VOLUME I OF II
HUMAN HEALTH RISK ASSESSMENT
DISPOSAL SPECIALISTS, INC. SITE
ROCKINGHAM, VERMONT

Prepared for:

Disposal Specialists, Inc.
Route 5, Missing Link Road
Rockingham, Vermont 05101

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DISPOSAL SPECIALISTS, INC. SITE
ROCKINGHAM, VERMONT

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HUMAN HEALTH RISK ASSESSMENT
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1.0 INTRODUCTION

The Disposal Specialists, Inc. (DSI) site baseline human health risk assessment (HHRA) was performed in conjunction with the DSI Site Remedial Investigation/Feasibility Study (RI/FS) in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the Superfund Amendments and Reauthorization Act (SARA). The risk assessment process provides for the assessment of potential adverse effects to human health and the environment for sites which have been placed on the National Priorities List (NPL) by the U.S. Environmental Protection Agency (EPA) . This HHRA supplements the draft RI report previously submitted to EPA, the FS and ecological risk assessment which are currently being prepared as separate documents. For a comprehensive list of acronyms used in this report, refer to Appendix A.

The primary focus of the HHRA is to assess baseline conditions at the site and to evaluate potential risks to human health in the absence of remediation. Baseline conditions were defined as conditions existing as of February 1993. The HHRA draws on information provided from site topography and geology, site history, field activities, analytical results, screening data, and other sources. Within this framework, the risk assessment identifies potential hazards associated with the site, selects constituents of concern, assesses the toxicological and/or carcinogenic significance of those constituents, develops scenarios for exposure pathways, and characterizes potential risks.

In the risk assessment process, three primary elements provide the basis to assess potential risks at a site. First, an identification of potential hazards is performed to assess whether constituents are present at a site which may pose a hazard and, if so, the media (e.g., soil, surface water, etc.) which contains these constituents. The outcome of this analysis, presented as Section 4.0, identifies constituents and media to be further evaluated. Second, an identified constituent of concern is described in toxicological terms through a dose-response assessment; this information is contained in Section 5.0.

Once target constituents and media have been described, a pathway and receptor analysis, also known as an exposure assessment, is conducted. In this analysis, a determination is made as to whether a complete exposure pathway exists between affected media and potential human receptors. This analysis is presented in Section 6.0. If a complete pathway is not found to exist between an affected media and a potential receptor, exposure does not occur and that scenario is not considered further in the risk assessment. If a complete pathway is found to exist, potential risks are quantified for that receptor. These results are presented in Section 7.0.

Methods of risk evaluation are based primarily upon the EPA documents, "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual" (HHEM); "Supplemental Risk Assessment Guidance for the Superfund Program, EPA Region 1" (SRA); "Superfund Public Health Evaluation Manual" (SPHEM); and "Superfund Exposure Assessment Manual" (SEAM).

2.0 SITE HISTORY AND OVERVIEW

2.1 BACKGROUND

The DSI landfill site is located on the west side of U. S. Route 5 in the Town of Rockingham in Windham County, Vermont. A locus map is presented as Figure 1. The DSI property comprises approximately 99.5 acres of land of which approximately 17 acres are occupied by the landfill. The landfill is situated on a glacial terrace located along the west side of the Connecticut River. The land surface slopes steeply to the river from a prominent ridge located west of the landfill known as Hogan Hill.

Currently, the DSI site is comprised of an active facility used as an office and dispatch area for DSI's waste management business, a staging area for recycling, a vehicle maintenance garage, and an inactive municipal solid waste (MSW) landfill. The active facility consists of a main building and several support buildings. Buildings, facility structures (e.g., underground storage tanks, truck scale, etc.), and other pertinent site information are presented in Figure 2.

The DSI property is bordered by undeveloped land to the west and north and by U. S. Route 5 to the east. One seasonal camp, three permanent residences, and a private club (the Hit or Miss Club) are located east of the site between Route 5 and the Connecticut River. The residences and camp are served by a private well located at the south end of the DSI property. The Hit or Miss Club is served by a private well on club property. Residences are also located south of the DSI property and are served by individual private wells. The Charlestown, New Hampshire Publicly Owned Treatment Works (POTW), which discharges treated waste water effluent to the Connecticut River, is located east of the landfill on the east side of the Connecticut River. The Springfield, Vermont POTW, located approximately 5 miles from the site, discharges treated waste water effluent to the Black River which drains into the Connecticut River upstream of

the site. Also, the Old Springfield Landfill Superfund site is located approximately 5 miles north of the site.

The 1990 census estimates for Bellows Falls, which includes the Town of Rockingham, indicates that approximately 5,500 people live in the census area. The Springfield, Vermont town line is located approximately one-third of a mile north of the landfill. NUS Corporation (NUS) (NUS, 1987) estimated that approximately 875 people using ground water as a water supply live within a three-mile radius of the DSI site on the Vermont side of the Connecticut River.

The climate of Rockingham, Vermont is characterized by variable and widely fluctuating daily and annual temperature ranges. Mean January and July temperatures in the southeastern Vermont climatic region are 19 degrees and 68 degrees Fahrenheit, respectively. The mean annual temperature is 44 degrees Fahrenheit. Cold, dry air masses from sub-arctic North America and warm, moist air masses from the Gulf of Mexico primarily affect Vermont's weather. The prevailing wind direction at the Springfield airport is from the west. Total annual precipitation in the southeastern Vermont climatic region is approximately 45 inches. The snowfall rates in Vermont range widely with topographic variation; however, annual snowfall in the Connecticut River Valley is approximately 55 to 60 inches.

2.2 SITE HISTORY

A summary of the site chronology is presented in the following paragraphs. The DSI site was first developed in the early 1960's when sand and gravel excavated from the site were used for embankment fill during construction of Interstate 91. Aerial photographs indicate that by 1965, excavation activities had been discontinued and the area had been regraded.

In January 1968, the site, owned by Harry K. Shepard, Inc., received approval from the Vermont Department of Health to operate a municipal solid waste landfill in the former excavation area. Landfill operations began in September 1968 and in 1969 Harry K. Shepard, Inc. deeded the property to Disposal Specialists, Inc. (DSI) and DSI subsequently conducted landfill operations. In 1973 DSI and Harry K. Shepard, Inc. were purchased by Browning-Ferris, Inc. and Harry K. Shepard, Inc.'s name was changed to BFI of Vermont (BFIVT). The site continued to be operated by DSI and BFIVT as a landfill until November 1991 when landfill operations ceased and an interim soil cover was placed over the landfill.

In 1979, the Vermont Department of Environmental Conservation (VTDEC) collected and analyzed ground water samples from six bedrock wells in the vicinity of the landfill. Based upon results of that analysis, the VTDEC required DSI to supply nearby residents with bottled water. In 1980, a new supply well was installed on DSI property and serviced the residents previously supplied with bottled water. Currently, no residents in the vicinity of the landfill are supplied bottled water by DSI.

A series of Assurance of Discontinuance Agreements between DSI and the VTDEC required DSI to demonstrate that the landfill would not further degrade ground water or surface water quality in the vicinity of the landfill. Consequently, beginning in 1979, a series of hydrogeologic investigations at the site were performed to investigate ground water flow and water quality conditions at the landfill.

During the period from 1985 to 1987, an NUS Corporation Field Investigation Team (NUS/FIT) on behalf of the EPA completed a preliminary assessment Superfund study (NUS, 1985) and final site inspection report (NUS, 1987) to evaluate whether the DSI site warranted further investigation under the National Contingency Plan (NCP). Based upon these NUS reports and a Hazard Ranking

Score, the site was included on the EPA National Priorities List in October 1989 as the BFI-Rockingham landfill.

During the spring of 1992, DSI initiated negotiations with the EPA to conduct a Remedial Investigation/Feasibility Study (RI/FS) in accordance with NCP requirements. An Administrative Order, EPA Docket No. I-92-1053, for RI/FS activities was entered into by DSI and BFIVT in July 1992 and became effective August 8, 1992.

Pursuant to Paragraph 20 of the Statement of Work for the Administrative Order, DSI was to perform an RI to determine the nature, extent, and distribution of contamination that exists at the DSI landfill site. In response to this requirement, Balsam was retained to perform the RI as well as the FS. A draft RI report (Balsam, 1992) and a draft initial screening of alternatives report (Balsam 1992a) were completed and submitted to the EPA and VTDEC on November 6, 1992. EPA comments regarding these two documents were received and are currently being addressed.

Also, pursuant to Paragraph 47 of the Administrative Order, the Route 5 slope stabilization and seepage control system was designed during the summer of 1992 and constructed during the fall and winter of that same year. The primary purposes of the Route 5 slope stabilization and seepage control system were to: 1) collect seepage discharging within the surface drainage ditch to the east of the landfill and immediately adjacent to Route 5, 2) reduce seepage beneath Route 5, and 3) reduce soil pore water pressure in the localized area along Route 5.

2.3 REMEDIAL INVESTIGATION

The draft RI report includes the most current and complete characterization of the site. Data for each investigation conducted during the RI and RI findings are presented in that report. A discussion of the procedures used to perform these

investigations is presented in the Field Sampling Plan (FSP) (Balsam, 1991) and the interpretation used to reach conclusions presented in the HHRA are presented in the RI report (Balsam 1992).

Several investigatory methods were used during the RI to: characterize the site and study areas and describe the nature, source(s), and extent of contamination; identify potential contaminant pathways; provide data necessary to assess potential risks to public health and the environment; and provide data sufficient to identify remedial actions, select a remedy, and support remedial design requirements. These investigations included:

- An assessment of surface features through review of aerial photographs and a study of bedrock outcrops,
- Test pit investigations,
- Geophysical evaluations,
- Soil and bedrock evaluations,
- Ground water evaluations,
- Water level elevation measurements,
- Surface water and sediment evaluations,
- Air quality surveys, and
- Ecological evaluations.

3.0 ENVIRONMENTAL SETTING

3.1 TOPOGRAPHY

The DSI site is located on Route 5 (Missing Link Road) on the southeastern slope of Hogan Hill in Rockingham, Windham County, Vermont. The landfill extends northeast-southeast along Hogan Hill, approximately parallel to Route 5. The area surrounding the site is hilly terrain. Elevations of local hill tops are in the range of 900 feet to 1,500 feet National Geodetic Vertical Data (NGVD) mean sea level (MSL). A significant feature of the landscape is the Connecticut River which flows from north to south in a well defined valley approximately 4,000 feet in width near the site (refer to Figure 1). The valley floor is at an elevation of approximately 300 feet MSL in the vicinity of the site.

Landfilled refuse is located within a former borrow pit area and is flanked to the northwest by steep bedrock slopes and by a steeply sloping overburden terrace to the east. Ground surface elevations across the site range from approximately 370 feet MSL on the east to approximately 600 feet MSL on the west. The landfill is surrounded primarily by wooded terrain.

3.2 ENVIRONMENTAL SETTING

This section provides a description of geology, including both surficial and bedrock geology, hydrology including both surface water and bedrock hydrology, and the landfill.

3.2.1 Geology

3.2.1.1 Surficial Geology

The DSI site is located on a glacial terrace. The upper strata of the terrace, reportedly consisting of sand and gravel, was excavated for embankment fill for the construction of Interstate 91 in the 1960's. According to the RI and previous reports (e.g., Haley and Aldridge, Inc., 1988), the upper terrace deposit consisted of up to 50 feet of gravel. The excavation apparently removed the majority of sand and gravel since large deposits of gravel and sand were not reported present in reports describing current or previous investigations.

According to Stewart and MacClintock (1969), the sediments in the Connecticut River basin were deposited as lacustrine sediments consisting of a discontinuous basal till on top of bedrock, overlain by varved silt and clay, with sand and shoaling lake deposits as the uppermost strata. The uppermost unit encountered in soil borings advanced during the RI consists primarily of fine to medium sands and silts that are underlain by varved silt and clay. The varved silt and clay is underlain by a thin sand unit and basal till in some areas as indicated in borings.

The silt and clay are interpreted to have been deposited as lacustrine deposits on discontinuous glacial tills that mantled bedrock; this is consistent with the reported geologic history. A dense till was encountered overlying bedrock in some borings drilled to bedrock downgradient of the landfill. The sands above the till may represent glaciofluvial deposits emptying into the previously existing glacial lake (Lake Hitchcock). The till and sand layers appear to be discontinuous across the site.

The thickness of overburden encountered in borings varies from zero feet along the northwestern side of the landfill (e.g., MW-B3, DSI-MW-H27) to approximately 200 feet near the facility entrance (e.g., DSI-MW-E23). Overburden thins southeast of

Route 5 with the steep topography of zero to 50 feet in thickness near the Connecticut River based upon the observation of a bedrock outcrop along the river and seismic refraction data collected during the RI.

3.2.1.2 Bedrock Geology

The region surrounding DSI is generally characterized by linear ridges trending north-northeast which are separated by valleys. The ridges generally consist of more mafic rocks while the valleys are commonly underlain by more mica-rich or carbonate-rich rocks. Much of the bedrock in the area is covered with glacial-derived overburden. The regional geology according to Boxwell (1986) includes three primary lithologic formations separated by north-northeast trending bands of volcanic rocks. Most of the bedrock in the area is dominated by micaceous schists, metavolcanics, and impure quartzites. Described from east to west, and from youngest to oldest, the formations include the Littleton Formation, the Putney Volcanics, the Gile Mountain Formation, the Standing Pond Volcanics, and the Waits River Formation. The site is interpreted to be underlain by the Littleton Formation.

Regionally, these formations form the upper section of the Vermont Sequence, which occupies the Connecticut Valley-Gaspe Synclinorium (Boxwell, 1986). This sequence is characterized by north-northeast trending units which dip steeply to the east and flank the Green Mountain Anticlinorium to the west. The Vermont Sequence appears to have been folded and deformed by the upwarping of a series of Precambrian gneiss domes during the Acadian or Alleghenian Orogenies.

The contact between the Putney Volcanics and the Littleton Formation is a significant structural feature referred to as the Chicken Yard Line. Defined as an unconformity in southern Vermont, this contact may represent a tectonic break along which rocks preserving different geologic histories are juxtaposed. Several faults are evidenced along this line, trending north-south and ranging in dip from

vertical to 50 degrees west. This structural feature was mapped by Boxwell (1986) several thousand feet west of the study area, but does not appear to underlie the area.

Significant bedrock topographic relief occurs across the site with bedrock surface elevations ranging from over 600 feet MSL northwest of the landfill to less than 250 feet MSL beneath portions of the Connecticut River. RI investigations indicate that the bedrock geology is characterized by a sequence of inter-layered black to grey phyllite and slate, consistent with the Littleton Formation. Foliation generally trends north-northeast to north-northwest, and the primary fracture set strike follows this trend with steep to vertical dips. A secondary fracture set exhibits a strike approximately perpendicular to the foliation, also with dips near vertical.

3.2.2 Hydrology

3.2.2.1 Surface Water Hydrology

The DSI site is located within the Connecticut River drainage basin. The river flows in a southerly direction and is located approximately 500 feet east of the site. The river, designated as a Class B river, is suitable for recreation, fishing, and drinking water use after treatment. There are no known drinking water intakes in the Connecticut River within three miles downstream of the site.

Surface water from the site area is discharged to the Connecticut River by two primary pathways:

- Parking area runoff and runoff from the east side of the landfill are conveyed by a culvert which discharges approximately 50 feet from the Connecticut River, and,
- Runoff adjacent to Route 5 discharges overland to the Connecticut River.

Most surface water from the west side of the landfill flows in a high density polyethylene (HDPE) lined drainageway to an earthen retention pond where it likely recharges ground water. A small component of drainage from the west side of the landfill flows to a flat wooded area northeast of the landfill.

3.2.2.2 Ground Water Hydrology

Two ground water systems were identified based upon information obtained during previous investigations and the RI. A perched ground water system is present in overburden in the shallow sandy deposits and to a limited extent in the upper varved silt and clay unit. Ground water in overburden is laterally and vertically discontinuous as evidenced by dry overburden monitoring wells and piezometers in the areas northeast, southeast and southwest of the landfill. Overburden ground water is recharged by infiltrating precipitation and is interpreted to flow primarily horizontally toward Route 5 where it is principally intercepted by the Route 5 seepage control system. Vertical ground water flow in the overburden is restricted by the low hydraulic conductivity of the varved deposits underlying the more permeable sandy soil.

A second ground water system was identified in bedrock. Ground water flow in bedrock is generally toward the Connecticut River. Bedrock ground water is recharged northwest of the landfill where the bedrock surface is in close proximity to the ground surface, and discharges to the Connecticut River.

3.2.3 Disposal Area

The areal extent of waste encompasses approximately 17 acres (see Figure 2). The volume of waste contained within the landfill, including cover soil, was estimated to be approximately 1,200,000 cubic yards based upon the current landfill topography and the 1965 landfill area topography. The maximum landfill thickness is estimated to be approximately 100 feet. The outline of the landfill is

irregularly shaped and elongated with a length exceeding 1,600 feet and a width exceeding 500 feet.

In general, the primary types of waste accepted for disposal at the landfill include municipal, industrial and commercial solid wastes, construction and demolition debris, and, for a short period, ash from a municipal solid waste incinerator. From April 1987 to October 1988, municipal solid waste incinerator ash was placed in an approximately 1.5 acre expansion of the landfill. The expansion area was lined with high-density polyethylene and included a leachate collection system. After the disposal of ash ceased, an intermediate cover was placed on the expansion area. The lined area is depicted on Figure 2.

The "cell method" of waste disposal appears to have been used during the operating life of the landfill. This method involved placing daily receipts of waste in lifts, compacting with a track or steel-wheeled roller, and placing a soil cover over the area on a daily basis. This method provided some sanitary protection by limiting the extent of open waste areas, as well as providing some protection from excessive wind-blown debris. Disposal practices occurred first in the northeast portion of the landfill. A series of air photos indicates that disposal occurred in the southwestern portion of the landfill in the late 1970's and early 1980's.

A landfill gas collection was installed at the site during the winter of 1989/1990 to collect methane and other landfill gases. The collection system consists of 29 gas extraction wells and associated piping installed by DSI on the top, east and south sides of the landfill as well as in the natural soil between the landfill and facility buildings. A blower and McGill EGF-41 flare were also installed to dispose of the collected gas.

4.0 HAZARD IDENTIFICATION

Constituents associated with the DSI site which may pose a potential risk to human health were identified by assessing current and future foreseeable site conditions, evaluating the current site analytical database, reviewing historical analytical data for off-site domestic wells, considering the extent of contamination, and accounting for toxicity, concentration and other constituent characteristics. Based upon this evaluation, constituents of concern were selected for each affected environmental medium.

4.1 REVIEW OF ANALYTICAL DATABASE

Analytical data generated during the ground water, surface water and sediment sampling programs performed at the DSI site in October 1991 and March 1992 were evaluated to determine their applicability for use in the HHRA and served as the basis for estimating site risks. Ground water, surface water and sediment sample analyses were performed using EPA Contact Laboratory Program (CLP) protocols. As detailed in the RI, analytical results used in the HHRA have been reviewed and validated in accordance with EPA data validation guidelines. The analytical database used for the HHRA was extracted from the DSI site RI and is provided in Appendix B.

Historical analytical data for ground water from on-site monitoring wells and from off-site domestic wells were also reviewed for potential use in the risk assessment. Based upon the review, it was determined that while numerous sampling rounds may have been performed, there has been variation in the use of sampling methods, analytical methods, sample handling practices, and in the degree of supporting documentation for data analysis. Historical analytical data were therefore used only to assess data trends and to provide qualitative support for data generated from the October 1991 and March 1992 sampling rounds.

4.2 ASSUMPTIONS FOR DATA USE

Several assumptions were made to prepare the data presentation and to complete the evaluation supporting the risk assessment process. Constituents reported as estimated concentrations (i.e., qualified with a "J") were considered representative of the actual concentration. Analytical results qualified as rejected in data validation were not included in the risk assessment. Constituents reported as below detection limit (BDL), or otherwise unquantifiable, were considered as not detected (ND). In addition, for constituents reported as not detected, a value of one-half of the reported detection limit was used to estimate exposure point concentrations. Duplicate samples were considered to represent a single sample, and an average of duplicate sample results was therefore counted only once in the frequency tabulation.

Laboratory data for dissolved inorganic constituents were used in the risk assessment to evaluate potential exposure to ground water. It was judged that analytical data for dissolved inorganic constituents in ground water better represent conditions within the aquifer than analytical data for total inorganic constituents, which include constituents adsorbed to sediments and particulates.

4.3 MEDIUM-SPECIFIC DATA SUMMARY

Detected constituents in each medium to be quantitatively assessed (surface water and sediment) were tabulated along with their frequency of detection, range of detected concentrations, and location of maximum concentration. The rationale for not evaluating other media quantitatively (ground water, soil and ambient air) was also discussed in this section.

4.3.1 Ground Water

Ground water analytical data were categorized according to the ground water source, i.e., overburden ground water or bedrock ground water. Analytical results from upgradient monitoring wells were considered to represent background conditions and were included in the data summaries. Background concentrations for overburden ground water were derived using data from monitoring well GW-RS while background concentrations for the bedrock aquifer were derived using data from monitoring wells GW-I, MW-B3, MW-G25, MW-G26, MW-H27, MW-H28 and GW-OW3. Ground water samples were analyzed for the presence of VOCs, acid/base neutral extractable or semi-volatile organic compounds (ABNs), pesticides and polychlorinated biphenyls (pesticides/PCBs) and inorganic constituents. The data summary for constituents reported in ground water is presented in Table 1.

It is typically EPA policy to consider potential health effects related to domestic use of ground water when preparing a HHRA; however, this was not considered appropriate for the DSI site. As previously discussed in Section 3.3, and as discussed in detail in the RI, ground water present in site overburden adjacent to the landfill was not judged to be a viable aquifer for water supply purposes. This conclusion was reached after considering the relatively low hydraulic conductivity of these soils, the lower yields observed in site overburden wells during sampling, and the inadequacy of the yields to provide water for a domestic water supply. In addition, sufficient area does not exist between the landfill and Route 5 to permit construction of a dwelling due to the steep topography of the site. East of Route 5, overburden ground water was found to be either absent or present in only very limited amounts. For these reasons, overburden ground water was not included as a target medium for the HHRA.

Similarly, ground water derived from the bedrock aquifer has been determined to be impacted from the presence of VOCs and inorganic constituents in

the vicinity of bedrock monitoring wells MW-3, MW-4, MW-6, MW-7, MW-C17, MW-C18 and GW-L/D (the former Lester/Danforth water supply well). DSI currently owns the land between Route 5 and the Connecticut River which contains bedrock ground water affected by the DSI landfill. At present, no active use of this property is allowed; hence, there are no current users of the property. Furthermore, DSI has committed not to develop or sell this land in the future, then by virtually eliminating the possibility of future users. As part of final remedy for the site, DSI will prohibit future use of this land through deed restrictions should EPA so desire. However, regardless of EPA's desire, DSI is committed to not allow future use of bedrock ground water from this property, effectively eliminating potential ingestion of ground water derived from bedrock as a medium for consideration. Bedrock ground water was therefore not included as a target medium.

4.3.2 Retention Pond

Surface water and sediment samples were collected from the on-site retention pond and from the swale which gathers landfill surface water runoff and flows into the retention pond. Samples were collected from the swale at the point where the swale enters the retention pond and were considered to be representative of the pond. Surface water and sediment samples were analyzed for the presence of VOCs, ABNs, pesticides/PCBs and inorganic constituents. The data summary for constituents reported as detected in retention pond surface water and sediments is presented in Table 2.

4.3.3 Seep Surface Water and Sediments (Landfill Perimeter)

Intermittent seeps have been observed in several locations at the toe of the landfill slope. On-site observations appear to indicate flowing of the seeps in periods following heavy rains. Seeps were observed in these areas during the October 1991 and March 1992 sampling rounds but have not been observed as recently as

October 1992. The primary focus of the site characterization has been on two sampling stations: SD-SS1 (sediment) and SW-SW1 (water) located on the southwest side of the landfill, and SW-SW5 (water) and SD-SS5 (sediment) located on the northeast side of the landfill. Seep surface water and seep sediment samples from these stations were analyzed for the presence of VOCs, ABNs, pesticides/PCBs and inorganic constituents. The data summary for constituents reported in seep surface water and sediments collected near the toe of the landfill slope are presented in Table 3.

4.3.4 Seep Surface Water and Sediments (East of Route 5)

As previously discussed, prior to the installation of the seepage control and slope stabilization trench, overburden ground water emanating from the site discharged as seeps along Route 5. The seep drainage was channeled into culverts which run beneath the highway and was discharged to the ground surface. Samples of the seep water and associated sediment were collected at the location of the past discharges, from the culverts (SW-SW2/SD-SS2, SW-SW3/SD-SS3, SW-SW4/SD-SS4, and SW-SW6/SD-SS6) and within the drainage channels which eventually discharge to the Connecticut River (SW-SW8 and SW-SW9). Seep surface water and seep sediment samples were analyzed for the presence of VOCs, ABNs, pesticides/PCBs and inorganic constituents. The data summary for constituents reported as detected in seep surface water and sediments east of Route 5 is presented in Table 4.

Seeps once present east of Route 5, which were sampled during the RI, are being collected by the Route 5 slope stabilization and seepage control system. Therefore, surface water from these former seeps will not be evaluated in the HHRA. However, due to the presence of detectable levels of constituents in drainageway sediments downslope of the seeps, sediments from within the drainageways will be retained for evaluation as a target medium in the HHRA.

4.3.5 Connecticut River Surface Water

Three Connecticut River surface water samples were collected from the riverbank closest to the landfill during each of the October 1991 and March 1992 sampling events. One sample was collected directly downgradient of the landfill (SW-RW1), one sample (SW-RW2) was collected approximately 500 feet upgradient of sample station SW-RW1, and one sample (SW-RW3) was collected approximately 500 feet upgradient of sample station SW-RW2. Surface water samples collected from the Connecticut River were analyzed for VOCs, pesticides/PCBs and inorganic constituents. Due to the low or non-detectable levels of constituents observed in river water samples, river water will not be evaluated in the HHRA. The data summary for constituents reported in Connecticut River surface water is presented in Table 5.

4.3.6 Soil

Soil sampling was performed in conjunction with the soil boring program and the installation of monitoring wells. During 1991, the landfill was covered with clean fill from a local source (personal communication with K. Greenwood, DSI Facility Manager; April 1992). Subsequent field headspace screening using an HNu PI-101 photoionization detector (PID) has provided further evidence of non-detectable levels of VOCs in surface soil samples collected from a depth of up to 6 inches below the fill cover surface. Surficial soils will therefore not be evaluated in the HHRA.

4.3.7 Ambient Air

Ambient on-site air was screened for the presence of VOCs during site investigation activities using an HNu PID. Screening results indicated that VOCs were not detectable above ambient background levels and evidence of detectable levels of VOCs migrating directly through the existing landfill cover have not been

detected. A more comprehensive and quantitative air monitoring program was completed on December 9, 1992 to confirm the results of previous ambient air screening and, secondarily, to monitor potential emissions generated from the excavation associated with preliminary remediation activities. A total of 4 VOCs (acetone, toluene, benzene and 1,1,1-trichloroethane) were reported present during the December 9, 1992 sampling event. One or more of these compounds were reported at three of the five air sampling locations with VOC concentrations ranging from 9.9 parts per billion (ppb) to 42 ppb; these levels are considered extremely low in relation to established Occupational Health and Safety Administration (OSHA) Permissible Exposure Limits (PELs) which range from 1,000 ppb (benzene) to 750,000 ppb (acetone). Based upon these results, it was concluded that further assessment of ambient air as a potential exposure medium is unwarranted.

4.4 CONSTITUENTS OF CONCERN

A selection process was used to identify constituents of concern in each medium to be evaluated quantitatively; i.e., retention pond surface water and sediment, seep surface water and sediment at the landfill perimeter, and seep sediment east of Route 5. Constituents of concern were selected to focus the risk evaluation on constituents most significant in estimating site risk. A hierarchical approach was used in which constituents of concern were selected based upon concentration, toxicity, frequency of detection, sample location, relation to background levels, comparison to applicable standards, and physical or chemical properties affecting fate and transport. Tables summarizing the selection process for constituents of concern are presented for retention pond surface water in Table 6, retention pond sediment in Table 7, seep surface water (at the landfill perimeter) in Table 8, seep sediment (at the landfill perimeter) in Table 9, and seep sediment (east of Route 5) in Table 10. A summary list of constituents of concern for each medium is presented in Table 11.

In accordance with EPA guidance (USEPA, 1989b), the first step in the screening process for selecting constituents of concern is to calculate a risk factor for each constituent detected in each identified medium at the site. Risk factors were estimated based on the maximum concentration reported for the constituents during the RI and the corresponding EPA-derived toxicity value. The following formula was used in this calculation:

$$R_{ij}=(C_{ij})(T_{ij})$$

Where: R_{ij} = risk factor for constituent i in medium j,

C_{ij} = maximum concentration of constituent i in medium j, and

T_{ij} = toxicity value for constituent i in medium j.

Constituent-specific risk factors were then summed to obtain a total risk factor for all constituents of potential concern in an environmental medium:

$$R_j = R_{1j} + R_{2j} +...+ R_{ij}$$

Where: R_j = total risk factor for the environmental medium, and

$R_{1j} +...+ R_{ij}$ = sum of risk factors for constituents 1 through i in medium j.

Detected constituents were separated into two groups according to their potential for eliciting either carcinogenic or non-carcinogenic health effects. Constituents with the potential for producing both carcinogenic and non-carcinogenic effects were evaluated under both categories if EPA-verified toxicity values were available, and separate risk factors (R_{ij}) were calculated. For constituents with non-carcinogenic effects, the toxicity value used was equal to one divided by the EPA-verified chronic oral reference dose (RfD), i.e., 1/RfD. A toxicity value equal to the EPA-verified oral slope factor was used for constituents with potential carcinogenic effects. Oral RfDs and slope factors were obtained from EPA's Integrated Risk Information System (IRIS), or if not available through IRIS, from EPA's Health Effects Assessment Summary Tables (HEAST), dated March 1992, including Supplement A, dated July 1992.

The ratio of the risk factor for each constituent to the total risk factor (R_{ij}/R_j) was used to approximate the relative risk for each constituent in medium j. A percent of the total risk factor was then calculated for each constituent to facilitate selection of constituents of concern. Constituents contributing one percent or less of the total percent risk for non-carcinogenic and carcinogenic effects were generally not retained as constituents of concern. This criterion was the most significant in reducing the list of detected compounds to a list of constituents of concern.

Additional criteria were considered in the selection process to further refine the list of constituents of concern, particularly for constituents for which EPA-verified toxicity data were unavailable. Constituents were not included as constituents of concern for seep or retention pond surface water if reported concentrations were less than the MCLs, or, if MCLs were unavailable, the Vermont primary ground water quality standards presented in "State of Vermont, Agency of Natural Resources, Department of Environmental Conservation, Ground Water Protection Rule and Strategy, Chapter 12," dated September 1988. Barium and lead were not retained for evaluation because of this criterion. In addition, constituents such as aluminum, calcium, iron, magnesium, potassium and sodium are not generally considered to pose a substantial health risk and, consequently, health-based drinking water regulations have not been established for them. These constituents were therefore not included as constituents of concern for seep or retention pond surface water. Tetrahydrofuran was not reported extensively in these media and was therefore not evaluated further.

Inorganic constituents which occur naturally in sediments were not included as constituents of concern for sediments if the concentrations were near or below the mean or median concentrations for soils referenced in Rose, Hawkes & Webb (1979). On this basis, the following inorganic constituents were not included as constituents of concern for retention pond sediment: barium, copper, lead, thallium, nickel, vanadium and zinc. Similarly, barium, cobalt, copper, lead,

thallium, and vanadium were not included as constituents of concern for seep sediment. In accordance with the approach used for surface water, constituents in sediments such as aluminum, calcium, iron, magnesium, potassium, and sodium were not considered to pose a significant health risk and were excluded from further evaluation.

Using the criteria described above, constituents of concern were identified for the five identified environmental media. For retention pond surface water, the constituents of concern are arsenic, manganese and 4-methylphenol, while constituents of concern for retention pond sediment are arsenic and manganese. Concentrations of constituents of concern reported in retention pond and swale surface water and sediments, and sampling locations are shown in Figure 3. Constituents of concern in seep water at the landfill perimeter are acetone, arsenic, 2-butanone, lead, 2-hexanone manganese, 4-methylphenol, nickel, and vanadium, while constituents of concern for seep sediment at the landfill perimeter are arsenic and manganese. Concentrations for constituents of concern reported in seep surface water and sediments at the landfill perimeter and sampling locations are shown in Figure 4. Constituents of concern in seep sediment east of Route 5 are arsenic, barium, benzo(a)pyrene, 2-hexanone and manganese. Concentrations for constituents of concern reported in seep sediment east of Route 5 are shown in Figure 5.

5.0 DOSE-RESPONSE ASSESSMENT

The dose-response section of the risk assessment provides the scientific data relating chemical exposure (dose) to potential health effects (response). Information is provided to evaluate the dose-response relationships for the constituents of concern.

5.1 BACKGROUND

In accordance with the EPA guidance, the reference dose (RfD) is used as the primary criterion for evaluating noncarcinogenic effects. In using this value, it is assumed that there is a concentration which serves as the threshold at which no critical adverse effects exist. This level is referred to as the "no observed-adverse effects level" (NOAEL). The following hierarchy of sources can be used to calculate RfDs in the event verified RfDs have not been established by EPA: drinking water standards and guidelines, such as Maximum Contaminant Levels (MCLs); Lifetime Health Advisories and Maximum Contaminant Level Goals (MCLG); Ambient Water Quality Criteria (AWQC); and Allowable Intakes, Chronic (AIC) or Subchronic (AIS).

It is EPA's policy that carcinogens are considered to lack a threshold of no adverse effects, which thus implies that any concentration carries some risk. Cancer potency factors (CPFs) or slope factors have been derived which estimate risks based upon extrapolation at various doses. A CPF is equal to the slope of the dose-response curve. The CPF multiplied by the dose provides an estimate of the upper 95 percent confidence interval of the incremental lifetime cancer risk, or the probability of the dose to cause cancer above normal background rates.

Carcinogens have been rated by EPA in a weight-of-evidence classification system to indicate the degree of confidence in the relationship between chemical exposure and the likelihood of causing human cancer. Ratings are based primarily on the

degree of evidence for cancer from human and animal studies. Major categories include: A, human carcinogen; B1, probable human carcinogen with limited evidence for carcinogenicity in humans; B2, probable human carcinogen with sufficient evidence of carcinogenicity in animals and inadequate or lack of evidence in humans; C, possible human carcinogen; D, not classified; and E, no evidence of carcinogenicity to humans.

The RfD values, CPF values, and other pertinent dose-response data for constituents of concern are shown in Table 12. References for dose-response values not listed in the Integrated Risk Information System (IRIS) or Health Effects Assessment Summary Tables (HEAST) are provided in the appropriate toxicological summary (Section 5.2).

5.2 TOXICOLOGICAL SUMMARIES FOR CONSTITUENTS OF CONCERN

This section provides general information and a toxicological summary for the constituents of concern which were evaluated quantitatively in this risk assessment. A toxicity assessment is included whereby carcinogenic and non-carcinogenic effects of the constituents are considered. Where available, information has been derived from the IRIS database, as of January 1993. Additional toxicological information in the form of current IRIS on-line printouts or excerpts from other appropriate sources are provided in Appendix C.

5.2.1 Acetone

Health effects due to inhalation of acetone may include eye, nose, and throat irritation, while ingestion may cause headache and dizziness (NIOSH, 1990). Direct skin contact may cause dermatitis (NIOSH, 1990). Histopathological studies with rats have suggested a relationship between orally administered doses of acetone and increases in tubular degeneration of the kidneys (IRIS, 1993).

Acetone is not classifiable as a human carcinogen (Class D) based on a lack of data concerning carcinogenicity in humans or animals (IRIS, 1993). Confidence in the established oral RfD of 1.0 times ten to the minus one (1.0E-01) milligrams/kilograms/day (mg/kg/day) is low because of the limited number of available studies and the lack of supporting studies (IRIS, 1993).

5.2.2 Arsenic

Arsenic, like most inorganic substances, is naturally occurring in soil and sediments (USEPA, 1987). Toxicological effects of arsenic are highly dependent on the medium in which it occurs, the form it takes (organic or inorganic), and its ionic state (trivalent or pentavalent). Organic forms of arsenic are much less toxic than inorganic forms, with trivalent inorganic arsenical compounds being much more toxic than pentavalent forms (USEPA, 1987).

Acute exposure due to ingestion of inorganic arsenic may result in changes in skin pigmentation, chronic headache, fatigue, muscle weakness, insomnia and gastritis, while chronic exposures to ingested inorganic arsenic have been shown to cause skin lesions, peripheral vascular disease, and neural degeneration (USEPA, 1984a). The function of bone marrow appears to be particularly impaired upon chronic exposure. Liver and kidney damage have been reported in laboratory rats upon oral exposure to arsenic (USEPA, 1984a).

Arsenic has been classified by EPA as a human carcinogen (Class A). An increased incidence of lung cancer has been observed upon inhalation of arsenical compounds (IRIS, 1993). Increases in the incidence of skin cancer upon ingestion of high arsenic concentrations have been reported. An oral RfD of 3.0E-04 mg/kg/day has been established by EPA to evaluate non-carcinogenic effects; however, a clear consensus at EPA for use of this value does not exist (IRIS, 1993). Strong scientific arguments have been made for various values within a range of a factor of two or three times this value (IRIS, 1993). The EPA Administrator

recommends that the unit risk of 5.0E-05/ug/l, derived from a drinking water study, be adopted to evaluate potential carcinogenic effects (IRIS, 1993). In recommending use of this unit risk to calculate a CPF, the EPA Administrator cautions that uncertainties associated with the use of this value may result in overestimation of risk by as much as an order of magnitude, even without consideration of the fraction of arsenic which may be in its organic (i.e., less toxic) form. The CPF can be calculated from this unit risk using the following equation:

$$CPF = (UR \times W)/(CR \times CF)$$

Where:

UR = unit risk (in /ug/l);
CR = consumption rate of 2 l/day;
CF = conversion factor of 10^{-3}; and
W = adult weight of 70 kg.

Therefore:

$$CPF = (5.0E\text{-}05/ug/l \times 70\ kg)/(2\ l/day \times 10^{-3})$$

$$CPF = 1.8E+00\ (mg/kg/day)^{-1}$$

5.2.3 Barium

The toxicity of barium is dependent upon the relative solubility of the form in which it occurs (Amdur et al., 1991). More soluble forms of ingested barium are absorbed with some accumulation in the skeleton. Less soluble barium salts may cause a benign, yet reversible, pneumoconiosis following inhalation. Accidental ingestion of soluble barium salts has resulted in gastroenteritis, muscular paralysis, decreased heart rate, and cardiac arrhythmias.

Barium is not classifiable as a human carcinogen (Class D) based on a lack of evidence for carcinogenicity in humans and animals (IRIS, 1993). Some data supports a possible relationship between long-term exposure and hypertension in the adult male resulting in the establishment of an oral RfD of 7.0E-02 mg/kg/day

(IRIS, 1993). This value is based upon a large database for barium, as EPA does not believe that any single study considered alone is sufficient to calculate an RfD.

5.2.4 2-Butanone (Methyl Ethyl Ketone or MEK)

Chronic effects from the inhalation of 2-butanone may include eye irritation or headache (Olishifski and McElroy, 1971). Ingestion may result in dizziness or nausea (NIOSH, 1990). An increased incidence in toxicity to the fetus has been observed in studies using rats (IRIS, 1993).

The compound is not classifiable as a human carcinogen (Class D) based on a lack of evidence for carcinogenicity in humans and inadequate evidence for carcinogenicity in animals (IRIS, 1993). Confidence in the established oral RfD of 5.0E-02 mg/kg/day is medium due to lack of adequate chronic studies (IRIS, 1993).

5.2.5 Benzo(a)pyrene

Benzo(a)pyrene, like most polynuclear aromatic hydrocarbons (PAHs), is suspected of producing toxic health effects following inhalation, dermal or oral exposure (GRI, 1988), resulting in irritation to skin and mucous membranes, and vomiting if swallowed in large quantities (Sittig, 1985). The liver, kidneys and skin appear to be target organs via these routes. Absorption and the subsequent distribution of PAHs throughout the body following exposure is most likely due to the high lipid solubilities (GRI, 1988).

An EPA-verified chronic oral RfD is not available (IRIS, 1993). According to EPA, benzo(a)pyrene is presently classified as a probable human carcinogen (Class B2) based upon a sufficient database for carcinogenicity in animals although specific data linking this compound to a carcinogenic effect in humans is lacking (IRIS, 1993). On this basis, EPA has established a CPF of 7.3E+00 mg/kg/day (IRIS, 1993). The compound will be evaluated for non-carcinogenic effects in terms of the

chronic oral RFD of 4.0E-02 mg/kg/day applied to naphthalene, a noncarcinogenic PAH. This methodology is similar to that used by EPA to assess the carcinogenic effects of PAH compounds (USEPA, 1989a).

5.2.6 2-Hexanone (Methyl n-Butyl Ketone or MBK)

Like other ketones, 2-hexanone is considered a central nervous system depressant. A study evaluating the uptake of 2-hexanone in human volunteers indicated that the compound was readily absorbed through the lungs, gastrointestinal tract and skin (Craft, 1983). Beyond this, the compound is considered mildly toxic by the ingestion and intraperitoneal exposure routes and much less toxic via the skin contact or inhalation routes (Sax and Lewis, 1989). Unlike other ketones, 2-hexanone has been shown to cause peripheral neuropathy (Amdur et al., 1991). A solvent interaction between 2-hexanone and 2-butanone has been reported which may enhance the severity of the neurotoxic effect although 2-butanone does not appear to produce this effect alone (Amdur et al. 1991).

EPA has not established a weight-of-evidence classification for this compound; however, a carcinogenicity assessment is currently under review (IRIS, 1993). Based upon structural similarities to 4-methyl-2-pentanone, the oral RfD of 5.0E-02 mg/kg/day for 4-methyl-2-pentanone has been used as a surrogate.

5.2.7 Lead

The major toxic effect of lead is on the nervous system (Amdur, et al., 1991). In adults, peripheral neuropathy may occur, but the most sensitive effect may be hypertension. Other target organs are the gastrointestinal and reproductive systems. The most susceptible populations appear to be children, in which clinically overt lead encephalopathy and long-term neurobehavioral effects have been found to occur. Currently, there is no scientific consensus concerning the effects of lead at low doses. Correlations and regression analyses of data on blood

lead levels and various health effects indicate a spectrum of adverse effects become apparent in populations having increased blood lead levels. It appears that changes in neurobehavioral development in children may occur at blood lead levels so low as to be essentially without a threshold.

According to EPA, lead is classified as a probable human carcinogen (B2). Based upon the concept that potential carcinogenic effects are essentially without a threshold, an oral RfD and an oral CPF have not been established by EPA (IRIS, 1993). However, recent promulgation of an MCL action level of 0.015 mg/l for drinking water at the point of use was based upon significant research on lead levels in blood. Using this MCL action level, and based upon EPA guidance for calculating RfD equivalents, an RfD equivalent of 1.4E-04 mg/kg/day was estimated for purposes of this study (USEPA, 1989a).

5.2.8 Manganese

Manganese is an essential element for a number of biologic processes in humans (Amdur, et al., 1991). Gastric absorption is less than five percent and the biologic half-life in the body is 37 days. Acute exposure via inhalation of high concentrations may result in pneumonitis. Chronic inhalation exposure has caused central nervous system toxicity. Systemic toxicity has, however, rarely been reported because humans efficiently regulate the body burdens of manganese. Extremely large doses of manganese cause gastrointestinal irritation. There are also reports of central nervous system effects from chronic consumption of large amounts of manganese dissolved in drinking water (IRIS, 1993). Based on these reports, EPA has developed on oral RfD for manganese of 1.0E-01 mg/kg/day (IRIS, 1993).

5.2.9 4-Methylphenol (p-Cresol)

In general, acute exposure to phenols may cause damage to kidneys, liver, spleen or lungs (Sax and Lewis, 1989). Ingestion of large quantities can cause corrosion of the lips, mouth, esophagus, and stomach (Sax and Lewis, 1989).

The compound 4-methylphenol is classified as Class C, possible human carcinogen; however, only anecdotal data are available for evidence of cancer in humans (IRIS, 1993). The database for incidence of carcinogicity in humans is judged to be inadequate, while animal data are limited (IRIS, 1993). An oral RfD of 5.0E-03 mg/kg/day has been established by EPA (USEPA, 1992b).

5.2.10 Nickel

Nickel is recognized as an essential nutrient found in metalloproteins and some enzymes; dietary nickel is metabolized and excreted in the feces (Craft, 1983). Typical daily human intake of nickel ranges from 100 to 300 ug/day.

While it has been known that dermal effects may result from contact with nickel compounds, many studies also support the finding of dermato-toxicity in hypersensitive humans following ingestion (IRIS, 1993). The principal concern for nickel exposures has been nasal and lung cancers resulting from inhalation of significant levels of insoluble nickel particulates. However, the insoluble forms of nickel and the inhalation of particulates are considered of minor importance at the DSI site.

Orally administered nickel has been associated with reduced body weight in rats and dogs, while nickel chloride in water administered by gavage to rats appeared to result in reduced organ weight (e.g., heart, liver, and kidney). Based upon these studies, EPA has established an oral RfD of 2.0E-02 mg/kg/day (IRIS, 1993). It is

important to note that hypersensitivity in humans was also considered by EPA but was not the primary factor in establishing the RfD.

5.2.11 Vanadium

Vanadium compounds have an affinity for fats and oils; consequently, fat is the largest contributor to body burden, followed by bone and teeth (Amdur, et al., 1991). Vanadium is moderately absorbed in most forms following ingestion and is excreted primarily in the urine (Amdur, et al., 1991).

Ingestion of vanadium compounds for medicinal purposes has produced gastrointestinal disturbances, minor anomalies in renal function and nervous system effects (Amdur, et al., 1991). This same study also suggested that the liver, adrenal glands and bone marrow may also be impacted by subacute exposures at high doses (Amdur, et al., 1991).

Orally administered vanadium pentoxide in rats has been associated with a decrease in the amount of cystine in the hair (IRIS, 1993). A significant decrease has also been reported in erythrocyte and hemoglobin levels of rats (IRIS, 1993). Based upon these studies, EPA has established an oral RfD of 9.0E-03 mg/kg/day; however, low confidence is assigned to this value due to lack of detail in the reference study and scarcity of specific data on vanadium pentoxide (IRIS, 1993).

6.0 EXPOSURE ASSESSMENT

The purpose of the exposure assessment is to characterize the exposure setting, identify populations potentially exposed to constituents at the site, develop and evaluate potential exposure pathways, estimate exposure point concentrations, select exposure variables, and estimate exposure doses. Estimated exposure doses are ultimately used in the risk characterization.

6.1 CHARACTERIZATION OF EXPOSURE SETTING

The exposure setting represents the arena in which a potential exposure could occur. In evaluating the exposure setting relative to the DSI site, on-site and adjacent off-site areas were considered.

6.1.1 Physical Setting

Several on-site structures are present on the DSI site: an office/garage, a garage, several sheds and a methane incinerator. The structures are built on concrete slabs and common use areas are paved. Access to the site is limited by sections of fence along the eastern and southern boundaries. The fence is not continuous; however, bedrock cliffs to the west and steep topography to the east provide natural barriers to the site and may limit access. The locations of significant on-site structures, other pertinent site features, and residential structures in the immediate vicinity of the site are shown on Figure 2.

Private residences, seasonal residences, and the Connecticut River are located to the south and east of the landfill. The closest occupied residence, referred to as the Greenwood residence, is approximately 200 feet from the southern site boundary. A mix of four seasonal and year-round residences are located approximately one-quarter mile northeast of the site along the Connecticut River.

The Hit or Miss Club, a private rod and gun club, is located directly across Route 5 from the site entrance. Apparently, the club is used on only limited occasions.

The surface topography of areas east of Route 5 which may be affected by the DSI site slopes steeply towards the Connecticut River. The steepness of this terrain would likely limit future development in areas along the river front. A small seasonal camp was once located on a plateau near the Lester/Danforth well. However, this area is very small and likely insufficient for future construction of a home. Therefore, potential development of this area would appear to be limited to the river front area although development of property in such close proximity to the Connecticut River may be restricted by wetland and floodplain limitations. Furthermore, as previously discussed, this area is currently owned by DSI, which has no plans to sell or develop this area.

Other pertinent off-site features include the Charleston, New Hampshire waste water treatment plant which is located on the east bank of the Connecticut River, i.e., opposite from the DSI Site. Vermont Route 5, a two-lane, paved road is adjacent to the eastern border of the landfill. Interstate 91 is about 0.6 miles west of the landfill. New Hampshire Highway Route 12 parallels the Connecticut River on the east side of the river.

6.1.2 Demographics

Based on statistics from the 1990 U.S. Census Bureau, the population for Bellows Falls, which includes the town of Rockingham, is 5,484. A rural portion of Charleston, New Hampshire, population 4,400, exists directly across the Connecticut River from the site. The Springfield, Vermont town line is located approximately one-third of a mile to the north of the DSI site.

EPA typically considers that children, the elderly, or populations with health impairments are potentially more sensitive to environmental exposure than the

general population. Therefore, an area within a one-mile radius was examined for the presence of sensitive receptor populations. Based upon this survey, it appears that there are no schools, nursing homes, hospitals or other such facilities within a one-mile radius of the site. Children are likely to reside in some of the nearby homes; this possibility is considered further in subsequent sections. Private wells, in addition to those described as adjacent to the site, are located within a one-mile radius of the site.

6.2 EVALUATION OF POTENTIAL HUMAN RECEPTORS AND POTENTIAL EXPOSURE POINTS

Potentially exposed on-site and off-site populations and potential on-site and off-site exposure points were reviewed for applicability in the estimation of exposure doses. Potentially exposed populations and pathways considered in this risk evaluation and the rationale for selecting pathways for quantitative evaluation are presented for potential current conditions in Table 13 and for potential future conditions in Table 14. A summary of pathways selected for quantitative evaluation is presented in Table 15.

6.2.1 Current Potentially Exposed Populations

6.2.1.1 On-Site Populations (DSI Facility)

Permanent populations are not presently located at the DSI facility; therefore, potential exposure for this group does not exist. The DSI facility currently contains a transfer and recycling station with 15 on-site workers. Employee job descriptions include office workers, shop workers, truck drivers, and a person who monitors methane concentrations and performs water level measurements at site monitoring wells (personal communication with K. Greenwood, DSI Facility Manager; April 1992).

Area adult residents bringing refuse and recyclables to the facility were also considered to be potentially exposed populations. However, since the transfer station and recycling station are located on pavement and an employee is on duty to receive all goods, it is unlikely that the residents would be exposed to site constituents.

Trespassers could potentially gain access to the facility, the landfill, and the landfill perimeter, portions of which are fenced along the property boundary. This would appear more likely for children than for other demographic groups. Given the nature of the facility, it is unlikely that very young children (i.e., those less than six years old) would wander from home to gain access. Younger children (i.e., 6 to 12 years of age) would be less likely to play at the facility than older children (i.e., 12 to 18 years of age). Therefore, children between the ages of 12 and 18 years were selected for evaluation as a potentially exposed population at the landfill facility.

6.2.1.2 On-Site Populations (East of Route 5)

Current populations on the DSI property east of Route 5 do not exist. However, as indicated for potential exposures at the DSI facility, children from off-site are the most likely population for potential exposure to impacted sediment associated with former surface seeps east of Route 5.

6.2.1.3 Off-Site Populations

Permanent off-site populations include residents adjacent to the site. As previously discussed, these residents are currently not exposed to constituents in off-site ground water, and DSI is supplying drinking water to select cross-gradient residents. In addition, impacted surface seeps are located only within the boundaries of the DSI property at the landfill perimeter. Consequently, there is no potential for off-site exposure to these media.

6.2.2 Current Potential Exposure Points (DSI Facility)

6.2.2.1 On-site Exposure Points (DSI Facility)

The 100-foot-wide retention pond and the drainage swale which directs surface water runoff to the retention pond are considered potential exposure points with somewhat limited access. Surface water within the pond is located 3 to 4 feet below the top of the bank and a fence is present around the pond, making it unlikely that a person would readily contact the water or sediments. Surface seeps which flow intermittently near the landfill perimeter also constitute potential on-site exposure points at the facility.

6.2.2.2 On-site Exposure Points (East of Route 5)

Sediments affected by prior surface seeps at the DSI property east of Route 5 constitute potential exposure points. Exposure to surface sediment east of Route 5 is possible where there are no barriers to access, i.e., beneath the culverts which once discharged impacted water to surface soils and down the steep slope along the drainage pathways.

6.2.2.3 Off-Site Exposure Points

There are no current off-site exposure points. As discussed, the potential for exposure to constituents in ground water does not exist, as private cross-gradient wells are not impacted by the landfill and DSI is supplying potable water to select residences. Seeps are not present beyond the DSI site boundary.

6.2.3 Future Potentially Exposed Populations

6.2.3.1 On-Site Populations (DSI Facility)

Potentially exposed future on-site populations are expected to be similar to current on-site populations and would focus on children who may trespass at the facility from nearby residences. However, future potential exposure to surface water seeps and sediment adjacent to the toe of the landfill should be eliminated by 1994 as DSI is currently in the process of recontouring the landfill in preparation for site closure. Recontouring activities are expected to be completed by late 1993 and should result in the elimination of perimeter seeps and associated sediment. Since the landfill will be left in place as part of the closure, it is DSI's intent to retain control of the DSI facility property and not permit future residential or intrusive development of the property. This intent is consistent with expected future consolidation of the waste mass and the steep slope characteristics which would prohibit site construction. This view appears consistent with opinions expressed by EPA headquarters which considers reasonable future use scenarios when assessing site risk. In turn, due to DSI's intentions for future uses of the site, it is highly improbable that a drinking water well would be drilled into the overburden ground water or bedrock aquifer beneath or immediately adjacent to the landfill in the future.

6.2.3.2 Off-Site Populations

Future off-site populations are expected to be similar to current off-site populations. The areas adjacent to the site are likely to include a limited residential population.

6.2.4 Future Potential Exposure Points

6.2.4.1 On-Site Exposure Points (DSI Facility)

Future on-site exposure to retention pond water and sediment at the DSI facility are unlikely to differ from current exposure points in the absence of remediation. Although recontouring of the landfill in 1993 should eliminate exposure to surface seeps and associated sediment at the landfill perimeter, it has been conservatively assumed that these exposure points would be present in the foreseeable future.

6.2.4.2 On-site Exposure Points (East of Route 5)

Potential future exposure points at the DSI property east of Route 5 are likely to be similar to the current exposure points, including potential exposure to constituents present in the surface sediment along the drainage pathways. DSI owns the downgradient property between Route 5 and the Connecticut River and intends to prevent future development of the property.

6.2.4.3 Off-Site Exposure Points

There are no future off-site exposure points predicted relative to the DSI site. Migration pathways of constituents presently reported at the site are likely to remain similar to the current situation and, therefore, will not result in different exposure points in the future. Specifically, ground water in residential wells located cross-gradient to the site are not impacted by site constituents, and conditions in ground water are likely to improve as operational measures at the site are completed. Moreover, as discussed previously, a water agreement restricting use of domestic water at some residences cross-gradient to the site with provisions for DSI to provide these residences with potable water has been, and will continue to be, an effective institutional control.

6.3 ESTIMATION OF EXPOSURE POINT CONCENTRATIONS FOR CONSTITUENTS OF CONCERN

Average and maximum concentrations for the constituents of concern for each medium were used as exposure point concentrations. Exposure point concentrations for seep surface water and sediment at the landfill perimeter, seep sediments east of Route 5, and retention pond surface water and sediments, were derived from the entire database generated for each of these media during the October 1991 and March 1992 sampling events. Equal access of the receptor to the sampling locations was therefore assumed. Calculated average concentrations and maximum concentrations reported for each medium are presented in Table 16.

6.4 ESTIMATION OF EXPOSURE DOSES FOR SELECTED EXPOSURE PATHWAYS

Exposure doses were calculated for each selected constituent of concern for an environmental medium and for each selected exposure pathway. Current and future exposure scenarios were considered. Estimates of exposure dose were derived using the calculated average and maximum exposure point concentrations. These estimates will serve as the basis for and will be evaluated collectively in the risk characterization.

6.4.1 Dermal Absorption and Incidental Ingestion of Retention Pond Sediments

Exposure parameters were developed for a potential scenario involving exposure of an older child to impacted retention pond sediment under current and future conditions. A summary of current and future exposure parameters is provided in Table 17. Estimated exposure doses are provided in Table 18.

An average body weight of 55.9 kilograms was assumed to represent the typical child (male or female) between 12 and 18 years of age (USEPA, 1989a). The duration of exposure was considered to be limited by climate, with April through

September, i.e., six months, judged to be the period of potential exposure. The frequency of exposure is substantially limited by access to the pond, which is located near the on-site buildings; therefore, a frequency of exposure five times per year for an average scenario and ten times per year for a maximum scenario was established. The averaging period of six years was used for a child from ages 12 to 18.

Children were assumed to be dressed in t-shirts, shorts, and shoes while playing at the retention pond exposure point. The surface skin area subject to dermal contact with impacted media was therefore calculated to be 8,195 square centimeters (cm^2). This value likely overestimates the exposed skin surface area as total leg and arm area values were used (USEPA, 1988). Portions of the arms, hands, and legs are normally somewhat covered by clothing. The rate of incidental ingestion at 100 mg/event for pond sediment, was derived from EPA guidance (USEPA, 1989a). An incidental ingestion rate of 0.5 l/event was considered a conservative value for retention pond surface water. Permeability constants for specific constituents were derived from EPA guidance, while the permeability constant for water of 8.0E-04 cm/hr was used for constituents without readily available data (USEPA, 1988). Dermal absorption of most inorganic constituents is generally considered negligible, with absorption factors generally reported in the literature at less than 0.1 percent (USEPA, 1992a). Consequently, transdermal exposure to inorganic constituents was not evaluated further in the HHRA. Absorption factors for organic constituents were derived from EPA guidance (USEPA, 1989a). The soil to skin adherence factor of 1.0 mg/cm^2 was modified from the EPA value for commercial potting soil as the adherence of sediment is likely to be less than for soil (USEPA, 1989a).

The equation below was used to estimate exposure doses for dermal absorption of constituents in retention pond sediment (USEPA, 1989a):

$$ED = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

ED = Daily absorbed exposure dose (mg/kg/day)
CS = Constituent concentration in sediment (mg/kg)
CF = Conversion factor (10^{-6} kg/mg)
SA = Skin surface area available for contact (cm^2)
AF = Sediment to skin adherence factor (mg/cm^2)
ABS = Absorption factor (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period of time over which exposure is averaged - days)

The equation below was used to estimate exposure doses for incidental ingestion of constituents in retention pond sediment USEPA, 1989a):

$$ED = \frac{CS \times IR \times CF \times AF \times FI \times EF \times ED}{BW \times AT}$$

where:

ED = Exposure dose (mg/kg/day)
CW = Constituent concentration (mg/kg)
IR = Ingestion rate (mg/day)
CF = Conversion factor (10^{-6} kg/mg)
AF = Absorption Factor (unitless)
FI = Fraction ingested from contaminated source (unitless)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period of time over which exposure is averaged - days)

The equation below was used to estimate exposure doses for dermal contact with constituents in retention pond surface water (USEPA, 1989a):

$$ED = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:

ED = Exposure dose (mg/kg/day)
CW = Constituent concentration (mg)
SA = Skin surface area available for contact (cm^2)
PC = Constituent-specific permeability constant (cm/hr)
ET = Exposure time (hours/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
CF = Volumetric conversion factor for water (1,000 cm^3)
BW = Body weight (kg)
AT = Averaging time (period of time over which exposure is averaged - days)

The equation below was used to estimate exposure doses for incidental ingestion of constituents in retention pond surface water (USEPA, 1989b):

$$ED = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

where:

ED = Exposure dose (mg/kg/day)
CW = Constituent concentration (mg)
IR = Ingestion rate (l/day)
EF = Exposure frequency (days/year)
ED = Exposure duration (years)
BW = Body weight (kg)
AT = Averaging time (period of time over which exposure is averaged - days)

6.4.2 Dermal Absorption and Incidental Ingestion of Seep Surface Water and Sediment (Landfill Perimeter)

Exposure parameters were also developed for a potential exposure scenario involving exposure of an older child to impacted seep surface water and sediment

at the landfill perimeter under current and future conditions. A summary of current and future exposure parameters is provided in Table 19. Estimated exposure doses are provided in Table 20.

Exposure parameters applied in this scenario were similar to those applied to the retention pond exposure pathway. Exceptions included the frequency of exposure which is likely to be somewhat different for an on-site location which is further removed from the facility office and transfer station than the retention pond. In addition, frequencies of exposure to seep surface water are likely to be very different from seep sediment. The seeps are intermittent and dependent upon heavy rainfall, while potential exposure to sediments is possible each time the exposure point is accessed by the receptor. For this reason, exposure frequencies of 24 days per year and 48 days per year were selected for average and maximum conditions of exposure to seep sediment, respectively. Conversely, the limited chance of contacting impacted seep water resulted in an estimated frequency for exposure to this medium of five days per year and ten days per year for average and maximum conditions, respectively. Equations used to calculate exposure doses are similar to those used for exposure to retention pond surface water and sediment.

6.4.3 Dermal Absorption and Incidental Ingestion of Sediment (East of Route 5)

Exposure parameters were developed for a potential exposure scenario involving exposure of an older child to impacted sediment under current and future conditions. A summary of current and future exposure parameters is provided in Table 21. Estimated exposure doses are provided in Table 22.

Assumptions used to evaluate this scenario were generally similar to those used to assess potential exposures at the retention pond and at the surface water seeps located at the landfill perimeter. Again, potential exposures were assumed for children between the ages of 12 to 18, weighing an average of 55.9 kilograms with

a skin surface area subject to dermal contact of 8,195 cm^2. Potential access to the seep sediment was assumed to be similar in frequency as access of children to the seeps present at the landfill perimeter, i.e., up to 24 times per year under average conditions and 48 times per year under maximum conditions. The rate of incidental ingestion for sediment at 100 mg/event, was derived from EPA guidance for soil (USEPA, 1989a). The soil to skin adherence factor (1.0 mg/cm^2) was modified from the EPA value for commercial potting soil as the adherence of sediment is likely to be less than for soil (USEPA, 1989a).

The equations used to estimate exposure doses for dermal absorption and incidental ingestion of constituents in seep sediment east of Route 5 are similar to those used to calculate exposure doses for retention pond sediment.

7.0 RISK CHARACTERIZATION

The risk characterization evaluates potential current and future foreseeable health risks associated with site conditions. Within the risk characterization, site-specific risks are characterized by integrating data developed in the Hazard Identification, Dose-Response Assessment and Exposure Assessment.

7.1 RISK EVALUATION METHODOLOGY

The risk evaluation is the final stage of the risk assessment. It involves the comparison of exposure doses and reference doses for noncarcinogens and the comparison of calculated risks and target risks for carcinogens. Methodologies for evaluating noncarcinogenic and carcinogenic risks for the selected compounds are presented below (USEPA, 1989b).

7.1.1 Noncarcinogenic Risk Evaluation

Noncarcinogenic risks are evaluated in terms of a threshold-response theory which assumes that multiple subthreshold exposures could possibly result in adverse health effects (USEPA, 1986). The hazard index is used as a means of assessing potential risk from noncarcinogenic health effects; however, it is not a mathematical prediction of incidence or severity of effects (USEPA, 1986). The hazard index is calculated for each noncarcinogenic constituent of concern by dividing the exposure dose in mg/kg/day by the RfD, also in mg/kg/day, to calculate a unitless estimate of risk. In accordance with EPA policy, if the hazard index is less than 1.0, risks associated with exposure to the constituents of concern are not considered to be significant, largely because of the built-in conservatism involved in deriving the RfD; when the hazard index exceeds 1.0, further evaluation of the toxicity of the compound and the associated assumptions is needed. This evaluation can often resolve whether the constituents should be of concern as a

potential health risk or whether the hazard index simply reflects an extremely high uncertainty associated with the derivation of the specific RfD.

In accordance with EPA guidance, calculated hazard indices are summed for each compound within each exposure pathway to provide a measure of the total risk for the mixture of constituents without regard to the specific toxic effect of each constituent. When this summed hazard index exceeds 1.0, endpoints of concern (i.e., target organs) for toxic effects are considered. In these situations, hazard indices are calculated for each different endpoint of concern within the exposure pathway.

7.1.2 Carcinogenic Risk Evaluation

Evaluation of the incremental lifetime cancer risk depends in part on the nature of the experimental data used by EPA to qualify a constituent as a carcinogen. When based on animal data, the incremental lifetime cancer risk corresponds to the upper 95th percentile of the probability of developing cancer, while, if based on human data, it is a maximum likelihood estimate (USEPA, 1989b).

The incremental lifetime cancer risk is calculated by multiplying the exposure dose in mg/kg/day by the CPF in $(mg/kg/day)^{-1}$ to obtain a unitless estimate of risk. Implicit in these calculations is that the exposure dose is considered an average daily exposure dose over the lifetime. As a consequence, the predicted risk may overestimate actual site risk (USEPA, 1986). The resulting estimate is therefore an upper-bound estimate of the potential carcinogenic risk at an exposure point.

7.2 RISK TO HUMAN HEALTH

The potential risks to human health were evaluated for each exposure pathway identified in the exposure assessment under current and future foreseeable land-use conditions. The intent was to provide reasonable and extremely conservative

assessments of the degree of risk associated with potential exposure to constituents via the exposure route, and to identify pathways of concern which may warrant attention during remediation.

7.2.1 Dermal Absorption and Incidental Ingestion of Retention Pond Surface Water

Potential exposure to retention pond surface water by incidental ingestion does not appear to present a significant risk to human health. The hazard index was calculated at 6.4E-03 under average conditions and 1.5E-02 under maximum conditions; these values are well below the EPA criterion of 1.0. Similarly, the incremental lifetime cancer risk for incidental ingestion of retention pond surface water was calculated at 5.7E-08 under average conditions and 9.5E-08 under maximum conditions, below the EPA acceptable risk range of 1.0E-04 to 1.0E-06.

Risks of exposure to retention pond surface water by dermal absorption were also within acceptable EPA risk criteria. The hazard index for dermal absorption ranged from 8.7E-03 under average conditions to 5.9E-02 under maximum conditions, with both values within the EPA recommended criterion of 1.0. Potential carcinogenic risk associated with dermal contact of surface water was not evaluated quantitatively but was considered to be negligible. Arsenic was the only potential carcinogenic constituent evaluated as a constituent of concern, and EPA considers transdermal absorption of inorganic constituents to be insignificant. Calculations for noncarcinogenic and carcinogenic risks associated with exposure to retention pond water under current and future conditions are presented in Table 23.

7.2.2 Dermal Absorption and Incidental Ingestion of Retention Pond Sediment

Potential exposure to retention pond sediment by incidental ingestion does not appear to present a significant risk to human health. The hazard index was

calculated at 2.5E-04 under average conditions and 1.2E-03 under maximum conditions; these values are well below the EPA criterion of 1.0. Similarly, the incremental lifetime cancer risk for incidental ingestion of retention pond sediment was calculated at 9.7E-08 under average conditions and 4.9E-07 under maximum conditions and were therefore below the EPA acceptable risk range of 1.0E-04 to 1.0E-06.

Risks of exposure to retention pond sediment by dermal absorption were not evaluated quantitatively as the constituents of concern for sediment, arsenic and manganese, are not considered to be absorbed significantly through the skin. Calculations for noncarcinogenic and carcinogenic risks associated with exposure to retention pond sediment under current and future conditions are presented in Table 24.

7.2.3 Dermal Absorption and Incidental Ingestion of Seep Surface Water (Landfill Perimeter)

Current and future risks of exposure to surface seep water by incidental ingestion may present a marginal risk. The hazard index for incidental ingestion ranged from 2.0E-01 under average conditions to 7.0E-01 under maximum conditions, with both values below the EPA recommended criterion of 1.0. The noncarcinogenic risk associated with ingestion was attributed primarily to the presence of lead. The incremental lifetime cancer risk calculated for ingestion of arsenic in seep water ranged from 3.2E-07 under average conditions to 9.8E-07 under maximum conditions and was therefore within the EPA acceptable risk range of 1.0E-04 to 1.0E-06.

Dermal absorption when contacting seep water may present a marginally elevated risk under a maximum exposure scenario. The hazard index for dermal absorption ranged from 2.7E-01 under average conditions to 1.5E+00 under maximum conditions, with the maximum value above the EPA recommended criterion of 1.0. The noncarcinogenic risks associated with dermal absorption were attributed

primarily to the presence of 2-butanone and 4-methylphenol which were reported at high concentrations in at least one seep location. Carcinogenic risk due to dermal absorption was considered to be negligible as arsenic, the only carcinogenic constituent of concern, is not likely to be absorbed through the skin to a significant degree. Calculations for noncarcinogenic and carcinogenic risks associated with exposure to seep water adjacent to the landfill perimeter under current and future conditions are presented in Table 25.

7.2.4 Dermal Absorption and Incidental Ingestion of Seep Sediment (Landfill Perimeter)

Current and future risks of exposure to seep sediment at the landfill perimeter by incidental ingestion were within acceptable EPA risk criteria. The hazard index for incidental ingestion ranged from 2.5E-03 under average conditions to 1.2E-02 under maximum conditions, with both values below the EPA recommended criterion of 1.0. The incremental lifetime cancer risk ranged from 6.9E-08 under average conditions to 2.4E-07 under maximum conditions and was below or within the EPA acceptable risk range of 1.0E-04 to 1.0E-06.

Risks of exposure to seep sediment by dermal absorption were not evaluated quantitatively but were considered to be within acceptable EPA risk criteria. The constituents of concern, arsenic and manganese, are not absorbed transdermally to a significant extent. Calculations for noncarcinogenic and carcinogenic risks associated with exposure to seep sediment under current and future conditions are presented in Table 26.

7.2.5 Dermal Absorption and Ingestion of Seep Sediment (East of Route 5)

Future potential noncarcinogenic and carcinogenic risks associated with ingestion of sediment in drainage ways east of Route 5 were estimated to be below EPA's recommended risk ranges. The hazard index for ingestion of seep sediment ranged from 1.1E-02 under average conditions to 6.7E-02 under maximum conditions, with

both hazard indices below the EPA recommended criterion of 1.0. Arsenic contributed somewhat more to the noncarcinogenic risk of ingestion than manganese. The incremental lifetime cancer risk for ingestion of sediment ranged from 3.7E-07 under average conditions to 2.4E-06 under maximum conditions and was below or within the EPA acceptable risk range of 1.0E-04 to 1.0E-06. The carcinogenic risk estimate was attributed primarily to arsenic.

Risks of exposure to seep sediment east of Route 5 by dermal absorption was estimated to be insignificant. The hazard index for dermal absorption ranged from 3.1E-06 under average conditions to 1.3E-05 under maximum conditions, with both values being well below the EPA recommended criterion of 1.0. The incremental lifetime cancer risk ranged from 7.7E-08 under average conditions to 3.2E-07 under maximum conditions, both below the EPA acceptable risk range of 1.0E-04 to 1.0E-06. Calculations for future noncarcinogenic risk and incremental lifetime cancer risk for ingestion and dermal contact with seep sediment located east of Route 5 are shown in Table 27.

8.0 UNCERTAINTIES AND LIMITATIONS

Uncertainties are inherent to each stage of the risk assessment process. It is, therefore, important to identify those uncertainties most critical to the evaluation and to consider their possible impact on the estimation of site risk. These uncertainties may lead to overestimation or underestimation of site risks. The identification and discussion of these uncertainties provides a perspective for evaluating conclusions of the risk assessment.

8.1 SITE-SPECIFIC

The risk assessment is dependent upon the quality and nature of the environmental sampling data. Sampling bias or selection of specific analytical methodologies can cause skewing of the data. At the DSI site, this is exemplified in the biased selection of monitoring well, seep, and drainage pond sampling locations in known or suspected areas of contaminant impact. Conclusions in the HHRA are based upon two sampling rounds; therefore, a potential also exists for seasonal or annual fluctuations in constituent concentrations.

As previously discussed, future potential human exposure to downgradient bedrock ground water does not represent a realistic scenario due to the Water Agreement under which water must be supplied to any owner of three specified cross-gradient private wells for 20 years following full landfill closure. Additionally, DSI currently owns the property downgradient of the landfill between Route 5 and the Connecticut River. DSI has no intentions of selling or developing this land and is willing to place future use restrictions on the property deed to ensure those intentions.

Conditions in ground water are also likely to improve in the future. Constituents presently identified in ground water would be subject to degradation, dissolution, and dispersion, and future constituent concentrations would likely be less than

current concentrations. It is also probable that full landfill closure under existing state requirements will necessitate some form of source remediation, significantly reducing constituent concentrations. These measures will impede the percolation of rain water through the present landfill cap, thereby limiting the amount of leachate generated by the landfill.

8.2 HAZARD AND DOSE-RESPONSE ASSESSMENT

The initial selection of constituents of concern carries a degree of uncertainty, especially when the list of detected constituents is extensive. Toxicity values and relative risk values used to select indicator compounds are considered to be a preliminary screening tool. However, potential health effects may be underestimated for compounds not included in the final list of constituents of concern because little toxicity information has been established or because of other data limitations. Uncertainty has been limited somewhat in the HHRA by a hierarchical approach to select constituents of concern which, in addition to toxicity values, also considers factors such as frequency of occurrence, concentration, and relation of compound concentrations to background levels and applicable drinking water standards. Use of maximum concentrations for constituents may also skew the selection process.

Uncertainty also exists in the derivation of the individual RfDs and for the selected constituents of concern. Because uncertainties exist in dose-response estimates, EPA has chosen to quantify risk using the upper 95th percentile confidence interval which results in an overestimation of the potential site risks. A series of uncertainty factors are typically applied by EPA when deriving the RfD which may result in substantial overestimation of compound toxicity because

inadequate or insufficient experimental data are available. The application of an uncertainty factor occurs in each of the following circumstances:

- A factor of 10 when accounting for populations variations (i.e., extrapolating effects from animal to human populations);
- A factor of 10 when using a subchronic study to assess chronic effects;
- A factor of 10 when using a Lowest Observable Adverse Effect Level (LOAEL) as the basis of calculation; and
- An additional modifying factor may also be used.

The chronic oral RfDs used for benzo(a)pyrene and 2-hexanone were surrogate values which were applied based upon similarities to other compounds. Rationale was provided for selection of these RfDs; however, uncertainty exists in the values without constituent-specific data.

8.3 EXPOSURE ASSESSMENT

The methodologies involved in calculating average and maximum exposure point concentrations may result in overestimation or underestimation. Use of maximum exposure point concentrations is extremely conservative and implies that maximum concentrations were detectable at each exposure point. Even average concentrations are likely biased toward areas of contaminant impact and may not represent a "typical" exposure concentration.

Methods used to calculate exposure doses also carry a degree of uncertainty which may result in overestimation of risk. For instance, potential exposures to surface seeps and the retention pond are based upon media contact with the entire surface area of the legs and arms of a child. It is probable that potentially exposed skin surface areas would be considerably less, with a corresponding decrease in exposure dose. Moreover, the amount of seep water ingested may be much lower than the 0.5 l/event conservatively presented in the exposure assessment.

8.4 RISK CHARACTERIZATION

Uncertainty in the risk characterization is the by-product of uncertainties presented in earlier stages of the HHRA. Risk summation techniques apply additional uncertainty as they assume independence of action by the constituents and provide no means of addressing chemical interactions. Consequently, incremental lifetime cancer risk estimates may be artificially more conservative as risk estimates from a number of different carcinogens are combined.

9.0 SUMMARY

The HHRA has provided estimates of risk associated with potential on-site and off-site exposure to constituents of concern under current and future conditions. The majority of the risk estimates are within EPA's acceptance criteria and, therefore, do not constitute a "significant" risk; however, some risk estimates were identified which, under the specific exposure assumptions (e.g., maximum cases) presented in this report, are slightly outside EPA's acceptance criteria for characterizing "significant" risk. A summary of the results for this report are presented below.

Acceptable risks were found to be associated with constituents reported in most on-site media due to decreased exposure frequency of potential receptors (e.g., less opportunity for potential exposure because of barriers to site access) or as a result of limited potential exposure points (e.g., a drinking water well does not presently exist on-site and is not likely to be installed in the future). Current and future risks assessed for dermal contact and incidental ingestion of retention pond surface water and sediments do not appear to be significant for a child who may trespass at the DSI site and play in these areas on an infrequent basis. Similarly, significant risks do not appear to be associated with dermal contact and incidental ingestion of sediments located in the drainage ways across Route 5.

With respect to potential current and future exposure to seep sediment adjacent to the landfill perimeter, associated risks were found to be below EPA acceptable levels. Risks associated with potential ingestion of seep water adjacent to the landfill under current and future exposure conditions were found to be below EPA acceptable levels. Risks associated with potential dermal contact to this seep water under average conditions were found to be below acceptable levels, while the estimated risk calculated assuming maximum conditions exceeded the EPA acceptable level (i.e., a calculated hazard index of 1.5 versus the EPA level of 1.0).

It is important to note that this baseline risk assessment, in evaluating potential risks in the absence of remediation, does not fully take into account natural processes or significant activities which are already occurring at the site. A trench has been under construction which has intercepted affected seeps previously occurring east of Route 5, thus allowing natural surface water runoff in drainage ways to attenuate seepage-associated constituent levels in drainage way sediment. Additionally, as part of the 1993 landfill recontouring activities, intermittent and affected sediment adjacent to the landfill toe of the slope will be eliminated, thus addressing this potential exposure pathway. In the near future, remedial activities will involve the construction of an impermeable landfill cap which should prevent percolation of rain water through the refuse (i.e., the likely source) and will further limit impacts associated with the site.

As part of the upcoming FS, each significant potential risk identified in this HHRA, as well as significant potential risks identified in the ecological risk assessment, will be addressed in terms of remedial action. Based upon a suite of remedial actions presented in the FS which will reduce potential risks to acceptable levels, a remedial action program which achieves each remedial objective in an effective manner will be selected by EPA for implementation at the DSI site.

10.0 REFERENCES

ATSDR (1989). Toxicological Profile for Arsenic. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. March 1989. NTIS No. PB89-185706.

Amdur, M.O., Doull, J., Klaassen, C.D. (1991) Toxic effects of metals in "Casarett and Doull's Toxicology: the Basic Science of Poisons," 4th ed., Pergamon Press, New York, pp.623-680.

Balsam Environmental Consultants, Inc. 1991. "Remedial Investigation Field Sampling Plan, *Disposal Specialists, Inc. Facility, Rockingham, Vermont.*" Balsam Environmental Consultants, Inc., 5 Industrial Way, Salem, New Hampshire 03079.

Balsam Environmental Consultants, Inc. 1991. "Draft Remedial Investigation Report. Disposal Specialists, Inc. Facility, Rockingham, Vermont." Balsam Environmental Consultants, Inc., 5 Industrial Way, Salem, New Hampshire 03079.

Balsam Environmental Consultants, Inc. 1992a. "Draft Development and Initial Screening of Remedial Alternatives Report, Disposal Specialists, Inc. Site, Rockingham, Vermont." Balsam Environmental Consultants, Inc., 5 Industrial Way, Salem, New Hampshire 03079.

Balsam Environmental Consultants, Inc. 1992b. "Summary Assessment Report, Disposal Specialists, Inc. Facility, Rockingham, Vermont." Balsam Environmental Consultants, Inc., 5 Industrial Way, Salem, New Hampshire 03079.

Craft, B.F. (1983). Solvents and Related Compounds in "Environmental Occupational Medicine," W.M. Rom (editor), Little, Brown & Co., Boston, pp. 511-533.

GRI (1988). Management of Manufactured Gas Plant Sites, Volume 3: Risk Assessment. Gas Research Institute, Chicago, IL. GRI-87/0260-3.

IRIS (1993). Integrated Risk Information System. U.S. Environmental Protection Agency. Database accessed January 1993.

NIOSH (1990). NIOSH/OSHA Pocket Guide to Chemical Hazards. National Institute for Occupational Safety and Health, Occupational Safety and Health Administration. DHEW (NIOSH) Pub. No. 90-120.

NUS Corporation 1987. "Hazardous Ranking System Package, Browning - Ferris Industries/Rockingham, Rockingham, Vermont, Volume I and Volume II." NUS Corporation. TDD No. TI-8706-09.

OSHA (1980). Documentation of the Threshold Limits Values, 4th edition, Occupational Safety & Health Administration.

Olishifski J.B. and F.E. McElroy (1971). Fundamentals of Industrial Hygiene. National Safety Council, Chicago, IL. 990pp.

Rose, A.W., H.E. Hawkes and J.S. Webb (1979). Geochemistry In Mineral Exploration, Second edition, Academic Press, New York, New York, 657 p.

Sax, N.I. and R.J. Lewis (1989). Dangerous Properties of Industrial Materials. Van Nostrand Rheinhold, New York.

Sittig, M. (1985). Handbook of Toxic Hazardous Chemicals and Carcinogens Second Edition. Noyes Publications, Park Ridge, NJ, 950 pp.

USEPA (1986). Superfund Public Health Evaluation Manual. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. October 1986. EPA/540/1-86/060.

USEPA (1987). Quality Criteria for Water: 1986. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, DC. May 1987. EPA 440/5-86-001, updates 1 and 2 included.

USEPA (1988). Superfund Exposure Assessment Manual. U.S. Environmental Protection Agency, Office of Remedial Response, Washington, D.C. April 1988. EPA/540/1-88/001 (OSWER Directive: 9285.5-1).

USEPA (1989a). Supplemental Risk Assessment Guidance for the Superfund Program. Draft Final. U.S. Environmental Protection Agency, Region I. June 1989. EPA 901/5-89-001.

USEPA (1989b). Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual (Part A). Interim Final. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. December 1989. EPA/540/1-89/002.

USEPA (1990). Exposure Factors Handbook. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Washington, D.C March 1990. EPA/600/8-89/043.

USEPA (1991). Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual. Supplemental Guidance, Standard Default Exposure Factors. Interim Final. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. March 1991. OSWER Directive: 9285.6-03.

USEPA (1992a). Dermal Exposure Assessment: Principles and Applications. Interim Report. U.S. Environmental Protection Agency, Office of Research and Development, January, 1992. EPA/600/8-91/011B.

USEPA (1992b). Health Effects Assessment Summary Tables, U.S. Environmental Protection Agency, Office of Research and Development, Office of Emergency Remedial Response, Washington, D.C. March 1992. OERR 9200.6-303(92-1). Includes Supplement A, July 1992.

USEPA (1992c). Drinking Water Regulations and Health Advisories. U.S. Environmental Protection Agency, Office of Water. December 1992.

Vermont Agency of Natural Resources, Department of Environmental Conservation. September 1988. Chapter 12 Ground Water Protection Rule and Strategy. Rule Number 88-37.

TABLE 1
DATA SUMMARY FOR CONSTITUENTS DETECTED IN GROUND WATER
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Overburden Ground Water				Bedrock Aquifer			
	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Volatile Organic Compounds:								
Vinyl Chloride	ND	1/14	0.100	MWB13D	ND	3/34	0.0030-0.0057	MWA11
Methylene Chloride	ND-0.005	2/14	7.2-8.6	MWB13D	ND	1/34	0.005J	MWA12
Chloroethane	ND	1/14	0.096	MWB13D	ND	5/34	0.0068-0.0425	MWA12
Chloromethane	ND	0/14	ND	---	ND	3/34	0.0095-0.0128	MWA12
Acetone	ND	3/14	0.008-5.8	MWB13D, MWC15	ND	3/34	0.031-0.28	MWE24, MW3
Carbon Disulfide	ND	1/14	0.001	MWB13D	ND	2/34	0.002-0.006	MW9, MWA11
1,1-Dichloroethene	ND	2/14	0.26-0.28	MWB13D	ND	0/34	ND	---
1,1- Dichloroethane	ND	4/14	0.002-5.75	MWB13D	ND	10/34	0.00299-0.024	MW3
1,2- Dichloroethene (total)	ND	4/14	0.005-1.4	MWB13D	ND	6/34	0.00277-0.005J	MWA11
1,2- Dichloethane	ND	2/14	0.135-0.15	MWB13D	ND	5/34	0.001-0.0032	MWA12
2-Butanone	ND	3/14	0.38-13.0	MWB13D	ND	2/34	0.073-0.37	MW3
1,1,1-Trichloroethane	ND	2/14	3.5-4.9	MWB13D	ND	1/34	0.00279	MW4
Trichloroethene	ND	2/14	0.15-0.17	MWB13D	ND	5/34	0.00275-0.00293	MW10
2-Hexanone	ND	2/14	0.02-0.385	MWB13D, MWC15	ND	1/34	0.044	MW3
4-Methyl 2-Pentanone	ND	2/14	0.02-0.22	MWB13D, MWC15	ND	1/34	0.031	MW3
Tetrachloroethene	ND	1/14	0.03	MWB13D	ND	2/34	0.002J-0.012J	MW9
Toluene	ND	3/14	0.004-1.8	MWB13D	0.0011-0.006	14/34	0.001J-0.265	MW3
Chlorobenzene	ND	0/14	ND	---	ND	3/34	0.002-0.006J	MW6
Ethylbenzene	ND	3/14	0.01-0.085	MWB13D	ND	11/34	0.002-0.38	MW3

Notes:

1. Concentrations are reported in parts per million (ppm) or milligrams per liter (mg/L). Some samples results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Background concentrations are derived using analytical data for monitoring well GW-RS (overburden ground water) and using monitoring wells GW-I, MW-B3, MW-G25, MW-G26, MW-H27, MW-H28, and GW-OW3 (bedrock ground water). Frequency does not include background samples.
4. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 1 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN GROUND WATER
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Overburden Ground Water				Bedrock Aquifer			
	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Xylenes (total)	ND	2/14	0.21-0.27	MWB13D	0.001-0.005	11/34	0.003-1.2	MW3
Tetrahydrofuran	ND	0/7	ND	---	ND	4/34	0.058J-0.26J	MW6
Chloroform	ND	2/14	0.004-0.158	MWB13D	ND	1/34	0.026J	MWE24
Benzene	ND	2/14	0.006-0.023	MWB13D	0.00088-0.004	10/34	0.002J-0.017	MW3, MW6
1,2-Dichloropropane	ND	1/14	0.006	MWB13D	ND	0/34	ND	---
Semivolatile Organic Compounds:								
Diethylphthalate	ND	2/14	0.001-0.002	MWE22	ND	10/32	0.0015-0.016	MW6, MW3
Bis(2-ethylhexyl)phthalate	ND-0.009	6/13	0.001J-0.008J	MWC15, MWD19	ND	10/33	0.001-0.062J	MWE23
Butylbenzylphthalate	ND	0/7	ND	---	ND	1/32	0.005J	MW10
1,4-Dichlorobenzene	ND	0/7	ND	---	ND	6/32	0.002J-0.003	MW6/MW3, MW3
4-Methylphenol	ND	3/14	0.003-3.55	MWB13D, MWC15	ND	3/30	0.001J-0.03	MW3
2,4-Dimethylphenol	ND	0/7	ND	---	ND	4/30	0.003J-0.009J	MW3, MW6
Naphthalene	ND	0/7	ND	---	ND	6/32	0.003J-0.006J	MW6
4-Chloro-3-Methylphenol	ND	1/14	0.002	MWC15	ND-0.001	3/32	0.015-0.026	MW6
1,2-Dichlorobenzene	ND	0/7	ND	---	ND	6/32	0.001J-0.002J	MW6, MW3/MW6
Nitrobenzene	ND	0/7	ND	---	ND	1/32	0.002J	MW6
Pentachlorophenol	ND	0/7	ND	---	ND	1/32	0.003J	MW6
Phenol	ND	3/14	0.001-5.45	MWB13D, MWC15	ND	1/30	0.008J	MW3
2-Methylphenol	ND	0/7	ND	---	ND	1/30	0.004J	MW3
Bis(2-chloroisopropyl)ether	ND	0/14	ND	---	ND	1/32	0.10	MW4

Notes:

1. Concentrations are reported in parts per million (ppm) or milligrams per liter (mg/L). Some samples results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Background concentrations are derived using analytical data for monitoring well GW-RS (overburden ground water) and using monitoring wells GW-1, MW-B3, MW-G25, MW-G26, MW-H27, MW-H28, and GW-OW3 (bedrock ground water). Frequency does not include background samples.
4. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 1 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN GROUND WATER
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Overburden Ground Water				Bedrock Aquifer			
	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Pesticides/PCBs:								
Endosulfan	ND	1/7	0.00055	MWB13D	ND	0/16	ND	---
Inorganic Constituents (dissolved):								
Aluminum	ND	3/14	0.0477-0.331	MWC16, MWB13D	ND-0.154J	2/32	0.0467J-0.128	MWC18
Antimony	ND	0/14	ND	---	ND	1/32	0.028	MWG
Arsenic	ND	3/14	0.0025-0.0031	MWC16	ND-0.0121	18/32	0.0029-0.282	MW6, MWLD
Barium	0.006-0.0092	14/14	0.0064-1.3	MWB13D	ND-0.0257	30/32	0.0031J-1.85J	MWA12
Calcium	13.1-13.4	14/14	14.1J-2410	MWB13D	2.05-36.5	29/32	7.39-190	MWA12
Chromium	ND	1/14	0.0144	MWC15	ND-0.0122	5/32	0.0029-0.0806	MWC17
Cobalt	ND	2/14	0.184-0.364	MWB13D	ND-0.0803	10/32	0.0147-0.105	MW6
Copper	0.096-0.121	4/14	0.0207-0.0775	MWB13D, MWE22	ND-0.0519	6/32	0.0072-0.23	MWF
Iron	ND	4/14	0.358-13.3	MWB13D	ND-2.32	13/32	0.106-71.6	MW3
Lead	ND-0.0127	2/14	0.0114-0.0176	MWB13D	ND	2/32	0.0017J-0.0021	MWF
Magnesium	2.0-2.21	14/14	2.65-380	MWB13D	ND-4.59	25/32	1.77-97.7	MW10, MWA12
Manganese	ND	12/14	0.0026-128	MWB13D	ND-1.23	28/32	0.0014-5.83	MW4
Mercury	ND	1/14	0.023	MWB13D	ND	2/32	0.00035-0.0006	MW10
Nickel	ND	2/14	0.556-0.708	MWB13D	ND-0.0404	14/32	0.0186-0.102	MW9, MWA12
Potassium	0.833-0.952	14/14	0.75J-436.5	MWB13D	ND-24.1	29/32	0.441J-142	MWC17, MW6
Selenium	ND	0/14	ND	---	ND	4/32	0.0023J-0.003	MWLD, MW10

Notes:

1. Concentrations are reported in parts per million (ppm) or milligrams per liter (mg/L). Some samples results are reported as *"ND"* or not detected; sample results qualified with a *"J"* are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Background concentrations are derived using analytical data for monitoring well GW-RS (overburden ground water) and using monitoring wells GW-I, MW-B3, MW-G25, MW-G26, MW-H27, MW-H28, and GW-OW3 (bedrock ground water). Frequency does not include background samples.
4. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 1 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN GROUND WATER
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Overburden Ground Water				Bedrock Aquifer			
	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Inorganic Constituents (dissolved) continued:								
Silver	ND	1/14	0.0178	MWB13D	ND	1/32	0.00148	MW6
Sodium	1.7-1.86	14/14	3.63J-424	MWB13D	3.81-41.1	30/32	1.580J-255	MW6
Vanadium	ND	4/14	0.002-0.0037J	MWC15, MWC16	ND-0.0076	6/32	0.0015-0.0067J	MW3, MW6
Zinc	ND-0.0425	10/14	0.0035J-0.365	GW-B7, MWC16	ND-0.124	15/32	0.0018-0.242	MWF, MWE24

Notes:

1. Concentrations are reported in parts per million (ppm) or milligrams per liter (mg/L). Some samples results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Background concentrations are derived using analytical data for monitoring well GW-RS (overburden ground water) and using monitoring wells GW-I, MW-B3, MW-G25, MW-G26, MW-H27, MW-H28, and GW-OW3 (bedrock ground water). Frequency does not include background samples.
4. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 4
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN RETENTION POND SURFACE WATER AND SEDIMENT
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Pond Surface Water			Pond Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Volatile Organic Compounds:						
Acetone	1/4	0.062	SWPW3	8/18	0.01J-0.47J	SDPS1, SDPS3A(b)
Carbon Disulfide	0/4	ND	---	1/18	0.095	SDPS3B(b)
2-Butanone	0/4	ND	---	10/18	0.004J-0.27J	SDPS1, SDPS1(a)
2-Hexanone	0/4	ND	---	1/18	0.01J	SDPS1
Tetrahydrofuran	0/4	ND	---	1/6	0.001J	SDPS2
Chloroform	0/4	ND	---	1/18	0.003J	SDPS3B(a)
Toluene	1/4	0.012	SWPW1	0/18	ND	--
Xylenes (total)	0/4	ND	---	1/18	0.002J	SDPS2(a)
4-Methyl-2-Pentanone	0/4	ND	---	1/18	0.003J	SDPS1(b)
Semivolatile Organic Compounds:						
Bis(2-ethylhexyl)phthalate	0/4	ND	---	1/9	0.92J	SDPS1
Benzo(b)fluoranthene	0/4	ND	---	2/9	0.058J-0.065J	SDPS1
Fluoranthene	0/4	ND	---	1/9	0.068J	SDPS1
Phenol	3/4	0.013-0.14J	SWPW1	1/9	0.11J	SDPS1
4-Methylphenol	2/4	0.001J-0.21J	SWPW1	0/9	ND	---
2-Methylphenol	1/4	0.004J	SWPW3	0/9	ND	---
Pyrene	0/4	ND	---	1/9	0.064J	SDPS1
Diethylphthalate	1/4	0.011J	SWPW1	0/9	ND	---

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 2 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN RETENTION POND SURFACE WATER AND SEDIMENT
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Pond Surface Water			Pond Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Pesticides/PCBs:	0/2	ND	---	0/4	ND	---
Inorganic Constituents (total):						
Aluminum	3/4	0.218-2.64	SWPW3, SWPW1	8/8	5,320-21,200	SDPS1, SDPS3B
Arsenic	2/4	0.0043J-0.005J	SWPW1	4/8	1.9J-5.5J	SDPS1, SDPS3A(a)
Barium	4/4	0.0086-0.095	SWPW1	7/8	18.9-99.1	SDPS1, SDPS3B(a)
Beryllium	0/4	ND	---	3/8	0.24-4.7	SDPS2
Calcium	4/4	7.39-240J	SWPW1	8/8	1,200-3,370	SDPS1, SDPS2(a)
Chromium	2/4	0.0094-0.0121	SWPW1	8/8	9.4-34.7	SDPS1, SDPS3B(a)
Cobalt	2/4	0.0098-0.0126	SWPW1	8/8	6.3-21.5	SDPS1, SDPS3B(a)
Copper	0/4	ND	---	8/8	18-68.3	SDPS1, SDPS3B(a)
Iron	4/4	0.484-14.9	SWPW1	8/8	12,000-40,100	SDPS1, SDPS3B(a)
Lead	3/4	0.0018J-0.0074	SWPW3, SWPW1	8/8	4.5-17.8	SDPS1
Magnesium	4/4	1.13-35.6	SWPW1	8/8	2,690-10,700	SDPS1, SDPS3B(a)
Manganese	4/4	0.204-6.18	SWPW1	8/8	145-677	SDPS1, SDPS2
Nickel	1/4	0.0096	SWPW3	8/8	13.5-41.5	SDPS1, SDPS3B(a)
Potassium	4/4	1.34-26.5	SWPW1	8/8	585-3,630J	SDPS1, SDPS2(a)
Silver	1/4	0.0017	SWPW1	0/8	ND	---

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 2 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN RETENTION POND SURFACE WATER AND SEDIMENT
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Pond Surface Water			Pond Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Inorganic Constituents (total) continued:						
Sodium	4/4	1.71-69.8	SWPW1	4/8	48.7-163J	SDPS2(a)
Thallium	0/4	ND	---	2/8	0.48J-0.49J	SDPS3B(a)
Vanadium	1/4	0.0061	SWPW1	8/8	12.9-45	SDPS1, SDPS3B(a)
Zinc	1/4	0.006J	SWPW1	8/8	31.4J-108J	SDPS1, SDPS3B(a)

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 3

DATA SUMMARY FOR CONSTITUENTS DETECTED IN SEEP SURFACE WATER AND SEDIMENT (LANDFILL PERIMETER) DISPOSAL SPECIALISTS, INC. ROCKINGHAM, VERMONT

	Seep Surface Water			Seep Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Volatile Organic Compounds:						
Acetone	2/4	0.01-1.2	SWSW5, SWSW1	2/4	0.013J-0.12J	SDSS1
1,2-Dichloroethene (total)	1/4	0.002J	SWSW1	0/4	ND	---
2-Butanone	3/4	0.001J-1.6	SWSW1	2/4	0.004J-0.052J	SDSS1
1,1,1-Trichlorethane	1/4	0.003J	SWSW1	0/4	ND	---
2-Hexanone	1/4	0.39J	SWSW1	0/4	ND	---
4-Methyl-2-pentanone	2/4	0.025-0.1J	SWSW1	1/4	0.004J	SDSS1
Carbon Disulfide	0/4	ND	---	1/4	0.002J	SDSS1
Toluene	1/4	0.13	SWSW1	1/4	0.012J	SDSS1
Ethylbenzene	1/4	0.017	SWSW1	1/4	0.002J	SDSS1
Xylenes (total)	1/4	0.038	SWSW1	2/4	0.004J	SDSS1
Tetrahydrofuran	1/2	0.091J	SWSW5	0/2	ND	---
Semivolatile Organic Compounds:						
4-Methylphenol	2/4	0.78J-0.930	SWSW1	1/4	0.067J	SDSS1
Phenol	2/4	0.098-0.28J	SWSW1	2/4	0.043J-0.052J	SDSS1
2-Methylphenol	1/4	0.006J	SWSW1	0/4	ND	---
Di-n-octylphthalate	0/4	ND	---	1/4	0.023J	SDSS1
Diethylphthalate	2/4	0.005J-0.018J	SWSW1	0/4	ND	---
Bis(2-ethylhexyl)phthalate	0/4	ND	---	1/4	1.7J	SDSS1
Phenanthrene	0/4	ND	---	1/4	0.05J	SDSS1
Pyrene	0/4	ND	---	1/4	0.035J	SDSS1
Fluoranthene	0/4	ND	---	2/4	0.036J-0.0415	SDSS1

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 3 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN SEEP SURFACE WATER AND SEDIMENT (LANDFILL PERIMETER)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Seep Surface Water			Seep Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Benzo(b)fluoranthene	0/4	ND	---	1/4	0.029J	SDSS1
Pesticides/PCBs:	0/2	ND	---	0/2	ND	----
Inorganic Constituents (total):						
Aluminum	4/4	0.832-142	SWSW1	4/4	2,700J-10,500	SDSS5, SDSS1
Arsenic	2/4	0.0142J-0.0521J	SWSW1	4/4	2.7-6.7	SDSS5, SDSS1
Barium	4/4	0.152-0.982	SWSW1	4/4	10J-113	SDSS5, SDSS1
Calcium	4/4	58.2-443J	SWSW1, SWSW5	4/4	573J-4020	SDSS5, SDSS1
Chromium	3/4	0.0056-0.231	SWSW1	4/4	4.1-19.3	SDSS1
Cobalt	4/4	0.0078-0.167J	SWSW1	3/4	3.6-20.6	SDSS5, SDSS1
Copper	1/4	0.46J	SWSW1	3/4	19-22.9	SDSS5, SDSS1
Iron	4/4	8.4-344	SWSW1	4/4	6,840J-45,800	SDSS5, SDSS1
Lead	3/4	0.0075J-0.514J	SWSW1	4/4	5.2J-33.1	SDSS1
Magnesium	4/4	19.5-166J	SWSW1	4/4	1,420-5,640	SDSS1
Inorganic Constituents (total): continued						
Manganese	4/4	2.65J-13J	SWSW1	4/4	100J-2,860	SDSS5, SDSS1
Mercury	1/4	0.001	SWSW1	1/4	0.16	SDSS1
Nickel	3/4	0.0122-0.454	SWSW1	3/4	14.7-21.4	SDSS5, SDSS1
Potassium	4/4	21.7-61.8	SWSW1	4/4	494-2,270	SDSS1

Notes:

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2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 3 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN SEEP SURFACE WATER AND SEDIMENT (LANDFILL PERIMETER)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Seep Surface Water			Seep Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Sodium	4/4	59.5-132J	SWSW1	2/4	50.5-56.1J	SDSS1
Vanadium	3/4	0.0087-0.32J	SWSW1	4/4	5.4-24.2	SDSS1
Thallium	0/3	ND	---	1/4	0.46J	SDSS5
Zinc	1/4	0.854-3.96J	SWSW1	4/4	16J-63.9	SDSS5, SDSS1

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 4
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN SEEP SURFACE WATER AND SEDIMENT (EAST OF ROUTE 5)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Seep Surface Water			Seep Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Volatile Organic Compounds:						
Vinyl Chloride	2/12	0.074J-0.170	SWSW3, SWSW2	1/8	0.45J	SDSS3
Chloroethane	4/12	0.140-0.89	SWSW3,SWSW6	3/8	0.098-0.2J	SDSS3
Methylene Chloride	2/12	0.097J-0.45	SWSW3	1/8	1.1J	SDSS3
Acetone	3/12	0.46-1.3	SWSW4, SWSW9	5/8	0.005J-17.0J	SDSS3
1,1-Dichloroethene	0/12	ND	---	1/8	0.009J	SDSS3
1,1-Dichloroethane	5/12	0.035J-3.0	SWSW3	1/8	1.3J	SDSS3
1,2-Dichloroethene (total)	5/12	0.012J-4.3	SWSW3	3/8	0.006J-2.2J	SDSS3
1,2-Dichloroethane	1/12	0.012J	SWSW3	0/8	ND	-----
2-Butanone	9/12	0.16J-14.0	SWSW3	5/8	0.011J-18.0J	SDSS3
Trichloroethene	0/12	ND	---	1/8	0.05	SDSS3
1,1,1-Trichlorethane	1/12	0.64J	SWSW3	1/8	0.39	SDSS3
Tetrachloroethane	0/12	ND	---	1/8	0.012J	SDSS3
Benzene	0/12	ND	---	1/8	0.008J	SDSS3
2-Hexanone	8/12	0.099-1.6	SWSW3	5/8	0.011J-3.8J	SDSS3
4-Methyl-2-pentanone	7/12	0.03-1.0	SWSW6, SWSW3	5/8	0.005J-1.2J	SDSS3
Toluene	7/12	0.057J-3.0	SWSW3	4/8	0.017J-2.1J	SDSS3
Chlorobenzene	0/12	ND	---	1/8	0.004J	SDSS3
Ethylbenzene	5/12	0.016J-0.23J	SWSW3	5/8	0.003J-0.36	SDSS3
Xylenes (total)	7/12	0.022J-0.89J	SWSW3	5/8	0.010J-1.2J	SDSS3
Tetrahydrofuran	2/6	0.13J-0.53J	SWSW3	2/4	0.04J-0.28J	SDSS3

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations. A "B" qualifier indicates that the concentration of an inorganic constituent is less than the Contract Required Detection Limit (CRDL) but greater than the instrument detection limit (IDL).
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 4 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN SEEP SURFACE WATER AND SEDIMENT (EAST OF ROUTE 5)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Seep Surface Water			Seep Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Semivolatile Organic Compounds:						
4-Methylphenol	6/12	0.001J-24.0J	SWSW4, SWSW3	3/8	0.16J-7.1	SDSS3
Phenol	7/12	0.015J-3.6J	SWSW4, SWSW3	3/8	0.076J-1.6J	SDSS3
2-Methylphenol	2/12	0.044J-0.056	SWSW4, SWSW9	0/8	ND	---
Anthracene	0/12	ND	---	1/8	0.089J	SDSS2
Bis(2-chloroisopropyl) Ether	1/12	0.062J-0.07J	SWSW6	0/8	ND	---
Diethylphthalate	2/12	0.005J-0.054J	SWSW2	0/8	ND	---
Bis(2-ethylhexyl)phthalate	0/12	ND	---	1/8	0.88J	SDSS3
Phenanthrene	0/12	ND	---	6/8	0.052J-0.3J	SDSS4, SDSS2
Pyrene	0/12	ND	---	6/8	0.081J-0.91J	SDSS2
Fluoranthene	0/12	ND	---	6/8	0.098J-1.2J	SDSS2
Acenaphthylene	0/12	ND	---	2/8	0.048J-0.14J	SDSS2
Dibenzo(a,h)anthracene	0/12	ND	---	1/8	0.082J	SDSS2
Benzo(b)fluoranthene	0/12	ND	---	6/8	0.075J-1.3J	SDSS2
Benzo(a)anthracene	0/12	ND	---	5/8	0.046J-0.77J	SDSS2
4-Chloro-3-Methylphenol	0/12	ND	---	1/8	0.061J-0.077J	SDSS2
Chrysene	0/12	ND	---	6/8	0.051J-0.4J	SDSS2
Benzo(a)pyrene	0/12	ND	---	4/8	0.071J-0.53J	SDSS2
Indeno(1,2,3-cd)pyrene	0/12	ND	---	3/8	0.064J-0.39J	SDSS2
Benzo(g,h,i)perylene	0/12	ND	---	3/8	0.041J-0.3J	SDSS4, SDSS2
Naphthalene	0/12	ND	---	1/8	0.75J	SDSS3

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations. A "B" qualifier indicates that the concentration of an inorganic constituent is less than the Contract Required Detection Limit (CRDL) but greater than the instrument detection limit (IDL).
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 4 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN SEEP SURFACE WATER AND SEDIMENT (EAST OF ROUTE 5)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Seep Surface Water			Seep Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Pesticides/PCBs:						
4,4'-DDD	0/5	ND	---	1/3	0.0049J	SDSS6
4,4'-DDT	0/5	ND	---	1/3	0.008J	SDSS6
Inorganic Constituents (total):						
Aluminum	6/12	0.032-199J	SWSW4, SWSW9	8/8	1,450J-16,500J	SDSS6
Arsenic	11/12	0.0021-0.218J	SWSW6, SWSW8	7/8	2.4J-64.8J	SDSS2
Barium	12/12	0.0752-2.88J	SWSW3	8/8	74.3J-2,240J	SDSS2
Beryllium	2/12	0.002-0.0047B	SWSW9	1/8	0.4	SDSS6
Cadmium	2/11	0.0029-0.0037	SWSW3	2/7	0.83-1.3	SDSS2
Calcium	12/12	103-655	SWSW3	8/8	2,470J-92,900J	SDSS4, SDSS2
Chromium	3/12	0.0033-0.314	SWSW9	5/8	3.7-27.6	SDSS6
Cobalt	11/12	0.0053-0.174	SWSW9	7/8	6.9-20.8J	SDSS4, SDSS6
Copper	0/12	ND	---	7/8	4.9-29.3J	SDSS6
Cyanide	1/12	0.0198	SWSW9	2/8	1.6-2.3	SDSS4
Iron	12/12	0.993-505	SWSW3	8/8	27,900J-338,000J	SDSS4, SDSS3
Lead	4/12	0.0016J-0.119J	SWSW4, SWSW9	8/8	2.6J-32.2J	SDSS6, SDSS2
Magnesium	12/12	17.2-167J	SWSW6, SWSW9	8/8	1,530-9,140	SDSS6
Manganese	12/12	0.222-12.2	SWSW3, SWSW6	8/8	349-3,810	SDSS6, SDSS3
Nickel	8/12	0.0145-0.393	SWSW3, SWSW9	4/8	14.3-32.3	SDSS6
Potassium	12/12	15.3-206J	SWSW3	8/8	683-2,250	SDSS6

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations. A "B" qualifier indicates that the concentration of an inorganic constituent is less than the Contract Required Detection Limit (CRDL) but greater than the instrument detection limit (IDL).
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 4 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN SEEP SURFACE WATER AND SEDIMENT (EAST OF ROUTE 5)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Seep Surface Water			Seep Sediment		
	Frequency of Detection	Detected Range (ppm)	Location of Maximum	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Inorganic Constituents (total): continued						
Selenium	1/8	0.0026J	SWSW8	0/8	ND	---
Silver	2/12	0.0017-0.0021	SWSW4	0/8	ND	---
Sodium	12/12	96.7-816	SWSW3, SWSW2	4/8	186-1,420	SDSS2
Vanadium	6/12	0.0031-0.353	SWSW3, SWSW9	8/8	11.7J-32.3J	SDSS6
Thallium	0/8	ND	---	2/8	0.67J-0.79J	SDSS2
Zinc	9/12	0.0454-0.929	SWSW3, SWSW9	8/8	98.9J-637	SDSS2

Notes:

1. Concentrations are reported in parts per million (ppm) or in milligrams per liter (mg/L) for water and milligrams per kilogram (mg/kg) for sediment. Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations. A "B" qualifier indicates that the concentration of an inorganic constituent is less than the Contract Required Detection Limit (CRDL) but greater than the instrument detection limit (IDL).
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 3
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN CONNECTICUT RIVER SURFACE WATER
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Volatile Organic Compounds:				
Acetone	ND-0.005	0/4	ND	SWRW3
Semivolatile Organic Compounds:				
4-Methylphenol	ND	1/2	0.002J	SWRW2
Inorganic Constituents (total):				
Aluminum	0.295-3.96J	4/4	0.188-24.9J	SWRW3, SWRW2
Barium	0.0109-0.0256	4/4	0.0103-0.128	SWRW1, SWRW2
Beryllium	ND	1/4	0.0011	SWRW2
Calcium	11.3-14.7	3/4	12.4-13.5	SWRW3
Chromium	ND-0.006	2/4	0.04	SWRW2
Cobalt	ND	1/4	0.026	SWRW2
Lead	ND	1/4	0.0198J	SWRW2
Iron	0.681-7.13J	4/4	0.464-47.0J	SWRW3, SWRW2
Magnesium	ND-2.24	3/4	1.73-17.5	SWRW3, SWRW2
Manganese	0.0943-0.285J	4/4	0.0951-1.6J	SWRW2
Nickel	ND	1/4	0.0463	SWRW2
Potassium	1.64-1.90	4/4	1.15-6.55	SWRW3, SWRW2

Notes:

1. Concentration are reported in parts per million (ppm) or milligrams per liter (mg/L). Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Background concentrations are derived using analytical data for surface water sampling station SW-RW3. Frequency does not include background sample.
4. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 5 (continued)
DATA SUMMARY FOR CONSTITUENTS DETECTED
IN CONNECTICUT RIVER SURFACE WATER
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	Background Concentration (ppm)	Frequency of Detection	Detected Range (ppm)	Location of Maximum
Inorganic Constituents (total) continued:				
Sodium	ND-7.27	3/4	5.49-16.7	SWRW3, SWRW2
Vanadium	ND-0.0078	2/4	0.0018-0.0476	SWRW1, SWRW2
Zinc	ND-0.0032	1/4	0.0026	SWRW3

Notes:

1. Concentration are reported in parts per million (ppm) or milligrams per liter (mg/L). Some sample results are reported as "ND" or not detected; sample results qualified with a "J" are considered to be estimated concentrations.
2. Analytical data for detected constituents based upon October 1991 and March 1992 sampling results.
3. Background concentrations are derived using analytical data for surface water sampling station SW-RW3. Frequency does not include background sample.
4. Both locations are noted if the location of maximum concentration differs between sampling rounds.

TABLE 6
SELECTION OF CONSTITUENTS OF CONCERN - RETENTION POND SURFACE WATER
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

NONCARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/L)	CHRONIC ORAL RfD (mg/kg/day)	TOXICITY VALUE (1/RfD)	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS CONSTITUENT OF CONCERN
ACETONE	0 062	1 0E-01	1.0E+01	6.2E-01	5.0E-03	0 5	Low relative risk
TOLUENE	0.012	2.0E-01	5 0E+00	6 0E-02	4 8E-04	0 0	Low relative risk
PHENOL	0.14	6 0E-01	1.7E+00	2.3E-01	1 9E-03	0 2	Low relative risk
2-METHYLPHENOL	0.004	5 0E-02	2 0E+01	8 0E-02	6 4E-04	0 1	Low relative risk
* 4-METHYLPHENOL	0.21	5 0E-03	2.0E+02	4.2E+01	3 4E-01	33 7	
DIETHYLPHTHALATE	0 011	8 0E-01	1 3E+00	1.4E-02	1 1E-04	0 0	Low relative risk
* ARSENIC	0 005	3 0E-04	3 3E+03	1.7E+01	1 3E-01	13 4	
BARIUM	0 095	7 0E-02	1.4E+01	1.4E+00	1.1E-02	1 1	Below MCL of 2 mg/L
CHROMIUM	0 012	1.0E+00	1 0E+00	1.2E-02	9 7E-05	0 0	Low relative risk, below MCL of 0 1 mg/L
* MANGANESE	6.18	1 0E-01	1 0E+01	6.2E+01	5.0E-01	49 6	
NICKEL	0 0096	2 0E-02	5 0E+01	4.8E-01	3 9E-03	0 4	Low relative risk, below proposed MCL of 0.1 mg/L
SILVER	0 0017	5 0E-03	2 0E+02	3.4E-01	2.7E-03	0 3	Low relative risk
VANADIUM	0 006	7.0E-03	1.4E+02	8 6E-01	6 9E-03	0.7	Low relative risk
ZINC	0 006	3 0E-01	3 3E+00	2 0E-02	1.6E-04	0.0	Low relative risk
	TOTAL RISK FACTOR:			1.2E+02			

CONSTITUENTS LACKING EPA-VERIFIED TOXICITY DATA:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/L)	RATIONALE FOR NOT SELECTING AS A COMPOUND OF CONCERN
ALUMINUM	2.64	Not considered a substantial health risk
CALCIUM	240	Not considered a substantial health risk
COBALT	0 0126	Comparable to background levels
LEAD	0.0074	Below proposed MCL action level of 0 015 mg/L
IRON	14 9	Not considered a substantial health risk
MAGNESIUM	35 6	Not considered a substantial health risk
POTASSIUM	26 5	Not considered a substantial health risk
SODIUM	69 8	Not considered a substantial health risk

* = Constituent of concern for retention pond surface water

NOTES

1 Chronic oral reference doses (RfDs) derived from EPA's Integrated Risk Information System (IRIS) in January 1993, with the exception of zinc which was derived from EPA's Health Effects Summary Tables (HEAST) and Supplement A, dated March and July 1992, respectively.

2 Low relative risk was defined as less than or equal to 1 0 percent of the total risk factor

3 Note that constituents with potential carcinogenic risks other than arsenic were not detected and therefore were not screened for carcinogenic risks

TABLE 7
SELECTION OF CONSTITUENTS OF CONCERN - RETENTION POND SEDIMENT
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

NONCARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	CHRONIC ORAL RfD (mg/kg/day)	TOXICITY VALUE (1/RfD)	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS CONSTITUENT OF CONCERN
ACETONE	0.47	1.0E-01	1.0E+01	4.7E+00	1.3E-04	0.0	Low relative risk
2-BUTANONE	0.27	5.0E-02	2.0E+01	5.4E+00	1.5E-04	0.0	Low relative risk
4-METHYL-2-PENTANONE	0.003	5.0E-02	2.0E+01	6.0E-02	1.6E-06	0.0	Low relative risk
CARBON DISULFIDE	0 095	1 0E-01	1 0E+01	9.5E-01	2 6E-05	0.0	Low relative risk
CHLOROFORM	0 003	1 0E-02	1.0E+02	3.0E-01	8 2E-06	0.0	Low relative risk
XYLENES (TOTAL)	0 002	2.0E+00	5.0E-01	1 0E-03	2.7E-08	0.0	Low relative risk
BIS(2-ETHYLHEXYL)PHTHALATE	0 92	2 0E-02	5 0E+01	4 6E+01	1 3E-03	0.1	Low relative risk
PHENOL	0 11	6.0E-01	1.7E+00	1.8E-01	5.0E-06	0 0	Low relative risk
FLUORANTHENE	0 068	4 0E-02	2 5E+01	1 7E+00	4 7E-05	0.0	Low relative risk
PYRENE	0 064	3.0E-02	3 3E+01	2 1E+00	5 9E-05	0 0	Low relative risk
* ARSENIC	5 5	3 0E-04	3 3E+03	1.8E+04	5.0E-01	50 3	
BARIUM	99 1	7 0E-02	1 4E+01	1.4E+03	3.9E-02	3 9	Comparable to background levels
BERYLLIUM	4 7	5.0E-03	2 0E+02	9.4E+02	2 6E-02	2 6	Comparable to background levels
CHROMIUM	34 7	1.0E+00	1 0E+00	3 5E+01	9.5E-04	0.1	Low relative risk, comparable to background levels
* MANGANESE	677	1 0E-01	1 0E+01	6 8E+03	1 9E-01	18 6	
NICKEL	41 5	2 0E-02	5 0E+01	2 1E+03	5.7E-02	5 7	Comparable to background levels
VANADIUM	45	7 0E-03	1.4E+02	6 4E+03	1 8E-01	17 7	Comparable to background levels
ZINC	108	3.0E-01	3 3E+00	3 6E+02	9 9E-03	1 0	Comparable to background levels
	TOTAL RISK FACTOR:			3.6E+04			

* = Constituent of concern for retention pond sediment

NOTES:

1 Chronic oral reference doses (RfDs) derived from EPA's Integrated Risk Information System (IRIS) in January 1993, with the exception of 2-butanone, 4-methyl 2-pentanone, vanadium and zinc which were derived from EPA's Health Effects Summary Tables (HEAST) and Supplement A, dated March and July 1992, respectively.

2 Low relative risk was defined as less than or equal to 1 0 percent of the total risk factor

TABLE 7 (continued)
SELECTION OF CONSTITUENTS OF CONCERN - RETENTION POND SEDIMENT
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

CARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	SLOPE FACTOR (mg/kg/day)-1	TOXICITY VALUE	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS A CONSTITUENT OF CONCERN
CHLOROFORM	0.003	6.1E-03	6.1E-03	1.8E-05	1.8E-06	0.0	Low relative risk
BIS(2-ETHYLHEXYL)PHTHALATE	0.92	1.4E-02	1.4E-02	1.3E-02	1.3E-03	0.1	Low relative risk
* ARSENIC	5.5	1.8E+00	1.8E+00	9.9E+00	1.0E+00	99.9	
	TOTAL RISK FACTOR:			9.9E+00			

CONSTITUENTS LACKING EPA-VERIFIED TOXICITY DATA:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	RATIONALE FOR NOT SELECTING AS A COMPOUND OF CONCERN
2-HEXANONE	0.01	Low concentration
TETRAHYDROFURAN	0.001	Low concentration
BENZO(b)FLUORANTHENE	0.065	Likely similar to the low level non-carcinogenic risk presented for pyrene
ALUMINUM	21200	Comparable to background levels
CALCIUM	3370	Not considered a substantial health risk
COBALT	21.5	Comparable to background levels
COPPER	68.3	Comparable to background levels
IRON	40100	Not considered a substantial health risk
LEAD	17.8	Comparable to background levels
MAGNESIUM	10700	Not considered a substantial health risk
POTASSIUM	3630	Not considered a substantial health risk
SODIUM	163	Not considered a substantial health risk
THALLIUM	0.49	Comparable to background levels

* = Constituent of concern for retention pond sediment

NOTES:

1. Oral slope factors derived from EPA's Integrated Risk Information System (IRIS) in January 1993, the value for arsenic was calculated from the recommended EPA unit risk
2. Low relative risk was defined as less than or equal to 1.0 percent of the total risk factor

TABLE 8
SELECTION OF CONSTITUENTS OF CONCERN - SEEP SURFACE WATER (LANDFILL PERIMETER)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

NONCARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/L)	CHRONIC ORAL RfD (mg/kg/day)	TOXICITY VALUE (1/RfD)	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS CONSTITUENT OF CONCERN
* ACETONE	1.2	1.0E-01	1.0E+01	1.2E+01	1.9E-02	1.9	
trans-1,2-DICHLOROETHENE	0.002	9.0E-03	1.1E+02	2.2E-01	3.5E-04	0.0	Low relative risk
* 2-BUTANONE	1.6	5.0E-02	2.0E+01	3.2E+01	5.0E-02	5.0	
4-METHYL-2-PENTANONE	0.1	5.0E-02	2.0E+01	2.0E+00	3.1E-03	0.3	Low relative risk
1,1,1-TRICHLOROETHANE	0.003	9.0E-02	1.1E+01	3.3E-02	5.2E-05	0.0	Low relative risk
TOLUENE	0.13	2.0E-01	5.0E+00	6.5E-01	1.0E-03	0.1	Low relative risk
ETHYLBENZENE	0.017	1.0E-01	1.0E+01	1.7E-01	2.7E-04	0.0	Low relative risk, below MCL of 0.7 mg/L
XYLENES (TOTAL)	0.038	2.0E+00	5.0E-01	1.9E-02	3.0E-05	0.0	Low relative risk, below MCL of 10 mg/L
PHENOL	0.28	6.0E-01	1.7E+00	4.7E-01	7.3E-04	0.1	Low relative risk
2-METHYLPHENOL	0.006	5.0E-02	2.0E+01	1.2E-01	1.9E-04	0.0	Low relative risk
* 4-METHYLPHENOL	0.93	5.0E-03	2.0E+02	1.9E+02	2.9E-01	29.2	
DIETHYLPHTHALATE	0.018	8.0E-01	1.3E+00	2.3E-02	3.5E-05	0.0	Low relative risk
* ARSENIC	0.0521	3.0E-04	3.3E+03	1.7E+02	2.7E-01	27.3	
BARIUM	0.982	7.0E-02	1.4E+01	1.4E+01	2.2E-02	2.2	Below MCL of 2 mg/L
CHROMIUM	0.231	1.0E+00	1.0E+00	2.3E-01	3.6E-04	0.0	Low relative risk
* MANGANESE	13	1.0E-01	1.0E+01	1.3E+02	2.0E-01	20.4	
MERCURY	0.001	3.0E-04	3.3E+03	3.3E+00	5.2E-03	0.5	Low relative risk; below MCL of 0.002 mg/L
* NICKEL	0.454	2.0E-02	5.0E+01	2.3E+01	3.6E-02	3.6	
* VANADIUM	0.32	7.0E-03	1.4E+02	4.6E+01	7.2E-02	7.2	
ZINC	3.96	3.0E-01	3.3E+00	1.3E+01	2.1E-02	2.1	Below SMCL of 5 mg/L
TOTAL RISK FACTOR:				6.4E+02			

* = Constituent of concern for seep surface water (at landfill perimeter)

NOTES:

1. Chronic oral reference doses (RfDs) derived from EPA's Integrated Risk Information System (IRIS) in January 1993, with the exception of 1,1,1-trichloroethane, 2-butanone, 4-methyl 2-pentanone, bis(2-chloroisopropyl)ether, mercury, vanadium and zinc which were derived from EPA's Health Effects Summary Tables (HEAST) and Supplement A, dated March and July 1992, respectively.
2. Low relative risk was defined as less than or equal to 1.0 percent of the total risk factor.

TABLE 8 (continued)
SELECTION OF CONSTITUENTS OF CONCERN - SEEP SURFACE WATER (LANDFILL PERIMETER)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

CONSTITUENTS LACKING EPA-VERIFIED TOXICITY DATA:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/L)	RATIONALE FOR NOT SELECTING AS A COMPOUND OF CONCERN
TETRAHYDROFURAN	0.091	Not considered a substantial health risk
* 2-HEXANONE	0.39	
ALUMINUM	142	Not considered a substantial health risk
CALCIUM	443	Not considered a substantial health risk
COBALT	0.167	Comparable to background levels
COPPER	0.46	Below proposed MCL of 1.3 mg/L
* LEAD	0.514	
IRON	344	Not considered a substantial health risk
MAGNESIUM	166	Not considered a substantial health risk
POTASSIUM	61.8	Not considered a substantial health risk
SODIUM	132	Not considered a substantial health risk

* = Constituent of concern for seep surface water (at landfill perimeter)

NOTES:

1 Note that constituents with potential carcinogenic risks other than arsenic were not detected and therefore were not screened for carcinogenic risks

TABLE 9
SELECTION OF CONSTITUENTS OF CONCERN - SEEP SEDIMENT (LANDFILL PERIMETER)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

NONCARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	CHRONIC ORAL RfD (mg/kg/day)	TOXICITY VALUE (1/RfD)	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS CONSTITUENT OF CONCERN
CARBON DISULFIDE	0.002	1.0E-01	1.0E+01	2.0E-02	3 5E-07	0.0	Low relative risk
ACETONE	0.12	1.0E-01	1.0E+01	1.2E+00	2 1E-05	0 0	Low relative risk
TOLUENE	0.012	2.0E-01	5.0E+00	6.0E-02	1 0E-06	0.0	Low relative risk
2-BUTANONE	0 052	5.0E-02	2 0E+01	1.0E+00	1 8E-05	0.0	Low relative risk
4-METHYL-2-PENTANONE	0 004	5.0E-02	2 0E+01	8 0E-02	1 4E-06	0.0	Low relative risk
ETHYLBENZENE	0 002	1.0E-01	1.0E+01	2 0E-02	3 5E-07	0.0	Low relative risk
XYLENES (TOTAL)	0 004	2.0E+00	5 0E-01	2 0E-03	3 5E-08	0.0	Low relative risk
BIS(2-ETHYLHEXYL)PHTHALATE	1 7	2.0E-02	5 0E+01	8 5E+01	1 5E-03	0 1	Low relative risk
DI-N-OCTYLPHTHALATE	0 023	2 0E-02	5.0E+01	1.2E+00	2 0E-05	0 0	Low relative risk
PHENOL	0 052	6.0E-01	1 7E+00	8 7E-02	1 5E-06	0.0	Low relative risk
4-METHYLPHENOL	0 067	5 0E-03	2 0E+02	1 3E+01	2.3E-04	0.0	Low relative risk
FLUORANTHENE	0 041	4 0E-02	2.5E+01	1.0E+00	1 8E-05	0.0	Low relative risk
PYRENE	0 035	3.0E-02	3 3E+01	1.2E+00	2 0E-05	0.0	Low relative risk
* ARSENIC	6 7	3.0E-04	3 3E+03	2 2E+04	3 9E-01	38 5	
BARIUM	113	7.0E-02	1.4E+01	1.6E+03	2 8E-02	2 8	Comparable to background levels
CHROMIUM	19 3	1 0E+00	1 0E+00	1 9E+01	3 3E-04	0.0	Low relative risk; comparable to background levels
* MANGANESE	2860	1.0E-01	1.0E+01	2 9E+04	4.9E-01	49.4	
MERCURY	0 16	3.0E-04	3.3E+03	5 3E+02	9.2E-03	0.9	Low relative risk; comparable to background levels
NICKEL	21.4	2 0E-02	5.0E+01	1 1E+03	1 8E-02	1.8	Comparable to background levels
VANADIUM	24 2	7 0E-03	1.4E+02	3 5E+03	6 0E-02	6.0	Comparable to background levels
ZINC	63 9	3 0E-01	3 3E+00	2 1E+02	3 7E-03	0.4	Low relative risk
	TOTAL RISK FACTOR:			5.8E+04			

* = Constituent of concern for seep sediment (at landfill perimeter)

NOTES

1 Chronic oral reference doses (RfDs) derived from EPA's Integrated Risk Information System (IRIS) in January 1993, with the exception of 2-butanone, 4-methyl 2-pentanone, di-n-octylphthalate, vanadium and zinc which were derived from EPA's Health Effects Summary Tables (HEAST) and Supplement A, dated March and July 1992, respectively

2 Low relative risk was defined as less than or equal to 1 0 percent of the total risk factor.

TABLE 9 (continued)
SELECTION OF CONSTITUENTS OF CONCERN - SEEP SEDIMENT (LANDFILL PERIMETER)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

CARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	SLOPE FACTOR (mg/kg/day)-1	TOXICITY VALUE	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS A CONSTITUENT OF CONCERN
BIS(2-ETHYLHEXYL)PHTHALATE	1.7	5.1E-02	5 1E-02	8.7E-02	7.1E-03	0 7	Low relative risk
* ARSENIC	6.7	1 8E+00	1.8E+00	1.2E+01	9.9E-01	99 3	
	TOTAL RISK FACTOR:			1.2E+01			

CONSTITUENTS LACKING EPA-VERIFIED TOXICITY DATA:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	*RATIONALE FOR NOT SELECTING AS A COMPOUND OF CONCERN*
BENZO(b)FLUORANTHENE	0 029	Likely similar to the low level non-carcinogenic risk presented for pyrene
PHENANTHRENE	0 05	Likely similar to the low level non-carcinogenic risk presented for pyrene
ALUMINUM	10500	Not considered a substantial health risk
CALCIUM	4020	Not considered a substantial health risk
COBALT	20 6	Comparable to background levels
COPPER	22 9	Comparable to background levels
IRON	45800	Not considered a substantial health risk
LEAD	33 1	Comparable to background levels
MAGNESIUM	5640	Not considered a substantial health risk
POTASSIUM	2270	Not considered a substantial health risk
SODIUM	56.1	Not considered a substantial health risk
THALLIUM	0.46	Comparable to background levels

* = Constituent of concern for seep sediment (at landfill perimeter)

NOTES:

1. Oral slope factors derived from EPA's Integrated Risk Information System (IRIS) in January 1993
2. Low relative risk was defined as less than or equal to 1 0 percent of the total risk factor

TABLE 10
SELECTION OF CONSTITUENTS OF CONCERN - SEEP SEDIMENT (EAST OF ROUTE 5)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

NONCARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	CHRONIC ORAL RfD (mg/kg/day)	TOXICITY VALUE (1/RfD)	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS CONSTITUENT OF CONCERN
METHYLENE CHLORIDE	1.1	6.0E-02	1.7E+01	1.8E+01	6.1E-05	0.0	Low relative risk
TETRACHLOROETHENE	0.012	1.0E-02	1.0E+02	1.2E+00	4.0E-06	0.0	Low relative risk
1,1-DICHLOROETHENE	0.009	9.0E-03	1.1E+02	1.0E+00	3.3E-06	0.0	Low relative risk
trans-1,2-DICHLOROETHENE	2.2	9.0E-03	1.1E+02	2.4E+02	8.2E-04	0.1	Low relative risk
1,1-DICHLOROETHANE	1.3	1.0E-01	1.0E+01	1.3E+01	4.3E-05	0.0	Low relative risk
1,1,1-TRICHLOROETHANE	0.39	9.0E-02	1.1E+01	4.3E+00	1.4E-05	0.0	Low relative risk
ACETONE	17.0	1.0E-01	1.0E+01	1.7E+02	5.7E-04	0.1	Low relative risk
2-BUTANONE	18.0	5.0E-02	2.0E+01	3.6E+02	1.2E-03	0.1	Low relative risk
4-METHYL-2-PENTANONE	1.2	5.0E-02	2.0E+01	2.4E+01	8.0E-05	0.0	Low relative risk
TOLUENE	2.1	2.0E-01	5.0E+00	1.1E+01	3.5E-05	0.0	Low relative risk
ETHYLBENZENE	0.36	1.0E-01	1.0E+01	3.6E+00	1.2E-05	0.0	Low relative risk
CHLOROBENZENE	0.004	2.0E-02	5.0E+01	2.0E-01	6.7E-07	0.0	Low relative risk
XYLENES (TOTAL)	1.2	2.0E+00	5.0E-01	6.0E-01	2.0E-06	0.0	Low relative risk
BIS(2-ETHYLHEXYL)PHTHALATE	0.88	2.0E-02	5.0E+01	4.4E+01	1.5E-04	0.0	Low relative risk
PHENOL	1.6	6.0E-01	1.7E+00	2.7E+00	8.9E-06	0.0	Low relative risk
4-METHYLPHENOL	7.1	5.0E-03	2.0E+02	1.4E+03	4.7E-03	0.5	Low relative risk
ANTHRACENE	0.089	3.0E-01	3.3E+00	3.0E-01	9.9E-07	0.0	Low relative risk
FLUORANTHENE	1.2	4.0E-02	2.5E+01	3.0E+01	1.0E-04	0.0	Low relative risk
NAPHTHALENE	0.075	4.0E-02	2.5E+01	1.9E+00	6.3E-06	0.0	Low relative risk
PYRENE	0.91	3.0E-02	3.3E+01	3.0E+01	1.0E-04	0.0	Low relative risk
4,4'-DDT	0.008	5.0E-04	2.0E+03	1.6E+01	5.3E-05	0.0	Low relative risk
* ARSENIC	64.8	3.0E-04	3.3E+03	2.2E+05	7.2E-01	72.1	
* BARIUM	2240	7.0E-02	1.4E+01	3.2E+04	1.1E-01	10.7	
BERYLLIUM	0.4	5.0E-03	2.0E+02	8.0E+01	2.7E-04	0.0	Low relative risk
CADMIUM	1.3	5.0E-04	2.0E+03	2.6E+03	8.7E-03	0.9	Low relative risk
CHROMIUM	27.6	1.0E+00	1.0E+00	2.8E+01	9.2E-05	0.0	Comparable to background levels
CYANIDE	2.3	2.0E-02	5.0E+01	1.2E+02	3.8E-04	0.0	Low relative risk
* MANGANESE	3810	1.0E-01	1.0E+01	3.8E+04	1.3E-01	12.7	
NICKEL	32.3	2.0E-02	5.0E+01	1.6E+03	5.4E-03	0.5	Low relative risk, comparable to background levels
VANADIUM	32.3	7.0E-03	1.4E+02	4.6E+03	1.5E-02	1.5	Comparable to background levels
ZINC	637	3.0E-01	3.3E+00	2.1E+03	7.1E-03	0.7	Relatively low contributor to site risk
TOTAL RISK FACTOR:				3.0E+05			

* = Constituent of concern for seep sediment (east of route 5)

NOTES:

1 Chronic oral reference doses (RfDs) derived from EPA's Integrated Risk Information System (IRIS) in January 1993, with the exception of 2-butanone, 4-methyl-2-pentanone, 1,1,1-trichloroethane, naphthalene, vanadium and zinc which were derived from EPA's Health Effects Summary Tables (HEAST) and Supplement A, dated March and July 1992, respectively

2 Low relative risk was defined as less than or equal to 1.0 percent of the total risk factor

TABLE 10 (continued)
SELECTION OF CONSTITUENTS OF CONCERN - SEEP SEDIMENT (EAST OF ROUTE 5)
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

CARCINOGENIC EFFECTS:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	SLOPE FACTOR (mg/kg/day)-1	TOXICITY VALUE	RISK FACTOR	RELATIVE RISK	PERCENT RISK	RATIONALE FOR NOT SELECTING AS A CONSTITUENT OF CONCERN
VINYL CHLORIDE	0 45	1.9E+00	1.9E+00	8 6E-01	7 1E-03	0.7	Low relative risk
METHYLENE CHLORIDE	1.1	7 5E-03	7 5E-03	8 3E-03	6 8E-05	0.0	Low relative risk
TRICHLOROETHENE	0.05	1.1E-02	1.1E-02	5.5E-04	4 6E-06	0.0	Low relative risk
TETRACHLOROETHENE	0 012	5 1E-02	5.1E-02	6 1E-04	5 1E-06	0.0	Low relative risk
1,1-DICHLOROETHENE	0 009	6 0E-01	6.0E-01	5 4E-03	4 5E-05	0.0	Low relative risk
BENZENE	0 008	2 9E-02	2.9E-02	2 3E-04	1.9E-06	0.0	Low relative risk
BIS(2-ETHYLHEXYL)PHTHALATE	0 88	5.1E-02	5 1E-02	4.5E-02	3 7E-04	0.0	Low relative risk
* BENZO(a)PYRENE	0 53	7 3E+00	7.3E+00	3 9E+00	3 2E-02	3 2	
4,4'-DDD	0 0049	2 4E-01	2 4E-01	1 2E-03	9 8E-06	0.0	Low relative risk
4,4'-DDT	0 008	3 4E-01	3.4E-01	2 7E-03	2 3E-05	0 0	Low relative risk
* ARSENIC	64 8	1 8E+00	1.8E+00	1.2E+02	9 7E-01	96.8	
	TOTAL RISK FACTOR:			1.2E+02			

CONSTITUENTS LACKING EPA-VERIFIED TOXICITY DATA:

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	RATIONALE FOR NOT SELECTING AS A COMPOUND OF CONCERN
CHLOROETHANE	0 2	Likely low contributer to site risk
* 2-HEXANONE	3 8	
TETRAHYDROFURAN	0 28	Low frequency of detection
BENZO(a)ANTHRACENE	0 77	Likely similar to the low level non-carcinogenic risk presented for pyrene
BENZO(b)FLUORANTHENE	1 3	Likely similar to the low level non-carcinogenic risk presented for pyrene
BENZO(g,h,i)PERYLENE	0 3	Likely similar to the low level non-carcinogenic risk presented for pyrene
DIBENZO(a,h)ANTHRACENE	0 082	Low frequency of detection, low concentration
4-CHLORO-3-METHYLPHENOL	0 077	Low frequency of detection
CHRYSENE	0 4	Likely similar to the low level non-carcinogenic risk presented for pyrene
IDENO(1,2,3-cd)PYRENE	0 39	Likely similar to the low level non-carcinogenic risk presented for pyrene
PHENANTHRENE	0 3	Likely similar to the low level non-carcinogenic risk presented for pyrene
ALUMINUM	16500	Not considered a substantial health risk
CALCIUM	92900	Not considered a substantial health risk
COBALT	20 8	Comparable to background levels
COPPER	29 3	Comparable to background levels
IRON	338000	Not considered a substantial health risk
LEAD	32 2	Comparable to background levels
MAGNESIUM	9140	Not considered a substantial health risk
POTASSIUM	2250	Not considered a substantial health risk
SODIUM	1420	Not considered a substantial health risk
THALLIUM	0 79	Comparable to background levels

* = Constituent of concern for seep sediment (east of route 5)

NOTES:

1 Oral slope factors derived from EPA's Integrated Risk Information System (IRIS) in January 1993, with the exception of vinyl chloride, trichloroethene, benzene, 4,4'-DDD and 4,4'-DDT which were derived from EPA's Health Effects Summary Tables (HEAST) and Supplement A dated March and July 1992.

2 Low relative risk was defined as less than or equal to 1 0 percent of the total risk factor

TABLE 11

CONSTITUENTS OF CONCERN
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

Retention Pond Surface Water	Retention Pond Sediment	Seep Surface Water (Landfill Perimeter)	Seep Sediment (Landfill Perimeter)	Seep Sediment (East of Route 5)
Arsenic	Arsenic	Acetone	Arsenic	Arsenic
Manganese	Manganese	Arsenic	Manganese	Barium
4-Methylphenol		2-Butanone		Benzo(a)pyrene
		2-Hexanone		2-Hexanone
		Lead		Manganese
		Manganese		
		4-Methylphenol		
		Nickel		
		Vanadium		

TABLE 12

DOSE RESPONSE DATA
FOR CONSTITUENTS OF CONCERN
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

	NON-CARCINOGENIC PROPERTIES		CARCINOGENIC PROPERTIES		
Constituent	**Chronic Oral RfD (mg/kg/day)**	**Target Organ or Critical Effect**	**Chronic Oral CPF (mg/kg/day)$^{-1}$**	**EPA Weight-of-Evidence Classification[7]**	**Target Organ**
Acetone	1.0E-01[1]	Liver, kidneys		D	
Arsenic	3.0E-04[1]	Skin	1.8E+00[5]	A	Skin
Barium	7.0E-02[1]	Increased blood pressure		D	
Benzo(a)pyrene	Not established by EPA	Digestive system, lungs	7.3E+00[1]	B2	Multiple tumor sites
2-Butanone	5.0E-02[2]	Central nervous system		D	
2-Hexanone	5.0E-02[3]	Nervous system		Not classified	
Lead	1.4E-04[4]	Blood enzymes, central nervous system	Not established by EPA	B2	
Manganese	1.0E-01[1]	Central nervous system		D	
4-Methylphenol	5E-03[2]	Reduced weight, central nervous system	Not established by EPA	C	
Nickel	2.0E-02[1]	Skin, pulmonary tract		Not classified	
Vanadium	9.0E-03[1]	Skin, digestive tract		Not classified	

Notes:

1 Dose-response data derived from the U.S. Environmental Protection Agency's (EPA's) Integrated Risk Information System (IRIS) Database, January, 1993.

2 Dose-response data obtained from EPA's Health Effects Assessment Summary Tables (HEAST), March 1992 and Supplement A, dated July 1992.

3 Oral RfD for 2-butanone was used as a surrogate for 2-hexanone based on structural similarities.

4 Oral RfD for lead derived using proposed MCL action level of 0.015 mg/L.

5 Calculated from recommended unit risk of 5.0E-05/ug/L (IRIS, 1993).

6 EPA weight-of-evidence categories are as follows: A, human carcinogen; B1, probable human carcinogen, limited evidence of carcinogenicity in humans; B2, probable human carcinogen, sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans; C, possible human carcinogen; and D, not classified.

TABLE 13

POTENTIAL CURRENT LAND USE HUMAN HEALTH EXPOSURE PATHWAYS
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation	Reason for Selection or Exclusion
Older Children (on-site)	Direct contact with and incidental ingestion of retention pond water and sediments.	Yes	Although fenced, pond may be accessible by children in the vicinity of landfill.
Site Workers (on-site)	Direct contact with and incidental ingestion of retention pond water and sediments.	No	Infrequent opportunity for pond contact based on site worker job descriptions.
Site Workers (at landfill perimeter)	Direct contact with and incidental ingestion of constituents in surface water seeps and sediments.	No	Infrequent opportunity for seep contact based on site worker job descriptions.
Older Children (at landfill perimeter)	Direct contact with and incidental ingestion of seep water and sediments near toe of landfill.	Yes	Possibility for contact with impacted media.
Site Workers	Ingestion and dermal absorption of constituents in ground water from an on-site well.	No	No on-site water supply well for potable water.
Older Children (east of Route 5)	Direct contact with and incidental ingestion of constituents in seep sediments.	Yes	Former drainage culverts accessible by children. Seep water no longer flows.
Residents (off-site)	Ingestion and dermal absorption of constituents in ground water from local wells cross-gradient of landfill.	No	No use of affected wells. BFI supplies water to residences located cross-gradient to the site. No current ground water exposure pathway exists.
Residents (off-site)	Direct contact with and incidental ingestion of surface water from the Connecticut River downgradient of the landfill.	No	Constituents associated with the site have not been detected at elevated levels in surface water samples from the Connecticut River.

TABLE 14

POTENTIAL FUTURE LAND USE HUMAN HEALTH EXPOSURE PATHWAYS
DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation	Reason for Selection or Exclusion
Residents or Site Workers (on-site)	Ingestion and dermal absorption of constituents in ground water from a hypothetical domestic well installed on-site.	No	Overburden is not a productive aquifer. Slope of site (>15%) prohibits construction on-site. Deed restriction will limit future on-site activities. Uncontaminated potable water source currently available.
Older Children (on-site)	Direct contact with and incidental ingestion of constituents in retention pond water and sediments.	Yes	The retention pond and drainage swale may be accessible by children in vicinity of the landfill. The pond is fenced.
Site Workers (at landfill perimeter)	Direct contact with and incidental ingestion of constituents in seep surface water and sediments.	No	Site workers not engaged in activities which should bring them in contact with seeps.
Older Children (at landfill perimeter)	Direct contact with and incidental ingestion of seep water and sediments near toe of landfill.	Yes	Possibility for contact with impacted media.
Site Workers (on-site)	Direct contact with and incidental ingestion of constituents in retention pond water and sediments.	No	Negligible or no opportunity for pond contact based on site worker job descriptions.
Older Children (East of Route 5)	Direct contact with and incidental ingestion of constituents in seep sediments.	Yes	Former drainage culverts accessible by children. Seep water no longer flows.
Residents (east of Route 5)	Ingestion and dermal absorption of constituents in bedrock ground water from a downgradient domestic well.	No	Land will be deeded, in perpetuity, to a local conservation organization, therefore, no potential use of ground water. Water agreement requires BFI provide water to select area residences for 20 years following landfill closure.
Residents (off-site)	Direct contact with and incidential ingestion of surface water from the Connecticut River downgradient of the landfill	No	Given remedial actions in progress, constituents associated with the site are less likely to be detected in the Connecticut River than under current conditions.

TABLE 15

POTENTIAL EXPOSURE PATHWAYS SELECTED FOR RISK EVALUATION

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

POTENTIALLY EXPOSED POPULATION	POTENTIAL EXPOSURE MEDIUM	POTENTIAL EXPOSURE ROUTE
Current Land Use		
Older Children (east of Route 5)	Seep sediments in drainage pathways.	Dermal absorption Incidental ingestion
Older Children (at landfill perimeter)	Seep water and sediments at the toe of landfill.	Dermal absorption Incidental ingestion
Older Children (on-site)	Retention pond water and sediments.	Dermal absorption Incidental ingestion
Future Land Use		
Older Children (east of Route 5)	Seep sediments in former drainage pathways.	Dermal absorption Incidental ingestion
Older Children (at landfill perimeter)	Seep water and sediments at the toe of landfill.	Dermal absorption Incidental ingestion
Older Children (on-site)	Retention pond water and sediments.	Dermal absorption Incidental ingestion

TABLE 16

ESTIMATED EXPOSURE POINT CONCENTRATIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

MEDIUM	CONSTITUENT	AVERAGE CONCENTRATION (mg/l)	MAXIMUM CONCENTRATION (mg/l)
Seep Surface Water (Landfill perimeter)	Acetone	0.366	1.20
	Arsenic	0.017	0.052
	2-Butanone	0.527	1.60
	2-Hexanone	0.101	0.390
	Lead	0.138	0.514
	Manganese	6.39	13.0
	4-Methylphenol	0.430	0.930
	Nickel	0.136	0.454
	Vanadium	0.090	0.320
Retention Pond Surface Water	Arsenic	0.003	0.005
	Manganese	3.00	6.18
	4-Methylphenol	0.062	0.210

MEDIUM	CONSTITUENT	AVERAGE CONCENTRATION (mg/kg)	MAXIMUM CONCENTRATION (mg/kg)
Seep Sediment (Landfill perimeter)	Arsenic	3.80	6.70
	Manganese	875	2,860
Seep Sediment (East of Route 5)	Arsenic	19.4	64.8
	Barium	896	2240
	Benzo(a)pyrene	0.255	0.530
	2-Hexanone	0.582	3.80
	Manganese	1850	3810
Retention Pond Sediment	Arsenic	2.20	5.50
	Manganese	277	677

NOTE:

1. Average and maximum concentrations for surface water and sediments were derived using data from each of the October 1991 and March 1992 sampling events. Analytical results are presented in Appendix B.

TABLE 17
CURRENT AND FUTURE EXPOSURE PARAMETERS
POTENTIAL EXPOSURE OF CHILDREN BY DERMAL
ABSORPTION AND INCIDENTIAL INGESTION
OF RETENTION POND SURFACE WATER AND SEDIMENT

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

Age	12 - 18 years
Duration of Exposure (April - September)	6 months/year
Frequency of Exposure [1]	5 exposures/year (average) 10 exposures/year (maximum)
Body Weight [2]	55.9 kg
Skin Surface Area Exposed [3] (older child assumed to be wearing t-shirt, shorts, and shoes)	8,195 cm^2
Soil to Skin Adherence Factor [4]	1.00 mg/cm^2
Absorption Factors	**Dermal Gastric**
Volatile Organic Compounds[5]	0.5 1.0
Inorganic Constituents (metals)[6]	Negligible 1.0
Incidental Ingestion Rate[5]	100 mg/day (sediment) 0.5 L/day (water)
Dermal Permeability Constants [7]	
Volatile Organic Compounds	8.0E-04 cm/hr
Inorganic Constituents (metals)	8.0E-04 cm/hr
Exposure Time	2 hours/day
Exposure Duration	6 years
Conversion Factors	
Sediments	10^{-6} kg/mg
Seep Water	1 L/1000 cm^3

Notes:

1. Based on site visits by Balsam staff and on-site worker observations.
2. Average of the mean body weights of male and female children ages 12 - 18 (USEPA, 1990).
3. Arms, hands, and legs exposed. Average 50th percentile values for male and female children ages 12 - 18 (USEPA, 1990).
4. Modified from adherence value of commercial potting soil (1.45 mg/cm^2). Adherence of sediment is likely to be less than for soils as the water may wash the sediments from the skin (USEPA, 1989a).
5. EPA default values (USEPA, 1989a).
6. Dermal absorption of inorganic constituents considered neglible; default value used for gastric absorption (USEPA, 1989a; USEPA, 1992a).
7. The permeability constant for water was used as a default value for constituents without a value specified in EPA's Superfund Exposure Assessment Manual (SEAM) (USEPA, 1988).

TABLE 18
EXPOSURE DOSES FOR INGESTION AND DERMAL ABSORPTION - RETENTION POND WATER AND SEDIMENT
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF RETENTION POND WATER:

	Concentrations		Ingestion Rate	Duration of Exposure	Body Weight	Exposure Frequency		Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Constituent	Average (mg/L)	Maximum (mg/L)	(L/day)	(years)	(kg)	Average (days/year)	Maximum (days/year)	Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
Arsenic	0.003	0.005	0.5	6	55.9	5	10	6	70	3.7E-07	3.2E-08	6.1E-07	5.3E-08
Manganese	3.00	6.18	0.5	6	55.9	5	10	6		3.7E-04		7.6E-04	
4-Methylphenol	0.062	0.210	0.5	6	55.9	5	10	6		7.6E-06		2.6E-05	

INGESTION OF RETENTION POND SEDIMENT:

	Concentrations		Ingestion Rate	Duration of Exposure	Body Weight	Exposure Frequency		Gastric Absorption Factor	Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Constituent	Average (mg/kg)	Maximum (mg/kg)	(mg/day)	(years)	(kg)	Average (days/year)	Maximum (days/year)		Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
Arsenic	2.20	5.50	100	6	55.9	5	10	1	6	70	5.4E-08	4.6E-09	2.7E-07	2.3E-08
Manganese	277	677	100	6	55.9	5	10	1	6		6.8E-06		3.3E-05	

TABLE 18 (continued)
EXPOSURE DOSES FOR INGESTION AND DERMAL ABSORPTION - RETENTION POND WATER AND SEDIMENT
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

DERMAL CONTACT WITH RETENTION POND WATER:

	Concentrations		Skin Surface Area	Duration of Exposure	Body Weight	Exposure Frequency		Permeability Constant	Exposure Time	Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Constituent	Average (mg/L)	Maximum (mg/L)	(cm2)	(years)	(kg)	Average (days/year)	Maximum (days/year)	(cm/hr)	(hours/day)	Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
4-Methylphenol	0.062	0.210	8195	6	55.9	5	10	1.75E-01	2	6		4.4E-05		3.0E-04	

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic and manganese, are considered negligible in contributing to increased risk and were therefore not evaluated.

TABLE 19
CURRENT AND FUTURE EXPOSURE PARAMETERS
POTENTIAL EXPOSURE OF CHILDREN BY DERMAL
ABSORPTION AND INCIDENTAL INGESTION
OF SEEP WATER AND SEDIMENT (LANDFILL PERIMETER)

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

Age	12 - 18 years
Duration of Exposure (April - September)	6 months/year
Frequency of Exposure (seep sediment) [1] (based upon 1 or 2 exposure(s) per week; April through September)	24 days/year (average) 48 days/year (maximum)
Frequency of Exposure (seep surface water) [1]	5 days/year (average) 10 days/year (maximum)
Body Weight [2]	55.9 kg
Skin Surface Area Exposed [3] (older child assumed to be wearing t-shirt, shorts, and shoes)	8,195 cm^2
Soil to Skin Adherence Factor [4]	1.00 mg/cm^2

Absorption Factors	**Dermal**	**Gastric**
Volatile Organic Compounds[5]	0.5	1.0
Semivolatile Organic Compounds[5]	0.05	1.0
Inorganic Constituents (metals)[6]	Negligible	1.0

Incidental Ingestion Rate[5]	100 mg/day (sediment) 0.5 L/day (water)
Dermal Permeability Constants [7]	
Volatile Organic Compounds	8.0E-04 cm/hr
2-Butanone	5.0E+00 cm/hr
4-Methylphenol	1.75E-01 cm/hr
Inorganic Constituents (metals)	8.0E-04 cm/hr
Exposure Time	2 hours/day
Exposure Duration	6 years
Conversion Factors	
Sediments	10^{-6} kg/mg
Seep Water	1 L/1000 cm^3

Notes:

1. Based on site visits by Balsam staff and on-site worker observations.
2. Average of the mean body weights of male and female children ages 12 - 18 (USEPA, 1990).
3. Arms, hands, and legs exposed. Average 50th percentile values for male and female children ages 12 - 18 (USEPA, 1990).
4. Modified from adherence value of commercial potting soil (1.45 mg/cm^2). Adherence of sediment is likely to be less than for soils as the water may wash the sediments from the skin (USEPA, 1989a).
5. EPA default values (EPA, 1989a).
6. Dermal absorption of inorganic constituents considered negligible; default value used for gastric absorption (USEPA, 1989a; USEPA, 1992a).
7. The permeability constant for water was used as a default value for constituents without a value specified in EPA's Superfund Exposure Assessment Manual (SEAM) (USEPA, 1988).

TABLE 20
EXPOSURE DOSES FOR INGESTION AND DERMAL ABSORPTION - SEEP WATER AND SEDIMENT (LANDFILL PERIMETER)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF SEEP WATER:

	Concentrations		Ingestion Rate	Duration of Exposure	Body Weight	Exposure Frequency		Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Compound	Average (mg/L)	Maximum (mg/L)	(L/day)	(years)	(kg)	Average (days/year)	Maximum (days/year)	Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
Acetone	0.366	1.20	0.5	6	55.9	5	10	6		4.5E-05		1.5E-04	
Arsenic	0.017	0.052	0.5	6	55.9	5	10	6	70	2.1E-06	1.8E-07	6.4E-06	5.5E-07
2-Butanone	0.527	1.60	0.5	6	55.9	5	10	6		6.5E-05		2.0E-04	
2-Hexanone	0.101	0.390	0.5	6	55.9	5	10	6		1.2E-05		4.8E-05	
Lead	0.138	0.514	0.5	6	55.9	5	10	6		1.7E-05		6.3E-05	
Manganese	6.39	13.0	0.5	6	55.9	5	10	6		7.8E-04		1.6E-03	
4-Methylphenol	0.430	0.930	0.5	6	55.9	5	10	6		5.3E-05		1.1E-04	
Nickel	0.136	0.454	0.5	6	55.9	5	10	6		1.7E-05		5.6E-05	
Vanadium	0.090	0.320	0.5	6	55.9	5	10	6		1.1E-05		3.9E-05	

INGESTION OF SEEP SEDIMENT:

	Concentrations		Ingestion Rate	Duration of Exposure	Body Weight	Exposure Frequency		Gastric Absorption Factor	Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Compound	Average (mg/kg)	Maximum (mg/kg)	(mg/day)	(years)	(kg)	Average (days/year)	Maximum (days/year)		Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
Arsenic	3.8	6.70	100	6	55.9	24	48	1	6	70	4.5E-07	3.8E-08	1.6E-06	1.4E-07
Manganese	875	2860	100	6	55.9	24	48	1	6		1.0E-04		6.7E-04	

TABLE 20 (continued)
EXPOSURE DOSES FOR INGESTION AND DERMAL ABSORPTION - SEEP WATER AND SEDIMENT (LANDFILL PERIMETER)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

DERMAL CONTACT WITH SEEP WATER

	Concentrations		Skin Surface Area	Duration of Exposure	Body Weight	Exposure Frequency		Permeability Constant	Exposure Time	Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Constituent	Average (mg/L)	Maximum (mg/L)	(cm2)	(years)	(kg)	Average (days/year)	Maximum (days/year)	(cm/hr)	(hours/day)	Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
Acetone	0.366	1.20	8195	6	55.9	5	10	8.00E-04	2	6		1.2E-06		7.7E-06	
2-Butanone	0.527	1.60	8195	6	55.9	5	10	5.00E+00	2	6		1.1E-02		6.4E-02	
2-Hexanone	0.101	0.390	8195	6	55.9	5	10	8.00E-04	2	6		3.2E-07		2.5E-06	
4-Methylphenol	0.430	0.930	8195	6	55.9	5	10	1.75E-01	2	6		3.0E-04		1.3E-03	

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic, lead, manganese, nickel and vanadium, are considered negligible in contributing to increased risk and were therefore not evaluated.

TABLE 21
CURRENT AND FUTURE EXPOSURE PARAMETERS
POTENTIAL EXPOSURE OF CHILDREN BY DERMAL
ABSORPTION AND INCIDENTAL INGESTION
OF SEEP SEDIMENT (EAST OF ROUTE 5)

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

Age	12 - 18 years
Duration of Exposure (April - September)	6 months/year
Frequency of Exposure [1] (based upon 1 or 2 exposure(s) per week; April through September)	24 days/year (average) 48 days/year (maximum)
Body Weight [2]	55.9 kg
Skin Surface Area Exposed [3] (older child assumed to be wearing t-shirt, shorts, and shoes)	8,195 cm^2
Soil to Skin Adherence Factor [4]	1.00 mg/cm^2

Absorption Factors	**Dermal**	**Gastric**
Volatile Organic Compounds[5]	0.5	1.0
Semivolatile Organic Compounds[5]	0.05	1.0
Inorganic Constituents (metals)[6]	Negligible	1.0

Incidental Ingestion Rate[5]	100 mg/day (sediment) 0.5 L/day (water)
Dermal Permeability Constants [7]	
Volatile Organic Compounds	8.0E-04 cm/hr
2-Butanone	5.0E+00 cm/hr
4-Methylphenol	1.75E-01 cm/hr
Inorganic Constituents (metals)	8.0E-04 cm/hr
Exposure Time	2 hours/day
Exposure Duration	6 years
Conversion Factors	
Sediments	10^{-6} kg/mg
Seep Water	1 L/1000 cm^3

Notes:

1. Based on site visits by Balsam staff and on-site worker observations.
2. Average of the mean body weights of male and female children ages 12 - 18 (USEPA, 1990).
3. Arms, hands, and legs exposed. Average 50th percentile values for male and female children ages 12 - 18 (USEPA, 1990).
4. Modified from adherence value of commercial potting soil (1.45 mg/cm^2). Adherence of sediment is likely to be less than for soils as the water may wash the sediments from the skin (USEPA, 1989a).
5. EPA default values (EPA, 1989a).
6. Dermal absorption of inorganic constituents considered negligible; default value used for gastric absorption (USEPA, 1989a; USEPA, 1992a).
7. The permeability constant for water was used as a default value for constituents without a value specified in EPA's Superfund Exposure Assessment Manual (SEAM) (USEPA, 1988).

TABLE 22
EXPOSURE DOSES FOR INGESTION AND DERMAL ABSORPTION - SEEP SEDIMENT (EAST OF ROUTE 5)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF SEEP SEDIMENT:

	Concentrations					Exposure Frequency			Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Compound	Average (mg/kg)	Maximum (mg/kg)	Ingestion Rate (mg/day)	Duration of Exposure (years)	Body Weight (kg)	Average (days/year)	Maximum (days/year	Gastric Absorption Factor	Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
Arsenic	19.4	64.8	100	6	55.9	24	48	1	6	70	2.3E-06	2.0E-07	1.5E-05	1.3E-06
Barium	896	2240	100	6	55.9	24	48	1	6		1.1E-04		5.3E-04	
Benzo(a)pyrene	0.255	0.530	100	6	55.9	24	48	1	6	70	3.0E-08	2.6E-09	1.2E-07	1.1E-08
2-Hexanone	0.582	3.80	100	6	55.9	24	48	1	6		6.8E-08		8.9E-07	
Manganese	1860	3810	100	6	55.9	24	48	1	6		2.2E-04		9.0E-04	

DERMAL CONTACT WITH SEEP SEDIMENT:

	Concentrations					Exposure Frequency				Averaging Time		Average Exposure Doses		Maximum Exposure Doses	
Compound	Average (mg/kg)	Maximum (mg/kg)	Skin Surface Area (cm2/event)	Duration of Exposure (years)	Body Weight (kg)	Average (days/year)	Maximum (days/year	Dermal Absorption Factor	Adherence Factor (mg/cm2)	Noncarcinogen (years)	Carcinogen (years)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)	Noncarcinogen (mg/kg/day)	Carcinogen (mg/kg/day)
Benzo(a)pyrene	0.255	0.530	8195	6	55.9	24	48	0.05	1.0	6	70	1.2E-07	1.1E-08	5.1E-07	4.4E-08
2-Hexanone	0.582	3.80	8195	6	55.9	24	48	0.05	1.0	6		2.8E-07		3.7E-06	

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic, barium, and manganese, are considered negligible in contributing to increased risk and were therefore not evaluated.

TABLE 23
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORPTION - RETENTION POND SURFACE WATER
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF RETENTION POND WATER:

Potentially Carcinogenic Constituents	EPA Weight-of-Evidence Classification	Oral Cancer Potency Factor (mg/kg/day)-1	Concentrations		Exposure Doses		Lifetime Cancer Risk	
			Average (mg/L)	Maximum (mg/L)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	A	1.8E+00	0.003	0.005	3.2E-08	5.3E-08	5.7E-08	9.5E-08
						TOTAL:	5.7E-08	9.5E-08

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/L)	Maximum (mg/L)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	Skin	3.0E-04	0.003	0.005	3.7E-07	6.1E-07	1.2E-03	2.0E-03
Manganese	Central Nervous System	1.0E-01	3.00	6.18	3.7E-04	7.6E-04	3.7E-03	7.6E-03
4-Methylphenol	Central Nervous System	5.0E-03	0.062	0.210	7.6E-06	2.6E-05	1.5E-03	5.1E-03
						TOTAL:	6.4E-03	1.5E-02

TABLE 23 (continued)
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORPTION - RETENTION POND SURFACE WATER
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

DERMAL CONTACT WITH RETENTION POND WATER:

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/L)	Maximum (mg/L)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
4-Methylphenol	Central Nervous System	5.0E-03	0.062	0.210	4.4E-05	3.0E-04	8.7E-03	5.9E-02
						TOTAL:	8.7E-03	5.9E-02

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic and manganese, are considered negligible in contributing to increased risk and were therefore not evaluated.

TABLE 24
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORPTION - RETENTION POND SEDIMENT
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF RETENTION POND SEDIMENT:

Potentially Carcinogenic Constituents	EPA Weight-of-Evidence Classification	Oral Cancer Potency Factor (mg/kg/day)-1	Concentrations		Exposure Doses		Lifetime Cancer Risk	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	A	1.8E+00	2.2	5.5	5.4E-08	2.7E-07	9.7E-08	4.9E-07
						TOTAL:	9.7E-08	4.9E-07

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	Skin	3.0E-04	2.2	5.5	5.4E-08	2.7E-07	1.8E-04	9.0E-04
Manganese	Blood enzymes	1.0E-01	277	677	6.8E-06	3.3E-06	6.8E-05	3.3E-04
						TOTAL:	2.5E-04	1.2E-03

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic and manganese, are considered negligible in contributing to increased risk and were therefore not evaluated.

TABLE 25
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORPTION - SEEP WATER (LANDFILL PERIMETER)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF SEEP WATER:

Potentially Carcinogenic Constituents	EPA Weight-of-Evidence Classification	Oral Cancer Potency Factor (mg/kg/day)-1	Concentrations		Exposure Doses		Lifetime Cancer Risk	
			Average (mg/L)	Maximum (mg/L)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	A	1.8E+00	0.017	0.052	1.8E-07	5.5E-07	3.2E-07	9.8E-07
						TOTAL:	3.2E-07	9.8E-07

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/L)	Maximum (mg/L)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Acetone	Liver, Kidneys	1.0E-01	0.366	1.20	4.5E-05	1.5E-04	4.5E-04	1.5E-03
Arsenic	Skin	3.0E-04	0.017	0.052	2.1E-06	6.4E-06	6.9E-03	2.1E-02
2-Butanone	Central Nervous System	5.0E-02	0.527	1.60	6.5E-05	2.0E-04	1.3E-03	3.9E-03
2-Hexanone	Nervous System	5.0E-02	0.101	0.390	1.2E-05	4.8E-05	2.5E-04	9.6E-04
Lead	Central Nervous System	1.0E-04	0.138	0.514	1.7E-05	6.3E-05	1.7E-01	6.3E-01
Manganese	Central Nervous System	1.0E-01	6.39	13.0	7.8E-04	1.6E-03	7.8E-03	1.6E-02
4-Methylphenol	Central Nervous System	5.0E-03	0.430	0.930	5.3E-05	1.1E-04	1.1E-02	2.3E-02
Nickel	Skin, Pulmonary Tract	9.0E-03	0.136	0.454	1.7E-05	5.6E-05	1.9E-03	6.2E-03
Vanadium	Skin, Digestive Tract	2.0E-02	0.090	0.320	1.1E-05	3.9E-05	5.5E-04	2.0E-03
						TOTAL:	2.0E-01	7.0E-01

TABLE 25 (continued)
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORTION - SEEP WATER (LANDFILL PERIMETER)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

DERMAL CONTACT WITH SEEP WATER:

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/L)	Maximum (mg/L)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Acetone	Liver, Kidneys	1.0E-01	0.366	1.20	1.2E-06	7.7E-06	1.2E-05	7.7E-05
2-Butanone	Central Nervous System	5.0E-02	0.527	1.60	1.1E-02	6.4E-02	2.1E-01	1.3E+00
2-Hexanone	Central Nervous System	5.0E-02	0.101	0.390	3.2E-07	2.5E-06	6.5E-06	5.0E-05
4-Methylphenol	Central Nervous System	5.0E-03	0.430	0.93	3.0E-04	1.3E-03	6.0E-02	2.6E-01
						TOTAL:	2.7E-01	1.5E+00

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic, lead, manganese, nickel and vanadium, are considered negligible in contributing to increased risk and were therefore not evaluated.

TABLE 26
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORPTION - SEEP SEDIMENT (LANDFILL PERIMETER)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF SEEP SEDIMENT

Potentially Carcinogenic Constituents	EPA Weight-of-Evidence Classification	Oral Cancer Potency Factor (mg/kg/day)-1	Concentrations		Exposure Doses		Lifetime Cancer Risk	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	A	1.8E+00	3.80	6.70	3.8E-08	1.4E-07	6.9E-08	2.4E-07
						TOTAL:	6.9E-08	2.4E-07

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	Skin	3.0E-04	3.80	6.70	4.5E-07	1.6E-06	1.5E-03	5.3E-03
Manganese	Blood enzymes	1.0E-01	875	2860	1.0E-04	6.7E-04	1.0E-03	6.7E-03
						TOTAL:	2.5E-03	1.2E-02

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic and manganese, are considered negligible in contributing to increased risk and were therefore not evaluated.

TABLE 27
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORPTION - SEEP SEDIMENT (EAST OF ROUTE 5)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

INGESTION OF SEEP SEDIMENT:

Potentially Carcinogenic Constituents	EPA Weight-of-Evidence Classification	Oral Cancer Potency Factor (mg/kg/day)-1	Concentrations		Exposure Doses		Lifetime Cancer Risk	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	A	1.8E+00	19.4	64.8	2.0E-07	1.3E-06	3.5E-07	2.4E-06
Benzo(a)pyrene	B2	7.3E+00	0.255	0.530	2.6E-09	1.1E-08	1.9E-08	7.8E-08
						TOTAL:	3.7E-07	2.4E-06

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Arsenic	Skin	3.0E-04	19.4	64.8	2.3E-06	1.5E-05	7.6E-03	5.1E-02
Barium	Increased Blood Pressure	7.0E-02	896	2240	1.1E-04	5.3E-04	1.5E-03	7.5E-03
Benzo(a)pyrene	Digestive Tract	4.0E-02	0.255	0.530	3.0E-08	1.2E-07	7.5E-07	3.1E-06
2-Hexanone	Nervous System	5.0E-02	0.589	3.80	6.8E-08	8.9E-07	1.4E-06	1.8E-05
Manganese	Blood enzymes	1.0E-01	1850	3810	2.2E-04	9.0E-04	2.2E-03	9.0E-03
						TOTAL:	1.1E-02	6.7E-02

TABLE 27 (continued)
POTENTIAL RISK ASSOCIATED WITH INGESTION AND DERMAL ABSORPTION - SEEP SEDIMENT (EAST OF ROUTE 5)
CURRENT AND FUTURE CONDITIONS

DISPOSAL SPECIALISTS, INC.
ROCKINGHAM, VERMONT

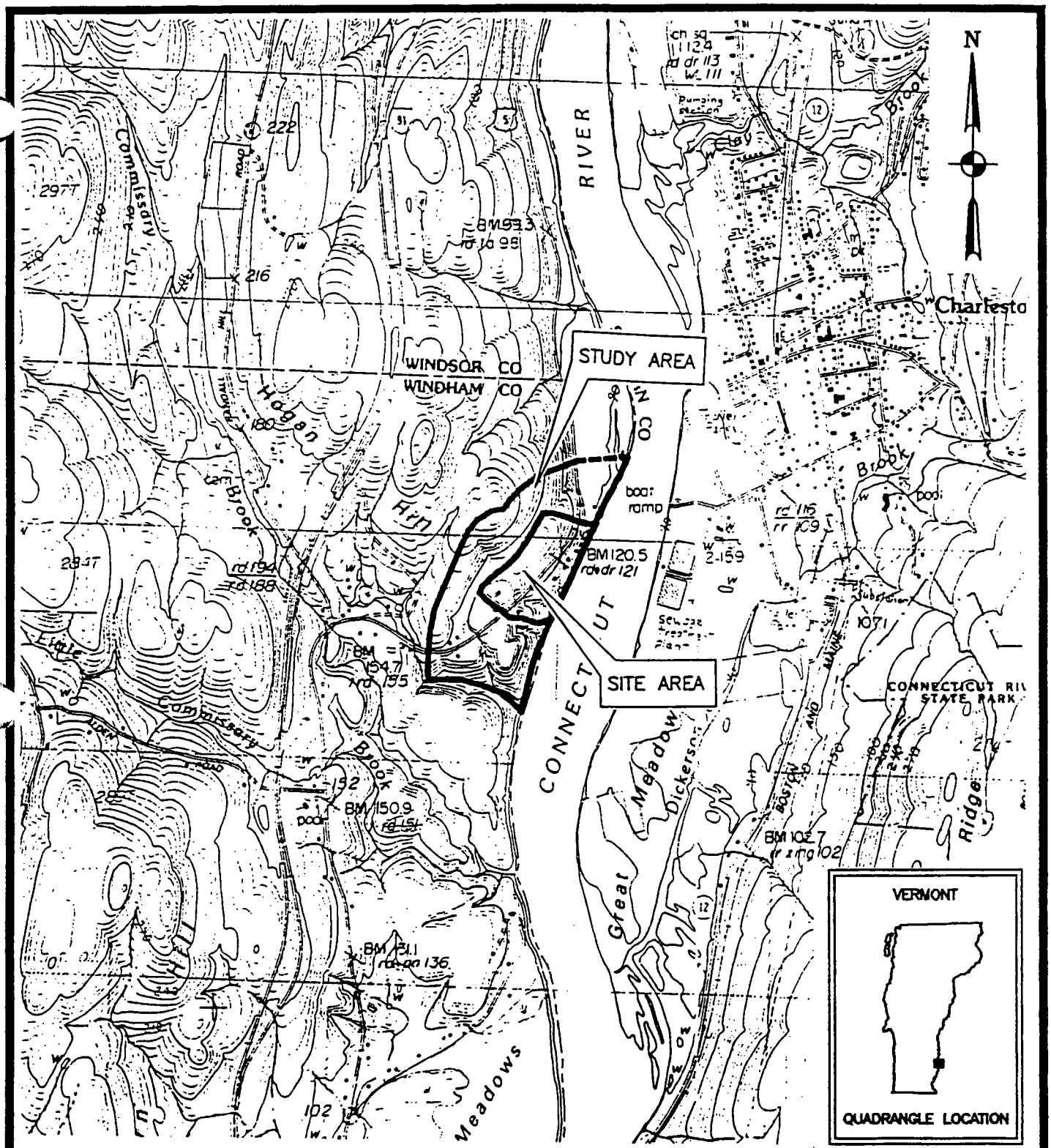
DERMAL CONTACT WITH SEEP SEDIMENT:

Potentially Carcinogenic Constituents	EPA Weight-of-Evidence Classification	Oral Cancer Potency Factor (mg/kg/day)-1	Concentrations		Exposure Doses		Lifetime Cancer Risk	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Benzo(a)pyrene	B2	7.3E+00	0.255	0.530	1.1E-08	4.4E-08	7.7E-08	3.2E-07
						TOTAL:	7.7E-08	3.2E-07

Noncarcinogenic Constituents	Endpoint of Concern	Chronic Oral Reference Dose (mg/kg/day)	Concentrations		Exposure Doses		Hazard Index	
			Average (mg/kg)	Maximum (mg/kg)	Average (mg/kg/day)	Maximum (mg/kg/day)	Average	Maximum
Benzo(a)pyrene	Digestive Tract	4.0E-02	0.255	0.530	1.2E-07	5.1E-07	3.1E-06	1.3E-05
2-Hexanone	Nervous System	5.0E-02	0.582	3.80	2.8E-07	3.7E-06	5.6E-06	7.3E-05
						TOTAL:	3.1E-06	1.3E-05

NOTE:

Dermal contact and absorption of inorganic constituents, i.e., arsenic, barium, and manganese, are considered negligible in contributing to increased risk and were therefore not evaluated.



SOURCE:

USGS
BELLOWS FALLS, VERMONT–NEW HAMPSHIRE
7.5 X 15 MINUTE SERIES TOPOGRAPHICS
1985
CONTOUR INTERVALS IN METERS MSL

0 2100 4200

APPROXIMATE SCALE (FEET)

BALSAM
ENVIRONMENTAL CONSULTANTS, INC.
7 COMMUNITY DR., AUGUSTA, ME. 04330

CLIENT:	DISPOSAL SPECIALISTS, INC.
PROJECT:	DSI LANDFILL ROCKINGHAM, VT.
TITLE:	SITE LOCUS

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	FIGURE NO:
S.A.V.	D.J.H.	S.C.S.	M.A.D.	1
SCALE:	DATE:	FILE NO:	PROJECT NO:	
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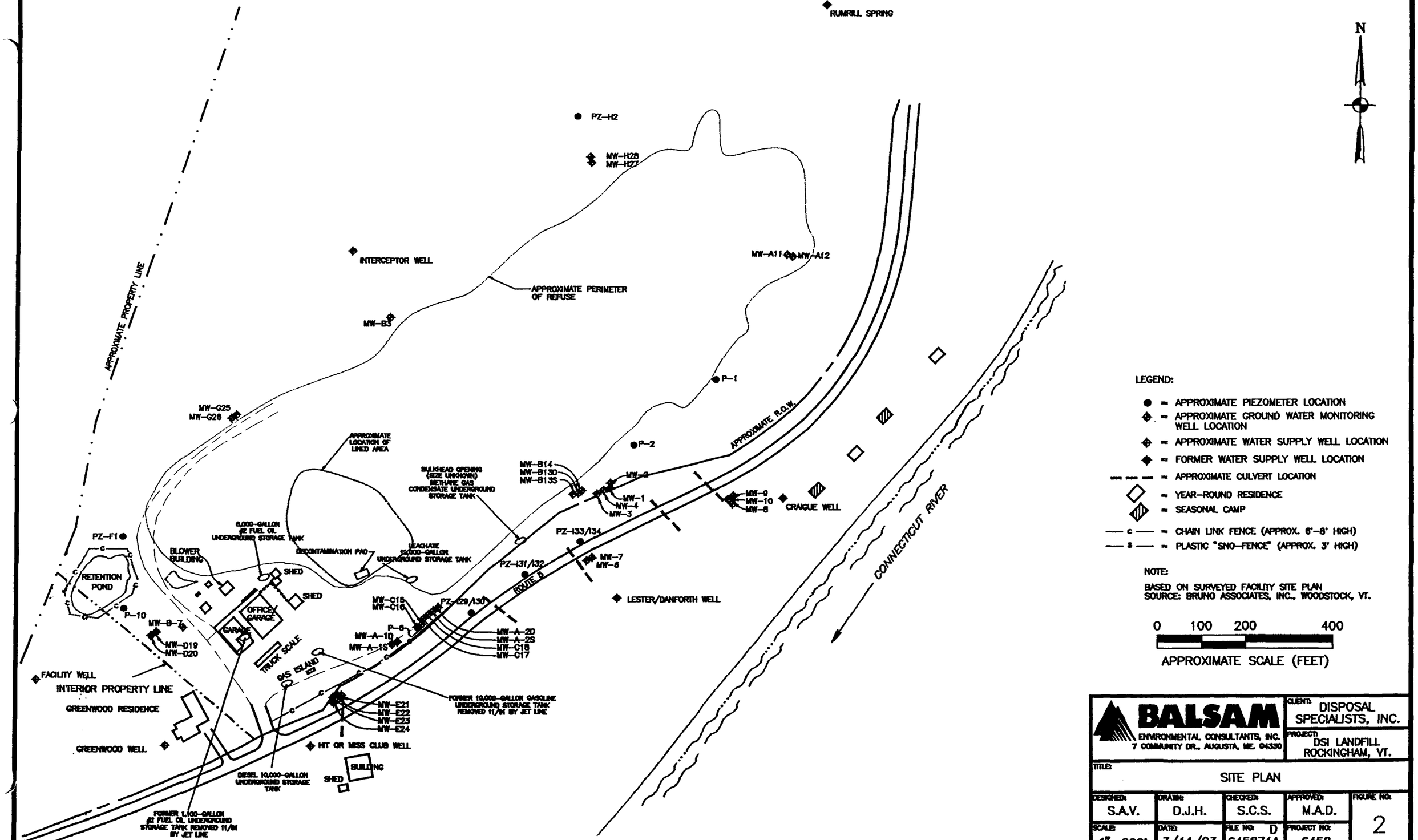


LEGEND:

- ● = APPROXIMATE PIEZOMETER LOCATION
- ◈ = APPROXIMATE GROUND WATER MONITORING WELL LOCATION
- ◈ = APPROXIMATE WATER SUPPLY WELL LOCATION
- ◆ = FORMER WATER SUPPLY WELL LOCATION
- = APPROXIMATE CULVERT LOCATION
- ◇ = YEAR-ROUND RESIDENCE
- ▨ = SEASONAL CAMP
- —c— = CHAIN LINK FENCE (APPROX. 6'-8' HIGH)
- —s— = PLASTIC "SNO-FENCE" (APPROX. 3' HIGH)

NOTE:

BASED ON SURVEYED FACILITY SITE PLAN
SOURCE: BRUNO ASSOCIATES, INC., WOODSTOCK, VT.

0 100 200 400

APPROXIMATE SCALE (FEET)

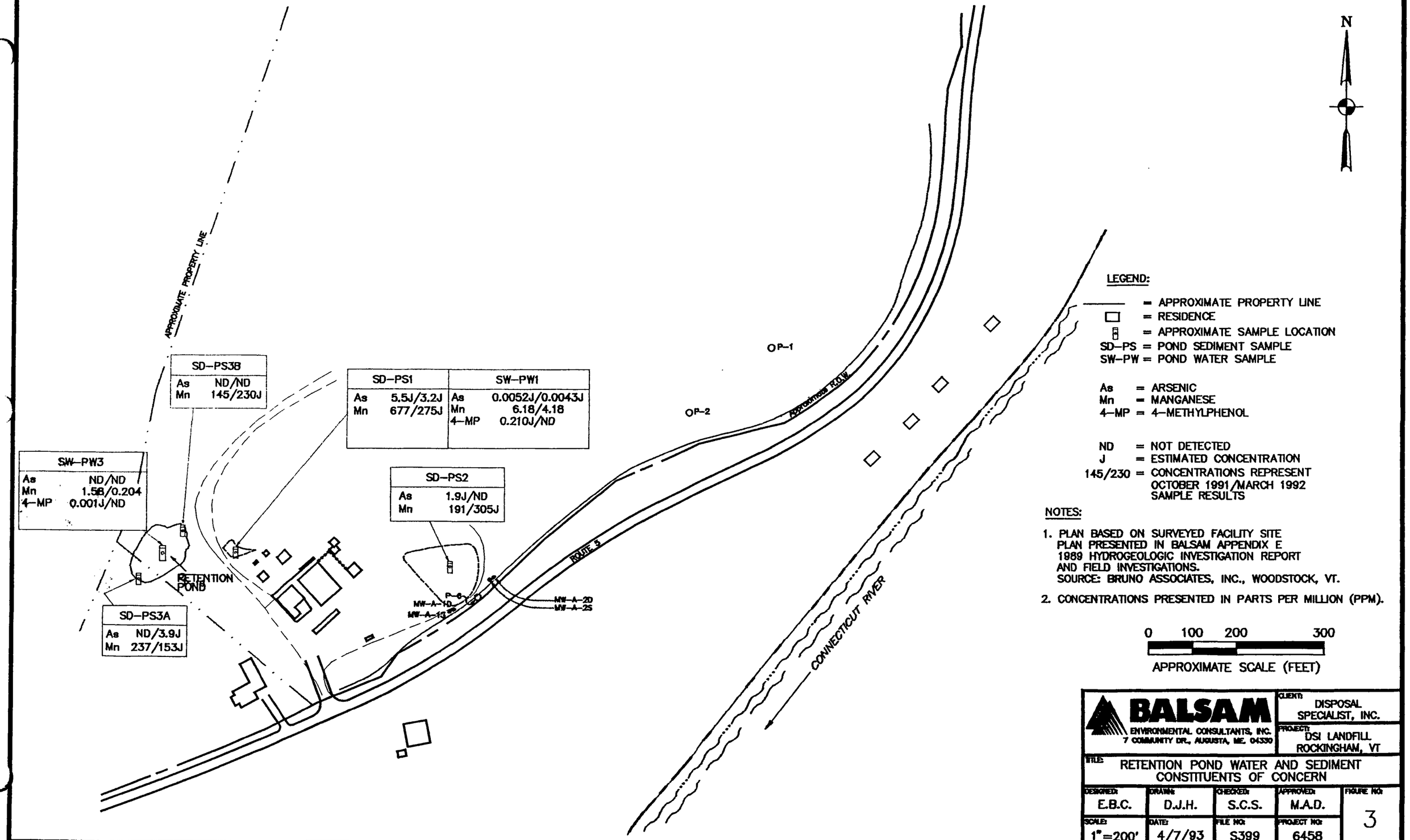
BALSAM
ENVIRONMENTAL CONSULTANTS, INC.
7 COMMUNITY DR., AUGUSTA, ME. 04330

CLIENT: DISPOSAL SPECIALISTS, INC.

PROJECT: DSI LANDFILL ROCKINGHAM, VT.

TITLE: SITE PLAN

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	FIGURE NO:
S.A.V.	D.J.H.	S.C.S.	M.A.D.	2
SCALE:	DATE:	FILE NO: D	PROJECT NO:	
1"=200'	3/11/93	645871A	6458	



LEGEND:

——— = APPROXIMATE PROPERTY LINE
□ = RESIDENCE
▯ = APPPROXIMATE SAMPLE LOCATION
SD–PS = POND SEDIMENT SAMPLE
SW–PW = POND WATER SAMPLE

As = ARSENIC
Mn = MANGANESE
4–MP = 4–METHYLPHENOL

ND = NOT DETECTED
J = ESTIMATED CONCENTRATION
145/230 = CONCENTRATIONS REPRESENT OCTOBER 1991/MARCH 1992 SAMPLE RESULTS

NOTES:

1. PLAN BASED ON SURVEYED FACILITY SITE PLAN PRESENTED IN BALSAM APPENDIX E 1989 HYDROGEOLOGIC INVESTIGATION REPORT AND FIELD INVESTIGATIONS. SOURCE: BRUNO ASSOCIATES, INC., WOODSTOCK, VT.
2. CONCENTRATIONS PRESENTED IN PARTS PER MILLION (PPM).

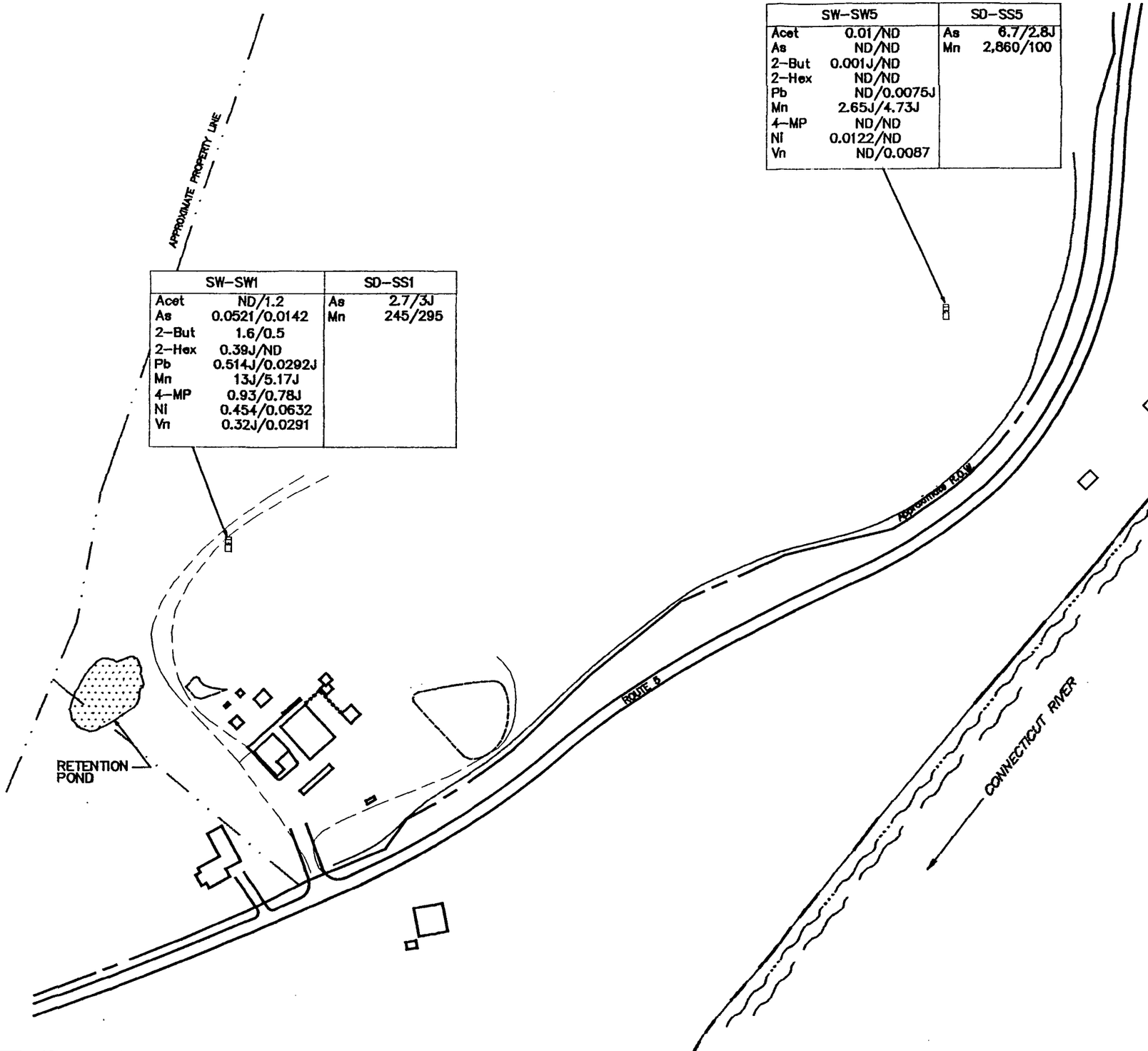
0 100 200 300
APPROXIMATE SCALE (FEET)

BALSAM ENVIRONMENTAL CONSULTANTS, INC.
7 COMMUNITY DR., AUGUSTA, ME. 04330

CLIENT: DISPOSAL SPECIALIST, INC.
PROJECT: DSI LANDFILL ROCKINGHAM, VT

TITLE: RETENTION POND WATER AND SEDIMENT CONSTITUENTS OF CONCERN

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	FIGURE NO:
E.B.C.	D.J.H.	S.C.S.	M.A.D.	3
SCALE: 1"=200'	DATE: 4/7/93	FILE NO: S399	PROJECT NO: 6458	



N

LEGEND:

———	= APPROXIMATE PROPERTY LINE
□	= RESIDENCE
▬	= APPROXIMATE CULVERT LOCATION
▯	= APPROXIMATE SAMPLE LOCATION
SD-SS1	= SEEP SEDIMENT SAMPLE
SW-SW1	= SEEP WATER SAMPLE
As	= ARSENIC
Ni	= NICKEL
Mn	= MANGANESE
4-MP	= 4-METHYLPHENOL
Acet	= ACETONE
2-But	= 2-BUTANONE
2-Hex	= 2-HEXANONE
Vn	= VANADIUM
Pb	= LEAD
ND	= NOT DETECTED
J	= ESTIMATED CONCENTRATION
245/393	= CONCENTRATIONS REPRESENT OCTOBER 1991/MARCH 1992 SAMPLE RESULTS

NOTES:

1. PLAN BASED ON SURVEYED FACILITY SITE PLAN PRESENTED IN BALSAM APPENDIX E 1989 HYDROGEOLOGIC INVESTIGATION REPORT AND FIELD INVESTIGATIONS. SOURCE: BRUNO ASSOCIATES, INC., WOODSTOCK, VT.
2. CONCENTRATIONS PRESENTED IN PARTS PER MILLION (PPM).

0 100 200 300

APPROXIMATE SCALE (FEET)

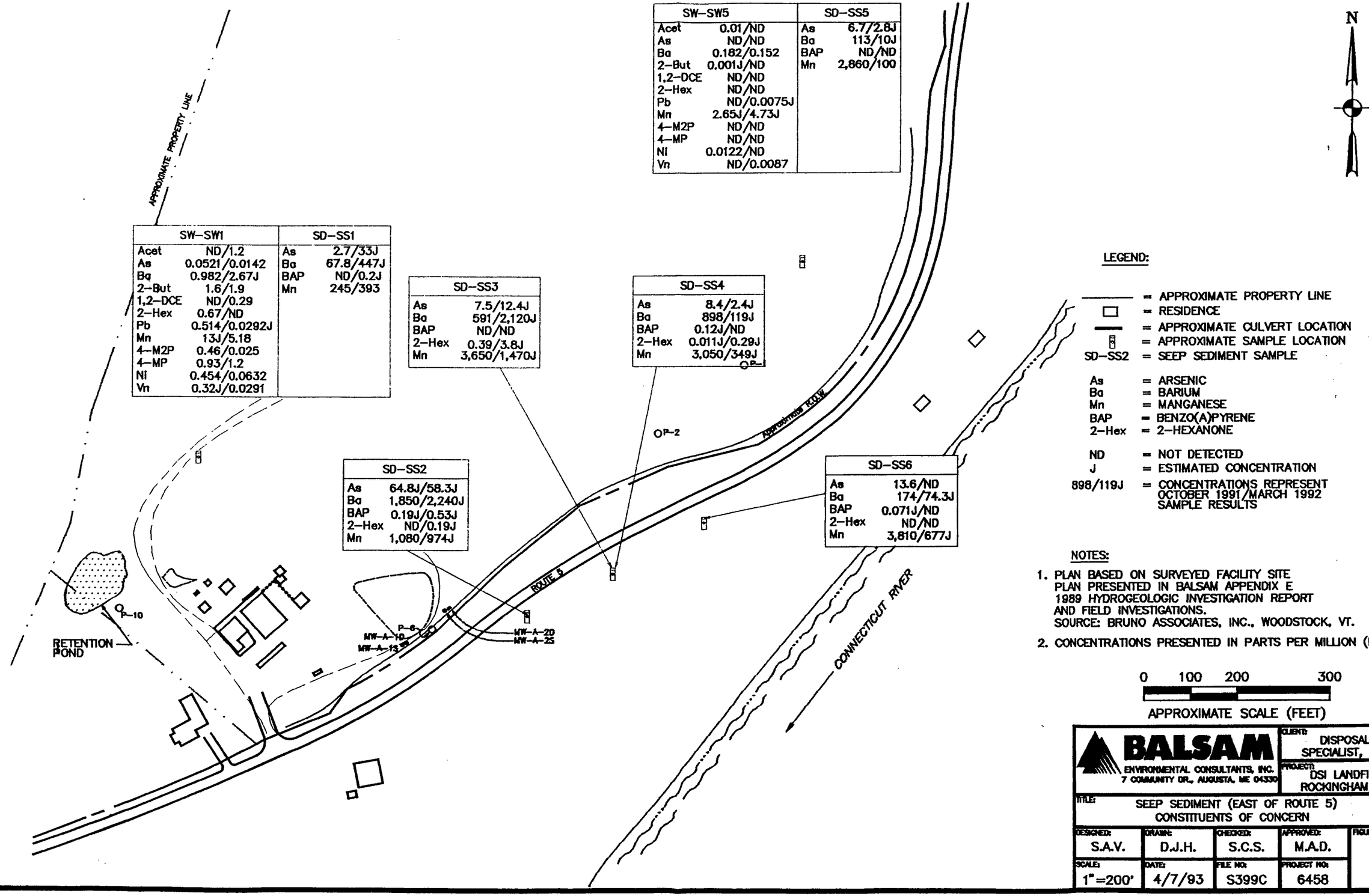
BALSAM
ENVIRONMENTAL CONSULTANTS, INC.
7 COMMUNITY DR., AUGUSTA, ME 04330

CLIENT: DISPOSAL SPECIALIST, INC.

PROJECT: DSI LANDFILL ROCKINGHAM, VT

TITLE: SEEP WATER AND SEDIMENT (LANDFILL PERIMETER) CONSTITUENTS OF CONCERN

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	FIGURE NO:
S.A.V.	D.J.H.	S.C.S.	M.A.D.	4
SCALE: 1"=200'	DATE: 4/7/93	FILE NO: S399D	PROJECT NO: 6458	



LEGEND:

———	= APPROXIMATE PROPERTY LINE
□	= RESIDENCE
▬	= APPROXIMATE CULVERT LOCATION
▯	= APPROXIMATE SAMPLE LOCATION
SD-SS2	= SEEP SEDIMENT SAMPLE
As	= ARSENIC
Ba	= BARIUM
Mn	= MANGANESE
BAP	= BENZO(A)PYRENE
2-Hex	= 2-HEXANONE
ND	= NOT DETECTED
J	= ESTIMATED CONCENTRATION
898/119J	= CONCENTRATIONS REPRESENT OCTOBER 1991/MARCH 1992 SAMPLE RESULTS

NOTES:

1. PLAN BASED ON SURVEYED FACILITY SITE PLAN PRESENTED IN BALSAM APPENDIX E 1989 HYDROGEOLOGIC INVESTIGATION REPORT AND FIELD INVESTIGATIONS. SOURCE: BRUNO ASSOCIATES, INC., WOODSTOCK, VT.
2. CONCENTRATIONS PRESENTED IN PARTS PER MILLION (PPM).

0 100 200 300

APPROXIMATE SCALE (FEET)

BALSAM ENVIRONMENTAL CONSULTANTS, INC.
7 COMMUNITY DR., AUGUSTA, ME 04330

CLIENT: DISPOSAL SPECIALIST, INC.

PROJECT: DSI LANDFILL ROCKINGHAM, VT

TITLE: SEEP SEDIMENT (EAST OF ROUTE 5) CONSTITUENTS OF CONCERN

DESIGNED:	DRAWN:	CHECKED:	APPROVED:	FIGURE NO:
S.A.V.	D.J.H.	S.C.S.	M.A.D.	5
SCALE: 1"=200'	DATE: 4/7/93	FILE NO: S399C	PROJECT NO: 6458	