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DUNN

REMEDIAL INVESTIGATION/FEASIBILITY STUDY FICA LANDFILL SITE NUMBER 314047

VOLUME 1 of 2

Prepared for:
J&T Recycling

Submitted to NYSDEC

January 22, 1993

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Prepared for:

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1.0 INTRODUCTION

1.1 General

The FICA Landfill is presently inactive and is located on Van Wagner Road in the Town of Poughkeepsie, Dutchess County, as shown in Figure 1. The landfill previously operated under a permit issued by the NYSDEC Region 3 pursuant to the NYSDEC Solid Waste Management Facilities regulations (6NYCRR Part 360). Operating records indicate that mixed municipal and commercial wastes from the greater Poughkeepsie area were disposed of at the landfill. Review of operating records do not indicate that hazardous wastes were disposed at the landfill.

The landfill reportedly began operation in 1971, and reportedly closed in 1985 in accordance with its NYSDEC operating permit.

The site was subsequently listed by the NYSDEC as an inactive hazardous waste disposal site in accordance with Article 27, Title 13 of the Environmental Conservation Law (ECL). The NYSDEC designated that the site presents a significant threat to the environment and assigned a classification of 2.

In 1983 the NYSDEC conducted a Phase I Preliminary Investigation which was prepared by Ecological Analysts, Inc. The results of this site investigation are summarized in a report dated 1983 which concluded that further site investigations are warranted.

Pursuant to an Interim Consent Order dated October 20, 1989, a Work Plan was developed which sets forth the scope of the RI/FS program as well as the detailed method and procedures to be employed. A copy of the Interim Consent Order is presented as Appendix A. The RI/FS Work Plan was ultimately approved by the NYSDEC in December of 1989.

This work plan details a phased, systematic approach to performing an acceptable Remedial Investigation (RI)/Feasibility Study (FS) as originally outlined by the Technical Approach

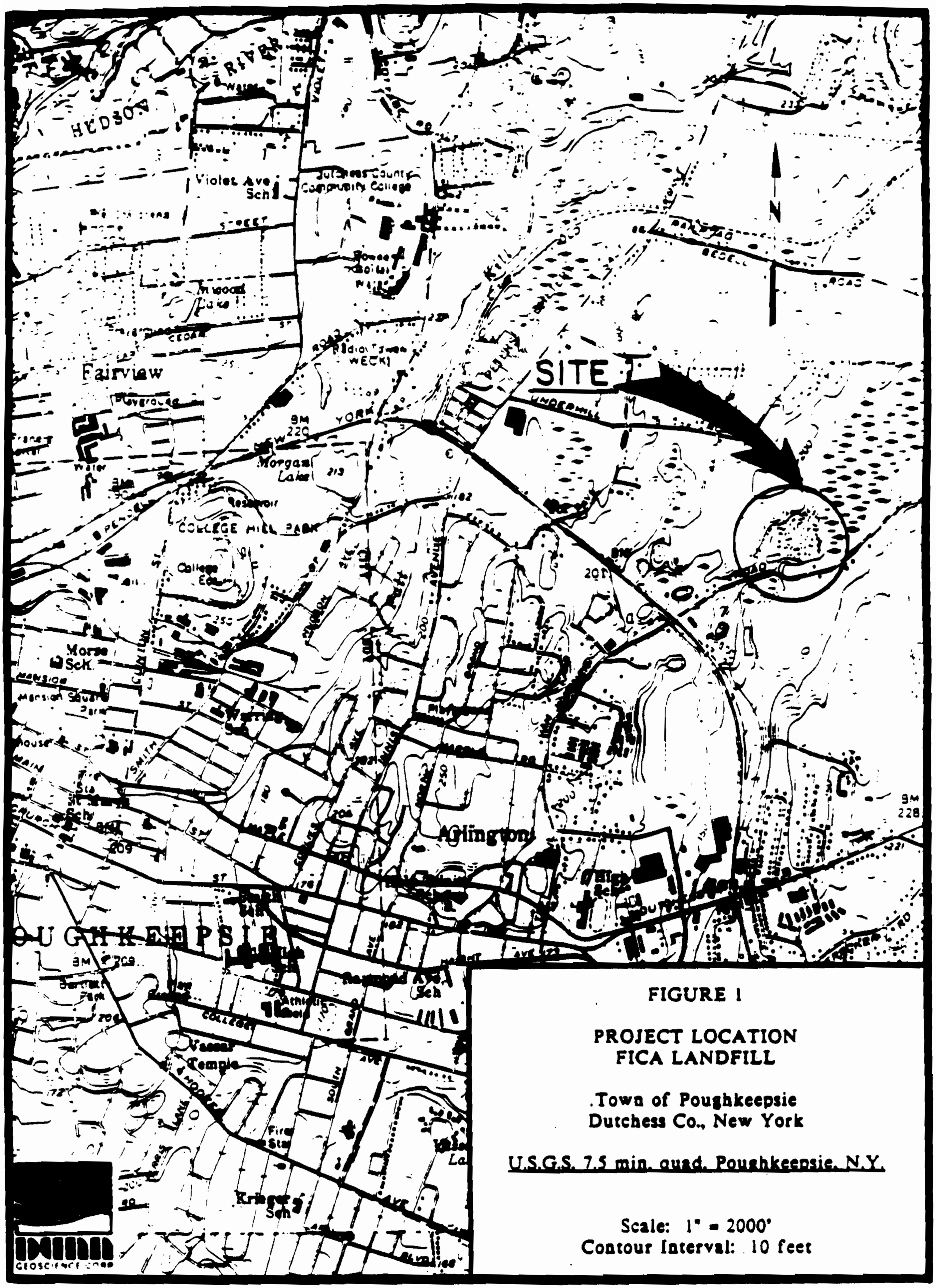

FIGURE 1

PROJECT LOCATION
FICA LANDFILL

.Town of Poughkeepsie
Dutchess Co., New York

U.S.G.S. 7.5 min. quad. Poughkeepsie, N.Y.

Scale: 1" = 2000'
Contour Interval: 10 feet

document dated May 31, 1989 which was submitted to and accepted by the New York State Departments of Law (NYSDOL) and Environmental Conservation (NYSDEC).

The RI is planned in phases with each phase building upon the knowledge and experience gained through earlier phases. The overall RI must develop all data necessary to effectively screen and evaluate the range of available remedial technologies such that specific viable remedial alternatives may be identified and developed. The RI must also develop the detailed data necessary to recommend a specific remedial program for the site.

The Preliminary Site Investigation was conducted in the Spring of 1989. The findings of the investigation are presented in the RIFS Work Plan and are detailed in Section 1.3 of this report. The scope of the Remedial Investigation/Feasibility Study and Interim Remedial Program presented herein were developed, based upon the findings and conclusions of the Preliminary Site Investigation. The technical scope of the RI/FS and Interim Remedial Program were also discussed with the NYSDEC and NYSDOL at the June 13, 1989 meeting.

In addition, the approved RIFS Work Plan included an Interim Remedial Measures (IRM) Program designed to stabilize the southern slope of the landfill allowing placement of a final cover system designed in accordance with 6 NYCRR Part 360.

Prior to implementation of the IRM the NYSDEC required that a focused Feasibility Study be performed to further justify the IRM program and to evaluate the stability of the southern slope of the landfill. The IRM Work Plan was then modified and resubmitted to the NYSDEC in January 1991. This revised IRM Work Plan was subsequently approved and IRM activities commenced in the Spring of 1991.

1.2 Site Description and Background

The FICA Landfill comprises approximately 17 acres on the north side of Van Wagner Road in the Town of Poughkeepsie, just north of the City of Poughkeepsie. J&T Recycling, Inc. reportedly operated the landfill from 1971 to 1985, leasing the operating rights from the

FICA partnership. The landfill reportedly received mixed municipal and commercial waste from the greater Poughkeepsie area.

The immediate vicinity of the landfill is of varied land use. The area immediately west of the landfill consists of sparsely developed commercial properties zoned for industrial use. The area east and south of the landfill is a designated wetland area, and the area north of the site consists of open fields and woodland.

The landfill is situated in the drainage area tributary to the Casper Creek, which flows from the wetland adjacent to the landfill passing under Van Wagner Road as it flows to the south. Van Wagner Road itself is sparsely populated in the vicinity of the landfill with several homes located to the east. The area is reportedly served with municipal water.

A public meeting was held by NYSDEC in March of 1990 to inform local residents of the proposed RIFS and IRM Work Plans and to inform the public of the remedial objectives for the landfill. Following the public comment period the NYSDEC authorized initiation of the IRM and RIFS programs.

1.3 Previous Investigations

DUNN conducted investigations of the facility during the negotiation of the RIFS Work Plan document. These investigations are summarized in detail in Section 3.0 of the Approved RIFS Work Plan, and included an evaluation of previously existing data, updated survey and mapping of the site, and an evaluation of the hydrogeologic and environmental conditions of the site. The preliminary site investigations addressed the suitability of the pre 1990 monitoring wells and included a final cover assessment, surface water drainage survey, geophysical survey, fracture trace survey, and drinking water supply survey.

The preliminary site investigation was completed during 1989 and is summarized as follows:

1.3.1 Evaluation of Existing Data

DUNN personnel performed a comprehensive file review and literature search by collecting existing files, data, records, and reports concerning the previous operation of the FICA Landfill as well as the hydrogeologic and environmental conditions of the site and in the vicinity of the site.

The information collected yielded much information about the site and its surroundings. A particularly useful document was the Remedial Investigation/Feasibility Study Report for the nearby Shatz Federal Bearing Site. This report provided considerable background information concerning the hydrogeologic and environmental characteristics and setting of the area.

Previous analytical data for groundwater and surface water at the FICA Landfill were also available through the NYSDEC and NYSDOL. These data were evaluated in detail and were used to plan the sampling and analytical program for the RIFS. An expanded discussion and evaluation of existing data will be provided in Section 5.0 of this RIFS report.

1.3.2 Data Validation and Confirming Analyses

Much of the pre-1990 analytical data available for the FICA Landfill are incomplete and of questionable validity. In many cases the laboratory reports present method detection limits and not the actual sample detection limits. Further, some of the laboratory reports fail to identify the specific analytical methods utilized and also fail to provide any indication of the field and laboratory quality assurance/quality control (QA/QC) measures employed. Original laboratory reports were not available for much of the file data. The data were simply summarized in tables attached to various NYSDEC and NYSDOL internal memoranda.

None of the analyses were performed in accordance with currently accepted analytical methods and procedures. Due to the age of the existing data and the questionable sampling and analytical procedures, it was determined that the collection and analysis of confirming samples during the RIFS would be appropriate.

On May 3, 1989 DUNN collected leachate samples at the FICA Landfill. Mr. Thomas Gibbons of the NYSDEC Hazardous Waste Remediation Division accompanied DUNN personnel during this sampling effort. Sample locations are as follows:

- Leachate No. 1: Sample was obtained behind building from a seep.
- Leachate No. 2: Sample was collected from a seep on the north side of landfill along the dirt road at base of slope near stake S-5.
- Leachate No. 3: Sample was collected from a seep located approximately 54 feet southeast of existing groundwater monitoring well CM-1.
- CM-7: Sample was collected on the east side of the landfill, approximately midway up the slope above the wetland approximately 20 feet east of stake S-2.
- CM-4: Sample was collected from the leachate tank.

Samples CM-7 seep, leachate 1, -2 and -3 were collected by digging a shallow hole, allowing the hole to fill with water and solids to settle out. Volatile organic vials were filled directly from the seep water, the remaining sample containers were filled using a polyethylene dipper container. Sample containers for CM-4 standpipe seep sample were filled by using a bailer. A bottom-fill, check-valved, PVC bailer was slowly lowered into the standpipe and allowed to fill with water.

Sample were shipped to Cambridge Analytical Associates (Cambridge, Massachusetts) via overnight courier on May 4, 1989 for Target Compound List (TCL) Contract Laboratory Protocol (CLP) analysis. The CLP required the preparation of organic matrix spike and matrix spike duplicate sample and the inorganic matrix spike and lab duplicate samples. These were collected from CM-4 seep. Samples for leachate indicator parameter analysis were hand delivered to Bender Hygienic Laboratory (Albany, New York) on May 4, 1988.

The analytical results for this sampling effort were validated following the procedures presented in the Quality Assurance Project Plan (QAPP). Sample results from the Preliminary Site Investigation sampling round and the first sampling round in the RI have been used to further refine sampling locations, analytical parameters and matrices of concern to be targeted through the RIFS effort. Analytical results for this sampling effort are discussed in Section 5.0.

1.3.3 Site Survey and Base Mapping

On April 7, 1989 the FICA Landfill was surveyed in order to properly locate surface features, cover defects, existing monitoring wells and to establish updated landfill topography. These features were plotted on an existing map of the site to provide the base map from which the plates contained in this report were generated.

1.3.4 Existing Hydrogeological and Environmental Conditions

1.3.4.1 Site Investigations

On site reconnaissance investigations were conducted on April 6, 1989 for the purpose of collecting and verifying existing hydrogeologic and environmental conditions of the landfill and surrounding area. This reconnaissance investigation consisted of observing and documenting the following features:

- General site conditions,
- Topography,
- Surface drainage patterns,

- Wetlands,
- Soil types, and
- Rock outcrops

1.3.4.2 Evaluation of Existing Monitoring Wells

The existing monitoring wells installed prior to 1990 have been determined to be unsatisfactory for future water quality and hydrologic monitoring, because of inadequate construction procedures and materials, incomplete documentation of installations and the obvious distressed condition of the installations (heaved casings, broken or bent casings), and suspected hydraulic communication between vertical monitoring well pairs. For these reasons, water quality, aquifer characteristics and hydrogeologic interpretations derived from these existing wells are of questionable validity. DUNN therefore recommended proper abandonment of all monitoring wells on the site and the installation of a new array of monitoring wells in accordance with current construction and installation techniques. Well abandonment procedures and activities are presented in Section 3.0.

1.3.5 Landfill Cover Assessment

During the site inspection on April 6, 1989, landfill cover defects were identified and staked out so that the locations of such defects could be recorded during the landfill survey. Defects such as cracks, holes, ponded water, erosion channels (i.e., gullies) and seeps were identified during the site inspection. Olfactory evidence around the cracks suggested that landfill gases were escaping through the existing cap. At the time of the site inspection both active and inactive leachate seeps were noted. Erosion channels were found topographically downgradient of each seep. Ponded water was identified in several areas on and around the landfill. Inadequate site grading and/or differential settlement most likely accounts for the formation of these features. The landfill cover soils tentatively identified during the site inspection consisted predominantly of native till and weathered bedrock. The nature and density of the vegetation appeared to correspond with these materials. Vegetation was sparse or absent over the weathered bedrock, but was relatively well developed over the till.

1.3.6 Surface Water Drainage Survey

Areas of poor surface water drainage were noted during the site inspection. Surface drainage is radial on the landfill, with erosion channels more concentrated on the east and north slopes. Along the perimeter of the landfill drainage is collected in swales, streams and cuts and ultimately flows into Casper Creek which drains towards the south.

Along the northern boundary of the landfill surface drainage is conveyed within a natural swale that directs water into the wetland east of the landfill. Surface water from the eastern boundary is conveyed directly into the wetland via sheet flow, rills, gullies and other erosion channels which exhibited a light gray color adjacent to the toe of landfill. This wetlands area is the headwaters of Casper Creek, into which drainage from the east and south edge of the landfill flows. Along the western landfill boundary, surface drainage is conveyed via a combination of sheet flow, culverts, drainage ditches and erosional channels into the Casper Creek. This surface water becomes concentrated within a culvert that discharges into the creek near the entrance to the landfill property.

1.3.7 Geophysical Survey

A geophysical survey was conducted on April 6, 1989 using a Geonics Model EM-31 terrain conductivity (TC) meter. This instrument measures the TC of subsurface materials to an effective depth of approximately 18 feet.

The EM-31 survey was performed in a "walk-over" fashion by visually checking TC readings while walking across the landfill area. Based on previous EM investigations conducted over similar landfills, the following instrument responses are generally indicative of the landfill:

1. Highly variable EM readings over short distances (i.e. 2 to 5 feet).

2. Highly variable EM readings with horizontal rotation of the instrument.

3. Generally high EM readings, elevated above background readings for native, undisturbed rock and soil.

4. Readings less than zero which are indicative of shallow, buried metallic objects.

These instrument responses were confirmed by observations of the FICA landfill.

The suspected boundary of the landfill was delineated by walking traverses normal to the slope direction of the landfill and determining when background EM values were identified. Background readings over rock range generally from 2 to 4 mmhos/m, and 5 to 8 mmhos/m over soil. The boundary of the landfill was flagged for subsequent surveying. Generally, this landfill boundary coincided with the topographic breaks in slope at the landfill toe.

In the area of the landfill that was surveyed using the EM-31, two anomalies were identified and were presented in the RIFS Work Plan:

1. Target Range Area (see Figure 3 of the RIFS Work Plan): a high frequency of less than zero readings were observed indicating the presence of shallow, buried metallic objects.

2. Area between toe of slope and wetland (designated as Zone A on Figure 3 of the RIFS Work Plan): elevated TC readings were observed while walking traverses parallel to the landfill contour and in this relatively flat area. Elevated TC readings (maximum of 27 mmhos/m) were observed for a distance of approximately 100 feet. Such readings may be indicative of a

shallow water table, inorganic plume or more conductive subsurface materials (i.e., clay). Minor modifications to the proposed monitoring well locations may be made in this zone depending upon specific findings of the more detailed geophysical program which will be performed prior to the monitoring well installation program.

1.3.8 Lineament Survey

DUNN staff performed a lineament analysis of aerial photography dated 1980 at a scale of 1" = 2000' provided by Keystone Aerial Surveys. This analysis revealed the presence of two sets of lineaments oriented in a northeast to southwest and northwest to southeast direction. These lineaments were not oriented parallel or perpendicular to the ridge trends but at relatively shallow angles to the ridge.

1.3.9 Drinking Water Supply Survey

The NYSDOH was consulted concerning the known existence of private water supplies within the immediate project area and none were reported. At present, it appears most surface water drainage and groundwater discharge is to the wetland east of the landfills. Therefore, an investigation into possible impact to private water supplies should address private homes along Van Wagner Road in the Town of Poughkeepsie.

1.4 Interim Remedial Measures (IRM) Program

The approved IRM Work Plan for the FICA Landfill, dated January 29, 1991 sets forth the goals and objectives of the IRM program and provides the justification of need consistent with prevailing NYSDEC guidance. (See January 14, 1992 NYSDEC guidance memorandum entitled "Strategic Plan: Accelerated Remedial Actions" which specifically addresses accelerated remedial actions at Class 2, non-RCRA regulated landfills.)

This approach recognizes that most Class 2 landfills are composed of substantial quantities of municipal solid waste (MSW) mixed with smaller quantities of potentially hazardous waste. While a complete RI/FS is warranted at these sites to determine the full extent of contamination and any risks posed to human health and/or the environment, certain remedial measures should be evaluated very early in the RI/FS process for possible accelerated implementation based on historic data, early treatability tests, risk assessment or technologically based results with a bias for initiating appropriate remedial actions as early as possible in the remedial process.

In order to properly consider an IRM program, the NYSDEC guidance provides that:

- Placement of a final cover in accordance with 6NYCRR Part 360 will be a minimum requirement for all Class 2, non-RCRA regulated landfills unless the variance requirements under Part 360-1.7(c) are met.

- Areas or potential areas within the landfill mass (hot spots) which are amenable to on site treatment or removal and treatment must be addressed prior to capping. Hot spots may be identified by past disposal practices (discrete areas for drum disposal), geophysical testing, soil gas surveys, soil borings/testing, test pits, etc. If hot spots are identified they should be evaluated to determine the feasibility of remediating them.

- On site or off site areas (contaminated soils or sediments) which have the potential for consolidation into the main landfill must be addressed prior to capping. These areas would be identified by geophysical testing, test pits, soil borings, and soil/sediment testing.

- The entire landfill area must be adequately defined to allow the determination of final grades and elevations. This may be determined by past disposal practices, geophysical testing, test pits, and soil borings.

- The capping should be phased to allow deposition onto an uncapped area of drilling/trench spoils from monitoring well installation, groundwater recovery well installation, or leachate/groundwater collection trench excavations providing the phasing doesn't prolong the overall capping schedule. This will be influenced by the size of the landfill and the timing and duration of remedial design.

The IRM Program developed for the FICA landfill provides for the placement of the landfill final cover system and repair or correction of structural defects in a timely fashion. The IRM Work Plan included a detailed geotechnical evaluation of the landfills' steep southern slope and provided an evaluation of the alternatives for stabilizing the slope prior to final cover placement.

The preliminary investigations of the landfill did not indicate the presence of any hot spots requiring removal. Geophysical investigations were conducted to define the limits of fill and serve as the basis for the final grading plan.

Consistent with NYSDEC policy for IRM programs, alternatives were analyzed for the final cover system as follows:

Alternatives 1: No Action

Alternatives 2: Standard Part 360 Cover System Design

Alternatives 3: Modified Part 360 Cover System Design

Based upon the evaluation of alternatives, the modified Part 360 cover system design was selected by the IRM Report. The modified design did not include a full gas vent layer over the existing closed areas of the landfill since existing low permeability soil effectively controls the vertical migration of landfill gasses. In addition to the cover system the design did provide for the continued operation of the leachate collection system and long term monitoring of the landfill.

The approved IRM Work Plan is presented in its entirety as Appendix B.

The IRM program commenced in early 1991 with the construction of the Phase 1 and 2 liner and leachate collection system. The placement of construction and demolition debris (C&D) commenced in July of 1991. C&D placement has been at a rate below what was anticipated due largely to the slow down in the construction industry in the Hudson Valley.

Average daily disposal rates have ranged between 400 and 700 cy/day over the recent months of operation.

In July of 1992, the Phase 3 liner and leachate collection system was constructed and Phase 4 construction is scheduled for October 1992. Prior to initiation of Phase 4 the last remaining portion of the building will be demolished.

The IRM program also includes the phased installation of the final cover system. In March of 1992, bid documents were prepared for the geomembrane required for the final cover. The geomembrane design was selected since the local price for clay cover material was excessive. Additionally, concerns were raised by the NYSDEC regarding the need to undertake cover placement activities which will extend into the adjacent wetland. The use of the geomembrane will minimize the extent of cover placement into the wetland.

A second contract and bid specification concerning the earth work associated with the final cover system is currently out for bid. Upon award of the geomembrane and earth work contracts, final cover placement activities at the landfill will commence on the eastern slope. Final cover placement will then occur in phases progressing to the north, then west. The southern slope where C&D fill activities are continuing will be covered as the last phase of work.

The need for remedial actions beyond the scope of the IRM program, are evaluated in more detail in Section 9.0 of this report.

2.0 FIELD INVESTIGATIONS

2.1 General

All field related aspects of the RI/FS were conducted in accordance with the approved Work Plan, Quality Assurance Project Plan (QAPP), and the Field Health and Safety Plan (FHSP) developed for this project. However, in some instances, it was not entirely possible to follow the exact methodologies or details of those plans due to unexpected or varying site conditions.

The following sections provide details of the specific methodologies undertaken during completion of the various field investigations. Where appropriate, the sections outline any variances from the approved plans as well as the rationales behind such variances.

2.2 Supplemental Geophysical Survey

2.2.1 General

Based on the results of a preliminary geophysical survey conducted at the FICA Landfill, a supplemental terrain conductivity (T.C.) survey was performed on September 25 and 26, 1990 by DUNN personnel, to aid in characterizing the site for effective planning of subsequent investigations and/or remediation activities. The specific objectives of the supplemental survey were to:

1. Define the lateral extent of buried waste material.

2. Delineate possible groundwater plumes,

3. Identify concentrations of buried metal that could represent bulk metal objects, such as pipes, drums, tanks, etc.

The results of this survey were previously submitted to the NYSDEC in the IRM Work Plan and the results can be found in the IRM Work Plan which is presented in its entirety as

Appendix B. The nature and scope of the field investigations were not affected by the results of the supplemental geophysical survey. Therefore, this report does not contain a discussion of the results of the survey.

2.3 Soil Gas Survey

2.3.1 General

In November 1990, a soil gas survey was conducted at the FICA landfill by DUNN personnel. Samples were collected every 100 feet across the site. The objectives of the investigation were to evaluate the potential presence of volatile organics within the landfill, identify areas (if any) which exhibit elevated volatile concentrations and to provide information for the location of groundwater monitoring wells.

The two primary field activities in the soil gas investigation are sample collection and analysis. Sample collection includes installation of a soil gas probe and collection of a representative soil gas sample from the unsaturated zone. Sample analysis involves identification and quantification of specifically targeted volatile constituents within the soil gas sample. The following sections present the methodology used for each activity.

2.3.2 Sample Collection

Sampling locations were prepared by using a "slam bar" or KV soil gas probe driving a 5/8-inch steel rod to a maximum depth of four feet, removing it and inserting a 1/2-inch diameter hollow aluminum tube into the hole. Care was taken to ensure that the tube was not plugged or inserted into shallow groundwater. Following placement of the aluminum tube, surface soil, and/or a bentonite paste seal was packed into the annular space around the opening of the annulus to prevent the potential infiltration of surface air during sampling.

Soil gas samples were collected with a 125 milliliter gas sampling bulb. The sampling bulb consists of a glass tube with Teflon valves at either end to trap the gas sample, and a septa in the center for sample withdrawal. The top of the aluminum tube in the probe hole was connected with dedicated 1/2-inch polyethylene tubing to one of the valves on the gas sampling bulb. The other valve was connected with tubing to a laboratory bench style vacuum pump. The vacuum pump was used to create flow within the polyethylene tubing causing soil gas to be drawn up from the subsurface probe. The pump was operated until approximately 2 liters (6 volumes) were purged. After purging, the soil gas in the glass bulb was contained by closing the valve nearest the pump before the pump was stopped, to prevent backflow. The pump was shut off and removed from the glassware while the other valve (nearest the aluminum tube) was left open to the soil gas source for approximately two minutes to allow the system to come to equilibrium pressure. Following the equilibrating period, the second valve was closed and the sample was removed for analysis.

The dedicated polyethylene tubing was discarded and replaced at each new sampling location. The samples were labeled corresponding to the sample location and stored in a cool, dark place until being analyzed. A needle was inserted through the septa of the sampling bulb and a sample was withdrawn using a 500 microliter syringe for injection into the portable gas chromatograph.

2.3.3 Sample Analysis

Samples were analyzed on site using a Photo Vac 10S70 Gas Chromatograph (GC). The Photo Vac GC is equipped with a photoionization detector and an on-board computer which was programmed to analyze samples for 15 compounds.

The Photo Vac GC is capable of generating compound-specific quantitative data. After injection into the instrument, the gaseous sample passes first through a chromatographic column and then to the PID. The various VOCs pass through this column at different rates and thus reach the detector at different times after the injection. A strip-chart record of PID response versus retention time is obtained during each analysis and the presence of VOCs in the sample is manifested by peaks on this strip-chart record.

The PID is driven by a 10.6 electron-volt ultraviolet lamp which is capable of ionizing all categories of VOCs, however, the PIDs sensitivity to each compound varies. Table 2-1 details the practical quantitation limit (PQL) for the compounds of interest.

The portable GC measures the retention time (length of time between the initial injection of the sample and the detection of the peak) and integrates the detector response to measure the area under the peak. Each of the 15 compounds in the library exhibit a different retention time. The area is measured in millivolt seconds (mv-s) and is proportional to the concentration of the compound in the sample.

The portable GC must be calibrated to recognize the retention time of the VOCs of interest and accurately convert the peak areas into concentrations. Prior to the start of field activities, the instrument was calibrated for the 15 target VOCs. Standards were prepared by DUNN by injecting a measured volume of headspace, over a pure compound, into a one liter glass bulb that had been thoroughly flushed with organic free ("ultra zero grade") air. The concentration of the standard was calculated using the temperature of the room, the vapor pressure of the compound at that temperature, and the noble gas law.

A library was built within the instrument by sequentially analyzing each standard. A syringe was used to withdraw 250 microliters (ul) of the headspace gas and inject the gas into the instrument for analysis. A peak is detected for the standard and is recognized but not identified or quantitated by the instrument; the peak is simply recognized as having a certain retention time and peak area. The analyst enters both the identity and concentration of the standard and repeats this process for each of the remaining target VOCs. At the end of the initial calibration, the portable GC can identify and quantitate the peaks associated with the target VOCs, while other peaks which are recognized during an analysis remain unidentified and a retention time and peak area was reported rather than a compound and concentration.

The retention time and detector response were influenced by other conditions such as the internal temperature of the instrument and the rate of gas flow through the column. Although regulated, some variation in these conditions occurred and acts to shift the retention times and response factors of the target VOCs. Thus, continuing calibration was routinely performed.

The continuing calibration was performed by injecting a standard, typically toluene, into the portable GC for analysis. Using a keyboard command, the analyst instructed the instrument to recalibrate the library. After the peak was detected, the analyst entered both the identity and the concentration. The retention times and response factors for all of the target VOCs in the library were then linearly adjusted relative to that calibration standard. However, due to varying field conditions, continuing calibration was performed throughout each day at the analysts discretion.

The results of the Soil Gas survey were previously submitted to the NYSDEC in the IRM Work Plan. The interpretations of the results presented in the IRM Work Plan have not changed since the completion of the RI field investigations. In addition, the nature and scope of the field investigations were not affected by the results of the soil gas survey. Therefore, this report does not contain a discussion of the results of the survey. However, the results can be found in the IRM Work Plan which is presented in its entirety as Appendix B.

2.4 Drilling Program

2.4.1 Purpose and Scope

The purpose of the drilling program was to investigate subsurface conditions and to provide a monitoring network to evaluate groundwater quality as well as geologic and hydrogeologic conditions in the vicinity of the site. To meet these objectives, the drilling program included the abandonment of previously existing monitoring wells and the drilling and installation of several new monitoring wells around the perimeter of the site.

Drilling was initiated on August 19, 1991 and was completed on September 17, 1991. The approved work plan proposed the installation of twenty monitoring wells around the perimeter of the site. Due to varying site conditions including the shallow depth to bedrock, the generally unsaturated conditions of the overburden, and the depth to groundwater in the bedrock, the placement and number of wells installed during the drilling program differs from the placements anticipated under the RI/FS work plan. At four of the drilling locations (DGC-1, 5, 8 and 10), the overburden either was too thin or did not have a sufficient saturated thickness to allow for the installation of a monitoring well. Therefore, single bedrock monitoring wells were installed at these locations. At location DGC-3, the monitoring well was installed such that the screened interval intersected the overburden/bedrock interface. This well design was approved by the NYSDEC's on-site representative, prior to installation. Well clusters consisting of an overburden well and a bedrock well pair were proposed at locations DGC-4, DGC-6 and DGC-11. At location DGC-4, bedrock was very shallow (4 feet) and groundwater was encountered at a depth of 45 feet. As a result, only a single bedrock well was installed at this location. At location DGC-6, an overburden well was installed. Bedrock drilling did not encounter any appreciable amounts of water and so a single bedrock well, instead of a pair, was installed at location DGC-6. At location DGC-11, there was no overburden and, therefore, a bedrock well pair was installed. At location DGC-7, groundwater was encountered at a depth of approximately 50 feet. Therefore, a single bedrock well, rather than a well pair, was installed. At location DGC-2, a bedrock well pair, as proposed, was installed. As a result of the unexpected field conditions, a total of fourteen wells were installed at eleven locations during the drilling program.

All drilling, monitoring well abandonment and monitoring well installation procedures were performed by Parratt-Wolff, Inc. under the inspection of DUNN personnel. Parratt-

Wolff utilized a CME-55 drilling rig to complete the drilling program. Drilling activities were periodically inspected by representatives of the NYSDEC

2.4.2 Drilling Procedures

During the drilling program a total of fourteen test borings (DGC-series) and two soil borings (SB-series) were drilled at thirteen locations around the site. The fourteen test borings were subsequently converted into groundwater monitoring wells (Section 2.4.3). At locations where bedrock well pairs were installed, the test borings and wells were labeled with a "S" or "D" to designate shallow or deep (e.g.; DGC-2S or DGC-2D). Individual bedrock locations were designated with only a number (e.g.; DGC-8). The overburden test boring and monitoring well location was designated DGC-6-(OB). Location DGC-10A represents a replacement well for DGC-10 and is an individual bedrock well. The two soil borings (SB-7 and SB-8) were drilled as shallow overburden borings from which subsurface soil was sampled for laboratory analysis. All boring and well locations are shown on the Site Plan, Plate 1.

Two drilling methods were utilized during the drilling program. Hollow stem augers were used to drill the overburden portions of the borings and air rotary drilling methods were used to drill into the bedrock.

The overburden section of all borings were drilled with 4-1/4 inch inside diameter (I.D.) hollow stem augers. Continuous split spoon soil samples were collected at 2-foot intervals through the overburden at each drilling location following the ASTM standard D-1586 method. The split spoon sampler consists of a 2-foot long and 2-inch outside diameter (O.D.) split barrel with a drive head and shoe. Samples were obtained by driving the sampler with a 140-pound hammer falling 30-inches until either 24-inches of soil was penetrated or 100 hammer blows applied with less than 6-inches of penetration. The number of blows required to affect 6-inches of penetration were recorded.

At bedrock well locations, the hollow stem augers were advanced a minimum of 3-feet into bedrock to form a rock socket. A permanent 4-inch I.D. steel casing was then inserted to the bottom of the rock socket and grouted in place with a thick cement/bentonite grout. Grout was removed from the inside of the casings by flushing with potable water. The grout was allowed to cure around the casings for a minimum of 24-hours prior to initiating bedrock drilling. Bedrock drilling was accomplished utilizing a 3-7/8 outside diameter (O.D.) downhole hammer to advance the boring to the desired depth. A Sullair model 375-Q air compressor was used to operate the downhole hammer. Upon completion of each bedrock boring, potable water was added to the boring and then blown out with compressed air to remove cuttings and flush the boring walls prior to well installation.

All borings were logged on-site by the DUNN geologist. Samples of unconsolidated sediments were examined and described using a modified version of the Burmister Soil Classification System. The Burmister system allows for a rather precise identification of a soil grain size curve within a narrow range. In addition to color and grain size, other sample characteristics such as fill materials, soil structure and moisture content were recorded. Test boring logs were also maintained for the bedrock portions of all borings. Bedrock logging included a brief description (color and rock type) of the drill cuttings and a summary of drilling conditions. Representative portions of samples of both overburden and bedrock materials encountered during drilling were placed in jars, labeled and archived for possible future reference. All drill cuttings and unused portions of soil and rock samples were placed in approved DOT-17H 55-gallon drums, labeled, dated and stored at the corresponding well location. Detailed logs of all borings are presented in Appendix C.

2.4.3 Monitoring Well Installation

Upon completion of each test boring, a 2-inch I.D. monitoring well was installed. Installation and design of each well was based on information gathered during the drilling of each test boring such as the depth to groundwater and depth to bedrock. The bedrock monitoring wells were installed inside the 4-inch permanent steel casing which was previously grouted in place as discussed earlier. The overburden well was installed through the hollow stem augers.

All wells were constructed of 2-inch I.D, flush-joint, threaded, schedule 40 polyvinyl chloride (PVC). The wells consist of a 10 or 20-foot section of PVC screen (0.020-inch slots), bottom capped with threaded plugs and attached to the base of a solid riser pipe. The wells were assembled as they were lowered through the steel casing or augers to the bottom of the borehole. The annulus around the well screen was packed with a clean Morie grade 0 silica sand to approximately 2-feet above the screen. An approximate three foot thick bentonite seal (consisting of pellets or slurry) was placed above the sand pack. A thick cement/bentonite grout was placed from the top of the bentonite seal to approximately 1-foot below grade. The grout was introduced through a tremie pipe lowered to just above the bentonite seal. The permanent 4-inch steel casing described earlier was left in place and served as the protective casing for the bedrock wells. A 5-foot long protective steel casing was placed over the well and cemented into place. All wells were locked to prevent unauthorized access. Table 2-2 provides a summary of monitoring well construction details. Detailed monitoring well completion logs were prepared for each well and are presented in Appendix D.

2.4.4 Well Abandonment

Previously existing wells UD-CM-1, -9, -11, -14 and D-CM-2, -4, and -7 were abandoned during the drilling program. Each existing well was abandoned prior to drilling and installing a new, adjacent well. All wells were abandoned by the tremie grout method utilizing a thick, non-shrinking, cement/bentonite grout mixture. The inside of the well was initially grouted by inserting a tremie line to the bottom of the well and then pumping grout until the grout mixture returned to the top of the PVC well riser pipe. Subsequently, any void space in the original grout collars were also sealed by this tremie grout method.

At location D-CM-2, -4 and -7, the casings were removed, the PVC riser was cut approximately one foot below the surface and the remaining hole was backfilled with a soil/bentonite powder mix, and the location was marked with a labeled stake.

At locations UD-CM-1, -9, -11 and -14, the concrete pad surrounding the casing was broken into pieces and removed. The hole was then expanded to three feet in diameter and one foot deep, then the casing and PVC riser were cut off approximately one foot below surface. The hole was then backfilled with a soil/bentonite powder mix and the location was marked with a labeled stake. DUNN thoroughly inspected the former location of well D-CM-3. However, the well could not be located and is believed to have been destroyed and covered by excavation activity.

2.4.5 Drilling Decontamination Procedures

All drilling equipment was cleaned and decontaminated at several stages of the investigation to prevent cross-contamination and help ensure that samples collected were representative. Drilling equipment, including tires, the back end of the rig, tools, sampling equipment, auger flights, drill rods and related equipment, were washed down with water and steam cleaned, as appropriate, at a designated wash down area at the following project stages:

Before entering the site,

Between boreholes, and

Prior to leaving the site.

The designated wash down area consisted of a gravel pad capable of supporting vehicles. The pad was located in an area reportedly underlain by the asphalt liner of the landfill so that wash water was therefore collected by the existing leachate collections system.

The entire split spoon sampler was cleaned after each soil sample was collected. This decontamination procedure was as follows:

- detergent, potable water wash
- potable water rinse
- one percent HNO_3 acid rinse
- distilled water rinse
- methanol spray
- distilled water rinse and air dry

The split spoon sampler was then reassembled to obtain the next soil sample. All wash waters and rinses were collected and disposed of on the lined portion of the landfill.

2.4.6 Monitoring Well Development

Monitoring wells were developed using a WaTerra lift pump and by bailing. Well development is necessary for the following reasons:

1. To remove residual drilling water and formational silts and clays in an attempt to reduce turbidity during sampling that could potentially interfere with chemical analysis.

2. To increase the hydraulic conductivity immediately around the well, to obtain accurate water level measurements, and to reduce the potential of the well yielding an insufficient volume of water during groundwater sampling.

Well development at the FICA landfill was accomplished from September 9 to September 18, 1991. Wells DGC-2S, DGC-2D, DGC-3, DGC-4, DGC-5 and DGC-11D were developed by the bailing method, while wells DGC-1, DGC-6(OB), DGC-7, DGC-8, DGC-9, and DGC-10A were developed utilizing a WaTerra lift pump. The well development procedures were performed until a minimum of 5 well volumes were removed, additional well volumes were removed until turbidity levels reached 50 NTUs or stabilized.

Method 1 - WaTerra Lift Pump

Dedicated polyethylene tubing is inserted in the well to a depth of approximately 6 inches from the bottom of the well. The bottom of the tubing is fitted with a one way check valve which also acts as a surge block during pumping. The opposite end is connected to the WaTerra pump at the surface. The pump works by repeatedly moving the tubing up and down. During the upward motion the check valve closes and holds the water in the tubing. During the downward motion, the check valve opens allowing water to enter the base of the tubing as water is forced out of the top of the tubing at the surface. The position of the base of the tubing is periodically moved up and down across the length of the well screen to insure adequate development.

Method 2 - Bailing

Dedicated bailers consisted of 5 foot long, by 1 inch diameter PVC pipe with a check valve attached at the base. Bailers that are utilized for development purposes serve both as a surge-block device, to loosen the fine-grained material from the well annulus, and as a mechanism to remove water and sediment from the well. The surging is accomplished by rapidly raising and lowering the bailer within the screened section of the well.

2.4.7 Water Level Measurements

Water level measurements were obtained from monitoring wells prior to well development, groundwater sampling and hydraulic conductivity testing. Additional rounds were also obtained on various dates.

Measurements were obtained with an electric water level indicator which emits an audible tone when the probe contacts the water surface. The probe was cleaned with a non-phosphate liquid detergent solution followed by a deionized water rinse prior to each measurement to eliminate the potential of cross-contamination. The depth to water was recorded to within 0.01 foot for each measurement. This information was converted to water level elevation with respect to mean sea level, using the surveyed elevations of the measuring points (MP).

2.4.8 Hydraulic Conductivity Testing

Hydraulic conductivity testing was conducted on August 10 and 11, 1992 on all wells, except DGC-11D. Both slug and bail tests were performed as appropriate. Wells DGC-1, DGC-2S, DGC-2D, DGC-3, DGC-4, DGC-5, DGC-6(OB), DGC-6D, DGC-7, DGC-8, DGC-9, DGC-10A, and DGC-11S were slug tested. The slug tests involved quickly introducing a volume of deionized water (slug) into the well. The recovery of the water level was measured with a pressure transducer set below the static water level, and recorded with an Enviro-Labs DL-240P Data Logger.

The bail tests (used for slow recovering wells DGC-2D, DGC-6D, and DGC-9) consisted of removing a volume of groundwater and measuring the water level recovery. Due to their slow recharge rate, the recovery of these wells was recorded manually with an electronic water level meter, over the 2-day period.

Data obtained were analyzed according to the method developed by Hvorslev (1951). Results were checked using a second analysis method developed by the U.S. Department of the Navy (1971) and described by Cedergren (1977).

The principle behind Hvorslev's method is that a plot of recovery data versus time theoretically follows an exponential decline and theoretically forms a straight line on a semi-log plot. Horizontal hydraulic conductivity (K) is then calculated as follows:

$$K = r^2 \; [\ln (L/R)/2LT_O]$$

where:

K	=	hydraulic conductivity
r	=	radius of riser in which water level fluctuations occur
R	=	radius of well screen
L	=	well screen length
T_O	=	basic time lag

The basic time lag (T_O) is found from the straight-line fit to recovery data and is the time at which $H\text{-}h/H\text{-}H_O = 0.37$ or $\ln (H\text{-}h/H\text{-}H_O) = -1$. The computer program used to calculate hydraulic conductivity by this method utilizes linear regression techniques applied to the recovery data after logarithmic transformation:

$$\ln (H\text{-}h/H\text{-}H_O) = b_O + b_1 t$$

where:

H	=	head at equilibrium
h	=	head at some time (t)
H_O	=	head at t=0
b_O	=	y-intercept
b_1	=	slope
t	=	time

This methodology results in a quantitative and objective "forcing" of a straight line to the recovery data. The slope (b_1) and y-intercept (b_O) can be used to find T_O and thus K. The accuracy of the fit can be assessed using the R-squared (coefficient of determination) and residuals.

Hydraulic conductivity (K) was also calculated using the following equation (Department of the Navy, 1971).

$$K = R^2/2L(T_2-T_1)(\ln(L/R)\ln(H_1/H_2)$$

where:

K	=	hydraulic conductivity
R	=	inside radius or casing/screen
L	=	length of uncased/screened portion of well
H	=	pressure/distance of water level from equilibrium value
T	=	time expired from test start

2.5 Air Quality Survey

The Air Quality Survey specified by Section 4.5 of the approved RI/FS work plan is to be performed following installation of the final cover so that airborne emissions can be evaluated following implementation of the IRM. The IRM includes the installation of passive gas vents and a gas vent layer on the southern slope. Evaluation of air emissions from the landfill following implementation of the IRM will provide the basis for determining if additional remedial actions are warranted to address contaminant transport by way of the airborne migration pathway. The Air Quality Survey will be scheduled upon completion of the IRM program.

2.6 Sampling and Analytical Program

2.6.1 Purpose and Scope

Environmental sampling encompassed site subsurface soil, groundwater as well as sediment and surface water from the Casper Creek. Sample locations and analyses were chosen to determine the nature of the contaminants on the site and possible migration through the various media. The recommended field protocols used for each phase of the program are provided in the QAPP. The following sections briefly describe the scope of each phase of the sampling program and results are presented in Section 5.0.

2.6.2 Subsurface Soil

Subsurface soil samples were collected during the drilling program carried out between August 19 and September 17, 1991. As described in Section 2.4.2, samples were collected on a continuous basis from each boring utilizing split spoon samplers. All samples were placed into glass sample jars. Upon being opened, each sample was promptly scanned with an HNU model PI-101 photoionization detector (PID). A representative portion of each sample was placed in a glass jar sealed with aluminum foil and a screw top lid for subsequent headspace screening. Results of the PID scanning and headspace screening are presented in the test boring logs.

Based on PID scanning and the depth to the water table, selected soil samples were placed in laboratory supplied jars and sent to CTM Analytical Laboratories of Latham, New York for analysis. Each sample was analyzed for TCL volatile organic compounds (VOCs), TCL semi-VOCs, TAL metals, PCBs, pesticides and cyanide. A total of 11 subsurface soil samples were analyzed. Subsurface soil samples from ten of the eleven drilling locations were analyzed in accordance with the Work Plan. Due to the absence of overburden at location DGC-11, no sample was collected or analyzed. At all locations except DGC-3, DGC-6 and DGC-8, samples from the 2 foot interval immediately above the bedrock surface were collected for laboratory analysis. The sample from DGC-3 was collected beneath the fill layer from a depth of 12 to 14 feet. Both DGC-6 (OB) and DGC-8 were sampled at the interval of 6 to 8 feet below grade. Sample collection and analysis followed the procedures outlined in the approved QAPP. Matrix spike (MS), matrix spike duplicate (MSD) and lab duplicate samples were collected at location DGC-6. A blind field duplicate (X-1) was also collected at location DGC-6. The analytical results of the subsurface soil samples are discussed in Section 5.3

2.6.3 Groundwater

Between May 20 and 22, 1992, DUNN personnel collected groundwater samples from 13 of the 14 newly installed monitoring wells at the FICA Landfill. At the time the wells were sampled, well DGC-11D had only about 1-foot of water and as such did not allow for the collection of a sample.

Prior to collecting samples, the static water level in each of the wells was measured and the volume of the water in the well casings were calculated. A total of three well casing volumes of water was purged from all wells, except well DGC-2D, DGC-6D and DGC-9, prior to collecting samples. Due to the slow recharge rates of wells DGC-2D, DGC-6D and DGC-9, approximately 2-well volumes were removed from these wells. Wells DGC-1 and DGC-9 were purged with a WaTerra lift pump and sampled with clean, dedicated PVC bailers. The remaining wells were purged and sampled with dedicated PVC bailers.

There was a limited volume of water present in wells DGC-2D, DGC-6D and DGC-9 at the time of sampling because the wells had not sufficiently recharged from purging. Several attempts were made to collect additional samples from these wells during the round of sampling. However, each of the wells were ultimately sampled for a limited number of parameters as an insufficient sample volume was collected to allow sampling for all parameters. These wells were sampled for VOCs, BNAs and for PCBs/Pesticides. Sample results are evaluated in detail in Section 5.0. All remaining wells were sampled for the full list of parameters including TCL VOCs, TCL BNAs, PCBs/Pesticides, TAL metals plus boron, cyanide and the NYSDEC Part 360 base line leachate parameters.

All samples were analyzed for the complete list of NYSDEC CLP parameters consistent with the QAPP. The analytical results of the groundwater samples are discussed in Section 5.1.

A second round of groundwater samples were collected between October 12 and October 14, 1992. Based on the May 1992 analytical results, and with the approval of the NYSDEC, the groundwater samples collected during the October 1992 sampling event were analyzed for a modified list of parameters. The second round of sampling was conducted following the same procedures outlined above for the May 1992 round. A description of this modified sampling program is provided in Section 5.0.

2.6.4 Surface Water and Sediment

DUNN personnel collected four surface water and four sediment samples at the site on May 28, 1992. The sampling locations, proposed in the approved Work Plan were designed to characterize the potential impact to the wetland area, and to the Casper Creek prior to it flowing off site.

The four locations from which the surface water and sediment samples were collected were generally consistent with the locations proposed in the Work Plan. However, due to field conditions, some of the locations were modified slightly. The actual locations where the samples were collected are shown on the Site Plan, Plate 1.

Each of the four surface water and sediment samples, and the blind field duplicate sample were analyzed for the full TCL of parameters including VOCs BNAs, PCBs/Pesticides, metals and cyanide. Additionally the surface water samples were analyzed for boron, and the NYSDEC Part 360 baseline leachate parameters. The blind duplicate samples for both the surface water and sediment samples were collected at location 1, the furthest on-site downstream location along the Casper Creek. All samples were collected following the protocols outlined in the QAPP. All samples were analyzed for the complete list of NYSDEC CLP parameters and accompanying methods outlined in the QAPP. Samples were analyzed by CTM Analytical Laboratories of Latham, New York. The analytical results of the surface water and sediment samples are discussed in Section 5.2.

A second round of surface water and sediment samples were collected in October, 1992. At the request of the NYSDEC, the second round of sampling included the collection of additional samples beyond those collected in May 1992. Samples were collected in a manner consistent with that described above for the May 1992 round. A further description of this second round of sampling is provided in Section 5.2.

3.0 GEOLOGY

3.1 Regional Geologic Setting

The FICA Landfill is located along the eastern edge of the Hudson Lowlands physiographic province. The Hudson Highlands and the Taconic Highlands are located to the south and east of the site respectively. The Hudson Lowlands province, which represents a northern extension of the Valley and Ridge province, is characterized by relatively low elevation and relief, being the result of erosion along outcrop belts of primarily unresistant rocks. The height of the lowlands above the Hudson River varies from 100 to 300 feet. As a result of erosion, the lowlands are primarily composed of bedrock ridges that are aligned with their long axis parallel to the regional strike of the bedrock generally N20^{o}E. The relief of the bedrock ridges in this area range from 5 to 300 feet.

The geology of the region is generally comprised of sedimentary and metamorphic bedrock overlain by unconsolidated sediments resulting from glacial and alluvial deposition. According to Simmons, et. al. (1961) the bedrock underlying Dutchess County consists of four distinct formations, which from oldest to youngest are identified as undifferentiated granite and gneiss, Cheshire Quartzite, Stockbridge Limestone, and the Hudson River Formation.

The Hudson River Formation is the most widespread bedrock formation in the county and underlies the FICA Landfill. The formation (Simmons et

al., 1961) actually represents a group of predominantly argillaceous, middle to late Ordivician aged formations. Rock types within the formation range from shale, argillite and slate in the western part of the county to schist and phyllite in the east. The formation also contains beds of sandstone, limestone and conglomerate. The thickness ranges from a few to thousands of feet.

Bedrock beneath the site has also been mapped as the Normanskill Shale (Fisher, 1970). Described as a dark colored silty shale, mudstone, and argillite alternating with thin-bedded siltstones. This middle Ordivician age formation is most likely grouped by Simmons (1961) into the Hudson River Formation.

Unconsolidated deposits overlie the bedrock in the region and include sediments of glacial origin and alluvial sediments associated with recent deposition of streams and rivers. During Pleistocene time glacial ice advanced over and receded from the region several times. The advancing ice modified the surface topography through erosion and deposited a mantle of glacial till immediately over the bedrock surface. Glacial till is composed of a poorly sorted mixture of sediments including silt and clay, sand, gravel and boulders. As glacial ice receded, moderately well sorted sediments were deposited in glacial meltwater channels as glacial outwash. Temporary blockage of meltwater channels by ice blocks and sediments formed temporary glacial lakes and ponds. These low energy environments allowed deposition of lacustrine sediments consisting of clay, silt and fine sand.

Streams and rivers which have developed during post-glacial times have reworked the low areas depositing alluvium as channel and overbank floodplain sands, gravels and clays. Many of the small isolated ponds have become swamplands as they became filled in with silts and clays.

3.2 Site Geology

The site geology has been characterized from data generated during previous investigations conducted at the site, from field reconnaissance surveys performed by DUNN personnel, from available geological literature for the site and from information gathered from the drilling program completed in September, 1991. Descriptions of the bedrock and the overlying unconsolidated deposits are presented in the following sections. Three geologic cross sections showing the distribution of the unconsolidated deposits, and the sections of the bedrock that were penetrated during the drilling program were prepared. The locations of the cross sections are shown on Plate 2. The actual cross sections are presented on Plate 3.

3.2.1 Bedrock Geology

Bedrock was encountered at all of the eleven drilling locations during the drilling program. The bedrock is located at or near the ground surface across most of the site. At location DGC-11 it outcrops at the surface and it is present at less than 5-feet below grade at locations DGC-4, DGC-5, DGC-9 and DGC-10. It was encountered the deepest at locations DGC-3 and DGC-6 (22 and 27 feet respectively) where there is a trough in the bedrock surface. Bedrock depths varied from between 7 and 11 feet at the other four locations.

Bedrock beneath the site is a slightly metamorphosed shale, belonging to the Normanskill Formation. The shale has been metamorphosed to the extent that fracture cleavage has been imparted to the rock. The weathered surface of the bedrock seen in test borings and in outcrops, shows pronounced fracturing along cleavage planes as it has resulted in the decomposition of the rock into small fragments. The orientation of this bedding plane fracture cleavage network trends in a northeast-southwest direction.

3.2.2 Unconsolidated Deposits

During the drilling program, unconsolidated deposits were encountered at all of the drilling locations with the exception of DGC-11. Overburden at this location was apparently removed during previous quarrying operations.

The thickest section of unconsolidated deposits is present at locations DGC-3 and DGC-6 where the bedrock surface is at a relatively low elevation. A layer of sand and gravel, not encountered at the other locations was present immediately above the weathered bedrock at these locations. This unit is moderately well sorted and generally consisted of medium to fine gravel with a little coarse to fine sand and a trace of silt. A dense silt and clay deposit overlies the sand and gravel at these two locations. The silt and clay is most likely associated with deposition within the wetland along the east side of the site. A thin organic soil horizon, interpreted to represent the original grade, was identified at the top of the silt and clay unit at location DGC-3.

A layer of fill was found at all locations tested with the exception of DGC-11. At locations DGC-1,4,5,7,8,9 and 10, the fill unit was found to immediately overlie the weathered bedrock. The fill consisted of reworked natural sediments including varying amounts of clay, silt, sand, gravel (possibly former glacial till) and weathered bedrock fragments. This unit is probably a result of the extensive excavation that had taken place at the site.

4.0 HYDROGEOLOGY

4.1 Site Hydrogeology

4.1.1 Surface Water Hydrology

The entire FICA Landfill site is located within the Casper Creek watershed. Surface water runoff occurs in a radial pattern due to the site topography. However, all runoff generated from precipitation over the site, that does not eventually infiltrate the groundwater system, flows into the Casper Creek. The Casper Creek flows in a southerly direction and passes immediately to the east of the site. After converging with several small tributaries and passing through some small lakes and ponds, the Casper Creek flows into the Hudson River, approximately 8-miles south of the site.

4.1.2 Groundwater

Groundwater beneath the FICA Landfill occurs both within laterally discontinuous sections of the unconsolidated deposits and in the bedrock. During the investigation, fourteen wells were installed to characterize the groundwater flow regime. Groundwater level measurements were collected from each of the wells on several dates. Table 4-1 provides a summary of groundwater elevations calculated from these measurements. The set of measurements collected on May 20, 1992 were used to construct a groundwater contour map (Plate 4). Hydraulic conductivity (K) tests were performed on all wells except DGC-11D during the investigation. A summary of the test results are presented on Table 4-2 and detailed test reports are provided in Appendix E.

In the relatively low lying area near the landfill, water table conditions are present in the unconsolidated deposits. Water levels in bedrock wells in this area are essentially equivalent to those in the unconsolidated deposits indicating hydraulic connection between the bedrock and the overburden.

In areas of higher elevation, the unconsolidated deposits were unsaturated and water table conditions are present in the shallow bedrock. This condition indicates that precipitation which infiltrates the unconsolidated deposits drains into the shallow bedrock where lateral groundwater flow conditions persist.

Monitoring wells were installed in the bedrock unit at ten of the eleven drilling locations. An isolated bedrock well was not installed at location DGC-3. Shallow bedrock wells were installed at depths that generally corresponded to the first water bearing fracture that was encountered during drilling. Deep bedrock wells DGC-6D and DGC-11D did not intersect fractures with appreciable amounts of water and as a result, the wells have only a few feet of water in them. The hydraulic conductivity test result of DGC-6D (2.26×10^{-9} cm/sec) further suggests the absence of secondary porosity features. A K-test could not be performed on well DGC-11D as there is only about 1 foot of water in the well. Although well DGC-2D has a static water level similar to that of DGC-2S, the K-test result (7.92×10^{-9} cm/sec) indicates that this well also did not intersect a significant number of water bearing fractures.

The K-test results of the other bedrock wells ranged from 9.44×10^{-4} cm/sec to 2.85×10^{-5} cm/sec. With the exception of well DGC-1, all of these wells are screened at relatively shallow intervals in the bedrock.

The potentiometric surface in the bedrock is approximately 15 to 25-feet below the bedrock surface in the upland areas of the site (DGC-7,8,9 and 10A). The bedrock potentiometric surface exists near to or just above the bedrock surface within the low areas around the base of the landfill which closely corresponds with the groundwater elevation of the overburden wells and the elevation of the Casper Creek.

Based on historical topographic maps and on the present elevation at the site, it is possible that up to 90 feet of municipal and C&D wastes are present above the original grade at the center of the site. Typically, municipal wastes include a heterogeneous mixture of materials which are generally less compacted than the surrounding native soils. As a result, these conditions create an area where precipitation infiltrates more readily to the underlying groundwater. It is probable, given the condition of the existing landfill cover, that increased infiltration is occurring through the waste at the FICA Landfill. Depending on the infiltration rates, and the transmissivity of the underlying bedrock unit, it is possible that mounding of groundwater as is typically encountered with municipal landfills is occurring at the base of the waste and/or in the bedrock. This potential mound will be lessened by the presence of the leachate collection system over a portion of the site.

Data obtained during the investigation indicates that the primary groundwater flow system beneath the site exists in the bedrock unit. It is expected that the northeast-southwest trending bedding plane fracture network may initially cause some preferential groundwater movement in these directions. However, hydraulic head differences across the site exert a more significant influence on the groundwater flow regime. As a result, groundwater in the bedrock generally flows in an east-southeasterly direction from the upland areas toward the Casper Creek and associated wetland. The area of increased infiltration beneath the waste is likely to affect the groundwater flow pattern and most likely has created some groundwater mounding which will impart a slight radial component to groundwater flow in the vicinity of the landfill.

Hydraulic conductivity test results suggest that a higher concentration of secondary porosity features are present in the shallow section of the bedrock. It is therefore expected that more groundwater flows through the shallow bedrock than through the deep bedrock. Based on groundwater elevations, it appears that groundwater in the shallow bedrock discharges either to the unconsolidated sediments along the east and south sides of the site or directly to the Casper Creek and associated wetland.

The groundwater flow regime for the site, as interpreted from data obtained during this investigation, is shown on the groundwater contour map, Plate 4. This plate was prepared using groundwater data from overburden, shallow bedrock and also selected deep bedrock wells. The water levels in the deep bedrock wells were used depending on the hydraulic conductivity values measured in each well. Wells which exhibited relatively high hydraulic conductivity (i.e.; 9.44×10^{-4} cm/sec to 2.85×10^{-5} cm/sec) were considered to be in the same hydrologic unit. These included wells DGC-1, DGC-2S, DGC-3, DGC-4, DGC-5, DGC-7, DGC-8, DGC-10A and DGC-11S.

Deep bedrock wells DGC-2D, DGC-6D, and DGC-9 were not used to prepare the groundwater contour map because, as indicated by their generally low hydraulic conductivity values, they apparently are not completed in the same hydrologic unit. Well DGC-11D was also not used for preparing the groundwater contour map as it also did not intersect any water bearing fractures and is therefore essentially a dry well.

5.0 ENVIRONMENTAL ANALYTICAL DATA

Two rounds of groundwater, surface water and sediment samples were collected at the FICA site. The first set of samples were collected in May 1992 and the second set was collected in October 1992. All samples collected in May 1992 were analyzed for the NYSDEC Target Compound List (TCL) organics, the Target Analyte List (TAL) inorganics and the New York State Part 360 leachate indicator parameters (aqueous samples only). The TCL organics and the TAL inorganics were analyzed following the NYSDEC ASP, CLP (September, 1989) protocols. The leachate indicator parameters were analyzed following the procedures detailed in the approved QAPP. The volatile organic analytical procedure was modified to provide lower detection limits. The modifications to the method have been detailed in the approved QAPP.

Based on the May 1992 analytical results, and with the approval of the NYSDEC, the sampling program for the October 1992 sampling event was modified, and at the request of NYSDEC, additional sediment/surface water locations were sampled.

All groundwater surface water and sediment samples collected in October, 1992 were analyzed for PCBs/Pesticides by the NYSDEC, ASP, CLP (December, 1991) procedure with full CLP deliverables and volatile organics by EPA SW-846 Method 8240 with NYSDEC category A (reporting sheets only) deliverables. The CLP PCB/Pesticide procedure was modified in order to increase the analytical sensitivity. The modification consisted of concentrating the sample extract to 1 ml instead of the standard 10 ml. The groundwater, surface water, and sediment samples were also analyzed for additional analytes. A summary of the media and the compound classes are presented below.

October 1992
Sampling Program

Media	Analytical Parameters	Analytical Methods
Groundwater	TCL Volatile Organics TAL Metals	SW-846 8240* SW-846 methods*
	Leachate Indicators Part	SW-846 methods*
	360 Baseline	
	TCL Pesticides/PCBs modified**	CLP 91-3
Surface Water/Sediments***	TCL Volatile Organics	SW-486 8240*
At Original Four Locations	TAL Metals	SW-846 methods*
SW-1/Sed-1 through SW-4/Sed-4	Leachate Indicators Part	SW-846 methods*
	360 Baseline (Water Only)	
	TCL Pesticides/PCBs modified**	CLP 91-3
	Total Organic Carbon	
	(Sediments Only)	
Surface Water/Sediments	TCL Volatile Organics	SW-846 8240*
Five Additional Locations	Leachate Indicators Part	SW-846 methods*
	360 Baseline (Water Only) modified**	CLP-91-3
	Total Organic Carbon	
	(Sediments Only)	SW-846 method*

* NYSDEC ASP (December 1991) Category A (Reporting Sheets Only) deliverables only

** Full NYSDEC ASP (December 1991) CLP deliverables. Method will be modified by concentrating extract to 1mL instead of 10mL to increase analytical sensitivity.

*** The original SW-1/Sed-1 location will be moved further upstream into the wetland.

5.1 Groundwater Analytical Results

Groundwater analytical results are summarized in Tables 5.1 through 5.5. Laboratory Form I reporting sheets and data validation reports are provided in Appendix F.

Groundwater volatile organic data are presented in Table 5.1. Review of the laboratory analytical data reveals that overall, the landfill has had a minimal impact on groundwater quality downgradient of the site with respect to volatile organics.

Methylene chloride, chloromethane and bromomethane were reported in a number of the groundwater samples collected in May, 1992. However, the reported concentrations are considered laboratory-derived and not site related and are most likely laboratory and or transport derived.

Methylene chloride was detected in all but two of the first round groundwater samples. Methylene chloride is a common laboratory contaminant and was detected in all associated laboratory method blanks and field trip blanks. USEPA data validation guidelines states that for the common laboratory contaminants, sample results less than ten times an associated blank value should be disregarded. All sample methylene chloride results were less than ten times the blank values. The reported methylene chloride groundwater results are considered laboratory derived and not site related, and are reported in the tables as "ND+.

Chlormomethane and bromomethane were detected in several of the first round groundwater monitoring well samples. However, although neither of these compounds are common laboratory contaminants, both compounds were detected in the associated laboratory method blanks and field trip blanks. USEPA validation guidelines state that for the non-common laboratory contaminants, sample results less than five times the associated blank values should be disregarded. Analytical data indicate that both chloromethane and bromomethane are laboratory derived and not site related, and are reported in the summary table as "ND+."

Compounds which exhibited concentrations which exceeded the respective NYSDEC groundwater standard in at least one downgradient monitoring well include: benzene, chlorobenzene, ethylbenzene, xylenes, vinyl chloride, 1,1-dichloroethane and chloroethane. None of the compounds or concentrations detected above the groundwater standards are inconsistent with what would be expected from an unlined landfill that accepted municipal waste.

Groundwater from monitoring well DGC-6, DGC-5, DGC-3, DGC-7, DGC-2D and DGC-6D all exhibited benzene concentrations that exceeded the groundwater standard (0.7 ug/L). However, during the October sampling event, groundwater from DGC-5 was the only sample which exhibited benzene above the groundwater standard. The May, 1992 groundwater samples from DGC-3 and DGC-5 exhibited concentrations of chlorobenzene, ethylbenzene and total xylenes that exceeded the groundwater standard of 5ug/L for each compound. Xylenes were also detected above the groundwater standard in the May 1992 DGC-2D and the DGC-6D groundwater samples. Vinyl chloride was detected in two monitoring well groundwater samples at 3ug/L, which is just above the groundwater standard of 2ug/L. In May 1992, 1,1-Dichloroethane was detected above the groundwater standard in the DGC-7 groundwater sample, as was chloroethane in the DGC-5 sample.

Acetone was detected in the May, 1992 groundwater samples from monitoring wells DGC-60B, DEC-5, DGC-3 and DGC-6D at low concentrations below the 50 ppb groundwater guidance valve for non-specified organic contaminants. Acetone was also detected in the May, 1992 groundwater samples from wells DGC-11, DGC-2S, DGC-2D and DGC-9. However, it was also detected in the trip blank associated with these samples. The acetone concentrations in the DGC-11, DGC-2S, DGC-2D and DGC-9 samples were less than ten times the trip blank valve, indicating that the reported sample results from these wells were either laboratory or transport derived and not site-related; sample results from wells DGC-11, DGC-2D, DGC-2S and DGC-9 were flagged as "ND^+" in Table 5.1. Additionally, acetone was detected in one of the laboratory matrix spike blanks associated with this data package indicating a potential for laboratory derived acetone contamination.

Although acetone was not detected in the laboratory method blank associated with samples DGC-60B, DGC-5, DGC-3 and DGC-6D, acetone is a common laboratory contaminant, and the detection of acetone in a laboratory matrix spike blank associated with the data package makes the reported acetone hits in these wells questionable.

October 1992 groundwater analytical results reveal that groundwater from monitoring wells DGC-3 and DGC-5 continue to exhibit xylene concentrations that exceeded the groundwater standard. October 1992 results revealed that chlorobenzene was detected at trace concentrations below the laboratory reporting limit in DGC-5 and DGC-3. Consistent with the May 1992 results, ethylbenzene was detected in the October 1992 DGC-3 sample, however, it was not detected in the October 1992 DGC-5 sample. The October 1992 groundwater sample from monitoring well DGC-7 exhibited 1,1-dichloroethane above the groundwater standard, which is consistent with the May 1992 data.

Acetone was detected in the October 1992 groundwater samples from monitoring wells DGC-60B, DGC-3, DGC-2D and DGC-6D. Reported concentrations were below the 50 ppb NYSDEC groundwater guidance valve for non-specified organic contaminants.

Although volatile organics were detected in several monitoring wells at concentrations which exceeded the ground water standards, concentrations were generally, with the exception of benzene and xylene, only slightly higher than the respective standard. Data indicate that the landfill has not had a significant impact on groundwater quality with respect to volatile organics.

Semi-Volatile Organics

Groundwater samples were analyzed for semi-volatile organics during the May, 1992 sampling event. Based on the May 1992 data, NYSDEC concurred with DUNN that semi-volatile organics were not a concern in site groundwater and, therefore, the October 1992 samples were not analyzed for semi-volatiles. The May 1992 semi-volatile analytical data are summarized in Table 5-2. Groundwater analytical data reveal that with the exception of estimated concentrations of 2,4-dimethylphenol (2ug/L) in groundwater from monitoring wells DGC-5 and DGC-3, no semi-volatile parameters were detected above applicable groundwater standards. The DGC-03 and DGC-05 2,4-dimethylphenol results were estimated values below the Contract Required Detection Limit, and only slightly above the groundwater standard of 1 ug/L. The groundwater standard for phenols is based on aesthetic effects. The reported values do not represent a concern. Groundwater from DGC-5 exhibited naphthalene at 13 ug/L, which is slightly above the groundwater guidance value of 10 ug/L. The semi-volatile analytical data reveal that the FICA landfill has not had an impact on the quality of groundwater with respect to semi-volatile organic compounds.

Pesticides/PCBs

Pesticide/PCB groundwater analytical results are summarized in Table 5-3.

The May 1992 groundwater sample from monitoring well DGC-5 exceeded the NYSDEC groundwater standard for Delta-BHC of non detectable. The reported concentrations were estimated and below the CRQL. Delta-BHC was not detected in the October 1992 DGC-5 sample at a reporting limit of 5 parts per trillion (ppt). In May 1992, groundwater from monitoring well DGC-2S and DGC-01 exceeded the NYSDEC groundwater standard for dieldrin of non detectable. The reported concentrations were estimated and below the CRQL. Dieldrin was not detected in the October 1992 samples from either monitoring well at a reporting limit of 10 ppt.

Heptachlor was detected in the majority of the May 1992 groundwater samples at low concentrations. However, heptachlor was also detected in the laboratory method blank at 0.014 ppb.

All samples results were less than five times the laboratory method blank value. USEPA data validation guidelines state that for non common laboratory contaminants, sample results less than five times the blank value should be disregarded. Data indicates that the reported heptachlor results are laboratory derived and not site related; sample results are reported as "ND+," in Table 5-3. The October 1992 pesticide data supports the conclusion that the May 1992 groundwater heptachlor hits were laboratory derived. Heptachlor was not detected in any of the October 1992 groundwater samples at a reporting limit of 5 ppt.

Endosulfan sulfate was detected in the May 1992 groundwater sample from monitoring well DGC-03 at a low concentration. However, endosulfan sulfate was also detected in the laboratory method blank at 0.12 ug/L. The DGC-3 result was less than five times the laboratory method blank value. USEPA data validation guidelines state that for non common laboratory contaminants, sample results less than five times the blank value should be disregarded. Data indicates that the reported DGC-3 endosulfan sulfate result was laboratory derived and not site related. Sample results are reported as "ND+," in Table 5.3. Endosulfan sulfate was not detected in the October 1992 DGC-3 sample (at a reporting limit of 10 ppt) which supports the conclusion that the May 1992 endosulfan hit was laboratory related.

Data indicates that the FICA landfill has not had a significant impact on groundwater with respect to pesticides or PCBs.

Metals/Leachate Indicator Parameters

Metals and leachate indicator analytical results are summarized in Tables 5-4 and 5-5, respectively. May 1992 analytical data reveal that groundwater from downgradient monitoring well DGC-60B exhibited concentrations of arsenic, chromium, iron, lead, manganese, sodium and zinc concentrations that exceeded the respective groundwater standards. Arsenic, iron, manganese and sodium were also elevated in the October 1992 DGC-60B groundwater sample. The May 1992 and October 1992 groundwater samples from DGC-4 and DGC-01 exhibited barium, iron, manganese and sodium concentrations that exceeded the groundwater standards. The May 1992 and October 1992 boron concentrations in groundwater from wells DGC-1, DGC-3, DGC-5, DGC-6 and DGC-2S and the October 1992 DGC-2D boron concentration exceeded the groundwater standard (1.0 mg/L).

Almost all down gradient monitoring wells exhibited manganese, iron and sodium values that exceeded the groundwater standard. However, all groundwater samples were analyzed as total matrix samples, which most likely contributed to the groundwater metals load resulting in false high concentrations not representative of actual groundwater conditions for many of the metal parameters.

Review of the field turbidity data indicates that the groundwater samples collected at the FICA landfill were extremely turbid. Total matrix samples which contain sediment can exhibit metal concentrations which are not representative of actual groundwater conditions. Suspended matter occurring in total matrix samples, usually introduced as an unavoidable artifact in sampling, is likely to have metal ions adsorbed on its surface and as an integral component of the material itself. When samples are preserved with acid prior to analysis, per standard protocol, and especially when samples are prepared in the laboratory via hot acid digestion, per standard protocol, metals will be desorbed from the matrix itself resulting in metals concentrations higher than actually occurring in the groundwater.

Data reveal that the reported iron concentrations are most likely, to some extent, related to sample sediment load. Iron is one of the most abundant elements in the earths crust. It is not unusual for groundwater samples containing entrained sediment to exhibit total matrix iron values that exceed the groundwater standard.

The May 1992 groundwater sample from upgradient monitoring well DGC-8 had a turbidity of 380 NTUs and an iron concentration of 6.1 mg/L which exceeds the groundwater standard of 0.3 mg/L. The October 1992 groundwater sample from upgradient well DGC-9 exhibited an iron value of 10 mg/L. The high levels of iron detected in upgradient locations support the observation that a percentage of the iron detected in downgradient groundwater samples is naturally derived. However, the high leachate indicator results for the downgradient monitoring wells indicate that a significant percentage of the high iron is potentially landfill related. The iron groundwater standard is based on the aesthetic effects iron has on potable water supplies (i.e. taste and staining of laundry and porcelain etc.).

Due to the high mobility and exchange capacity of sodium, sample sediment loads generally do not affect groundwater sodium concentrations. The relatively high mobility of sodium results in the desorption of sodium from the native geological material. The sodium groundwater standard (20,000 ppb) is based on the sensitivity of people with high blood pressure. Groundwater samples commonly exhibit natural sodium concentrations which exceed the groundwater standard. The reported groundwater sample sodium values do not represent an environmental or public health threat.

Reported manganese values detected in downgradient monitoring wells are potentially landfill derived. Sample sediment loads generally only exhibit a minor influence on groundwater manganese concentrations. Additionally, upgradient manganese concentrations were significantly lower than downgradient values; although the May 1992 groundwater from upgradient well DGC-8 and the October 1992 groundwater sample from DGC-8 did exhibit a manganese concentration that was slightly higher than the groundwater standard.

Data for the leachate indicator parameters reveal that groundwater from at least one monitoring well exhibited chloride, sulfate, ammonia, color, turbidity and total dissolved solids that exceeded NYSDEC groundwater standards

May 1992 groundwater from monitoring wells DGC-3, DGC-5, DGC-6OB, X-1 Dup and the October 1992 sample from chloride exhibited concentrations that exceeded the groundwater standard of 250 mg/L. Sulfate was detected at concentrations which exceeded the NYSDEC groundwater standard (250 mg/L) in the May 1992 DGC-2S groundwater sample.

Almost all the groundwater samples exceeded the NYSDEC groundwater standard for total dissolved solid (500 mg/L) color (15 cpu) and turbidity (5 NTU). However, the high turbidity is considered a function of the geological material in which the monitoring wells were installed and the nature of monitoring well construction. This is supported by turbidity values from upgradient wells which also exhibited turbidity values that exceed the groundwater standard.

May 1992 and October 1992 groundwater samples from DGC-5, DGC-60B, DGC-01 and DGC-03 exhibited elevated concentrations of ammonia, TKN and COD. The data reveal that groundwater from these wells have been impacted by landfill leachate. The May 1992 and October 1992 TKN and ammonia groundwater results from monitoring well DGC-04 reveal that groundwater in the vicinity of DGC-04 has been impacted by leachate from the landfill, but to a much lesser extent than DGC-5, DGC-60B, DGC-01 and DGC-03.

In summary, groundwater analytical data indicate that the landfill has had a limited impact on groundwater quality with respect to volatile organics, and no significant impact on groundwater quality with respect to semi-volatile organics and PCB/pesticides. Metals and wet chemical analytical data reveal that groundwater from several monitoring wells located downgradient of the landfill exhibit concentrations of iron, manganese, sodium, ammonia, chloride, and total dissolved solids that exceeded groundwater standards.

5.2 Surface Water/Sediment Analytical Data

Two rounds of surface water and sediment samples, May 1992 and October 1992, were collected at the landfill. Analytical results are summarized in Tables 5-1 through 5-6.

During the May 1992 sampling event, four surface water and four sediment samples were collected from the wetland located east of the site and were analyzed for the NYSDEC TCL organics, TAL inorganics and the NYSDEC Part 360 Baseline leachate indicator parameters (aqueous samples only).

Sample SW-4/Sed-4 was collected upgradient of the facility. SW-3/Sed-3 and SW-2/Sed-2 were collected in the wetlands adjacent to monitoring wells MW-6 and MW-3, respectively. Sample SW-1/Sed-1 were collected from Casper Creek just north of Van Wagner Road.

Based on the results of the May 1992 data, the NYSDEC requested that five additional surface water/sediment samples be collected during the October sampling event in addition to the collection of samples at the May 1992 SW-4/Sed-4, SW-3/Sed-3 and SW-2/Sed-2 locations. Additionally, NYSDEC requested that the original (May 1992) SW-1/Sed-1 sampling location be relocated further upstream and into the wetland.

The May 1992 and October 1992 sample locations are shown in Figure 5.1 Surface water and sediment samples were not collected from the new SW-4A/Sed-4A and the SW-2/Sed-2A locations because of dry conditions at the locations that NYSDEC requested the samples to be collected. The new sample locations (SW-3A/Sed-3A, SW-5/Sed-5 and SW-6/Sed-6)

were analyzed for the NYSDEC TCL volatile organics and PCB/Pesticides, the Part 360 Baseline leachate indicator parameters (surface water only) and total organic carbon (sediments only). The original (May 1992) sampling locations (SW-2/Sed-2, SW-3/Sed-3 and SW-4/Sed-4) as well as location SW-1A/Sed-1A were analyzed for the NYSDEC TAL metals in addition to the same parameters the new locations were analyzed for.

Volatile Organics

Bromomethane was detected in surface water samples SW-1, SW-3, and SW-4 collected in May 1992, at low concentrations. However, bromomethane was also detected in the trip blank at 2 ppb. All sample results were less than five times the blank value. USEPA data validation guidelines state that for non common laboratory contaminants, sample results less than five times a blank value should be disregarded. Data indicates that the reported bromomethane was transport and/or laboratory derived and not site related. Additionally, bromomethane was not detected in any of the October 1992 surface water samples, which supports the conclusion that the May 1992 bromomethane hits were laboratory derived.

Chloroethane was detected in the May 1992 surface water sample from SW-3 at 9 ppb which is an estimated concentration below the contract required detection limit. It was detected at a trace concentration less than the laboratory reporting limit (5 ppb) in the October 1992 quantitation limit.

Methylene chloride was detected in the May 1992 sediment samples Sed-1, Sed-2, Sed-3, Sed-4, and the aqueous SW-1 sample at low concentrations. However, methylene chloride was also detected in the method blank at 1 ppb. The SW-1 and all sediment raw data values were less than ten times the blank concentration. USEPA data validation guidelines state that for common laboratory contaminants sample results less than ten times a blank value should be disregarded. Data indicates that the reported methylene chloride was laboratory derived and not site related. With the exception of a trace amount below the laboratory reporting limit, methylene chloride was not detected in any of the October 1992 surface water or sediment samples. The October results support the observation that the methylene chloride detected in the May 1992 surface water and sediment sample was laboratory derived and not site-related.

Acetone was detected in the May 1992 SW-2 and SW-3 surface water samples and the May 1992 Sed-2, Sed-3 and Sed-4 sediment samples at low concentrations. Acetone was not detected in the method blank or the transportation blank associated with these samples. However, it was detected in a trip blank associated with this package that was sent the previous day, and in a matrix spike blank sample associated with the data package, indicating the acetone value may be transportation and/or laboratory derived. The acetone values for SW-2 and SW-3 and the sediment samples are estimated values, less than the specified quantitation limit and less than the 50 ppb guidance value for non specified organic compounds.

The October 1992 surface water samples from locations SW-1A, SW-2, SW-3 and SW-3A exhibited acetone concentrations that were less than the NYSDEC 50 ppb groundwater guidance value for non-specified organic contaminants. Acetone was detected in the October 1992 sediment samples from downgradient locations Sed-2, Sed-3, Sed-1A, Sed-5 and Sed-6 and upgradient location Sed-4.

During both the May 1992 and the October 1992 sampling event, acetone was detected in the upgradient sediment sample (Sed-4) at concentrations that were comparable to the downgradient sample concentrations. Additionally, the most downgradient sample (Sed-1, May 1992; Sed-1A, October 1992) exhibited acetone concentrations that were significantly lower than the upgradient values.

In summary, volatile organic analytical results indicate that the FICA Landfill has not had a significant impact on wetland surface water or sediments with respect to volatile organics.

Semi-Volatile Organics

Semi-volatile organics wee collected from the surface water/sediments only during the May 1992 sampling event. Based on the May 1992 results, NYSDEC concurred that semi-volatile organics were not a concern and that semi-volatile organic analysis of the October samples was not required. No semi-volatile organics were detected in any surface water sample at concentrations above NYSDEC surface water standards.

Sediment semi-volatile data reveal several PAH compounds were detected in samples Sed-1, Sed-2, Sed-3 and upgradient sample Sed-4. However, no sediment sample exhibited PAH values that were elevated with respect to both the upgradient value and NYSDEC sediment criteria guidelines for the protection of aquatic life. Analytical data indicate that surface water and sediments in the wetland east of the site have not been significantly impacted with respect to semi-volatile organics.

Pesticide/PCBs

Surface water pesticide/PCB results are summarized in Table 5-3. Except for heptachlor and endosulfan sulfate all other pesticide compounds were non detectable in the May 1992 surface water samples. Heptachlor was detected in surface water sample SW-1 at a low concentration. However, heptachlor was also detected in the laboratory method blank at 0.014 ppb. All sample results were less than five times the laboratory method blank value. USEPA data validation guidelines state that for non common laboratory contaminant, sample results less than five times the blank value should be disregarded. Data indicate that the reported heptachlor result was laboratory derived and not site related; sample results in Table 5-3 are reported as "ND+.".

Endosulfan sulfate was detected in the May 1992 SW-3 surface water sample at a low concentration. However, endosulfan sulfate was also detected in the laboratory method blank at 0.12 ppb. All sample results were less than five times the laboratory method blank value. USEPA data validation guidelines state that for non common laboratory contaminant, sample results less than five times the blank value should be disregarded. Data indicate that the reported endosulfan sulfate result was laboratory derived and not site related; sample results in Table 5-3 are reported as "ND+."

With the exception of SW-3A no pesticides were detected in any of the surface water samples collected in October 1992. The October 1992 surface water analytical results support the observation that the heptachlor and endosulfan detected in the May 1992 surface water samples was laboratory derived and not site-related.

Sample SW-3A (October 1992) exhibited low level concentrations of 4,4'-DDE (0.01ug/L); methoxychlor (0.00066J ug/L), alpha chlordane (0.0016J ug/L) and 4,4-DDD (0.0022J ug/L); the methoxychlor, chlordane and 4,4-DDD values were estimated concentrations below the laboratory reporting limit but above the instrument detection limit.

The reported methoxychlor concentration in SW-3A is below the NYSDEC surface water standard for protection of aquatic life with respect to propagation. The 4,4'-DDE concentration is above the NYSDEC surface water standard (0.001 ug/L) for protection of wildlife with respect to bioaccumulation associated with the consumption of aquatic life/wildlife. However, the SW-3A 4,4'-DDE value is below the aquatic toxicity criteria concentration (<0.05 ug/L) reported in the NYSDEC, Division of Fish and Wildlife Sediment Criteria Document (December 18, 1989). The SW-3A 4,4-DDD concentration is just above the NYSDEC surface water standard (0.001 ug/L), but is below the aquatic toxicity value reported in the December 1989,) Sediment Criteria document. The SW-3A chlordane concentration is below both the NYSDEC aquatic toxicity value criteria (0.01 ug/L) Sediment Criteria Document (December 1989) and the USEPA water quality concentration for protection of wildlife with respect to chronic toxicity (0.17 ug/L). There is no NYSDEC surface water standard for chlordane, however, there is a guidance value of 0.002 ug/L based on human consumption of fish. The SW-3A chlordane value (0.0016 ug/L) is below this guidance value.

In summary, the May 1992 and October 1992 surface water analytical results indicate that the Fica Landfill has not significantly impacted surface water quality in the wetland east of the site with respect to pesticides/PCBs.

Sediment pesticide/PCB results are presented in Table 5-6 and are compared to the USEPA Interim Sediment Criteria Values (May 1988) and the NYSDEC Sediment Criteria (December 1989) assuming an average wetland sediment total organic carbon content of 4.29 percent. The average total organic carbon content of the wetland sediments is based on the total organic carbon analysis of seven wetland sediment samples. The sediment criteria values are based on either wildlife residue criteria or aquatic toxicity. The wildlife residue criteria are based on the accumulation of chemicals in aquatic life to levels that would be harmful to wildlife consumers of the aquatic life. Where available, the criteria for both the aquatic toxicity and wildlife residue are included in the table.

With the exception of heptachlor epoxide, methoxychlor, alpha chlordane, gamma chlordane and PCBs in sample Sed-3, alpha chlordane in sample Sed-2 and PCBs in sample

Sed-1A, all pesticide sample results were below the USEPA and NYSDEC sediment criteria guidance values.

The heptachlor epoxide (1.63 ug/kg) and methoxychlor (31 ug/kg) concentrations reported in the May 1992 Sed-3 sediment sample, were only slightly higher than the sediment criteria guidance values (Heptachlor epoxide, 1.29 ug/kg; Methoxychlor, 25.74 ug/kg). Additionally, neither parameter was detected in the October 1992 Sed-3 sediment sample. The alpha chlordane detected in the May 1992 sediment Sed-2 sample was not detected in the October 1992 sample, and the gamma chlordane and PCBs detected in the October 1992 sediment Sed-3 sample were not detected in the May 1992 sample. In order to provide additional information on the distribution of pesticides in wetland PK-13, samples from locations Sed-3A, Sed-5 and Sed-6 were collected in October 1992 in addition to the original May 1992 sample locations.

Sediment sample Sed-3A was collected (October 1992) approximately 100 feet east of sample location Sed-3. Samples Sed-5 and Sed-6 were collected approximately 300 feet and four hundred feet south of location Sed-3, respectively. The proposed SW-6/Sed-6 location, 100 feet east of SW-5/Sed-5, was dry, therefore, the location was moved 100 feet south of location SW-5/Sed-5.

Analytical results reveal that with the exception of 4,4'-DDE and 4,4'-DDD, no pesticides/PCBs were detected in Sed-3A, Sed-5 and Sed-6 samples. The 4,4'-DDE and 4,4'-DDD sample concentrations in all three samples were below the NYSDEC sediment criteria. The 4,4'-DDD concentrations in all downgradient samples were less than the concentration detected in the May 1992 upgradient Sed-4 sample.

There is an abandoned commercial apple orchard located upgradient and within 700 feet of wetland PK-13. This orchard is located upgradient of the FICA landfill. Historically, fruit orchards used lead arsenate and organochlorine pesticides (including DDT, DDD, dieldrin, endosulfan and endrin) as insecticides. The apple orchards located upgradient of the site represent a probable source of many of the pesticides detected in PK-13.

In summary, the absence of elevated pesticides/PCBs concentrations in the majority of the sediment samples from wetland PK-13, indicates that the pesticides/PCBs do not represent a major threat to either the ecology of wetland PK-13 or the surrounding areas. Pesticide concentrations were either comparable to the NYSDEC/EPA sediment criteria guidance values, or if greater than the criteria, were only detected in a limited number of samples.

Metals

With the exceptions of iron, magnesium, sodium, nickel and manganese, all May 1992 and October 1992 metal results were below any applicable surface water standards that are based on water supply standards. Since surface water in the wetland/Casper Creek is not used as a source of drinking water these standards are not considered applicable. Surface water does not represent a drinking water pathway.

Iron was detected in all May 1992 and October 1992 surface water samples at concentrations that exceeded the surface water standard for protection of aquatic life. Even though the upgradient sample SW-4 exceeded the surface water standard, the surface water samples from SW-2 and SW-3 were considerable higher than SW-4. Iron results in SW-2 and SW-3 are considered, to some extent, facility derived. The May SW-1 iron value was only slightly higher than the surface water standard and the October 1992 SW-1A iron value was less than the October 1992 upgradient SW-4 concentration.

Surface water from samples SW-2 and SW-3 exceeded the human surface water standard for sodium (20,000 ppb), magnesium (35,000 ppb), manganese, (300 ppb) and nickel (13 ppb). The October 1992 SW-1A manganese concentration exceeded the surface water standard but was less than the October 1992 upgradient SW-4 manganese value.

Zinc was detected in May 1992 surface water samples SW-2, SW-1 and SW-Dup (dup of SW-1) at a concentration that exceeded the surface water standard for aquatic life (30 ppb). However, zinc was detected in the upgradient sample SW-4 at 29.0 ppb indicating that the zinc results in SW-2, SW-1 and SW-Dup are naturally derived and not site related. Additionally, zinc was not detected in the October 1992 surface water samples.

Ammonia was detected in May 1992 surface water samples SW-1, SW-2, SW-3 and SW-4 at a concentration that exceeded the surface water standard for aquatic life. Although the upgradient sample SW-4 exceeded the aquatic related standard for ammonia, the SW-2 and SW-3 ammonia results were significantly higher than SW-4. The ammonia results for SW-2 and SW-3 are considered facility related. The October 1992 SW-3 ammonia concentration was consistent with the May 1992 SW-3 concentration. Ammonia was not detected in the SW-1A and SW-2 October 1992 surface water samples. The October SW-3A sample exhibited ammonia concentrations that exceeded the surface water standard. Ammonia was not detected in the October 1992 SW-6 and SW-5 surface water samples. Leachate indicator parameter results indicate that any leachate impact to the wetland is limited primarily to the area in the vicinity of SW-3/SW-3A.

The May 1992 SW-2 surface water chloride concentration was detected at the surface water standard for chloride (250 ppm). Sulfate was detected in surface water sample SW-2 at a concentration that exceed the human surface water standard (250 ppm). The May 1992 surface water samples from locations SW-2 and SW-3 exceeded the NYSDEC aquatic propagation based surface water standard for cobalt (5 ug/L). However, cobalt was not detected in the October 1992 samples collected at these locations.

Comparison of downgradient May 1992 sediment sample metal results to upgradient values reveals that sediment sample Sed-3 exhibited barium, cadmium, chromium, copper, magnesium, manganese, nickel and zinc values that were elevated to the upgradient Sed-4 sample. The May 1992 sediment samples Sed-1 and Sed-2 exhibited magnesium and manganese, and Sed-2 zinc values that were elevated with respect to upgradient Sed-4.

However, the October 1992 Sed-1 and Sed-2 magnesium and manganese values were less than the October downgradient Sed-4.

In summary, wetland surface water and sediment analytical data reveal that the landfill has not significantly impacted the wetland with respect to volatile organics, and semi-volatile organics. Several metals were detected in downgradient surface water and sediment samples at concentrations which were elevated with respect to upgradient. Leachate indicator parameters (ammonia, hardness, COD, and TOC) indicate that leachate from the landfill has impacted surface water quality, primarily in the area of SW-3/SW-3A. Sediment sample Sed-3 exhibited pesticide compounds at concentrations greater than the NYSDEC guidelines for protection of aquatic life, as were PCBs in sediment samples Sed-3 and Sed-1A. The sediment data generally indicate that sediment contamination is limited primarily to the area in the vicinity of Sed-3.

5.3 Sub-Surface Soil Samples

Analytical results for sub-surface soil samples collected during the monitoring well installation program are presented in Tables 5-7 and 5-8.

Sub-surface volatile organic data are summarized in Table 5-7. Data reveal that although several volatile organic compounds were detected typically on an occasional basis, none of the concentrations are considered to represent a concern. Concentrations were below clean-up guidelines that have been typically used throughout New York State.

Methylene chloride and acetone were detected in the majority of soil samples at low concentrations. However, methylene chloride is a common laboratory contaminant and was detected in both the laboratory method blank and trip blank at concentrations greater than 10 times their associated samples (before dilutions for percent solids corrections). USEPA data validation guidelines state that for common laboratory contaminants, samples less than ten times the blank valve should be disregarded. Data indicates that the reported methylene chloride results are either laboratory or transportation derived or both.

Sub-surface soil data reveal that no semi-volatile organic or PCB/pesticide parameters were detected at or above the laboratory reporting limit in any sub-surface soil sample.

Sub-surface metals analytical data are summarized in Table 5-8. Currently, NYSDEC has not established standards for metals in soils. However, comparison of metals results to natural background values reported in the literature and upgradient samples (DGC-8, -9 and -10) reveal that generally, metals were not elevated in sub-surface soil samples. Exceptions include barium, calcium and potassium in DGC-6 when compared to upgradient samples, and manganese in DGC-1 and DGC-5. With the exception of the manganese results, none of these parameters were significantly elevated with respect to natural background concentrations reported in the literature.

In summary, sub-surface soil data do not indicate any significant impact resulting from the landfill.

6.0 FATE AND TRANSPORT

The previous section summarized the distribution of contaminants for groundwater, subsurface soil, surface water and sediment. Based on the observed distribution of contamination and the low permeable nature of subsurface soils, the potential for migration exists in the groundwater, surface water and sediment media. As such the migration pathways and fate of the contaminants in each pathway need to be evaluated.

The Revised Work Plan for the FICA Landfill (Site) indicated that a quantitative baseline risk assessment will be prepared as part of the RIFS. The baseline risk assessment would provide an estimate of potential Site risks under the "no action alternative". However, as part of an Interim Remedial measure (IRM) at the Site, significant amounts of clean fill have been used to cover the landfill to prepare it for final capping. In effect, implementation of the IRM will result in Site conditions which would make any quantitative baseline risk assessment unrealistic and meaningless for future planning efforts. For this reason, a baseline risk assessment based on current data would serve no purpose and would only result in extremely overstated potential health risks. A risk assessment following full implementation of the IRM will have more value.

One step in any risk assessment is the "exposure assessment". The exposure assessment evaluates the locations, sources and types of environmental constituents, along with the population locations and activity patterns to determine what, if any, significant pathways of human exposure are viable. As outlined by the USEPA (Risk Assessment Guidance for Superfund, Volume 1 - Human Health Evaluation Manual, Part A, 1989), an exposure pathway generally consists of four elements:

- a source and mechanism of chemical release,
- a retention and transport medium (media),
- a point of potential human contact with the impacted media, and

- an exposure route at the contact point.

In order for an exposure pathway to be complete, all four of the above criteria must be met. The media of concern at the Site include soil, groundwater, and surface water and sediment.

By placing clean fill and a cover system over the soils and waste materials of concern on the Site, these soils and wastes will be at significant depth and unavailable for direct contact by individuals who may be present on the Site. Inhalation exposures due to the volatilization of contaminants into the air, or the generation of particulate aerosols from these soils of concern also can not occur. In addition, there currently exists a public water supply in the immediate vicinity of the site, however, some private residential wells are located within one half mile of the site. These wells have been tested by the NYSDOH and no contamination was detected. Therefore, the soil and groundwater pathways are not considered to be complete since an exposure contact point cannot be established. The surface water and sediment are the only media whereby potential human exposures may occur.

Preliminary evaluation of the sediment and surface water data collected during the RI indicate only low levels of some volatile organic chemicals (e.g., acetone, 2-butanone, toluene), semi-volatile organics (e.g., fluoranthene, benzo(a)pyrene), and inorganics (e.g., antimony, copper, magnesium, manganese). Based on the concentrations of these chemicals, their environmental fate, the conditions at the Site, potential human exposure pathways, and the interim remedial measures taken, it is not expected that the presence of these constituents presents a significant threat to human health. A full "baseline" risk assessment has not yet been completed. The appropriate time to complete such an assessment is at the completion of the IRM.

7.0 HABITAT ASSESSMENT

This section presents the findings of the Fish and Wildlife Impact Analysis (FWIA) of the FICA Landfill Site. A Step I site description and a Step II pathway/exposure analysis were performed and the results are presented in the following sections.

7.1 Step I Site Description

The objective of the Step I analysis is to identify the fish and wildlife resources that exist in the vicinity of the site which could potentially be affected by site related contaminants. This baseline analysis includes descriptions of the vegetative habitats, land use, fish and wildlife resources, value of the habitats to fish and wildlife, and the value of the resources to humans. Additionally, applicable fish and wildlife regulatory criteria are presented.

7.1.1 Landuse/Major Vegetative Communities Within One-half Mile of the Site

A covertype map detailing the major landuse/vegetative habitats or covertypes located within one-half mile of the site is presented in Figure 7.1. The covertype map was prepared through the evaluation/interpretation of aerial photographs and topographic maps, followed by field checking for accuracy. The base map was prepared from aerial photographs. The covertype classifications were performed using a combination of the New York Natural Heritage Program Classification System (NHPCS, Reschke, 1990) and the U.S. Geological Survey Classification System (Anderson, 1976).

Where access during field inspection of the covertype map was possible, the dominant vegetation in each covertype was identified for areas classified as terrestial natural (TN) and Palustrine (P). The determination of dominance was qualitative, based on visual estimation. Vegetative plots and transects were not used in determining dominance. These methods are beyond the scope of a Step I analysis.

The land use within one-half mile of the site is a mixture of agricultural, residential, undeveloped natural areas and abandoned agricultural fields. Natural areas identified as

TN or P and that are identified with a number on the covertype map were accessible during the field checking of the map. The areas not numbered were either similar in nature to other areas or access to these areas was not available. The numbers within each area correspond to the numbers and vegetative descriptions presented in Table 7.1.

There is a significant quantity of undeveloped natural habitat located within one-half mile of the site. The types of habitats/vegetative communities include deciduous forest, forested wetlands, emergent wetlands, successional old fields and riparian habitat.

An NYSDEC Class II Regulated Freshwater Wetland, PK-13, is located adjacent to and east/northeast of the site. Using the U.S. Fish and Wildlife Service (USFWS) classification criteria (Cowardin), Wetland PK-13 would primarily be considered a broad-leaved deciduous forested wetland. The majority of the wetland is forested, however, there is an area of emergent marsh approximately 2.5 acres in size located east of the landfill. A small creek (Casper Creek) meanders through and drains wetland PK-13. The creek in the vicinity of the site, at the time of the field truthing of the covertype map, was approximately two to three feet wide and one to two feet deep. However, in the spring, Casper Creek most likely carries considerably more water and floods the surrounding wetland. The dominant vegetative species in the forested parts of wetland PK-13 are red maple (Acer rubrum), American elm (Ulmus americana), swamp and white oak (Quercus bicolor, Quercus alba) in the overstory and common winterberry (Ilex verticillata) in the understory. The emergent marsh section of PK-13 is principally a dense stand of purple loosestrife and some silky dogwood.

Casper Creek flows south-southwest from PK-13 into NYSDEC wetland PK-5, a Class II wetland. Wetland PK-5 is principally a scrub shrub swamp following the U.S.F.W.S. Classification System. However, there are areas of emergent marsh and open water habitat within this wetland. The principle vegetative species in this are purple loosestrife, dogwood spp (Cornus spp), common winterberry, alder spp (Alnus spp) and common cattail (Typha latifolia).

The areas adjacent to and north and west of the site are successional shrub fields. The principle vegetative species in the field north of the site are common juniper (Juniperus communis), honeysuckle spp (Lonicera spp) and multi-flora rose (Rosa multiflora). The successional shrub field located adjacent to and west of the site contains common juniper, hawthorn spp (Crataegus spp), gray birch (Betula populifolia) and goldenrod spp (Solidago spp).

Within one-half mile of the site there are several tracts of deciduous forest. These are located south, west and northeast of the site. There are a series of emergent wetlands connected by a stream located west of the site which are regulated by NYSDEC as Freshwater Wetland PK-12. There is also one forested wetland located west of the site and a larger forested wetland northwest of the site which are not NYSDEC regulated wetlands. The vegetation present in these and other natural areas located within one-half mile of the site are presented in Table 5-1.

There is an apple orchard located approximately 2,000 feet north of the site that is no longer maintained or used for commercial purposes. However, the orchard has only recently been abandoned and the apple trees are still the dominant overstory species and produce large quantities of fruit. The understory in the orchards are grass spp. and various herbaceous species.

7.1.2 Wetlands Within One-Half Mile and Two Miles of the Site

There are three NYSDEC regulated wetlands located within one-half mile of the site. Plate 6 depicts the location of these wetlands in relation to the site. Plate 6 also shows the location of all NYSDEC regulated wetlands within a two mile radius of the site and any other significant resources.

The three NYSDEC wetlands located within one-half mile of the site are PK-13, PK-12 and PK-5 The location of these three wetlands have been discussed in the preceding section; all three have been classified by NYSDEC as Class II wetlands. NYSDEC wetland PK-13 is principally a broad-leaved deciduous forested wetland with one area of emergent wetland. Wetland PK-5 is primarily a scrub shrub wetland with areas of emergent vegetation and an associated pond. Wetland PK-12 is composed of emergent wetlands connected by a stream.

Other NYSDEC regulated wetlands located within a two mile radius of the site and their respective classifications are listed below. These wetlands are located either upgradient and/or at such a distance from the site that any impact from the site is unlikely.

PK-4	Class I
PK-3	Class II
PK-7	Class II
PK-2	Class II
HP-27	Class II
PV-60	Class III
PV-2	Class II
PV-65	Class II
PK-16	Class II

7.1.3 Streams Within One-Half and Two Miles of the Site

There are three NYSDEC classified streams located within two miles of the site: Wappinger Creek, Class B(t); Casper Creek, Class D; and Fall Kill, Class C. Casper Creek is the only one located within one-half mile of the site.

Casper Creek is located adjacent to and on the east side of the site. It flows in a southerly direction and is a tributary of the Hudson River. Casper Creek flows into and out of wetland PK-13. It is a Class D stream. NYSDEC defines a Class D stream as having water quality suitable for fish survival. However, due to such natural conditions as intermittency of flow, water conditions not conducive to game fish propagation or stream bed conditions, these streams will not support fish propagation. The waters are defined as suitable for primary and secondary contact recreation, however, other factors may limit their use for such purposes.

Fall Kill is a Class C stream located approximately 5,200 feet northwest of the site. The stream is located upgradient of the site and would not be affected by site activities.

Wappinger Creek is located approximately 6,200 feet southeast of the site and would not be expected to be impacted by site contaminants. It is a Class B(t) stream. The water quality in Class B streams is defined as suitable for primary and secondary contact recreation and for the propagation and survival of fish. The (t) denotes that the stream is suitable for the propagation and survival of trout species.

7.2 Resource Characterization Within One-half and Two Miles of the Site

Resource characterization consists of determining the wildlife species that may potentially utilize the habitats identified in the previous sections as existing within one half-mile of the site and any significant species or habitats that may exist within two miles of the site. Additionally, the general quality of the habitat in providing for the needs of the organisms, any areas of observed vegetative stress, leachate seeps, fish and/or wildlife mortality and any known wildlife population impacts related to site contaminants are discussed.

7.2.1 Endangered, Threatened or Special Concern Fish and Wildlife Species or Significant Habitats

The USFWS, the NYSDEC Wildlife Resources Center and the NYSDEC Region 3 Office were contacted regarding the known occurrence of endangered, threatened or special concern species or habitats located with a two mile radius of the site. The USFWS stated that there were no federally listed species of concern that were known to exist within a two mile radius of the site. However, the NYSDEC significant habitat unit stated that the Blanding's Turtle (Emydoidea blandingii), a threatened species in New York State, has historically been observed in the vicinity of the site.

There have been three documented observations of the Blanding's Turtle within a two mile radius of the site. The approximate locations of these observations are presented in Plate 6. Two of these observations were associated with wetland PK-13 and Casper Creek. The third observation was located in wetland PK-4, a Class I wetland located approximately 3,000 feet west of the site. The most recent observation was in 1985 from the area between PK-13 and PK-5.

A species is considered threatened in New York State if it is a native species that is likely to become endangered in the foreseeable future. The Blanding's Turtle is classified as S2 by the Natural Heritage Program. The S2 classification indicates that there are typically only 6 to 20 observations, few remaining individuals or other factors which make the species very vulnerable in New York State. Although the Blanding's Turtle is listed as threatened in New York State, it is not considered threatened by the USFWS. It is classified as G4 by the Natural Heritage Program, indicating that the species is secure globally, though it may be rare in parts of its range, especially at the periphery. In New York State the species is known to occur in three counties: Dutchess, Jefferson and St. Lawrence. The Dutchess County populations are disjuncted and outside the species' primary range. In New York State the Blanding's Turtle range is primarily in the Saint Lawrence River Valley. In Dutchess County, habitat loss due to development pressure is a major concern.

The Blanding's Turtle is an omnivore. It feeds primarily on invertebrates, crustaceans and fish in aquatic habitats and plant matter on land.

The Blanding's Turtle preferred non-breeding habitat is shall slow moving waters and shallow wetlands (marshes, bogs, small ponds) with aquatic vegetation, soft substrates and emergent features (logs, stumps, etc.) for basking. Eggs are generally laid in sandy soil in upland areas. Movement from wetland to wetland across upland habitat in search of nesting sites or hibernation sites is not unusual.

The three New York State regulated wetlands located within a half mile of the site do contain habitat that would appear to be suitable to the Blanding's Turtle. Although wetland PK-13 located adjacent to the landfill is principally a forested wetland, it does contain areas that would be considered suitable habitat. Wetland PK-5 located just south of the site most likely represents a higher quality habitat. However, A detailed habitat evaluation was not performed and is beyond the scope of a Step One baseline assessment.

7.2.2 Fish and Wildlife Species Potentially Using Habitats Within a Oneh-Half Mile Radius of the Site.

Mammals/amphibians, bird and fish species, that could potentially utilize the habitats within one-half mile of the site, for at least a portion of their life cycle are listed in Tables 7.2, 7.3 and 7.4, respectively. These lists are not meant to indicate that these species can always be found, or that all will be present at one time within one-half mile of the site. These lists were prepared following a limited field evaluatioin of habitats within one-half mile of the site and a review of available literature. Also, these lists are not the result of a site specific population survey. Actual population surveys are very complex and time intensive, and are beyond the scope of a Step One baseline evaluation.

Many wildlife species are very mobile and generally require a wide range of habitat types to meet their life cycle requirements. In addition, many species will only use the area within one-half mile of the site for a portion of their life requisites. Thus, all the species identified on these lists were not actually observed within one-half mile of the site.

During field checking of the covertype map the species listed below were directly observed within one-half mile of the 1

- White-tailed deer
- Ruffed grouse
- American crow
- Blue jay
- Red-tailed hawk
- Black-capped chickadee
- White-breasted nut hatch
- Downy woodpecker
- Eastern cotton-tail

7.2.3 General Habitat Quality Within One-Half Mile of the Site

The landuse/habitats within one-half mile of the site are a combination of residential, natural, limited agricultural and industrial/commercial. The following text describes the general quality of the different habitat types to wildlife.

There are numerous residential home and industrial/commercial businesses scattered within a half mile-radius of the site. Habitats available to wildlife within the cultivated areas associated with these areas is limited. The number of species utilizing these areas is limited to those adjusted to survival in close proximity to man, species that require small habitats for their life requisites and/or species that are highly mobile. Such speicies would include small birds (American Robin, sparrows, etc.) and small mammals (Eastern cotton tails, moles, Eastern gray squirrels, etc.). Generally, these habitats would be of marginal quality for other species. However, many of these areas are located in a rural setting, near or adjacent to habitats that would support larger and more diverse populations of wildlife.

There would be significant opportunities for the observation of wildlife associated with the residential areas.

In general, the undeveloped habitats located within a half mile radius of the site represent high quality wildlife habitats. The wetland areas are interspersed with successional fields and upland deciduous forest habitats. The juxtaposition of these habitats to one another provide a considerable amount of variety in habitat and a large amount of edge habitat. The deciduous forest areas are large enough to provide quality habitat for white-tailed deer. The presence of the wetlands and old fields in relation to the forested areas increase over all value of the habitats to white-tail deer, ruffed grouse, song birds and a variety of other species.

The successional field respresent quality habitat for species such as the Eastern cotton-tail which generally thrive best in early successional habitats. The old fields also represent feeding, resting and nesting ares for a variety of other mammals and birds.

Wetland PK-5 and wetland PK-12 most likely represent quality habitat for waterfowl, although the relatively small size of these wetlands would limit the number of birds using the areas. Both wetlands contain areas of open water and aquatic vegetation. Wetland PK-5 is adjacent to old field habitat which would potentially be utilized by waterfowl, such as the mallard, for nesting.

Wetland PK-13 located adjacent to the east of the landfill is most likely not good quality waterfowl habitat. With the exception of a brief period in the spring, the majority of the forested wetland is most likely not significantly flooded. Although there is an area of emergent vegetation adjacent to the site, it principally is vegetated by a dense stand of purple loosestrife which considerably reduces the value of the area to waterfowl. Waterfowl such as wood duck which feed on acorns would potentially utilize the forested wetland area for feeding.

Wetland PK-13 does represent quality habitat for white-tailed deer, gray squirrels, ruffed grouse and other species which would utilize the oaks and winterberry present in the wetland as a food source. As stated in the preceding section, wetlands PK-13, PK-12 and PK-5 do represent potential habitat for the Blanding's turtle.

Leachate outbreaks, characterized by the reddish orange color have been observed along the west side of wetland PK-13 adjacent to the landfill. The leachate most likely contains elevated ammonia concentrations considering the elevated levels detected in ground water monitoring wells in the area. Ammonia is toxic to aquatic life at concentrations less than what would be expected in the landfill leachate. However, ammonia would be expected to rapidly dissipate in the wetland environment to nontoxic concentrations. There has most likely been a localized impact on the aquatic life in the wetland in the vicinity of any leachate outbreaks. However, any impacts would most likely be localized to the area of the leachate and the impacted area would revert back to a normal state upon discontinuation of the leachate seep.

No areas of stressed vegetation were observed in the vicinity of the site during the field survey. However, the field survey was performed in December when observation of stressed vegetation would be difficult. However, there have been no reports of stressed vegetation at the site by other field personnel who have been at the site during the growing season.

DUNN has submitted a letter to the NYSDEC Wildlife Pathology Unit requesting information on known occurrences of wildlife mortality within a two mile radius of the site. No response has been received and it is assumed that there are no known cases. Additionally, no signs of stressed vegetation that could be attributed to site contaminants were observed.

7.2.4 Use of Natural Resources Within One-Half Mile of the Site by Humans

The habitats/wildlife located within one-half mile of the site would provide recreational opportunities for hunting, photography and observation of wildlife as well as limited fishing.

The old fields located within one-half mile of the site were most likely at one time used for agricultural purposes, as were the abandoned apple orchards, and could potentially be converted back to agricultural uses. Many of the old fields/agricultural fields have been and will most likely continue to be developed into residential homes, which reduces the value of the area to wildlife and associated recreational activities. The upland forested areas and the deciduous swamps subject to wetland regulation restrictions could be used for logging.

7.3 Applicable Fish and Wildlife Regulatory Criteria

The appropriate SCGs that may potentially be applicable to the site will be partially dependent on the selected remedial alternative (if any). This section presents the fish and wildlife SCGs that should be considered. SCGs will be further discussed in the Feasibility Report for the site.

Fish and wildlife related SCGs that may be applicable to the site are presented below:

- Clean Water Act, 233 U.S.C. 1261 et sea. Sec 404 regulates the discharge of pollutants, including dredged of fill materials into wetlands and other water bodies. Clean Water Act, 233 U.S.C. 1261 et seq. Sec 404 regulates the discharge of pollutants, including dredged of fill materials into wetlands and other water bodies.

- The Freshwater Wetlands Act (Article 24 of the Environmental Conservation Law) and the Freshwater Wetlands Implementing Regulations (6 NYCRR

Part 663 and 664) are designed to protect wetlands. Only wetlands that have been mapped by the State of New York are regulated.

- New York State Surface Water and Groundwater Standards, Title 6 Chapter 10 Part 700-703 NYCRR.

- Executive Order 11990, Protection of Wetlands - this order recognizes the value of wetlands and directs federal agencies to minimize the degradation, destruction and loss of wetlands.

- Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.)

- Fish and Wildlife Coordination Act.

7.4 Pathway/Exposure Evaluation

This section evaluates the potential for wildlife exposure to site related contaminants. This evaluation includes identification of habitats which could potentially be impacted by site related contaminants and the identification of possible food chain contamination pathways. The magnitude and significance of any potential exposure is dependent upon site chemistry, the extent of contamination and the landuse/habitats located near the site. Additionally, habitat quality and utilization and the extent/duration of exposure, are important factors in evaluating the significance of any impact the site may have on the ecosystems.

The habitat area with the greatest potential to be impacted by site related contaminants and therefore, a potential area for wildlife exposure to site related contaminants, is the wetland habitats associated with wetlands PK-13 and potentially PK-5 if PK-13 exhibited elevated chemical concentrations.

Surface water and sediment samples were collected from wetland PK-13 during two separate sampling events; May 1992 and October 1992. Analytical results from these events have been previously discussed in Section 5; data are summarized in Tables 5.1 through 5.6.

Review of the surface water and sediment data reveals that neither media in wetland PK-13 have been significantly impacted. Data indicate that site related contaminants have most likely not reached PK-5.

Surface water and sediment volatile organic results presented in Table 5-1 reveal that low concentration of acetone in several surface water and sediment samples, low concentrations of 2-butanone and toluene in the May 1992 Sed-3 sample, and no volatile organics were detected in the surface water sediment samples.

Semi-volatile organic results presented in Table 5-2 reveal that no semi-volatile parameters related to the landfill were detected in any surface water sample. Two sediment samples Sed-3 and Sed-1 exhibited low concentrations of several polynuclear aromatic hydrocarbons (PAH). However, all sample results were below the USEPA sediment criteria based on aquatic toxicity. Data indicate that surface water and sediments in wetland PK-13 have not been impacted by semi-volatile organic compounds.

Surface water and sediment pesticide/PCB analytical results are summarized in Tables 5-3 and 5-6, respectively. With the exception of the October 1992 SW-3A sample, pesticides and PCBs were not detected in any surface water sample. Comparison of the pesticide concentrations detected in SW-3A to surface water standards for protection of aquatic life reveal that the concentrations detected in SW-3A do not represent a significant threat. Review of the sediment pesticide/PCB data reveals that generally, pesticide/PCB concentrations were below applicable sediment criteria guidance values. The exceptions are PCBs in the October Sed-3 and Sed-1A samples and chlordane in the May Sed-2 sample and the May and October Sed-3 sample. The absence of elevated pesticides/PCB concentrations in the majority of the sediment samples from wetland PK-13 indicates that these compounds do not represent a significant threat to the ecology of the wetland or the surrounding habitats. Surface water and sediment pesticide/PCB concentrations are further discussed in Section 5.2.

Surface water and sediment metals and wet chemical analytical data are summarized in Tables 5-4 and 5-5. Metals data reveals that surface water samples SW-2 and SW-3 exhibited iron values that exceeded the surface water standard and that samples SW-3 and SW-3a and to a lesser extent SW-2 exhibited elevated leachate indicator parameter concentrations. Sediment sample metal results revealed that sample Sed-3 and to a lesser extent Sed-2 exhibited metal concentrations that were slightly elevated with respect to the upgradient Sed-4 values. Generally the metal/wet chemical data do not indicate a significant impact to the wetland. Elevated concentrations are generally restricted to the SW-3 area. Data are further discussed in Section 5.2.

In summary, chemical data indicate that the wetland PK-13, the habitat most likely to be impacted by site related contaminants, has not been significantly impacted. Data indicate that a Step II Fish and Wildlife Impact Analysis is not required.

8.0 REMEDIAL ACTION GOALS AND OBJECTIVES

The establishment of remedial action goals and objectives are based upon results of the Remedial Investigation (RI). The evaluations presented in this section are intended to identify and evaluate remedial action technologies. The evaluations presented in this section are limited to the identification and preliminary screening of remedial alternatives which may be required to supplement the ongoing IRM program. The detailed evaluation and comparative analysis of alternatives is included later in this final FS report. The evaluations made in this report are based on data collected for the remedial investigation to date and will be subject to refinement as more information is developed.

In accordance with NYSDEC and USEPA prevailing guidance documents (NYSDEC, 1989) (USEPA, 1988), remedial action objectives for the FICA landfill and technologies capable of achieving those objectives have been evaluated and are presented below.

The goal of this RIFS is the identification and analysis of remedial alternatives for the site which are consistent with the objectives of the Superfund Amendments and Reauthorization Act (SARA) Section 121 and NYSDEC Technical and Administrative Guidance Memorandum (TAGM) No. 4030 dated 9/13/89 and updated 5/15/90. The primary objective of Section 121 of SARA is the selection of remedial alternatives which are protective of human health and the environment. In addition, the selected remedy shall achieve applicable or relevant and appropriate requirements ARARs as described in Section 8.2 of this report. SARA Section 121 and TAGM 4030 set forth a preference for remediation which permanently and significantly reduces the toxicity, mobility or volume of hazardous substances.

The media of concern are groundwater, surface water and sediment in the vicinity of the landfill which are impacted by site derived contamination in excess of appropriate action levels.

Based on the above discussion, the remedial action objectives are as follows:

- Minimize the potential for human exposure to environmental media containing site related contaminants;

- Minimize the potential for off site migration of site related contaminants;

- Permanently contain, treat and/or dispose of contaminated media in a manner consistent with State and Federal regulations.

8.1 Applicable or Relevant and Appropriate Requirements (ARARs)

Applicable or relevant and appropriate requirements (ARARs) are defined in Section 121 (d) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, P.L. 96-510 as amended by P.L. 99-499 (CERCLA) as any Federal or State standard, requirement, criteria, or limitation which is legally applicable to the contaminants of concern or which is relevant and appropriate under the circumstances of the contaminant release or threatened release.

ARARs represent minimum requirements that a remedy must satisfy. ARARs can be waived providing one of the following circumstances is satisfied:

- The action taken is an interim measure and is only a part of the total remedial action which will attain the requirement when completed.

- Compliance with the requirement presents a greater risk than alternative options.

- Meeting the requirement is technically impracticable from an engineering perspective.

- An equivalent standard of performance that is equal to or better than that specified by the requirement can be achieved through the use of another method or approach.

- The State has not consistently applied a State requirement in similar circumstances involving other remedial actions within the State.

ARARs may be specific to either the site location, the contaminants present, or the remedial actions planned. Location specific ARARs may apply due to the geographical location of a site or its physical setting (e.g. in a wetland). Contaminant specific ARARs may apply due to the contaminants present or its concentration and typically include standards for environmental media and concentration levels relative to land disposal. Action specific ARARs apply to on site activities and may include design standards, discharge limits, or treatment requirements. These three types of ARARs are individually discussed below.

In addition, there are instances when ARARs do not exist for a particular contaminant or remedial action, or the existing ARARs are not protective of human health and the environment. Therefore, to-be-considered (TBC) criteria including, but not limited to, State draft reports, guidance documents and other unpromulgated criteria may be used to aid in the design and selection of a remedial alternative. TBCs will also be discussed below.

8.1.1 Location Specific ARARs

Location specific ARARs are requirements which apply to either chemical concentrations or remedial actions due to physiographical features of the site. The following location specific ARARs are potentially applicable to the site, particularly if remediation includes excavation, handling, and off site disposal of hazardous materials.

Federal:

- Executive Orders on Floodplain Management & Wetlands Protection (CERCLA Floodplain & Wetlands Assessments) #11988 and 11990

- RCRA Location Requirements for 100-year Floodplains (40 CFR 264.18)

- Fish & Wildlife Coordination Act (16 USC 661 note)
- Wetlands Construction & Management Procedures (40 CFR 6, Appendix A)

New York State:

- New York State Freshwater Wetlands Law ECL Article 24,71, Title 23)
- New York State Freshwater Wetlands Permit Requirements and Classifications (6NYCRR Part 663 and 664)
- New York State Floodplain Management Act and Regulations (ECL Article 36 and 6NYCRR Part 500)
- Endangered and Threatened Species of Fish & Wildlife Requirements (6 NYCRR Part 182)
- New York State Flood Hazard Area Construction Standards

8.1.2 Contaminant Specific ARARs

Contaminant specific ARARs are health or risk-based concentration limits for chemicals or methodologies that result in numerical values when applied to conditions in environmental media which may represent target cleanup concentrations. The following contaminant-specific ARARs are potentially applicable to the site, particularly if remediation includes excavation, handling and off site disposal of hazardous material.

Federal:

- Resource Conservation & Recovery Act (RCRA) Groundwater Protection Standards & Maximum Concentration Limits (40 CFR 264, Subpart F)

- Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) (40 CFR 141.11-141.16)

- Clean Water Act (CWA) (33 USC 1251)
  Effluent Limitations (40 CFR Part 301 & 302)
  Federal Water Quality Criteria (Part 304)
  Toxic & Pre-treatment Standards (Part 307)

- Health & Safety Standards

- National Ambient Air Quality Standards (NAAQS) (4O CFR 50)

<u>State</u>:

- New York State Groundwater Quality Standards (6 NYCRR Part 703)

- New York State Surface Water Quality Standards (6 NYCRR Part 701, 702, 704)

- New York State Drinking Water Act MCLs (10 NYCRR 5)

- New York State Raw Water Quality Standards (10 NYCRR 5)

- New York State RCRA Groundwater Protection Standards (6 NYCRR 373-2.6(e))

- New York Ambient Air Quality Standards (6 NYCRR 256 & 257)

8.1.3 Action Specific ARARs

Action specific requirements set controls or restrictions on the design, performance and other aspects of implementation for actions taken at the site. The following action specific ARARs are potentially applicable to the site, particularly if remediation includes excavation, handling, and off site disposal of hazardous materials.

Federal:

- RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal Systems, (i.e., landfills, incinerators, tanks, containers, etc.) (40 CFR 264 and 265) (Minimum Technology Requirements)

- RCRA Subtitle C Closure and Post-Closure Standards (40 CFR 264, Subpart G)

- RCRA Groundwater Monitoring and Protection Standards (40 CFR 264, Subpart F)

- RCRA Generator Requirements for Manifesting Waste for Off-site Disposal (40 CFR 263)

- RCRA Transporter Requirements for Off-Site Disposal (40 CFR 270)

- SDWA (Safe Drinking Water Act), Underground Injection Control Requirements (40 CFR 144 and 146)

- CWA (Clean Water Act) - NPDES Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125)

- Effluent Guidelines for Organic Chemicals, Plastics and Resins (Discharge limits) (40 CFR 414)

- CWA Discharge to Publicly - Owned Treatment Works (POTW) (40 CFR 403)

- DOT Rules for Hazardous Materials Transport (49 CFR 107, 171.1-171.500)

- Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904, 1910, 1926)

- National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61)

State:

- New York State Pollution Discharge Elimination System (SPDES) Requirements (Standards for Storm Water Runoff, Surface Water, and Groundwater discharges) (6 NYCRR 750-757)

- New York State RCRA Standards for the Design and Operation of Hazardous Waste Treatment Facilities (i.e., landfills, incinerators, tanks, containers, etc.) Minimum Technology Requirements (6 NYCRR 370-372)

- New York State RCRA Closure and Post-Closure Standards (Clean Closure and Waste-in-Place Closures) (6 NYCRR 372)

- New York State Solid Waste Regulations (Landfill Closure Requirements) (6NYCRR 360)

- New York State RCRA Generator and Transporter Requirements for Manifesting Waste for Off-Site Disposal (6 NYCRR 364 and 372)

- New York State Air Emission Requirements (VOC Emission for Air Strippers and Process Vents, General Air Quality) (6 NYCRR 200-212)

- New York State Inactive Hazardous Waste Disposal Site Remedial Program (6NYCRR 375)

- New York State Land Disposal Restrictions (6NYCRR 376)

8.1.4 Potential "To-Be-Considered" Guidance

There are instances when ARARs do not exist for a particular chemical or remedial action or the existing ARARs are not protective of human health and the environment. Therefore, other state and federal criteria, advisories and guidance may be used to aid in the design and selection of remedial alternatives for the site. The following "to-be-considered" criteria may be relevant to the site:

Federal:

- Safe Drinking Water Act National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)
- Proposed Maximum Contaminant Levels (50 Federal Register 46936-47022)
- Proposed Federal Air Emission Standards for Volatile Organic Control Equipment (52 Federal Register 3748) (air stripper controls)
- USEPA Drinking Water Health Advisories
- USEPA Health Effects Assessment (HEAs)
- TSCA Health Data
- Toxicological Profiles, Agency for Toxic Substances and Disease Registry, U.S. Public Health Service
- Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 Federal Register 9016)
- Cancer Assessment Group (National Academy of Science) Guidance
- Groundwater Classification Guidelines

- Groundwater Protection Strategy

- Waste Load Allocation Procedures

- Fish and Wildlife Coordination Act Advisories

- Federal Guidelines for Specification of Disposal Site for Dredged or Fill Material

State:

- New York State Underground Injection/Recirculation at Groundwater Remediation Sites (Technical Operating Guidance (TOG) Series 7.1.2)

- New York State Analytical Detectability for Toxic Pollutants (85-W-40 TOG)

- New York State Toxicity Testing for the SPDES Permit Program (TOG 1.3.2)

- New York State Regional Authorization for Temporary Discharges (TOG Series 1.6.1)

- New York State Air Guidelines for the Control of Toxic Ambient Air Contaminants (Air Guide 1)

- Fugitive Dust Suppression and Particulate Monitoring Program of Inactive Hazardous Waste Site (TAGM 4031)

- Selection of Remedial Actions to Inactive Hazardous Waste Sites (TAGM 4030)

8.2 Establishment of Cleanup Goals

In October 1991, the NYSDEC issued a draft document entitled, "Cleanup Policy and Guidelines - Volume 1," prepared by the Cleanup Standards Task Force. This document establishes the overall cleanup goals for NYSDEC remedial programs as well as guidance on how site conditions, existing state and federal statutory requirements, technical feasibility and cost-effectiveness will be taken into consideration in determining an appropriate remedial action. Additionally, this document contains environmental media standards and criteria for air, water, soils and aquatic sediments and the methodologies for developing them. The policy and guidance provided in this document has been used to establish cleanup goals. Of considerable importance in establishing clean up goals is the evaluation of the IRM program and a determination of the effectiveness of the IRM at reducing risks associated with the site.

In addition to the installation of the final cover and gas vent system, the long term remediation of the landfill may include the following elements:

- replacement leachate storage tank.
- on-site leachate treatment system.
- groundwater collection and cut off wall between landfill and wetland.
- surface water/sediment remediation.

At present the western portion of the landfill is underlain with an asphalt liner and leachate collection system. Collected leachate is piped to the leachate storage tank south of the landfill. Prior to entering the tank the landfill leachate is mixed with the leachate collected from the recently constructed C&D area. Recent records of leachate production are summarized in Table 8-1.

DUNN has previously recommended that the leachate tanks be replaced. Plate 5 presents the recommended replacement tank.

At present all collected leachate is transported by truck to the city of Poughkeepsie Wastewater Treatment Plant.

Various means of on site treatment are evaluated in Sections 9.0 and 10.0 in order to select the appropriate long term means for leachate management.

The identified impact to groundwater and the surface water and sediments of the wetland is in all likelihood due to the existing condition of the landfill cover. As previously stated there are numerous defects including cracks, erosion channels and improperly graded areas. As a result there is considerable amounts of precipitation run off which enters the waste mass ultimately becoming leachate which can potentially migrate to groundwater and the adjacent wetland.

Once the cover system is installed pursuant to the approved IRM the production of leachate will be substantially reduced. In the event that the landfill should continue to impact groundwater, and the surface water and sediments of the wetland, additional remedial actions may be required as discussed in Section 9.0.

8.2.1 Development of Risk Based Cleanup Goals

The Human Health Evaluation (HHE) indicated that there are no complete exposure pathways. Therefore, remedial actions beyond the scope of the approved IRM may not be warranted at this time. Future remedial action to supplement the IRM may be required if groundwater quality does not improve following installation of the final cover. Once remedial action has been determined to be warranted at a site, the baseline risk assessment can be used to assist in deriving or modifying cleanup goals for contaminated media (EPA, 1991a). Preliminary cleanup goals are often developed based on ARARs. When ARARs do not exist, risk-based preliminary cleanup goals are calculated using EPA health criteria (reference doses or cancer potency factors) and site-specific exposure assumptions (EPA, 1991a). These risk-based cleanup goals are generally medium-specific chemical concentrations that will pose no unacceptable threat to human health. For systemic toxicants, acceptable exposure levels are concentrations to which the human population may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety (EPA, 1990). The EPA has stated that in order to be protective of all noncarcinogenic effects, a chemical and medium-specific concentration is calculated that corresponds to a hazard quotient of 1.0 for the reasonable maximum exposed individual, or RME (EPA, 1991a). For carcinogenic effects, a concentration is calculated that corresponds to a 10^{-6} incremental lifetime risk of an individual developing cancer as a result of exposure to the potential carcinogen from all significant exposure pathways for a given medium (EPA, 1991a).

8.2.1.1 Preliminary Cleanup Goals for Sediment

The entire waste mass will be covered with a final cover, eliminating direct exposure to on site soils.

Sediments exhibiting increased levels of inorganic parameters do not pose a long term threat to human health as a result of potential exposures. From the standpoint of protecting public health, there is no reason for remediating the sediment.

At present the site is secure and access is controlled by a gate and physical obstacles. The wetland is not easily accessible to the public and therefore direct exposure to the sediment is not expected to be a problem requiring remedial action. Sediment removal will cause considerable disruption of the wetland.

8.2.1.2 Preliminary Cleanup Goals for Groundwater

Elevated levels of contamination were noted in groundwater at several locations. However, the baseline HHE indicated that there are no potential long-term health risks under current uses of the site since the majority of drinking water in the area is supplied by public water.

As previously noted groundwater at the site is affected by precipitation migrating through the fill. Once the cover is installed this source of contamination will be effectively controlled.

8.2.2 Development of ARAR Based Cleanup Goals

8.2.2.1 Preliminary Cleanup Goals for Sediment

The extent of sediment contamination in the wetland east of the landfill was further defined during the second sampling event in order to determine if removal or in situ treatment are warranted.

The human health evaluation concluded that direct exposure to the sediments is unlikely and if exposure did occur the health affects would be negligible.

The hydrology of the wetland indicates that the sediment could leach contamination to the surface water which flows to Casper Creek. Contaminants leaching from the sediments will not affect groundwater, since groundwater of the shallow bedrock appears to be discharging to the wetland.

A surface water quality protection concentration may be derived using the soil/water partitioning theory. Contaminants (solute) adsorbed to the sediment will undergo adsorption-desorption reactions when water is introduced into the media. The magnitude of adsorption-desorption between a specific solute and a given soil can be determined if certain physical characteristics of the solute and soil are known. These physical characteristics include: the organic carbon partition coefficient (Koc), or the octanol-water partition coefficient (Kow), for the solute; the porosity (n) and the fraction of organic carbon (FOC) of the soil.

The conditions affecting leaching are variable and given the fairly low level sediment contamination observed actual values are expected to be quite low and once the cover is installed on the landfill impacts to the sediments of the wetland should be greatly reduced or eliminated.

8.2.2.2 Preliminary Cleanup Goals for Groundwater

According to 6 NYCRR Parts 700-750, any discharge to the waters of New York State shall not cause or contribute to an exceedance of the Ambient Water Quality Standards and Guidance Values for Surface Waters and Groundwaters provided therein. Section 5.0 lists the parameters which exceed groundwater standards or guidelines.

8.2.3 Recommended Cleanup Goals

Exposure to the site specific chemicals (SSC's) were estimated using actual environmental analytical data. In order to mitigate the concerns associated with groundwater contamination, it would be necessary to remove contaminants to acceptable exposure levels. The acceptable exposure levels are derived to be protective of both carcinogenic and noncarcinogenic effects. For carcinogenic effects, acceptable exposure levels are calculated that correspond to a 10^{-6} incremental lifetime risk of an individual developing cancer as a result of exposure from all significant exposure pathways for a given medium. For noncarcinogenic effects, acceptable exposure levels are based on a hazard quotient of 1.0 for the reasonable maximum exposed individual from all significant exposure pathways.

In addition to being protective of human health, acceptable levels of contamination must be derived which are protective of groundwater quality. That is, levels which do not result in a contravention of New York State Water Quality Standards (6NYCRR Part 700).

Section 5.0 identified several parameters present in groundwater at the site at levels exceeding the applicable New York State Groundwater Standards. Given that direct exposure to site groundwater is not possible, and since much at the immediate vicinity of the site is serviced with public water (and the few homes on private wells within a half mile of the site, have been tested and found free of contamination), an appropriate goal for groundwater remediation is to mitigate the continuing releases through source control, containment, and/or groundwater withdrawal and treatment.

To this end the approved IRM program currently underway is expected to substantially reduce ongoing landfill leachate production. This goal can be accomplished by a range of remedial technologies and options presented in Sections 9.0-11.0 of this report.

Surficial soils of the landfill are being covered through the IRM effort and need not be addressed during the feasibility study. Sediments in the wetland also contain landfill derived substances. While there are no promulgated standards for remediation, the November 16, 1992 NYSDEC Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels (HWR-92-4046) outlines the basis for establishing soil cleanup objectives. The TAGM presents numerical recommended soil cleanup objectives. A copy of the TAGM is provided as Appendix G. However, in developing remedial options, the environmental benefit of addressing the sediments will need to be weighed with potential temporary or permanent destruction of the wetland.

Table 2-1

Soil Gas Practical Quantitation Limits for
Volatile Organics

Parameter	PQL (ppb)
Toluene	50
1,2-Dichloroethane	1,000
trans-1,2-Dichloroethene	20
cis-1,2-Dichloroethene	20
Benzene	20
Trichloroethene	20
Tetrachloroethene	50
m & p-Xylene	50
o-Xylene	50
Methyl Ethyl Ketone	1,000
Methyl Isobutyl Ketone	1,000
Chlorobenzene	50
Ethylbenzene	50
Vinyl Chloride	50
1,1-Dichloroethene	20

TABLE 2-2

FICA LANDFILL
WELL CONSTRUCTION DETAILS

Well I.D.	Ground Elevation	Meas. Pt. Elevation	Bedrock Elevation	Boring Depth	Screen Setting	Sand Pack	Bentonite Seal
DGC-1	158.3	159.69	147.3	71.1	61.1 - 71.1	58.2 - 71.1	54.8 - 58.2
DGC-2S	161.4	162.66	149.9	31.7	21.7 - 31.7	19.2 - 31.7	15.2 - 19.2
DGC-2D	161.5	162.66	150.5	86.5	66.5 - 86.5	63.0 - 86.5	60.0 - 63.0
DGC-3	163.4	164.21	141.4	27.1	16.9 - 26.9	16.0 - 27.1	13.0 - 16.0
DGC-4	159.4	160.5	155.2	51.1	41.1 - 51.1	39.5 - 51.1	36.0 - 39.5
DGC-5	159.7	160.63	157.7	19.7	9.7 - 19.7	8.0 - 19.7	4.5 - 8.0
DGC-6OB	155.5	157.7	NA	18.5	8.0 - 18.0	7.0 - 18.5	4.0 - 7.0
DGC-6D	155.5	156.23	128.5	96.5	76.5 - 96.5	74.4 - 96.5	70.4 - 74.4
DGC-7	223.46	224.87	215.96	56.9	46.9 - 56.9	44.7 - 56.9	41.3 - 44.7
DGC-8	222.5	224.38	212.2	56.2	46.2 - 56.2	43.4 - 56.2	39.8 - 43.4
DGC-9	227.6	228.92	222.4	97.5	77.5 - 97.5	75.7 - 97.5	72.3 - 75.7
DGC-10	Well abandoned & replaced with DGC-10A.						
DGC-10A	218.3	219.9	215.3	61.5	51.5 - 61.5	48.7 - 61.5	45.5 - 48.7
DGC-11S	170.4	171.89	170.4	21.8	11.8 - 21.8	9.7 - 21.8	6.7 - 9.7
DGC-11D	170.5	171.9	170.5	71.0	61.0 - 71.0	58.2 - 71.0	54.5 - 58.2

Notes:

1. NA = not applicable, well installed in overburden only.
2. All elevations are expressed in feet above mean sea level.
3. All other units are expressed in feet below grade.

TABLE 4-1

FICA Landfill
Ground Water Elevations

Well I.D.	Meas. Pt. Elevation	Water Level Elevation 3/26/92	Water Level Elevation 4/16/92	Water Level Elevation 4/22/92	Water Level Elevation 4/30/92	Water Level Elevation 5/20/92	Water Level Elevation 8/10/92	Water Level Elevation 10/12/92
DGC-1	159.69	150.13	149.94	150.34	150.29	149.66	149.51	147.75
DGC-2S	162.66	153.51	153.45	153.61	152.36	153.31	153.22	152.24
DGC-2D	162.66	153.57	153.81	152.92	152.66	153.94	151.26	152.13
DGC-3	164.21	151.72	151.36	151.94	150.61	151.57	151.09	150.48
DGC-4	160.50	153.93	153.59	154.25	152.80	153.40	152.95	152.23
DGC-5	160.63	156.76	156.00	157.73	156.03	155.46	155.29	154.44
DGC-6OB	157.70	155.06	154.95	155.35	154.00	154.76	154.50	153.97
DGC-6D	156.23	66.02	66.60	66.79	65.73	67.79	62.36	63.35
DGC-7	224.87	191.19	190.09	193.37	191.12	189.32	189.60	184.60
DGC-8	224.38	200.27	197.55	201.58	200.08	196.02	196.05	188.13
DGC-9	228.92	200.83	200.34	201.07	199.92	199.42	192.97	189.79
DGC-10A	219.90	179.79	179.12	180.31	178.20	178.97	179.06	177.73
DGC-11S	171.89	167.08	164.25	167.94	164.19	166.72	168.06	165.12
DGC-11D	171.90	101.14	101.26	101.18	100.20	101.40	101.73	101.81

TABLE 4-2

FICA Landfill,
Hydraulic Conductivity Test Results
August 10-11, 1992

Well ID		Test Method Hvorslev	DM-7
DGC-1	ft/day	1.38E+00	1.43E+00
	cm/sec	4.86E-04	5.05E-04
DGC-2S	ft/day	8.07E-02	3.20E-01
	cm/sec	2.85E-05	1.13E-04
DGC-2D	ft/day	2.25E-05	5.15E-05
	cm/sec	7.92E-09	1.82E-08
DGC-3	ft/day	2.69E+00	2.61E+00
	cm/sec	9.48E-04	9.22E-04
DGC-4	ft/day	5.66E-01	5.79E-01
	cm/sec	2.00E-04	2.04E-04
DGC-5	ft/day	2.67E+00	2.69E+00
	cm/sec	9.44E-04	9.50E-04
DGC-6OB	ft/day	1.03E+01	1.03E+01
	cm/sec	3.63E-03	3.62E-03
DGC-6D	ft/day	6.40E-06	3.45E-06
	cm/sec	2.26E-09	1.22E-09
DGC-7	ft/day	2.70E-01	2.74E-01
	cm/sec	9.52E-05	9.65E-05
DGC-8	ft/day	1.37E+00	1.37E+00
	cm/sec	4.84E-04	4.85E-04
DGC-9	ft/day	7.54E-06	1.96E-05
	cm/sec	2.66E-09	6.93E-09
DGC-10A	ft/day	1.91E+00	1.98E+00
	cm/sec	6.73E-04	6.97E-04
DGC-11S	ft/day	2.30E+00	2.28E+00
	cm/sec	8.12E-04	8.05E-04

Table 5-1
FICA Landfill
Volatile Organics
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	Chloro-methane	Bromo-methane	Chloro-ethane	Methylene Chloride	Acetone	Carbon Disulfide	1,1-Dichloro ethane	1,2-Dichloro-ethane	2-Buta-none	Benzene	Toluene	Chloro-benzene	Ethyl-benzene	Styrene	Xylene	1,2-Dichloro-propane	1,1,2,2-Tetra-Chloro-ethane	Vinyl Chloride
Detection Limit	10	10	10	2/5	10	2/5	2/5	2/5	10	2/5	2	2/5	2/5	2/5	2/5	2/5	2/5	2/5
DGC-04	ND+/ND	ND+/ND		ND+/ND		7/ND									1J/ND			
DGC-06(OB)	ND+/ND	ND+/ND	7J/T	ND+/ND	5J/14	2J/ND	4/ND	1J/ND		2J/ND					3/ND			
DGC-05			2J/ND		14/T	2J/T				7/6		6/T	9/ND		45/14			
X-1 Dup. (DGC-05), May 1992					9J/T	3/T				5/6		5/T	14 /ND		41/14			
DGC-03		ND+/ND	2J/ND		5J/11	1J/ND				7/T		6/T	9/6		48/18			
DGC-07				ND+/ND		9/T	14/11	1J/ND		3/ND						1J/ND		3/ND
DGC-08				ND+/ND		3/31												
DGC-10A				ND+/ND														
DGC-11	ND+/ND	ND+/ND		ND+/ND	ND+/ND	1J/ND												
DGC-2S				ND+/ND	ND+/ND	1J/T		3/ND										3/T
DGC-01				ND+/ND		ND/T									1J/ND			
DGC-2D				ND+/ND	ND+/200	ND/8			4J/ND	4/ND					7/T			
TB #2				2BJ/ND	1J/ND													
DGC-6D				ND+/ND	24/32				3J/ND	3/ND			2/ND		18/T			
DGC-09				ND+/ND	ND+/ND													
SW-1, May 1992		ND+/ND		ND+/ND														
Sed-1*, May 1992				ND+/ND														
SW-Dup, May 1992		ND+/ND			2J													
Sed-Dup*, May 1992				ND+/ND														
SW-2					5J/10													
Sed-2*				ND+/ND	14J/75													
SW-3		ND+/ND	ND/T	ND/T	6J/18													
Sed-3*				ND+/ND	31/340				28/ND		5J/ND	ND/T						
SW-4		ND+/ND																
Sed-4*				ND+/ND	15J/300						120/ND							
TB #3		2J/ND																
SW-1A, October 1992					13													
SW-2A, October 1992																		
SW-3A, Octoaber 1992					13													
SW-5, October 1992																		
SW-6, October 1992																		
SED-1A*, October					30													
SED-3A*, October 1992																		
SED-5*, October					630													
SED-6*, October 1992					390													
TB																		

* = Soil Sample
J = The concentration listed is an estimated value, which is less than the specified quantitation limit but greater than zero.
B = The analyte is found in the blanks as well as the sample.
Blank Space = not detected at or above the laboratory reported limit.
NA = not analyzed.
ND = Not detected at or above the laboratory reporting limit.
All aqueous sample results are reported in ug/L.
All soil sample results are reported in ug/kg.
Detection limits for soil samples varies according to thier percent solids and dilution factors.
ND+ = Not detected based on data validation.
T = Trace concentration below the laboratory reporting limit.

Table 5-2
FICA Landfill
Volatile Organics
Preliminary Summary
SDG No. DGC-04
May 1992

	4-Methyl phenol	2,4-Dimethyl-phenol	Benzoic Acid	1,2,4-Trichloro-benzene	Naph-thalene	2-Methyl naphthalene	Acena-phthene	N-nitrosodi-phenylamine	Fluro-anthene	Pyrene	Benzo(a)-anthracene	Bis-(2-Ethylhexyl)-pthalate	Di-n-octylph-halate	Benzo(k) fluoranthene	Benzo(a) pyrene	Phena-threne
Detection Limit	10	10	50	10	10	10	10	10	10	10	10	10	10	10	10	10
DGC-04																
DGC-06																
DGC-05		2J			13			2J				8J				
X-1 Dup. (DGC-05)					13		2J	2J								
DGC-03		2J										4J				
DGC-07																
DGC-08																
DGC-10A																
DGC-11S												7J				
DGC-2S												2J				
DGC-01																
DGC-2D												35				
DGC-6D	4J											31				
DGC-09												20				
SW-1																
Sed-1*									760J	450J	300J				270J	560J
SW-Dup																
Sed-Dup																
SW-2			3J													
Sed-2*											370J				350J	
SW-3			2J													
Sed-3*									490JV			690J		290J	260J	
Sed-3R*E									660J					270J	270J	
SW-4																
Sed-4*																
Sed-4RE																

* = Soil Sample
J = The concentration listed is an estimated value, which is less than the specified quantitation limit but greater than zero.
B = The analyte is found in the blanks as well as the sample.
Blank Space = not detected at or above the laboratory reported limit.
NA = not analyzed.
All aqueous sample results are reported in ug/L.
All soil sample results are reported in ug/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.
V = Estimated value based on data validation.

Table 5-3
FICA Landfill
Pesticide Organics Analysis
Preliminary Summary
SDG NO. DGC-04
May/October 1992

	Endosulfan I	Endrin Ketone	Delta-BHC	Heptachlor	Heptachlor-epoxide	Dieldrin	4,4'-DDE	Endosulfan sulfate	4,4'-DDT	Methoy-chlor	Alpha-Chlordane	4,4'-DDD	Gamma Chlordane	Aroclor 1242	Aroclor 1254	Endosulfan II
NYSDEC Groundwater Standard																
Detection Limit			0.100	0.100	0.100	0.20	0.20	0.20	0.20	1.0	1.0	0.20				
DGC-04																
DGC-06 (OB)																
DGC-05			.038J/ND										ND/.0009OPJ			
X-1 Dup			.029J/ND													
DGC-03								ND+/ND								
DGC-07				ND+/ND												
DGC-08				ND+/ND												
DGC-10A				ND+/ND												
DGC-11S				ND+/ND												
DGC-2S						.016J/ND										
DGC-01						.042V/ND							ND/0.00087J			
DGC-2D																
DGC-6D																
DGC-09				ND+/ND												
SW-1				ND+/ND												
SW-Dup																
SW-2			NA/ND	NA/ND	NA/ND	NA/ND	NA/ND	NA/ND	NA/ND	NA/ND	NA/ND	NA/ND				
SW-3								ND+/ND								
SW-4																
SW-1A, October 1992																
SW-3A, Octoaber 1992	0.0017JP						0.01			0.00066JP	0.0016JP	0.0022J				
SW-5, October 1992																
SW-6, October 1992																

All values expressed in ug/L.
NA = Not analyzed.
Blank Space = not detected at or above the laboratory reporting limit.
ND = not detected at or above the laboratory report.
ND+ = Not detected based on data validation.
J = The concentration listed is an estimated value, which is less than the specified quantitation limit but greater than zero.
V = Estimated value based on data validation.

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Table 5-4
FICA Landfill
Inorganic
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	Aluminum		Antimony		Arsenic		Barium		Beryllium		Cadmium	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	200		60.0		10.0		200		5.0		5.0 V	
DGC-04	2,240				3.7 B		1290	1100				
DGC-6OB	46,200 V	5600			44.5 V	34	861 V	590			6.5 V	
DGC-05				69	6.1 VB		622 V	710				
X-1 Dup. (DGC-05)					6.1 B		632	710				
DGC-03	2,490 V	1300	41.6 VB		22.6 V	24	635 V	590				
DGC-07	3,930	640		120	7.6 B	24	276	260				
DGC-08	3,450	780			3 B		58.9 B	ND				
DGC-9		5300						230				
DGC-10A	531	200	53.7 VB				46.3 B	60				
DGC-11 (S)	389	230										
DGC-2S	19,500	350	43 VB		45.5	18	194 B	150				
DG C-2D		8600				28		660				
DGC-01	542	750			6.9 B		1080	1000.0				
SW-1/SW-1A			41 VB									
SW-5	NA		NA		NA		NA		NA			NA
SED-1*/SED-1A	21,300	14,500			10.5		66.0	53.3	1 B			
SW-Dup												
Sed-Dup*	15,500		7.9 VB		8.2		46.8					
SW-2	927	NA	41.8 VB	NA	19.3	NA	362	NA		NA		NA
Sed-2	12,700	6,260	21.7 VB		12.4		82.3 B	21				
SW-3					5.8 B		160 B	190				
Sed-3*	14,900	7,850			5.0		316	314			1.9 V	1.8
SW-4		750										
Sed-4*	12,900	4,570	40.1 VB		8 B		109 B	99.1				

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NA = not analyzed.
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All soil sample results are reported in mg/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.
V = Estimated value based on data validation.

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Table 5-4 (continued)
FICA Landfill
Inorganic
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	Calcium		Chromium		Cobalt		Copper		Iron		Lead	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	5,000		10		50		25.0		100.0		3.0	
DGC-04	117,000	104,000					13.1 VB		7980 V	3000	4.4 B	13
DGC-6OB	213,000 V	216,000	66.7 V	18	40.8 VB	56	147 V	60	121000 V	41300	68.5 V	24
DGC-05	167,000 V	175,000					8 VB		23300 V	12500	3.8 VB	4
X-1 Dup. (DGC-05)	171,000 V	176,000	13.4 V				6 VB		23100 V	12700	3.6 B	7
DGC-03	259,000 V	242,000	14.8 V				43.1 V		23300 V	18300	16.8 V	8
DGC-07	156,000 V	154,000	19.5	15			23.1 VB		10100 V	3600	5.1	
DGC-08	30,700E V	31,400					23 VB		6100 V	1000	3.5 B	
DGC-9		45900.0		14						10000		22
DGC-10A	34,000 V	33900.0	15.7				9.9 VB		893 V	170	1 B	
DGC-11 (S)	23,100 V	35200.0					12.1 VB		698 V	370		4
DGC-2S	255,000 V	267,000	32.6	15	25.6 B	51	40.8 V		40900 V	6700	18.0	
DGC-2D		104,000		24						16700		33.000
DGC-01	104,000 V	105,000					10.7 VB		3200 V	5100		5
SW-1/SW-1A	32,200	46900.0					8.6 VB		374	2200		
SW-5	NA	46300.0	NA		NA		NA		NA	480	NA	
Sed-1*/SED-1A	25,800	2,610	28.5	22.8	20.8	14.6	50.3 VB	37.7	46000	28300	32.7 V	63.2
SW-Dup	31,600						8 VB		367			
Sed-Dup*	10,100		21.5		16.1		36.4 V		32300		16.6 V	
SW-2	28,400		22.0	NA	28.6 B	NA	11.4 VB	NA	95400	NA	6.3	NA
Sed-2	4,370	1,330	29.9	8.8	12.9 B		45.9 V	13.6	20200	12800	78.5 V	31.8
SW-3	121,000	161,000	9.6 B	10	14.3 B		5.4 VB		10700	18500		
Sed-3*	13,900	10,600	84.3	65	12.7 B	11.4	307 V	283	29300	34900	130	115
SW-4	27,500	42,800					8.4 VB		650	6800		11
Sed-4*	14,300	23,300	19.5	10			54.9 V		14100	10800	98.3	

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All soil sample results are reported in mg/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.
V = Estimated value based on data validation.

Table 5-4 (continued)
FICA Landfill
Inorganic
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	Magnesium		Manganese		Nickel		Potassium		Selenium	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	5,000		15		40		5,000		5.0	
DGC-04	36,800	30,600	2,510	1,800	10.4 VB	ND	8,040	7200		
DGC-6OB	86,300 V	68,400	21,200 V	11,200	124 V	53	46,500 VB	39,100		
DGC-05	95,600 V	113,000	10,500 V	8,300	59.2 V	76	199,000 VB	188,000		
X-1 Dup. (DGC-05)	96,500	115,000	10,300	8,500	62.2 V	76	206,000	194,000		
DGC-03	174,000 V	160,000	10,900 V	9,900	138 V	130	189,000 VB	148,000		
DGC-07	35,500	33,500	22,600	22,300	17.9 VB	ND	3,380 B	2,900		
DGC-08	8,010	7,000	431	160			1,720 B	1,400		
DGC-9		11,800		470		ND		5,700		
DGC-10A	8,240	8,400	74	74	11.9 VB	ND	1,650 B	1,400		
DGC-11 (S)	5,870	7,600	86	86	15.6 VB	ND	1,070 B	1,200		
DGC-2S	86,500	76,800	22,300	19,600	67.4 V	ND	7,210	4,700		
DGC-2D		20,800		820				13,000		
DGC-01	31,800	25,600	3,160	3,000	20.9 VB		39,200	30,400		
SW-1/SW-1A	6,430	8,100	194	1,200			570 B	3,800		
SW-5		7,900	NA	210	NA		NA	3,700	NA	
Sed-1*/SED-1A	23,100 V	7,380	1,240	559	46.5 V	27.4	825 B	862		
SW-Dup	6,330		192				630 B			
Sed-Dup*	12,700		867		31.7 V		558 B			
SW-2	62,600	NA	35,600	NA	38.9 VB	NA	22,400 B	NA		NA
Sed-2	4,370	2,760	745	137	40.1 V	11.5	1,040 B	312		
SW-3	43,900	47,800	13,500	13,700	21.6 B	33	27,000	30700.0		
Sed-3*	9,870	5,450	1,190	1,550	52.8 V	30.4	697 B	480	1 B	
SW-4	4,870 B	7,500	209	1,900			530 B	3,200		
Sed-4*	2,740 B	1,730	293	741	28.2 VB	ND	778 B	341	4.1 B	7.5

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All soil sample results are reported in mg/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.
V = Estimated value based on data validation.

Table 5-4 (continued)
FICA Landfill
Inorganic
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	Silver		Sodium		Thallium		Vanadium		Zinc		Mercury	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	10		50,000		10		50		20		0.2	
DGC-04			125,000	116,000			34.9 B		79.4 V		1.8 V	
DGC-6OB	6.3 VB		314,000 VB	311,000			88.3 V		311 V	46	0.36 V	0.3
DGC-05			488,000 V	603,000			29.8 VB		57.5 V			
X-1 Dup. (DGC-05)	3 B		470,000 B	626,000			38.3 B		55.8 V	22		
DGC-03	2 VB		902,000 V	862,000			34.4 VB		114 V	27		0.4
DGC-07	2.3 B		11,600	10,000					103 V			0.6
DGC-08	2.3 B		3,290 B	3,400			25.6 B		89.5 V	28		0.3
DGC-9				17,700						26		0.3
DGC-10A			7,350	8,200			21.9 B		74.8 V			
DGC-11 (S)			4,330 B	6,900					35.0 V			
DGC-2S	2.9 B		195,000	205,000			41.2 B		145 V			
DGC-2D				217,000						58		0.2
DGC-01			196,000	146,000			32.9 B		62.1 V			1.5
SW-1/SW-1A			21,400 B	30,000					31.4 V			
SW-5	NA			25,000	NA				NA		NA	
Sed-1*/SED-1A	2 B		162 B	182			26.0	23.8	184	141		
SW-Dup	2 B		21,900						35.2 V			
Sed-Dup*			96.4 B				15.9		152 V			
SW-2	8.8 B	NA	139,000	NA		NA		NA	65.3 V	NA		NA
Sed-2	1.8 B		488 B	76.1			43.2	10.5	332	145		
SW-3	2.3 B		144,000	175,000					29.3 V			
Sed-3*	45.7	49.5	240 B	381			20.6	12.6	372	267	1.4	1.7
SW-4			8,600	12,000					29.0 V			
Sed-4*			400 B	370			28.2 B		165 V	35.3		1

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ND = not detected at or above the laboratory reporting limit.
NA = not analyzed.
All aqueous sample results are reported in ug/L.
All soil sample results are reported in mg/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.
V = Estimated value based on data validation.

Table 5-5
FICA Landfill
Wet chemistry and Field Analyasis
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	TKN		Phenol Total		Nitrate		COD		Total Organic Carbon	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	0.2		0.05		0.2		1.0		1.0	
DGC-04	4.4	2.8					41	28	17	6
DGC-6OB	45	44					155	150	47	54
DGC-05	210	240				1.4	402	370	130	110
X-1 Dup. (DGC-05)	200	250		0.10		1.9	402	420	100	120
DGC-03	220	210				1.1	377	460	170	130
DGC-07	1.9	2.8					37	40	7	12
DGC-08	0.9	1.1			0.4	0.3	17	22	3	1
DGC-9						0.3				
DGC-10A	0.9						28	70	2	27
DGC-11 (S)	0.8				0.3	0.3	20	ND		1
DGC-2S	3.5	0.9					130	110	37	42
DG C-2D								22		12
DGC-01	27	22					100	66	28	26
SW-1 (A)	0.9						18	44	5	15
SW-5	NA		NA		NA		NA		NA	12
SED-1* (A)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-Dup (SW-1)	0.9	NA		NA		NA	21	NA	8	NA
Sed-Dup*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-2	27						170	27	60	12
Sed-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-3	28	42					93	110	30	34
Sed-3*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-4	0.9						24	33	2	13
Sed-4*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-3A	NA	18	NA		NA		NA	130	NA	49
SW-6	NA		NA		NA		NA	33	NA	13

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NA = not analyzed.
All aqueous sample results are reported in mg/L.
All soil sample results are reported in mg/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.

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Table 5-5 (continued)
FICA Landfill
Wet chemistry and Field Analyasis
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	Dissolved Solid		Color, CPU		Hardness		Sulfate		Turbidity, NTU	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	10		5		2		5		1	
DGC-04	779	690	7	ND	390	440	15	ND	175	16
DGC-6OB	1600	1700	45	25	750	850	31	5	360	45
DGC-05	2400	2900	60	90	880	960	43	16	790	64
X-1 Dup. (DGC-05)	2400	2900	60	90	910	1000	41	14	810	64
DGC-03	4000	4100	70	60	1500	1600	54	14	770	86
DGC-07	620	610	20	ND	550	490	24	18	150	10
DGC-08	140	150	7	ND	110	100	25	27	380	11
DGC-9		230				200		46		26
DGC-10A	170	130			120	140	33	32	190	5
DGC-11 (S)	120	100	5	ND	88	120	28	32	93	2
DGC-2S	1600	1600	50	20	950	1200	300	180	140	10
DGC-2D		830				450		28		9.6
DGC-01	1100	650	75	20	440	410	37	21	180	26
SW-1/SW-1A	190	260	35	70	110	150	15	6	1	2
SW-5	NA	250	NA	50.0	NA	140	NA	9	NA	1
Sed-1*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-Dup (SW-1)	210	NA	25	NA	120	NA	15	NA		NA
Sed-Dup*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-2	1600	263	85	70	1000	140	380	10	40	2
Sed-2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-3	1000	1000	30	20	540	640	30		9	6
Sed-3*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-4	150	140	40	70	96	190	20		2	
Sed-4*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-3A	NA	800	NA	50	NA	560	NA	6	NA	46
SW-6	NA	251	NA	60	NA	120	NA	10	NA	1

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NA = not analyzed.
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All soil sample results are reported in mg/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.

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Table 5-5 (continued)
FICA Landfill
Wet chemistry and Field Analaysis
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	BOD5		Alkalinity as CaCo3		Boron		Chloride		Ammonia	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	1		2		0.5		2		0.1	
DGC-04	16	15	460	390	0.76	0.63	190	190	3.5	2.3
DGC-6OB	18	11	1000	980	3.0	2.9	390	440	45	45
DGC-05	12	22	2000	2300	3.0	3.3	590	780	210	250
X-1 Dup. (DGC-05)	12	32	1900	2200	3.0	3.4	570	810	210	240
DGC-03	30	56	2500	2300	4.0	3.5	1,400	1,500	220	220
DGC-07	12	9	590	580			8	8	1.3	0.9
DGC-08	5	5	91	82			2	2		
DGC-9		8		130						0.1
DGC-10A		23	110	100				3	0.2	0.2
DGC-11 (S)	1	6	73	100				2		
DGC-2S	5	16	860	840	4.4	4.8	200	250	0.7	1
DGC-2D						1.4		200		0.8
DGC-01	17	8	650	520	1.2	1	210	10	27	2.4
SW-1/SW-1A	2	3	97	110		NA	35	58	0.2	ND
SW-5	NA		NA	110	NA		NA	49	NA	
Sed-1*	NA	NA	NA	NA	NA	NA	NA	NA		NA
SW-Dup (SW-1)	2	NA	98	NA		NA	36	NA	0.2	NA
Sed-Dup*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-2	17	3	670	100	3.1	NA	250	58	16	
Sed-2	NA	NA	NA	NA	NA		NA	NA	NA	NA
SW-3	18	24	710	740	1.4	1.7	190	270	32	38
Sed-3*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-4	2	3	82	130			13	23	0.2	
Sed-4*	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SW-3A	NA	34	NA	500	NA		NA	220	NA	11
SW-6	NA		NA	78	NA		NA	67	NA	

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All soil sample results are reported in mg/kg.
Detection limits for soil samples varies according to their percent solids and dilution factors.

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Table 5-5 (continued)
FICA Landfill
Wet chemistry and Field Analyasis
Preliminary Summary
SDG No. DGC-04
May 1992/October 1992

	PH,S.U.		Conductivity uhmos		Temperature OC		Eh, MV		DO	
	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92	May-92	Oct-92
Detection Limit	-		-		-		-		-	
DGC-04	7.11	7.1	1150	1237	19.0	14.4	400	NA	NA	NA
DGC-6OB	6.70	6.7	2320	2300	18.9	NA	100	NA	NA	NA
DGC-05	6.78	6.9	3950	5940	13.5	15.0	NA	NA	NA	NA
X-1 Dup. (DGC-05)	NA	6.8	NA	NA	NA	NA	NA	NA	NA	NA
DGC-03	6.75	6.7	6000	7790	18.0	11.2	85	NA	NA	NA
DGC-07	6.28	6.7	800	1006	16.5	15.7	128	NA	NA	NA
DGC-08	7.74	6.9	215	306	17.3	14.0	332	NA	NA	NA
DGC-9	NA	8.0	NA	NA	NA	NA	NA	NA	NA	NA
DGC-10A	7.30	8.0	250	210	17.2	NA	403	NA	NA	NA
DGC-11 (S)	7.70	7.0	180	220	18.5	NA	210	NA	NA	NA
DGC-2S	6.93	6.5	1700	NA	13.5	NA	74	NA	NA	NA
DGC-2D	NA	7.8	NA	NA	NA	NA	NA	NA	NA	NA
DGC-01	7.37	7.0	1400	1300	16	NA	145	NA	NA	NA
SW-1/SW-1A	7.79	7.1	160	245	15.2	NA	325	NA	8.6	NA
SW-5	NA	7.1	NA	260	NA	NA	NA	NA	NA	NA
Sed-1*	NA	6.8	NA	NA	NA	NA	NA	NA	NA	NA
SW-Dup (SW-1)	7.80	NA	160	NA	NA	NA	NA	NA	NA	NA
Sed-Dup*	NA	NA	NA	NA	15.2	NA	325	NA	8.6	NA
SW-2	6.53	NA	1700	272	16.3	NA	100	NA	10.2	NA
Sed-2	NA	6.9	NA	NA	NA	NA	NA	NA	NA	NA
SW-3	6.64	6.5	NA	1600	14		106.50	NA	9.8	NA
Sed-3*	NA	8.3	NA	NA	NA	NA	NA	NA	NA	NA
SW-4	7.33	7.2	170	230	14	NA	375	NA	8.6	NA
Sed-4*	NA	7	NA	NA	NA	NA	NA	NA	NA	NA
SW-3A	NA	NA	NA	1250	NA	NA	NA	NA	NA	NA
SW-6	NA	7.0	NA	320	NA	NA	NA	NA	NA	NA

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NA = not analyzed.
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Detection limits for soil samples varies according to their percent solids and dilution factors.

Table 5-6
FICA Landfill
Sediment Pesticide/PCB
Analytical Results
May/October 1992

Compound	Endrin Ketone	Heptachlor-epoxide	Dieldrin	4,4'-DDE	Endosulfan sulfate	4,4'-DDT	Methoxy-chlor	Alpha-Chlordane	4,4'-DDD	Gamma Chlordane	Endosulfan II	PCBs
SED-1, May 1992				0.12P		1.2J						
SED-2				ND/2.0				1.22/ND	2.4P/1.9			
SED-3		1.63P/ND	6P/ND	11J/21	25J/ND		31J/ND	6.4P/ND		ND/20P		ND/260
SED-4				20J/7.7					ND/3.3			
SED-1A, October 1992			3.7JP	3.4P								359
SED-3A, October 1992				4.1J					1.5J			
SED-5, October 1992				4.3					2.7J			
SED-6, October 1992				16					13			
SED-DUP				0.32P/ND		1.2J/ND						
USEPA Sediment Criteria Guidance Value			63.9**									
NYSDEC Sediment Criteria Guidance Value		1.29**/4.29*		35.5**		35.5*	25.74**	0.257*/0.257*	35.5*	0.257*/0.257*	1.29**	11,840**/25.74*

All values expressed in ug/L.
* Based on wildlife residue criteria.
** Based on aquatic toxicity criteria.
J = Estimated value.
P = High % difference between quantitation on the DB608 and the DB1701 analytical columns.
ND = Not detected.
Blank = Not detected.

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Table 5-7
Volatile Organic
Sub-Surface Soil Samples
EPA Method 8240
FICA Landfill
August and September 1991

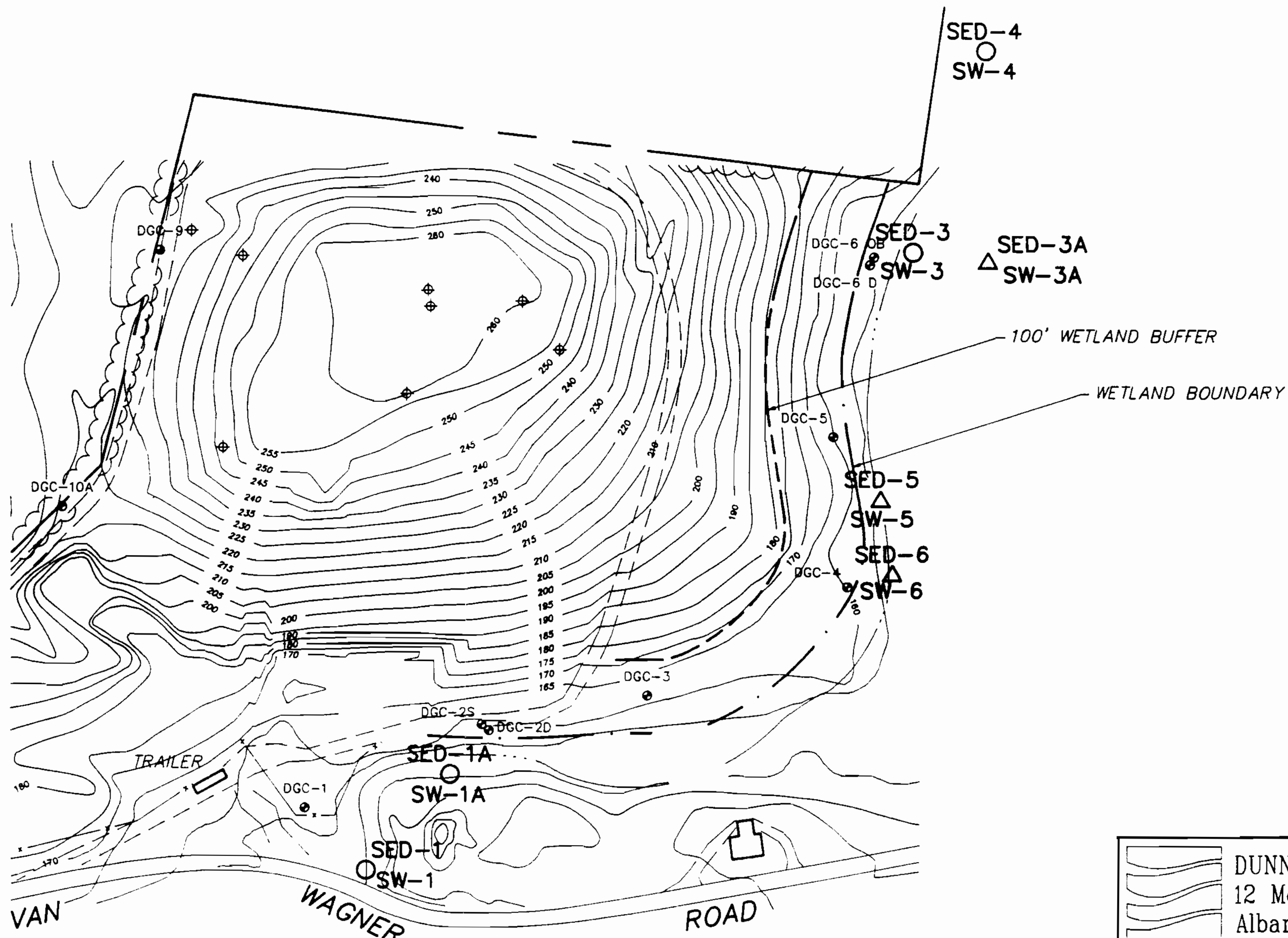
	Chloro-methane	Methylene Chloride	Toluene	Ethyl-benzene	Acetone	Carbon Disulfide	Xylene	2-Butanone	Benzene
DGC-8		8.5			9.2B				
DGC-9		10		7.5	25B		23		
Trip Blank		4.0J			3.4JB				
DGC-7		10	6.6	35	31B		110	7.7	
DGC-10		8.2			48B			7.2	
DGC-1		9.5			69B		1.6J	8.4	
Trip Blank		3.8J			12B				
DGC-6		14B			49B			6.5	
DGC-5, S-1					3.8B				1.8J
DGC-4, S-2		7.0B			7.0B				
DGC-3, S-7		7.6B			14B				
Trip Blank		3.2JB			3.1JB				
DGC-2		8.3B			23B	21			
Trip Blank		2.9JB			4.9JB				
DGC-6		7.4JB			26B				
X-1	26J	97JB			800B			280	
Trip Blank		4.1B			4.4B				

All samples presented in Table 5-6 are soils and units are expressed in ppb.
All Trip Blanks were distilled water and units expressed in ug/L.
A blank space indicates non-detectable.
J indicates result is less than the practical quantitation limits.
B = Detected in laboratory blank.

Table 5-8
Sub-Surface Soil Samples
Metals and Inorganics
FICA Landfill
August and September 1991

	DGC-8	DGC-9	DGC-7	DGC-10	DGC-1	FB	DGC-6	DGC-5 S-1	DGC-4 S-2	DGC-3 S-7	DGC-2	DGC-6
Aluminum	20,700	18,700	23,500	19,200	13,200	364	14,700	16,600	20,100	14,800	15,400	22,700
Arsenic	24.5	5.3	5.9	7.3	6.1		7.1	12.5	7.1	19.6	2.6	
Barium	25.9	45	35.9	18.9	43.6		32.5	40.8	55.8	28.3	58.5	99.8
Beryllium	0.56		0.78	0.81					0.81	0.58	0.58	1.8
Calcium	873	1,050	1,280	873	1,870	2,970	1,080	7,250	1,110	928	966	7,430
Chromium	26	19.8	29.7	24.1	18.3		18.3	22.4	20.5	17.9	17.6	22.2
Cobalt	104	11	16.5	13.7	11.6		9.3	15	10.6	15.3	10.0	
Copper	43.4	25.5	42.2	39.6	34.2		19.0	46.9	24.4	19.1	20.6	10.8
Iron	42,100	28,200	45,900	38,500	37,400	590	34,600	35,800	75,500	45,900	28,700	9,600
Lead	22.6	15.2	23.5	27.5	17.8	0.005	11.1	34	19.8	13.2	27.6	18.5
Magnesium	11,200	6,840	11,500	10,200	6,330		7,380	12,800	6,380	6,280	5,610	3,420
Manganese	918	483	1,360	675	3,520	30	420	2,400	756	437	413	720
Mercury		0.46										
Nickel	35	24.2	37.8	31.5	26.4		23.9	30.8	25.1	23.9	20.4	17
Potassium	901	791	833	769	753		650	682	620	710	825	1400
Selenium												8.9
Silver	1.2		1.1		1.1					1.2		
Sodium							118				123	775
Vandium	19.9	19.4	21.6	18.4	13.7		14.8	21.5	18.2	13.8	15	11.5
Zinc	91.1	70.4	82.4	66.9	76.7	2.6	67.6	90.2	76.9	73.6	190	28.7
PH, SU	- -	- -	7.0	6.7	7.7	7.6	7.0	6.9	6.3	6.0	6.2	7.0
% Total Solids	95	94	96	93	90		84	89	86	84	81	40

B = Also found in associated method blank.
All samples presented in Table 5-7 are soils and units and are expressed in mg/kg, unless otherwise specified.
A blank space indicates non-detectable.
- - = Not analyzed for.
Field Blank was distilled water and units are expressed in mg/L.



LEGEND

○ May and October 1992

△ October 1992

DUNN GEOSCIENCE ENGINEERING Co.
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SURFACE WATER/SEDIMENT SAMPLING LOCATIONS
FICA LANDFILL

POUGHKEEPSIE DUTCHESS CO., N.Y.

PROJECT NO. 00296-01601		DWG. NO. EC-112
SCALE: 1"=200'	DATE 21JAN93	FIGURE NO. 5-1