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DOCUMENT SUMMARY FOR REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORK PLAN FOR OPERABLE UNIT 1 (OU 1) NORTH GRINDER LANDFILL NTC ORLANDO FL
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DOCUMENT SUMMARY

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY (RI/FS) WORKPLAN

OPERABLE UNIT 1
NORTH GRINDER LANDFILL

NAVAL TRAINING CENTER
ORLANDO, FLORIDA
JANUARY 1996

Contract No. N62467-89-D-0317

ABSTRACT

The Department of Defense (DOD) conducts various programs at its facilities to investigate and clean up environmental conditions resulting from the use of hazardous materials. Two such programs underway at the Naval Training Center (NTC), Orlando are the *Installation Restoration (IR) Program* and the *Base Realignment and Closure (BRAC)* program.

The *Remedial Investigation/Feasibility Study (RI/FS)* Workplan discussed in this summary report was prepared as part of the IR Program at NTC, Orlando. This workplan specifically outlines upcoming investigations at the former landfill under the North Grinder Parade Field of the Main Base at NTC, Orlando, also known as operable unit (OU) 1.

This document summary is provided as a synopsis of the RI/FS workplan for OU 1. The complete workplan is available at the NTC, Orlando, Information Repository in the Orange County Public Library on Central Boulevard in downtown Orlando.

– words shown in italics are defined in the glossary –

I. INTRODUCTION

The workplan for *Operable Unit* 1 was designed to meet the objectives of the RI/FS, as described below:

- gather the information to determine the type and extent of contamination at the site;
- set standards for cleaning up the site; and
- identify and evaluate cleanup alternatives based on engineering factors, practicality, environmental and public health considerations, and cost.

II. SITE BACKGROUND AND SETTING

Site Description and History

The North Grinder Landfill site is in the northwest corner of the Main Base as shown in Figures 1 and 2. The landfill site is presently under both lawn and paved surfaces which are essentially flat. Historic aerial photographs show that landfilling operations at the site began sometime between 1940 and 1946. At that time, the property was wooded and was operated by the U.S. Army Air Corps.

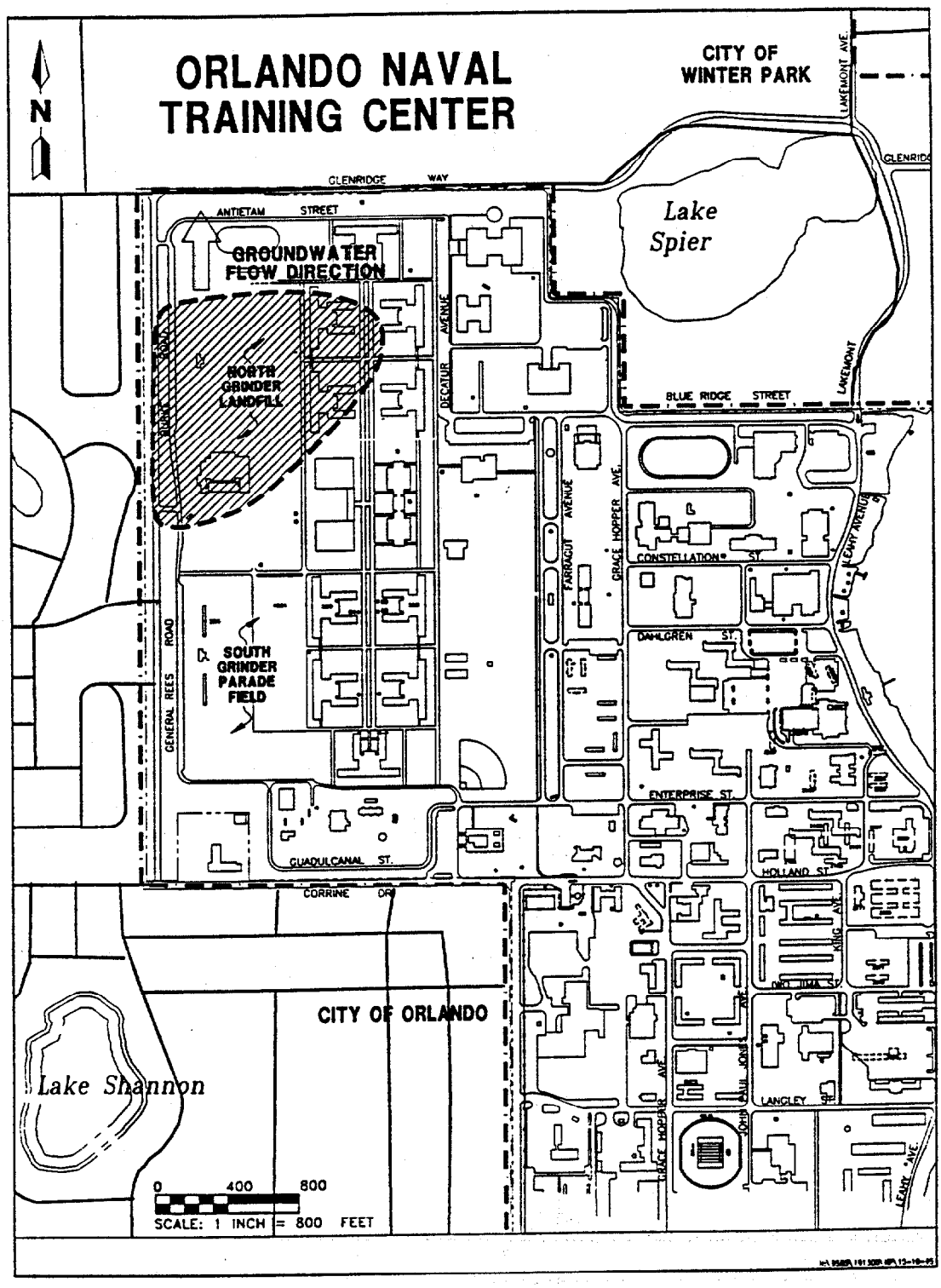

Figure 1. Location of North Grinder Landfill (Operable Unit 1)

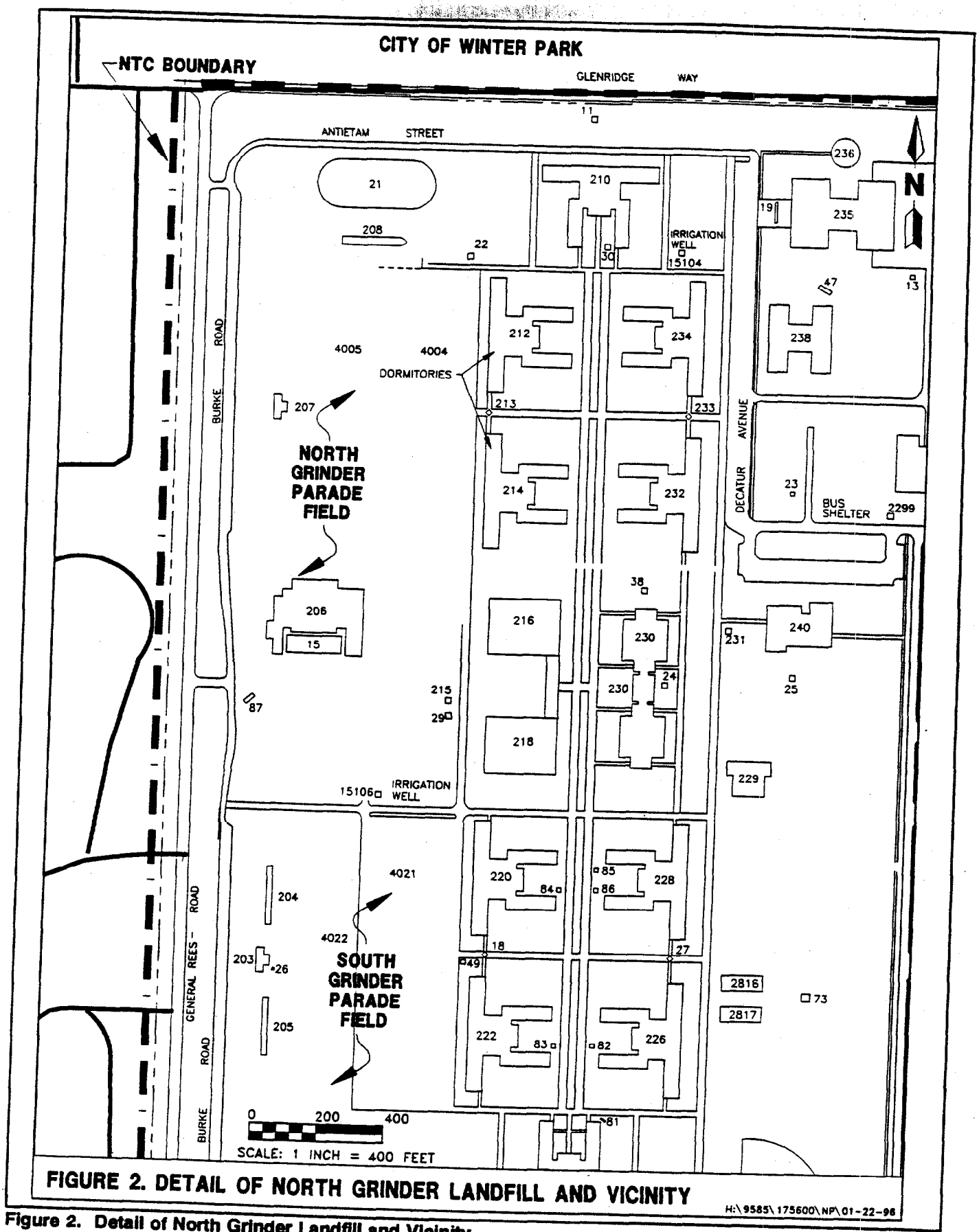

Figure 2. Detail of North Grinder Landfill and Vicinity

The landfill eventually covered 15 acres and was closed in 1967, prior to construction of two dormitories on its eastern edge. Aerial photos also indicated that the site housed a fire-fighting training area and a skeet-shooting range in addition to a sanitary landfill.

Hydrogeologic Setting

The ground beneath NTC, Orlando, is made up of three major layers: *surficial* sand and clay; a second layer of clay, sand, and carbonate material; and a deeper layer of *carbonates* from an earlier geological period. *Aquifers* or underground water, beneath the installation correspond to these earthen layers. These are the *surficial aquifer*, the *intermediate aquifer*, and the *Floridan aquifer*, which supplies Florida with much of its public water.

These characteristics cause the groundwater flow in the surface aquifer to be primarily horizontal. The potential for downward, or vertical, flow does exist, but at extremely low rates. These are important features when considering potential movement of groundwater contaminants at NTC, Orlando. For these reasons, the layer of most interest in the investigation of potential groundwater contamination at OU 1 is the surficial aquifer.

The groundwater flow at OU 1 generally follows the slope of the land surface, which falls to the west, north, and east toward nearby Lakes Spier and Howard. The potential for contaminant movement through groundwater in these directions will be studied during the investigation. Characteristics of the site also suggest that contaminants could move through the entire depth of the surficial sand, and, for that reason, this whole layer will be investigated. The need for studies of the deeper groundwater aquifers will be based on the findings of the surficial layer investigation.

Land Use

The North Grinder Parade Field occupies about 15 acres in the northwest corner of the NTC, Orlando, Main Base. Two adjacent dormitories occupy another 7.5 acres. The parade field is used for physical training, assembly, marching, and ceremonial activities.

Land uses at the Main Base include barracks, training and administrative facilities, drill fields, and recreational areas. Off-base areas to the west, north, and east are primarily single family residential homes. Glenridge Elementary School is located several hundred feet due north of the North Grinder Parade Field.

Review of Existing Data

Two previous environmental investigations have been completed at NTC, Orlando. The first was an *initial assessment study (IAS)* in 1985. The IAS included a records review and walkover of the installation. Nine potentially contaminated, including the North Grinder Landfill sites, were identified in the IAS. A subsequent *Verification Study* in 1986 recommended the North Grinder Landfill site for further investigation.

The IAS estimated the total waste volume in the North Grinder Landfill at 194,000 cubic yards. Approximately one-third of this material was excavated during construction activities and removed to an unknown location. Landfill wastes reportedly included:

- film and photographic chemicals;
- paint thinner;
- mess hall garbage;
- cardboard, paper, and plastics;
- hospital waste;
- tree limbs and construction debris; and
- residue from dry cleaning operations (contained *perchloroethene*, a cleaning agent).

Four monitoring wells were installed at or near the North Grinder Landfill during the verification study. The wells were sampled for substances which the *U.S. Environmental Protection Agency (USEPA)* has named as priority pollutants. Results of the monitoring well sampling are summarized in Table 1.

Table 1. Summary of Prior Groundwater Sampling Results at OU 1

Compound	Location	Concentration	Federal MCL	State MCL
Iron	MW-1	1.5 ppm	N/A	0.3[1] ppm
Arsenic	MW-3	68 ppb	50 ppb	50 ppb
Gross alpha	MW-1 through MW-4	20 to 41 pCi/L	15 pCi/L	15 pCi/L
Gross beta	MW-1 through MW-4	28 to 38 pCi/L	50 pCi/L[2]	50 pCi/L[2]
Methylene Chloride	MW-4	15 ppb	5 ppb	5 ppb

[1] Secondary maximum contaminant level.
[2] Gross beta regulatory MCL listed is a screening value, not a regulatory standard.

Notes: OU = operable unit.
MCL = maximum contaminant level.
MW = monitoring well.
ppm = parts per million.
N/A = not applicable.
ppb = parts per billion.
pCi/L = picocuries per liter.

Overview of the Cleanup Approach

OU 1 is being evaluated using the *Superfund Accelerated Cleanup Model (SACM)* recently developed by USEPA. SACM encourages early action during investigations and cleanup alternative development, especially at widely-studied sites such as municipal landfills. SACM's objective is to accelerate the entire cleanup process.

A key tool in SACM is the use of *presumptive remedies* where appropriate. These are preferred cleanup methods for common categories of sites (such as municipal landfills) and are based on experiences from past investigations at USEPA Superfund sites. For the OU 1 investigation, a presumptive remedy of *source containment* will be used for developing the workplan. It is recognized, however, that methods other than containment may be needed to achieve established cleanup standards.

SACM also recognizes that a level of uncertainty about site conditions is a part of the overall cleanup process that must be considered in the planning phase. Such uncertainties need not delay the site investigation as long as it is possible to continually test the working model of the site as the study progresses. This approach allows investigators to modify plans and procedures to meet conditions as they are found in the field.

"Data Needs" Evaluation

The Conceptual Site Model

The tool for determining what information is needed for the OU 1 investigation is the *conceptual site model*. The conceptual site model shows the ways in which contaminant releases may potentially occur at the site. It also identifies the types of environmental sampling needed to evaluate whether a release has in fact occurred. The model also provides a basis for potential responses to releases.

Primary release scenarios. The conceptual site model for OU 1, shown on Figure 3, identifies two primary ways by which contaminants may be released into the environment. They are:

Direct contact: *Ingestion* and skin contact with *biota* which has come in contact with contaminated waste.

Leaching: Contaminants can drain from the landfill into surrounding soil and groundwater.

Variations to primary release scenarios. The site model also identifies four potential variations to the direct contact and leaching releases described above.

These include:

- contaminated offsite sediment and surface water,
- contaminated offsite groundwater,
- effects on plant and animal food chains, and
- landfill gas releases.

It is assumed that the landfill's contents will remain onsite, that a soil cover will be part of any site cleanup plan, and that no utilities pass through the landfill. For these reasons, exposure by humans to contaminated landfill materials is not anticipated

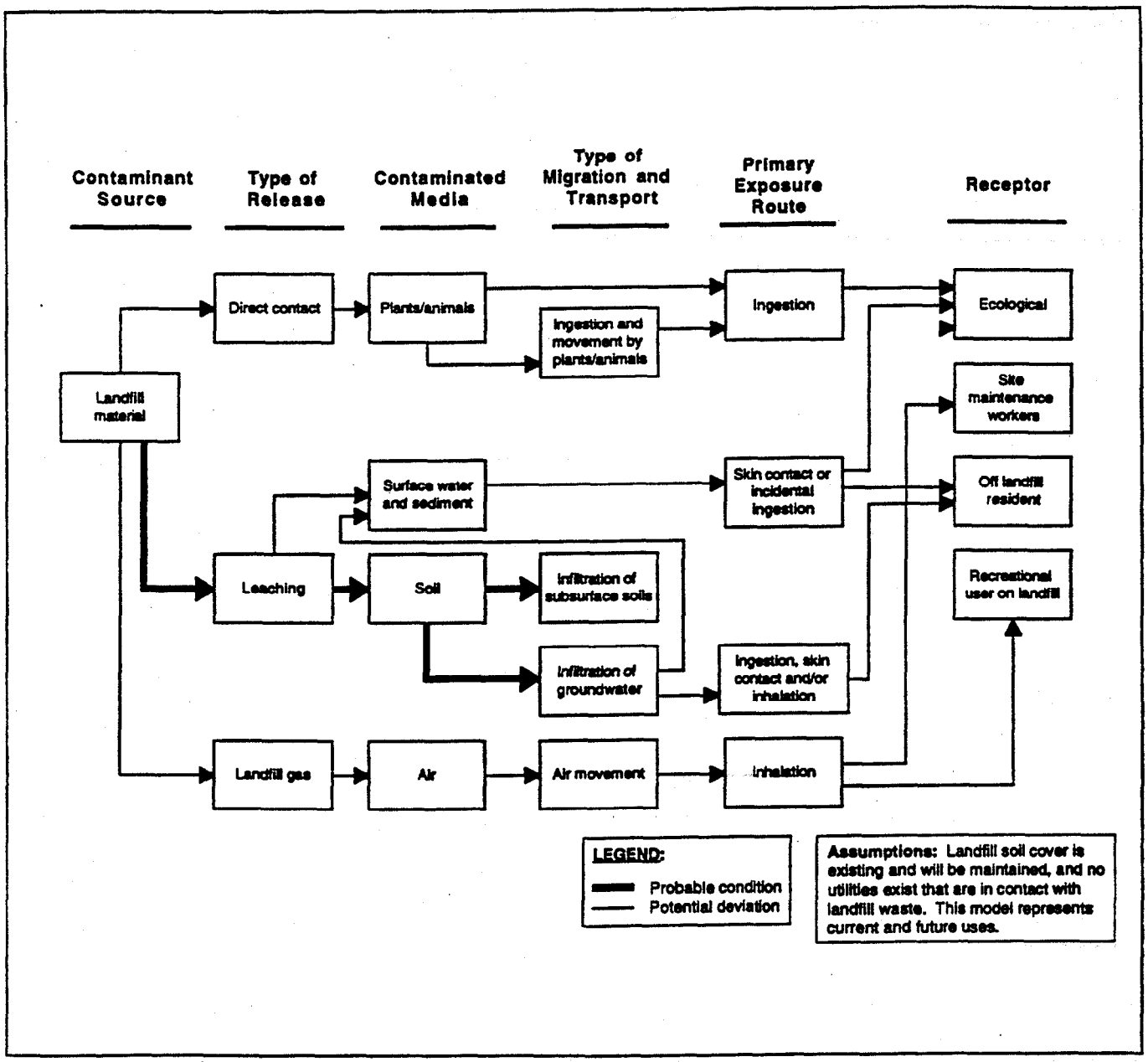

Figure 3. North Grinder Landfill Conceptual Site Model

through the primary release scenarios (direct contact and leaching). However, potential exposure may occur to humans and the environment through some of the variations to these primary release scenarios, as listed above.

Preliminary Risk Evaluation

A *preliminary risk evaluation* (PRE) provides a look at potential exposure to contaminated materials for both humans and the environment. The first step is identification of potential chemical hazards posed by the landfill waste, through historical records review and limited sampling. For OU 1, the potential hazards are organic, inorganic, and radionuclide chemicals. Figure 4 illustrates the exposure assessment step of a PRE, which identifies the potential receivers of contaminants and their likely exposure pathways.

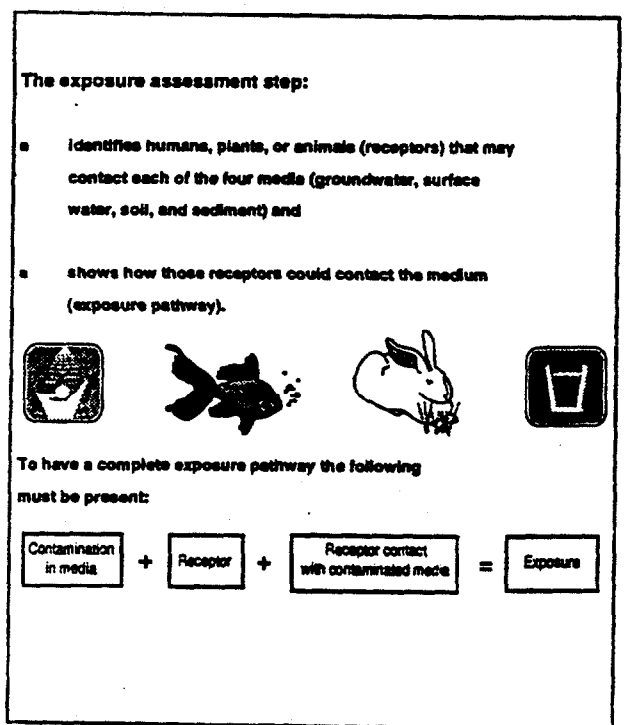

Figure 4. The Exposure Assessment Step of a Preliminary Risk Assessment

Human Health Evaluation

The human health portion of the PRE is broadly divided into three phases. The first is identification of individuals who, by their activities or proximity to the site, may potentially be exposed to contaminants. After considering probable future uses of the landfill site, these have been identified as:

- landfill maintenance workers,
- future recreational users, and,
- future offsite residents who use groundwater for household or irrigation uses.

The second phase is identification of potential exposure routes, or pathways, for humans. As shown in the conceptual model, no human exposure pathways are likely under the most probable site conditions. Other less likely potential exposure routes (those associated with the deviations listed in the previous section) were also considered in this phase.

The third step is identification of potential exposure routes under the presumptive remedy. As discussed earlier, the presumptive cleanup for OU 1 is source containment. Specifically, this remedy could include:

- a landfill cap,
- groundwater control for the source area,
- collection and treatment of landfill leachate and gas, and
- *institutional controls* on the site (such as deed or land use restrictions).

USEPA policy states that exposure routes addressed by the source containment remedy need not be fully evaluated during the RI/FS risk evaluation. This directive is based on cleanup experiences at landfill sites indicating this remedy adequately addresses such exposure routes.

It is important to recognize that selection of the actual remedy for OU 1 will be based on the results of the RI, and may include any, all, or none of the above elements.

Ecological Evaluation

The ecological portion of the PRE identifies the plants and animals potentially exposed to contaminants at OU 1, and the means by which such exposure could occur. Both land and water-borne species are identified, and their respective habitats described. A preliminary listing of rare, threatened, and endangered species which currently or at one time inhabited NTC, Orlando, property is provided in Table 2.

Table 2. Rare, Threatened, and Endangered Species

Common Name	Scientific Name	Status	
		Federal	State
Florida mouse	*Podomys floridanus*	C2	SSC
Southeastern kestrel	*Falco sparverius paulus*	C2	T
Short-tailed snake	*Stilosoma extenuatum*	C2	T
Eastern indigo snake	*Drymarchon corais couperi*	T	T
Gopher tortoise	*Gopherus polypemus*	C2	SSC
Americal alligator	*Alligoar mississippien-sis*	T(S/A)	SSC

Source: Florida Game and Fresh Water Fish Commission.

Notes: C2 = Federal candidate species.
SSC = species of special concern.
T = threatened.
T(S/A) = threatened due to similarity of appearance.

Probable exposures for land-based plants and animals in the North Grinder Landfill vicinity include food chain exposure and direct contact to and incidental ingestion of landfill material. Less likely exposure pathways for these species include direct contact or incidental ingestion of contaminated sediment or surface water and inhaling landfill gas. No probable exposure pathways for water-borne species were identified in the PRE although the research suggests potential exposure through direct contact or incidental ingestion of surface water and sediment.

As with the human health risk study and in accordance with USEPA policy, exposure routes addressed by the source containment remedy were not evaluated by the ecological health risk work.

Preliminary Identification of Remedial Action Technologies

This work involves the identification of the environmental laws which pertain to the cleanup at OU 1. The laws are known as the *applicable or relevant and appropriate requirements (ARARs)* for the site, and their identification will help ensure strict compliance with regulation. A detailed synopsis of all the identified ARARs can be found in Appendix A of the RI/FS workplan for OU 1.

The ARARs, together with the conceptual site model, form the basis for *preliminary remedial action objectives (RAOs)*. RAOs consider the specific site conditions (both existing and future) that must be addressed in the cleanup to protect the public and the environment. The RAOs for the North Grinder Landfill include:

- elimination of skin contact by site workers and future recreational users with a soil cover;
- elimination of all utilities passing through the landfill;
- containment of landfill gases and radioactive emissions (if found); and
- containment and/or treatment of contaminated groundwater, surface water, and sediment (if found).

The next step is to identify the potential cleanup technologies themselves. The purpose of this step is primarily to help plan and focus future RI activities.

Identification of cleanup methods is based on relevant information in the site model and on a review of cleanups at similar sites and of other technical literature. The potential cleanup technologies for OU 1 were found to include:

- institutional controls,
- landfill capping,
- containment of landfill material,
- collection and/or treatment of surface water,
- sediment treatment,
- collection and/or treatment of *leachate* and groundwater, and
- collection and/or treatment of landfill gas.

Summary of Data Needs and Project Data Quality Objectives

The three purposes for environmental data collection at OU 1 are: to verify probable site conditions and potential changes in them, to support the risk evaluation, and to support the feasibility study (FS), a detailed analysis of potential cleanup methods.

To ensure that each of these data needs are met, information on the following site conditions and characteristics will be collected during the RI: soil gas, groundwater, geology, sediment,. surface water, and ecology (plants and animals and their relationship to the environment).

A related aspect of the data collection program is establishment of *data quality objectives (DQOs)* by site investigators. These are guidelines which spell out the quality of the information needed from a distinct collection activity (for example, groundwater sampling). DQOs are needed to support subsequent project decisions or actions. The USEPA has identified five general levels of data quality requirements for sites such as OU 1, covering both field investigations and laboratory analysis work.

III. TECHNICAL APPROACH

A technical approach for each OU 1 field investigation program has been developed. Each approach is designed to support the conceptual site model and project data needs, and includes the specific sampling and other investigation techniques to do so. Technical approaches have been developed for the following programs and activities, with a summary of each approach provided:

- *geophysical surveys*;
- *soil gas* survey program;
- *direct push technology* investigations;
- surface soil, surface water, and sediment sampling program;
- *monitoring well* installation; and,
- *aquifer permeability testing*.

Geophysical surveys

Geophysical surveys will be performed to:

- determine the extent of the North Grinder Landfill,
- determine if the adjacent South Grinder parade area shows any indications of past landfill use,
- locate concentrated areas of wastes which may need removal, and
- estimate the landfill cover thickness and composition.

These surveys will include procedures known as remote sensing techniques, which allow investigators to evaluate below-ground geological conditions from the surface. Specific tests will include *magnetometer* and *terrain conductivity surveys* and use of *ground penetrating radar*.

Soil Gas Surveys

The soil gas program objectives are to:

- identify and characterize specific chemicals in the landfill cover to help design an appropriate cleanup,
- locate any concentrated areas of certain chemicals to assess the need to remove them, and,
- determine if methane (a gas commonly found at landfill sites) is present.

Investigators will use a remote sensing technique called passive soil gas collection to accomplish the first two objectives. The data gained from this testing will address some probable and potential exposure routes for humans and the environment, and will also satisfy some of the data needs identified earlier.

Direct Push Technologies

Direct push technologies (in which sampling instruments are inserted into the ground by mechanical means) will be used to help define any below-surface contaminant pathway (or *plume*) at the landfill.

TerraProbe℠ sampling of groundwater and soil vapor will be performed for this purpose. The TerraProbe℠ is a hydraulic ram that pushes a hollow steel rod fitted with a sampling device into the ground at desired sampling depths. Sixty TerraProbe℠ sampling locations each are proposed for the groundwater and soil vapor surveys.

A second direct push technology called *cone penetrometer testing (CPT)* will be used to characterize the uppermost aquifer at the landfill. CPT is similar mechanically to the TerraProbe℠ and can sample to greater depths. CPT will specifically assess engineering-based soil conditions. Fifteen CPT surveys have been proposed, and the specific locations will be selected based on TerraProbe℠ results or in-field lab analysis.

Surface Soil Sampling

The surface soil sampling program will be based on a sampling plan which reflects the SACM approach to investigations at sites like the North Grinder Landfill (see *Overview of the Cleanup Approach* for detail on SACM). Samples will be systematically taken from the soil cover at locations across the landfill boundary. The samples will be analyzed for "target" contaminants, which include certain metals and organic chemicals, and for pesticides. Analytical data on other "secondary" chemicals will also be gathered for risk assessment and cleanup treatment studies.

Surface Water and Sediment Sampling

Surface water and sediment sampling will be performed only if groundwater sampling and analysis (described below) indicate contamination. In this event, offsite surface water and sediment sampling in lakes located downgradient (generally north) of the landfill will be required. Sediment sampling would be also be taken at these locations, which likely would include Lakes Virginia, Berry, and Spier. If surface water and sediment sampling is required, five sampling locations for each material would be selected at each of the lakes. Such sampling will be done with an understanding that the lakes are in an urban environment and subject to uncontrolled releases from local sources, making it difficult to identify the exact sources of contamination.

Monitoring Well Installation

The objectives of the monitoring well installation program are to:

- characterize the extent of potential groundwater contamination from OU 1,
- develop sufficient information to complete the risk assessment and the FS, and
- establish locations suitable for future groundwater monitoring (if required).

The specifics of the monitoring well installation program will be based on information gathered from direct push technology testing. Proposed monitoring well locations and depths will be selected after evaluation of the direct push screening data. The locations will then be presented to the Navy and to government regulators in a brief report prepared by ABB-ES, an environmental consultant to the Navy. These key parties in the investigation will then meet to finalize the well locations and other details of the program.

It is expected that a series of well groupings placed to various depths will be required to characterize potential groundwater contamination in the uppermost aquifer at OU 1. Proposed locations for installation of monitoring wells are shown in Figure 5.

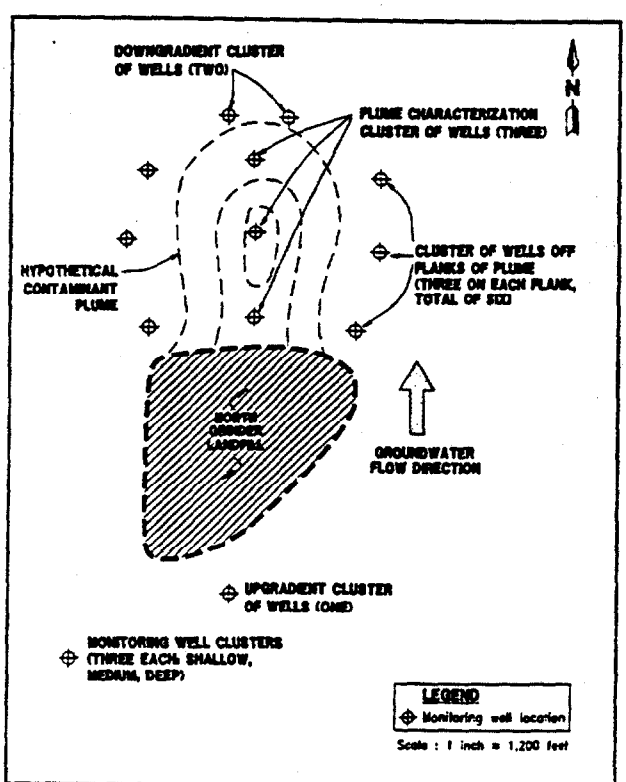

Figure 5. Placement of Operable Unit 1 Monitoring Wells

If a contaminant plume is found at the bottom of the surficial aquifer, monitoring wells will then be installed in the earthen layer below, known as the *Hawthorn Group*. Similarly, if contamination is found in the Hawthorn, additional monitoring wells (or, at minimum, sampling data from existing wells) will be required for the Floridan aquifer system, located below the Hawthorn layer.

The purpose of aquifer permeability testing at OU 1 is to gain specific scientific insights into the nature of the aquifer. This information will help in both tracking contaminant movement and in evaluating cleanup alternatives. One type of aquifer permeability tests, called *slug tests*, will be done for up to 14 of the newly installed monitoring wells. Slug test locations will be chosen to assess permeability at all sides of the site.

IV. SAMPLE ANALYSIS AND VALIDATION

Data Validation

The approach to ensuring the quality and reliability of data developed during field investigations is known as data validation. This includes Quality Control/Quality Assurance requirements for laboratory analyses. Indicators which measure data quality include the precision, accuracy, and completeness of the information. Data such as analytical results are also evaluated to ensure that they are representative of the overall data type and that they can be compared to other data within that type.

Data Evaluation

The data evaluation task looks at the usability of validated data results. Results that meet established DQOs are considered usable. These results are compared with background sampling results from a recent investigation at another site, using a combination of procedural- and contaminant-based comparisons (see *Data Needs and Project Data Quality Objectives*). The contaminants of concern for OU 1 will also be identified through the data evaluation process.

Data Management

The data management program tracks all the environmental data gathered during the field investigation,

from collection through data analysis and report evaluation. Coordination and management of contracted laboratories is also part of this program. Data management procedures will help make information readily available to investigators for use during environmental data analysis, risk assessment, and evaluation of cleanup alternatives. Figure 6 illustrates the data management process.

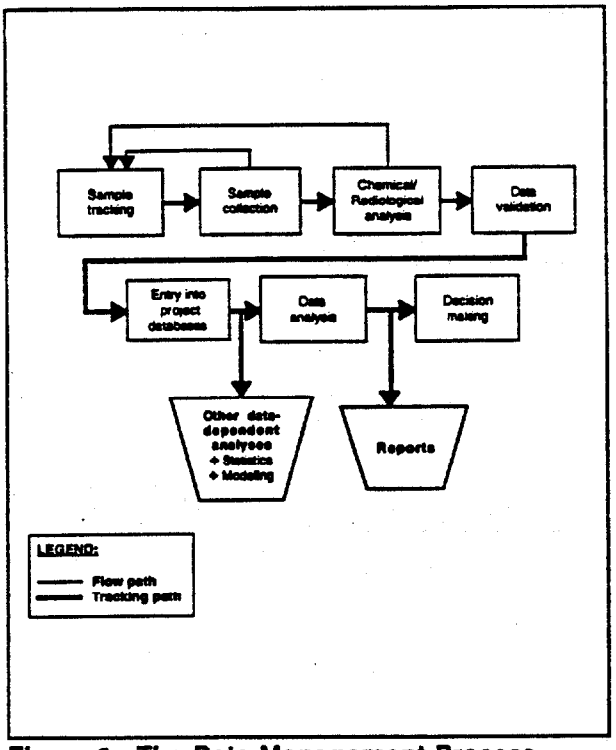

Figure 6. The Data Management Process

V. RISK EVALUATION

Human Health Evaluation

The focus of the human health evaluation is the potential risk posed to humans by chemicals in the North Grinder Landfill. As with the preliminary risk evaluation discussed earlier, the human health evaluation will rely on the presumed remedy of source containment. The human health evaluation expands on the preliminary work, as it takes an in-depth look at source containment as it will likely effect human exposure at the landfill and adjacent NTC property. A more detailed risk evaluation will not be conducted if source containment is found to adequately address these landfill-area exposure issues, but may be needed if contaminants are found to have moved further offsite.

The human health evaluation for OU 1 will include the following elements.

- **Hazard Identification.** summarizes the type and extent of contamination and identifies hazardous chemicals on the site.
- **Toxicity Assessment.** analyzes human health hazards from chemicals identified above (performed only if a second, more comprehensive, risk evaluation is necessary).
- **Exposure Assessment.** evaluates the potential for human exposure to landfill contaminants.
- **Risk Characterization.** combines findings of toxicity and exposure studies to describe human health risks from contamination that may have moved beyond the landfill.
- **Comparison to Health Standards and Guidelines.** compares data on contamination to available Federal and State health standards and guidelines.
- **Uncertainty Analysis.** identifies the assumptions and uncertainties associated with predicting human health risks and their potential effects upon the risk evaluation results.

Ecological Evaluation

This part of the risk evaluation looks at potential risks to the environment posed by contamination from the landfill under a source containment cleanup plan. The specific objectives of the ecological evaluation are:

- to see if the landfill's existing soil cover is sufficient to prevent exposures to plants and animals at the landfill, and
- to see if landfill contamination has traveled offsite to locations where other such exposures could occur.

The ecological evaluation will have much the same scope as the human health evaluation described above. However, its specific elements will look at potential environmental effects of landfill contaminants, instead of potential human health effects.

VI. INVESTIGATIVE-DERIVED WASTE MANAGEMENT

Investigative-derived waste (IDW) is discardable items or substances which result from the site investigation. IDW may include used protective clothing, decontamination fluids, drilling muds and cuttings, wastewater from monitoring well sampling activities, soil, and other spill- contaminated materials. IDW is not necessarily hazardous and will only be classified as such if it falls within the specific legal standards for hazardous waste.

The general approach to IDW is to reduce its volume by returning it to its source where possible, except for items such as protective clothing and some wastewater. This approach creates no additional environmental hazard than existed before the investigation and ensures that the IDW is treated during the eventual site cleanup.

IDW to be removed from the site for disposal will be placed in containers appropriate for the particular type of waste and labeled accordingly. The containers will then be sampled for specific contaminants and temporarily stored at an onsite field staging area. After the sampling results are received and evaluated, the Navy will determine the waste's legal classification, transportation methods, and the final disposal options. Options for the types of IDW anticipated at OU 1 are described below:

Wastewater: disposal through the base's water treatment system if contamination if within acceptable limits; if not, storage at the field staging area until limits are achieved through treatment.

Soil and Drilling Fluids: use as clean fill at onsite locations identified by the Navy if within acceptable limits; if not, storage at the field staging area for disposal under the final cleanup action.

Protective Equipment: typically not considered a hazardous waste at sites similar to NTC; only considered hazardous if radiation levels exceed applicable standards.

VII. REMEDIAL INVESTIGATION REPORT

The draft RI report for OU 1 will be prepared following USEPA guidelines and will include information on: site background, investigation activities, physical characteristics, the type, extent and potential movement of contamination, and risk evaluations. The probable site conditions described in the conceptual site model will also be verified or modified in the RI report. The draft report will be presented to members of the NTC, Orlando, BRAC Cleanup Team for review. The final RI report will include a section on public comments received on the draft and the Navy responses to them.

VIII. FEASIBILITY STUDY

After completion of the final RI report, a Feasibility Study (FS) will be conducted at the North Grinder Landfill. The FS will identify and screen potential cleanup methods for the site, and provide a detailed analysis of the technology and cost associated with each method. To accomplish this, the FS will be carried out in three distinct phases, presented below.

Alternative Technology Screening

As discussed in the **Overview of Cleanup Approach**, the presumptive remedy for OU 1 is source containment, supplemented as appropriate by other cleanup technologies suited to site conditions. The purpose of the technology screening step is to eliminate those technologies that would not be feasible or effective given the physical and chemical conditions identified in the RI. Technologies will be evaluated based on their effectiveness, feasibility of implementation, and cost.

Alternative Development Screening

The technologies remaining from the technology screening step will be assembled into combinations of cleanup measures known as **remedial alternatives.**

These measures must meet the established objectives for site cleanup. A brief description of the individual components of the remedial alternatives will be provided in the FS report. A second alternative screening step may be necessary depending on the total number of alternatives developed. This is considered unlikely, however, given the relatively limited number of cleanup options for a site like the North Grinder Landfill.

Alternative Evaluation

The remedial alternatives which survive the prior screening steps will be evaluated to enable site investigators to select an appropriate overall cleanup plan for OU 1. This evaluation will involve a detailed description of each alternative, an evalua tion of each alternative based on USEPA technical evaluation criteria, and a comparison of each alternative to the others, relative to the criteria.

This comparative analysis highlights the pros and cons of each alternative, and will be presented in the FS report in both narrative and table format for ease of comparison.

VIII. PROJECT SCHEDULE

Figure 7 shows the anticipated schedule for activities described in the OU 1 workplan, along with a time estimate for each task. Uncertainties associated with some of the field task schedules are indicated by dashed lines.

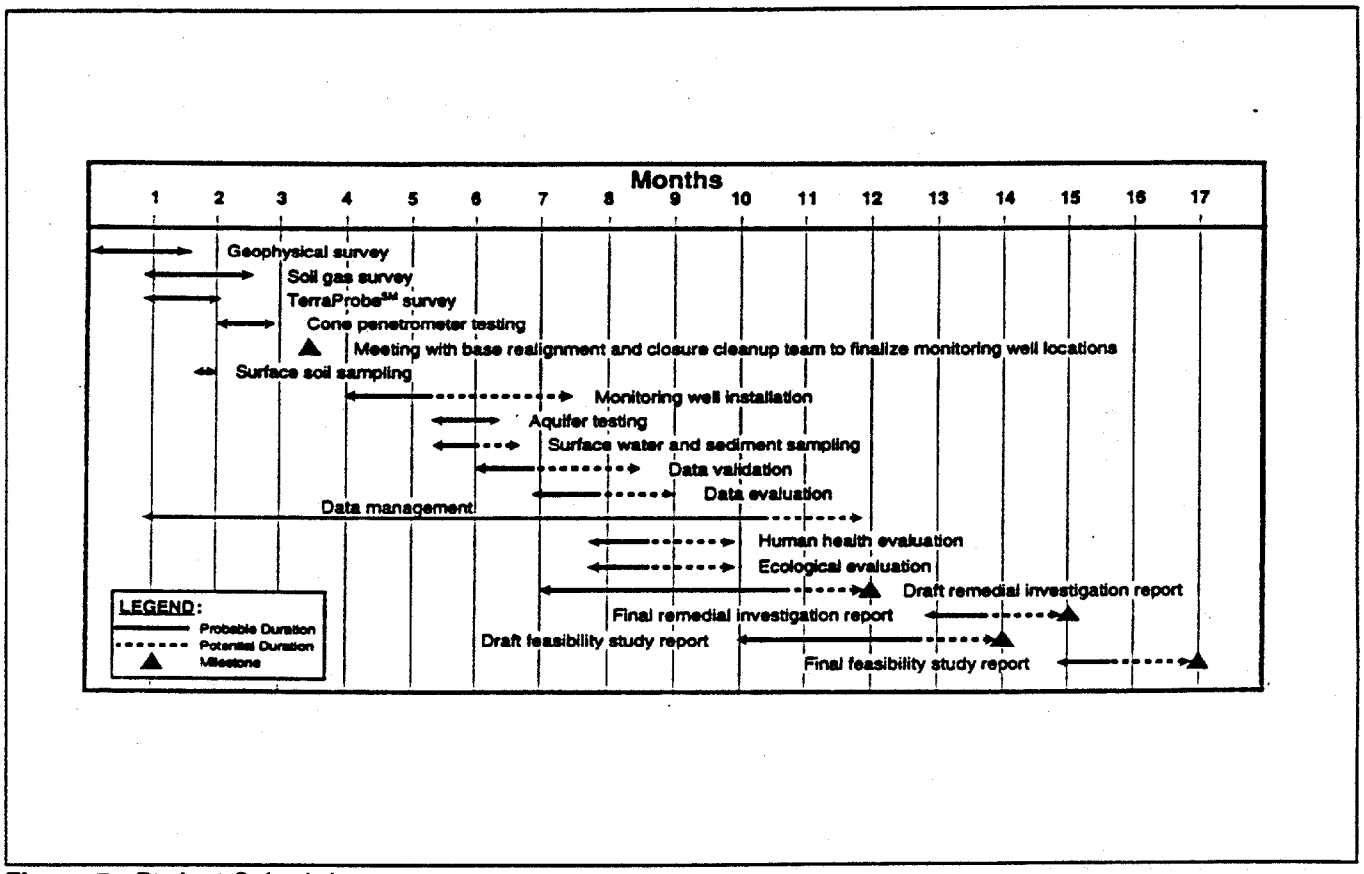

Figure 7. Project Schedule

GLOSSARY

Applicable or relevant and appropriate requirements (ARARs): the Federal and State requirements that a selected alternative must meet. These requirements may vary among sites, chemicals of concern, and remedial alternatives considered.

Aquifer: an underground layer of rock, sand, or gravel capable of storing and transmitting water within cracks and pore spaces, or between grains. The water contained in an aquifer is called groundwater.

Aquifer permeability testing: field studies conducted at monitoring wells to characterize groundwater flow, contaminant movement, and help evaluate potential cleanup alternatives.

Base Realignment and Closure (BRAC): the Federal legislation passed in 1990 to improve cost effectiveness at Department of Defense installations. That measure mandated the *BRAC* environmental program at NTC, Orlando, to ensure compliance with applicable environmental laws.

Biota: the animal and plant life of a particular region.

Carbonates: subsurface materials such as limestone which contain the element carbon.

Conceptual site model: a graphic illustration which provides an overview of known and potential site conditions which serves as a decision-making tool during the course of a risk assessment.

Cone penetrometer testing (CPT): a field investigation technique which uses hydraulic equipment to identify geological layers and sample groundwater.

Data quality objectives (DQOs): the specific quality requirements for a discrete data activity which are developed to support particular decisions during a site investigation.

Direct push technology: a range of field investigation techniques which employ hydraulic equipment to survey subsurface conditions. *Cone penetrometer testing* and *terraprobe*℠ surveys are forms of direct push technology.

Feasibility study: an engineering analysis and report which involves identifying and evaluating the most appropriate technical approaches for addressing contamination problems at a site undergoing an interim remedial action. The alternatives are evaluated for their effectiveness in protecting human health and the environment.

Federal candidate species (C2): plants or animals currently under consideration for protected status by the U.S. Fish and Wildlife Service.

Floridan Aquifer: the deepest of the three major geological formations which underlie Florida. Consisting of rock, sand, and gravel, it is Florida's primary source of potable water.

Geophysical surveys: field studies using magnetics and radar to determine subsurface conditions at a site, including the extent of past waste disposal.

Gross alpha/gross beta: measurement to determine the approximate quantity of alpha or beta radionuclides without specifically determining which radionuclides are present.

Groundwater: water found within an aquifer.

Hawthorn Group: the middle of three geological formations which underlie NTC, Orlando. The Hawthorn Group consists mainly of clay, sand, and carbonates, and is essentially impermeable.

Ground penetrating radar (GPR): a geophysical survey technique used to locate buried objects and map the extent of disposal areas at a waste site.

Initial assessment study (IAS): The process of collecting and reviewing information to identify solid waste management units and potential releases of contamination. The IAS determines the need for further investigation.

Installation Restoration Program: The DOD program to investigate, identify, evaluate, and, if necessary, clean up sites to protect human health and the environment.

Institutional controls: legal conditions or restrictions placed on deeds or land use plans at hazardous waste sites which have been cleaned up. Institutional controls may also involve implementation of long-term monitoring programs.

Intermediate Aquifer: the middle of the three principal water-bearing layers which underlie NTC, Orlando.

Investigative-derived waste (IDW): discarded materials from site investigations which have no further use and may need treatment before their disposal. IDW typically includes items like protective clothing worn by site workers or decontamination fluids.

Leachate: liquids (mainly water) that move through a landfill and pick up contaminants.

Magnetometry: a technique for locating buried objects by measuring fluctuations in the earth's magnetic field.

Maximum contaminant level (MCL): the highest amount of a particular chemical allowed in drinking water according to State and Federal regulations. MCLs are often used to determine if cleanup of groundwater is warranted.

Media: naturally occurring physical matter such as soil, groundwater, sediment, or surface water.

Methylene chloride: an colorless organic liquid widely used as an industrial solvent and paint stripper. Methylene chloride (also known as dichloromethane) is also a component in some aerosol and pesticide products, and is used in the manufacture of photographic film.

Monitoring well: Special wells drilled at specific locations on or off a hazardous waste site where groundwater can be sampled at selected depths and studied to determine such things as the direction of groundwater flow and the types and amounts of contaminants present.

Operable Unit: Grouping of sites based on types of waste disposed and/or the suspected contaminants of concern.

Parts per billion (ppb)/parts per million (ppm): units of measure commonly used to express low levels of contaminants. For example, if one drop of a contaminant chemical were mixed in a competition-size swimming pool, the water would contain about one *ppm* of that chemical.

Perchloroethene: a chemical solvent commonly used in dry-cleaning operations.

Picocuries per liter (pCi/l): A unit of measure for radioactive material.

Preliminary remedial action objectives (RAOs): cleanup goals established early in a site investigation which identify specific contaminants, types of contamination (i.e., groundwater, soil, etc.), and probable exposure routes that must be addressed by the site remediation.

Preliminary risk evaluation: a screening-level study that evaluates risks to humans and the environment for contaminants present in soil, water, sediments, and air.

Presumptive remedies: preferred cleanup technologies for common categories of sites which are selected based on past hazardous waste site investigations in the USEPA Superfund program.

Remedial Investigation: The first part of a two-part remedial investigation and feasibility study (RI/FS). The RI involves collecting and analyzing information about a site to determine the nature and extent of contamination that may be present. The investigation also determines how conditions at the site may affect human health and the environment.

Slug tests: a technique to determine the rate and direction of groundwater movement by using weights (or slugs) that fit into monitoring wells.

Soil gas: easily evaporated chemicals (called volatile organic compounds, or VOCs) which are commonly found in soil covers and at the surface of landfills. Methane is a common soil gas at landfill sites.

Source containment: actions such as construction of physical barriers which are designed to prevent continued release of waste substances into the environment.

Species of special concern (SSC): a protected status for certain animals as designated by the Florida Game and Freshwater Fish Commission.

Superfund Accelerated Cleanup Model (SACM): a process developed by USEPA to encourage flexibility and expedite investigations at hazardous waste sites, especially for sites with similar characteristics like municipal landfills.

Surficial sand: the layer of sand closest to the surface in a given geologic setting

Surficial aquifer: the layer of groundwater closest to the surface in a given hydrogeological setting.

Terrain conductivity survey: technique for locating buried objects by measuring variations in the conductivity of the earth's surface

TerraProbe™: A hydraulic ram that pushes a hollow steel rod fitted with a sampling device into the ground to desired sampling depths.

Threatened: a protective status for listed plants and animals offered under both Federal and State of Florida law.

Threatened due to similarity of appearance (T[S/A]): a protective status for animals offered under Federal law.

U.S. Environmental Protection Agency (USEPA): the Federal agency that is involved in identifying regulations and concurring with the preferred remedy at a site.

Verification study: a preliminary study at NTC, Orlando, which recommended the North Grinder Landfill (OU 1) for additional investigation.