
**DOCUMENTATION OF
ENVIRONMENTAL INDICATOR
DETERMINATION
CURRENT HUMAN EXPOSURES
UNDER CONTROL**

RCRA RECORDS CENTER
FACILITY Pratt & Whitney Aircraft
I.D. NO. 10001449511
FILE LOC. R-13
OTHER _____

DIV UTC

**Pratt & Whitney
415 Washington Avenue
North Haven, CT**

**March 2000
Revised:
September 2000
May 2001**

Prepared for

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Prepared by

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LEA Comm. No. 68VF201

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DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

Interim Final 2/5/99

Current Human Exposures Under Control

Facility Name: Pratt & Whitney, North Haven Facility
Facility Address: 415 Washington Avenue
Facility EPA ID #: CTD001449511

1. Has **all** available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

If yes - check here and continue with #2 below.

If no - re-evaluate existing data, or

If data are not available skip to #6 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Current Human Exposures Under Control" EI

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

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Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program, the EI are near-term objectives, which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The “Current Human Exposures Under Control” EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program’s overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

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2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be “**contaminated**”¹ above appropriately protective risk-based “levels” (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	<u>Yes</u>	<u>No</u>	<u>?</u>	<u>Rationale / Key Contaminants</u>
Groundwater	<u>X</u>	<u> </u>	<u> </u>	<p><u>There are exceedances of Federal Primary and Secondary Maximum Contaminant Levels (MCLs) in the three (3) power house dewatering wells and the six (6) facility process water wells. Compounds that exceed the MCLs include: cadmium, manganese, nickel, nitrate (as N), 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, chloroform, tetrachloroethylene, trichloroethylene and vinyl chloride.</u></p> <p><u>There are numerous exceedances of the generic Pratt & Whitney groundwater screening levels based on surface water protection (Table 3-7) at a total of 62 wells.</u></p>
Air (indoors) ²	<u> </u>	<u>X</u>	<u> </u>	
Surface Soil (e.g., <2 ft)	<u>X</u>	<u> </u>	<u> </u>	<p><u>Benzo[a]pyrene was detected in a single sample (NH-RSK-SS-07) at a concentration of 2,800 µg/kg, above the generic screening level for Groundskeepers and On-site Recreators. However, the 95% UCLs on the mean for benzo[a]pyrene in both surface sample data sets for these two exposure scenarios were below their respective screening levels.</u></p>
Surface Water	<u>X</u>	<u> </u>	<u> </u>	<p><u>Aluminum, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, nickel, silver, zinc, carbon tetrachloride, chloroform, 1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, tetrachloroethylene, trans-1,2-dichloroethylene, trichloroethylene, dichloromethane, methyl-tert-butyl-ether (MTBE) and vinyl chloride were detected in surface water above the respective screening levels.</u></p>

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Sediment

 X

Benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenzo[a,h]anthracene and indeno(1,2,3-cd)pyrene were detected in two locations (NH-RSK-SD-02 and NH-RSK-SD-04) above the respective screening levels.

Subsurf. Soil (e.g., >2 ft)

 X

Though subsurface soil at portions of the site is reasonably expected to be contaminated, exposure to subsurface soil is controlled through the Design Process Review (DPR), an institutional control, to ensure analytical data for subsurface soils are reviewed or generated/evaluated prior to exposure.

Air (outdoors)

 X

Exposure to outdoor air (trench air) is considered applicable to Excavating Laborers and Maintenance Workers. As the subsurface soil at portions of the site is reasonably expected to be contaminated, it is similarly reasonably expected that excavation laborers may be exposed to contaminated air during the performance of excavations. The exposure to air by excavation laborers is limited through the implementation of an institutional control, the Design Process Review (DPR), to ensure analytical data for subsurface soils and/or groundwater are reviewed or generated/evaluated prior to exposure.

 If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

 X If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

 If unknown (for any media) - skip to #6 and enter "IN" status code.

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Rationale and reference(s):

The North Haven facility primarily engages in manufacturing processes and experimental testing for engine parts and assemblies for aircraft engines and spare engine parts. Typical manufacturing operations include forming, machining, heat treating, welding, application of protective coatings, non-destructive testing, bonding, chemical cleaning, abrasive cleaning, chemical stripping, pickling, anodizing and nickel plating.

The facility is located on approximately 160 acres of land situated between Washington Avenue to the east, and the Quinnipiac River to the west. The current facility location was the site of a hog farm until 1952, when Pratt & Whitney purchased it. The first 600,000 square feet of the main factory was constructed in 1952. The remaining 600,000 square feet of the main factory, located to the south of the original structure, was constructed in 1956. The facility includes the main factory building, a powerhouse, a dilute industrial wastewater treatment facility, and several ancillary structures, along with paved parking and covered storage areas. There is approximately 35 feet of topographic relief on the site, ranging from approximately 10 feet above mean sea level (MSL) at the Quinnipiac River to approximately 45 feet MSL near the main factory building.

A report entitled *Conceptual Site Models and Screening Levels for Pratt & Whitney's VCAP Connecticut Facilities*, was prepared by Gradient Corporation (Gradient Report). This report was issued on December 19, 1997 and revised on September 18, 1998 and September 15, 1999. A copy of applicable portions of this report, those portions addressing the North Haven facility, has been included in Attachment No. 1. For the North Haven facility, the Gradient Report provides a facility-specific conceptual site model, a description of facility-specific exposure media and exposure pathways, a description of potential receptors, a rationale and approach to screening analytical data generated for exposure media, and screening levels for exposure media. For the North Haven Facility, the Gradient Report identifies the applicable receptors, exposure media and pathways that require screening as follows:

- 1) Groundskeepers, Samplers, Trespassers and On-site Recreators: surface soil by ingestion and dermal contact (Table 3-10);
- 2) Maintenance and Indoor Workers, Samplers and On-site Recreators: indoor air inhalation (Table 3-4);
- 3) Off-site Residents: indoor air by inhalation (Table 3-5);
- 4) Samplers: surface water, ingestion and dermal contact (Tables 3-6, 3-7 and MCLs (for process water potentially affecting surface water and sediment));
- 5) Trespassers and Off-site Recreators: surface water, ingestion and dermal contact (Tables 3-6 and 3-7);
- 6) Samplers, Trespassers and Off-site Recreators: sediment, ingestion and dermal contact (Table 3-10);

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- 7) Maintenance Workers: groundwater by dermal contact (Table 3-8), and;
- 8) Indoor Workers: groundwater by dermal contact (MCLs for process water only).

This documentation of environmental indicator determination is based on a review of all available relevant/significant data as it applies to these receptors for the identified exposure media and pathways.

Groundwater

The following discussions and resulting conclusions are based on the review and evaluation of available groundwater data for the site. Specifically, the discussions and resulting conclusions are based on the following:

- Groundwater samples collected from groundwater monitoring wells installed at the Pratt & Whitney North Haven facility as part of the Voluntary Corrective Action program (VCAP) groundwater monitoring since December 1998;
- Over 150 different groundwater sampling locations (i.e. monitoring wells, piezometers, etc.) sampled since January 1982;
- Three (3) power house groundwater dewatering wells and the six (6) facility process water wells have been sampled since May 1979; and
- University of Waterloo field studies performed in 1999 and 2000 to evaluate the effect of a sheet-pile cell on dissolved-phase groundwater contamination emanating from the location of an historic release of industrial solvent.

Site plans for the North Haven facility indicating groundwater sampling locations are provided in Attachment No. 2. Each of the site plans depict topographic features for the site. A complete listing of constituents in groundwater for which samples were analyzed is provided in Attachment No. 3. To present a hardcopy table of all sample results, or even a hardcopy table of all detected constituents in groundwater, would be too voluminous to include in this document. The groundwater analytical data set can be submitted electronically under a separate cover.

Site geology has been identified in the course of multiple site investigations. The unconsolidated deposits on the site have been differentiated into three units. The upper most unit consists of brown to red, fine to medium sand with some to trace quantities of gravel and little silt. The intermediate unit is composed of red and brown silt and clay. A lower sand unit is present beneath the silt and clay. A basal till layer was also reported in some soil borings. Geologic cross-sections previously prepared by Fuss & O'Neill, Inc. are provided in Attachment No. 2.

The site hydrogeology has been interpreted from soil borings and on-site monitoring wells as consisting of four distinct zones within the unconsolidated aquifer. These zones

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are related to the upper sand unit; the silt/clay layer; the lower sand unit; and the northwest corner of the site where the silt/clay layer is absent and the lower and upper sand units combine. The silt/clay layer, where present, acts as a semi-confining layer.

Groundwater flow in the upper aquifer, as interpreted from water levels measured in the on-site monitoring wells, is generally from east to west toward the Quinnipiac River. There are, however, local inconsistencies due to groundwater withdrawal from the process wells, and the absence of the silt/clay layer in the vicinity of the process wells PW-01N and PW-02D and the presence of the former surface impoundments (located in the central portion of the site). It should be noted, the former surface impoundments currently exist as a pond in the central portion of the site. The pond is a surficial representation of groundwater and is neither fed nor drained by a stream. For example, groundwater contours developed from water table elevations observed during the December 1998 VCAP sampling (see Groundwater Monitoring Data site plan provided in Attachment No. 2) indicate a localized northwest gradient at the northwest corner of the site which may be attributed to these two process wells located in that area. A review of process well usage indicates that only PW-02 and PW-06 have been used for pumping at the facility since January 1998. During this period the majority of process well water usage was from PW-02, but PW-06 was used between June and September 1999. The groundwater contours generated for December 1998 (during a period of pumping from only PW-02) depicting a localized northwest gradient in the vicinity of process well PW-02 appear to support that localized groundwater flow is influenced by the pumping from this well.

Groundwater flow direction observed in the lower sand unit of the aquifer is consistent with regional north-to-south flow toward the Quinnipiac River. However, as noted above, the flow pattern on the Pratt & Whitney site is also influenced by pumping from the process wells.

The groundwater data provided in the attachments have been compared to the numeric screening levels published in the Gradient Report. Specifically, the groundwater data were compared to the numeric screening criteria published in Tables 3-7 and 3-8 of the above referenced report, as well as the MCLs. The groundwater monitoring well network at the site is determined adequate in number and spatial distribution to assess the quality of groundwater that discharges to surface water bodies at the site and the potential for exposure to maintenance and indoor workers.

To address potential exposures to Maintenance Workers while servicing and maintaining facility dewatering pumps, the groundwater data from the three (3) power house groundwater dewatering wells was compared to the numeric screening criteria listed in Table 3-8 of the Gradient Report. The table is titled *Generic P&W Groundwater Screening Levels Based on Dermal Contact, P&W VCAP, Connecticut Facilities*. There

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were no exceedances of the generic screening criteria for these dewatering wells. Attachment No. 3 includes a database listing of constituents for groundwater collected from the power house groundwater dewatering wells.

To address potential exposures to Indoor Workers from contact with process waters, the groundwater data from the three (3) power house groundwater dewatering wells and the six (6) process water wells was compared to the MCLs. The power house dewatering wells were included in the data set because water from these wells is combined with the facility's process water. Exceedances were identified for: cadmium, manganese, nickel, nitrate (as N), 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, chloroform, tetrachloroethylene, trichloroethylene and vinyl chloride. Attachment No. 3 includes database listings of constituents for groundwater collected from the power house groundwater dewatering wells and the facility process water wells, as well as tables of exceedances of the MCLs for these wells.

To address potential exposures to Samplers from contact with surface water that might be affected by the discharge of facility process waters, the groundwater data from the three (3) power house groundwater dewatering wells and the six (6) process water wells was compared to the MCLs. The power house dewatering wells were included in the data set because water from these wells is combined with the process water. Exceedances of the MCLs were identified for: cadmium, manganese, nickel, nitrate (as N), 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, chloroform, tetrachloroethylene, trichloroethylene and vinyl chloride.

To address potential impacts to surface water bodies, the groundwater data for the site was compared to the numeric screening criteria listed in Table 3-7 of the Gradient Report. The table is titled *Generic P&W Groundwater Screening Levels (SLs) Based on Surface Water Protection, P&W VCAP, Connecticut Facilities*. A total of 62 wells (three (3) power house wells, six (6) process wells and 53 monitoring wells) had compounds that exceeded the screening criteria in Table 3-7. These compounds include: aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, silver, zinc, cyanide (total), carbon tetrachloride, 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, tetrachloroethylene, trans-1,2-dichloroethylene, trichloroethylene, dichlorodifluoromethane and MTBE. Attachment No. 3 includes a database listing of detected constituents for groundwater that exceeds the Table 3-7 criteria.

The potential for exposure to Off-site Residents by indoor air impacted by volatile organic compounds in groundwater was indeterminate at the time of the Gradient Report because it was unclear if groundwater contaminant plumes had the potential to impact residential areas. From a review of the available groundwater analytical data, coupled with the fact that groundwater flow at the site is towards the Quinnipiac River, it is

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concluded that contaminated groundwater at the site does not have the potential to impact abutting residential areas. Groundwater contours developed during the December 1998 VCAP sampling event depicted on the Groundwater Monitoring Data site plan provided in Attachment No. 2 support this conclusion. Further information supporting the conclusion that contaminated groundwater at the site does not have the potential to impact adjoining residential areas is provided in a response to Question 4 below. The information is in the form of a study performed by the University of Waterloo to assess the degree and extent of dissolved-phase groundwater contamination emanating from an historic release of industrial solvent, the majority of which is contained by a sheet-pile cell. The results of the study further support the conclusion that contaminated groundwater flows toward the Quinnipiac River and does not flow in the direction of abutting residential areas.

Indoor Air

With respect to indoor air, five indoor air samples, including a duplicate sample, were collected in November 1998 in an effort to assess concentrations of volatile organic compounds present in indoor air at the main factory building and the power house. These samples, collected at the locations identified as NH-RSK-AS-01 through NH-RSK-AS-05 and identified on the site plan provided in Attachment No. 2, were collected as part of the comprehensive risk assessment sampling program to evaluate potential exposure pathways at the site. Specifically, samples NH-RSK-AS-01 through NH-RSK-AS-04 were collected within the main manufacturing buildings in the areas of known VOC groundwater contamination and were biased to the location of manufacturing processes which utilize groundwater derived from onsite process wells. Sample NH-RSK-AS-05 was collected from within the facility powerhouse. Provided as Attachment No. 4 is a copy of the report entitled *Indoor Air Monitoring in Support of VCAP Risk Assessment, Pratt & Whitney, North Haven, Connecticut*, including a database listing of analytical data for the indoor air samples.

The indoor air sample data provided in the attachments have been compared to the numeric screening criteria listed in Table 3-4 of the Gradient Report. The table is titled *Generic P&W Indoor Air Screening Levels (SLs) P&W VCAP, Connecticut Facilities*. The sample data set is adequate to assess the quality of indoor air likely to be encountered by Maintenance and Indoor Workers, Samplers and On-site Recreators at the site. The comparison indicated that the detected concentrations are below the screening levels.

Surface Soil

The following discussions and resulting conclusions are based on the review and evaluation of available surface soil data for the site. Specifically, the discussions and resulting conclusions are based on the following:

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- Surface soil samples (identified as NH-RSK-SS-01 through NH-RSK-SS-18) collected during VCAP risk assessment sampling activities in March 1998. These surface soil samples were analyzed for the presence of volatile organic and semi-volatile organic compounds, PCBs, metals, and total petroleum hydrocarbons.
- Approximately 280 surface soil samples (collected from the 0 to 0.5 foot interval) collected during the period from 1988 to 1993. These surface soil samples were analyzed for the presence of one or more of the following: volatile organic compounds; semi-volatile organic compounds; PCBs, metals; and/or total petroleum hydrocarbons.
- Surface soil samples collected by Fuss & O'Neill, Inc. in the vicinity of NH-RSK-SS-07.

The locations of all surface soil samples described above are provided on the site plan(s) provided in Attachment No. 2.

Surface soil data was compared to the numeric screening criteria listed in Table 3-10 of the Gradient Report. The table is titled *Generic P&W Soil Screening Levels (SSLs) Based on Dermal Contact, P&W VCAP, Connecticut Facilities*. The sample data set is adequate to assess the quality of surface soils in those areas likely to be encountered by Groundskeepers, Samplers, Trespassers, and On-site Recreators at the site. The comparison indicated that a single semi-volatile organic compound (SVOC), benzo[a]pyrene, was detected in a single surface soil sample (NH-RSK-SS-07) at a concentration of 2,800 µg/kg, above the numeric criteria for Groundskeepers and On-site Recreators published in the above-referenced table.

In an effort to evaluate the areal distribution of semi-volatile organic compounds detected in surface soils and sediment at the site, a site map depicting the location of all surface soil and sediment sampling locations and the concentration of SVOCs detected in each sample was compiled. A copy of this map is included in Attachment No. 2. From a review of the site map, it is apparent that the concentrations of SVOCs in sample NH-RSK-SS-07 are elevated in relation to other surface soil samples collected in the vicinity (NH-RSK-SS-05, NH-RSK-SS-06, NH-RSK-SS-08, and NH-RSK-SS-09). Subsequent visits and observations of the NH-RSK-SS-07 sample location observed the presence of asphalt and asphalt pieces in the area. The elevated SVOCs detected at the NH-RSK-SS-07 location are likely attributable to the presence of asphalt fragments in the soil and not from any industrial contamination source. In further support of this, historic aerial photographs indicate the presence of a driveway in the location of NH-RSK-SS-07.

In addition, in July 2000 additional surface soil samples were collected at three locations surrounding sample location NH-RSK-SS-07 and again from the location of NH-RSK-

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SS-07 (refer to site plan in Attachment No. 2). Observations during the advancement of hand auger soil borings performed by Fuss & O'Neill, Inc. in July 2000 confirmed the presence of asphalt at the location of NH-RSK-SS-07 at a depth of 2 inches below the ground surface. As summarized below, the concentrations of benzo[a]pyrene detected in each of the three additional samples as well as the resample of NH-RSK-SS-07 are below the concentration of benzo[a]pyrene initially detected well NH-RSK-SS-07.

July 2000 Surface Soil Sampling Data

Sample Location	Observed benzo[a]pyrene concentration (µg/kg)
Resample NH-RSK-SS-07	280
NH-RSK-SS-07A (0-1 ft.)	1,200
NH-RSK-SS-07A (1-2 ft.)	290
NH-RSK-SS-07B (0-1 ft.)	None Detected
NH-RSK-SS-07B (1-2 ft.)	None Detected
NH-RSK-SS-07C (0-1 ft.)	2,000
NH-RSK-SS-07C (1-2 ft.)	600

Though available evidence indicates that the elevated concentration of benzo[a]pyrene results from the presence of asphalt, the data set was further evaluated. For the purposes of evaluating the benzo(a)pyrene exceedance of the generic screening levels, it is appropriate to compare the 95% upper confidence limit (UCL) of the mean for the surface soil data set in the vicinity of the NH-RSK-SS-07 sample location (i.e. including locations (NH-RSK-SS-07A through -07C). The resample of the original NH-RSK-SS-07 sample location was not included in this 95% UCL calculation; the original sample exceedance of 2,800 µg/kg was retained. The 95% UCL of the mean of the log-normally distributed data set for the 0-1 ft. horizon for benzo[a]pyrene in the vicinity of NH-RSK-SS-07 is 910 µg/kg and is well below the relevant screening levels (1,600 µg/kg for Groundskeepers, and 2,000 µg/kg for On-site Recreators).

Similarly, if the data set were expanded to include benzo(a) pyrene from the 1-2 ft. horizon, the 95% UCL of the mean of the log-normally distributed data set in the vicinity of NH-RSK-SS-07 is calculated to be 532 µg/kg; also well below the corresponding screening levels.

Provided as Attachment No. 5 is a copy of the report entitled *Surface Soil Sampling in Support of VCAP Risk Assessment, Pratt & Whitney, North Haven, Connecticut*, including a database listing of analytical data for surface soil samples and a summary of the benzo[a]pyrene results in the data sets for the Groundskeepers and the On-site Recreators exposure areas. To present a table of all sample results, or even a table of all

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detected constituents in surface soil would be too voluminous to include in this document. If desired, these tables can be provided upon request.

Surface Water

The following discussions and resulting conclusions are based on the review and evaluation of available surface water data for the site. Specifically, the discussions and resulting conclusions are based on the following:

- Surface water samples collected at 5 locations (and included one duplicate) at the locations are identified on the site plan in Attachment No. 2 as NH-RSK-SD-01 through NH-RSK-SD-05. These surface water samples were collected as part of the VCAP risk assessment sampling program in April 1999 and were analyzed for volatile organic compounds and metals.
- Over 200 surface water samples collected during the period from 1986 to 1995.

Site plans for the North Haven facility indicating surface water sampling locations are provided in Attachment No. 2. All surface water data was compared to the numeric screening criteria listed in Table 3-6 of the Gradient Report. The table is titled *Generic P&W Surface Water Screening Levels (SLs) P&W VCAP Facilities*. Exceedances were identified for the following compounds: aluminum, barium, cadmium, chromium, copper, iron, lead, magnesium, manganese, nickel, silver, zinc, carbon tetrachloride, chloroform, 1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, tetrachloroethylene, trans-1,2-dichloro-ethylene, trichloroethylene, dichloromethane, methyl-tert-butyl-ether (MTBE) and vinyl chloride.

Provided as Attachment No. 6 is a copy of the report entitled *Surface Water and Sediment Sampling in Support of VCAP Risk Assessment, Pratt & Whitney, North Haven, Connecticut*. Attachment No. 6 also includes a database listing of analyses performed on all surface water samples described above and a summary of the exceedances of screening levels presented in Table 3-6 noted from a review of all surface water samples. To present a table of all sample results, or even a table of all detected constituents in surface water, would be too voluminous to include in this document. The surface water analytical data set can be submitted electronically under a separate cover.

While all surface water data have been reviewed, the historic surface water data is not considered to be relevant or significant for the purpose of evaluating current surface water quality and potential human exposures due to the time that has passed since the collection and analysis of these historic samples. The more recent VCAP risk assessment surface water sampling network is adequate to assess surface water quality in those areas likely to be encountered by Off-site Recreators, Samplers and Trespassers at the site.

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Surface water sample locations NH-RSK-SD-01 through -05 provide adequate coverage of historic sampling locations, with the exception of the 8 historic surface water sampling locations within the Quinnipiac River. The surface water samples collected within the Quinnipiac River are not considered relevant with regard to this determination. This conclusion is based on the fact that impacts from site operations on the surface water quality of the Quinnipiac River is based on an evaluation of onsite surface water quality samples that are representative of discharges to the Quinnipiac River and an evaluation of groundwater samples collected from those locations that are representative of discharges to a surface water. As a result, further discussion regarding historic sampling locations within the Quinnipiac River has not been provided. Discussions regarding impacts to surface water as a result of onsite operations are provided below and in the following parts of this document.

A review of the analytical data for the current VCAP risk assessment surface water sampling indicated the presence of the following constituents/compounds in surface water at the site: barium; total chromium; copper; nickel; zinc; acetone; chloroform; cis-1,2-dichloroethylene; methyl-tert-butyl ether (MTBE); tetrachloroethylene; 1,1,1-trichloroethane; trichloroethylene; and vinyl chloride. From an evaluation of historic groundwater data, it is apparent that the above constituents/compounds detected in surface water were also detected in groundwater. Furthermore, a review of groundwater data since January 1, 1998 from nineteen monitoring wells identified as most representative of groundwater discharging to surface water (see discussion on pages 20 and 21) indicated that all constituents/compounds detected in surface water except for acetone, chloroform and MTBE are present in the groundwater discharging to surface water.

A comparison of the recent VCAP surface water data indicated exceedances of one or more of the following compounds from the Table 3-6 criteria at each of the VCAP risk assessment surface water sampling locations: chromium, nickel, zinc, cis-1,2-dichloroethylene, MTBE, trichloroethylene and vinyl chloride.

The maxima for chromium was 0.014 mg/l compared to a screening level of 0.01 mg/l. The maxima for zinc was 0.0371 mg/l compared to a screening level of 0.02 mg/l. The maxima for cis-1,2-dichloroethylene was 52 µg/l compared to a screening level of 5 µg/l. However, the maximum contaminant level (MCL) for: chromium is 0.1 mg/l; zinc is 5 mg/l, and cis-1,2-dichloroethylene is 70 µg/l. Based on a comparison of the maxima to these MCLs, there were no exceedances of surface water criteria.

Further evaluation of the presence of nickel, MTBE, trichloroethylene and vinyl chloride in the VCAP risk assessment surface water samples is presented in the following parts of this document.

Handwritten notes:
- MCL
MCL
MCL 4.3 µg/l
MCL 5 µg/l
MCL 2 µg/l

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Sediment

The following discussions and resulting conclusions are based on the review and evaluation of available sediment data for the site. Specifically, the discussions and resulting conclusions are based on the following:

- As part of the comprehensive risk assessment sampling activities, sediment samples were collected at 5 locations identified on the Site Plan in Attachment No. 2 as NH-RSK-SD-01 through NH-RSK-SD-05 in April 1999. The sediment samples were analyzed for the presence of VOCs, SVOCs, PCBs, metals, total organic carbon (TOC) and TPH.
- Sediment samples collected from 19 locations in 1990 and 1991.

Provided as Attachment No. 6 is a copy of the report entitled *Surface Water and Sediment Sampling in Support of VCAP Risk Assessment, Pratt & Whitney, North Haven, Connecticut*. In addition, Attachment No. 6 includes a database listing of analytical data for all sediment samples described above.

The sediment data provided in the attachments have been compared to the numeric screening criteria listed in Table 3-10 of the Gradient Report. The table is titled *Generic P&W Soil Screening Levels (SSLs) based on Soil Ingestion and Dermal Contact (mg/kg) P&W VCAP, Connecticut Facilities*. The sampling is determined adequate to assess the quality of sediment in those areas likely to be encountered by Samplers, Trespassers, and Off-site Recreators. The comparison indicated exceedances of generic sediment screening levels for benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenzo[a,h]anthracene and indeno(1,2,3-cd)pyrene at sample locations NH-RSK-SD-02 and NH-RSK-SD-04.

In an effort to evaluate the areal distribution of semi-volatile organic compounds detected in surface soil and sediment at the site, a site map depicting the location of all surface soil and sediment sampling locations and the concentration of SVOCs detected in each sample was compiled. A copy of this map is included in Attachment No. 2. From a review of the site map, it is apparent that the concentrations of SVOCs detected in NH-RSK-SD-02 and NH-RSK-SD-04 are elevated in relation to the remaining three sediment samples collected during risk assessment sampling activities at the site. The 19 historic sediment samples were not analyzed for the presence of semi-volatile organic compounds. The significance of the concentrations of SVOCs detected in NH-RSK-SD-02 and NH-RSK-SD-04 are discussed in Question No. 4 below.

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Footnotes:

- ¹ “Contamination” and “contaminated” describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based “levels” (for the media, that identify risks within the acceptable risk range).
- ² Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

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3. Are there **complete pathways** between “contamination” and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

Potential Human Receptors (Under Current Conditions)

<u>“Contaminated” Media</u>	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food ³
Groundwater	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>
Surface Water	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>No</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>
Sediment	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>No</u>	<u>Yes</u>	<u>Yes</u>	<u>No</u>
Soil (subsurface e.g., >2 ft)	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>
Air (outdoors)	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>	<u>No</u>

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors’ spaces for Media which are not “contaminated”) as identified in #2 above.
2. enter “yes” or “no” for potential “completeness” under each “Contaminated” Media -- Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential “Contaminated” Media - Human Receptor combinations (Pathways) do not have check spaces (“___”). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

- _____ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter “YE” status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).
- X If yes (pathways are complete for any “Contaminated” Media - Human Receptor combination) - continue after providing supporting explanation.
- _____ If unknown (for any “Contaminated” Media - Human Receptor combination) - skip to #6 and enter “IN” status code

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Rationale and Reference(s):

A copy of applicable portions of the Gradient Report, those portions addressing the North Haven facility, has been included in Attachment No. 1. For the North Haven facility, the Gradient Report provides a facility-specific conceptual site model, a description of facility-specific exposure media and exposure pathways, a description of potential receptors, a rationale and approach to screening analytical data generated for exposure media, and screening levels for exposure media.

Groundwater, Subsurface Soil and Trench Air (Outdoor Air)

Excavating Laborers and Maintenance Workers were identified in the Gradient Report as having an exposure pathway for groundwater and subsurface soil. However, the implementation of the Design Process Review (DPR) controls these receptors' exposures to contaminants in groundwater, subsurface soil, and trench air (outdoor air encountered during performance of excavation of subsurface soil). A DPR is completed prior to any activity that results in the excavation of soil (the potential source of exposure to constituents in groundwater, subsurface soil and air, due to soil movement). The DPR includes an assessment of available analytical data for soil and groundwater in the area where the proposed activity will occur. If no data are available, or if existing data are incomplete, samples are collected. The data for the areas are compared to the screening criteria. If there are exceedances of applicable screening levels, all subsurface work in the area is conducted by personnel who have received appropriate health and safety training.

Maintenance Workers were further identified as having the potential for exposure to groundwater specifically while maintaining the dewatering well pumps at the power house. As described under Question No. 2 above, there are identified exceedances of generic screening criteria for this exposure receptor, media and pathway. The significance of these exceedances will be discussed in a subsequent portion of this EI.

Indoor Workers were further identified as having the potential for exposure (via inhalation and dermal contact) to groundwater used as process water. As described under Question No. 2 above, there are identified exceedances of generic screening criteria for this receptor via the dermal contact with groundwater pathway. The significance of these exceedances will be discussed in a subsequent portion of this EI. With regard to the inhalation pathway, as described in Question No. 2 above, indoor air sampling locations were selected to evaluate the potential for indoor air impacts as a result of volatilization of contaminants from underlying groundwater into indoor airspaces. Furthermore, indoor air sample locations were biased to portions of the facility where groundwater was used in manufacturing processes. As no exceedances of generic screening levels were noted for indoor air, no discussion of significance has been provided.

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With regard to the potential for off-site residents to be affected as a result of exposure to indoor air by indoor air impacted by volatile organic compounds, further information in support of the conclusion that this will not occur was obtained as a result of field studies performed by the University of Waterloo (UW). In 1999 and 2000 the UW performed field studies to evaluate the effect of the sheet-pile cell on dissolved-phase groundwater contamination emanating from the release area. The results of the study are summarized in response provided to Question 4 below. The study determined that contaminated groundwater will remain within the existing area of contaminated groundwater as defined by the monitoring locations designated at the time of this determination. Furthermore, the UW generated a groundwater contour map utilizing data collected in September 1999. This map, provided in Attachment No. 2, supports the previous conclusion that groundwater flow at the site is toward the Quinnipiac River (in a direction parallel to and away from abutting residential properties) and that contaminated groundwater at the site follows this same flow path. As a result, the residential exposure pathway is incomplete and is not considered further.

Surface Water and Sediment

The Gradient Report identified Samplers, Trespassers and Off-site Recreators as having an exposure pathway for surface water and sediment by ingestion and dermal contact. As described under Question No. 2 above, there are identified exceedances of generic screening criteria for these exposure receptors, media and pathways. The significance of these exceedances will be discussed in subsequent portions of this EI.

Footnotes:

³ Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.)

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- 4 Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be “**significant**”⁴ (i.e., potentially “unacceptable” because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable “levels” (used to identify the “contamination”); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable “levels”) could result in greater than acceptable risks)?

 X If no (exposures can not be reasonably expected to be significant (i.e., potentially “unacceptable”) for any complete exposure pathway) - skip to #6 and enter “YE” status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to “contamination” (identified in #3) are not expected to be “significant.”

 If yes (exposures could be reasonably expected to be “significant” (i.e., potentially “unacceptable”) for any complete exposure pathway) - continue after providing a description (of each potentially “unacceptable” exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to “contamination” (identified in #3) are not expected to be “significant.”

 If unknown (for any complete pathway) - skip to #6 and enter “IN” status code

Rationale and Reference(s):

Groundwater

As discussed under Question No. 2, exceedances of the MCLs were identified at the three (3) power house groundwater dewatering wells and the six (6) process water wells. The comparison with the MCLs was conducted to address potential exposures to Indoor Workers from contact with process waters. However, a closer evaluation of the data indicates that use of groundwater as process water is not expected to pose significant risks. The screening results presented in Question No. 2 utilized all available data from the on-site process wells and the power house wells, with some measurements from the late 1970s.

Groundwater concentrations have declined significantly over time at the process water wells. Graphs of concentration versus time at each process water well are provided in Attachment No. 3 to illustrate the declining trend(s) for contaminants identified to exceed

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the MCLs. To account for this declining trend in concentrations, the following data set was used to screen against risk-based criteria developed for Indoor Workers (presented in Attachment No. 1):

Process Wells Since a comprehensive data base exists for the process wells (designated as "PW" in Table 1 and Table A in Attachment No. 3), the maximum value detected in the last eight monitoring events was used; and

Power House Wells Since the data base for these wells is smaller as compared to the process wells, the maximum recorded value for each chemical at these wells was used.

The screening results are presented in the table below¹:

Chemical	Exposure Concentration (µg/l)	Risk-based Criteria for Indoor Workers (µg/l)
Process Wells		
1,1,2-Trichloroethane	21	906
Trichloroethylene	34	1,936
Tetrachloroethylene	46	18
Nitrate	17,350	4,866,667
Power House Wells		
Trichloroethylene	620	1,936
Tetrachloroethylene	13	18
Nickel	120	657,000
Chloroform	130	8,094
1,1-Dichloroethylene	16	35
Manganese (total)	119	340,667

The screening results indicate that concentrations for all chemicals, except tetrachloroethylene (PCE), were less than the risk-based criteria. The maximum PCE concentration at the process wells was approximately 2.5 times the screening level. Since the screening criteria for PCE is based on a cancer risk of 1×10^{-6} , the maximum PCE concentration represents a cancer risk of 2.5×10^{-6} , *i.e.*, within the range of cancer risks (10^{-6} to 10^{-4}) considered acceptable by USEPA. Furthermore, because concentrations for the other chemicals did not exceed the risk-based criteria, the incremental contribution to total risks from these chemicals is expected to be less than 1×10^{-6} , *i.e.*, insignificant. Overall, the total human health risks posed to Indoor Workers as a result of usage of groundwater as process water are not expected to be significant.

¹ The approach of screening groundwater concentrations against criteria is conservative, *i.e.*, health-protective, because it ignores any loss of VOCs from the well head to the point of use. In addition, the data used in the screening is approximately 4 to 9 years old, and current groundwater concentrations are expected to be even lower due to ongoing groundwater use.

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Surface Water

As discussed under Question No. 2, exceedances of the generic screening levels for surface water (Table 3-6) were identified for nickel, MTBE, trichloroethylene and vinyl chloride in the VCAP risk assessment surface water samples. It should be noted that the screening levels listed in the Gradient Report were developed based on readily available published criteria. The readily available published criteria cited are protective of both human and ecological exposure. However, other applicable screening criteria with respect to evaluation of human exposures exist. Risk-based screening criteria, protective of human health, were developed for Samplers, Trespassers and Off-site Recreators based on site-specific exposure assumptions by Gradient Corporation. These criteria are provided in Attachment No. 1 and are as follows (the most strict limit is shown in parentheses): nickel (29,749 mg/l); MTBE (186,235 µg/l); trichloroethylene (1,574 µg/l); and vinyl chloride (17 µg/l). Comparison with these criteria did not indicate any exceedances. Therefore, surface water at the site is not expected to pose significant risks to humans.

As discussed under Question No. 2, exceedances of the MCLs were identified at the three (3) power house groundwater dewatering wells and the six (6) process water wells. The comparison with the MCLs was conducted to evaluate the potential for exposures to Samplers from contact with surface water and sediment that might have been impacted by process water discharges. However, a closer evaluation of the data indicates that the process water discharging to the surface water is not expected to pose significant risks. The screening results presented in Question No. 2 utilized all available data from the on-site process wells and the power house wells, with some measurements from the late 1970s. However, groundwater concentrations have declined significantly over time at these locations. To account for this declining trend in concentrations, the following data set was used to screen against risk-based criteria developed for Samplers (presented in Attachment No. 1):

- | | |
|-------------------|--|
| Process Wells | Since a comprehensive data base exists for the process wells (designated as "PW" in Table 1 and Table A in Attachment No. 3), the maximum value detected in the last eight monitoring events was used; and |
| Power House Wells | Since the data base for these wells is smaller as compared to the process wells, the maximum recorded value for each chemical at these wells was used. |

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The screening results are presented in the table below²:

Chemical	Exposure Concentration (µg/l)	Risk-based Criteria for Samplers (µg/l)
Process Wells		
1,1,2-Trichloroethane	21	628
Trichloroethylene	34	1,574
Tetrachloroethylene	46	16
Nitrate	17,350	4,267,223
Power House Wells		
Trichloroethylene	620	1,574
Tetrachloroethylene	13	16
Nickel	120	381,133
Chloroform	130	5,676
1,1-Dichloroethylene	16	29
Manganese (total)	119	301,857

The screening results indicate that concentrations for all chemicals, except tetrachloroethylene (PCE), were less than the risk-based criteria. The maximum PCE concentration at the process wells was approximately 2.5 times the screening level. Since the screening criteria for PCE is based on a cancer risk of 1×10^{-6} , the maximum PCE concentration represents a cancer risk of 2.5×10^{-6} , *i.e.*, within the range of cancer risks (10^{-6} to 10^{-4}) considered acceptable by USEPA. Furthermore, because concentrations for the other chemicals did not exceed the risk-based criteria, the incremental contribution to total risks from these chemicals is expected to be less than 1×10^{-6} , *i.e.*, insignificant. Overall, the total human health risks posed to Samplers as a result of potential exposure to surface water or sediment that might be impacted by process water are not expected to be significant.

Groundwater Discharging to Surface Water

As discussed under Question No. 2, exceedances of the groundwater screening levels based on surface water protection (Table 3-7) were identified in a total of 62 wells (three (3) power house wells, six (6) process wells and 53 monitoring wells). However, groundwater from the majority of the wells with exceedances (43 of the total of 62) does not discharge directly to a surface water. Nineteen wells (listed below) have been identified for the purpose of evaluating exceedances of the Table 3-7 criteria as they best represent groundwater that may discharge to surface water and are a subset of wells on the site for which groundwater samples have been frequently collected. It should be noted, other wells may exist on site that would result in the collection of groundwater

² The approach of screening groundwater concentrations against criteria is conservative, *i.e.*, health-protective, because it ignores any loss of VOCs from the well head to the point of use. In addition, the data used in the screening is approximately 4 to 9 years old, and current groundwater concentrations are expected to be even lower due to ongoing groundwater use.

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samples that are representative of a discharge to surface water. However, these other wells have not been included in the list below as groundwater samples have not been collected from those locations for several years. The wells presented below are the closest, upgradient wells to the surface water bodies at the site for which data are available that are representative of current conditions at the site. This well network is adequate to assess groundwater quality that is representative of that which may discharge to a surface water on the site.

MW-02-S1	MW-09-S1	MW-34-S1
MW-03-S1	MW-10-S1	MW-54-S1
MW-04-S1	MW-11-S1	MW-56-S1
MW-05-S1	MW-12-S1	MW-57-S1
MW-06-S1	MW-21-S1	PW-06D
MW-07-S1	MW-30-S1	
MW-08-S1	MW-33-S1	

Compounds in groundwater at these wells that exceed the Table 3-7 criteria include: arsenic, cadmium, copper, iron, lead, manganese, silver, zinc, 1,1-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, tetrachloroethylene, trans-1,2-dichloroethylene, trichloroethylene and dichlorodifluoromethane.

However, historic groundwater data at these wells is not considered to be relevant or significant for the purpose of evaluating current potential impacts to surface water quality (and potential resultant human exposures) due to the time that has passed since the collection and analysis of these samples. Graphs of concentration versus time for the majority of the wells listed above are provided in Attachment No. 3 to graphically illustrate trend(s) for contaminants identified to exceed Table 3-7 criteria. Note that graphs were not prepared for certain wells (MW-10-S1, MW-11-S1, MW-12-S1, MW-21-S1, MW-33-S1, MW-34-S1, MW-56-S1 and MW-57-S1) because, for the contaminants identified to exceed Table 3-7 criteria, there were only one or two data points and a graph would not present any discernable trend(s).

From a review of the graphs in Attachment No. 3, it is evident that individual contaminant concentrations have either shown a marked decrease over time or individual contaminant concentrations fluctuate within a finite range. Furthermore, the results of the study performed by UW show a significant drop in peak TCE concentrations, of about 3 orders of magnitude, over the 1200 ft travel distance between the western edge of the facility and the Quinnipiac River. UW has concluded that it expects that several attenuation mechanisms are at work, including dispersion, discharge to the pond and streams, diffusion into (and out of) the underlying aquitard, and degradation. It is also expected that the plume is dissipating, as a significant portion of the source zone has been cut-off through the installation of the sheet-pile cell. Given that a significant groundwater

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quality database exists for the Site (i.e. numerous wells monitored over a long time period) and the observed concentration time trends, it is concluded that groundwater concentrations are not increasing over time. Therefore, groundwater concentrations recorded after September 1, 1995, approximately one year after the sheet-pile source control was implemented, at the previously identified nineteen monitoring wells (located near surface water bodies) were compared to Table 3-7 criteria.

Comparison indicated exceedances of Table 3-7 criteria for the following compounds: arsenic, manganese, zinc, cis-1,2-dichloroethylene and trichloroethylene. These exceedances occurred at only five of the wells (MW-02-S1, MW-03-S1, MW-04-S1, MW-30-S1 and MW-54-S1).

The generic criteria listed in the Gradient Report and used to identify exceedances for groundwater discharging to a surface water were developed based on readily available published criteria. The readily available published criteria cited are protective of both human and ecological exposure. However, other applicable screening criteria with respect to evaluation of human exposures exist. Specifically, in evaluating the significance of direct human exposures to a surface water, in consideration of the effects of groundwater discharges to the surface water, comparison of MCL multiplied by a dilution attenuation factor of 10 is considered an applicable screening criterion. The use of a default dilution attenuation factor of 10 is considered appropriate in the evaluation of the data from locations MW-02-S1, MW-03-S1, MW-04-S1, and MW-54-S1 as the northern most onsite unnamed tributaries to the Quinnipiac River receive dry weather discharges from onsite processes (discharges from X and Y drain – refer to Site Plan in Attachment No. 2.). The cumulative dry weather flows from X and Y drain are in the range of 100,000 gallons per day. The dry weather discharges likely exceed the flow of groundwater to these unnamed tributaries by far more than a factor of 10. The use of a default dilution attenuation factor of 10 in evaluating discharges of groundwater to the Quinnipiac River is a conservative approach consistent with the approach utilized in the calculation of the surface water protection criteria in the Connecticut Remediation Standard Regulation. The applicable screening criteria for evaluation of direct human exposures to surface water in consideration of the effects of groundwater discharge to the surface water are as follows:

• Arsenic	0.05 mg/l x 10	=	0.5 mg/l
• Manganese	0.05 mg/l x 10	=	0.5 mg/l
• Zinc	5 mg/l x 10	=	50 mg/l
• cis-1,2-DCE	70 µg/l x 10	=	700 µg/l
• TCE	5 ug/l x 10	=	50 ug/l

After comparing the maxima to 10 x the MCLs, there remain only the exceedance for cis-

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1,2-dichloroethylene and trichloroethylene at only two of the wells (MW-02-S1 and MW-54-S1).

The above approach was not applied to the evaluation of data from MW-30-S1 as this well is located along a reach of an unnamed tributary that does not receive dry weather process water discharges. However, the single exceedance for arsenic noted in groundwater collected from location MW-30-S1 during May 1999 is based on data from an unfiltered groundwater sample. The analytical data for the unfiltered sample indicates a concentration of 0.0053 mg/l, slightly above the Table 3-7 criteria of 0.004 mg/l. The groundwater sample collected from this location during the same sampling event that was filtered prior to analysis resulted in the detection of arsenic at a concentration of 0.0012 mg/l, well below the screening criteria. As a result, it is concluded that the concentration in arsenic detected in groundwater that exceeded the Table 3-7 criteria results from sediment or other colloidal material within the sample and the filtered groundwater sample is most representative of groundwater that discharges to surface water. As the filtered sample analytical results do not exceed the Table 3-7 criteria, it is concluded that no exceedance of the Table 3-7 criteria exists for this location.

As a means to assess a worst case impact to surface water as a result of groundwater discharging to surface water, an evaluation was performed based on the assumption that all groundwater passing MW-02-S1 were to enter the surface water as a point source discharge over a period of time for which relevant data were available. To perform the evaluation, the 95% UCL of the mean of the dataset for MW-02-S1 was calculated to obtain a biased-high, but statistically valid concentration of cis-1,2-dichloroethylene in well MW-02-S1. The 95% UCL of the mean of the log-normally distributed data set for cis-1,2-dichloroethylene for groundwater at MW-02-S1 since September 1, 1995 is 666 µg/l. This is below the applicable screening level of 700 µg/l. As a result, the concentration of cis-1,2-dichloroethylene present detected in MW-02-S1 is determined to be insignificant.

Similarly, the 95% UCL of the mean of the log-normally distributed data set for cis-1,2-dichloroethylene for groundwater at MW-54-S1 since September 1, 1995 is 404 µg/l which is below the applicable screening level of 700 µg/l.

The 95% UCL of the mean of the data sets for trichloroethylene at MW-02-S1 and MW-54-S1 each exceed the 10 x the MCL screening level. However, other applicable screening criteria with respect to evaluation of human exposures exist. Risk-based screening criteria, protective of human health, were developed for evaluation of direct human exposures to surface water in consideration of the effects of groundwater discharging to the surface water based on site-specific exposure assumptions by Gradient Corporation. These criteria are provided in Attachment No. 1 and the strictest limit for trichloroethylene is 15,740 µg/l. Comparison of the maxima at wells MW-02-S1 and

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MW-54-S1 for groundwater since September 1, 1995 with this criterion does not indicate an exceedance.

In addition to evaluating trends in groundwater discharging to surface water at the wells identified above, historic VOC concentrations in groundwater were also evaluated on a site-wide basis. Drawings prepared by Fuss & O'Neill, Inc. depicting total VOCs detected in groundwater (1993 and 1994) are provided in Attachment No. 2. Graphs of detected VOCs concentrations versus time (since January 1992) for wells MW-31-S1, MW-45-S1, MW-46-S1, MW-48-S1, MW-52-S1 and MW-53-S1 are provided in Attachment No. 3. These wells were selected to graphically illustrate the declining trend(s) for VOCs identified in the Fuss & O'Neill drawings for wells down-gradient of the sheet-pile cell (see location on the site plan provided in Attachment No. 2). The sheet-pile cell was installed in November and December of 1994 to contain an historic TCE release. The sheet pile cell was installed to the depth of a confining silt/clay aquitard. The graphs for these wells downgradient of the sheet-pile cell illustrate the expected decline in VOCs in groundwater from those depicted in the Fuss & O'Neill drawings from 1993 and 1994 (before the cell was installed).

An area of groundwater contamination located at the facility is presently under study by various outside parties, including the University of Waterloo (UW), as part of scientific research into proposed remediation technologies for dense non-aqueous phase liquids (DNAPL). This area, commonly referred to as the sheet-pile cell or, alternately, the former "area of concern no. 17" (AOC17), is the site of an historic TCE release (see location on the site plan provided in Attachment No. 2). The majority of this TCE release is presently contained within the limits of a sheet pile perimeter installed to the depth of a confining silt/clay aquitard located beneath the DNAPL release. The sheet-pile cell was installed in November and December of 1994. In 1999 and 2000 the UW performed field studies to evaluate the effect of the sheet-pile cell on dissolved-phase groundwater contamination emanating from the release area. The results of the study are summarized in the following paragraphs and are provided herein. The results support the conclusion that contaminated groundwater plumes are decreasing with time and will remain within the limits as defined by the monitoring locations designated at the time of this determination. Figures referenced in the following paragraphs have also been provided in Attachment No. 2.

During the performance of the investigation, the UW collected groundwater samples from discrete sampling locations along three transects oriented roughly perpendicular to the groundwater flow direction at the site. Groundwater samples were collected during two events in July and October 1999. At each monitoring location along the transects, groundwater samples were collected at depth-discrete vertical intervals using either multilevel bundle samplers (which are permanent installations, thus allowing temporal sampling) or the Waterloo Profiler (temporary sample locations). Volatile organic

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compound analyses were typically performed in the field using a portable SRI GC housed in a mobile laboratory.

Transect 1

Included in Attachment No. 2 are plots showing TCE and cis-dichloroethylene (cis-DCE) contours along Transect 1. These figures were compiled from analytical data for groundwater samples collected during the July and October 1999 sampling events. Note that these figures are vertically exaggerated by a factor of 30. TCE was the predominate VOC detected along this transect. The highest TCE concentration observed along this transect was approximately 34,000 mg/l. The highest concentrations are present at the base of the aquifer, consistent with the nature of the upgradient TCE DNAPL source zone. The dissolved-phase VOC plume is over 800 ft wide along this transect.

Transect 2

Included in Attachment No. 2 are plots showing TCE and cis-dichloroethylene contours along Transect 2 in 1999. The highest concentrations occur in the vicinity of where the small stream crosses the transect, just north of the pond. The highest TCE concentration along the transect was about 3,000 mg/l (roughly an order of magnitude lower than the highest concentration detected along Transect 1). The cis-DCE plume generally overlaps the TCE plume, although the concentrations are generally lower (the maximum cis-DCE concentration was about 150 mg/l). This indicates that some TCE transformation is occurring to cis-DCE. The southern end of the plume was not fully delineated characterized in 1999 and additional multilevel wells were installed in 2000 to delineate the southern end of the plume. Along the transect just downgradient of the pond, a "clean" zone occurs where TCE concentrations were below detection limits, except at the base of the aquifer. It is expected that this is a result of recharge from the pond, with only a portion of the plume passing under the pond. The pond was sampled at a few locations near the upgradient bank in August 2000, and all samples had detectable TCE and cis-DCE, with the highest concentrations in the mg/L range.

Transect 3

Included in Attachment No. 2 are plots showing TCE and cis-DCE contours along Transect 3, located just upgradient of the Quinnipiac River. These figures were compiled from analytical data for groundwater samples collected during the July and October 1999 sampling events. The peak TCE concentration along this transect was less than 50 mg/l (roughly two orders of magnitude lower than the maximum observed concentration along Transect 2). The cis-DCE concentrations along this transect are in a similar range as TCE (i.e. 10's of mg/l).

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Dissolved VOC Concentrations vs. Distance

The results of the study performed by UW show a significant drop in peak TCE concentrations, of about 3 orders of magnitude, over the 1200 ft travel distance between the western edge of the facility and the river. UW has concluded that it expects that several attenuation mechanisms are at work, including dispersion, discharge to the pond and streams, diffusion into (and out of) the underlying aquitard, and degradation. It is also expected that the plume is dissipating, as a significant portion of the source zone has been cut-off through the installation of the sheet-pile cell.

Groundwater Flow Direction

As discussed in the response to Question 2 above, a groundwater contour map had been developed for the 1998 VCAP groundwater sampling event. Additionally, the UW generated a groundwater contour map utilizing data collected in September 1999. This map, provided in Attachment No. 2, supports the previous conclusion that groundwater flow at the site is toward the Quinnipiac River and that contaminated groundwater at the site also flows to the Quinnipiac River.

Of all the compounds detected in groundwater at concentrations above the generic P&W screening levels, arsenic and cadmium are considered potentially bioaccumulative compounds. Arsenic was detected in 21 of 229 (9.2 percent) of groundwater samples collected at the site for which it was analyzed. Arsenic was observed in groundwater samples from wells distributed throughout the facility site. No identifiable trend or areas of concentration were observed. P&W generic groundwater screening levels for arsenic were exceeded in only 5 of the 229 (2.2 percent) groundwater samples. Cadmium was detected in 68 of 652 (10.4 percent) of groundwater samples collected at the site for which it was analyzed. As with arsenic above, cadmium was observed in groundwater samples from wells distributed throughout the facility site. No identifiable trend or areas of concentration were observed. P&W generic groundwater screening levels for cadmium were exceeded in only 15 of the 652 (2.3 percent) groundwater samples. Due to the infrequent detection of these compounds in groundwater at the site, coupled with the spatial distribution of the locations from which compounds were detected, potential bioaccumulative affects are not considered relevant in the evaluation of the data.

Sediment

As discussed under Question No. 2, sediment samples have been collected from 24 locations at the site; 5 locations during risk assessment sampling and 19 historic sampling locations. From a review of the data associated with samples collected from these locations, exceedances of the screening levels for sediment were identified for benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, dibenzo[a,h]anthracene and

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indeno(1,2,3-cd)pyrene at locations NH-RSK-SD-02 and NH-RSK-SD-04.

Additional evaluations conducted by Gradient Corporation demonstrated that these poly-aromatic hydrocarbon (PAH) compounds are not expected to pose significant risks. To understand the significance of risks posed *via* sediment exposure, “risk ratios” were calculated to quantify potential carcinogenic and non-carcinogenic risks for Samplers, Trespassers, and Off-Site Recreators. Risk ratios were calculated by dividing the maximum detected concentration by the chemical’s screening level. Since the screening levels were risk-based and were calculated using a target cancer risk of 1×10^{-6} and a hazard quotient of 1.0, risk ratios can be used to quantify risks. The sum of risk ratios for multiple chemicals (for a given pathway and receptor) times the target risk used for calculating the screening level represents the total risk posed by that pathway. For example, if the sum of risk ratios for carcinogenic compounds was 10, the cancer risks posed would be 10×10^{-6} or 1×10^{-5} .

Sediment-related risk ratios for the three receptors for chemicals that exceeded the screening levels are provided in Attachment No. 6. Note, the PAH compounds of interest are carcinogens and do not have non-cancer toxicity factors available. Therefore only cancer risk ratios were calculated and summed. Cancer risk ratios were quantified using both the average and the maximum concentration for the carcinogenic PAHs that exceeded the screening levels. The average concentration was used in addition to the maximum concentration because: 1) all sediment samples were obtained from within the same exposure unit; and 2) exposure concentrations within the same exposure unit are best represented by the arithmetic mean. Using the cancer risk ratios, cancer risks *via* the sediment pathway for Samplers were calculated to range from 1.9×10^{-6} (average) to 3.4×10^{-5} (maximum). Whereas the cancer risk for Trespassers and Off-Site Recreators was calculated to range from 5.8×10^{-8} (average) to 4×10^{-6} (maximum). These calculated risks for the sediment pathway (even using the maximum concentration) are within the range of cancer risks (10^{-4} to 10^{-6}) considered “acceptable” by USEPA. In addition, the cancer risks using the average concentration are on the order of 10^{-6} (or lower), *i.e.*, less than or equal to the lower bound of USEPA’s target cancer risk range. In addition, the contribution to risks due to potential exposures *via* surface water and soil-related pathways, the other complete pathway for these receptors, is also insignificant since the detected surface water and soil concentrations were below their respective screening levels. Therefore, cumulative risks to Samplers, Trespassers, and Off-site Recreators, *i.e.*, considering all complete pathways, are not significant since they are well within risk targets established by USEPA.

Footnotes:

- ⁴ If there is any question on whether the identified exposures are “significant” (*i.e.*, potentially “unacceptable”) consult a human health Risk Assessment specialist with appropriate education, training and experience.

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5 Can the “significant” exposures (identified in #4) be shown to be within **acceptable** limits?

_____ If yes (all “significant” exposures have been shown to be within acceptable limits) - continue and enter “YE” after summarizing and referencing documentation justifying why all “significant” exposures to “contamination” are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).

_____ If no (there are current exposures that can be reasonably expected to be “unacceptable”)- continue and enter “NO” status code after providing a description of each potentially “unacceptable” exposure.

_____ If unknown (for any potentially “unacceptable” exposure) - continue and enter “IN” status code

Rationale and Reference(s):

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6. Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

 X YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the Pratt & Whitney North Haven facility, EPA ID Number CTD001449511, located at 415 Washington Avenue, North Haven, Connecticut under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

 NO - "Current Human Exposures" are NOT "Under Control."

 IN - More information is needed to make a determination.

Completed by (signature) Ernest Waterman Date 5-29-2002
(print) Ernest Waterman
(title) Co-leader

Supervisor (signature) Matthew R. Hagland Date 5/29/02
(print) Matthew R. Hagland
(title) Section Chief
(EPA Region or State) Reg. I.

Locations where References may be found:

EPA Region I
One Congress Street, Suite 1100
Boston, MA 02114

Contact telephone and e-mail numbers

(name) Ernest Waterman
(phone #) 617-413-1369
(e-mail) Waterman.ernest@epa.gov

FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.

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LIST OF ATTACHMENTS

- ATTACHMENT NO. 1** COPIES OF APPLICABLE SECTIONS, *CONCEPTUAL SITE MODELS AND SCREENING LEVELS FOR PRATT & WHITNEY'S VCAP CONNECTICUT FACILITIES*, GRADIENT CORPORATION, DECEMBER 19, 1997, REVISED SEPTEMBER 18, 1998, AND SEPTEMBER 15, 1999, AND OTHER APPLICABLE CRITERIA AND RATIONALE DEVELOPED BY GRADIENT CORPORATION
- ATTACHMENT NO. 2** SITE PLANS, GEOLOGIC CROSS-SECTIONS AND GROUNDWATER CONTOURS (DECEMBER 1998) DISTRIBUTION OF VOCs IN GROUNDWATER, AND UW INVESTIGATION RESULTS
- ATTACHMENT NO. 3** SUMMARY OF GROUNDWATER ANALYTICAL DATA AND CONSTITUENTS DETECTED IN GROUNDWATER AND GRAPHS OF CONCENTRATIONS VERSUS TIME AT CERTAIN WELLS
- ATTACHMENT NO. 4** SUMMARY OF INDOOR AIR ANALYTICAL DATA AND CONSTITUENTS DETECTED IN INDOOR AIR
- ATTACHMENT NO. 5** SUMMARY OF SURFACE SOIL ANALYTICAL DATA AND CONSTITUENTS DETECTED IN SURFACE SOIL
- ATTACHMENT NO. 6** SUMMARY OF SURFACE WATER AND SEDIMENT ANALYTICAL DATA AND CONSTITUENTS DETECTED IN SURFACE WATER AND SEDIMENT