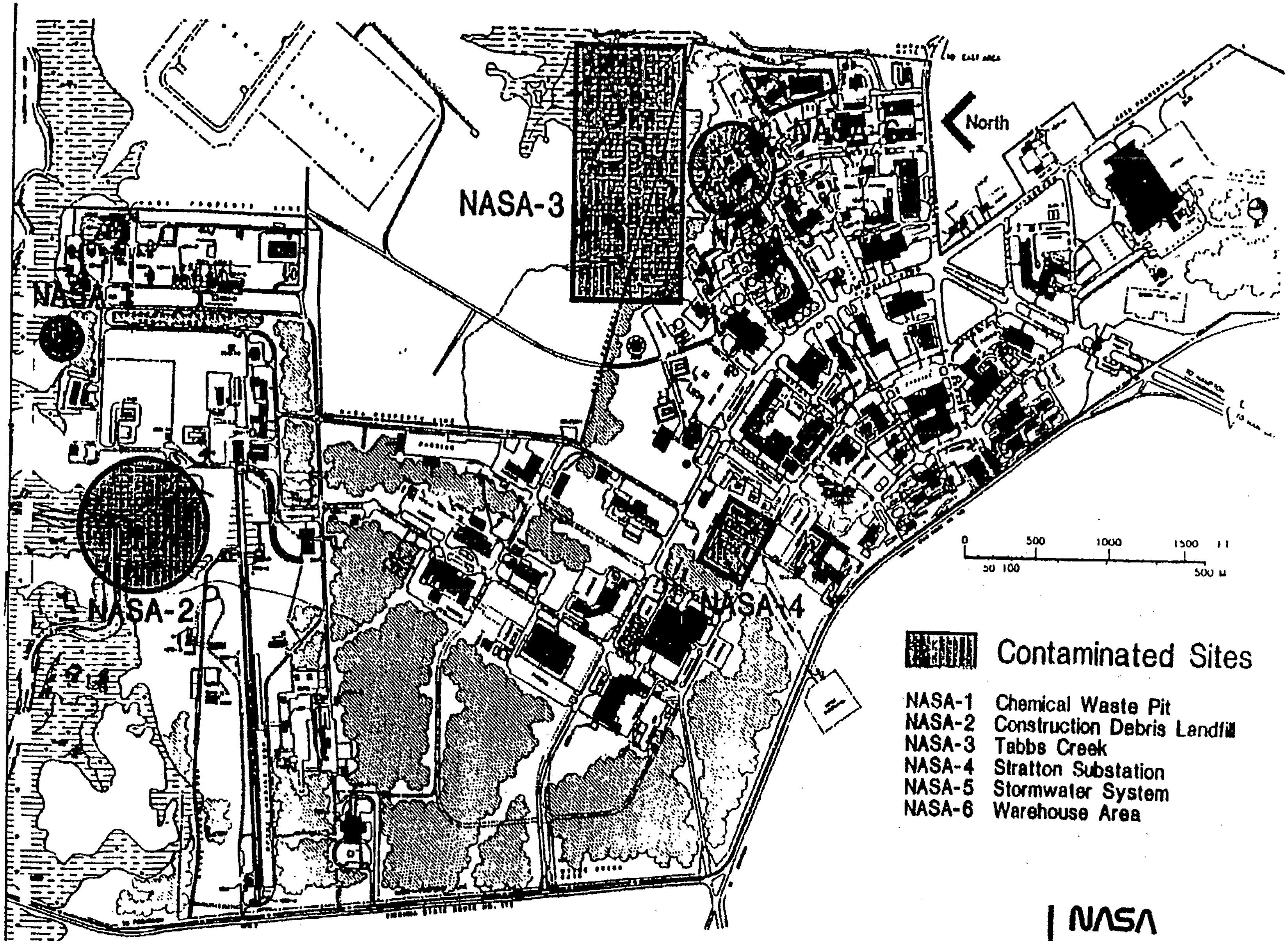


Figure 2
NASA LaRC West Area Contaminated Site Locations

NASA
National Aeronautics and Space Administration
Langley Research Center

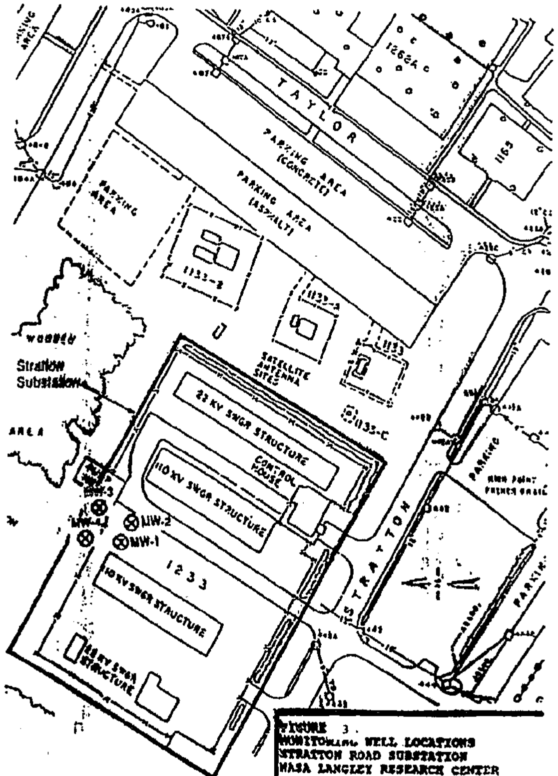


FIGURE 3.
MONITORING WELL LOCATIONS
STRATTON ROAD SUBSTATION
NASA LANGLEY RESEARCH CENTER

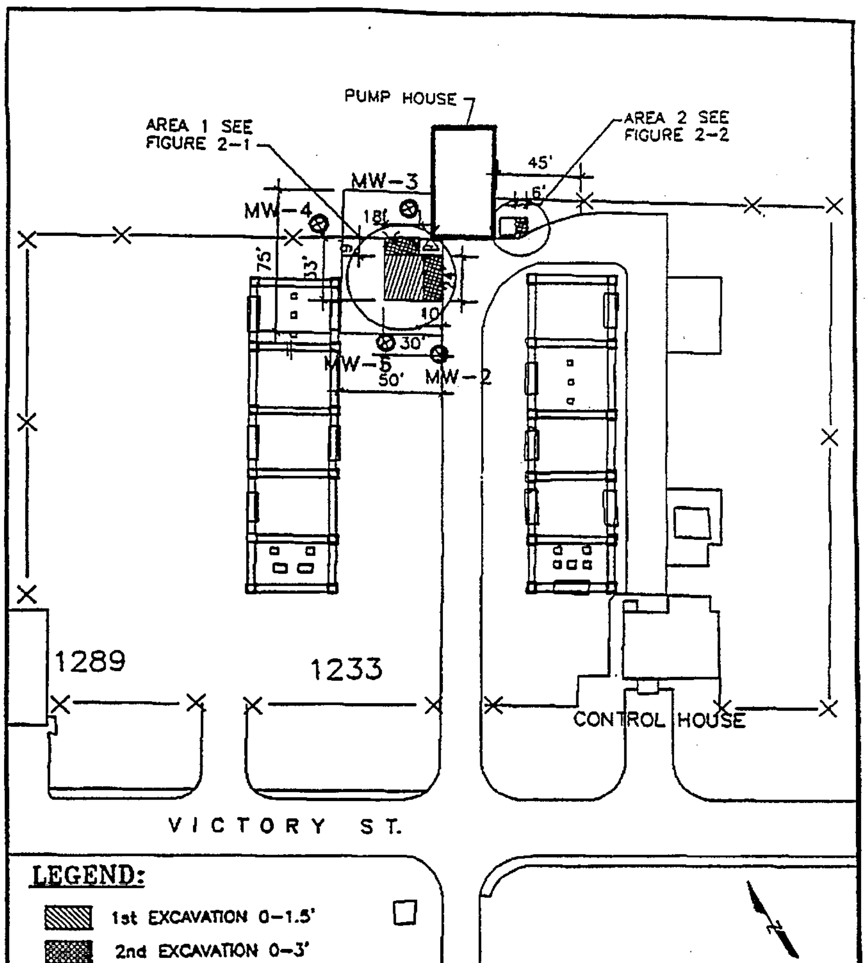
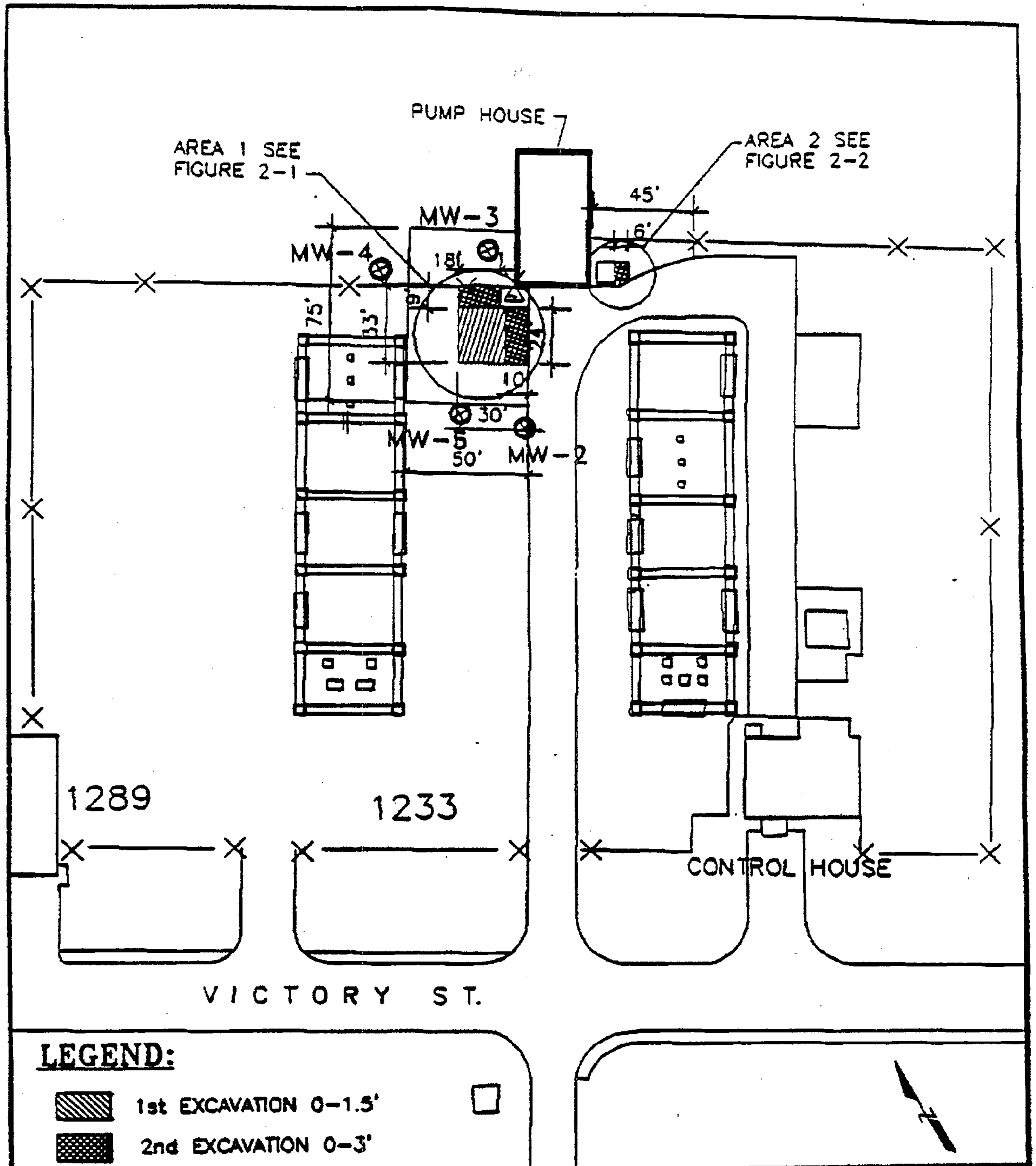


FIGURE 4
STRATTON SUBSTATION SRS SITE
LAYOUT MAP
NASA LANGLEY RESEARCH CENTER

0 60 FT.
SCALE

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-F1-2

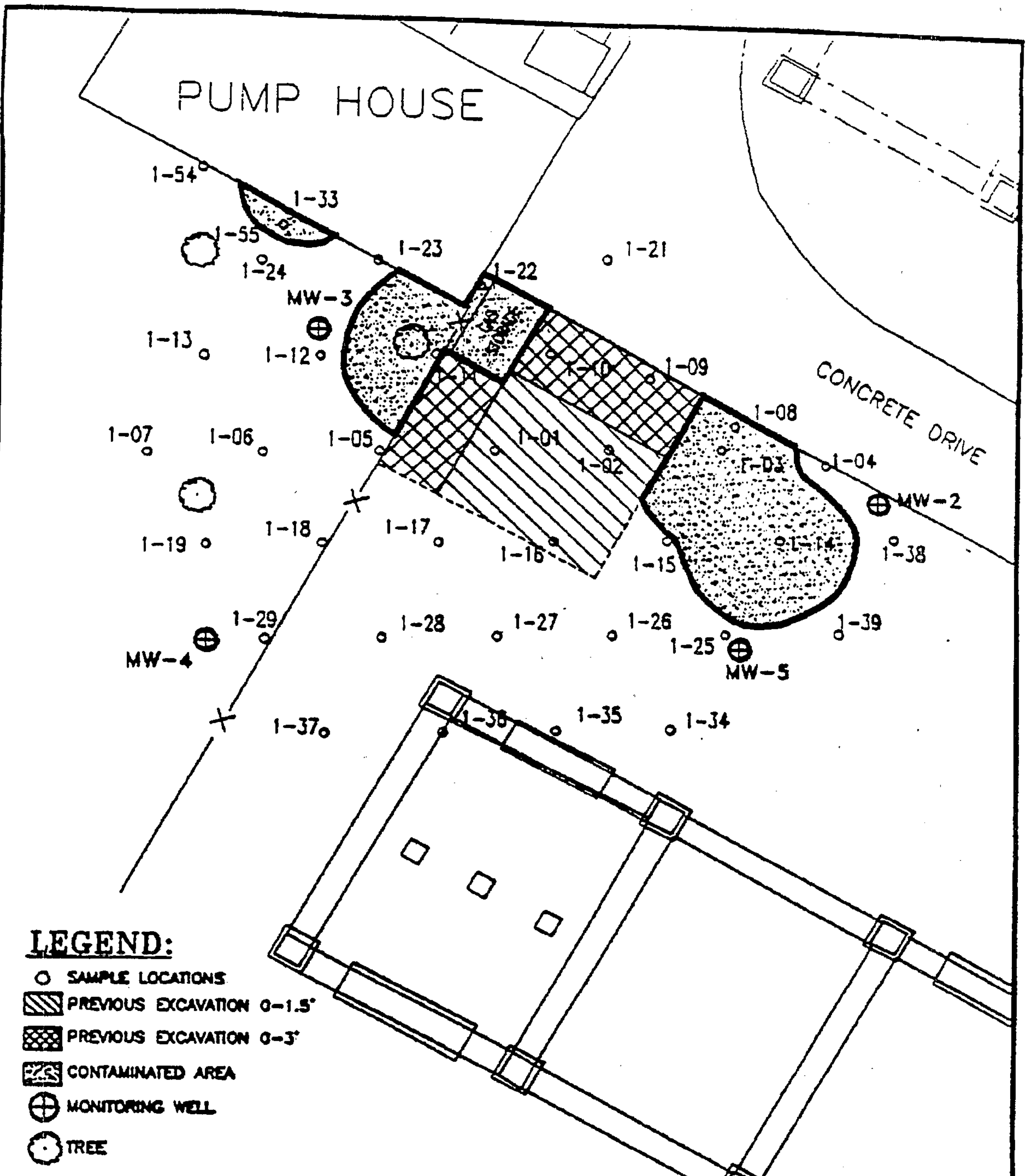


0 60 FT.
SCALE

FIGURE 5
STRATTON SUBSTATION SRS SITE LAYOUT MAP
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-F1-2



NORTH

0 20 FT.
SCALE

FIGURE 6
AREA 1
0 – 0.5 FEET CONTAMINATED AREAS AT STRATTON SUBSTATION SITE NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-1

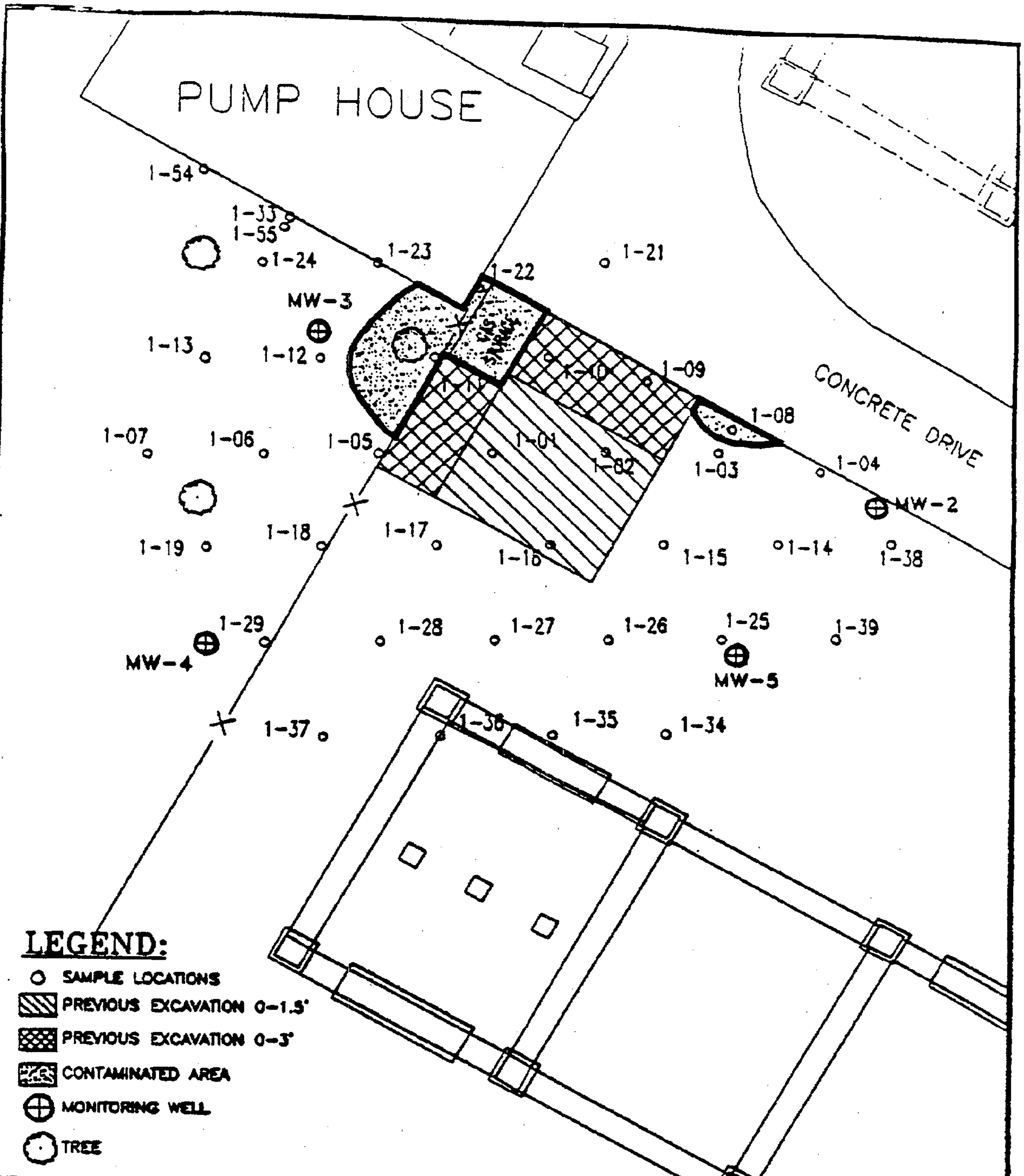
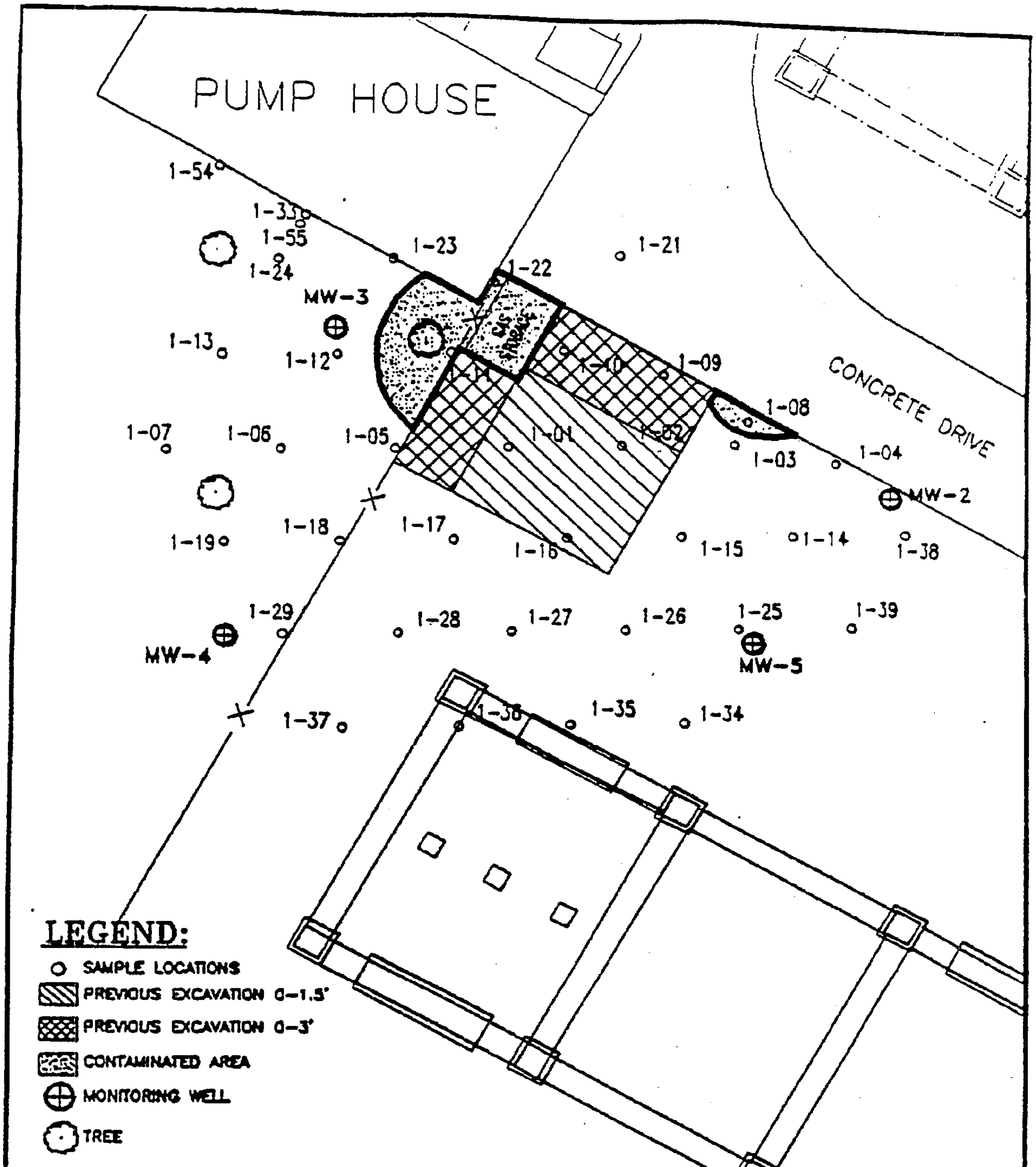


FIGURE 7
AREA 1
0.5 - 1.0 FEET CONTAMINATED AREAS AT
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-2



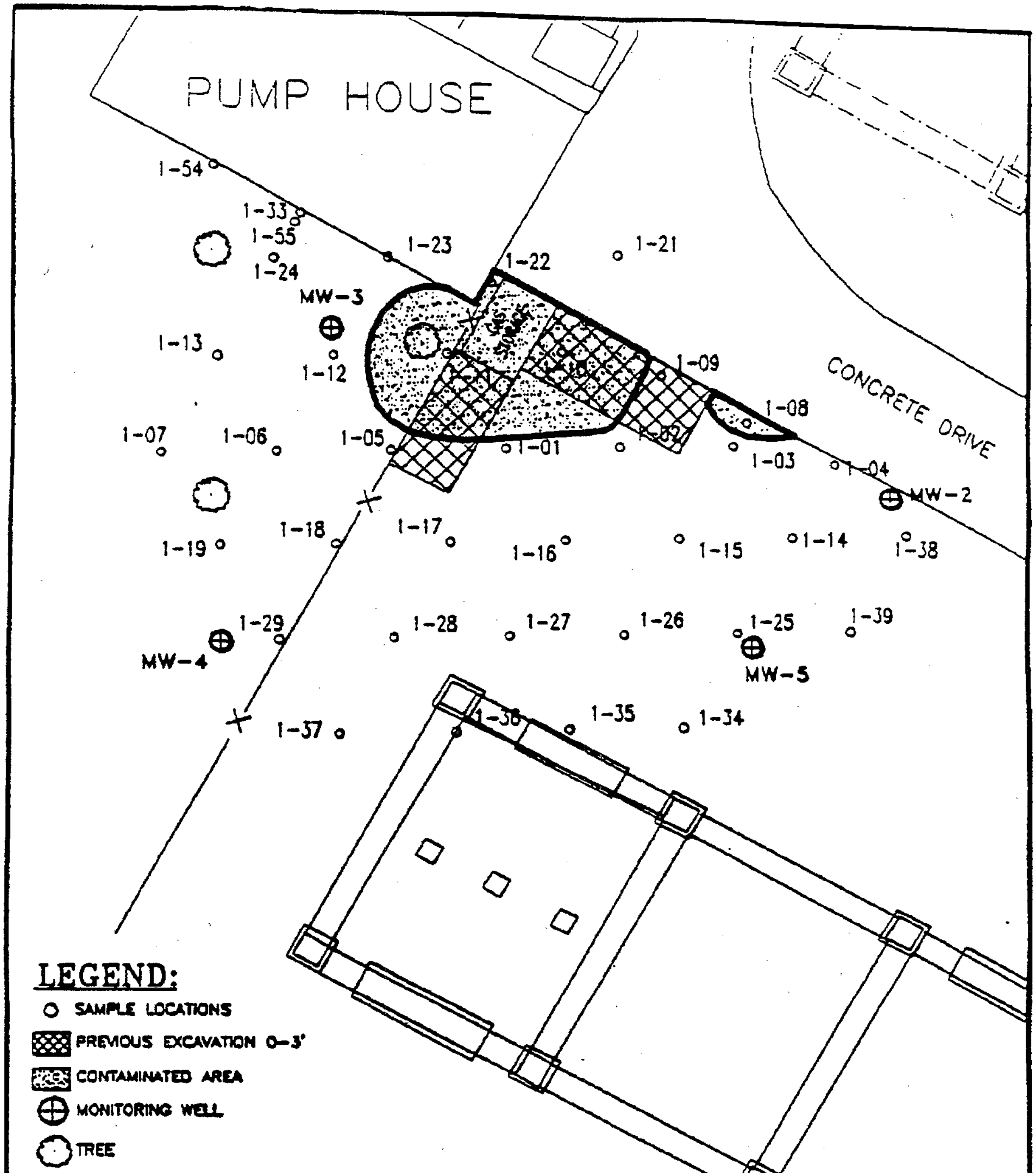
NORTH

0 20 FT.
SCALE

FIGURE 8
AREA 1
1.0 - 2.0 FEET CONTAMINATED AREAS AT STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-3



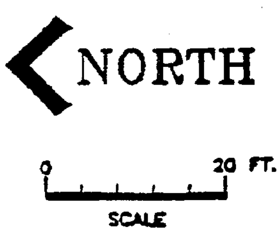
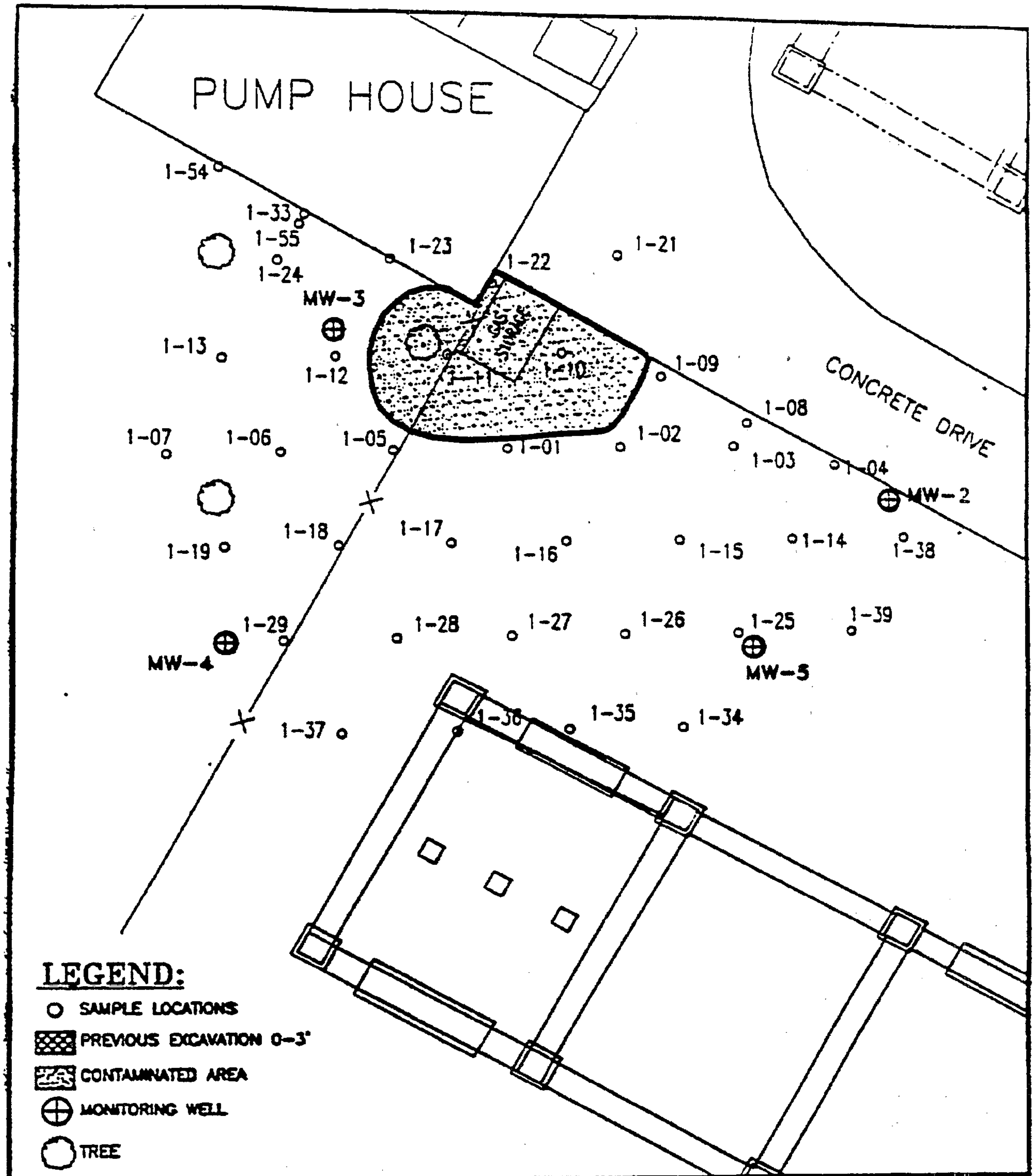


FIGURE 9
AREA 1
2.0 - 3.0 FEET CONTAMINATED AREAS AT STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-4



NORTH

0 20 FT.
SCALE

FIGURE 10
AREA 1
3.0 - 4.0 FEET CONTAMINATED AREAS AT
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 11-98	NASA\TON94\94-41-5

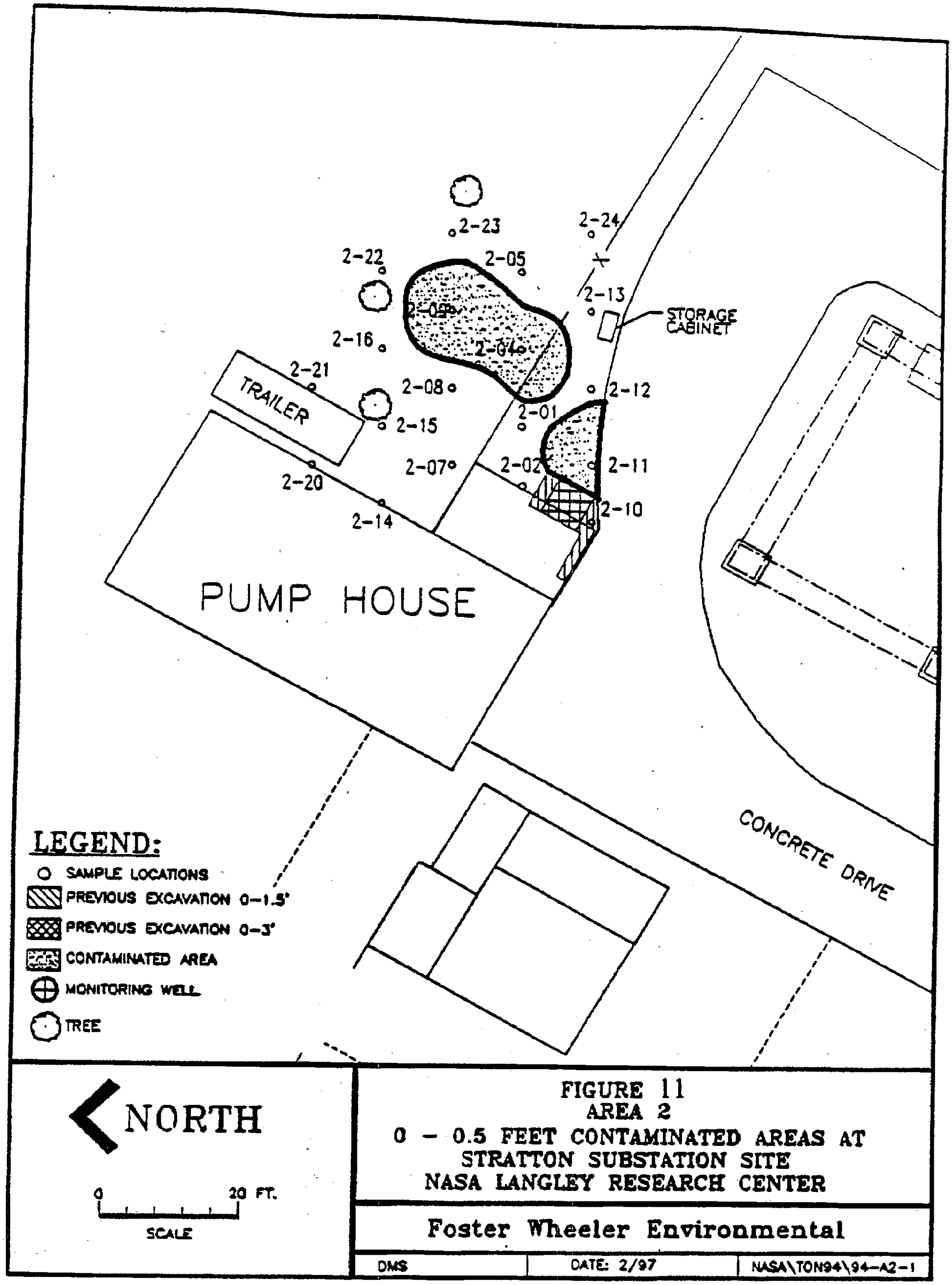


FIGURE 11
AREA 2
0 – 0.5 FEET CONTAMINATED AREAS AT
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A2-1

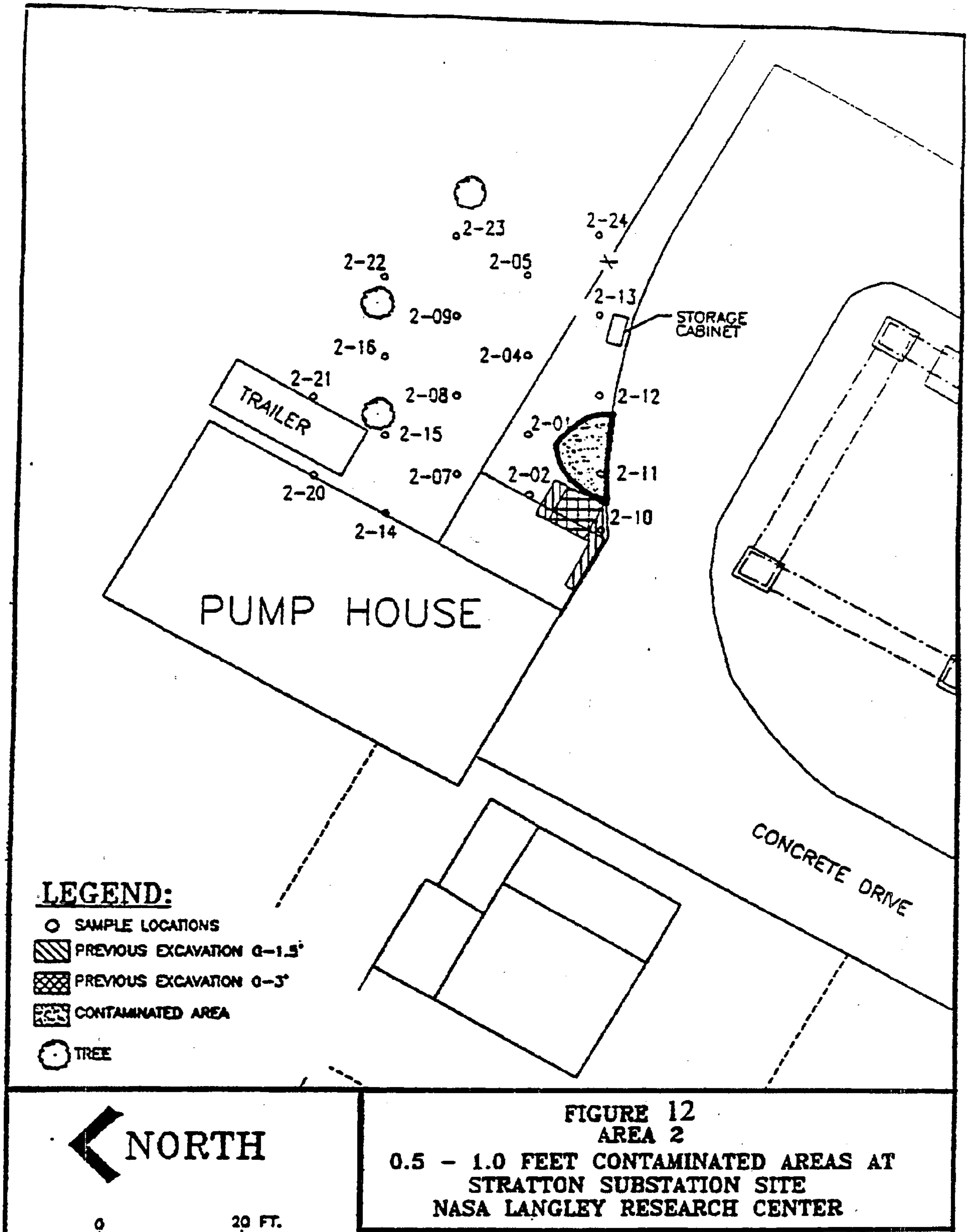
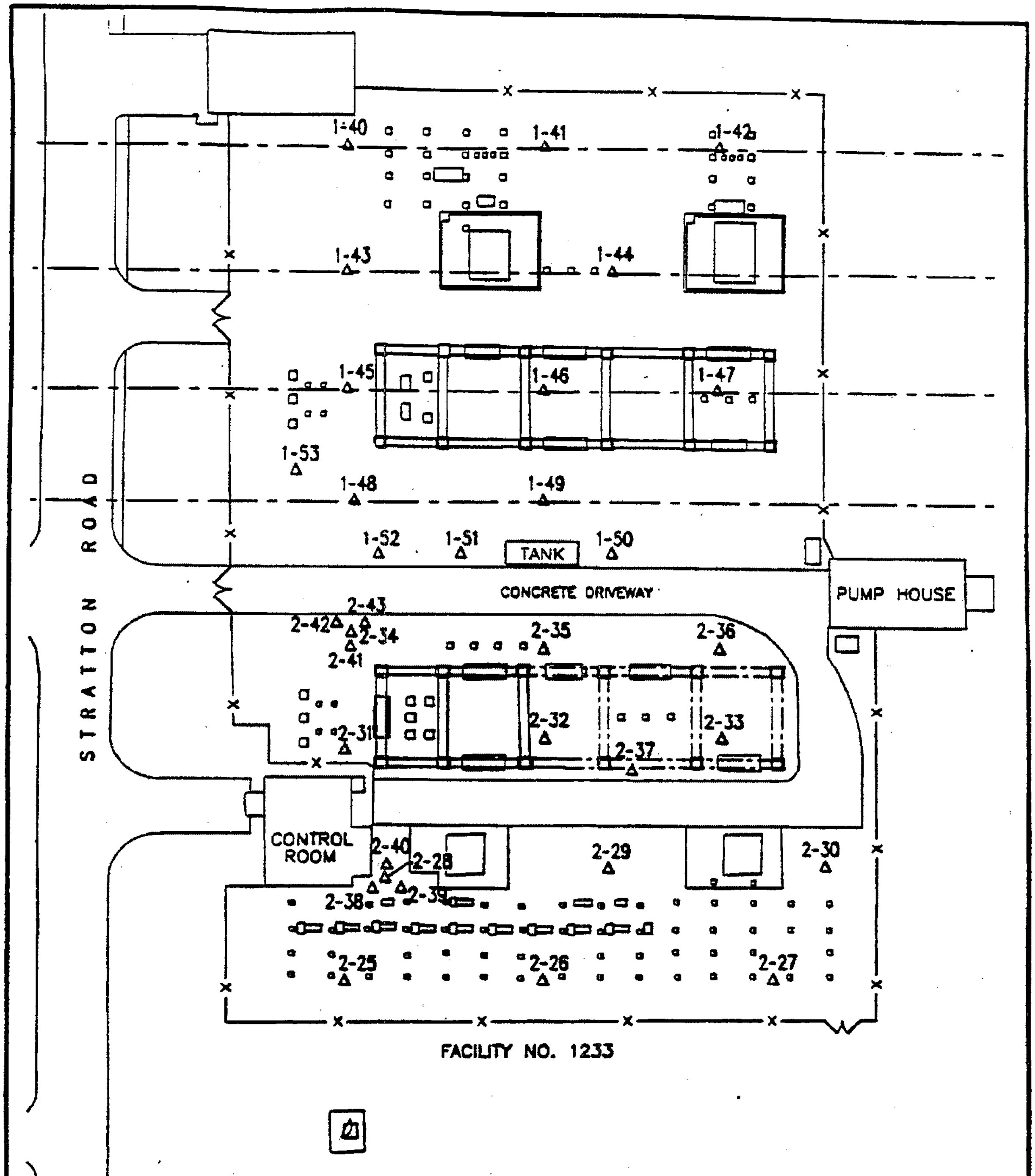


FIGURE 12
AREA 2
0.5 - 1.0 FEET CONTAMINATED AREAS AT
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A2-2



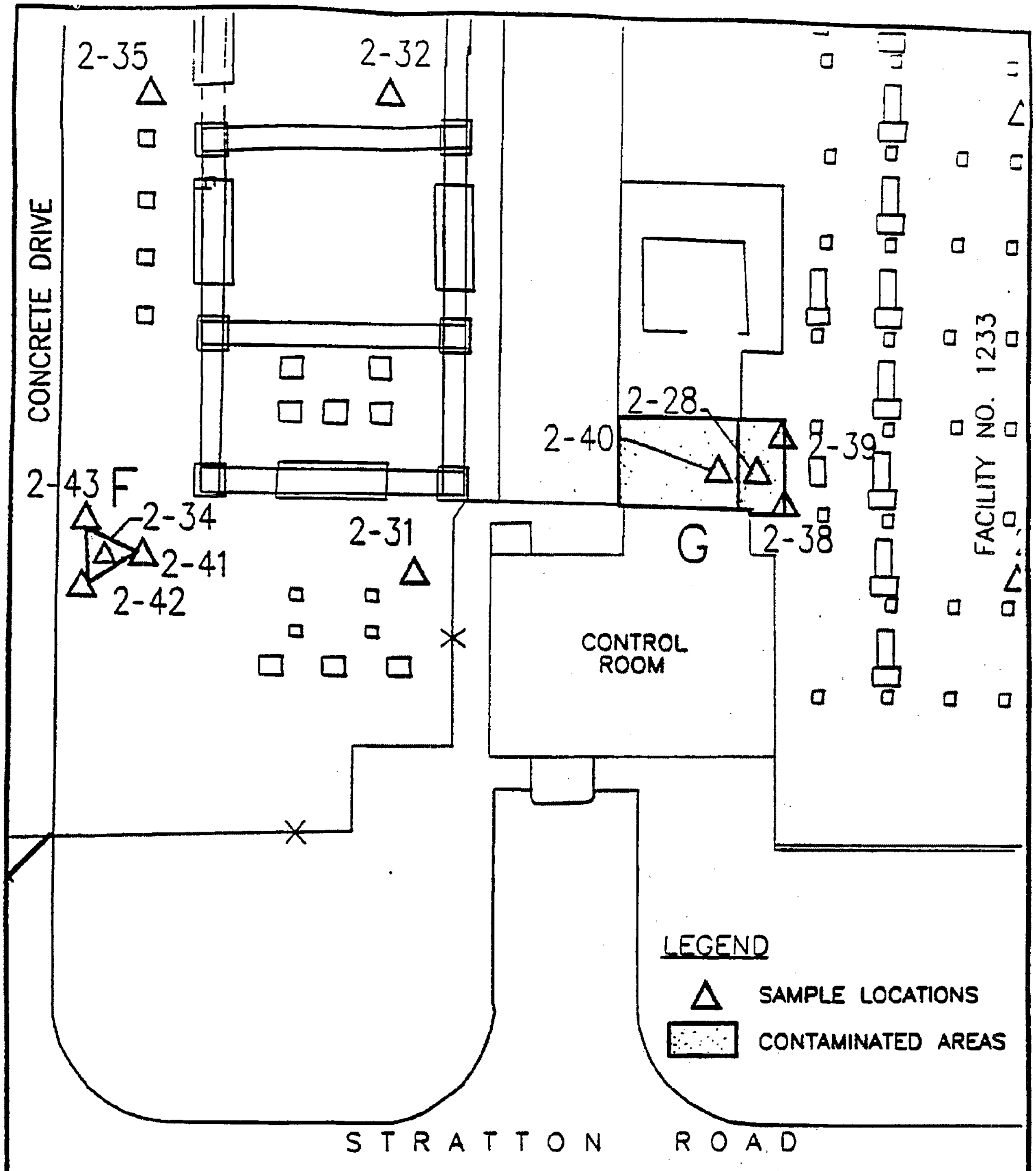
NORTH

0 50 FT.
SCALE

FIGURE 13
SUPPLEMENTAL INVESTIGATION
SOIL SAMPLE LOCATION MAP
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

MAO	DATE: 04/29/97	NASA\TON94\94-A3-23



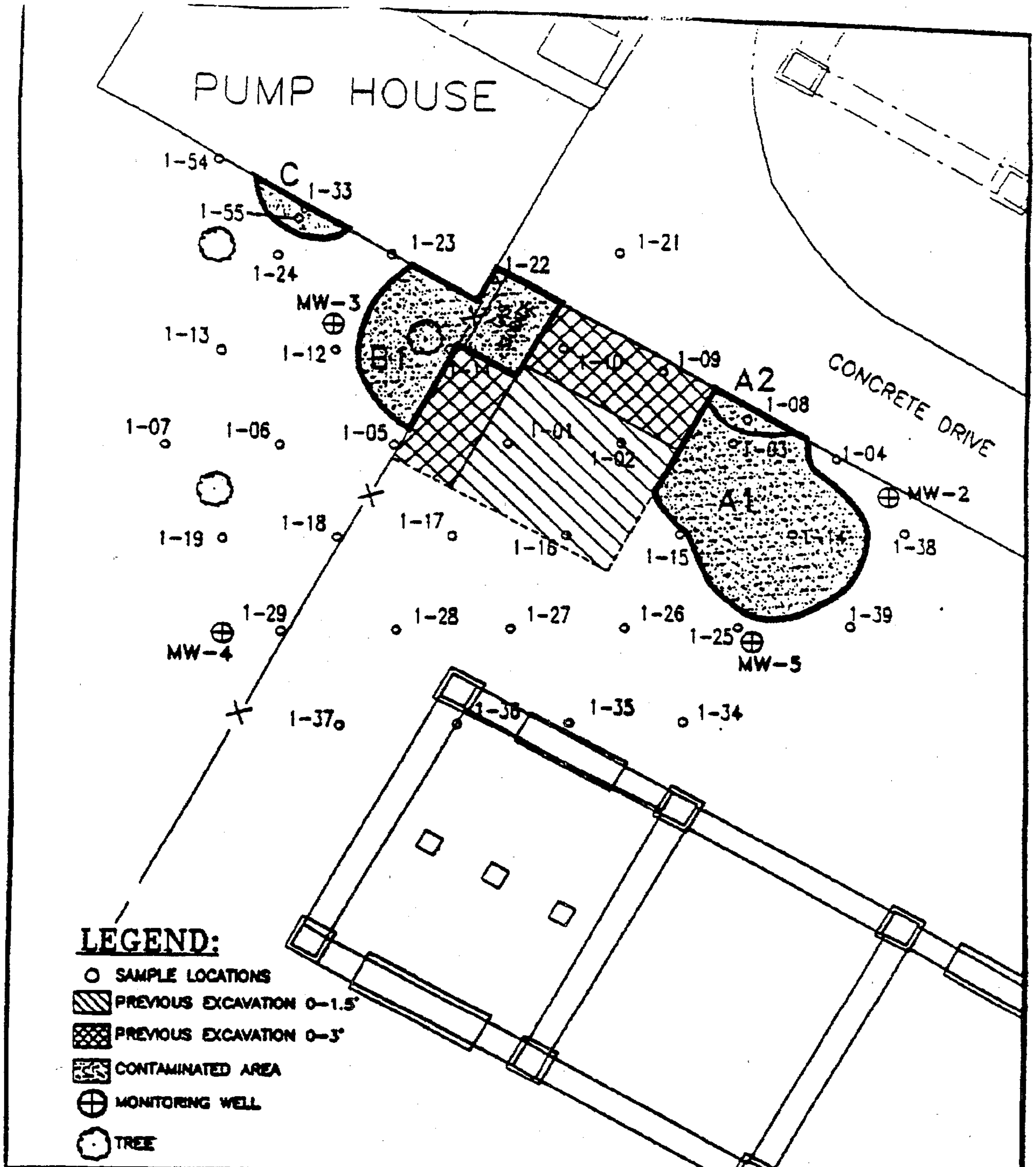
NORTH

0 25FT.
SCALE

FIGURE 14
OTHER AREAS
0–0.5 FEET CONTAMINATED AREAS AT
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

MAO	DATE: 11/98	NASA\TON94\94-3-21



NORTH

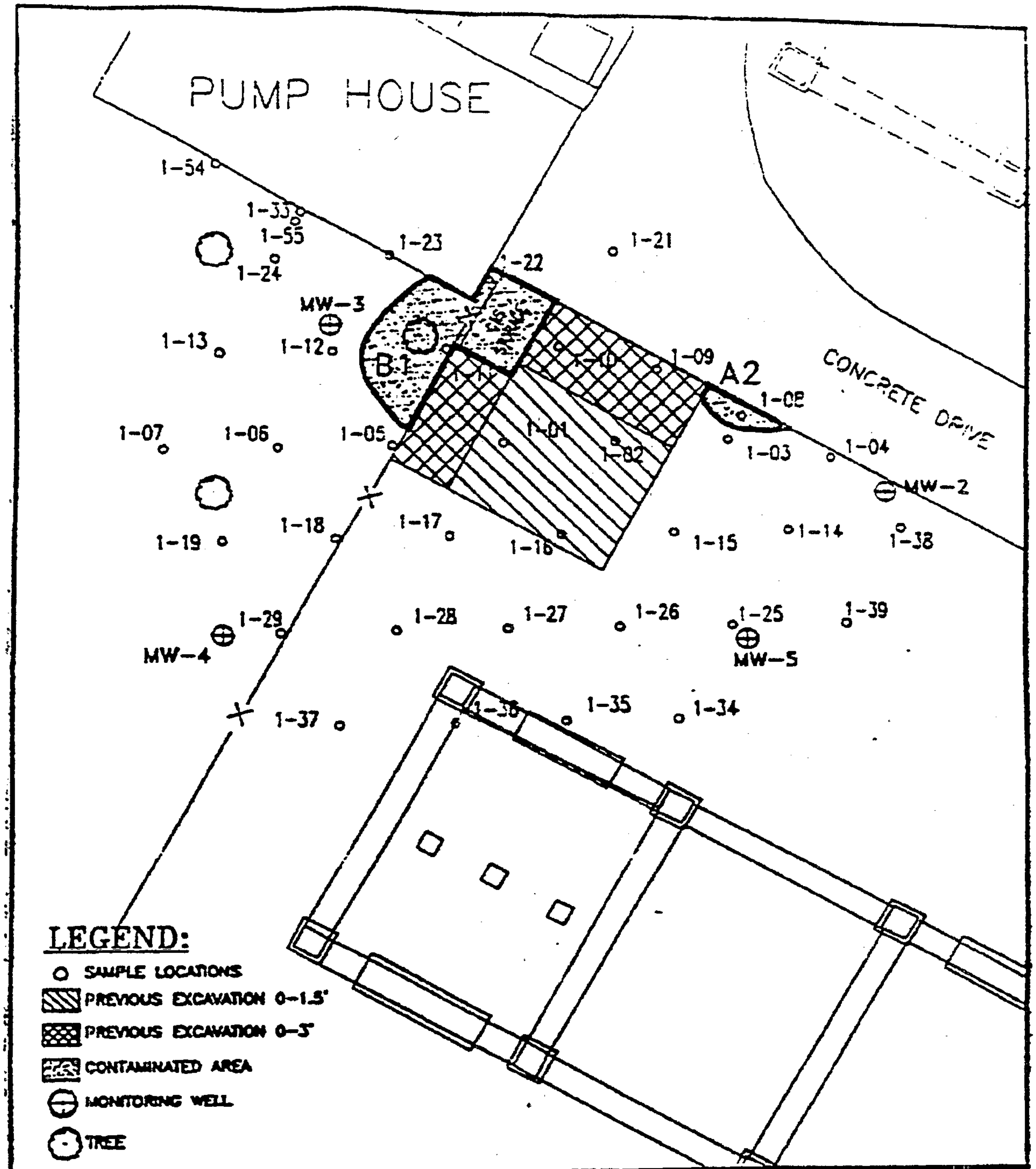
0 20 FT.

SCALE

FIGURE 15
AREA 1
EXTENT OF CONTAMINATION AT 0-0.5 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-41



NORTH

0 20 FT.

SCALE

FIGURE 16
AREA 1
EXTENT OF CONTAMINATION AT 0.5-1.0 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-42

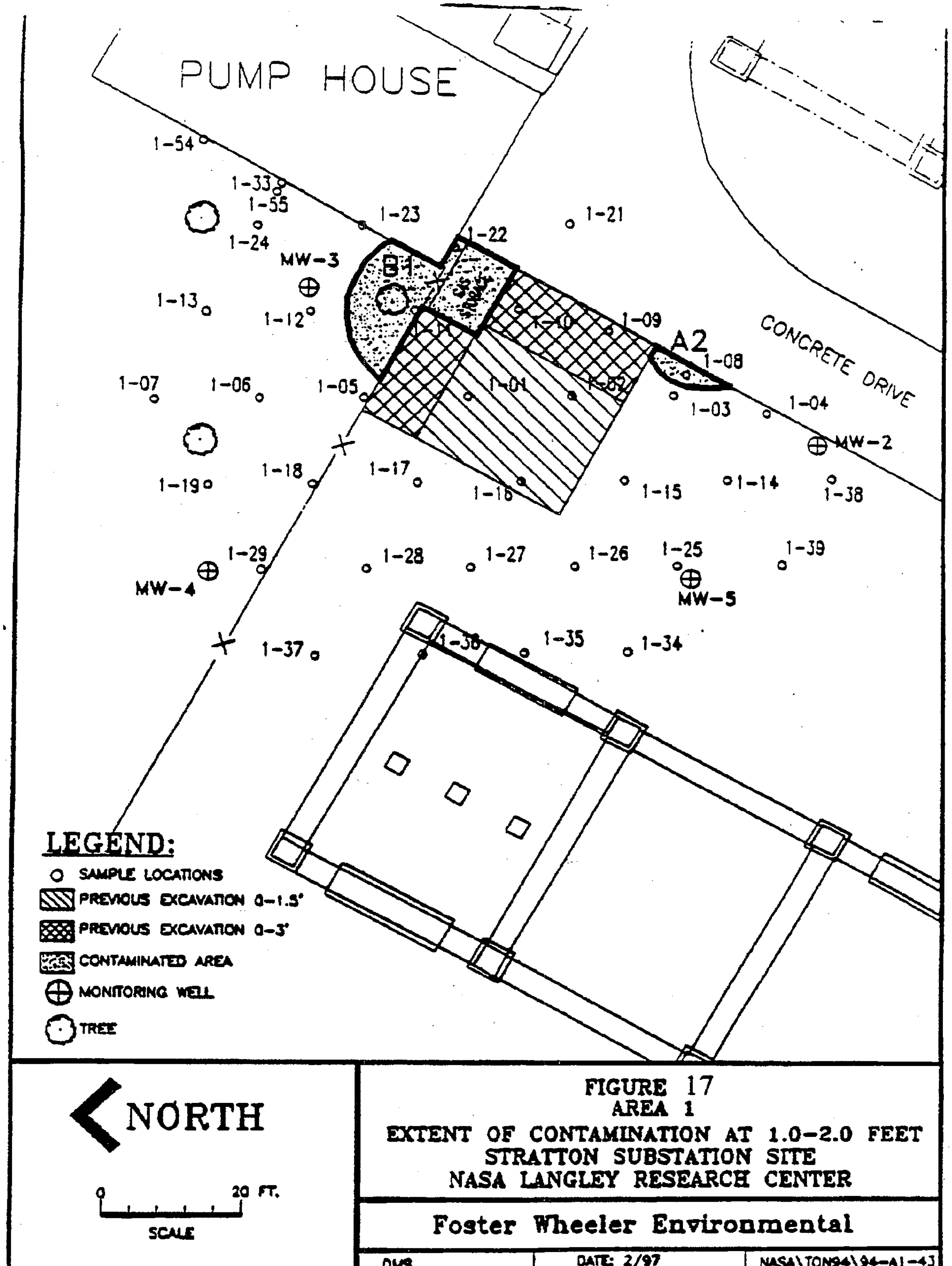


FIGURE 17
AREA 1
EXTENT OF CONTAMINATION AT 1.0-2.0 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-43

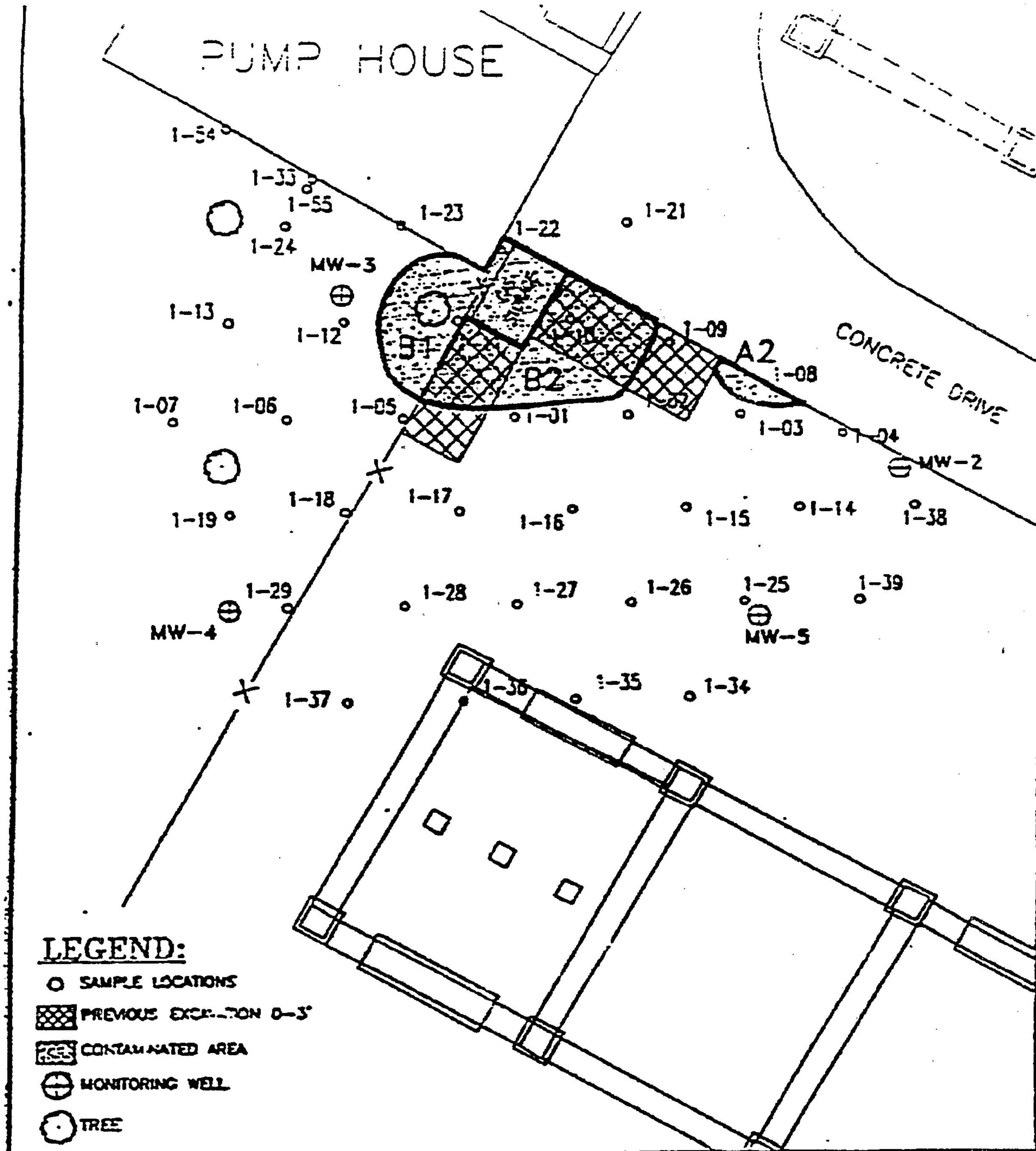
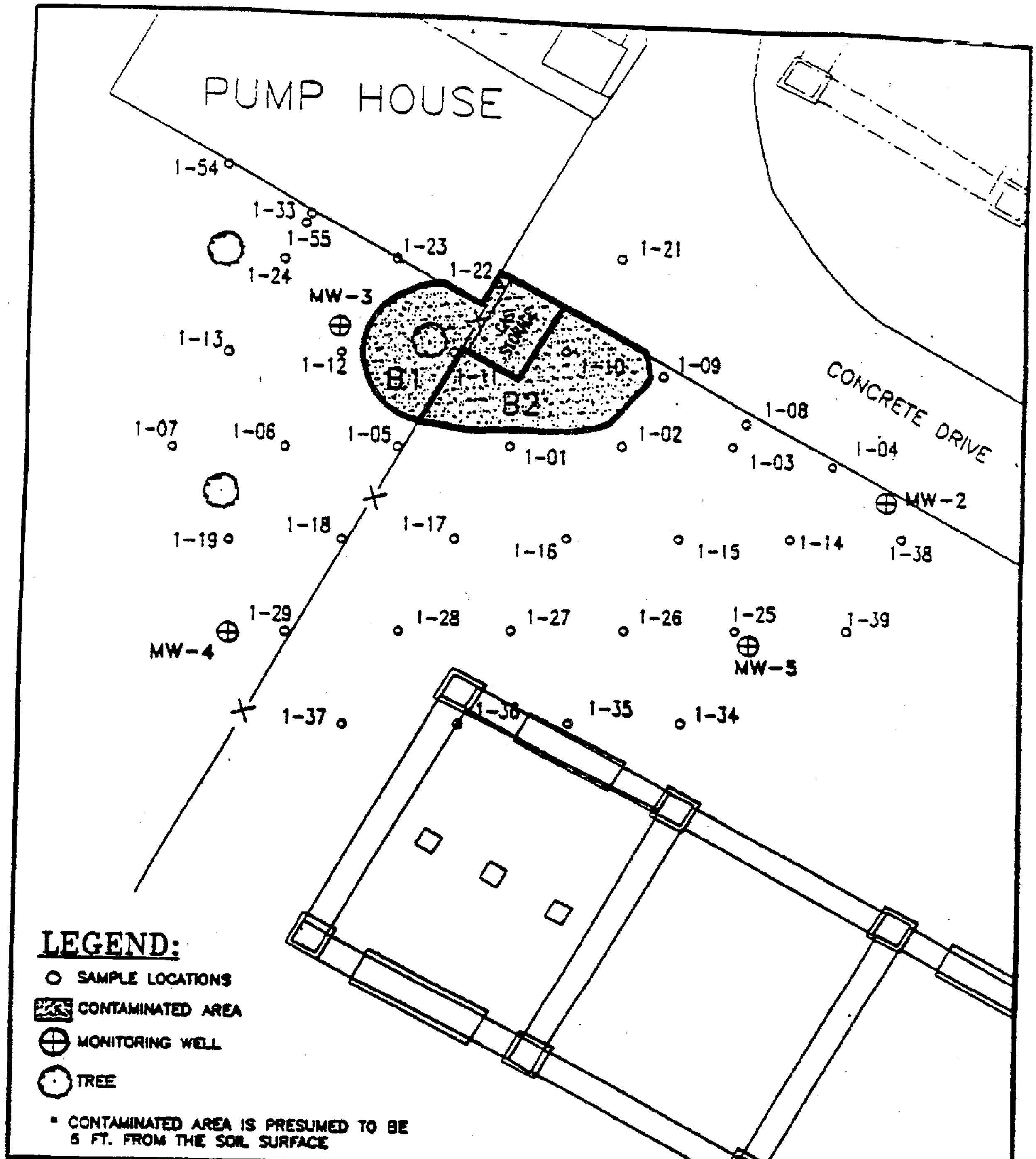


FIGURE 18
AREA 1
EXTENT OF CONTAMINATION AT 2.0-3.0 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-44



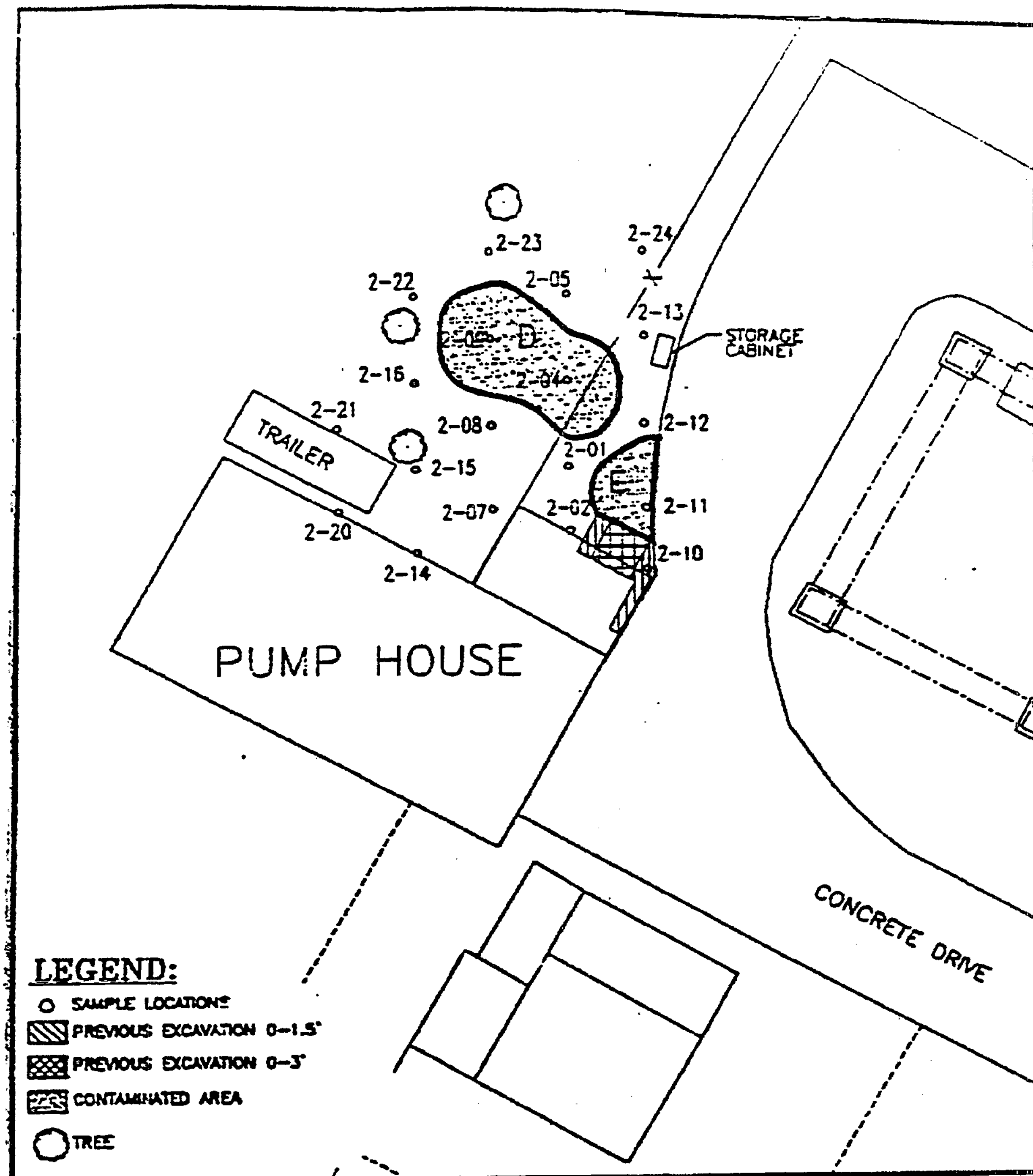
NORTH

0 20 FT.
SCALE

FIGURE 19
AREA 1
EXTENT OF CONTAMINATION AT 3.0–4.0 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A1-45



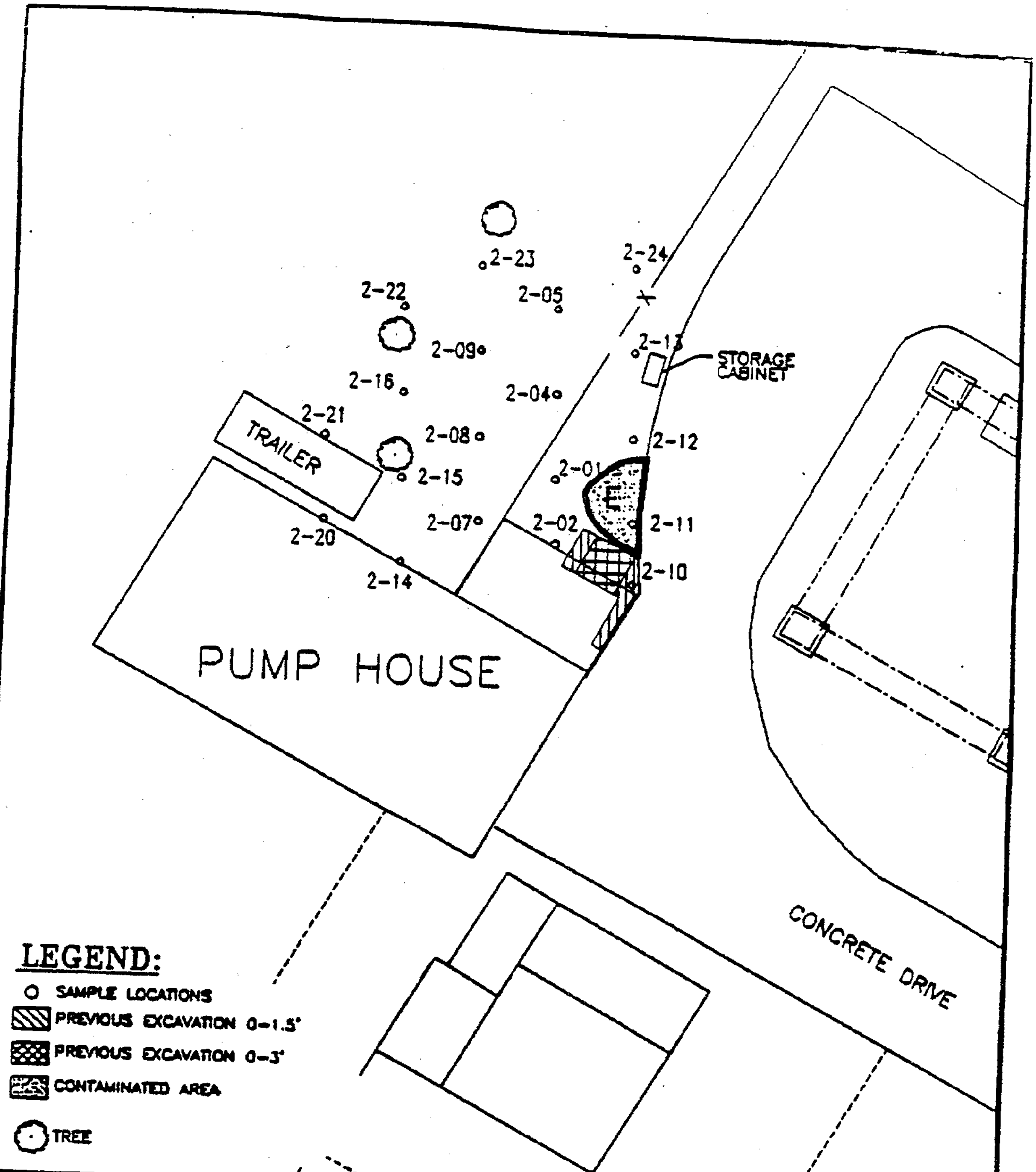
NORTH

0 20 FT.
SCALE

FIGURE 20
AREA 2
EXTENT OF CONTAMINATION AT 0-0.5 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A2-48



NORTH

0 20 FT.

SCALE

FIGURE 21
AREA 2
EXTENT OF CONTAMINATION AT 0.5-1.0 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

DMS	DATE: 2/97	NASA\TON94\94-A2-47

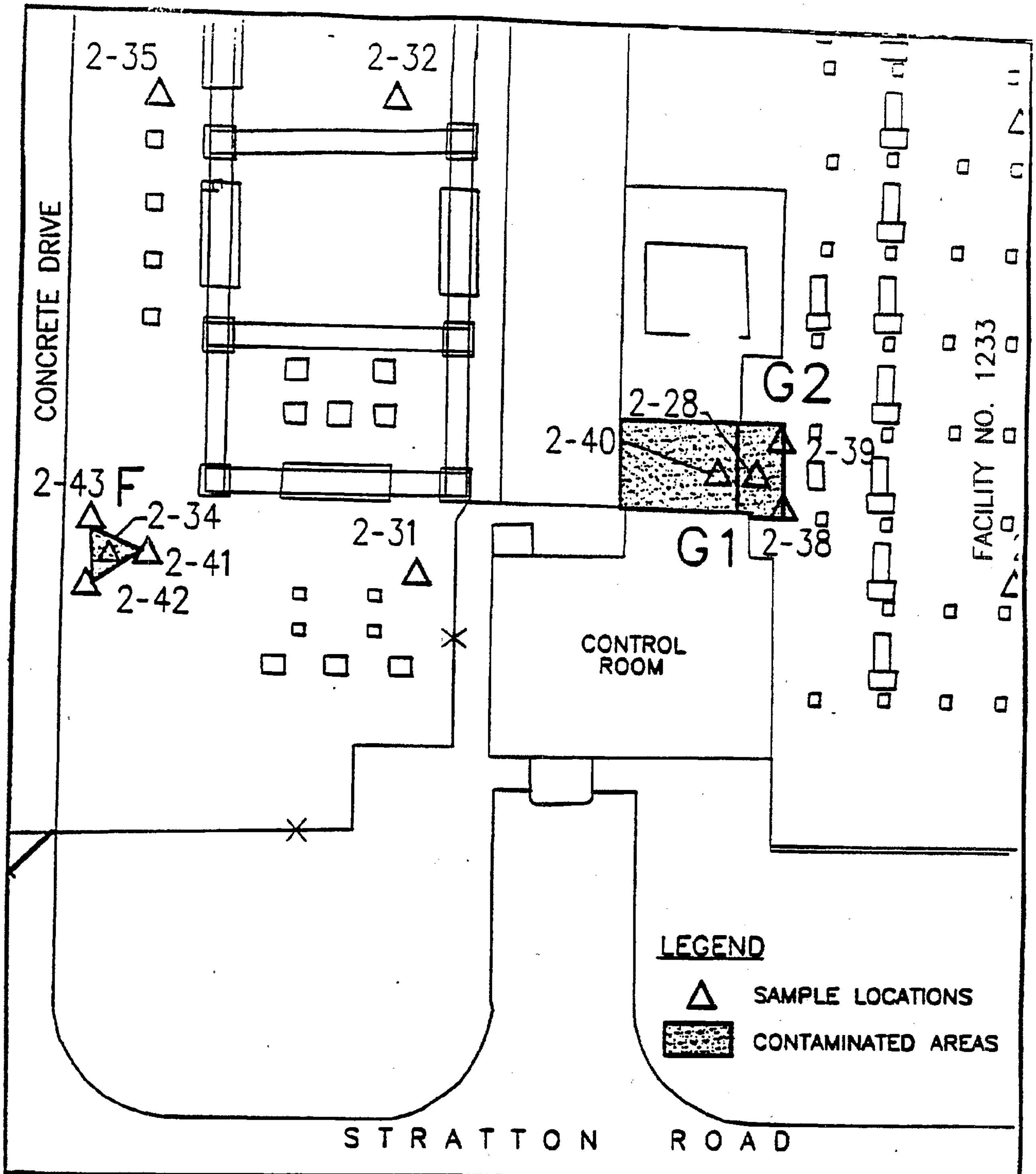


FIGURE 22
OTHER AREAS
EXTENT OF CONTAMINATION AT 0-0.5 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

MAO	DATE: 11/98	NASA\TON94\94-A3-48

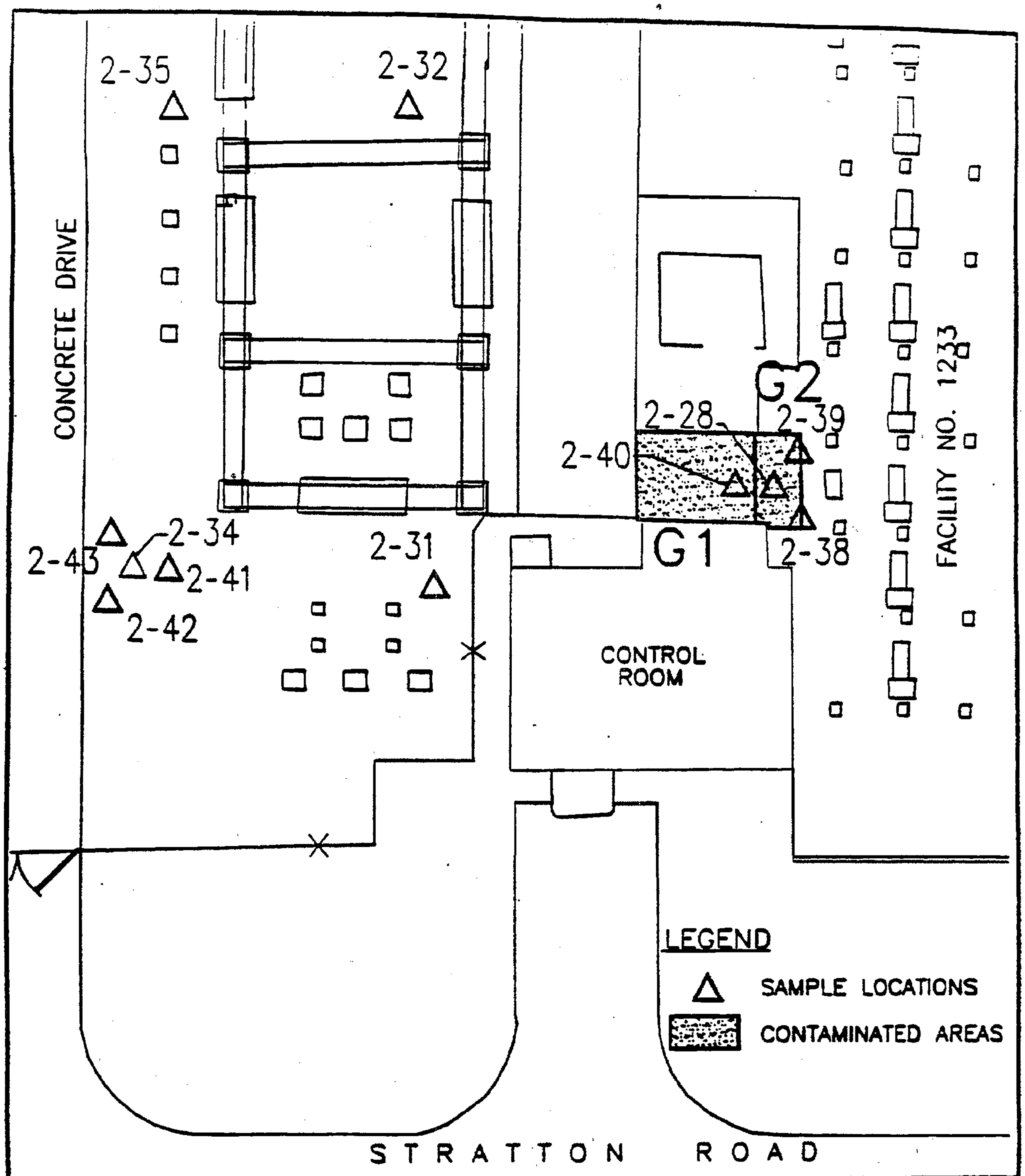


FIGURE 23
OTHER AREAS
EXTENT OF CONTAMINATION AT 0.5–1.0 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

MAO	DATE: 11-98	NASA\TON94\94-A3-49

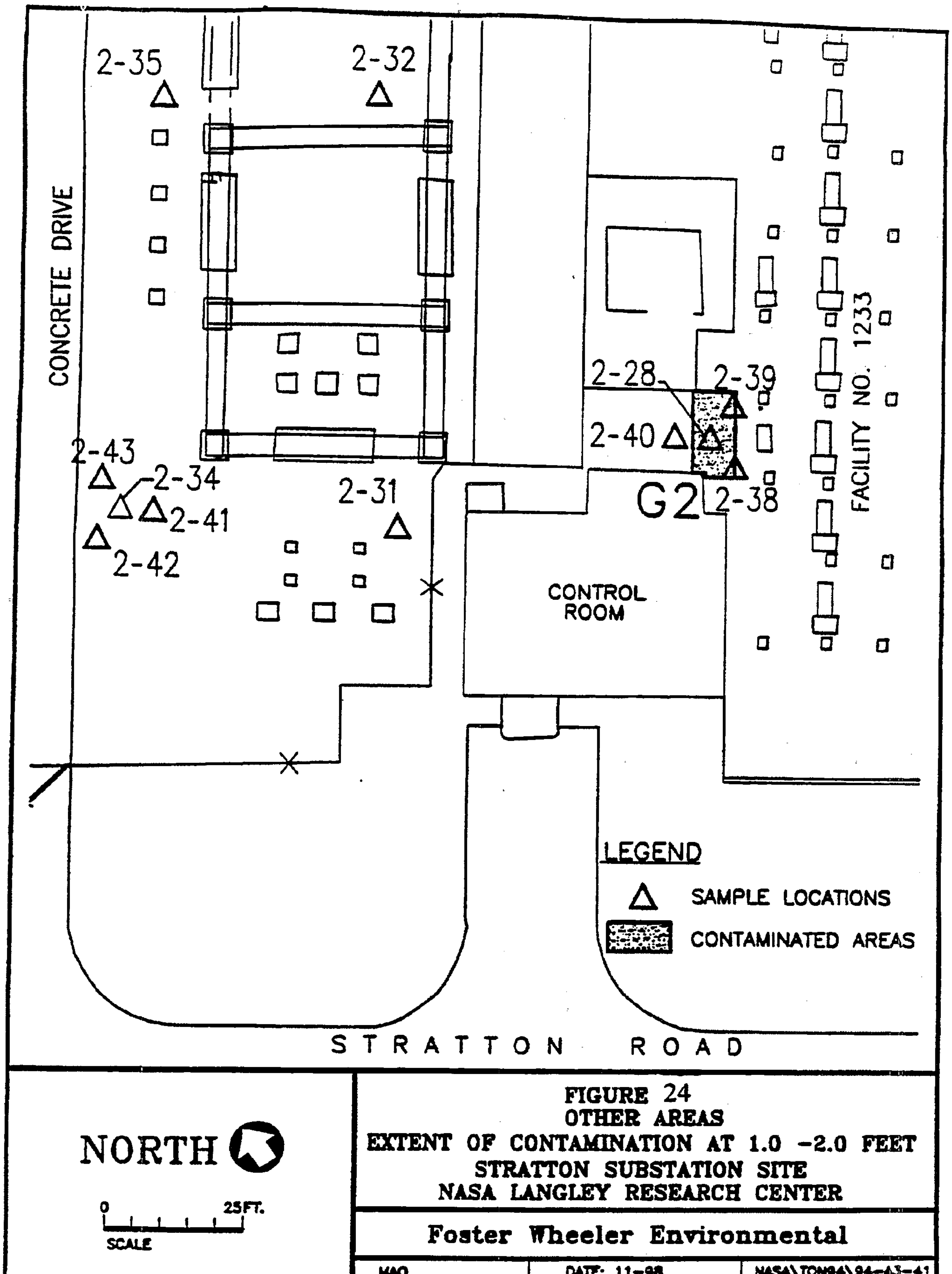


FIGURE 24
OTHER AREAS
EXTENT OF CONTAMINATION AT 1.0 -2.0 FEET
STRATTON SUBSTATION SITE
NASA LANGLEY RESEARCH CENTER

Foster Wheeler Environmental

MAO	DATE: 11-98	NASA\TON94\94-A3-41

APPENDIX B

TABLES

Table 2
Area and Volume of Contaminated Soil Calculation

Section	Area (ft^2)	Deepest Depth above PCB Cleanup Level (ft)	Depth Range below PCB Cleanup Level (ft)	Depth Assumed (ft)	Volume (ft^3)
<u>Area 1</u>: A1	500	0.5	0.5 - 1.0	0.5	250
A2	50	3.0	unknown	4.0	200
B1	370	4.0	unknown	6.0[1]	2,220
B2	310	4.0	unknown	6.0[1]	1,240[2]
C	50	0.5	0.5 - 1.0	0.5	25
Soil Total	1280				3,785
Gravel	705			0.5[3]	353
Area 1 Total					4,238 (157 cy)
<u>Area 2</u>: D	380	0.5	0.5 - 1.0	0.5	190
E	100	1.0	1.0 - 2.0	1.0	100
Soil Total	480				290
Gravel	100			0.5[3]	50
Area 2 Total					340 (13 cy)

Table 2 (continued)
Area and Volume of Contaminated Soil Calculation

Section	Area (ft^2)	Deepest Depth above PCB Cleanup Level (ft)	Depth Range below PCB Cleanup Level (ft)	Depth Assumed (ft)	Volume (ft^3)
Other Areas: F	50	0.5	0.5 - 1.0	0.5	25
G1	300	1.0	1.0 - 2.0	1.0	300
G2	150	2.0	unknown	4.0	600
Soil Total	500				925
Gravel	425			0.5	213
Other Areas Total					1,138 (42 cy)

[1] Assume the depth of contamination for sections B1 and B2 is 6 ft and for sections A2 and G2 is 4 ft.
[2] The contaminated soil in B2 area begins 2 ft below the surficial soil.
[3] Assume the gravel cover above the contaminated soil is contaminated and 0.5 ft thick in average.

Table 3
Identification of Remedial Technologies

Response Action	Remedial Technology	Process Options	Description	Screening Comments
No Action	None	Not Applicable	No remedial action/long-term monitoring.	Required for consideration by NCP.
Limited Action	Institutional Controls	Fencing Use and Access Restrictions	Fence contaminated portions of site. Limit access and use in the contaminated area.	Not effective for migration prevention and ecological protection. Potentially applicable; site is within Federal facility.
	Public Awareness	Warning Signs/Inform Public	Post and maintain warning signs around site. News releases, posters, brochures, and public meetings.	Potentially applicable.
	Monitoring	Monitoring	Perform periodic monitoring of groundwater and soil.	Potentially applicable.
Containment	Capping	Non-RCRA Cap	Compacted clay, soil, stone, or other material over areas of contamination.	Potentially applicable.
		RCRA Cap	RCRA multimedia cap.	Potentially applicable.
	Barriers	Slurry Wall	Vertical trench excavated under slurry of bentonite and water.	Not effective for preventing contaminant migration down to groundwater.
		Grout Curtain	Pressure injection of grout in a regular pattern of drilled holes.	Not effective for preventing contaminant migration down to groundwater.
		Sheet Piling	Precast concrete or steel.	Not effective for preventing contaminant migration down to groundwater.
Removal/Treatment/ Disposal	Removal	Excavation	Excavation using conventional equipment.	Potentially applicable.
	Solidification/Stabilization	Cement/Pozzolanic Agents	Immobilization in a low-permeability matrix.	Potentially applicable.
	Soil Washing	Solution/Surfactant Washing	Soil washing with solutions of acids/bases, chelates, or surfactants.	Not effective for PCBs.
		Solvent Extraction	Removal of contaminants with immiscible solvent.	Potentially applicable.

Table 3 (continued)
Identification of Remedial Technologies

Response Action	Remedial Technology	Process Options	Description	Screening Comments
Removal/Treatment/ Disposal (continued)	Chemical	Dechlorination (KPEG)	Use of chemical reagents such as KPEG to decompose PCBs.	Potentially applicable.
		Dechlorination by Lime Treatment	Decomposition of PCBs by addition of quicklime to contaminated soil.	Lab studies by EPA have confirmed the process is not effective in achieving remedial objectives.
		Dechlorination (BCD)	Use of hydrogen donor in decomposition of PCBs	Potentially applicable
	Thermal	Off-Site Incineration	Off-site incineration of contaminated soil at commercial facility.	Potentially applicable.
		On-Site Incineration	Portable or transportable incinerator set up on-site.	Potentially applicable.
		Low Temperature Desorption	Volatilization of organics by heating	Potentially applicable.
		Vitrification	Immobilization of inorganics and pyrolysis of organics using electrically-generated heat.	Potentially applicable.
		Desorption and Vapor Extraction	Utilizes a fluidized bed and a gas treatment system	Potentially applicable
		Thermal Gas Phase Reduction	A front-end thermal desorption unit is used to treat solid. Then a thermochemical reaction forms smaller and lighter hydrocarbons by reduction.	Potentially applicable
	Biological	Composting	Biological degradation of contaminated soil by naturally occurring microorganisms.	Not effective for highly chlorinated PCBs.
		Bioreactors	Slurried soil in reaction unit to enhance biological degradation.	Not effective for highly chlorinated PCBs.

Table 3 (continued)
Identification of Remedial Technologies

Response Action	Remedial Technology	Process Options	Description	Screening Comments
Removal/Treatment/ Disposal (continued)	In-Situ Treatment	Biodegradation	Enhanced biodegradation using injections of microorganisms and/or nutrients.	Not effective on high concentrations of PCBs in soil.
		Soil Flushing	Desorption of contaminants by flushing with water or other solutions.	Not effective with PCBs which are immobile.
		Soil Venting	Injection of air into soil to vaporize contaminants.	PCBs have a low vapor pressure which limits the effectiveness of technology.
		Stabilization	Mixing of cement/pozzolan material with soil in place to form impermeable solid.	Potentially applicable.
		Vitrification	Immobilization of inorganics and pyrolysis of organics using electrically-generated heat.	Not feasible at sites with a high water table.
		Radio Frequency Heating	Electromagnetic heating of soils to mobilize and/or destroy organics.	Not feasible because of the relatively low vapor pressures of site contaminants and high water table.
	Disposal	Off-site Landfill	Transportation of excavated soil to a commercial landfill.	Potentially applicable.
		On-site Landfill	Construction of a landfill onsite.	The site lacks suitable area for landfill construction.
		On-site Backfill	Disposal of treated soil to its origin.	Potentially applicable.

Table 4
Evaluation of Process Options

Remedial Technology	Process Option	Effectiveness	Implementability	Cost
No Action	No Action	Does not achieve remedial action objectives.	May not be acceptable to local government/public.	No capital and O&M.
Institutional Controls	Use and Access Restrictions	Effectiveness depends on continued future implementation. Does not reduce contamination.	Requires legal authority to enforce restrictions.	Low capital and O&M.
Public Awareness	Warning Signs/Public Meetings	Effective in informing workers and public of risks on site. No contaminant reduction.	Easily implemented.	Low capital and O&M.
Monitoring	Monitoring	Useful for documenting conditions. Does not reduce risk by itself.	Easily implemented.	Low capital, medium O&M.
Capping	Non-RCRA Cap	Effective in preventing direct contact and reducing contaminant migration. Susceptible to erosion. No reduction in TMV (through treatment).	Easily implemented. Would change the area drainage pattern.	Low capital, low O&M.
	RCRA Cap	Effective in minimizing infiltration and preventing direct contact. No reduction in TMV (through treatment).	Not easy to implemented for site contamination with small and isolated hot spot areas.	High capital and O&M.
Removal	Excavation	Effective in removing contaminated soil. Waste requires further processing to achieve remedial objectives.	Easily implemented. Use commercially available equipment.	Medium capital, no O&M.
Solidification/ Stabilization	Cement/Pozzolanic	Effective in stabilizing PCB-contaminated soil. Treatability study required to determine proper formula. Process could be reversed under adverse conditions such as low pH.	Technology widely available. Considered by some not to be a treatment technology.	Low capital and O&M.
Soil Washing	Solvent Extraction	Effectiveness varies with system and process. Treatability study is required to determine effectiveness.	Limited experience. No commercial system exists.	Medium capital, low O&M.

Table 4 (continued)
Evaluation of Process Options

Remedial Technology	Process Option	Effectiveness	Implementability	Cost
Chemical Treatment	Dechlorination (KPEG)	Effective in destruction of PCBs. Limited experience in treating PCB-contaminated solids.	Limited experience in treating solids. Availability could be problematic because of limited number of vendors.	Medium capital, low O&M.
	Base Catalyzed Dechlorination Process (BCD)	Completely dehalogenates PCBs.	Limited experience, especially in treating solids. Can be used with Anaerobic Thermal Processor (ATP) system.	Unknown
Thermal Treatment	Off-site and On-site Incineration	Best Demonstrated Available Technology (BDAT) for treating PCBs. Contamination is destroyed.	Commercial facilities are available. Requires excavation and either transportation of contaminated soil to off-site incineration unit. Small waste volume is not cost-effective to be treated on-site.	Off-site: High capital, no O&M. On-site: Medium capital, no O&M.
	Low-temperature Thermal Desorption	Has been demonstrated at other hazardous waste sites to extract and destroy PCBs.	Only one commercial unit is available. Small waste volume is not cost-effective to be treated on-site.	Medium capital, no O&M.
	Vitrification	Effective in destruction of PCBs.	Limited experience. No commercial system exists.	Medium capital, low O&M.
	Desorption and Vapor Extraction	Effective in removal of PCBs from soil.	Limited experience. No commercial system exists.	Medium capital.
	Thermal Gas Phase Reduction	A demonstration scale unit was effective in removal of PCBs and their destruction.	Limited experience. No commercial system exists.	Medium capital.
In-Situ Treatment	In-situ Stabilization	Effectiveness may not be significant because of low mobility of PCBs in soil. Also, effectiveness is a concern when performing underwater. Treatability Study required to determine proper formula. Process could be reversed under adverse conditions such as low pH.	Easily implemented. Considered by some not be a treatment technology.	Low capital and O&M.
Disposal	Off-site TSCA Landfill	Effective in isolating waste to reduce risk.	Several commercial facilities are available. Long distance for transportation.	Medium capital, no O&M.
	On-site Backfill	Effective in disposing treated soil may not be significant because of low mobility of PCBs in soil.	Easily implemented.	Low capital, low O&M.

Table 5
Summary of Alternatives Evaluation

ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 EXCAVATION/OFF-SITE INCINERATION	ALTERNATIVE 3 EXCAVATION/OFF-SITE DISPOSAL
Description: No remedial action.	Construct a stockpile/dewatering pad, excavate soil to below cleanup level, and treat at an off-site TSCA incineration. Pump and treat infiltrated groundwater. Backfill and restore the site. Implement use restriction.	Construct a stockpile/dewatering pad, excavate soil to below cleanup level, and dispose at an off-site TSCA landfill. Pump and treat infiltrated groundwater. Backfill and restore the site. Implement use restriction.
Overall Protection: Risk to human health and the environment would remain virtually the same as identified in baseline risk assessment. Risks to human health are within EPA's acceptable range.	Protects human health and the environment. Risk to human health and the environment from contaminated soil significantly and permanently reduced by removal and incineration of contaminants.	Protects human health and the environment. Risk to human health and the environment from contaminated soils significantly and permanently reduced by removal to permitted landfill.
Compliance with ARARs: Not compliance with the TSCA requirement for soil. Location of site does not trigger location-specific ARARs.	Comply with TSCA requirements and cleanup goals. Location of site does not trigger location-specific ARARs. Construction activities would comply with action-specific ARARs.	Comply with the TSCA requirements and cleanup goals. Location of site does not trigger location-specific ARARs. Construction activities would comply with action-specific ARARs.
Long-Term Effectiveness: Not effective in reducing contaminants in soil and groundwater. Site restoration depends on natural degradation and flushing of contaminants.	Effective in eliminating risk by removing source of contamination to the cleanup level. Reduces loading contaminants into groundwater. Removal and incineration are irreversible and are reliable.	Effective in eliminating risk by removing source of contamination to the cleanup level. Reduces migration of contaminants into groundwater. Landfilling is a reversible process but can be reliable if managed properly.

Table 5 (continued)
Summary of Alternatives Evaluation

ALTERNATIVE 1 NO ACTION	ALTERNATIVE 2 EXCAVATION/OFF-SITE INCINERATION	ALTERNATIVE 3 EXCAVATION/OFF-SITE DISPOSAL
<u>Reduction of Toxicity, Mobility, or Volume</u> No reduction in toxicity, mobility, or volume	Significant reduction in toxicity, mobility, and volume of contaminated soil. Some reduction in toxicity and volume in groundwater by reduction of source of contaminants from soil.	Significant reduction of toxicity and volume of contaminated soil on-site. Mobility of contaminants in soil reduced by disposing in a permitted landfill. Some reduction of toxicity and current volume in groundwater by reducing contaminants from soil.
<u>Short-Term Effectiveness</u>: No remedial action implemented. No additional adverse environmental impacts caused by implementation of this alternative.	Some risk to public and workers during implementation. Dust suppression techniques would be used. Workers would be required to wear protective equipment. Disturbed areas would be restored. Site work for implementation would require one month to complete.	Some risk to public and workers during implementation. Dust suppression techniques would be used. Workers would be required to wear protective equipment. Site work for implementation would require one month to complete.
<u>Implementability</u>: No remedial action implemented.	Excavation and incineration technologies are demonstrated and commercially available. Approval for discharge of treated water and approval of soil receiving state agency would be required.	Excavation technologies and disposal are demonstrated and commercially available. Institutional controls can be implemented by NASA. Approval for discharge of treated water and approval of soil receiving state agency would be required.
<u>Cost</u>: Capital: $ 0	Capital: $445,000	Capital: $ 294,000

Table 6
Potential Chemical-Specific ARARs for PCBs in Soil

Media	ARARs	Requirements
Soil	Toxic Substances Control Act (TSCA), 40 CFR, Part 761, Subpart G: PCB Spill Cleanup Policy	1-10 ppm (nonrestricted area) 10-25 ppm (restricted area) 25-50 ppm (outdoor electrical substations)

Table 7
Action-Specific

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
A. COMMON TO ALL ALTERNATIVES			
RCRA Preparedness and Prevention (40 CFR 264.30-264.31)	Relevant and Appropriate	This regulation outlines the requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
RCRA Contingency Plan and Emergency Procedures (40 CFR 254.50-254.56)	Relevant and Appropriate	This regulation outlines the requirements for safety equipment and spill control.	Plans will be developed and implemented during remedial design. Copies of the plans will be kept on-site.
Virginia Solid Waste Management Regulations (9 VAC 20-80-10 to 790) December 1988	Relevant and Appropriate	This regulation establishes criteria for siting, design/construction, operation, groundwater monitoring; and closure of sanitary landfill.	Below 1 ppm, PCBs will be disposed of in a sanitary landfill. Above 50 ppm, PCBs will be managed according to Federal law (TSCA). Between 1 ppm and 50 ppm, PCBs will be disposed of in facilities with double liners and double leachate collection systems.
B. OFF-SITE DISPOSAL			
Waste Transportation Department of Transportation (DOT) Rules for Transportation of Hazardous Materials (49 CFR Parts 171, 172, 177, 179)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	This regulation will be applicable to any company contracted to transport hazardous material from the site.
TSCA-PCB Waste Disposal Records and Reports (40 CFR 761.202, 205, 207 to 211 and 218)	Applicable	This regulation establishes the responsibility of generators, transporters, and disposers of PCB waste in the handling, transportation, and management of the waste. Requires a manifest and recordkeeping.	This regulation will be applicable to any company contacted to transport PCB material from the site.
VHWMR, Hazardous Waste Management Regulations (9 VAC 20-60-10 et seq.), July 1, 1991	Applicable	The Virginia Department of Waste Management has adopted certain DOT regulations governing the transport of hazardous materials.	This regulation will be applicable to any company contracted to transport hazardous material from the site.
Virginia Regulations Governing the Transportation of Hazardous Material (9 VAC 20-110-10 et seq.).	Applicable	These regulations designate the manner and method by which hazardous materials shall be loaded, unloaded, packed, identified, marked, placarded, stored, and transported.	This regulation will be applicable to any company contracted to transport hazardous material from the site.

Table 7 (continued)
Action-Specific ARARs for Remediation

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
B. OFF-SITE DISPOSAL (continued)			
<u>Discharge</u> Clean Water Act (40 CFR 100 et seq.)	Relevant and Appropriate	The National Pollutant Discharge Elimination System (NPDES) permit requirements for point source discharge must be met, including the NPDES Best Management Practice Program. These regulations include, but are not limited to, requirements for compliance with water quality standards, a discharge monitoring system, and records maintenance.	Project will meet NPDES permit requirements for point source discharges.
Virginia Department of Environmental Quality (DEQ) (9 VAC 25-31-10 to 940) Permit Regulation [Virginia Pollutant Discharge Elimination System (VPDES) and Virginia Pollution Abatement (VPA) Permit Program], Adopted March 28-29, 1982	Applicable	The permit governs the discharge of any pollutants, including sewage, industrial wastes, or other wastes, into or adjacent to State waters that may alter the physical, chemical, or biological properties of State waters, except as authorized pursuant to VPDES or VPA permit.	The permittee shall comply with all EPA toxic effluent standards and prohibitions promulgated under the Act within the time provided by the regulations. The permittee shall take all reasonable steps not to adversely affect human health or the environment. Proper operation and maintenance includes effective plant performance; and adequate funding, licensed operator staffing and laboratory process control, including appropriate quality assurance procedures.
<u>Disposal</u> TSCA Chemical Waste Landfill (40 CFR 761.75)	Applicable	Covers the basic design, monitoring, and operations requirements for chemical waste landfill use to dispose PCB wastes.	Any off-site facility accepting PCB waste from the site must be properly permitted. Implementation of the alternative will include consideration of all requirements.
TSCA Disposal Requirements (40 CFR Part 761.60)	Applicable	Requires liquid PCBs at concentrations greater than 500 ppm to be disposed of in an incinerator or by another technology capable of providing equal treatment. Liquid at concentrations above 50 ppm but less than 500 ppm and soils contaminated above 50 ppm may also be disposed of in a chemical waste landfill.	Alternative development will consider disposal requirements.

Table 7 (continued)
Action-Specific ARARs for Remediation

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
Disposal (continued)			
RCRA Land Disposal Restrictions (40 CFR 268, Subpart D)	Applicable	After November 8, 1988, movement of excavated materials to a new location and placement in or on land would trigger land disposal restrictions (for non-CERCLA actions). CERCLA actions became regulated under this requirement on November 8, 1990.	If soil is RCRA waste, the excavated material will be properly disposed or treated as required by the regulations.
Virginia Hazardous waste Management Regulations (9 VAC 20-80-10 et seq.): Hazardous Waste Permit Program. Part X	Applicable	Covers the basic permitting, application, monitoring, and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted. Implementation of the alternative will include consideration of requirements.
Virginia Solid Waste Management Regulations (9 VAC 20-80-10 et seq.)	Applicable	Virginia program to properly manage solid waste treatment, storage, or disposal of any solid wastes containing PCB concentrations between 1.0 ppm and 50.0 ppm.	This regulation may be applied to the disposal of debris off-site or on-site. PCB concentrations between 1.0 ppm and 50.0 ppm are restricted to disposal in sanitary landfills or industrial waste landfills with leachate collection, liners, and appropriate groundwater monitoring as required in Part V of the VSWMR.
C. EXCAVATION AND/OR STABILIZATION			
CAA, National Ambient Air Quality Standards (NAAQS) for Total Suspended Particulate (40 CFR 129.105, 750)	Relevant and Appropriate	This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter. Fugitive dust emissions from site excavation activities must be maintained below 1 g/m^3 (primary standard).	Proper dust suppression methods such as water spray would be specified when implementing excavation and/or solidification/stabilization actions.
40 CFR 264, Subpart L	To be Considered	Provides requirements to design and operate waste piles.	Performance standards would be specified for compliance.
RCRA (40 CFR 264)	Relevant and Appropriate	Requires owner/operator to control wind disposal of particulate matter.	Fugitive dust emissions will be controlled during implementation to maintain concentrtaions below these levels.
CAA, NAAQS 40 CFR 50	Applicable	Provides air quality standards for particulate matter, lead NO_2, SO_2, CO, and volatile organic matter	Same as above.

Table 7 (continued)
Action-Specific ARARs for Remediation

ARARs	Status	Requirement Synopsis	Action to be Taken to Attain ARARs
C. EXCAVATION AND/OR STABILIZATION (continued)			
Virginia Air Pollution Control Law, Code of Virginia Sections (10.1 – 1300 et seq.; Virginia Department of Air Pollution Control, Regulations for the Control and Abatement of Air Pollution (9 VAC 5-10-10)	Applicable	The Virginia Department of Air Pollution Control's air emissions standards must be met with regard to the potential release of toxic pollutants subject to the Department's standards that are released due to remedial activities at a site. Also, any disturbances of surface or underlying soil at a site, or treatment of soil or water must meet the Air Board's standards for particulate emissions to the air.	Proper dust suppression methods and monitoring will be required when implementing excavation and/or solidification actions to prevent particulate matter from becoming airborne.
Virginia Erosion and Sediment Control Law, Code of Virginia Sections 10.1-560 et seq.; and the Virginia Erosion and Sediment Control Handbook (4 VAC 50-30-10 et seq.)	Applicable	Outlines Virginia Erosion and Sediment Control Law Regulations and practices to minimize erosion.	Recommended practices will be followed during excavation. No "land disturbing" activity, as governed by the State statute or a local erosion and sediment control ordinance, may take place until an erosion and sediment control plan for the activity has been submitted and approved by the proper authority.
Virginia Stormwater Management Regulations (1990) (4 VAC 3-20-1 et seq.); Chesapeake Bay Preservation Act, VA Code Ann. § 10.1 – 2100 to 2116; Chesapeake Bay Preservation Area Designation and Management Regulations (9 VAC 10-20-10 to 280)	Applicable	Requires State agencies and local stormwater management programs to maintain post-development runoff characteristics; controls non-point source pollution, establishes acceptable administrative procedures; requires stormawater management programs with erosion and sediment control, and other land development-related programs; and reviews and evaluates local management programs.	Proper management of stormwater programs.

APPENDIX C

GLOSSARY

Glossary of Terms

Aquifer: A saturated, permeable geologic formation or structure that is capable of yielding water in usable quantities under ordinary hydraulic gradients.

Downgradient: The direction tah groundwater flows similar to "downstream" for surface water.

Endpoints of Concern: Conclusions that can be drawn from an investigation.

Fate and Transport: Includes the tendency for a chemical to migrate through the enviroinment and the degree to

Feasibility Study (FS): Report that summarizes the devlopment and analysis of remedial alternatives considered for the cleanup of CERCLA sites.

Groundwater: The supply of fresh water found beneath the Earth's surface in the interstices between soil grains, in fractures, or in porous formations.

Leachate: Water that collects contaminants as it trickles through wastes, pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may resukt in hazardous substances entering surface water, groundwater or soil.

Receptors: Any living organism or environmental medium which is exposed to contaminations from a discharge.

Remedial Action: Implementation of plans and specifications, developed as part of the design, to remediatea site.

Remedial Investigation (RI): The RI is prepared to report the typem extentm and potential for transport of constituents of potential concer at a hazardous watse site, and directs the types of cleanup options that are developed in the FS.

Semi-volatiles: Compounds that do not readily volatilize at standard temoerature and pressure. Compunds that are amenable to analysis by extraction if the sample with an organic solvent.

Target Analyte List: A standard list of metals to analyze in samples.

Volatilization: To evaporate or cause to evaporate.