Health Assessment for

HAMILTON STANDARD

WINDSOR LOCKS, CONNECTICUT

CERCLIS NO. CTD001145341

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Agency for Toxic Substances and Disease Registry
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HEALTH ASSESSMENT
FOR THE
HAMILTON STANDARD RCRA FACILITY CTD001145341
WINDSOR LOCKS, CT

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SUMMARY

The Hamilton Standard Plant is a Resource Conservation and Recovery Act (RCRA) facility and is located in an industrial/ residential area of western Windsor Locks, CT, south of Bradley International Airport and north of the Farmington River. Groundwater and surface water are the primary contaminated media, and volatile organic compounds (VOCs) and metals are the major contaminants. PCB-contaminated soil is present at three locations on-site. During remedial activities, on-site workers could be exposed via ingestion or inhalation of PCB-contaminated dust. Residents south of the facility may continue to use private wells (in the water table aquifer) and/or surface water streams for drinking water, bathing, or irrigation even though they have access to municipal water supplies. Residents east of the facility are the closest public populations to the site and may use private wells for drinking water and other domestic uses. To verify human exposure pathways associated with this water use, a well and surface water use survey should be conducted. Since off-site contaminant migration to the south has been documented and on-site contamination is hydrologically upgradient from these residential areas, the potential is great for continued off-site migration and possible human health impacts (should the water use survey verify exposure). Hamilton Standard is currently upgrading its waste water treatment plant and is working with the Connecticut Department of Environmental Protection (CTDEP) and the Environmental Protection Agency (EPA) Region 1 staff on remedial actions at several solid waste management units (SWMUs) which should mitigate the potential for impact. Monitoring of the water table aquifer, the bedrock aquifer, and sediment and surface water in Seymour Brook for volatile organic compounds (VOCs) and metals is suggested to determine if contamination of these media poses a potential for current or future health effects. Air monitoring for VOCs in three on-site buildings is also suggested to assess potential exposure to workers. Containment measures should also be implemented at the hydrazine transfer sites at the facility.

BACKGROUND

A. SITE DESCRIPTION

This health assessment was performed to assess any current or future impact on public health from groundwater, surface water, and soil contamination at several solid waste management units (SWMUs) within the Hamilton Standard RCRA facility (Appendices A and B). This health assessment was requested in a memorandum (April 8, 1987) from the EPA Region 1 Land Disposal Permit Assistance Section to the Agency for Toxic Substances and Disease Registry (ATSDR). This memorandum cited known on-site and off-site contamination at the Hamilton Standard

facility, exposure routes of concern, and the proximity of the public to the facility. This memorandum specifically mentioned soil contamination from polychlorinated biphenyls (PCBs) and contamination of the water table aquifer with volatile organic compounds (VOCs) and metals.

The Hamilton Standard facility occupies 300 acres of gently rolling, glaciated terrain in northern Connecticut. It is bounded by Rainbow Brook and Watts Pond to the west and by Seymour Hollow to the east. The northern and southern boundaries are defined by Hamilton Road and Highway 20.

Hamilton Standard, an employer of approximately 8,000 people, has been in operation since the early 1950s and is engaged in the development, production, and sale of aerospace equipment. Specific hazardous wastes at this site include: waste water treatment sludges from electroplating; chromic acids and alkalies; cyanides; waste oils; hydrazine; and solvents.

Hamilton Standard filed a Notification of Hazardous Waste Activity with the EPA Region 1 on August 18, 1980. Hamilton Standard, currently, maintains an interim status for waste storage at several locations, for waste oil burning in a thermal treatment unit, and for transport of waste from nearby satellite facilities. The facility has a National Pollutant Discharge Elimination System (NPDES) permit (No. CT0000582) which allows discharges from three outfall points to the Farmington River and Rainbow Brook and has applied for a fourth NPDES point to Rainbow Brook. Hamilton Standard currently has fourteen air emission sources registered with the state.

On May 21, 1980, the Windsor Health Department received complaints of a peculiar odor and taste in well water from residents along Rainbow Road, just south of the Hamilton Standard property. During June and July, water samples were collected from Rainbow Road residences with private wells. Fourteen wells serving thirteen residences were found to be contaminated with VOCs. The residents were immediately given an alternate water supply from a nearby fire hydrant, and shower facilities at a community park were made available. In September, a Metropolitan District Commission (MDC) water line was extended along Rainbow Road making the public water supply available to these residents.

In July of that year, an inspection of Hamilton Standard was made by representatives of the Hazardous Waste Unit and the Water Compliance Unit of the CTDEP and officials from Hamilton Standard's Plant Engineering Section. Plans were made to sample groundwater at the southern boundary of the facility and surface water near the inlet and outlet of Watts Pond (SWMU 39). Analysis of these samples revealed VOC contamination. Soil samples taken from Hamilton Standard's Original Fire Training Area (SWMU-25) also revealed concentrations of

VOCs. In later correspondence to the Windsor Health Department, the CTDEP stated that "the Hamilton Standard site appears to be a probable source of some of the contamination present in the Rainbow Road area."

In response to abatement orders from the CTDEP and the EPA, Hamilton Standard retained consultants and contractors to: excavate waste and contaminated soil; install a groundwater monitoring well network;characterize hydrogeologic conditions at the facility; and collect and analyze groundwater, soil, and surface water samples to assess the nature and extent of contamination. Details of these activities at specific SWMUs are given in Appendix C.

On July 7, 1985, contaminated groundwater was intercepted during installation of a sewer line along Rainbow Road. The water had a strong "petroleum-like" smell and analyses revealed VOC contamination. Residents along Rainbow Road also complained of strong odors emanating from Rainbow Brook from time to time. The Windsor Health Department confirmed these reports and traced the odor along Rainbow Brook to the point where it flowed from Hamilton Standard's property. Further investigation by the health department was not conducted because the department does not have legal authority to investigate sources of pollution outside of the Town of Windsor.

In May 1986, Hamilton Standard contacted Rainbow Road residents with an offer to pay for service connection to the MDC water system or to reimburse residents who had previously paid for MDC connection. Hamilton Standard stressed that this offer of payment or reimbursement was not an admission of responsibility and was contingent upon residents having their contaminated wells sealed in compliance with the CTDEP's Contaminated Private Well Abandonment Policy. As of July 7, 1988, eight of fifteen home owners had had their contaminated wells sealed. While it is known that the remaining seven home owners have service connections to the MDC water line, it is not known if they continue to use private well water for drinking or other household purposes.

A Consent Order (No. 4402, August 8, 1986) negotiated with the Region I EPA requires Hamilton Standard to investigate on-site contamination and take any necessary remedial actions to minimize or eliminate contamination. Hamilton Standard was also instructed to monitor groundwater wells at three Rainbow Road residences. The Consent Order also describes actions to be taken by Hamilton Standard should analyses reveal unacceptable contaminant levels in the monitored wells.

A draft RCRA Preliminary Assessment (PA) was issued in June 1986. This PA identified several SWMUs at the facility, ten of which have had known contaminant releases. SWMUs, contaminant releases, and remedial actions which are pertinent to the evaluation of the health threat from the facility are described in Appendix C. A report,

"Revised Plans for Remedial Investigations, Feasibility Studies, and Remedial Measures", was issued February 23, 1988. This report includes details on remedial actions proposed at several of the SWMUs. Pertinent information from this report is also included in Appendix C.

B. SITE VISIT

A site visit was conducted by ATSDR, EPA Region 1 personnel, and the site assessment team from the Office of Risk Analysis at Oak Ridge National Laboratory on June 23, 1988. The Hamilton Standard facility consists of two large manufacturing buildings and various treatment and storage areas. During the site visit, areas of special interest included storage, treatment, and inactive disposal sites; three NPDES discharge points; two houses located east of the facility; and the Rainbow Road residential area. A security perimeter fence extends around the facility, and interior fences and locked gates prevent unauthorized personnel from entering the B2 Landfill, the Back Forty Landfills, and the Fire Training Areas.

The facility utilizes hydrazine, a strong reducing agent, as a propellant in the testing of engines. Waste hydrazine is collected at a hydrazine storage tank in the northwestern part of the facility and is transferred by tanker-trucks to the Industrial Waste Treatment Plant (IWTP) prior to treatment and discharge. The sites where hydrazine transfer occurs are not bermed or contained. Should spills or leaks occur during transfer operations, the potential for immediate exposure and off-site contaminant migration via natural drainage is great.

Two residential areas are located near the facility. The largest is located approximately one-half mile south of Hamilton Standard, south of Highway 20 on Rainbow Road. Most homes in the Rainbow Road community have small yards and, in some cases, garden plots. The second residential area consists of two homes located to the east of the facility less than 1000 feet from the plant's east parking lot.

An inactive sewage disposal plant is near the northwest corner of the Hamilton Standard property, and an active sewage disposal plant lies to the east of the facility, across Seymour Hollow. The active plant discharges sewage to the Farmington River through a pipe which lies along Seymour Hollow. Hamilton Standard's waste water treatment effluent is also discharged to this pipe subsequent to passing through NPDES point 001.

ENVIRONMENTAL CONTAMINATION AND PHYSICAL HAZARDS

A. ON-SITE CONTAMINATION

Current data indicate that groundwater in the water table aquifer, surface water, and soil are the primary contaminated media at the Hamilton Standard facility. VOCs and metals are the main contaminants present in the surface water and groundwater; soil contamination is primarily from PCBs. Appendix D lists the concentrations for the contaminants of concern in these media.

The area exhibiting the highest concentrations of VOC contamination in groundwater is in the vicinity of monitoring well MW-102, located between Buildings 1 and 2, near a drop off, staging, and storage area for drum deliveries (SWMU 40). Other areas of groundwater contamination are located at the southern end of the facility downgradient of the B2 Landfill (SWMU-24), the Back Forty Landfill (SWMU-19), and the Waste Pile (SWMU-4). The groundwater contaminant plume downgradient of these sites extends beyond Rainbow Brook, the southern boundary of the Hamilton Standard facility.

In 1983, high concentrations of chromium were found in on-site groundwater south of Building 2 and southwest of the B2 Landfill. Relatively high concentrations of chromium near the southern boundary of the facility indicated the possibility of off-site contaminant migration. Current data (1987-1988) indicate that chromium contamination on-site is diminishing.

Contaminant concentrations in surface water were recently measured at four locations along Rainbow Brook and one of its tributaries. VOCs were detected at levels exceeding regulatory standards in the intermittent tributary located in the drainage basin of the B2 Landfill (SWMU-24).

Despite excavation of contaminated soil in the past, residual PCB-contaminated soil remained in excess of EPA clean-up standards at three locations at the Hamilton Standard facility, SWMUs 11, 25, and 38. The long residence time of PCBs in soil (Arthur D. Little, Inc., 1987) suggests that PCBs at these sites are still present. Residual VOC contamination from spills and leaks from a waste oil tank also remains in the soil at SWMU 11.

Twenty-eight of the thirty-seven SWMUs identified in a Draft RCRA PA (June 1986) and listed in Appendix B are designated as potential sources of contaminant release to the air. Only five SWMUs have had known releases to the air, and only one of these SWMUs remains in use (the Thermal Treatment Unit). According to the Draft RCRA Preliminary Assessment prepared for the Region II EPA, this unit has had only trace releases of contaminants from the burning of solvents and waste oils.

B. OFF-SITE CONTAMINATION

Contaminants found on-site are also present in off-site groundwater and surface water, usually at lower levels. Appendix E lists the off-site concentrations for the contaminants of concern in these media.

The most recent quarterly monitoring data (1987-1988) of three private wells south of the Hamilton Standard facility reveal trace amounts of VOCs and chromium in the water table aquifer. However, these wells are on the fringe of a VOC plume which was identified in 1980, and the 1987-1988 data alone may not be representative of the full extent of off-site groundwater contamination. Thus, to provide a more realistic off-site contamination assessment, data from the 1980 sampling event at the residences along Rainbow Road are included in Appendix E; Figure 2 in Appendix A depicts the extent of the trichloroethylene plume in 1980.

Contamination in off-site surface water has been found in Rainbow Brook south of Hamilton Standard beyond Route 20 and in Seymour Brook to the east of the facility. Of the contaminants found in Rainbow Brook, only trichloroethylene was found to exceed EPA maximum contaminant levels for drinking water. Discharges through NPDES point 001 into Seymour Hollow exceeded permit limitations monthly for the past year for total chromium and once (2/88) for hexavalent chromium.

C. PHYSICAL HAZARDS

The very steep sloping edge of the B2 Landfill (SWMU-24) may present a physical hazard at the Hamilton Standard facility. A fall down this hill could result in personal injury to workers. A locked gate restricts entry into the area where the landfill is located, but the interior landfill fence is down along one section, allowing easy entry.

DEMOGRAPHICS OF POPULATIONS NEAR THE SITE

There are two residential areas in the vicinity of Hamilton Standard. The larger is located approximately one-half mile from the facility on Rainbow Road in the city of Windsor. This area consists of houses with small yards and backyard gardens. Approximately twenty-one homes in this area were identified as having private wells. Fourteen wells were contaminated, and eight wells have been certified as sealed by the Windsor Department of Health. All homes in this area have access to the public water system.

The smaller residential area, the closest population to the facility, is located less than 1000 feet from the east parking lot of the plant in the city of Windsor Locks. These homes do not have access to the municipal water supply and may utilize private wells.

No large-scale farming operations exist in the area; however, a residence to the southwest of the facility uses groundwater for drinking water purposes and to water a herd of sheep. This residence is on the perimeter of the VOC plume, and the well is monitored by Hamilton Standard to assess westward movement of the contaminant plume.

EVALUATION

A. SITE CHARACTERIZATION (DATA NEEDS AND EVALUATION)

1. Environmental Media

Data are lacking for the following potentially contaminated areas at Hamilton Standard site: Seymour Brook surface water and sediment, Waste Pile sediment (SWMU-4), MW-102 soil (SWMU 40), bedrock aquifer groundwater, water table aquifer groundwater at two nearby residences, and garden vegetables irrigated with potentially contaminated water.

Because of known accidental discharges of untreated waste from the IWTP to Seymour Brook and other discharges to NPDES point 001, which have exceeded permit limitations, surface water and sediment samples from Seymour Brook are needed to assess the possibility of exposure to people downstream of the site.

No data are available for contaminant concentrations in Waste Pile sediments (SWMU-4), which consists of spoils dredged from Watts Pond. Analyses of these sediments are needed to determine if contamination exists.

High VOC levels in the groundwater collected from MW-102 indicate a need for environmental monitoring to allow source determination and provide contaminant characterization.

While it is unlikely that contamination has migrated from the water table aquifer to the bedrock aquifer, insufficient data exist to verify this assumption and, therefore, this environmental pathway cannot be adequately assessed.

The closest populations to the Hamilton Standard facility are two residences located just east of the plant's eastern parking lot. These homes do not have access to the municipal water supply and may utilize private wells. Analytical data from these wells and from private wells along Rainbow Road which may remain in use are needed to determine if contamination exists.

One household has been observed using surface water from Rainbow Brook to irrigate a backyard garden. Without stream monitoring data to characterize the levels of VOCs and metals in the stream, this environmental pathway cannot be assessed.

2. Quality Control and Quality Assurance

The accuracy of the conclusions presented in this health assessment is dependent on the availability and reliability of the data provided. Descriptions of protocols in association with these data indicate that standard EPA or CTDEP sampling protocols were used in sampling the various media at Hamilton Standard, but little analytical Quality Assurance/Quality Control (QA/QC) documentation has been provided. Because it is not possible to determine if adequate QA/QC procedures were followed, it is assumed for the purposes of this health assessment that the data provided for review are of acceptable quality.

B. ENVIRONMENTAL PATHWAYS

Several environmental pathways have been identified for the Hamilton Standard site: the movement of contaminants via groundwater and volatilization from contaminated groundwater; surface water flow overland and in natural drainage channels; and the transfer or transformation of contaminants from the soil by volatilization, surface runoff, fugitive dust emissions, and leachate production.

Groundwater is distributed between two aquifers, a shallow water table aquifer and a deep bedrock aquifer. The two aquifers are separated by an aquitard composed of low permeability glaciolacustrine and till deposits.

The water table aquifer is approximately 13 to 56 feet thick and ranges between 15 and 60 feet below the ground surface. Flow in this aquifer is southerly with localized variations. Flow rate ranges from 0.01 to 0.1 feet/day depending on the permeability of the soil and the variation in hydraulic gradient throughout the site. A prominent subsurface valley exists in the till and glaciolacustrine deposits south of Building 2 and extends beyond the southern boundary of the Hamilton Standard facility. The water table aquifer is thickest in the subsurface valley, and groundwater flow converges in the valley, causing an increased flow along its trend. This characteristic of the water table aquifer suggests the possibility of facilitation of off-site migration of contaminated groundwater.

The bedrock aquifer has not been thoroughly studied at Hamilton Standard because of the assumption that little or no communication

occurs between the two aquifers because of the relatively impermeable aquitard. However, the possibility of contaminant movement to the bedrock aquifer cannot be ruled out. Besides natural leakage, one potential migration route is through abandoned uncased wells in the southern part of the Hamilton Standard property, which may act as conduits between the aquifers.

Surface water at Hamilton Standard consists of Rainbow Brook, its tributaries, and Seymour Brook. Rainbow Brook is located at the western edge of the facility where it is dammed to form Watts Pond, a current source and discharge point for water used in the manufacturing processes at Hamilton Standard. A tributary of Rainbow Brook drains the B2 Landfill (SWMU-24). A smaller tributary drains the area around Building 3 near the southern boundary of Hamilton Standard property. Seymour Brook, an off-site stream, provides drainage from the eastern edge of Hamilton Standard. All of these surface water bodies flow to the south and enter the Farmington River located approximately 2000 feet south of Hamilton Standard.

The primary areas of known soil contamination are the Original Fire Training Area (SWMU-25), the Hot Fuel Lab Waste Oil System (SMWU 11), and the "Graveyard" (SWMU 38). PCB contamination is present in the surface and subsurface soils at these locations. PCBs are highly immobile in the soil/groundwater system because of rapid and strong sorption; however, the presence of organic solvents may increase their mobility. The most recent groundwater data from these locations do not show PCBs at significant levels. This may be misleading, as earlier analyses of unfiltered samples revealed higher levels of PCBs, suggesting that PCB-contaminated sediments may be mobile in the groundwater system. Volatilization of PCBs is expected to be slow. This fact, combined with the relative isolation of these areas from routine facility operations, suggests that volatilization of PCBs will be of little concern. The potential for migration of contaminants from the "Graveyard" is decreased due to the cover placed on the area subsequent to soil excavation. Should soil in the B2 Landfill (SWMU-25) and the MW-102 area be contaminated, the potential exists for contaminant transport via leachate production, surface water runoff, or fugitive dust emissions.

Contamination of sediments in Seymour Hollow and the Waste Pile (SWMU 4) is possible due to known contaminant releases documented in Appendix C. Contaminated sediments transported by surface water runoff or waste constituents leached from the sediments could be a potential source of surface water and groundwater contamination.

Contamination of air in the vicinity of the Thermal Treatment Plant is possible, as indicated by the known contaminant releases documented in Appendix C. The location of Buildings 1, 2, and 2A over areas of known soil and groundwater contamination could result in an accumulation of VOC contaminants inside these buildings as a result of volatilization.

Although there are no data available for contaminant levels in the food chain, the known contamination in Rainbow Brook, coupled with the use of the brook to irrigate a garden, indicates that the food chain may be a possible environmental pathway.

C. HUMAN EXPOSURE PATHWAYS

The potential human exposure pathways at Hamilton Standard are discussed below in relation to contaminated media at the site.

Currently, the only possibility for on-site exposure to contaminated groundwater is through the inadvertent ingestion, dermal absorption, or the inhalation of volatilized contaminants from groundwater that may occur during sampling. However, because of the infrequent nature of the sampling program, exposure will be for short durations and at low levels. Thus, protective measures as defined by OSHA should be adequate for protection of human health in this situation.

As stated earlier in the Site Description Section, several wells along Rainbow Road which were located within a VOC-contaminated groundwater plume have not been certified sealed and may remain in use (Figure A.2). There is a definite possibility of exposure to off-site contaminated groundwater through ingestion of water from private wells located on Rainbow Road and Stevens Mill Road south of Hamilton Standard and at residences just east of the facility. Although the detected levels of off-site groundwater contamination are low (Appendix E), these levels were measured in wells located on the edge of the contaminant plume or in the bedrock aquifer (Figure A.2). Therefore, contamination in these wells may not be indicative of the potential for exposure of Rainbow Road residents who have wells within the contaminant plume. Ingestion, dermal absorption, and inhalation of water or water vapor during showers, baths, and other domestic uses may be additional exposure pathways at these residences.

A remote possibility exists for exposure to on-site surface water. Although no workers are exposed to surface water on a regular basis, there is a possibility of inadvertent ingestion, inhalation, or dermal absorption during sampling activities or routine maintenance work at the facility. As for groundwater sampling, protective measures as defined by OSHA should be adequate for protection of human health in this situation.

Off-site surface water from Rainbow Brook is used by at least one household for garden irrigation. Contamination may adhere to the peel or may accumulate in the vegetable presenting the possibility for exposure by ingestion. Incidental ingestion, dermal absorption, and inhalation of water or water vapor during other uses of contaminated

surface water may pose additional exposure pathways to residents along Rainbow Brook or Seymour Hollow.

Soil at the Original Fire Training Area (SWMU 25), the "Graveyard" (SWMU 38), and the Hot Fuel Lab Waste Oil System (SWMU 11) is contaminated with PCBs (VOC contamination also exists at SWMU 11). The immobile nature of PCBs in the soil retards the transfer of contamination to surface water or groundwater; however, a potential route of exposure to PCB-contaminated soil exists through the inhalation of dusts that may be liberated during future remedial actions at these sites.

Transport of contaminants from the B2 Landfill (SWMU 24) or the MW-102 area could affect the area's surface water and groundwater. However, current plans to cap the B2 Landfill should mitigate contaminant migration from this SWMU. Fugitive dust emissions during remedial actions at these locations could pose inhalation risks to on-site workers.

Volatilization of VOCs from the groundwater and soil in the vicinity of Buildings 1, 2, and 2A could result in contaminant accumulation inside these buildings and could potentially pose inhalation risks to on-site workers.

PUBLIC HEALTH IMPLICATIONS

Improper waste handling and waste disposal at the Hamilton Standard facility have resulted in on-site soil contamination and groundwater and surface water contamination both on- and off-site. Levels of contamination in these media may pose potential health concerns to on-site personnel and remedial workers and nearby off-site populations. The exposure pathways and contaminants of concern are summarized below for each of the contaminated media.

Because residents near the site may continue to use unsealed private wells, the presence of off-site contaminated groundwater and the continued off-site migration of on-site contaminants may present a potential threat to human health. Known past exposure to contaminated groundwater intensifies the concern. Exposure to contaminants in groundwater and surface water may occur through ingestion, dermal absorption, and inhalation of steams and vapors. Contaminants of concern identified in groundwater and/or surface water are: carbon tetrachloride, hexavalent chromium and total chromium, 1,1-dichloroethylene, 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene.

Exposure to soil contaminants may occur through ingestion, dermal absorption, and inhalation, especially during remedial activities. Soil contaminants of concern are PCBs and VOCs.

Health effects associated with the contaminants of concern are discussed below relative to possible exposure from all of the contaminated media. Because chronic exposure to the chemicals identified at Hamilton Standard principally affects the liver and kidney, individuals suffering from alcoholism or with chronic liver or kidney disease maybe at greater risk.

ON-SITE CONTAMINATION

Groundwater and surface water

The chemicals of concern and concentration ranges in on-site groundwater and surface water are tabulated in Appendix D. Although on-site groundwaters and surface waters are not presently used as drinking water supplies, inadvertent ingestion of contaminated waters could occur during handling of process water or during sampling activities. Many of the contaminants of concern exceed primary drinking water standard MCLs (see Appendix D); several exceed the EPA Office of Drinking Water draft health advisories. Health advisory levels which are exceeded in on-site groundwater (health advisory values in ug/l) are:

1-day: tetrachloroethylene (2,000)

10-day: carbon tetrachloride (160) and tetrachloroethylene (2,000)

longer term (child): carbon tetrachloride (71) and tetrachloroethylene (1,400)

longer term (adult): carbon tetrachloride (250) and tetrachloroethylene (5,000)

lifetime: hexavalent chromium (120), total chromium (120), 1,1-dichloroethylene (7), 1,1,1-trichloroethane (200)

Only tetrachloroethylene in on-site surface water exceeds the 1-day, 10-day, and longer term (child) proposed health advisory levels.

Because many of the contaminants of concern are volatile in aqueous systems and are found in high concentrations in some areas of the Hamilton Standard facility, inhalation of volatilized chemicals may be a more significant exposure route than ingestion. Further, contact with process waters or with surface and groundwaters (during sampling activities) presents the possibility for exposure via dermal absorption. In addition, exposure through multiple pathways may also have additive effects increasing the potential for adverse health impacts.

Health effects associated with exposure to the chemicals of concern in on-site groundwater and surface water are given below. Due to the infrequency and short duration of on-site exposure via ingestion or dermal absorption, health effects attributable to acute exposure at on-site concentrations will be emphasized. Protective measures as defined by OSHA should be adequate for protection of human health and should be implemented when exposure to on-site groundwater or surface water may occur.

The VOC and hexavalent chromium contaminants found in groundwater and surface water may cause eye and skin irritation as a result of short-term exposure. Without adequate protection for personnel, repeated exposure to these contaminants may result in contact dermatitis.

These organic contaminants are very volatile in aqueous systems, and thus inhalation may be a significant route of exposure, especially in areas which exhibit the highest concentration of VOCs in the groundwater and soil. These on-site areas include SWMU 11, SWMU 38, and the area around MW-102. VOC accumulation, and therefore inhalation exposure, may also be significant inside buildings 1, 2, and 2A (which are located near or over these VOC-contaminated areas), since attenuation or dilution of contaminants may be inhibited. In addition, the VOCs found on-site are not strongly sorbed by the sandy soil which underlies the site, further augmenting the potential for volatilization.

Data on inhalation exposure at this site are not available to evaluate the potential health implications of this pathway. However, inhalation of VOC vapors at low concentrations are known to cause headaches and dizziness, and inhalation of chromium may also cause ulcerations of the nasal septa. At higher VOC concentrations, short-term exposure may cause central nervous system depression; recovery usually takes place upon discontinuation of the exposure.

Soil

Soil contaminants and concentration ranges which have been identified in on-site surface and subsurface soils are tabulated in Appendix D. PCB contamination in some on-site soils exceeds 50 ppm, the EPA clean-up standard (a policy directive under TSCA). PCB contamination is not pervasive in the soil at the facility and exists in only three localized areas one of which is covered by asphalt or buildings. Insufficient data exist to determine the types of VOCs in on-site soils at these locations.

Hamilton Standard personnel and remedial workers may become exposed to contaminants in surface and subsurface soils via ingestion, dermal absorption, and inhalation of vapors and fugitive dusts. Although

site-specific data are not available, inhalation is an exposure pathway of concern during remediation since soil-disturbing activities may lead to a substantial increase in quantities of PCBs and VOCs in the ambient air. Protective clothing should be worn during remediation activities which may expose workers to subsurface soils and gases.

In occupational settings where PCB contamination exists, eye, nose, and throat irritations are common. Acute exposure, which is most likely to occur in this situation, can result in nausea and fatigue. Adverse health impacts associated with inhalation of VOCs are the same as those associated with exposure to on-site groundwater and surface water (previously discussed).

OFF-SITE CONTAMINATION

Off-site groundwater and surface water

Off-site contaminant concentrations are tabulated in Appendix E. While off-site levels are much lower than those measured on-site, there is the possibility of continued contaminant migration off-site. Further, although some of the contaminants addressed are found at low levels off-site, many of these chemicals have similar mechanisms of action; therefore, exposure to multiple contaminants may have synergistic or additive effects, increasing the potential for adverse health effects. Multiple exposure pathways may also have additive effects, thereby increasing the potential for unacceptable risk. Since longer-term exposure is more likely in off-site situations, symptoms associated with chronic exposures will be emphasized.

The off-site groundwater concentrations given in Appendix E represent contaminant levels at the front of a contaminant plume defined in 1980 (Figure A.2). Therefore, even though these concentrations do not exceed MCLs or draft health advisory levels, they should not be considered conservative unless the proposed water use survey indicates that there is no exposure to groundwater from the more contaminated part of the plume. Surface water in Rainbow Brook contained trichloroethylene in excess of the established MCL, but had no contaminant concentrations which exceeded ODW health advisory levels.

Of the contaminants of concern, only carbon tetrachloride and chromium have been classified as potential human carcinogens. Should the proposed water well survey verify that exposure to contaminated groundwater is occurring, this exposure could result in excess cancer risks to receptors. Long-term exposure to chromium is currently unlikely since chromium contamination is localized off-site in Seymour Brook surface water. This contamination is a result of discharges through Hamilton Standard's NPDES point 001 which exceeded the MCL set for hexavalent chromium, and the ODW draft lifetime health advisory of

7 ug/l. Short-term dermal contact can result in skin irritation, and inhalation of chromium may cause nasal lesions.

Systemic effects associated with chronic exposure to off-site contaminant concentrations may include damage to the liver, kidneys, and lungs and may affect the central nervous system and the gastrointestinal tract. Several factors including ethanol ingestion, drug use, and starvation can potentiate the toxicity of these contaminants. Therefore, people who drink alcohol or who diet may be at higher risk. Prolonged dermal contact with off-site contamination may cause skin irritation and dermatitis; short-term inhalation or ingestion may cause headache, dizziness, and drowsiness. Exposure through multiple pathways or exposure to more than one contaminant in any pathway may have additive effects increasing the potential for adverse health impacts.

PHYSICAL HAZARDS

A precipitous slope along the southern boundary of the B2 Landfill is a potential hazard to Hamilton Standard personnel who have access to the landfill area. The construction of the RCRA cap on the landfill will necessitate the regrading of the landfill surface in order to place the clay cover material; this may eliminate this hazard.

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

Based on information reviewed, ATSDR has concluded that this site is of potential health concern because of the potential risk to human health resulting from possible exposure to hazardous substances at concentrations that may result in adverse health effects. As noted in the Human Exposure Pathways Section above, human exposure to VOCs may be occurring (and occurred in the past) via ingestion of contaminated groundwater from the water table aquifer below the Hamilton Standard facility and its environs.

The potential for groundwater contaminant migration from Hamilton Standard to areas of private well use and the lack of groundwater remediation present a possibility that contamination of private wells, south and east of the facility, will continue in the future.

A potential exists for exposure of remedial workers at Hamilton Standard to PCB-contaminated soil at the Original Fire Training Area (SWMU-25) and the Hot Fuels Lab (SWMU-11) and to metals-contaminated soil at the B-2 Landfill (SWMU-24); however, health and safety procedures and personal protective measures implemented in these areas will aid in reducing the potential for exposure.

The B2 Landfill (SWMU-24) presents a potential physical hazard from a fall down the steep slope; however, planned remediation may eliminate this hazard in the near future.

B. RECOMMENDATIONS

1. A water well use survey should be conducted along Rainbow Road and Stevens Mill Road and at the two residences east of the Hamilton Standard Facility. This survey should include all residences shown on Figure A.2, including the residences along Stevens Mill Road and the two residences east of the facility.

2. Monitoring of the water table aquifer at off-site locations should be expanded to include those residences immediately east of the facility (metals and VOCs) and along Rainbow Road and Stevens Mill Road (VOCs) where private wells remain in use for potable/domestic or irrigation purposes. The residences east of the facility should be provided with an alternate water supply if contamination is found at levels which pose health risks.

3. Monitoring of the bedrock aquifer for VOC contamination should be conducted in the southern part of the Hamilton Standard property since groundwater flow is predominately to the south and old production wells in this area could act as conduits for contaminant migration to the bedrock aquifer.

4. Monitoring of Seymour Hollow surface water and sampling of sediment for metals and VOCs should be conducted downstream of the facility (i.e., where Seymour Brook flows under Highway 20) to determine if these media are contaminated.

5. Provisions should be made for the containment of possible hydrazine spills should spills occur in the future at the transfer stations located near the hydrazine storage tank and the industrial waste treatment plant (IWTP).

6. In accordance with CERCLA as amended, the Hamilton Standard site has been evaluated for appropriate follow-up with respect to health effects studies. Although there are indications that human exposure to off-site contaminants may be occurring (and occurred in the past), this site is not being considered for follow-up health studies at this time because exposure of nearby public populations to hazardous substances has not been verified.

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REFERENCES

Arthur D. Little, Inc. 1987. The Installation Restoration Program Toxicology Guide Vol. 2., Arthur D. Little, Inc., Cambridge, MA.

Dames and Moore. 1988. Revised Plans for Remedial Investigations, Feasibility Studies and Remedial Measures, United Technologies Corporation, Hamilton Standard Division, Windsor Locks, CT.

Dames and Moore. 1986. Conceptual Remedial Investigation/Remedial Measures Plans, United Technologies Corporation, Hamilton Standard, Windsor Locks, CT.

Dames and Moore. 1985. Consulting Services for Remedial Action Plan, United Technologies Corporation, Hamilton Standard Division, Windsor Locks, CT.

Dames and Moore. 1985. Environmental Assessment, Closed Landfill South of Building No. 2, Hamilton Standard, Windsor Locks, CT.

Dames and Moore. 1984. Report, Chromium Contamination, Phase IV Hydrogeological Study, Hamilton Standard, Windsor Locks, CT.

EPA. 1987. Site Analysis, United Technologies Corporation, Hamilton Standard Division, Windsor Locks, CT, Environmental Monitoring Systems Laboratory, Las Vegas, NV.

EPA. 1984. Health Assessment Document for Chromium Final Report. Environmental Criteria and Assessment Office, Research Triangle Park, NC, EPA-600/8-83-014F.

EPA. 1984. Health Effects Assessment for 1,1,1-Trichloroethane. Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH.

EPA. 1984. Health Assessment Document for Carbon Tetrachloride Final Report. Environmental Criteria and Assessment Office, Cincinnati, OH, EPA-600/8-82-001F.

EPA. 1984. Health Assessment Document for 1,1,1-Trichloroethane (Methyl Chloroform) Final Report. Office of Health and Environmental Assessment, Washington, D.C., EPA-600/8-82-003F.

Fan, A.M. and I. Harding-Barlow. 1987. Chromium. In, Advances in Modern Environmental Toxicology, Volume XI Genotoxic and Carcinogenic Metals: Environmental and Occupational Occurrence and Exposure. Princeton Scientific Publishing Co., Inc., pp. 87-143.

Geraghty and Miller, Inc. 1982. Investigation of Groundwater Along the Northern Boundary of the Hamilton Standard Facility, Windsor Locks, CT.

Geraghty and Miller, Inc. 1982. Investigation of Groundwater Conditions at the Hamilton Standard Facility, Windsor Locks, CT.

Geraghty and Miller, Inc. 1981. Investigation of Groundwater Conditions at the Hamilton Standard Facility, Windsor Locks, CT.

Lappenbusch, William L. 1988. Contaminated Waste Sites, Property and Your Health. Lappenbusch Environmental Health , Inc., Alexandria, VA.

Naughton, William, J. 1986. Draft RCRA Preliminary Assessment, United Technologies Corporation, Hamilton Standard Division, Windsor Locks, CT, GCA Corporation, GCA Technology Division Inc., Bedford, MA.

NIOSH. 1977. Occupational Exposure to Polychlorinated Biphenyls (PCBs). U.S. Department of Health, Education, and Welfare. Public Health Service. National Institute for Occupational Safety and Health, Washington, D.C.

NRC. 1978. Chloroform, Carbon Tetrachloride, and Other Halomethanes: An Environmental Assessment. Environmental Studies Board, Commission on Natural Resources, National Research Council. National Academy of Sciences, Washington, D.C., p. 294.

Sax, I.R. and R.J. Lewis, Sr. 1987. Hazardous Chemicals Desk Reference, Van Nostrand Reinhold Company, NY.

Sittig, Marshall. 1981. Handbook of Toxic and Hazardous Chemicals. Noyes Publications, NJ.

Stewart, R.D., Gay, H.H., Schaffer, A.W., Erley, D.S., and V.K. Rowe. 1969. Arch. Environ. Health, Vol. 19. pp. 467-472.

APPENDICES

Appendix A: Site maps

Appendix B: Solid waste management units at Hamilton Standard

Appendix C: Solid waste management unit descriptions

Appendix D: On-site contamination at Hamilton Standard

Appendix E: Off-site contamination near Hamilton Standard

ORNL-DWG 88-12341

Figure A.1

HAMILTON STANDARD SITE MAP WITH SOLID WASTE MANAGEMENT UNITS INDICATED BY NUMBER

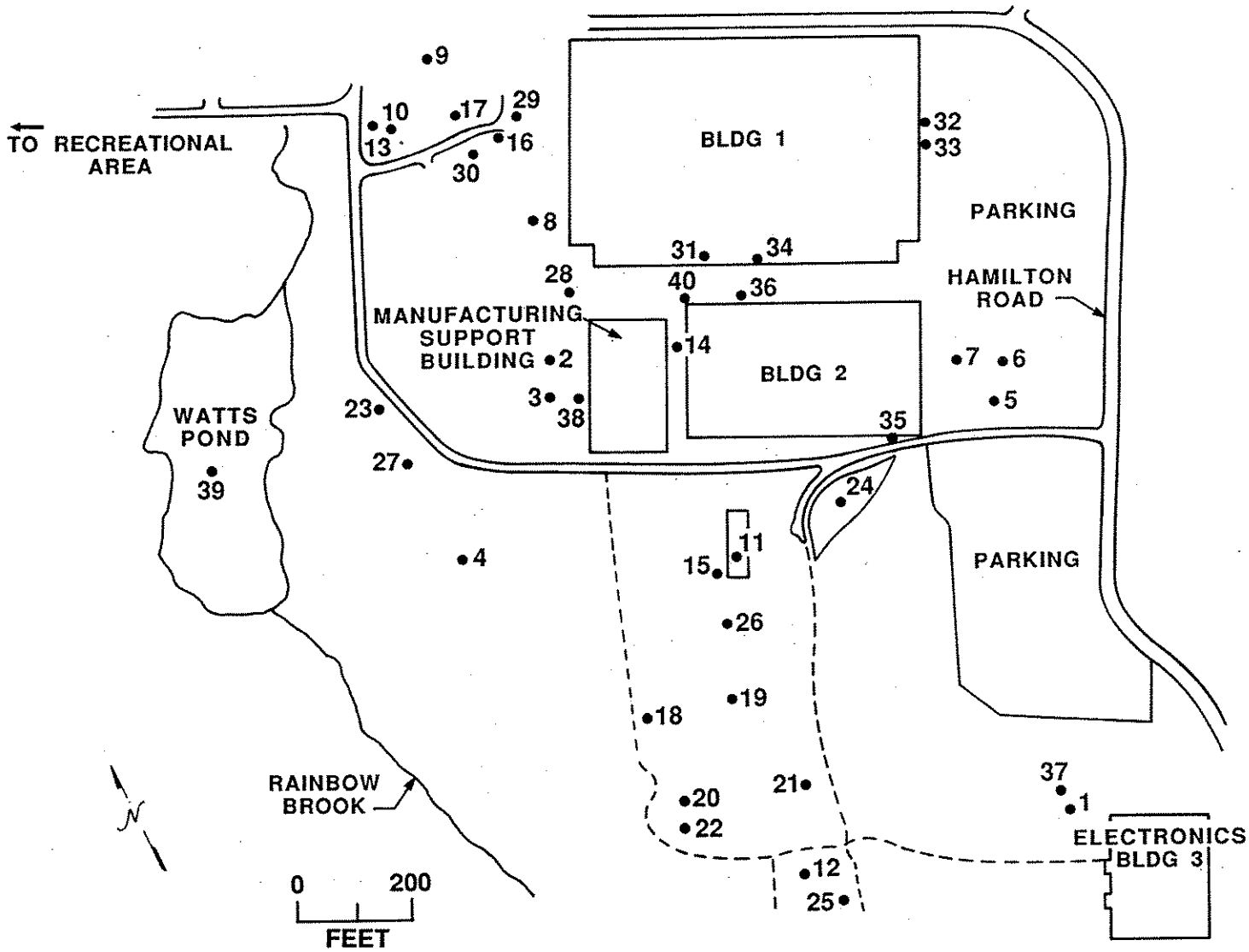

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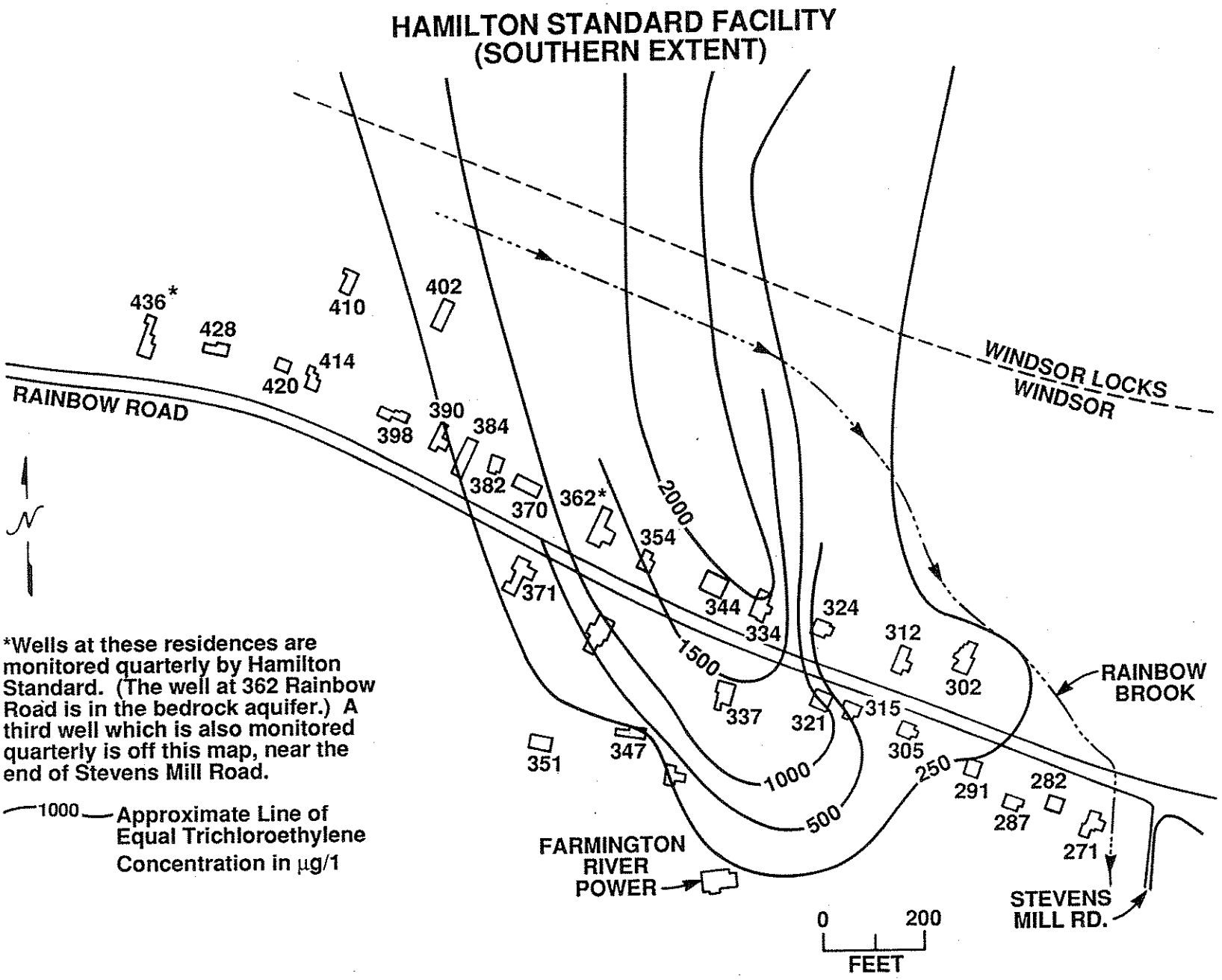
Figure A.2



Appendix B: Solid waste management units at Hamilton Standard

A Draft RCRA Preliminary Assessment (PA) (June 1986) identified 37 SWMUs at the Hamilton Standard site. The SWMU numbers and titles are listed below. SWMUs 38-40 are not included in the Draft PA; however, personal communication with EPA Region 1 personnel indicates that these sites will be added as SWMUs in future drafts of the PA.

SWMU #	SWMU Title
1,2,3	Drum Storage Areas
4	Waste Pile
5,6	Surface Impoundments
7	Industrial Waste Treatment Plant
8	Thermal Treatment Plant
9	Storage Tank
10	Hydrazine Treatment System
11	Hot Fuel Lab Waste Oil System
12	Hydrazine Storage Area
13	Former Hydrazine Treatment System
14	Bldg. No. 2 Test Rig Accumulation Area
15	Hot Fuel Lab Drum Storage
16	Air/Cold Fuel Lab Accumulation Area
17	Biomed Drum Storage
18-22	Back Forty Landfills
23	Perimeter Road Landfill
24	B2 Landfill
25	Original Fire Training Area
26	Back Forty Fire Training Area
27	Underground Waste Storage Tank
28	Three Underground Storage Tanks
29	Underground Waste Oil Tank
30	Underground Waste Oil Tank
31	Drain Chip/Waste Oil Storage Tank
32	Underground Petroleum-Toluene Tank
33	Underground Flammable Liquid Tank
34	Two Underground Storage Tanks
35	Two Underground Waste Oil Storage Tanks
36	Underground Flammable Liquids Storage Tank
37	Three Underground Waste Chemical Tanks
38	"Graveyard"
39	Watts Pond
40	MW-102 Area

Appendix C: Solid waste management unit descriptions

A draft RCRA Preliminary Assessment (PA) (June 1986) identified several SWMUs at the Hamilton Standard site; a list of these SWMUs is given in Appendix B. SWMUs which potentially contribute to present health threats are described below along with any known contaminant releases and any subsequent remediation activities. Ten of these SWMUs have had known contaminant releases and are designated with "*". SWMUs 38, 39, and 40 were not included in the draft PA; however, personal communication with EPA Region 1 personnel indicates that these sites will be added as SWMUs to future drafts of the PA.

- Waste Pile (SWMU 4) In July 1978, Hamilton Standard (with permission from the CTDEP) dredged approximately 14,000 cubic yards of silt and organic material from the bottom of Watts Pond. In order to accommodate the spoils, Hamilton Standard bermed a 450' x 450' area. These dredging spoils have not been characterized; however, Hamilton Standard is proposing to conduct a soil gas survey in this area and to analyze samples of the waste pile sediment.

- Surface impoundments* (SWMUs 5 and 6) These impoundments received metal hydroxide sludges from the Industrial Waste Water Treatment Plant from 1953 to 1982. The sludge was dried in the impoundments by evaporation and percolation and was periodically transferred to the B2 Landfill. In March 1981, 24,000 gallons of cyanide-bearing wastewater were accidentally released to the surface impoundments prior to treatment. These impoundments were excavated in 1983, and the underlying soil and traprock were removed in 1985. Soil samples were taken during excavation until analyses for metals revealed no EP Tox levels above drinking water standards. The impoundments were then backfilled. The impoundments were certified clean closed by the CTDEP and EPA Region 1 on November 5, 1985. Hamilton Standard continues to monitor groundwater around the impoundments, specifically for metals.

-Industrial Waste Treatment Plant* (SWMU 7) This plant consists of various storage and treatment tanks and treats dilute rinse waters from electroplating and cleaning operations. Treatment includes: cyanide destruction, Cr^{+6} reduction, pH adjustment, clarification, and settling. Known releases of contamination include accidental discharges of untreated water into the surface impoundments and also into a discharge conduit which passes through NPDES point 001. Other discharges which are in noncompliance with the permit have also been documented. Subsequent to passing through the NPDES point the Hamilton Standard conduit connects with a sewer conduit which travels

approximately one mile to the Farmington River and lies along Seymour Hollow. The integrity of the sewer conduit is poor and releases to Seymour Brook have been observed. Hamilton Standard is presently upgrading its waste treatment plant and repairs to the sewer conduit are planned. Concentrated solutions from the manufacturing processes and sludge generated in the IWTP are currently disposed of off-site via a closed waste collection system (tank to tank-truck to an EPA licensed disposal facility).

- Thermal Treatment Plant* (SWMU 8) This plant burns waste oil and non-halogenated solvents which pass waste analysis criteria in industrial boilers for heat recovery. Trace amounts of solvents and waste oils have been released to the air. Hamilton Standard does not currently monitor releases from this plant.

- Hot Fuel Lab Waste Oil System* (SWMU 11) This system contained two furnaces used to heat fuels for development projects and product testing. The furnaces once utilized PCB-contaminated oil which was replaced with other heat transfer fluid in 1985. Subsequent testing indicated that PCB contamination still existed, and the system is no longer used. A series of buried tanks and waste oil collection systems existed in the area around the furnace building. It is suspected that the tanks and associated sumps may have been potential sources of contamination. Soil was excavated in this area in 1985. Hamilton Standard plans to remove the machinery and the building and to excavate residual contaminated soil to a PCB level of < 10 ppb prior to capping.

- Former Hydrazine Treatment System* (SWMU 13) This system chlorinated waste hydrazine to form nitrogen and hydrochloric acid. The process resulted in excess chlorine which was discharged to a storm drain from 1969 to 1982.

- Back Forty Landfill* (SWMU 18) This elongated trench (250' x 10' x 6') was used for disposal of barrels of waste materials, including chlorinated organics, solvents, and possibly grinding sludges generated from the manufacturing processes. Approximately 127 barrels and surrounding contaminated soil were removed in 1982. Residual soil samples were collected and analyzed during excavation, and when samples revealed no significant contamination, the CTDEP gave Hamilton Standard permission to backfill the trench.

- Back Forty Landfills and Perimeter Road Landfill (SWMUs 19-23) Interviews with Hamilton Standard personnel revealed

that these areas at one time were used to dispose of barrels of waste material. After conducting a magnetometer survey, Hamilton Standard excavated anomalous areas and found only non-hazardous scrap metal and miscellaneous paper trash. No further characterization was done. Hamilton Standard is proposing a soil gas survey for these areas, including SWMU 18.

- B2 Landfill* (SWMU 24) This landfill (300' x 75' x 30') was active from 1953 to 1980 and was used to dispose of miscellaneous barrels of waste material, paper, trash, brush, demolition debris, and metal hydroxide sludges from the surface impoundments (SWMUs 5 and 6). Waste material was placed at the head of a ravine and was allowed to slide downslope. The sludges disposed of in the landfill are believed to have contained various heavy metals, including chromium, cadmium, zinc, copper, and lead. Results of investigations between 1981-1984 suggest that the landfill may be a source of chromium contamination in the groundwater. A pipe currently passes through the landfill and carries runoff from Building No. 2; this runoff produces an intermittent stream. Hamilton Standard plans to plug this pipe and cap the landfill with a 5-part RCRA cap in order to reduce the generation of leachate. Approval of the conceptual design of the cap was granted by the CTDEP on July 14, 1987. They have also applied for an NPDES outfall point for the intermittent stream to characterize the nature of the water passing through or over the landfill.

- Original Fire Training Area* (SWMU 25) (200' x 200') This area was utilized for chemical fire training exercises. Known releases include flammable liquids such as degreasers, solvents, waste oils, and fuel sometimes contaminated with PCBs. Approximately 88 tons of soil have been removed from the site and Hamilton Standard is proposing further excavation. Presently, Hamilton Standard is characterizing the eastern extent of contamination at the site, as erosion may have transported some contaminated soil toward a gully. Subsequent to this characterization, the soil will be excavated to a <10 ppb PCB contaminant level and backfilled.

- Back Forty Fire Training Area* (SWMU 26) (100' x 100') This area was utilized for chemical fire training exercises. Flammable liquids containing waste fuels, solvents, and oils were poured into metal pans, set on fire, and extinguished with the use of various fire apparatus. Spillage of flammable liquids occurred during the training exercises. Some contaminated soil has been excavated;

however, no PCB contamination exists at this area. In 1982, all obviously contaminated soil, estimated in the field on the basis of sensory observation (sight and olfaction) was removed.

(Hamilton Standard is proposing further assessment of the contamination at the fire training areas by conducting a soil gas survey. This survey will be augmented by excavation of pits and soil borings to determine the horizontal and vertical extent of contamination. Once the magnitude of contamination is known, the areas will be excavated to a residual PCB level below 10 ppb and capped with clean soil.)

- "Graveyard"* (SWMU 38) This area just west of the Manufacturing Support Building was once the site of a barrel storage area. The barrels contained PCB-contaminated organics from degreasing operations, and due to spills and leaks at the site the surrounding soil was contaminated. Hamilton Standard excavated approximately 400 cubic yards of PCB- and solvent-contaminated soil from the "graveyard" area. Samples collected following the excavation revealed PCBs and total VOCs at concentrations as high as 63 ug/g and 950 ug/g, respectively. The area has now been paved over and is partially covered by an addition to Building 2A. Hamilton Standard is proposing further assessment of this area by conducting a soil gas survey and soil sample analyses.

- Watts Pond* (SWMU 39) This man-made reservoir in the Rainbow Creek valley has provided process water for Hamilton Standard's manufacturing operations since 1955. The pond also receives cooling water blowdown from the facility through NPDES point 002.

- MW-102 Area (SWMU 40) Monitoring well 102 has consistently shown the highest on-site VOC contamination levels. This well is located between Buildings 1 and 2, near a drop off, staging, and storage area for drum deliveries to Building 2. Hamilton Standard is proposing further assessment of this area by conducting a soil gas survey and soil sample analyses.

-Underground Storage Tanks at Hamilton Standard In August 1986, Hamilton Standard initiated a Tank Integrity Program. This program includes subsurface investigation and tank inventories to evaluate the possibility of product/waste loss. Should leakage occur or have occurred the tank is removed, and remedial action involving soil removal, soil fixation, and/or groundwater treatment may be implemented.

Appendix D: On-site contamination at Hamilton Standard.

GROUNDWATER[a] (Water table Aquifer 15-60 ft from the surface)	Concentration Range ug/l	SURFACE WATER[a]
Chemical of Concern		
Carbon Tetrachloride	<1 - 447	<1
Chromium VI	<10 - 120	10 - 10
Chromium (Total)	<10 - 120	10 - 50
1,1-Dichloroethylene	<1 - 108	<1
1,1,1-Trichloroethane	<1 - 1600	<1
Trichloroethylene	<1 -23580	<1 - 4300
Tetrachloroethylene[b]	<1 - 6480	<1 - 2400

SOIL

PCBs found at the Original Fire Training Area (SWMU-25) for samples taken in 1983 and 1985. The 1985 sampling data represent a new set of soil borings that were placed outside the area of contamination identified in 1983.

Depth	Concentration Range ug/g
(1983)	
0- 2	ND[c] - 1100
4- 6	0.1 - 230
6- 8	ND
8-10	0.1 - 0.8
(1985)	
0- 2	ND - 350
4- 6	ND - 6.3

PCBs and Total VOCs found in soils at the Hot Fuels Lab (SWMU-11).

Contaminant	Concentration Range ug/g[d]
PCBs	
Surface	137.8 - 417.8
0- 2 ft	<1 - 83.2
4- 6 ft	<1 - 5.9
10-12 ft	<1 - 55.0
Total VOCs (ug/l)	14.3 - 1262.8

[a]There is no known exposure via ingestion of on-site groundwater or surface water.
[b]Synonym is Perchloroethylene.
[c]Not detected above detection limits.
[d]Except where specified otherwise.

Appendix E: Off-site contamination near Hamilton Standard.

GROUNDWATER
(Water table aquifer 30-60 ft from the surface)

	Concentration Range ug/l	
Chemical of Concern	1987-1988[a]	1980[b]
Carbon Tetrachloride	<1	BDL[c] - 170
Chromium VI	<10 - 10	(Not analyzed)
Chromium (Total)	<10 - 30	(Not analyzed)
1,1-Dichloroethylene	<1	(Not analyzed)
1,1,1-Trichloroethane	(Not Analyzed)	BDL - 300
Trichloroethylene	<1	BDL - 2000
Tetrachloroethylene[d]	(Not Analyzed)	BDL - 37

(Bedrock Aquifer 100-150 ft below the surface)

	Concentration Range ug/l
Chemical of Concern	
Carbon Tetrachloride	<1
Chromium VI	(Not Analyzed)
Chromium (Total)	<10
1,1-Dichloroethylene	<1
1,1,1-Trichloroethane	<1
Trichloroethylene	<1
Tetrachloroethylene	<1

SURFACE WATER

	Concentration Range ug/l	
Chemical of Concern	Rainbow Brook	Seymour Brook[e]
Carbon Tetrachloride	<1	<1
Chromium VI	<10 - 40	0 - 55
Chromium (Total)	10 - 50	40 - 505
1,1-Dichloroethylene	<1	<1
1,1,1-Trichloroethane	<1 - 1.9	<1
Trichloroethylene	<1 - 11.9	<1
Tetrachloroethylene	<1 - 2.4	<1

[a]Quarterly monitoring data at the three residences denoted on Figure 2 in Appendix A.
[b]Data from Rainbow Road residences.
[c]BDL = below detection limit. Detection limit not given.
[d]Synonym is Perchloroethylene.
[e]1987-1988 NPDES data.