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Department of Environmental Conservation

Division of Environmental Remediation

Record of Decision

Cornell University
Radiation Disposal Site
Lansing, Tompkins County
Site Number 7-55-001

March 2002

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New York State Department of Environmental Conservation
GEORGE E. PATAKI, *Governor* ERIN M. CROTTY, *Commissioner*

DECLARATION STATEMENT - RECORD OF DECISION

Cornell University Radiation Disposal Site
Town of Lansing, Tompkins County, New York
Site No. 7-55-001

Statement of Purpose and Basis

The Record of Decision (ROD) presents the selected remedy for the Cornell University Radiation Disposal Site inactive hazardous waste disposal site which was chosen in accordance with the New York State Environmental Conservation Law. The remedial program selected is not inconsistent with the National Oil and Hazardous Substances Pollution Contingency Plan of March 8, 1990 (40CFR300).

This decision is based on the Administrative Record of the New York State Department of Environmental Conservation (NYSDEC) for the Cornell University Radiation Disposal Site inactive hazardous waste disposal site and upon public input to the Proposed Remedial Action Plan (PRAP) presented by the NYSDEC. A listing of the documents included as a part of the Administrative Record is included in Appendix B of the ROD.

Assessment of the Site

Actual or threatened release of hazardous waste constituents from this site, if not addressed by implementing the response action selected in this ROD, presents a current or potential significant threat to the environment.

Description of Selected Remedy

Based on the results of the Remedial Investigation/Feasibility Study (RI/FS) for the Cornell University Radiation Disposal Site and the criteria identified for evaluation of alternatives, the NYSDEC has selected Alternative 2, containment of the waste and collection and treatment of contaminated groundwater. The components of the remedy are as follows:

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS and SRI will be resolved.
2. Operation and maintenance of the existing IRM cap. This includes any necessary upgrades to meet current or future performance criteria.
3. Soil-bentonite slurry wall around the waste mass, keyed into fractured shale bedrock.

4. Vertical grout curtain under the slurry wall that seals the fractured shale zone and any transitional zones down to the top of the relatively impermeable competent bedrock.
5. Piezometers inside and outside of the slurry wall to monitor its performance.
6. Operation and maintenance of the groundwater IRM collection and treatment systems.
7. Natural attenuation and monitoring of the plume.

While no current threat to drinking water supplies exists, a groundwater recovery and treatment system has been installed and will be operated to capture and treat contaminated groundwater that exceeds drinking water standards and prevent further movement of contaminants to the south past Snyder Road. A small portion of the groundwater plume south of Snyder Road containing concentrations of paradioxane at levels above groundwater guidance values and also containing tritium at low levels below drinking water standards will not be captured by the groundwater recovery system. This portion of the plume will be allowed to naturally attenuate . A groundwater and surface water monitoring program will be implemented to evaluate the effectiveness of the source and plume containment measures and to monitor the progress of natural attenuation of the plume. Institutional controls, including deed notification of the presence of contamination on the Cornell University property, will be implemented. Additional land use limitations and restrictions will be implemented as needed.

New York State Department of Health Acceptance

The New York State Department of Health concurs with the remedy selected for this site as being protective of human health.

Declaration

The selected remedy is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action to the extent practicable, and is cost effective. This remedy utilizes permanent solutions and alternative treatment or resource recovery technologies, to the maximum extent practicable, and satisfies the preference for remedies that reduce toxicity, mobility, or volume as a principal element.

3/28/2002
Date

Michael J. O'Toole
Michael J. O'Toole, Director
Division of Environmental Remediation

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RECORD of DECISION

Cornell University Radiation Disposal Site
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SECTION 1: SUMMARY OF THE RECORD OF DECISION

The New York State Department of Environmental Conservation (NYSDEC) in consultation with the New York State Department of Health (NYSDOH) has selected a remedy to address the significant threat to the environment created by the presence of hazardous waste at the **Cornell University Radiation Disposal Site (RDS)**. As more fully described in Sections 3 and 4 of this document, landfilling operations from the late 1950s through 1978 have resulted in the disposal of hazardous wastes, including solvents and radionuclide-contaminated materials, at the site, some of which have migrated from the site to surrounding areas, including site groundwater and surface water. These disposal activities have resulted in a significant environmental threat associated with the release of contaminants to shallow groundwater and associated surface water.

The primary environmental threat and contaminant of concern at the site is paradioxane (also known as 1,4-dioxane), a common laboratory solvent used in radiological research. Paradioxane has been found in site groundwater and surface water at levels exceeding New York State regulatory guidance values. Radionuclides have also been detected at the site, though at generally low concentrations. The primary radioisotope of concern is tritium, which has been found in site groundwater at levels exceeding area background levels, but well below any health-based or environmental groundwater or drinking water standards.

In order to eliminate or mitigate the significant threat to the environment that the hazardous waste disposed at the site has caused, the NYSDEC has selected Alternative 2, containment of the waste and collection and treatment of contaminated groundwater. The components of the remedy are as follows:

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS and SRI will be resolved.
2. Operation and maintenance of the existing IRM cap. This includes any necessary upgrades to meet current or future performance criteria.

3. Soil-bentonite slurry wall around the waste mass, keyed into fractured shale bedrock.
4. Vertical grout curtain under the slurry wall that seals the fractured shale zone and any transitional zones down to the top of the relatively impermeable competent bedrock.
5. Piezometers inside and outside of the slurry wall to monitor its performance.
6. Operation and maintenance of the groundwater IRM collection and treatment systems.
7. Natural attenuation and monitoring of the plume.

The recommended alternative involves the installation of a vertical subsurface barrier wall (slurry wall) around the perimeter of the radiation disposal area, and a vertical, subsurface grout curtain, at depth, to seal off the fractured shale bedrock around the site perimeter. A slurry wall is an impermeable, vertical wall installed from the ground surface to the top of bedrock; a grout curtain is a method of sealing off bedrock by injecting a cement grout into the fractures of the rock. The existing site cap will be maintained to eliminate direct contact with the waste materials and reduce percolation of surface water through the waste.

While no current threat to drinking water supplies exists, a groundwater recovery and treatment system has been installed and will be operated to capture and treat contaminated groundwater that exceeds drinking water standards and prevent further movement of contaminants to the south past Snyder Road. A small portion of the groundwater plume south of Snyder Road containing concentrations of paradioxane at levels above groundwater guidance values and also containing tritium at low levels below drinking water standards will not be captured by the groundwater recovery system. This portion of the plume will be allowed to naturally attenuate. A groundwater and surface water monitoring system will be developed to evaluate the effectiveness of the source and plume containment measures and to monitor the progress of natural attenuation of the plume. Institutional controls, including deed notification of the presence of contamination on the Cornell University property, will be implemented. Additional land use limitations and restrictions will be implemented as needed.

The selected remedy, discussed in detail in Section 7 of this document, is intended to attain the remediation goals selected for this site in Section 6 of this Record of Decision (ROD), in conformity with applicable standards, criteria, and guidance (SCGs).

Certain actions, known as Interim Remedial Measures (IRMs), have been undertaken at the Cornell Radiation Disposal Site (RDS) in response to the threat identified above. IRMs are conducted at sites when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS. The IRMs undertaken at this site included the installation of a 60-mil thick high density polyethylene (HDPE) liner ("landfill cap") over the waste area to preclude surface water infiltration. The synthetic cap was covered with a soil barrier layer for protection from physical and ultraviolet (sunlight) damage and seeded to prevent erosion. The area around the waste cell was graded and drains were installed to direct surface water away from the waste and cap. Additionally, a conveyance pipeline was installed below ground to transport groundwater from the RDS to the adjacent Cornell University Chemical Disposal Site (CDS) groundwater treatment facility located approximately one-third mile to the southeast. The site has been fully fenced and gated to prevent humans and wildlife from entering the waste area. This work was completed in September 1996.

A work plan for the implementation of a groundwater recovery IRM was approved by the NYSDEC in August 1998. Recovery wells have been installed along the north side of Snyder Road, downgradient of the disposal area. These wells will collect contaminated groundwater and convey it, via the previously installed pipeline, to the Cornell University CDS facility for treatment and discharge. The necessary modifications to the existing treatment plant are complete and performance testing of the system is underway. Start up of the system is anticipated in early 2002.

The remedy selected for this site and discussed in various sections of this ROD incorporates the completed capping and groundwater IRMs into the final remedy.

SECTION 2: SITE LOCATION AND DESCRIPTION

The RDS is located north of Snyder Road in the Town of Lansing, Tompkins County, New York. The site location is shown on Figure 1. The RDS is a approximately 2-acre (290 feet by 300 feet) inactive low level radioactive waste landfill. The site is surrounded by an 8- foot high chain link fence topped with three strands of barbed wire. Two gates near the perimeter of the site are used to control access. Initial entry is through a locked twenty-foot sliding gate along Snyder Road. A single lane dirt road leads from this gate at Snyder Road 350 feet north to the site. Direct access to the site area is restricted by the site fence and a second locked gate.

All lands immediately adjacent to the site are owned by Cornell University. Directly to the north and northeast are wooded, undeveloped lands containing several areas of NYSDEC-designated wetlands. In this area and to the northwest are two sets of experimental ponds managed by Cornell's Department of Soil, Crop, and Atmospheric Sciences for research purposes. Approximately one-half mile to the south of the RDS are the runways of the Tompkins County Airport, the closest commercial facility. Along the southeast and southwest boundaries of the site are additional undeveloped fields used by Cornell University for research purposes.

Approximately one-third mile to the southeast of the RDS is Cornell University's Chemical Disposal Site (CDS). Between 1962 and 1977, Cornell operated the CDS as a landfill for the disposal of chemical wastes from university laboratories. The site is closed and capped. Site groundwater is recovered and treated through an on-site treatment facility.

The RDS is located approximately 3 miles from Cayuga Lake at an elevation of 1120 feet above mean sea level. Water bodies within the vicinity of the RDS eventually flow into Cayuga Lake. The investigation area is rolling in nature, with the RDS located on a knoll. The site is adjacent to two surface water drainage ways. To the east is an intermittent stream that flows under Snyder Road and across the Tompkins County Airport property. This stream is fed by a man-made pond at the eastern edge of the investigation area. A second drainage ditch runs west along Snyder Road and then crosses under the road to the airport property.

The nearest downgradient residential well used for drinking water purposes is located on Bush Lane, approximately 5,200 feet west-southwest from the site.

SECTION 3: SITE HISTORY

3.1: Operational/Disposal History

The RDS was operational from the late 1950's through June 1978 in accordance with regulations in effect at the time. Low level radioactive waste, generated by radiological research, was buried in tenches excavated at the site. Wastes included the carcasses of animals that were placed in drums and boxes and then buried. Contaminated laboratory materials were also disposed. Additionally, vials containing"cocktails" of chemical solvents (e.g., toluene, alcohols, paradioxane, naphthalene, and xylene) used in the scintillation process (i.e., the process used to count or measure radioactive emissions) were also disposed at the site.

The estimated maximum volume of waste material is 38,667 cubic yards, of which approximately 9,400 cubic yards is comprised of low level radioactive waste. Based on available records, it was calculated that as of January 1993, approximately 1.1 curies of carbon-14, 5.5 curies of tritium, 12 millicuries of strontium-90, 95 millicuries of cesium-137, and lesser amounts of other isotopes remained at the site. The chart below shows the radio-isotope activity remaining in the RDS, based on radioactive decay.

Isotope	Half-Life	January 1993	January 2001	January 2002
Tritium (H-3)	12.3 years (y)	5.5 Curies (Ci)	3.5 Ci	3.3 Ci
Carbon 14 (C-14)	5730 y	1.1 Curies (Ci)	1.1 Ci	1.1 Ci
Strontium 90 (Sr-90)	29.1 y	12 Millicuries (mCi)	9.9 mCi	9.7 mCi
Cesium 137 (Cs-137)	30.1 y	95 Millicuries (mCi)	79 mCi	77 mCi

Note: A millicurie is equivalent to one-thousandth (10^{-3}) of a curie.

To put these activity values in perspective, the tritium activity (amount of radiation) currently present in the Cornell RDS is less than half of the activity found in self-luminous exit signs routinely used in commercial, industrial, and public buildings.

3.2: Remedial and Regulatory History

Initial disposal of waste at the site was permitted in 1956 under a non-specific exemption license from the Atomic Energy Commission. Subsequently (in 1963), the New York State Department of Health became the regulatory authority for such facilities. Operation of the site is currently regulated by the New York State Department of Environmental Conservation under Title 6 of the New York Code of Rules and Regulations (6 NYCRR), Part 380 series (for the management of radioactive materials), the 6 NYCRR part 370 series (for the management of hazardous waste), and 6 NYCRR Part 360 (for the management of solid wastes). The site is listed on the New York State Registry of Inactive Hazardous Waste Disposal Sites as Site Code 755001. Remedial activities at the site are being conducted pursuant to an Order on Consent with Cornell University (see Section 5 - Enforcement Status).

Investigations conducted at the site prior to the Remedial Investigation include the following:

- 1974 to Present NYS Environmental Radiation Surveillance Program - sampling of surface water and homeowner well water by NYSDOH and NYSDEC
- 1984 Preliminary Investigation - groundwater sampling
- 1994 Preliminary Environmental Assessment - groundwater, soils, and surface water sampling; radiation surveys; and, risk assessment
- 1995 Assessment of Scintillation Fluid Compounds - characteristics of materials disposed at the RDS
- 1996 Sampling and Analysis Report - groundwater and surface water sampling
- 1996 to 2000 Biological Monitoring Program - sampling and survey of various biota

SECTION 4: SITE CONTAMINATION

To evaluate the contamination present at the site and to evaluate alternatives to address the significant threat to human health and/or the environment posed by the presence of hazardous waste, Cornell University has conducted a Remedial Investigation/Feasibility Study (RI/FS).

4.1: Summary of the Remedial Investigation

The purpose of the Remedial Investigation (RI) was to define the nature and extent of any contamination resulting from previous activities at the site. Based on the results of several previous studies, the investigative activities focused on groundwater and surface water as the routes of potential exposure. Figure 2 shows the general site layout and sampling locations.

The RI was conducted by Cornell University in two phases, the first Remedial Investigation and a Supplemental Remedial Investigation (SRI). The first phase field work was conducted between October 1995 and December 1996 and the Supplemental RI field work between June and December 1997. Results of these studies are presented in two reports:

Remedial Investigation Report
Cornell University Radiation Disposal Site
Lansing, New York
August 1997

Supplemental Remedial Investigation
Cornell University Radiation Disposal Site
Lansing, New York
February 1999

The RI and SRI included the following tasks:

- Installation of numerous soil borings and groundwater monitoring wells in soil and bedrock.

- Sampling of soil, vegetation, sediment, surface water, and groundwater.

- Pump test and geotechnical tests to determine physical and hydraulic properties of soil and bedrock.

- Water well surveys to determine the presence of receptors.

Along with previous investigations, the RI and SRI described above, and annual monitoring required by NYSDEC for regulatory purposes, there have been 30 separate sampling events (from December 1993 through December 2001) for groundwater and surface water conducted at the site. These include sampling at 35 groundwater locations and 42 surface water locations. Monitoring of the site continues.

To determine which media contain contamination at levels of concern, the RI analytical data was compared to environmental Standards, Criteria, and Guidance values (SCGs). Groundwater, drinking water and surface water SCGs identified for the Cornell Radiation Disposal Site are based on NYSDEC Ambient Water Quality Standards and Guidance Values and Part 5 of New York State Sanitary Code. For soils, NYSDEC TAGM 4046 provides soil cleanup guidelines for the protection of groundwater, background conditions, and health-based exposure scenarios. In addition, for soils, site specific background concentration levels can be considered for certain classes of contaminants. Guidance values for evaluating contamination in sediments are provided by the NYSDEC "Technical Guidance for Screening Contaminated Sediments". Radionuclide levels were also compared with applicable ambient water quality standards and were additionally compared with background and historical radionuclide concentration levels determined through analysis of off-site wells and surface water sampling points.

Additionally, consultants for Cornell produced a Baseline Human Health Risk Assessment (BHHRA) in February 1999. The BHHRA was designed to evaluate potential human health risks associated with existing exposures to contaminants at the RDS.

Based on the RI and SRI results, in comparison to the SCGs and potential environmental exposure routes, certain areas and media of the site require remediation. These are summarized below. More complete information can be found in the RI and SRI reports.

Chemical concentrations are reported in parts per billion (ppb). Radionuclide concentrations, in water, are generally reported as picocuries/liter (pC/L). For comparison purposes, where applicable, SCGs are provided for each medium. (See Table 1).

4.1.1 Site Geology and Hydrogeology

Two geologic units underlie the RDS: the overburden consisting of soil and glacial till deposits, and shale bedrock. The bedrock is shallow, generally within 12 feet of the surface. The bedrock can be further characterized by a shallow, highly fractured zone and a deeper zone of more competent rock. A thin transitional zone exists between the upper fractured rock and the lower competent bedrock. The primary zone of groundwater flow is in the interface area composed of the lower overburden/till and the upper fractured zone of bedrock. Groundwater also is found in the till and competent rock zones, though flow is minor compared to the interface zone.

The direction of flow is westerly in the till/overburden, southwesterly in the interface zone, and west southwest in the competent bedrock. The flow direction for the interface zone is shown on Figure 3.

4.1.2 Nature of Contamination:

As described in the RI and SRI reports, groundwater and surface water samples were collected at the site to characterize the nature and extent of contamination. The main categories of contaminants which exceed their SCGs are volatile organic compounds (VOCs) and radionuclides. Specifically, the following were identified as contaminants of concern:

- paradioxane (VOC)
- dichloroethene (VOC)
- benzene (VOC)
- tritium (radionuclide)
- strontium (radionuclide)

Paradioxane is the most widespread and persistent volatile contaminant found in the groundwater and surface water. Tritium is the most prevalent radionuclide found associated with the site.

4.1.3 Extent of Contamination

Table 1 summarizes the extent of contamination for the contaminants of concern in groundwater and surface water and compares the data with the SCGs for the site. The following are the media of concern which were investigated and a summary of the findings of the investigation.

Groundwater

The primary zone of groundwater migration from the site is through the interface area composed of the lower overburden/till and the upper fractured zone of bedrock. While groundwater is also found in the till and deeper, competent rock zones, the flow is minor compared to the interface zone.

The direction of flow is westerly in the till/overburden, southwesterly in the interface zone, and west southwest in the competent bedrock. Thus, groundwater from the site travels from the waste cell area, southwest across Snyder Road, in the direction of the Tompkins County Airport.

Paradioxane is the primary contaminant of concern at the RDS due to the frequency of detections and the concentrations found in groundwater. Paradioxane is present in concentrations in excess of the guidance value of 50 ppb in a number of groundwater wells downgradient of the site. Of the 35 monitoring points used in this and previous investigations, 16 have exhibited paradioxane above the guidance value. The highest concentrations and greatest frequency of detections have been observed in locations close to the waste cell and in interface wells (wells completed in the lower till/upper fractured bedrock), the primary route for groundwater migration from the site. The highest concentration of paradioxane detected was 12,000 ppb found in well RDS-1WS in September 1997. The main mass of the paradioxane plume (estimated at 92% of the total mass) is located north of Snyder Road, on Cornell University property. Of the wells installed south of Snyder Road, only one location, RDS-13WS on the Tompkins County Airport property, has consistently shown concentrations above the 50 ppb guidance value. Figure 4 shows the distribution of paradioxane in groundwater. The contours on the Figure indicate the areas of concentrations greater than 50 ppb, including a small portion on the airport property. The groundwater IRM will capture and treat that portion of the plume located north of Snyder Road.

Dichloroethene (DCE) and benzene were also detected in groundwater downgradient of the site, though in much lower concentration and frequency of detection compared to paradioxane. DCE was detected at a maximum concentration of 12.6 ppb (compared to the standard of 5 ppb) in 2 of 35 wells. Benzene was detected in concentrations up to 6 ppb (compared to the standard of 0.7 ppb) in 3 of 35 wells. Observations of DCE and benzene were confined to downgradient areas north of Snyder Road and do not extend off-site to the airport property.

Tritium and strontium-90 have been observed in groundwater downgradient of the site in concentrations in excess of background levels. Tritium is the most widespread of the radionuclides detected. For purposes of discussion, the concentrations of tritium and strontium are compared to background levels measured from the surrounding area (unaffected by the site) as well as drinking water standards set by the State and Federal regulations. Tritium is elevated above background in most interface wells located north of Snyder Road and at three locations on the airport property (RDS-11INT/WS, RDS-13WS, and RDS-14WS. Concentrations of tritium found range from below background to 13,200 picocuries/liter (pC/L). Twelve of the 35 wells sampled show levels above the background concentration of 300 pC/L. Tritium concentrations above the drinking water standard of 20,000 pC/L have not been observed at any locations.

Strontium-90 was found in concentrations above the background level of 2.28 pC/L in three wells (RDS-1WS RDS-2WS, and RDS-9WS), located immediately adjacent and downgradient of the disposal area. In two of the wells (RDS-1WS and RDS-2WS), concentrations were in excess of the drinking water standard of 8 pC/L, with a maximum detection of 16.63 pC/L. No detection of strontium above background levels or drinking water standards were noted south of Snyder Road.

Given the time since the original disposal, the declining radio-isotope activities, and the presence of the cap installed in 1996, concentrations of radionuclides in groundwater are expected to steadily decline. The radionuclide plume will, however, also be captured by the groundwater collection IRM.

Figure 5 shows the distribution of tritium and strontium concentrations above background in the groundwater.

A well survey was conducted during the Supplemental Remedial Investigation to identify users of groundwater in the site area. Four residential wells and one commercial well, for the Nutritional and Environmental Analytical Services (NEAS), were found within one mile and generally downgradient of the site. Two of the closest residential wells on Bush Lane (approximately 5,200 feet from the site) were sampled and found to be free of paradioxane or other contaminants of concern. The closest groundwater user to the site was the NEAS facility well located approximately 3,200 feet southwest and directly downgradient of the site. The well was sampled in September and December of 1997 and January and March of 1998. The December 1997 event detected paradioxane at 23 ppb. In the previous and subsequent sampling events, paradioxane was not detected. As a precaution, the NEAS well was taken out of service following the December 1997 sampling and the facility was put on the public water system.

Surface Water

Surface water in the vicinity of the site flows from northeast to southwest through culverts and ditches. The surface water drains into two tributaries of Twin Glens Creek and enters Cayuga Lake approximately 3 miles from the site. Figure 6 shows the pathways of surface water flow from the site.

Paradioxane is also the primary contaminant of concern in the surface water. Paradioxane has been detected in drainage ditches north of Snyder Road and in surface water and wetland seeps on the airport property. The greatest concentrations observed were 505 ppb and 300 ppb at the SW-7 and 7E location, respectively, on the airport property. Only 5 locations, of the 42 routinely sampled, have ever had detections greater than the 50 ppb guidance value for paradioxane. The detections in surface water on the airport are likely due to surface discharges of groundwater from the shallow aquifer on site. Occurrences of higher concentrations of paradioxane correlate well to seasonal periods of high groundwater elevation. Surface water sampling locations and contaminant distribution are shown in Figure 7.

Surface water at SW-30 has been sampled 26 times since January 1995. SW-30 is located at the outlet of Twin Glens Creek approximately 2.9 miles downstream from the RDS. Paradioxane was detected in three sampling events in that time. In the ninth sampling event, in December 1997, paradioxane was detected at an estimated concentration of 25 ug/l (estimated because the concentration was less than the required reporting limit but higher than the analytical method detection limit). In December 1998, paradioxane was detected at 11 ug/l but a second duplicate sample taken at the same time and location and analyzed did not detect paradioxane. Similarly, another detection of 19 ug/l was found in June 1999 but again not detected in the confirmatory duplicate sample. A detection of 1 ug/l (estimated concentration) was noted in March 2001. The surface water guidance value for paradioxane is 50 ug/l. A sampling location, upstream of SW-30, SW-31, has been sampled 25 times, generally during the same event as SW-30. SW-31 is located near North Triphammer Road approximately 1.8 miles downstream from the RDS. SW-31 has never had a detection of paradioxane.

Given the low frequency of detections, the low concentrations (below surface water and drinking water standards), and the non-detects in upstream samples, it is difficult to attribute the contamination noted in SW-30 to the site. As noted previously, paradioxane is a common industrial contaminant and has been associated with anti-freeze compounds from automobiles and deicing from compounds used at airports. The stream passes through the airport, along and under various highways, through a manufacturing company's water retaining pond, and through mixed residential and commercial neighborhoods on its three mile journey to the lake. Paradioxane has also been found in other surface water bodies not associated with the RDS in at least one location upstream of the CDS. For purposes of the Remedial Investigation and remedy selection, the sporadic detections at SW-30 are considered to be anomalous and not representative of releases from the site.

4.2 Interim Remedial Measures:

Interim Remedial Measures (IRMs) are conducted at sites when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS.

In September 1996, a capping IRM was completed at the site. The RDS was cleared of vegetation. The mulched vegetation and fill materials were used to smooth and regrade the area. A 60-mil thick, high density polyethylene (HDPE) liner was placed over the site to reduce infiltration of precipitation through the waste material and conveying contaminants to the groundwater and surface water. The liner also precludes any physical contact by humans or wildlife with the waste material. The liner is covered by a protective layer of soil to guard against physical damage and prevent deterioration of the synthetic material from ultraviolet radiation from sunlight. To prevent trespassers and wildlife from entering the site, an 8-foot chain link fence topped with barbed wire was installed around the perimeter of the site. A conveyance pipeline was installed below ground level to transport contaminated water from the RDS to the adjacent Cornell University Chemical Disposal Site groundwater treatment plant, approximately one-third mile to the southeast. Electrical service was installed at the site. Additionally, a subsurface tile drain investigation was conducted to determine the presence of any agricultural field drains that may provide a preferential path for water migration. Rudimentary drains were found and plugged.

A groundwater IRM has been implemented at the RDS. A technical work plan for a Groundwater IRM was approved by NYSDEC in August 1998 and the design of the system was completed in the fall of 2000. The IRM consists of a series of groundwater recovery wells along the north side of Snyder Road, downgradient of the RDS disposal area. This alignment will capture virtually all of the paradioxane with concentrations in excess of the cleanup goal of 50 ppb as well as a significant portion of the tritium plume that is above background concentrations. The water will be pumped via the conveyance line installed previously to the CDS treatment plant for treatment and discharge. Construction of the recovery wells and modifications to the existing CDS treatment plant are complete. Performance testing of the treatment system is underway. Start up of the system is planned for early 2002. The plume area to the south of Snyder Road, not captured by this IRM, would be the subject of natural attenuation and radioactive decay and undergo routine monitoring, as discussed elsewhere in this plan.

4.3 **Summary of Human Exposure Pathways:**

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the health risks can be found in the Baseline Human Health Risk Assessment (BHHRA) report.

Cornell produced a Baseline Human Health Risk Assessment (BHHRA) in February 1999. The BHHRA was designed to evaluate potential human health risks associated with existing exposures to contaminants at the RDS. This work supplemented the risk assessment performed in 1994 as part of the Preliminary Environmental Assessment. That work concluded that risks associated with the site, in its unremediated state, were well below levels of concern.

An exposure pathway is how an individual may come into contact with a contaminant. The five elements of an exposure pathway are 1) the source of contamination; 2) the environmental media and transport mechanisms; 3) the point of exposure; 4) the route of exposure; and 5) the receptor population. These elements of an exposure pathway may be based on past, present, or future events.

A completed exposure pathway is one that has all five factors present. The presence of a completed pathway does not mean populations have been exposed; it just gives an indication that the potential for such exposure exists. No known exposures to waste materials or contaminants have been identified at the site. For evaluation purposes, the only pathway determined to be complete at the site is the surface water pathway. Groundwater is not a completed pathway as no receptors have been identified and no drinking water wells are contaminated. The NEAS facility well located approximately 3,200 feet southwest and directly downgradient of the site did indicate paradioxane at low levels in December 1997. However, previous and subsequent sampling events did not detect the contaminant. The December 1997 result is not considered to be representative of contaminant conditions in groundwater at that location. As a precaution, the NEAS well was taken out of service following the December 1997 sampling and the facility was put on the public water system. The direct physical exposure pathway has been eliminated by the capping IRM completed in 1996.

Under the current land use and environmental conditions at the site, the BHHRA identified three groups of potential receptors that could be exposed to site contaminants through contaminated surface water:

- occasional area users such as trespassers, researchers, hunters, and maintenance workers
- Tompkins County Airport workers
- residents living near surface water drainage from the RDS

Cancer risk estimates were calculated for the three groups identified. The cancer risk refers to the probability that an individual in a specific population could develop cancer from site-related exposures, in this case, to paradioxane, tritium, or strontium-90. The risk calculations indicate that exposure (via any route such as ingestion, inhalation, dermal contact, etc.) to the RDS contaminants in surface water do not pose a human cancer threat greater than the USEPA target cancer risk of one in one million (sometimes represented as $1x10^{-6}$).

As a conservative measure, the BHHRA also evaluated risks for populations using well water and residents using water from Cayuga Lake for drinking, though no evidence exists of any potential exposures to these populations. Results of the evaluation indicate no unacceptable risk to the populations.

Radiological dose estimates for the RDS were calculated and compared to naturally occurring and man-made background sources of radiation. Results indicate that the annual radiation dose expected from potential exposure to RDS radionuclides is well below the average radiation dose received by U.S. residents from other sources. The value calculated was approximately 40,000 times less than the allowable exposure limit of 25 millirem/year established in NYS regulations for LLRW (or Low-Level Radioactive Waste) disposal sites.

SECTION 5: <u>ENFORCEMENT STATUS</u>

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers.

The NYSDEC and Cornell University entered into an Order on Consent (Index # A7-033395-08) in August 1996. The Order obligates Cornell University to implement a full remedial program.

SECTION 6: <u>SUMMARY OF THE REMEDIATION GOALS</u>

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. The overall remedial goal is to meet all Standards, Criteria And Guidance (SCGs) and be protective of human health and the environment. At a minimum, the remedy selected should eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The goals selected for this site are:

- Eliminate, to the extent practicable, off-site migration of groundwater and surface water that do not attain NYSDEC Standards, Criteria And Guidance (SCGs) values.
- Eliminate, to the extent practicable, human and environmental exposures to radionuclides.
- Eliminate, to the extent practicable, the exceedance of applicable environmental quality standards related to releases of contaminants to the waters of the state.
- Minimize the generation of new radioactive and mixed wastes (radioactive and hazardous) during the remediation process.
- Isolate and contain, to the maximum extent practicable, the radioactive and hazardous wastes.

SECTION 7: <u>SUMMARY OF THE EVALUATION OF ALTERNATIVES</u>

The selected remedy must be protective of human health and the environment, be cost effective, comply with other statutory laws and utilize permanent solutions, alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Cornell Radiation Disposal Site were identified, screened and evaluated in the report entitled *Radiation Disposal Site Feasibility Study Report, Cornell University, Lansing, New York*, dated February 1, 1999.

A summary of the detailed analysis follows. As presented below, the time to implement reflects only the time required to implement the capital construction portion of the remedy, and does not include the time required to design the remedy, procure contracts for design and construction or to negotiate with responsible parties for implementation of the remedy.

7.1: Description of Remedial Alternatives

The potential remedies are intended to address containment and isolation of waste materials, and control and treatment of surface water and groundwater at the site. The alternatives developed (Alternatives 1, 2, 3, 5, and 6) for detailed evaluation include a No Further Action alternative, two conventional landfill containment alternatives, a containment option involving new landfill construction, and a waste removal and disposal option. Alternative 4 was developed in the early stages of alternative evaluation and was intended to be a combination of containment and source removal technologies, including the sealing of the bottom of the landfill. As discussed in the Feasibility Study, this alternative was removed from the detailed evaluation of alternatives. The bottom sealing option was determined to be difficult to implement (due to the nature of the waste materials) and of uncertain effectiveness. Because Alternative 4 did not provide any greater protection or effectiveness than Alternative 2, it was dropped from further analysis.

All alternatives incorporate the Groundwater IRM as an integral part of the overall remedial strategy. This IRM was discussed in detail in Section 4.2. The capital costs associated with construction of the 1996 Capping IRM and the new Groundwater IRM are not included in the costs presented below.

All alternatives also incorporate the natural attenuation of the groundwater plume in the area South of Snyder Road. As discussed in Section 4, this portion of the plume contains a relatively small mass of contaminants relative to the area north of the road and generally exhibits concentrations that are already below the drinking water guidance value of 50 ppb for paradioxane. The tritium portion of the plume south of the road is well below any applicable concentration standards. Once the source of contamination is cut off by the Groundwater IRM wells to the north of the road, the plume concentrations will naturally be reduced by attenuation and radioactive decay. Given the absence of receptors (i.e, there are no active drinking water wells within the plume) and the low initial concentrations, this option is considered protective of the public health and environment.

Institutional controls are also an integral part of all the alternatives evaluated. These will include a formal filing and recording of declarations and notifications to any potential purchasers of the Cornell University property of the contamination present on the property. The notification will indicate that an existing hazardous waste remedial program, under the authority of the New York State Department of Environmental Conservation, is ongoing to address on-site and off-site contamination. Additional land use limitations and restrictions will be negotiated with the property owners as needed.

The alternatives do not specifically call for active remediation or treatment of affected surface water. The correlation of high groundwater elevations and flow direction with observed concentrations of paradioxane in the surface water seeps on the airport property indicate a connection to the observed groundwater plume, i.e, a small amount of shallow groundwater is discharging to the surface of the ground on the airport. The existing cap on the landfill already precludes direct runoff from the site waste to surface water bodies. Capture of groundwater via the groundwater IRM system and the enhancement of groundwater containment via the evaluated technologies (slurry wall, grout curtain, and source area groundwater collection) will effectively cut off the source of contaminated groundwater and will mitigate the surface water problem in the drainage ditches and surface seeps on the airport property.

The costs presented for each alternative include capital costs for construction and operation and maintenance costs. The costs are estimated over a 30 year period, for engineering cost development purposes only; operation, maintenance, and monitoring activities will continue for as long as necessary. The operation and maintenance costs for all the alternatives, including the No Further Action alternative, are relatively high. This is due to the extensive monitoring and sampling (including costly analysis for both radioactive and hazardous waste parameters) required under the various regulatory programs that apply to the site.

The *Time to Implement* listed is the time needed for capital construction of the alternative.

Alternative 1:

No further action, beyond the completed capping interim remedial measure and the groundwater collection interim remedial measure.

The No Further Action alternative is evaluated as a procedural requirement and as a basis for comparison. It requires continued monitoring only. This alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment beyond that provided for by the capping IRM and the groundwater IRM.

Alternative 1 includes:

8. Operation and maintenance of the IRM cap.
9. Operation and maintenance of the groundwater IRM collection and treatment systems.
10. Natural attenuation of the groundwater plume south of Snyder Road.
11. Long-term monitoring of groundwater and surface water.

Total Present Worth Cost:	*$5,826,000*
Capital Cost:	*$ 0*
Annual O&M:	*$ 379,000*
Time to Implement	*1 year*

Alternative 2:

Containment with slurry wall and grout curtain, groundwater collection, treatment, and discharge, natural attenuation.

Alternative 2 involves implementing the following:

1. Operation and maintenance of the IRM cap.
2. Operation and maintenance of the groundwater IRM collection and treatment systems.
3. Soil-bentonite slurry wall around the RDS, keyed in to the shale bedrock.
4. Vertical grout curtain under the slurry wall that seals the fractured shale bedrock to the top of the unfractured, competent rock
5. Natural attenuation of the groundwater plume south of Snyder Road.
6. Long-term groundwater and surface water monitoring.

Total Present Worth Cost:	*$ 6,904,000*
Capital Cost:	*$ 2,784,000*
Annual O&M:	*(Years 1-10) $399,000*
	(Years 11-20) $210,000
	(Years 21-30) $15,000
Time to Implement	*2 years*

Alternative 3:

Containment with slurry wall, source-area groundwater collection, treatment, and discharge, natural attenuation.

Alternative 3 is similar to Alternative 2 except that it provides for collection and treatment of contaminated water from inside the waste cell (in addition to the water outside the cell through the groundwater IRM), thus, allowing the elimination of the grout curtain. The alternative includes:

1. Operation and maintenance of the IRM cap.
2. Operation and maintenance of the groundwater IRM collection and treatment systems.
3. Soil-bentonite slurry wall around the RDS, keyed in to the shale bedrock.
4. Installation and operation of source area groundwater collection wells, with subsequent treatment of source water at the CDS treatment plant.
5. Natural attenuation of the groundwater plume south of Snyder Road.
6. Long-term groundwater and surface water monitoring.

Total Present Worth Cost:	*$ 6,974,000*
Capital Cost:	*$ 1,627,000*
Annual O&M:	*(Years 1-10) $485,000*
	(Years 11-20) $279,000
	(Years 21-30) $96,000
Time to Implement	*2 years*

Alternative 5:

Excavation of source area and off-site disposal, groundwater collection, treatment, and discharge, natural attenuation.

Alternative 5 involves the removal and off-site disposal of the waste mass. The containment aspects of the other alternatives (slurry wall, grout curtain, IRM cap) are not included. The collection of groundwater through the groundwater IRM system is retained. Specifically, the alternative includes:

1. Operation and maintenance of the groundwater IRM collection and treatment systems.
2. Excavation, staging, characterization, and segregation of the contents of the RDS waste mass.
3. Transportation and disposal of the excavated wastes at an off-site facility.
4. Treatment of groundwater recovered during excavation process.
5. Natural attenuation of the groundwater plume south of Snyder Road.
6. Long-term groundwater and surface water monitoring for 20 years.

Total Present Worth Cost:	*$154,807,000*
Capital Cost:	*$151,151,000*
Annual O&M:	*(Years 1-10) $366,000*
	(Years 11-20) $175,000
Time to Implement	*2 years*

Alternative 6:

Excavation of source area and on-site disposal, groundwater collection, treatment, and discharge, natural attenuation.

Alternative 6 involves the construction of a new, mixed waste containment cell on Cornell University property in an area near the existing RDS site. This cell would be constructed pursuant to applicable regulations for the establishment of new disposal facilities for both hazardous wastes and low-level radioactive wastes.

1. Operation and maintenance of the groundwater IRM collection and treatment systems.
2. Construction of a new mixed waste containment cell.
3. Excavation, staging, characterization, and segregation of the contents of the RDS waste mass.
4. Transportation and disposal of the excavated wastes in the new facility.
5. Treatment of groundwater recovered during excavation process.
6. Natural attenuation of the groundwater plume south of Snyder Road.
7. Long-term groundwater and surface water monitoring.

Total Present Worth Cost:	*$ 28,975,000*
Capital Cost:	*$24,791,000*
Annual O&M:	*(Years 1-10) $403,000*
	(Years 11-20) $190,000
	(Years 21-30) $59,000
Time to Implement	*2 years*

7.2 <u>Evaluation of Remedial Alternatives</u>

The criteria used to compare the potential remedial alternatives are defined in the regulation that directs the remediation of inactive hazardous waste sites in New York State (6 NYCRR Part 375). For each of the criteria, a brief description is provided, followed by an evaluation of the alternatives against that criterion. A detailed discussion of the evaluation criteria and comparative analysis is included in the Feasibility Study.

The first two evaluation criteria are termed threshold criteria and must be satisfied in order for an alternative to be considered for selection.

1. <u>Compliance with New York State Standards, Criteria, and Guidance (SCGs)</u>. Compliance with SCGs addresses whether or not a remedy will meet applicable environmental laws, regulations, standards, and guidance.

Alternative 1, No Further Action, will not achieve all of the Remedial Action Objectives and will not achieve the chemical/action/location specific SCGs, due to the lack of full containment of the waste materials. All of the other alternatives fully contain or remove the waste mass, thus allowing all SCGs to be met.

2. <u>Protection of Human Health and the Environment</u>. This criterion is an overall evaluation of each alternative's ability to protect public health and the environment. To satisfy this criterion, an alternative must do the following:

- reduce exposure to contaminants to acceptable levels after remediation
- reduce the magnitude of residual public health risk (based on excess cancer risk) after remediation
- reduce environmental risks to acceptable levels after remediation

Based on the results of the RI and SRI and the Baseline Human Health Risk Assessment performed at the site, all of the alternatives are considered to be protective of the public health and the environment due to the implementation of the capping and groundwater collection IRMs at the site.

The cap precludes exposure to the waste materials and the groundwater IRM will collect contaminated groundwater that exceeds the drinking water standards. Thus, on a technical scoring basis, the alternatives are equal.

On a relative basis, however, Alternative 1 is the least protective due to its lack of complete containment of the waste, thus the potential for future contaminant migration is increased. The containment alternatives (2 , 3, and 6) achieve a higher level of protectiveness due to containment of the waste mass. Alternative 5 could be considered to be the most protective, as the waste will be removed entirely from the site.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

3. Short-term Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

There are no known short-term risks associated with the implementation of Alternative 1. Alternative 2 and 3 are similar in short-term effectiveness. Construction of these two would pose a low amount of risk to workers, the public, and the environment. Slurry wall and grout curtain construction will be done in areas outside the waste mass, thus no mobilization of contaminants is anticipated. Alternative 3 poses a higher risk in construction and operation due to the need to install wells through highly contaminated areas and collect, transport, and treat highly contaminated source area water. Source area removal may also mobilize contaminants from the waste mass which are currently in equilibrium and not in the existing groundwater plume.

Alternatives 5 and 6 present a high degree of short-term risk due to the engineering difficulties associated with excavation of the waste mass. Due to the variable nature of the waste, effective controls on the release of radioactive and hazardous materials to the air, surface water, and groundwater during construction would be difficult to implement. Handling and repackaging of the wastes in containers acceptable for transport or re-burial in a new cell will provide enormous potential for human and environmental exposure. The presence of animal carcasses and laboratory materials in the fill would pose great physical and biological risk to workers. Transport of the mixed wastes, whether to a nearby new landfill cell, or a great distance to an existing, permitted disposal facility, poses additional risks to this community and others.

The length of time needed to meet the Remedial Action Objectives will be somewhat determined by the results of continued monitoring of the groundwater plume south of Snyder Road. Preliminary estimates are that it will take approximately 8 years of pumping for paradioxane concentrations to be reduced to below guidance value levels in the area north of Snyder Road. For the area south of Snyder Road, it is estimated that it will take approximately 20 years for levels to be naturally attenuated to concentrations less than 50 ppb. This time frame can be applied to all alternatives.

Actual remedial construction estimates are approximately 1 year for Alternative 1 and approximately 2 years for Alternatives 2, 3, 5, and 6. The time to complete the construction of Alternative 6 does not include the time needed to complete the permitting and siting process for the new cell.

4. Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the controls intended to limit the risk, and 3) the reliability of these controls.

Alternative 1 has a lower potential for long-term effectiveness due to the lack of complete containment of the waste and the potential for future migration of contamination from the site. Alternatives 2 and 3 are similar in long-term effectiveness, though source area pumping of groundwater in Alternative 3 may not be as effective in controlling contaminant migration as the physical grout curtain barrier proposed in Alternative 2. Alternative 6 offers a high degree of effectiveness as a containment measure. All the containment options are technologically reliable and easily monitored for performance. Again, Alternative 3 relies on source area pumping to provide a measure of isolation for the highly contaminated groundwater within the waste disposal area and may not be as reliable as physical barriers. Alternative 5 offers the highest degree of effectiveness and reliability as the waste is removed entirely (though the groundwater plume will remain to be treated and monitored).

5. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

A remedial alternative that is permanent typically incorporates destruction, separation, treatment, solidification, or fixation such that the hazardous characteristics of the waste are changed or mitigated. For radioactive materials, no such readily applied technologies are currently available. At best, the mobility of the waste can be controlled (that is, isolated or otherwise contained) and the volume of wastes produced during remediation can be controlled.

For all alternatives, the mobility and toxicity of the groundwater will be reduced through the collection and treatment of contaminated groundwater. Alternative 1 controls mobility the least, Alternative 2 and 6 are essentially equivalent in containment effectiveness. Alternative 3 has a lower mobility factor than the other containment options, but offers a reduction in toxicity as it will collect and treat more highly contaminated water from the source area, thus reducing the concentration of contaminants collected by the groundwater IRM system. Relative to the site property, Alternative 5, as a removal and off-site disposal option, offers the highest site reductions in toxicity and mobility.

In terms of minimizing the creation of new waste during the construction, the Groundwater IRM was specifically designed to comprehensively collect hazardous waste contaminants (i.e., paradioxane) migrating through the groundwater from the site, but also to minimize the collection of radionuclide-contaminated groundwater, which would require costly treatment and special handling. As discussed in Section 4, the groundwater area most impacted by radionuclides, other than tritium, is confined to the area immediately downgradient of the waste mass. Pump test and groundwater flow analyses were conducted during the design to model the reaction of the aquifer and develop a design that would effectively capture the tritium and paradioxane plumes but avoid mobilizing additional radioactive constituents (such a strontium) that are not currently migrating off-site.

Alternative 1 is the option that creates the least amount of new mixed wastes which have to be managed. Alternative 2 creates the least waste for the containment options. Due to the active pumping of highly contaminated water, Alternative 3 may mobilize radionuclides that may require special treatment and handling. The excavation of wastes in Alternatives 5 and 6 would generate significant amounts of new wastes to be handled. These wastes include groundwater (and associated wastes from treatment) from dewatering operations and surface water runoff collected during construction. The transport and re-disposal requirements would dictate a significant increase in the total volume of radioactive and hazardous materials. For example, the disposal and retrieval requirements of the new cell would require the waste to be consolidated, stabilized, and repackaged. Likewise, the transport regulations for both alternatives would require the waste to be stabilized/repackaged prior to movement.

6. <u>Implementability</u>. The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, etc..

Alternative 1 is easily implementable. Alternative 2 also poses no significant technical implementation problems. The slurry wall and grout curtain technologies are routinely installed, effective, and the necessary expertise and material for construction are readily available. The implementation of Alternative 3 presents some difficulties due to the installation of source area recovery wells into a highly contaminated area. The actual installation of the wells could be problematic due to the nature of the fill and provisions must be made for the handling of highly contaminated water. Alternatives 5 and 6 are considered very difficult to implement. Excavation of the waste in both alternatives will pose extreme engineering and handling difficulties due to the highly variable and uncertain nature of the waste. As discussed in Sections 3. <u>Short-term Effectiveness</u> and 5. <u>Reduction of Toxicity, Mobility or Volume,</u> above, disturbance of the waste mass will potentially mobilize contaminants, present hazardous to workers and the surrounding community, and generate a significant increase in waste volume. Comprehensive temporary storage, handling, and treatment facilities will be needed to properly characterize and prepare the waste for each scenario. For Alternative 6, the technical suitability of nearby land for the creation of a new low-level radioactive waste site is unknown.

From an administrative implementability standpoint, finding off-site disposal facilities with suitable capacity and permits for the waste (Alternative 5) will be difficult. A stated above, the construction of a new disposal cell (Alternative 6) poses additional difficulties. Rigorous technical siting and permitting requirements exist for the construction of low-level radioactive waste and hazardous waste landfills. The time and investigations required to meet these regulations will be extensive. The suitability of the Cornell University property or other surrounding lands for a new cell is unknown. There are no known permitting or regulatory impediments to implementation of the other alternatives.

7. Cost. Capital and operation and maintenance costs are estimated for each alternative and compared on a present worth basis. Although cost is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the remaining criteria, cost effectiveness can be used as the basis for the final decision. The costs for each alternative are presented in Table 2.

Alternative 1 is the least costly option. Of the containment options, Alternative 2 is the least costly. Alternative 5 is the most expensive due to disposal costs associated with the large volume of radioactive and hazardous waste to be transported to an off-site facility.

This final criterion is considered a modifying criterion and is taken into account after evaluating those above. It is evaluated after public comments on the Proposed Remedial Action Plan have been received.

8. Community Acceptance - Concerns of the community regarding the RI/FS reports and the Proposed Remedial Action Plan have been evaluated. Written comments were received primarily from members of the Tompkins County Environmental Management Council, the Tompkins County Water Resource Council, and a locally based environmental information company. No written comments were received from other local residents, businesses, or municipalities. The comments concerned the extent of investigation of surface water and groundwater, the potential impacts and benefits of the creation of a new waste disposal facility, or the complete removal of the waste from the site. The "Responsiveness Summary" included as Appendix A presents the public comments received and the Department's response to the concerns raised.

SECTION 8: SUMMARY OF THE SELECTED REMEDY

Based upon the results of the RI/FS, and the evaluation presented in Section 7, Cornell University is proposing **Alternative 2** as the remedy for this site. The NYSDEC and NYSDOH are in agreement with this remedy selection. Given the nature and extent of contamination and site conditions, this remedy meets or exceeds the requirements for the remediation of inactive hazardous waste sites under the regulatory programs applicable to the site.

Alternative 2 provides for the conventional containment of the RDS source area with a combination of slurry wall, vertical grout curtain, and the previously installed landfill cap; collection and treatment of contaminated groundwater north of Snyder Road (the area where groundwater contaminant levels exceed the cleanup standard of 50 ppb for paradioxane); and, natural attenuation and monitoring for the remainder of the groundwater plume. The alternative does not specifically call for active remediation or treatment of affected surface water. The correlation of high groundwater elevations and flow direction with observed concentrations of paradioxane in the surface water seeps on the airport property indicate a connection to the observed groundwater plume, i.e, a small amount of shallow groundwater is discharging to the surface of the ground on the airport. The existing cap on the landfill already precludes direct runoff from the site waste to surface water bodies. Capture of groundwater via the groundwater IRM system and the enhancement of groundwater containment via the evaluated technologies (slurry wall, grout curtain, and source area groundwater collection) will effectively cut off the source of contaminated groundwater and will mitigate the surface water problem in the drainage ditches and surface seeps on the airport property. Figure 8 presents a conceptual plan of the selected remedy.

This selection is based upon the detailed evaluation of the five remedial alternatives developed for the site. These included a No Further Action alternative, two conventional landfill containment alternatives, a containment option involving new landfill construction, and a waste removal and disposal option.

With the exception of the no further action alternative, each of the alternatives will comply with the threshold criteria. The no further action alternative was thus determined to be unable to accomplish the remedial goals for the site.

With respect to the majority of the balancing criteria, there were significant differences between the conventional containment alternatives (Alternatives 2 and 3) and the removal/containment alternatives (Alternatives 5 and 6).

Alternatives 2 and 3 are similar in short-term effectiveness. Construction of these two would pose the least amount of risk to workers, the public, and the environment. Alternative 3 poses a slightly higher risk due to the need to collect, transport, and treat highly contaminated source area water. Alternatives 5 and 6 present a high degree of short-term risk due to the engineering difficulties associated with excavation of the waste mass. Due to the variable nature of the waste, effective controls on the release of radioactive and hazardous materials during construction will be difficult to implement. The presence of animal carcasses and laboratory materials in the fill will pose great physical and biological risk to workers. Transport of mixed wastes poses an additional risk.

Alternatives 2, 3, and 6 represent equivalent high levels of long-term effectiveness and permanence. Alternative 5 is considered more effective and permanent due to the removal of the waste mass; however, management of the groundwater plume will remain as with the other alternatives.

Alternatives 2, 3, and 6 will reduce, to a similar degree, the mobility of wastes due to functionally equivalent containment technologies. Alternative 5 will remove the waste, thus reducing the mobility of the wastes relative to the site to the greatest degree. Alternatives 5 and 6, however, will significantly increase the volumes of mixed wastes produced during the remedial construction process. The excavation, staging, and characterization process, along with dewatering operations, will generate large volumes of material that would have to be managed as hazardous wastes.

Alternative 3 will also produce increased volumes of mixed waste due to source area removal of highly contaminated water.

The implementability of Alternative 2 is considered very high. The technologies proposed are effective and routinely constructed. The shallow depth to bedrock and the transition from fractured rock to relatively impermeable bedrock is conducive to the conventional containment technology proposed. Alternative 3 is considered slightly less implementable due to the inherent difficulties of installation of source area wells into highly contaminated areas. Alternatives 5 and 6 are considered difficult to implement. Excavation of the waste will pose extreme engineering and handling difficulties due to the nature of the waste. Finding off-site disposal facilities with suitable capacity and permits for the waste (Alternative 5) will be difficult. The construction of a new disposal cell (Alternative 6) poses additional difficulties. Rigorous technical siting and permitting requirements exist for the construction of low-level radioactive waste and hazardous waste landfills. The time and investigations required to meet these regulations will be extensive. The suitability of the Cornell University property or other surrounding lands for a new cell is unknown.

Alternative 2 is the least costly of the alternatives retained. Alternative 5 is the most costly due to the expense of waste handling and off-site transport and disposal of the waste.

The detailed elements of the selected remedy are as follows:

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS and SRI will be resolved.
2. Operation and maintenance of the existing IRM cap. This includes any necessary upgrades to meet current or future performance criteria.
3. Installation of a soil-bentonite slurry wall around the waste mass, keyed into fractured shale bedrock.
4. Installation of a vertical grout curtain under the slurry wall that seals the fractured shale zone and any transitional zones down to the top of the relatively impermeable competent bedrock.
5. Installation of piezometers inside and outside of the slurry wall to monitor its performance.
6. Operation and maintenance of the groundwater IRM collection and treatment systems.
7. Natural attenuation and monitoring of the plume.

The estimated total present worth cost to implement Alternative 2 is $6,904,000. The capital cost to construct the remedy is estimated to be $ 2,784,000. The operation and maintenance activities include groundwater and surface water sampling and analysis on a quarterly and annual basis, groundwater IRM performance monitoring, plume attenuation monitoring and modeling, and costs associated with the operation of the groundwater treatment system. The monitoring costs are relatively high and the activities extensive due to the various regulatory programs (radioactive waste, hazardous waste, solid waste) that apply to the site. The costs are projected in 10 year periods, with the years 1-10 costing $399,000 per year, years 11-20 costing $210,000 per year, and costs dropping off to maintenance levels of $15,000 per year once groundwater concentrations decrease in the off-site plume.

As the remedy results in untreated hazardous waste remaining at the site, a long term monitoring program will be instituted. A groundwater and surface water monitoring network will be developed to document mitigation of groundwater movement from the landfill, evaluate surface water conditions, and to monitor the progress of the natural attenuation of the groundwater plume. This program will determine the overall effectiveness of the containment system and the groundwater collection system. A contingency plan will be developed to implement more active remedial measures should the plume not attenuate as expected. Institutional controls will also be implemented. These will include a formal filing and recording of declarations and notifications to any potential purchasers of the Cornell University property of the contamination present . The notifications will also indicate that an existing hazardous waste remedial program, under the authority of the New York State Department of Environmental Conservation, is ongoing to address on-site and off-site contamination. Additional land use limitations and restrictions will be negotiated with the property owners as needed.

SECTION 9: HIGHLIGHTS OF COMMUNITY PARTICIPATION

As part of the remedial investigative and remedy selection process, a number of Citizen Participation activities were undertaken in an effort to inform and educate the public about conditions at the site and the potential remedial alternatives. The following public participation activities were conducted:

- Repositories for documents pertaining to the site were established.
- A mailing list was established which includes nearby property owners, local political officials, media and other interested parties.
- Cornell University periodically prepared and distributed a newsletter describing activities at the site.
- Cornell University and NYSDEC conducted and attended numerous small group meetings with local officials and other private interested parties.
- An internet website providing information about the site was established.
- Fact Sheets presenting the Proposed Remedial Action Plan and announcing the public participation opportunities were mailed to those parties on the mailing list.
- A 60-day comment period was held from April 13, 2001 to June 13, 2001 to provide an opportunity for public participation in the remedy selection process.
- Public meetings were held in the Ithaca area on April 26, 2001 and May 15, 2001. The meetings were to present the results of the FS, to describe the remedial alternatives, to present the preferred remedial alternative identified in the Proposed Remedial Action Plan, and to answer questions from the public.
- A Responsiveness Summary has been prepared to address comments received during the public comment period and at the public meetings.

Table 1
Nature and Extent of Contamination

MEDIA	CLASS	CONTAMINANT OF CONCERN	CONCENTRATION RANGE	FREQUENCY of EXCEEDING SCGs/BKG	SCG/ BKG
Groundwater	Volatile and Semi-Volatile Organic Compounds (VOCs/SVOCs)	Paradioxane	ND to 12,000 ppb	16 of 35	50 ppb
		1,2-Dichloroethene	ND to 12.6 ppb	2 of 35	5 ppb
		Benzene	ND to 6 ppb	3 of 35	0.7 ppb
	Radionuclides	Tritium	Less than background to 13,200 picocuries/liter (pC/L)	12 of 35	20,000 / 300 pC/L
		Strontium-90	Less than background to 16.63 picocuries/liter	2 of 35	8/2.28 pC/L
Surface Water	Volatile and Semi-Volatile Organic Compounds (VOCs/SVOCs)	Paradioxane	ND to 505 ppb	5 of 42	50 ppb

Note: SCG denotes Standards, Criteria, and Guidance from various sources including NYS Class GA groundwater standards, NYSDOH standards for drinking water supplies, and federal drinking water standards.

BKG denotes background levels of radionuclides derived from site investigation sampling and analysis. For tritium, the 300 pC/l background level represents the upper activity range of tritium found in background locations in areas unaffected by the site.

Table 2
Remedial Alternative Costs

Remedial Alternative	Capital Cost	Annual O&M Cost	Total Present Worth Cost
Alternative 1- No Further Action	$0	Yr 1-30 $379,000	$5,826,000
Alternative 2 - Containment variation w/grout curtain	$2,784,000	Yr 1-10 $399,000 Yr 11-20 $210,000 Yr 21-30 $15,000	$6,904,000
Alternative 3 - Containment variation w/source area pumping	$1,627,000	Yr 1-10 $485,000 Yr 11-20 $279,000 Yr 21-30 $96,000	$6,974,000
Alternative 5 - Waste removal/off-site disposal option	$151,151,000	Yr 1-10 $366,000 Yr 11-20 $175,000	$154,807,000
Alternative 6 - Waste removal/New cell construction option	$24,791,000	Yr 1-10 $403,000 Yr 11-20 $190,000 Yr 21-30 $59,000	$28,975,000

FIGURE 1

SITE LOCATION

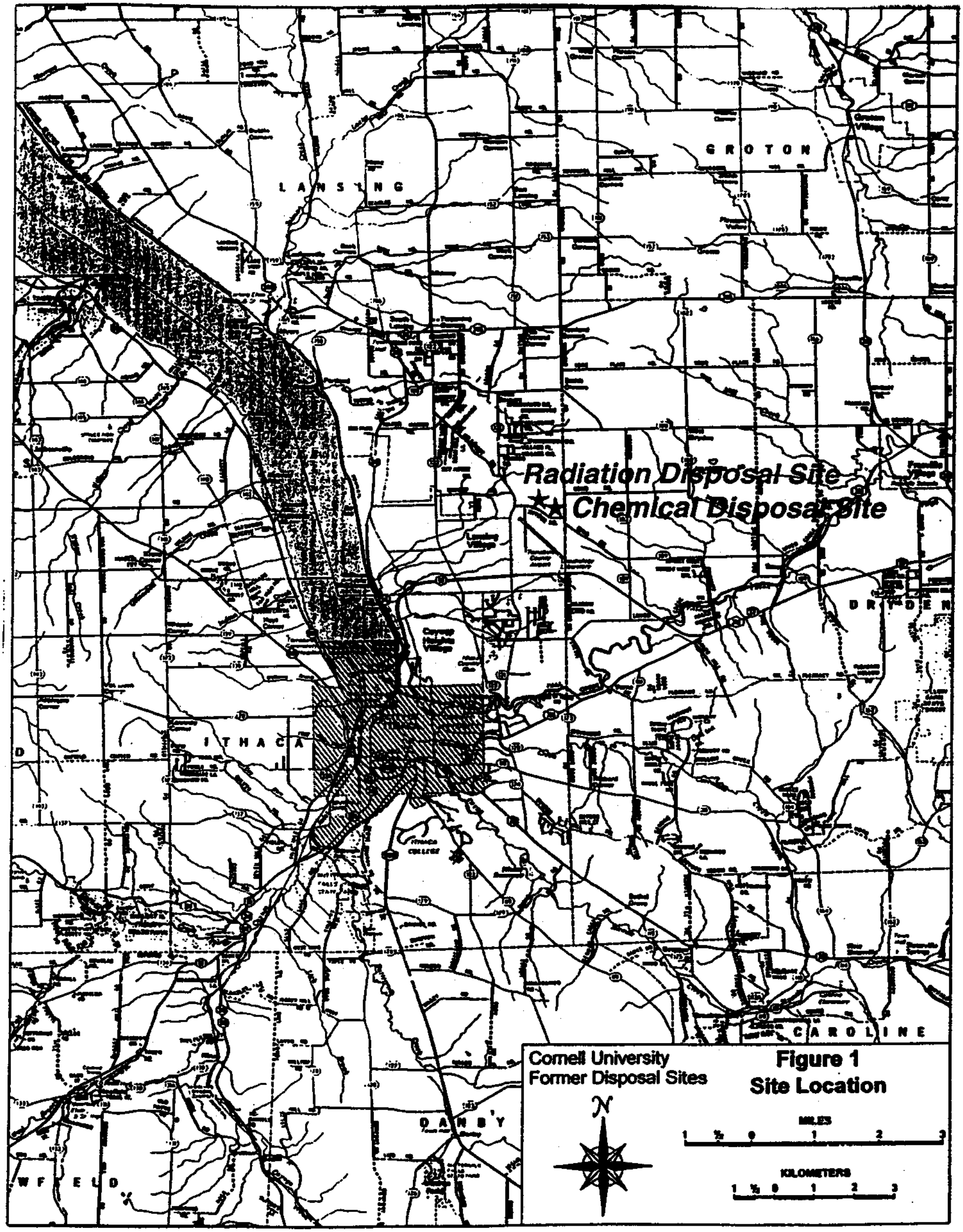
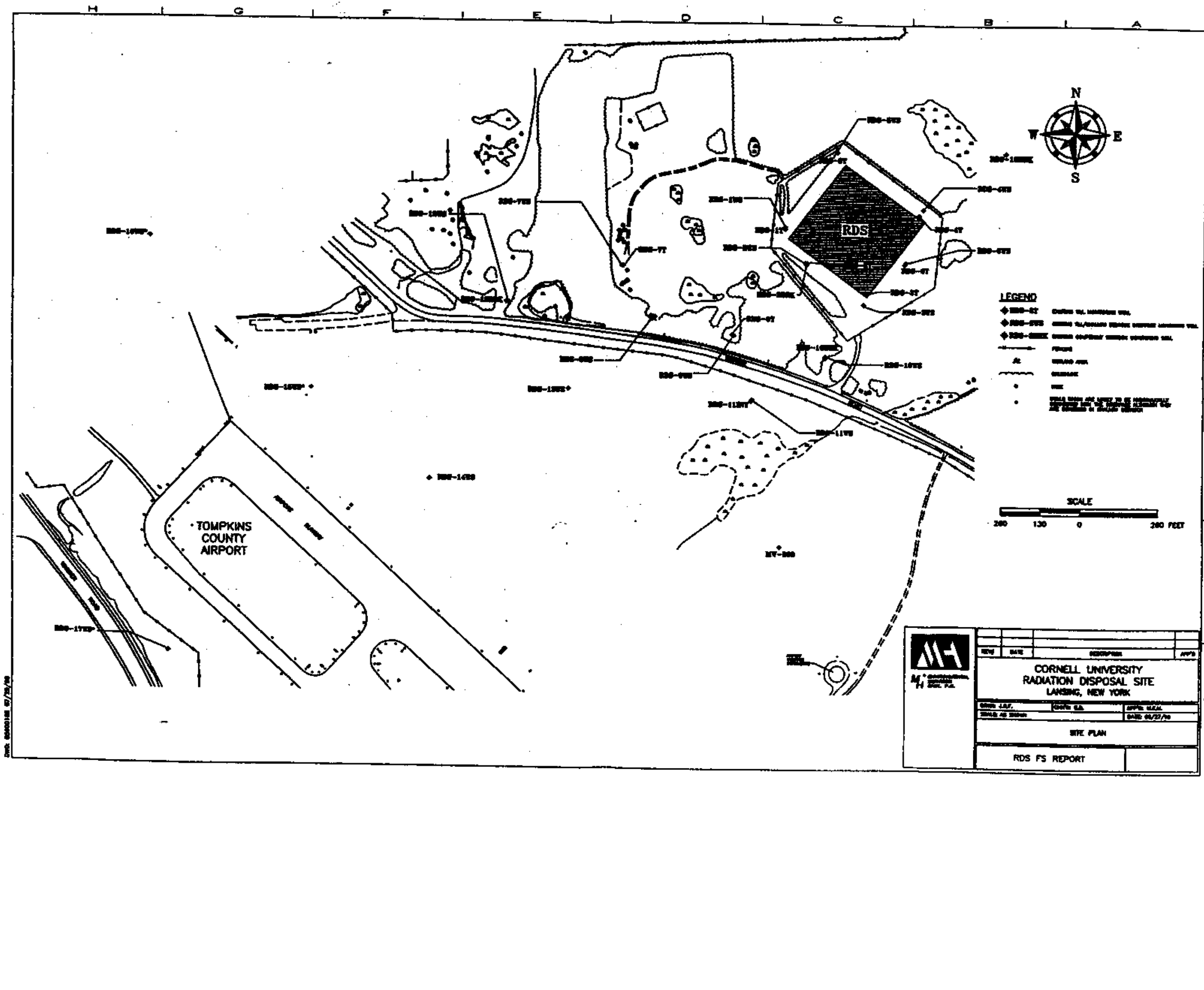


Figure 1
Site Location

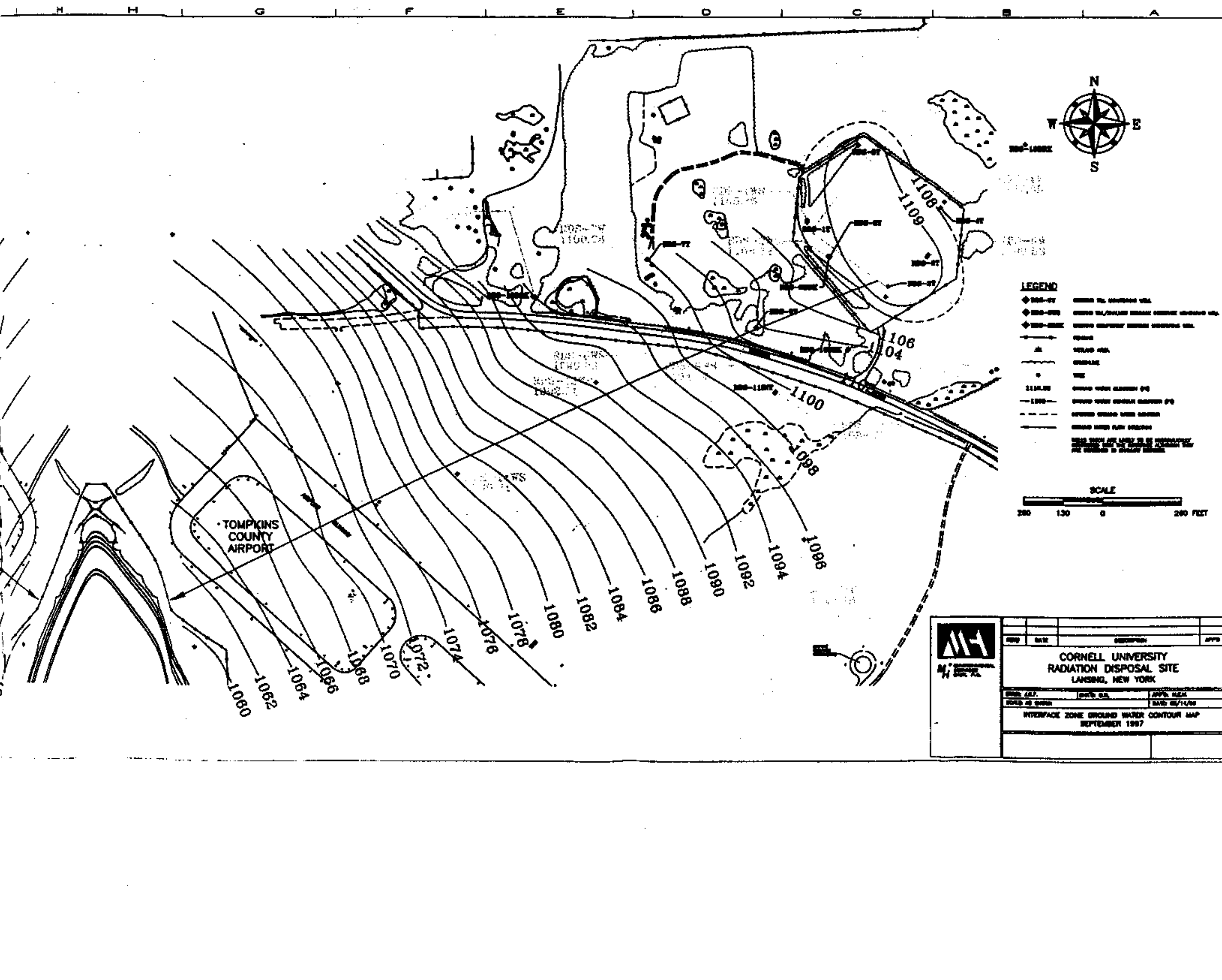


H
G
F
E
D
C
B
A
6
5
4
3
2
1
N
E
S
W
RDS
TOMPKINS
COUNTY
AIRPORT
LEGEND
SCALE
260
130
0
260 FEET
CORNELL UNIVERSITY
RADIATION DISPOSAL SITE
LANSING, NEW YORK
SITE PLAN
RDS FS REPORT

Fig. 2

FIGURE 3

GROUNDWATER FLOW DIRECTION



TOMPKINS
COUNTY
AIRPORT
1060
1062
1064
1066
1068
1070
1072
1074
1076
1078
1080
1082
1084
1086
1088
1090
1092
1094
1096
1098
1100
1104
1106
1108
1109
N
S
E
W
LEGEND
SCALE
CORNELL UNIVERSITY
RADIATION DISPOSAL SITE
LANSING, NEW YORK
SEPTEMBER 1997

FIGURE 4

EXTENT OF PARADIOXANE

ABOVE 50 PPB IN GROUNDWATER

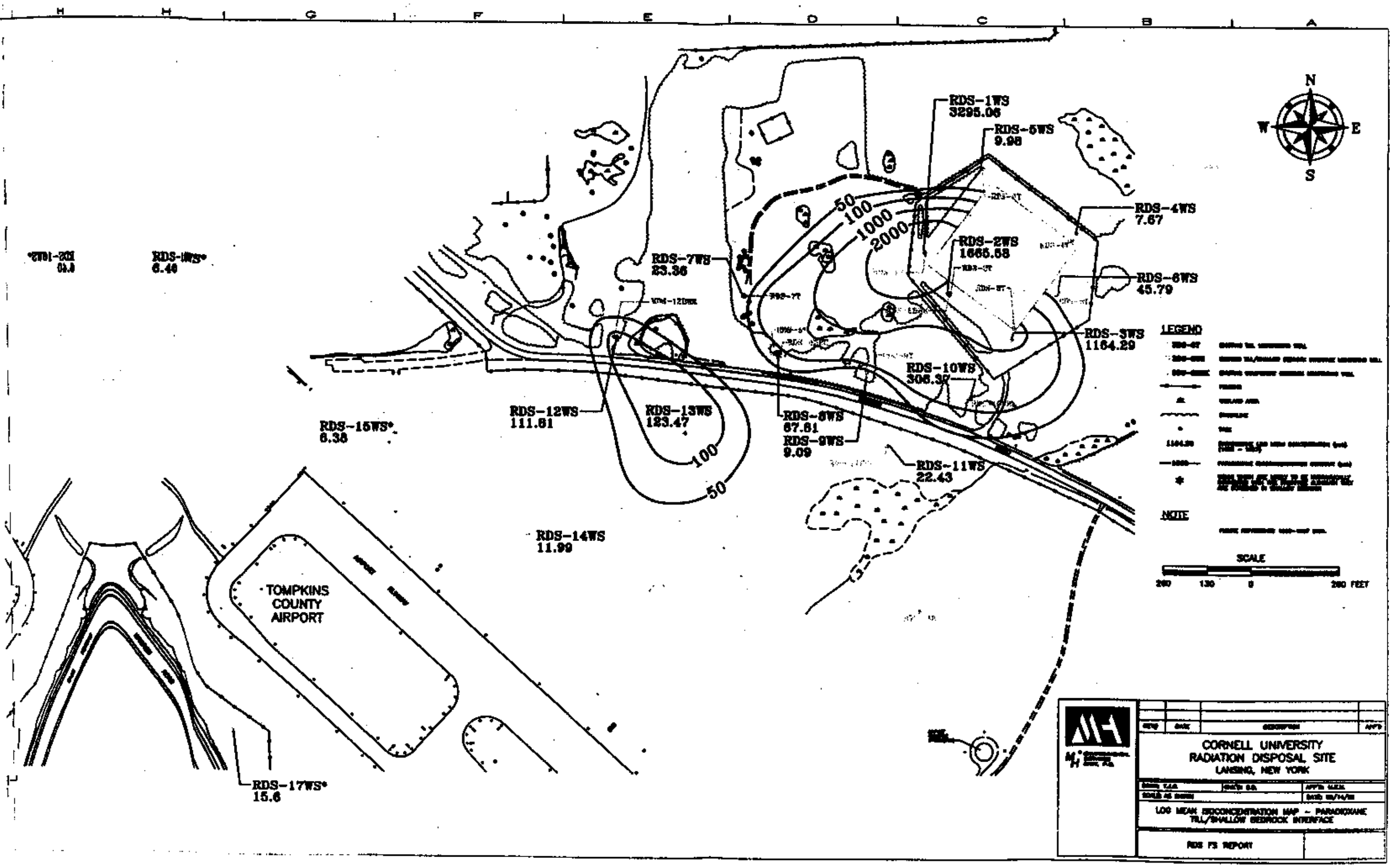
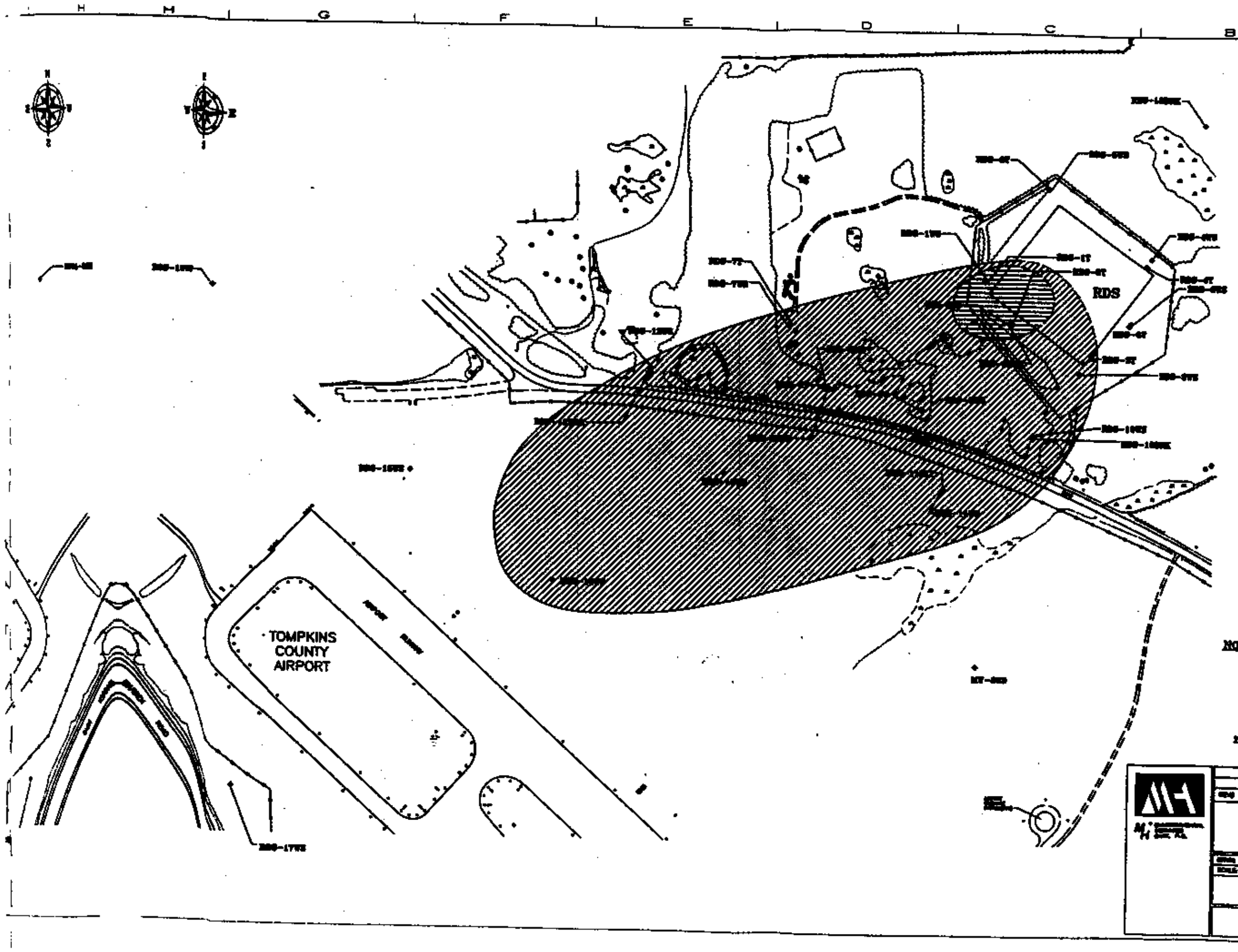

N
S
E
W
RDS-1WS
3295.06
RDS-5WS
9.98
RDS-4WS
7.67
RDS-2WS
1665.58
RDS-6WS
45.79
RDS-3WS
1164.29
RDS-7WS
23.36
RDS-10WS
306.32
RDS-12WS
111.81
RDS-13WS
123.47
RDS-8WS
67.81
RDS-9WS
9.09
RDS-11WS
22.43
RDS-15WS*
6.38
RDS-14WS
11.99
RDS-17WS*
15.6
50
100
1000
2000
TOMPKINS
COUNTY
AIRPORT
LEGEND
NOTE
SCALE
260 FEET
CORNELL UNIVERSITY
RADIATION DISPOSAL SITE
LANSING, NEW YORK
RDS FS REPORT

FIGURE 5

EXTENT OF TRITIUM and STRONTIUM

ABOVE BACKGROUND in GROUNDWATER



1995-1997	
TRITIUM STATISTICS	
WELL #	MEAN (pCi/l)
RDS-1WS	4110.56
RDS-2T	914.35
RDS-2WS	2613.43
RDS-3WS	4701.37
RDS-7T	997.73
RDS-7WS	1229.88
RDS-8WS	1407.19
RDS-10WS	1675.30
RDS-11INT	1650.00
RDS-11WS	2845.00
RDS-12WS	863.00
RDS-13WS	1295.90
RDS-14WS	377.00

1995-1997	
STRONTIUM STATISTICS	
WELL #	MEAN (pCi/l)
RDS-1WS	7.124
RDS-2WS	6.516

LEGEND

NOTE: ALL MEAN CONCENTRATIONS ARE BELOW NYSDEC WATER QUALITY STANDARDS:

Sr-90 – 8 pCi/L

Tritium – 20,000 pCi/L

SCALE

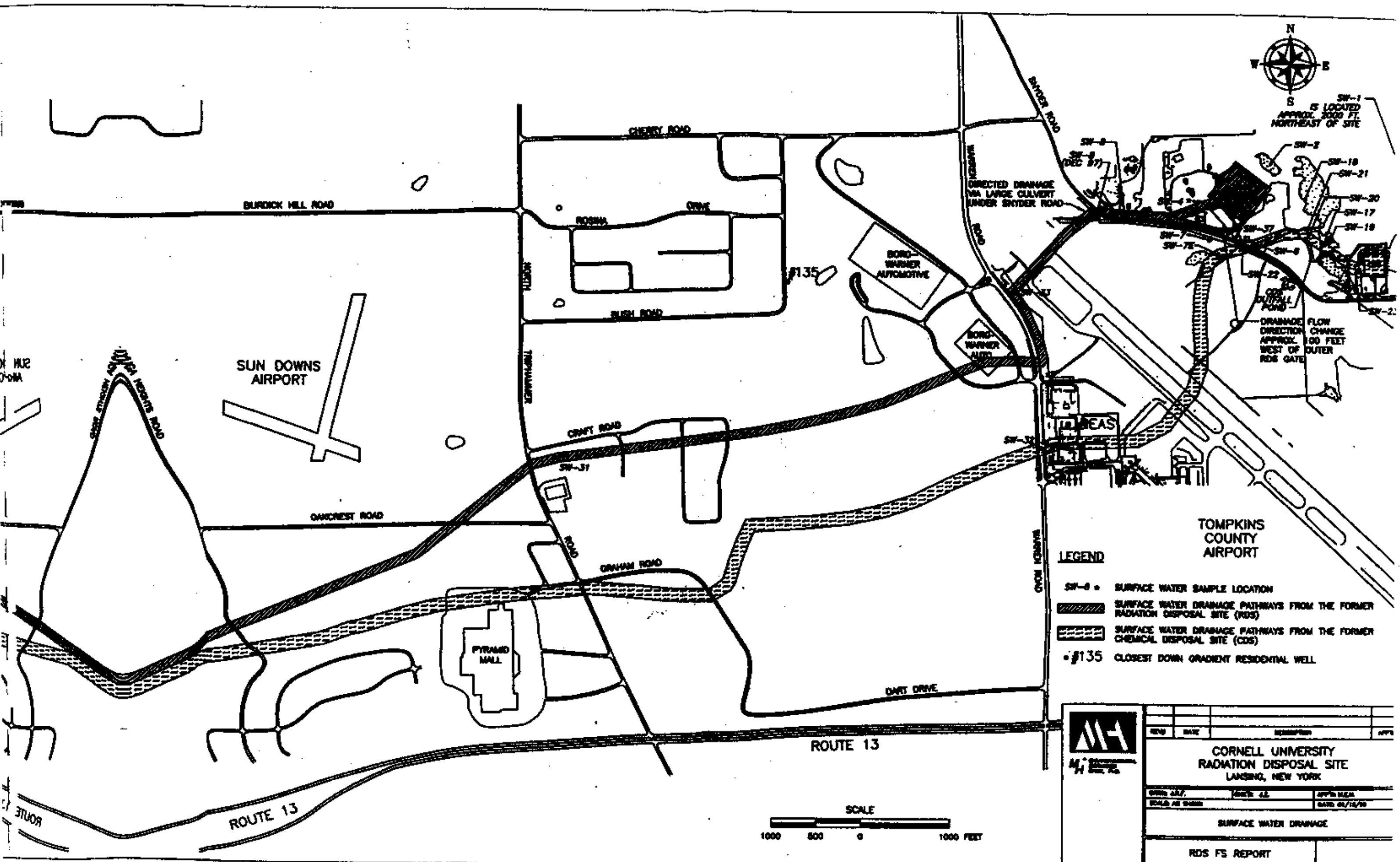
CORNELL UNIVERSITY
RADIATION DISPOSAL SITE
LANSING, NEW YORK

MEAN TRITIUM AND STRONTIUM CONCENTRATIONS ABOVE BACKGROUND IN GROUNDWATER

FIGURE 6

SURFACE WATER

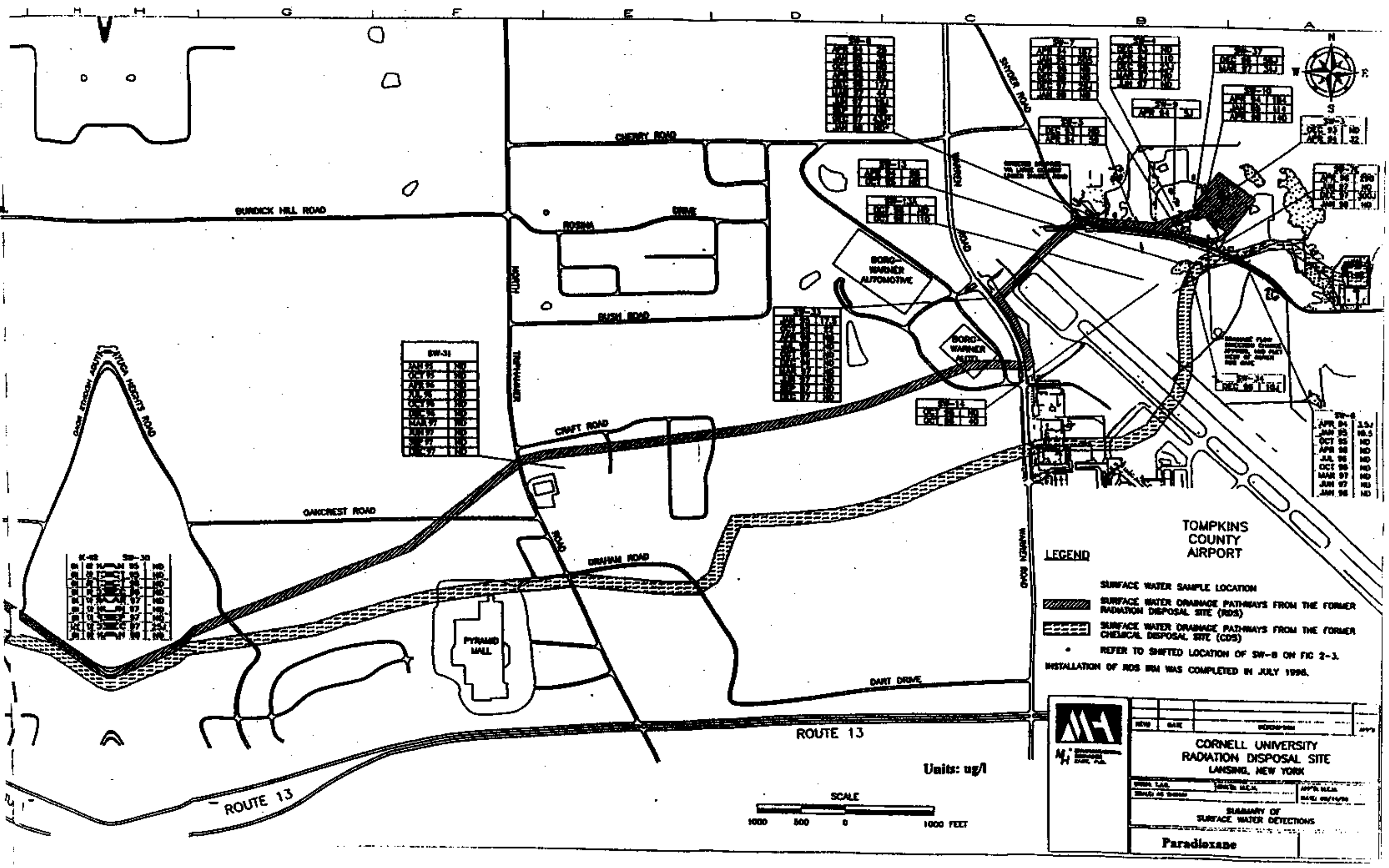
DRAINAGE PATHWAYS



CHERRY ROAD
BURDICK HILL ROAD
ROSINA
DRIVE
BUSH ROAD
NORTH
TRIPHAMMER
ROAD
SUN DOWNS
AIRPORT
CRAFT ROAD
OAKCREST ROAD
GRAHAM ROAD
PYRAMID
MALL
DART DRIVE
ROUTE 13
ROUTE 13
SNYDER ROAD
WARREN
ROAD
DIRECTED DRAINAGE
VIA LARGE CULVERT
UNDER SNYDER ROAD
BORG-
WARNER
AUTOMOTIVE
BORG-
WARNER
AUTO
#135
BEAS
SW-31
TOMPKINS
COUNTY
AIRPORT
SW-1
IS LOCATED
APPROX. 2000 FT.
NORTHEAST OF SITE
DRAINAGE FLOW
DIRECTION CHANGE
APPROX. 100 FEET
WEST OF OUTER
RDS GATE
N
S
E
W
LEGEND
SW-6 • SURFACE WATER SAMPLE LOCATION
SURFACE WATER DRAINAGE PATHWAYS FROM THE FORMER RADIATION DISPOSAL SITE (RDS)
SURFACE WATER DRAINAGE PATHWAYS FROM THE FORMER CHEMICAL DISPOSAL SITE (CDS)
• #135 CLOSEST DOWN GRADIENT RESIDENTIAL WELL
SCALE
1000 500 0 1000 FEET
CORNELL UNIVERSITY
RADIATION DISPOSAL SITE
LANSING, NEW YORK
SURFACE WATER DRAINAGE
RDS FS REPORT

FIGURE 7

SURFACE WATER SAMPLING RESULTS

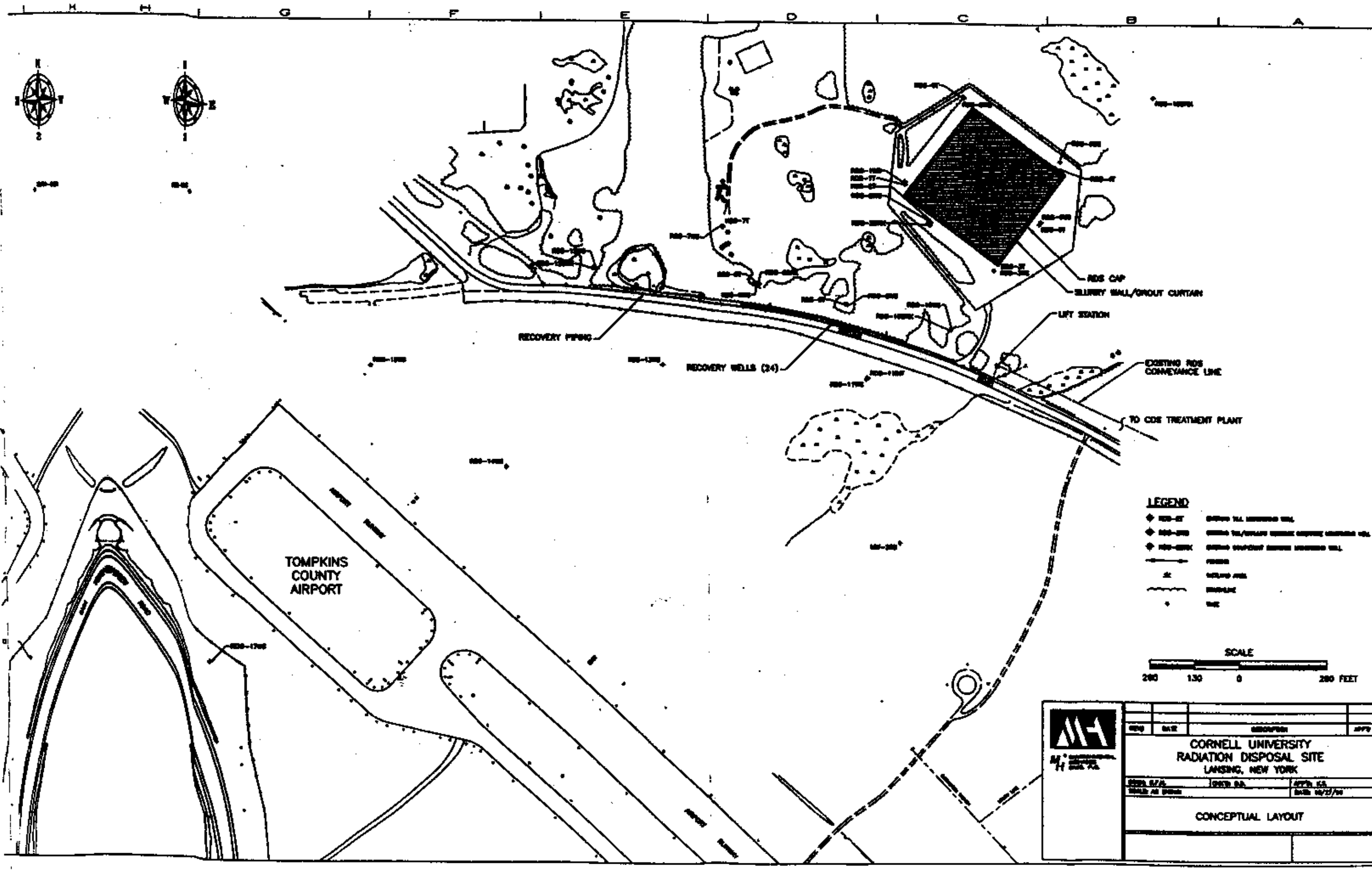


CHERRY ROAD
BURDICK HILL ROAD
ROSINA DRIVE
BUSH ROAD
NORTH TRIPHAMMER ROAD
CRAFT ROAD
OAKCREST ROAD
GRAHAM ROAD
PYRAMID MALL
DART DRIVE
ROUTE 13
ROUTE 13
WARREN ROAD
SNYDER ROAD
BORG-WARNER AUTOMOTIVE
BORG-WARNER AUTO.
SW-31
TOMPKINS COUNTY AIRPORT
LEGEND
SURFACE WATER SAMPLE LOCATION
SURFACE WATER DRAINAGE PATHWAYS FROM THE FORMER RADIATION DISPOSAL SITE (RDS)
SURFACE WATER DRAINAGE PATHWAYS FROM THE FORMER CHEMICAL DISPOSAL SITE (CDS)
REFER TO SHIFTED LOCATION OF SW-8 ON FIG 2-3.
INSTALLATION OF RDS IRM WAS COMPLETED IN JULY 1996.
Units: ug/l
SCALE
1000 500 0 1000 FEET
CORNELL UNIVERSITY
RADIATION DISPOSAL SITE
LANSING, NEW YORK
SUMMARY OF SURFACE WATER DETECTIONS
Paradioxane

FIGURE 8

CONCEPTUAL PLAN

SELECTED REMEDIAL ALTERNATIVE



TOMPKINS COUNTY AIRPORT
RECOVERY PIPING
RECOVERY WELLS (24)
RDS CAP
SLURRY WALL/GROUT CURTAIN
LIFT STATION
EXISTING RDS CONVEYANCE LINE
TO CDS TREATMENT PLANT
LEGEND
SCALE
260 130 0 260 FEET
CORNELL UNIVERSITY
RADIATION DISPOSAL SITE
LANSING, NEW YORK
CONCEPTUAL LAYOUT

APPENDIX A

RESPONSIVENE$S SUMMARY

RESPONSIVENESS SUMMARY

Proposed Remedial Action Plan

Cornell University Radiation Disposal Site
Town of Lansing, Tompkins County
Site No. 7-55-001

The Proposed Remedial Action Plan (PRAP) for the Cornell University Radiation Disposal Site was prepared by the New York State Department of Environmental Conservation (NYSDEC) and issued for pubic comment on April 13, 2001. The PRAP identified the preferred remedy for the site, summarized the other alternatives considered, and discussed the reasons for choosing the proposed remedy.

The detailed elements of the proposed remedy are as follows:

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS and SRI will be resolved.
2. Operation and maintenance of the existing IRM cap. This includes any necessary upgrades to meet current or future performance criteria.
3. Soil-bentonite slurry wall around the waste mass, keyed into fractured shale bedrock.
4. Vertical grout curtain under the slurry wall that seals the fractured shale zone and any transitional zones down to the top of the relatively impermeable competent bedrock.
5. Piezometers inside and outside of the slurry wall to monitor its performance.
6. Operation and maintenance of the groundwater IRM collection and treatment systems.
7. Natural attenuation and monitoring of the plume.

While no current threat to drinking water supplies exists, a groundwater recovery and treatment system has been installed and will be operated to capture and treat contaminated groundwater that exceeds drinking water standards and prevent further movement of contaminants to the south past Snyder Road. A small portion of the groundwater plume south of Snyder Road containing concentrations of paradioxane at levels above groundwater guidance values and also containing tritium at low levels below drinking water standards will not be captured by the groundwater recovery system. This portion of the plume will be allowed to naturally attenuate.

The current groundwater and surface water monitoring network will be used and upgraded to document mitigation of groundwater movement from the landfill, evaluate surface water conditions, and to monitor the progress of the natural attenuation of the low level groundwater plume. This program will determine the overall effectiveness of the containment system and the groundwater collection system. A contingency plan will be developed to implement more active remedial measures should the plume not attenuate as expected. Institutional controls will also be implemented. These will include a formal filing and recording of declarations and notifications to any potential purchasers of the Cornell University property of the contamination present. The notifications will also indicate that an existing hazardous waste remedial program, under the authority of the New York State Department of Environmental Conservation, is ongoing to address on-site and off-site contamination. Additional land use limitations and restrictions will be negotiated with the property owners as needed.

Public Participation Activities

The PRAP was prepared by the New York State Department of Environmental Conservation (NYSDEC) and announced via a Fact Sheet (Attachment 1) sent to over 500 addresses on the site mailing list, articles in the local newspapers, and selected mailings of the complete PRAP to local officials and interested parties. The mailing list includes local citizens, businesses, local, state and federal governmental agencies, media, and environmental organizations. A 60-day comment period was established from April 13, 2001 to June 13, 2001. The normal 30-day comment period was extended after a request for more time from the Tompkins County Environmental Management Council. Public meetings were held at the DeWitt Middle School in Ithaca, NY on April 26, 2001 and May 15, 2001. The meetings included presentations by NYSDEC officials on the results of the Remedial Investigation and Feasibility Study and discussions of the proposed remedy. The meetings provided an opportunity for the public to ask questions, discuss their concerns, and provide comment on the proposed plan. These comments will become part of the Administrative Record for this site. Written comments were also received from several parties during the course of the public comment period.

Document repositories were established to provide the public opportunity to review technical documents. These included the Tompkins County Public Library in Ithaca, the Lansing Village Hall in Lansing, the Cornell Environmental Compliance Office in Ithaca, and the NYSDEC office in Albany.

NYSDEC and Cornell University officials have also participated in a number of small group meetings during the course of the project and during the public comment period for the PRAP. These included several meetings with the Tompkins County Environmental Management Council.

Cornell University also has periodically mailed newsletters on the status of the project since 1993. Reports on the progress of the remediation have been produced annually since 1998. Cornell maintains a website at http://www.eco.pdc.cornell.edu/DSC/default.htm that contains up to date information on the site. The Proposed Remedial Action Plan was posted on the website.

Public Meeting Comments

The following are comments received at the public meetings, followed by the NYSDEC response. Where possible, comments of a similar nature have been grouped together.

Comment 1: Are there any existing health threats to people along Snyder Road? Are there any active pathways for human exposure to contaminants from the site?

Response 1: No known human exposures to waste materials or contaminants have been identified at the site. Direct physical exposure was eliminated by the capping IRM completed in 1996. Groundwater is not a complete pathway of exposure as no receptors have been identified and no drinking water wells have been contaminated with site-related contaminants. In the Baseline Human Health Risk Assessment completed in 1999, Cornell evaluated the risk to potential receptors from surface water contamination noted in ditches and seeps on the airport property. This included evaluation of risk to occasional area users (trespassers, researchers, hunters, and workers), airport workers, and residents living near the surface drainage from the RDS. Additionally, the potential risks for populations using well water and residents using water from Cayuga Lake for drinking water were evaluated as a conservative measure, though no evidence exist of any potential exposure to these populations. Results of the risk assessment indicate no unacceptable risk to any of the populations evaluated.

Annual estimates of average yearly net radiation received in the vicinity of the RDS are similar to that found in areas away from the RDS and are well below the annual health-based dose limits. It should be noted that the Baseline Human Health Risk Assessment concluded that the site, in its unremediated state, poses no unacceptable risk.

Comment 2: Are there any impacts on wildlife? Is there a potential for bio-accumulation in animals or impacts on the food chain?

Response 2: There are no known impacts on wildlife from the RDS. The contaminants of concern do not generally have a high potential for bioaccumulation in biota. Samples of vegetation in the vicinity of the RDS taken during the Remedial Investigation indicated that levels of radionuclides found downgradient of the site were less or similar to locations sampled upgradient of the site.

Cornell University has conducted annual biological monitoring of the site area since 1996. Results of the evaluation of the aquatic macroinvertebrate communities do not indicate any site related impacts.

Comment 3: What is the extent of groundwater contamination in the deeper bedrock aquifer. Are wells to the north and northeast affected by the site? Has the groundwater in the area to the north of the site been adequately investigated?

Response 3: At the meeting, the extent of the groundwater plumes of paradioxane and tritium were discussed using maps and other display materials.

The primary route of contaminant transport from the site is through the shallow, fractured bedrock zone. The greatest groundwater flow and highest concentration of contaminants is located in this area. Flow direction is to the southwest. The competent bedrock at depth, by contrast, has very little groundwater flow and low concentrations of the parameters of concern. The highest concentrations noted in the competent rock were found directly adjacent to the waste cell and were just above the 50 ug/l guidance value for paradioxane. Contaminant concentrations in the shallow wells in the same locations as the bedrock wells were generally orders of magnitude higher. The remedial alternatives evaluated appropriately targeted the shallow zone. The groundwater conditions in the deeper zones, however, will continue to be monitored as part of the operation and maintenance of the remedial system.

A number of groundwater monitoring wells were installed north and northeast of the RDS site and the adjacent CDS site. The number and type of wells installed were adequate to determine groundwater conditions in that direction. Given the groundwater flow directions noted during the investigations and in subsequent monitoring and review of the results of analysis of the monitoring wells, the RDS site is not impacting areas to the north and northeast of the disposal cell.

Comment 4: What is the significance of the contamination noted in the NEAS well? What is the source for the paradioxane hit at the NEAS well, what is the depth of the well, and how many samples have been collected and at what frequency?

Response 4: The Nutritional and Environmental Analytical Services (NEAS) facility well is located approximately 3,200 feet from the site in the airport industrial and commercial area. The well is approximately 150 feet deep and was used for drinking water. The well was sampled five times from September 1997 to June 1998. The December 1997 sampling event detected paradioxane at an estimated concentration of 23 ug/l. The previous sampling event and the three subsequent events did not detect paradioxane. As a conservative protective measure, the well was taken out of service following the December 1997 sampling and the facility hooked up to the public water supply using an existing hookup.

The significance of the contamination noted in the well is difficult to ascertain. The well is an open hole completion, thus the geologic source of the water is unknown. The fact that the detection was low and not reproducible leads one to question its validity. Paradioxane is a common industrial contaminant and has been associated with anti-freeze compounds from automobiles and deicing compounds used at airports. Proximity to the airport and its deicing operations may explain the source of paradioxane; the lack of significant contamination at depth in wells located between the NEAS and the RDS site suggests the RDS may not be the source.

Comment 5: Has the groundwater been sampled through various times of the year to evaluate seasonal variations?
What impact does rainfall patterns have on the sampling results?
Has Cornell tracked this or made any correlations?

Response 5: Groundwater and surface water has and is being monitored at various times throughout the year. The current sampling plan calls for quarterly sampling; the timing corresponds to winter, spring, summer, and fall and is designed to sample the groundwater at periods at maximum and minimum groundwater elevation in the subsurface and in relative dry and wet periods. Rainfall, climatic conditions in general, and the time of year can have significant impact on groundwater and surface water flow and movement. At the RDS, these effects are generally minimal. Groundwater contaminant distribution and flow of groundwater do not change significantly from season to season. Detections of paradioxane in surface water seeps on the airport property are due to discharges of shallow groundwater. There are indications that the concentrations of paradioxane in the surface water seeps are higher during periods of high groundwater elevation.

Comment 6: Reference was made to 1994 Cornell University Master thesis by Wayne Jeffs regarding the potential for regional artesian conditions. A correlation between the RDS/CDS area wetlands and the artesian conditions was made and then a question was asked whether or not this had been taken into consideration and what effect it might have on the site.

Response 6: Artesian conditions in the shallow groundwater aquifer have been noted in the area of the RDS, particularly on the airport property. In that area, very shallow groundwater discharges to the surface in the form of surface water seeps. Some of these seeps have contained paradioxane in excess of surface water guidance values. Artesian conditions have not been noted in the immediate vicinity of the waste disposal cell, however, where vertical gradients exist from the shallow, weathered shale aquifer down to the bedrock aquifer.

Comment 7: Does DEC feel confident about its assessment of groundwater flow without a detailed computer modeling effort having been carried out?

Response 7: Extensive investigations have been conducted at the RDS and the adjacent CDS facilities since at least 1984. Numerous monitoring wells (35 well locations) have been installed in all aquifer units of concern to assess groundwater flow and contaminant distribution. Pump tests and other geotechnical tests have been completed to determine the physical and hydraulic properties of soil and bedrock. The geology and hydrogeology of the area is well established at this point. While refinement and enhancement of the monitoring system and the data base is ongoing, the basic hydrologic model first developed at the beginning of the Remedial Investigation has been confirmed. Groundwater flow directions are well known and have been used to guide the design and installation of the Groundwater IRM recovery wells now in place.

Comment 8: One commenter was concerned that their review of the recent data appeared to show, compared to 1998 data, that a shift of contamination to the southwest had occurred. Is monitoring of groundwater being done in that direction?

Response 8: Monitoring of areas to the southwest of the RDS continues on a routine basis. A number of wells are located on that vicinity and are sampled on a quarterly basis. Groundwater flow, contaminant distribution, and the concentrations of paradioxane found in those wells has remained relatively stable since 1998. Comparisons of the extent of the paradioxane and tritium plumes on the airport property from 1998 - 2000 indicate that the area of groundwater contamination in excess of the guidance values and background values has not changed.

Comment 9: Where does the 50 ppb groundwater guidance value for paradioxane come from and what is it based on? Why is the 50 ppb guidance value for paradioxane in NY appropriate when other states (notably North Carolina at 7 ppb) have lower standards?

Response 9: Standards and guidance values are ambient water quality values that are set to protect the state's waters. They are derived according to scientific procedures set in regulation in Title 6 of the NY Code of Rules and Regulations Part 702. A standard is a value that has been promulgated and placed into regulation. Standards for surface water and groundwater are found in Part 703 of Title 6. A guidance value may be used where a standard for a substance or group of substances has not been established. Some substances fall into a group known as Principal Organic Contaminants. The general guidance value for these materials is 5 ug/l. Paradioxane falls into a group known as Unspecified Organic Contaminants. For these chemicals the general organic guidance value for groundwater and surface water of 50 ug/l applies. Generally, substances fall into this category when data on the affects of a particular chemical on fish, wildlife, and humans is lacking or inconclusive. As data is generated, standards and guidance values can change.

North Carolina does have a lower guidance value for paradioxane. In essence, that state has grouped paradioxane into a category similar to NY's principal organic contaminant. It should be noted, however, that the analytical methodology approved for use by North Carolina laboratories for paradioxane is unable to detect concentrations less than 20 ug/l. Thus, the defacto standard is higher than 7 ug/l. The treatment system for the RDS groundwater has been designed conservatively to treat the paradioxane to as low a concentration as possible. Though the permitted effluent concentration for discharge will be 50 ug/l, performance testing of the system indicates treatment levels of less than 10 ug/l will be achievable.

Comment 10: John Dennis expressed concern about a "solvent smell" noted in the stream draining the site and airport, but acknowledged it may be from deicing activities at the airport. He also stated that a neighbor's well smelled of solvent and the family had health problems.

Another concern was that the houses near the Equine Research Center had not been sampled and that the workers there no longer used the water from their on-site well due to a perception that the water was contaminated from the RDS and CDS. It was stated that DEC and Cornell have not done a systematic sampling of homeowner wells.

Response 10: Solvent smells in drainage pathways from the RDS have not been noted during any of the investigations conducted at the site. The concern about the neighbors' well will be forwarded to the local health department for follow-up.

Houses near the Cornell University Equine Drug Research Facility on Warren Drive are not likely to be impacted from the RDS due to the groundwater flow directions observed during the course of the Remedial Investigation. Two wells were previously in use at the equine facility. The facility is now served by the public water system. One of the wells is in use as a groundwater elevation monitoring point in the annual monitoring program for the Cornell CDS. Flow data indicates that these wells are not impacted by the Cornell RDS.

As part of the Supplemental Remedial Investigation completed in 1999, Cornell University did a systematic residential and commercial well survey of the surrounding area. Cornell looked for residential and commercial wells in an area approximately one-mile from the site in the generalized direction of groundwater flow. Additionally, Cornell mailed out more than 500 letters to homes and businesses in the area. Local archives and records were also searched. Four residential wells and one commercial well were identified. Three of the wells were on Bush Lane and one on Cherry Road. The closest residential well is approximately 5,200 feet from the site. The commercial well was the NEAS well previously discussed in Comment 4. Three of the homeowner wells were sampled. No contaminants were detected.

The Tompkins County Department of Health and the NYS Department of Health have sampled a number of homeowner wells in the area for radionuclides since 1974 as part of a state-wide environmental radiation surveillance monitoring program. The results from this sampling were used to establish background conditions for comparison to the RDS results.

John Anderson of the Tompkins County Health Department offered to sample any residential wells if residents were concerned that their wells were contaminated.

Comment 11: What was the extent of sampling along Mohawk Road in the vicinity of sample SW-1?

Response 11: SW-1 is a sampling location along Mohawk Road to the east of the Cornell RDS and CDS sites. At the point where SW-1 is located, Mohawk Road is built of fill directly on a wetland area. Water is collected from the wetland area near the point where water passes through a culvert under the road. The location is designed to monitor upgradient or background conditions to use in comparison to downgradient locations near the RDS site. It is not located in the same local drainage system as the RDS site. The location has been sampled 16 times since 1993. In March 1997, paradioxane was detected at an estimated concentration of 20 ug/l. In June 1998, paradioxane was detected at 55 ug/l. That level was slightly above the surface water guidance value of 50 ug/l. As the location is upstream of the Cornell sites and outside of the drainage pathway from the RDS, the source of the paradioxane is likely due to road runoff.

Comment 12: Was the paradioxane hit in sample SW-30 an anomaly and has the lake been affected? If not an anomaly, where is the paradioxane coming from (the site, airport, road runoff)? If from the site, what is our remedy for the surface water?

Response 12: Surface water at SW-30 has been sampled 26 times since January 1995. SW-30 is located at the outlet of Twin Glens Creek approximately 2.9 miles downstream from the RDS. Paradioxane was detected in three sampling events in that time. In the ninth sampling event, in December 1997, paradioxane was detected at an estimated concentration of 25 ug/l (estimated because the concentration was less than the required reporting limit but higher than the analytical method detection limit). In December 1998, paradioxane was detected at 11 ug/l but a second duplicate sample taken at the same time and location and analyzed did not detect paradioxane. Similarly, another detection of 19 ug/l was found in June 1999 but again not detected in the confirmatory duplicate sample. A detection of 1 ug/l (estimated concentration) was noted in March 2001. The surface water guidance value for paradioxane is 50 ug/l. A sampling location, upstream of SW-30, SW-31, has been sampled 25 times, generally during the same event as SW-30. SW-31 is located near North Triphammer Road approximately 1.8 miles downstream from the RDS. SW-31 has never had a detection of paradioxane.

Given the low frequency of detections, the low concentrations (below surface water and drinking water guidance values), and the non-detects in upstream samples, it is difficult to attribute the contamination noted in SW-30 to the site. As noted previously, paradioxane is a common industrial contaminant and has been associated with anti-freeze compounds from automobiles (and deicers from the airport runway). The stream passes through the airport, along and under various highways, through a manufacturing company's water retaining pond, and through mixed residential and commercial neighborhoods on its three mile journey to the lake. Paradioxane has also been found in other surface water bodies not associated with the RDS (in at least one location upstream of the CDS, as discussed in Comment 11). For purposes of the Remedial Investigation, the sporadic detections at SW-30 were considered to be anomalous and not representative of releases from the site. For information purposes, a summary of the results of surface water sampling completed to date at the site is provided in Attachment 2.

Regardless of the ultimate source of the paradioxane in surface water, the Baseline Human Health Risk Assessment did evaluate populations using well water and residents using water from Cayuga Lake for drinking water as a conservative measure, though no evidence exists of any potential exposure to these populations. Results of the risk assessment indicate no unacceptable risk to any of the populations evaluated.

The selected remedy does not call for the active remediation or treatment of affected surface water. The correlation of high groundwater elevations and flow direction with observed concentrations of paradioxane in the surface water seeps on the airport property indicate a connection to the observed groundwater plume, i.e, a small amount of shallow groundwater is discharging to the surface of the ground on the airport. The existing cap on the landfill already precludes direct runoff from the site waste to surface water bodies. Capture of groundwater via the groundwater IRM system and the enhancement of groundwater containment via the evaluated technologies (slurry wall and grout curtain) will effectively cut off the source of contaminated shallow groundwater and will mitigate the surface water problem in the drainage ditches and surface seeps on the airport property.

Comment 13: How close is the SW-30 sampling location to the Lake Source Cooling Project and the Bolton Point water intake?

Response 13: The outlet of the tributaries from the site is approximately one and one-half miles from the Lake Source Cooling Project and approximately two miles from the Bolton Point intake.

Comment 14: Ms. Dooley Kiefer, representing the Tompkins County Environmental Council, asked the NYSDEC to comment on the Duke University radioactive waste site, how it compares, and apparent disparities between the Duke site and Cornell in cost and approach.

Response 14: At the meeting, the NYSDEC project manager indicated he was unaware of the Duke University site, but offered to follow up. The details of the Duke site and a comparison to the RDS site is presented in Attachment 3 of this responsiveness summary.

Comment 15: It was noted that the PRAP stated there was a significant environmental threat posed by the site but, it was still listed in the NYS Registry of Inactive Waste Disposal Sites as a class 3 site, which signifies the presence of hazardous waste but where action can be deferred. It was recommended that the site be reclassified as a class 2 site, which indicates the disposal of hazardous waste where action is needed.

Response 15: The site is indeed still listed as a class 3 on the NYS Registry of Inactive Hazardous Waste Disposal Sites. This classification was assigned to the site when it was originally placed on the Registry. At the time, limited information was available to assess the significance of the site. At this time, the only threat is to potential receptors of shallow surface water seeps on the airport and ditches immediately adjacent to the site. That threat, though very low as noted in the risk assessments, is the basis for the statement in the PRAP concerning the threat to the environment. The NYSDEC will re-evaluate the need to reclassify the site. Regardless of the classification, Cornell University has committed to remediation of the site as outlined in the PRAP.

Comment 16: It was noted that the slurry wall containment system for another NYS site, the Dewey Loeffel Landfill, may have failed and allowed site contamination to escape. What confidence does DEC have that the containment system selected will perform properly and protect the public and the environment?

Response 16: The Dewey Loeffel containment system consisting of a slurry wall, cap, and leachate collection was installed in the early 1980's. The technology used in the containment of contaminated sites and the necessary knowledge and expertise of consultants and regulators in the operation and maintenance of such systems, particularly in the area of water management, has advanced considerably since then. Site selection, proper installation, and management of site waters are essential to the proper performance of a slurry wall. The performance difficulties associated with the Loeffel site are unique to that site and do not necessarily provide an indication of the potential performance of the RDS containment system. The slurry wall at Loeffel did not fail; it has performed and is performing as expected. Unfortunately, the existing leachate collection system was insufficient to handle site conditions. As a result, water containing contaminants migrated out of the disposal site. The "fix" at the site involves the expansion of the existing leachate collection system.

The geology of the RDS site is amenable to the successful implementation of a slurry wall. The depths are minimal and the bedrock material underlying the site rapidly becomes more impermeable at depth. Downward vertical gradients exist in the aquifers of concern. The addition of a grout curtain to seal off fractures at depth adds a measure of protection to the system. Grout curtains have been used successfully in a variety of applications, to control movement of fluids through fractured rock. The bedrock at the RDS that will be grouted is not that highly fractured so a good seal and subsequent acceptable performance of the grout curtain is expected.

Comment 17: In the Remedial Objectives section of the PRAP, what is meant by "minimizing the generation of mixed waste"?

Response 17: "Mixed waste" is a regulatory term and refers to a combination of hazardous waste and radioactive waste. Very few disposal facilities are permitted to accept mixed wastes and therefore, the disposal costs for these materials are quite high. Facilities for either hazardous waste or radioactive waste are more plentiful and the costs for disposal are much less.

Comment 18: One commenter was concerned that the NYSDEC saw significant technical and administrative difficulties in siting a new disposal cell, yet we were willing to close the facility in place.

Response 18: Alternatives 5 , Excavation and Off-site Disposal, and 6, Excavation and Disposal in an On-site Disposal Cell both involve the excavation, handling, repackaging and transport of the waste from the current disposal cell at the RDS. There are significant difficulties, both regulatory and technical, associated with that effort. Section 7 of the PRAP discusses these alternatives in detail. Generally, the difficulties associated with the excavation of the waste mass present enormous short-term risks to workers and the community, and the engineering implementability is extremely difficult. Due to the nature of the waste (chemicals, containers, animal carcasses), excavation, handling and packaging of the materials in containers suitable for disposal or transport poses enormous potential for human and environmental exposure. Effective controls on the release of radioactive and hazardous materials to the air and water would be difficult to implement with certainty. The presence of the animal carcasses and laboratory chemicals in the fill would pose biological and physical threats to workers and the surrounding residential and commercial communities. Transportation of the waste poses additional concerns. It should be noted that relatively little contamination is migrating from the site in its unremediated state. The level of radionuclides is very low and the paradioxane plume has extended a rather short distance onto the airport property. The risks associated with disturbing the site and disposing the waste in another community or on adjacent land dwarf those identified in the risk assessments for a contained and monitored site.

From a regulatory perspective, finding suitable off-site disposal facilities with the capacity and permits for mixed waste would be difficult. The construction of a new disposal cell on Cornell property would be an extensive undertaking. The technical siting criteria and permit requirements for a new low-level radioactive waste facility are rigorous and the suitability of Cornell property for such a facility is unknown. The costs of the two alternatives involving excavation are prohibitive compared to the containment remedies and they will provide no greater measure of protection to the public health and environment once completed, while posing large risks during the implementation of the remedies.

Comment 19: Has Cornell visited other paradioxane contaminated sites to evaluate treatment options and how well they work?

Response 19: Cornell did investigate several sites where paradioxane was noted as the principle contaminant of concern. Paradioxane is a rather difficult contaminant to treat; the primary system that has shown to have success is a combination of ultraviolet light treatment and chemical oxidation. Cornell visited some active treatment facilities and spoke with treatment plant operators of facilities where UV/oxidation systems are in place. The system constructed at the adjacent Chemical Disposal Site, as part of the groundwater IRM noted in the PRAP, will effectively treat the paradioxane to below discharge levels required under NYS regulations.

Comment 20: What does Cornell currently do with any waste generated at the University?

Response 20: Cornell University disposes of all university generated waste in a number of ways, in accordance with current regulations and requirements. No wastes are disposed in either the RDS or the adjacent Chemical Disposal Site; both these facilities have been closed since the 1970's.

Comment 21: What will be the source of the funds for the remediation?

Response 21: Cornell University is the responsible party for the RDS. As such, Cornell is responsible for all costs associated with the investigation and remediation of the site. Cornell and the NYSDEC entered into an Administrative Order on Consent in 1996 which specifies the responsibilities of Cornell, including the reimbursement of state administrative costs, such as site inspections and report reviews. The RDS site did receive some wastes from an entity of Cornell that was affiliated with the State University of New York system. As such, Cornell may seek some funding for remedial activities from New York State through special budget appropriations.

Comment 22: Is there a chance DEC will perform further investigation in response to these comments? Is there a potential for the DEC to change its remedy selection based on comments received during the comment period?

Response 22: The NYSDEC considers very seriously information received from the public during the public comment period. If information is presented that provides specific concerns about the extent of investigation that would cause the remedy selection to be questioned, DEC will entertain additional investigation. At this point, given the comprehensive extent of the Remedial Investigation activities conducted by Cornell and the long and extensive sampling data base established, it is unlikely that significant further investigations will be warranted. It should be noted that during the formal Design program for the remedy, pre-design investigation activities, including well installation and sampling, are often conducted to verify or resolve any uncertainties noted in the RI. Likewise, if specific technical comments on the evaluation of alternatives and the remedy selection are received that call into question the appropriateness of the remedy, it is possible the remedy could be changed.

Written Comments

Four letters and two e-mails were received during the comment period. Responses to specific comments are offered below.

- A letter dated June 13, 2001 was received on June 18, 2001 from Frank P. Proto, Chairman of the Tompkins County Water Resources Council. A committee of the council has recommended that NYSDEC consider the selection of Alternative 6 as the preferred remedial option.

Comment WRC-1: The slurry wall is intended to vastly slow down, not stop, contaminants from entering the shallow unconsolidated (surficial) aquifer surrounding the site. Pumping from wells surrounding the site is intended to capture contaminants that pass through. The grout curtain is intended to diminish flow of contaminants from the site into bedrock fractures beneath the site. Since it is a perimeter structure of limited depth it does not stop downward vertical flow of contaminants.

Response: A slurry wall does indeed have some permeability, though it is extremely low. Slurry walls typically achieve a permeability of 10^{-8} cm/sec, which is about 6 orders of magnitude less permeable than the surrounding soils. The groundwater IRM is designed to capture downgradient groundwater at a rate similar to the natural groundwater flow rate. This is to avoid mobilizing contaminants that have yet to migrate from the cell, before the additional containment structures (slurry wall and grout curtain) are in place. Though very little flow was encountered in the bedrock beneath the site, the grout curtain will provide an added level of protection. There will still be a downward vertical gradient at the waste cell after the containment structures are in place, however its magnitude is greatly diminished due to the presence of the cap installed in 1996. The cap precludes infiltration of rain water and snow melt, thus the driving force for the movement of water through the waste mass is greatly reduced.

Comment WRC-2: There exists the possibility of contaminants at the site other than those listed in Table 1 on page 25 of the Cornell University radiation Disposal Site: Proposed Remedial Action Plan April 2001). We encourage additional effort to identify these contaminants and monitor those that will adversely impact human health and the environment.

Response: Early in the investigation process, Cornell developed a list of potential wastes disposed at the RDS. This list guided our initial list of materials for which to sample and analyze. The list can be found in the Preliminary Environmental Assessment. A list of potential scintillation compounds (the primary source of the paradioxane at the site) can be found in the RI report and a separate report called the Assessment of Scintillation Fluid Compounds, October 1995.

The sampling protocol for the Preliminary Environmental Assessment, the Remedial Investigation and some of the subsequent monitoring looked for approximately 150 different chemicals, in addition to the radionuclides and physical field parameters (such as pH, conductivity, temperature, dissolved oxygen, etc.). As the data base grew, it became apparent that the suite of chemicals detected was stable and the list of parameters analyzed for on a routine basis was scaled back somewhat. Table 1 only list those contaminants that have been detected at the site in concentrations of concern. Monitoring after the remedy is in place will include periodic analysis for the contaminants of concern. It should be noted that paradioxane is not on the list of chemicals routinely analyzed for in the inactive hazardous waste site program; special analytical methods are required for this parameter.

Comment WRC-3: The groundwater regime of the site is poorly characterized, indicating the need for additional study of ground water movement and flow at the site to better determine the path and potential impacts of contamination emanating from the site.

Response: The RDS has been the subject of extensive investigations since the 1980's. A Preliminary Environmental Assessment was completed in 1994, a Remedial Investigation in 1997, and a Supplemental Remedial Investigation in 1999. The database is large. Sampling has occurred on at least a quarterly basis since 1995. Almost 40 wells, over 40 surface water sampling points, and homeowner and commercial wells have been the subject of nearly 30 separate sampling events. For comparison, the average Remedial Investigation performed on an inactive hazardous waste disposal site involves less than half the number of wells, less than 6 surface water and sediment sampling points and remedy selection is usually based on two sampling events. NYSDOH and TCDH sampling for radiological parameters has taken place in the area since 1974. Annual monitoring for biological parameters has occurred since 1996. Radiological dosimeter readings have been taken since 1993. The results consistently indicate no significant impact to any potential receptor from the disposal of radioactive material at the RDS. The paradioxane contamination is well documented and explained in the various site reports and the PRAP. Sufficient information exists regarding environmental conditions at the site to generate a suitable remedial plan for the site.

Comment WRC-4: Anomalous detections of paradioxane at great distances from the site suggest transport of contaminants along bedrock fractures. Efforts should be made to determine if the RDS is the source of these anomalies. If so, then remedial actions at the site should include measures that better ensure prevention of further contamination from entering bedrock fractures.

Response: Please refer to the response to Comment 3 and WRC-1. It is well documented that the RDS is the source of paradioxane in groundwater in shallow fractured bedrock wells near the site. The low levels of paradioxane noted in bedrock wells drilled during the site investigations are also attributed to the RDS. The only anomalous detections of paradioxane found in groundwater at any distance from the site is in the NEAS well. A discussion of that well and its significance is found in the response to Comment 4. The remedial actions planned for the site will control the migration of contaminants through control of infiltration, reduction of lateral flow, and collection of groundwater on the downgradient side of the waste cell. The reader is also directed to the discussion of anomalous surface water detections of paradioxane in the response to Comment 12.

- A letter dated June 13, 2001 was received on June 13, 2001 via fax from Barbara Ebert, Chair of the Environmental Review Committee of the Tompkins County Environmental Management Council (EMC). The EMC urged the NYDSEC to reconsider selection of Alternative 2 and endorsed the selection of Alternative 6 as the preferred remedy.

Comment EMC-1: The "competent" bedrock below the RDS site is still an unknown. The existence of vertical fractures in this bedrock, which would allow the continued out-migration of radioactive and carcinogenic waste from the site, has not been ruled out. The rejection of Alternative 4 due to uncertainties involved in the sealing the "bottom" of the site serves as evidence that leaving the waste on its current site could be a problem. It is inappropriate to select an option that does not attempt to completely contain these potentially harmful materials.

Response: The bedrock beneath the site had been adequately studied. Fractures are present in the rock and have provided a route of migration for contaminants. As discussed in the site documents, PRAP, and several responses above, the vast majority of the contamination is found in the shallow zone near the disposal cell.

The bottom sealing portion of Alternative 4 was determined to be unfeasible due to the nature of the waste materials disposed at the site, rather than due to the unsuitability of the bedrock below the site. To seal off the bottom with the waste in place would involve digging or drilling through the waste mass, presenting all those short term risks and engineering difficulties discussed for the various excavation and removal scenarios. Were the bedrock accessible in that location, without the enormous risk of waste release and environmental exposure, bottom sealing would be technically feasible. The proposed plan provides acceptable containment of the waste given the site conditions. The design for the grouting program will address vertical fractures.

Comment EMC-2: The committee lacks confidence in the cost estimates provided for the alternatives. Cost was a factor in the scoring of each alternative, and the accuracy of these estimates has not been established.

Response: The costs for the various alternatives developed were established using accepted engineering practices. The calculations and basis used are included in the Feasibility Study. As noted in Attachment 3 , the costs of disposal for radioactive and mixed wastes used in Alternatives 5 and 6 may actually be low given the recent experience of Duke University.

Cost is included in the numerical scoring but is considered a balancing criterion in the detailed evaluation of alternatives. Where two or more alternatives meet the requirements of other criteria, such as protection of public health and the environment, cost effectiveness can be used as the basis for remedy selection. Given the low risk posed by the site in its unremediated state, the costs for Alternatives 5 and 6 are considered to be prohibitive, compared to the other alternatives evaluated.

Comment EMC-3: It is not clear that a comprehensive list of toxins deposited at the site is known, and removal of the contaminated soil from the site would reduce the potential risk.

Response: Please see the response for Comment WRC-2

Comment EMC-4: The committee is aware of toxic waste sites where a slurry wall and grout curtain system was installed and failed to prevent off-site migration of contaminants, so we have doubts about the effectiveness of this "technology."

Response: Please see the response for Comment 16 and WRC-1.

Comment EMC-5: The committee believes it is practical, possible, and necessary to construct a low-level radioactive waste facility on Cornell University land in Tompkins County; the current RDS site is, de facto, a radioactive dump without the necessary safeguards. The excavation of the site and the construction of an above-ground containment cell - one that can be routinely inspected for leaks - will provide better protection of human health and safety in the long term.

Response: The response to Comment 18 explains that the amount of radionuclides migrating from the site in its current state is very low. The Baseline Human Health Risk Assessment demonstrates that they do not currently pose a significant risk to the environment or the public. The activities of radioactive waste disposed of in the RDS are many orders of magnitude below those for wastes disposed of in a commercial LLRW disposal facility. The potential threats to the environment or public health are comparatively lower as well. Therefore, this site does not warrant the level of safeguards required for a new disposal facility.

Beyond the need to enforce applicable regulations, radiological regulators are bound by the principle of maintaining exposures to workers, the environment, and the public to levels that are As Low as Reasonably Achievable, commonly referred to as the ALARA principle. The very real risks to the workers who would be involved in the excavation of the wastes and creation of a new disposal facility, and the increased potential for exposures to the public from these activities, vastly outweigh the vanishingly small potential threat that is posed by the site in its current state. Therefore, creation of a new disposal cell for this waste does not pass the ALARA test. However, implementation of the remedies required in this ROD will provide additional safeguards and further reduce the already low potential radiological risks posed by the site. Implementation of these actions, and the significantly lower risks and costs associated with them, follow the ALARA principle. Finally, in order to help put the various closure options into perspective, it should be noted that even in its present state, barring inadvertent intrusion into the waste itself, there are no credible pathways by which wastes at the RDS can cause radiological exposure limits for the public to be exceeded.

Comment EMC-6: In addition, the EMC urges NYSDEC to mandate more rigorous analysis and testing at the RDS site and its broader vicinity and along all possible out-migration pathways, especially creeks.

Response: Please see the responses for Comments 7, 12, and WRC- 3.

- A letter dated June 13, 2001 was received on June 13, 2001 via fax from Dooley Kiefer of Ithaca, NY. The letter concerned a Duke University radiation disposal site with similar characteristics to the Cornell site.

Response: Please see Attachment 3 for details on the Duke University site. The information was gained from the Duke University project manager. The site is indeed similar to the RDS. The main differences are in waste quantity, which significantly affects the estimated cost of remediation, and in the waste types (radioactive wastes, mixed wastes, and animal carcasses) which would require handling. Duke had to dispose of 36 cubic yards of radioactive waste, a tiny fraction of the waste volume for RDS. This alone accounts for the enormous disparity in remedial costs estimated under the removal scenarios in the Feasibility Study (comparison of costs based on areal extent rather than volume does not provide a true picture). The costs incurred by Duke (which are more recent numbers) are much higher on a per unit basis than that estimated for the RDS site; we could appropriately adjust upward the estimates for RDS. The presence of mixed wastes, which are a regulatory hurdle and very expensive to dispose, also help explain the cost disparity. The state of North Carolina also has no intention of requiring Duke to remediate the paradioxane plume, despite their lower standard for paradioxane in groundwater. Another similarity and good news, for both sites, is that risk assessments performed indicate no unacceptable risks to the surrounding populations and potential receptors.

- An e-mail was received on May 2, 2001 from Barbara Ebert, Chair of the Environmental Review Committee of the Tompkins County Environmental Management Council (EMC).

Comment ERC-1: The e-mail had several questions concerning the adequacy of the proposed containment system.

Response: Please see the responses to Comments 16 and EMC-5.

- An e-mail was received on May 30 from Barbara Ebert, Chair of the Environmental Review Committee of the Tompkins County Environmental Management Council (EMC).

Comment ERC-2: The e-mail sought additional information on the Duke University site and information about the use of the grout curtain and slurry wall system at other sites in New York State.

Response: Please see the responses offered previously for Comment 16 and EMC-5 and Attachment 3 concerning the Duke University site. Slurry wall systems have been used as a primary part of the remedy at 14 inactive hazardous waste sites in NYS. A number of slurry walls have been used to close municipal solid waste landfills. Grout curtains have been used extensively in the construction industry, particularly in the area of dam construction and repair, and in the environmental field to control movement of water in fractured rock. A recent example of grouting in a field application is the GE Hudson Falls Capacitor Plant site in Hudson Falls, NY. Grout was injected into fractured rock through a series of drilled wells, with good success, as a means of controlling the flow of PCB oil through the site bedrock to the Hudson River. The grouting is part of an overall remedy, much like that for the RDS, that includes source control measures and groundwater collection. Under appropriate site conditions, a grout curtain is a good tool for controlling contaminant migration.

- A letter dated June 13, 2001 was received on June 14, 2001 via fax from Walter Hang of Toxics Targeting, Inc., of Ithaca, NY. The letter contained comments about the extent of investigation and conclusions presented in the Remedial Investigation. Mr. Hang advocates additional investigation of surface water and groundwater and supports the creation of a new disposal cell (Alternative 6). Many of the concerns in Mr. Hang's letter are reflected in the comments and responses presented above. These include:

  Inappropriate classification of the site - please see response to Comment 15.
  Significance of detections of contaminants at location SW-30 in Twin Glens Creek - please see the response to Comments 10, 12, 13, and WRC-4.
  Significance of detections at SW-1 - Please see the response to Comment 11.
  Extent of groundwater monitoring and conclusions on the extent of contamination - Please refer to the responses to Comments 3 through 8, 10, WRC-3 and WRC-4.
  Creation of a new disposal facility - Please see responses to Comments 18, WRC-1, EMC-1, EMC-3, and EMC-5.
  Concerns over the potential failure of cap, slurry wall, and grout curtain - This issue was discussed in the responses to Comments 16, WRC-1, WRC-4, EMC-4, and ERC-1 and 2.

Press Coverage

The Cornell University Radiation Disposal Site was the subject of several articles in the local press during the public comment period. These included:

- Ithaca Journal, April 23, 2001 - Article on the PRAP and sidebar on the upcoming public meetings.
- Ithaca Journal, April 27, 2001 - Article on the April 26 public meeting and sidebar on the upcoming May 15 public meeting.
- Ithaca Journal, May 16, 2001 - Article on the May 15 public meeting.
- Ithaca Journal, May 24, 2001 - Article regarding website information on New York State hazardous waste sites referencing the Cornell site and the comment period for the PRAP.
- Ithaca Times Newsline, June 6-12, 2001 - Article about the site and noting the comment period.

News Channel 7 of Ithaca attended the May 15th public session and covered the meeting briefly in its evening news segment.

Copies of the above articles are included in Attachment 4.

ATTACHMENT 1

Fact Sheet
Proposed Remedial Action Plan

New York State Department of Environmental Conservation

Fact Sheet

April 2001

Proposed Remedial Action Plan

Cornell University Radiation Disposal Site

Inactive Hazardous Waste Disposal Site

Lansing, Tompkins County, New York

SITE ID # 755001

PUBLIC MEETING ANNOUNCEMENT

The NYS Department of Environmental Conservation, working cooperatively with the NYS Department of Health, invites you to attend a public meeting and availability session to discuss the Proposed Remedial Action Plan for the Cornell University Radiation Disposal Site. Representatives from NYSDEC and NYSDOH will be available to answer questions about the site. Comments can be made at the meetings, or at any time during the public comment period which ends June 13, 2001.

Public Meeting:	April 26, 2001 7:00 - 9:00 P.M. DeWitt Middle School, 560 Warren Road Ithaca, NY
Availability Session:	May 15, 2001 4:00 - 6:00 P.M and 7:00 - 9:00 P.M. DeWitt Middle School, 560 Warren Road Ithaca, NY

INTRODUCTION

The New York State Department of Environmental Conservation (NYSDEC) in consultation with the New York State Department of Health (NYSDOH) is proposing a remedy to address the significant threat to the environment created by the presence of hazardous waste at the **Cornell University Radiation Disposal Site (RDS)**. Landfilling operations from the late 1950s through 1978 have resulted in the disposal of hazardous wastes, including solvents and radionuclide-contaminated materials, at the site.

The primary environmental threat and contaminant of concern at the site is paradioxane (also known as 1,4-dioxane), a common laboratory solvent used in radiological research. Paradioxane has been found in site groundwater and surface water at levels exceeding New York State regulatory guidance values. Radionuclides have also been detected at the site, though at generally low concentrations. The primary radioisotope of concern is tritium, which has been found in site groundwater at levels exceeding area background levels, but well below any health-based or environmental groundwater or drinking water standards.

The following remedy is proposed:

- landfill containment by cap, slurry wall, and grout curtain;
- groundwater recovery, treatment, and discharge; and
- natural attenuation and continued monitoring of the untreated portion of the groundwater plume.

The RDS is located north of Snyder Road in the Town of Lansing, Tompkins County, New York. The RDS is a approximately 2-acre (290 feet by 300 feet) inactive low level radioactive waste landfill.

All lands immediately adjacent to the site are owned by Cornell University. Approximately one-half mile to the south of the RDS are the runways of the Tompkins County Airport, the closest commercial facility. Approximately one-third mile to the southeast of the RDS is Cornell University's Chemical Disposal Site (CDS). Between 1962 and 1977, Cornell operated the CDS as a landfill for the disposal of chemical wastes from university laboratories. The site is closed and capped. Site groundwater is recovered and treated through an on-site treatment facility.

SITE HISTORY

The RDS was operational from the late 1950's through June 1978 in accordance with regulations in effect at the time. Low level radioactive waste, generated by radiological research, was buried in tenches excavated at the site. Wastes included the carcasses of animals that were placed in drums and boxes and then buried. Contaminated laboratory materials were also disposed. Additionally, vials containing"cocktails" of chemical solvents (e.g., toluene, alcohols, paradioxane, naphthalene, and xylene) used in the scintillation process (i.e., the process used to count or measure radioactive emissions) were also disposed at the site.

Initial disposal of waste at the site was permitted in 1956 under a non-specific exemption license from the Atomic Energy Commission. Subsequently (in 1963), the New York State Department of Health became the regulatory authority for such facilities. Operation of the site is currently regulated by the New York State Department of Environmental Conservation.

The NYSDEC and Cornell University entered into an Order on Consent (Index # A7-033395-08) in August 1995. The Order obligates Cornell University to implement a full remedial program.

Pursuant to the Consent Order, Cornell University has performed a Remedial Investigation and Feasibility Study (RI/FS). The RI determined the type and extent of contamination at the site. The FS evaluated possible remedies for that contamination. The RI was conducted in two phases from October 1995 through February 1999.

The investigations revealed the presence of volatile organic compounds (VOCs) and radionuclides in the groundwater beneath the site and in surface water. Paradioxane is the primary contaminant of concern at the RDS due to the frequency of detections and the concentrations found in groundwater. Paradioxane is present in concentrations in excess of the guidance value of 50 ppb in a number of groundwater wells downgradient of the site. The highest concentrations and greatest frequency of detections have been observed in locations close to the landfill.

Of the radionuclides present, tritium and strontium-90 have been observed in groundwater downgradient of the site in concentrations in excess of background levels. Tritium is the most widespread of the radionuclides detected. Tritium is elevated above background levels of 300 pCi/l in many wells north of Snyder Road and at three locations on the adjacent airport property. However, tritium concentrations above the drinking water standard of 20,000 pC/L have not been observed at any locations.

Strontium-90 was found in concentrations above the background level of 2.28 pC/L in three groundwater wells located immediately adjacent and downgradient of the disposal area. In two of the wells, concentrations were in excess of the drinking water standard of 8 pC/L. No detection of strontium above background levels or drinking water standards were noted south of Snyder Road.

Surface water in the vicinity of the site flows from northeast to southwest through culverts and ditches. The surface water drains into two tributaries of Twin Glens Creek and enters Cayuga Lake approximately 3 miles from the site. Paradioxane is also the primary contaminant of concern in the surface water. Paradioxane has been detected in drainage ditches north of Snyder Road and in surface water and wetland seeps on the airport property.

To assess potential human and environmental exposures, Cornell University produced a Baseline Human Health Risk Assessment (BHHRA) in February 1999. The BHHRA was designed to evaluate potential human health risks associated with existing exposures to contaminants at the RDS. The assessment concluded that risks associated with the site, in its unremediated state, were well below levels of concern.

The primary environmental threat at the site is associated with surface water contamination noted in drainage ditches and wetland seeps on the airport property

INTERIM REMEDIAL ACTIONS

Interim Remedial Measures (IRMs) are conducted at sites when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS.

In September 1996, a capping IRM was completed at the site. A 60-mil thick, high density polyethylene (HDPE) liner was placed over the site to reduce infiltration of precipitation through the waste material and to preclude physical contact by humans or wildlife with the waste material. A conveyance pipeline was installed below ground level to transport contaminated water from the RDS to the adjacent Cornell University Chemical Disposal Site groundwater treatment plant, approximately one-third mile to the southeast.

Construction of a groundwater IRM is underway at the RDS. The IRM consists of a series of groundwater recovery wells along the north side of Snyder Road, downgradient of the RDS disposal area. This alignment will capture virtually all of the paradioxane with concentrations in excess of the cleanup standard of 50 ppb as well as a significant portion of the tritium plume that is above background concentrations. The water will be pumped to the CDS treatment plant for treatment and discharge.

PROPOSED REMEDIAL ACTION

Based upon the results of the RI/FS, the NYSDEC is proposing as the remedy for this site a containment of the RDS source area using a combination of slurry wall, vertical grout curtain, and the previously installed landfill cap. The remedy also includes the collection and treatment of contaminated groundwater north of Snyder Road (the area where groundwater contaminant levels exceed the cleanup standard of 50 ppb for paradioxane) and natural attenuation and monitoring for the remainder of the groundwater plume.

This selection is based upon a detailed evaluation of remedial alternatives developed for the site. These included a No Further Action alternative, two landfill containment alternatives, construction of a new landfill, and a waste removal and disposal option.

The estimated total present worth cost to implement the remedy is $6,904,000. The capital cost to construct the remedy is estimated to be $ 2,784,000. Average annual operation and maintenance costs range from $399,000 in the early years of intensive monitoring to $15,000 per year once groundwater concentrations decrease in the off-site plume. The operation and maintenance activities include groundwater and surface water sampling and analysis on a quarterly and annual basis, groundwater IRM performance monitoring, plume attenuation monitoring and modeling, and costs associated with the operation of the groundwater treatment system.

YOUR OPPORTUNITIES TO BE INFORMED AND INVOLVED

The PRAP discusses NYSDEC's proposed remedy to address hazardous waste contamination at the Cornell University Radiation Disposal Site. Following the comment period and public meetings, NYSDEC will issue a Record of Decision outlining the State's final selected remedy for this site. Your comments on the PRAP are important to ensure that the concerns of your community are considered in NYSDEC's final decision. The Record of Decision will include a summary of responses to all comments received at the public meeting and during the public comment period.

Document Repositories

Documents pertaining to the site, such as the PRAP, RI and FS reports, are available for public review at the repositories listed below.

NYSDEC Central Office
Div. Of Environmental Remediation
50 Wolf Road, Room 242
Albany, NY 12233-7010
518-402-9774

Cornell University
Environmental Compliance Office
130 East Hill Plaza, 345 Pine Tree Road
Ithaca, NY
607-255-6572

Lansing Village Hall
2405 Triphammer Road
Lansing, NY

Tompkins County Public Library
312 Cayuga Street
Ithaca, NY

For Further Information:

If you have any questions or comments concerning the proposed remedy, investigation or reports in the repositories, feel free to contact any of the following individuals. Any comments on the PRAP received by June 13, 2001 will be included in the Record of Decision.

Martin Brand, Project Manager
NYS Dept. of Environmental Conservation
50 Wolf Road, Albany, NY 12233-7010
Telephone 518-402-9774

Dan Geraghty
NYS Department of Health, BEEI
Flanigan Square
547 River Street, Room 300
Troy, NY 12180-2216
Telephone 518-402-7890

Additional information on the Cornell University Radiation Disposal Site can be found on the Internet at http://eco.pdc.cornell.edu/DSC/default.htm.

ATTACHMENT 2

Summary of Paradioxane Detections in Surface Water

Historical Paradioxane Detection Summary - Surface Water

Cornell University Radiation Disposal Site
Lansing, New York

Location	December 1993*	April 1994*	January 1995*	June 1995*	October 1995	April 1996	July 1996	October 1996	December 1996	March 1997	June 1997	September 1997	December 1997	January 1998	March 1998	June 1998
SW-1	ND	ND								20J	ND	DRY	ND		ND	55
SW-6		3.45 J	10.5		ND	ND	ND	ND		ND	ND	DRY	NS[2]	ND	ND	34
SW-7		167	505	DRY	DRY	ND	DRY		ND	DRY	DRY	DRY	29 J	ND	ND	64
SW-7B						290	DRY				ND	DRY	300 J	ND	40	
SW-8		24.7	32.1	DRY	ND	52			17J	44	19 J	ND	43 J	ND	ND	ND/83
SW-30			ND	DRY	ND		ND	ND	ND	ND	ND	ND	25 J	ND	ND	ND
SW-31			ND	DRY	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	DRY
SW-32			ND	DRY	ND	ND	ND	ND	ND	ND	ND	NS[1]	ND	ND	ND	ND
SW-33			17.5	DRY	22	ND	ND	ND	ND	ND	ND	ND	ND	ND	14	ND
SW-37									56J	31 J	DRY	DRY	DRY		120	
SW-40															ND	28
SWRDS-11																
SWRDS-13							DRY		ND	DRY						

Samples from October 1995 - September 2001 analyzed at Severn-Trent Lab unless otherwise noted.
* : Sampled by Dames & Moore
Results reported in ug/L.
ND/83: Original sample result/Duplicate sample result
Blank cells indicate that no sample was collected from the corresponding locations.

ND: Not Detected
J: Estimated Concentration
NS: Not sampled as planned.
[1]: Not sampled due to an oversight.
[2]: Not sampled because the water at the location was frozen.

Historical Paradioxane Detection Summary - Surface Water

Cornell University Radiation Disposal Site

Lansing, New York

Location	September 1998	December 1998	March 1999	June 1999	September 1999	December 1999	March 2000	June 2000	September 2000	December 2000	March 2001	July 2001	September 2001	December 2001		
SW-1			ND	DRY	DRY	ND	ND	ND	DRY	ND	[3]	ND	DRY	ND		
SW-6	ND	6J	ND	DRY	ND	11	ND	ND	ND	ND	[3]	ND	DRY	4.9 J		
SW-7			38		DRY	ND	DRY	160 J	DRY	DRY	[3]	DRY	DRY	ND		
SW-7B			DRY	DRY	DRY	DRY	59	310 J	DRY	DRY	[3]	DRY	DRY	1.5 J		
SW-8			ND		DRY	DRY	19	150 J	DRY	DRY	[3]	DRY	DRY	DRY		
SW-30	ND	11/ND	ND/ND	19/ND	ND	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND	1 J	ND/ND	ND/ND	ND		
SW-31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	[3]	ND	ND	ND		
SW-32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	[3]	ND	ND	ND		
SW-33	ND	18	9J	ND	ND	ND	2 J	ND	ND	ND	[3]	ND	ND	2.6 J		
SW-37			9J	DRY	DRY	DRY	69	1100 J	DRY	DRY	DRY	DRY	DRY	DRY		
SW-40	ND	16	30	DRY	DRY	36	14	ND	NS	35	[3]	ND	DRY	19.4		
SWRDS-11							ND	DRY	DRY	DRY	[3]	DRY	DRY	DRY		
SWRDS-13							ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY		

Samples from October 1995 - September 2001 analyzed at Severn-Trent Lab unless otherwise noted.

* : Sampled by Dames & Moore

[3] Sample analyzed at General Engineering Labs via Method 8270 extraction; results rejected after QA/QC review.

Results reported in ug/L.

ND/83: Original sample result/Duplicate sample result

Blank cells indicate that no sample was collected from the corresponding locations.

Samples from December 2001 analyzed by General Engineering Laboratories

ND: Not Detected

J:Estimated Concentration

NS: Not sampled as planned.

[1]: Not sampled due to an oversight.

[2]: Not sampled because the water at the location was frozen.

ATTACHMENT 3

Details of Duke University Radiation Site

Responsiveness Summary - Cornell University Radiation Disposal Site

Duke University - Duke Forest Low Level Radioactive Waste Site

Background

Duke University land used for the disposal of radioactive materials including animal carcasses, solvents, chemical lab wastes, and solid wastes. Unknown quantity of radiological wastes. Initial disposal of chemical wastes included fourteen 55-gallon drums and five 5-gallon pails of chemical lab wastes.

- operated from 1961 to 1970
- 10,000 square foot open trench disposal area
- 27 dry (above water table) trenches at depths of 14-16 feet below grade
- well defined trenches with clean soil between
- 1986 disposal of lab wastes from a university building
- strontium main radionuclide of concern

Response Actions/Investigations

Closed in 1970
Capped with clay in 1985
Groundwater investigation 1987-1989 detected paradioxane
Remedial Investigation 1990-1997 documented plume of paradioxane extending 500 feet
Remediation began in October 1997, completed January 1998

Details of Remediation

1985 clay cap was removed.

Soils:
Excavation of disposal area involved segregation of trench materials from clean inter-trench areas, determined visually after initial sampling
Approximately 6,000 cubic yards of soil excavated, sampled every 100 yards
36 cubic yards segregated for disposal as radioactive waste, disposed at Envirocare facility in Utah.
Approximately 34 yards of soil were contaminated with paradioxane, classified as industrial waste due to low concentrations and shipped to Laidlaw facility in South Carolina.

Animal Carcasses:
Due to significant water infiltration and aerobic conditions, most of large animal carcasses had decomposed significantly, most carcasses were small and in plastic bags. These were classified as medical wastes for disposal, shipped to BFI for incineration.

Chemical Wastes:
Majority of chemical waste was from the 1986 dumping. This included 1,492 small lab containers and 346, 55-gallon drums of waste.
No mixed radioactive and hazardous wastes.

Groundwater:
Paradioxane plume migration of approximately 500 feet downgradient from disposal cell. Confined to Duke University property.

Remedy selected is no action, with monitoring. The groundwater standard for paradioxane in NC is 7 ug/l. The state lab required method detection limit (the lowest concentration that can be reported confidently) is 20 ug/l. The cleanup limit used by North Carolina for this project (to determine clean from contaminated) was 58 ug/l.

Cost of Remedy

Total $1.3 million for all work including sampling, excavation, and disposal

Radioactive wastes cost $140,000 for disposal of 36 cubic yards, not including shipping, or $3,888 per yard.

Carcasses cost $0.25 per pound for incineration due to classification as medical waste (radioactive waste cost is $25/pound)

The present-worth cost of future groundwater monitoring is not available.

Comparison to Cornell University RDS

Similarities

Periods of operation:	overlap
Disposal method:	similar, open trench, uncontained radioactive and chemical materials depths below grade are similar
Materials:	paradioxane as primary solvent disposed radionuclide disposal lab animal carcass disposal
Groundwater:	paradioxane plume migrating from site

Differences

Size:	Cornell 2-acres Duke 1/4-acre
Disposal Conditions:	Cornell - wet trench, anaerobic conditions, into weathered bedrock, overlapping trenches completely fill defined disposal area Duke- dry trench, aerobic conditions, into overburden soils, clean soil areas between 27 well-defined trenches
Waste Volume:	Cornell - initial volume 38,667 cubic yards/9,400 rad waste, 54,200 cubic yards to be handled under removal scenarios. Duke - initial volume unknown/36 yards rad waste found. 6,000 cubic yards of clean fill handled under removal scenario. Cornell - chemical wastes and rad wastes mixed Duke - wastes segregated, no mixed wastes identified

Materials:	Cornell - radionuclides include tritium, cesium, strontium, carbon-14 Duke - strontium was radionuclide of concern Cornell - large quantity of lab animal carcasses a concern due to better condition and contamination with radionuclides Duke - small quantity of bagged carcasses for disposal, classified as medical wastes (not possible for Cornell site under NYS regulations)
Groundwater:	Cornell - tritium plume has migrated from site, majority of paradioxane plume to be actively captured and treated. Duke - no management of paradioxane plume, no radionuclides detected in groundwater.
Remedy Costs:	Cornell - Excavation and removal costs based on estimates of waste in place. The two major components are: 26,255 cu. yds rad waste ($2,430/yd incl. Transport) 2,917 cu. yds mixed waste ($8,100/yd incl. Transport) This includes the disposal of the animal carcasses as radioactive wastes as required by NYS and Federal regulation. Duke - Removal costs based on excavation of approx. 6,000 cu.yds of clean soil, disposal of 36 cu. yds of rad waste ($3,888/yd not. Incl. Transport), and approximately 86 cubic yards of chemical wastes.

OESO
Duke University

Newsletter

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DUKE FOREST LOW-LEVEL RADIOACTIVE WASTE SITE EXCAVATED

A quarter-acre Duke Forest site used to bury low-level radioactive waste and unneeded chemicals has been excavated and the waste materials have been removed and disposed of according to current Federal and State regulations. This "source removal" is an important step in the on-going remedial action at the site, which is located southwest of N.C. 751 and west of Kerley Road in the Durham Division of Duke Forest. The site was chosen in 1961 because it was believed its physical properties minimized chances of runoff and leaching of wastes. At that time, landfill burial was the federally prescribed disposal method of such wastes and the site was operated under a permit from the Atomic Energy Commission.

The site was used for "open trench" burial of low-level radioactive waste until January 1970. The wastes were not packaged in drums prior to disposal and were simply deposited into the newly dug trenches. Also, in early 1970, fourteen 55-gallon drums and five 5-gallon pails of unneeded chemicals were buried at the site when the Chemistry Department moved into its new building. This "one time" chemical disposal ultimately led to the site being designated as an "orphan hazardous waste disposal site" subject to the provisions of the Superfund regulations.

The first indication of environmental impact was identified in 1978 when testing demonstrated that foliage from several tree stumps within the waste site fence contained radioactive strontium, apparently because their roots had penetrated trenches where the waste was buried. These trees were removed and maintenance at the site was improved to limit growth of vegetation. The University then capped the site in 1985 with a layer of clay. Since then, both Duke and state officials have conducted periodic checks to ensure that no radioactive materials were migrating from the site.

In 1987, the university drilled four monitoring wells at the site to help monitor radiation levels in groundwater. Water samples also were analyzed for a spectrum of chemicals monitored by the U.S. Environmental Protection Agency. Only trace levels of organic chemicals were found. Similar testing of the water was done periodically for the next two years. In December 1988, the state also began testing well water at the nearest eight residences and no unacceptable levels of chemicals were found.

In April 1989, the chemical testing of water samples was broadened to search for a wider range of chemicals than those monitored regularly by the EPA. All samples from the monitoring wells at the site were found to contain elevated levels of paradioxane, a colorless solvent that was used as a dispersing agent in scintillation fluid. Paradioxane is classified as a probable human carcinogen, which can affect the human body if it is inhaled, swallowed or touched. It also can cause liver and kidney damage, skin irritation and other symptoms. Duke reported publicly the presence of paradioxane in November 1989.

In 1990, the University entered into a voluntary Consent Agreement with the State and conducted an expanded remedial investigation to better characterize the extent of the paradioxane migration from the site. This characterization was completed in late 1997 and documented that the plume of contaminated groundwater had migrated approximately 500 feet toward the southeast of the site. This location is still more than 1,000 feet inside the boundaries of the Duke Forest.

With this new level of confidence regarding the hydrogeology of the site, the University proposed excavating the original source materials to minimize future releases of contaminants to the environment. The State approved our workplan in April 1997, and the actual excavation commenced in October and proceeded until January 1998. The removal strategy involved an "open pit" excavation of the entire site, thus removing all of the wastes and soils, to a depth ranging from 14 to 16 feet, within the 10,000 square foot area.

All of the wastes were carefully segregated from the adjacent soils and all the low-level radioactive wastes were placed into 55 gallon drums, while the chemical containers were taken to an isolated area at the site for characterization and packaging by a hazardous waste contractor. The total volume of excavated low-level radioactive wastes included 238 55-gallon drums of scintillation vials and test tubes, 17 drums of needles and syringes, 43 drums of lab wastes, and 48 drums of animal carcasses. In addition, 1,492 containers of hazardous chemicals were removed for disposal.

More than 6,000 cubic yards of soil were excavated from the site, and after extensive analysis for both radiological and chemical contamination, the majority of the soil was found to be free of any significant contaminants and were returned to the pit. Only about 60 cubic yards of soil required shipment off-site as contaminated radiological or chemical waste.

All of the excavated waste has been removed from the site, and we are in the final phase of getting the contaminated soils accepted for final disposal. Once these soils have been shipped, the North Carolina Department of Environmental and Natural Resources has given us permission to remove fencing and warning signs, thus providing unrestricted access to this section of the Duke Forest.

The entire excavation and disposal cost approximately $1.3 million. However, this proactive measure has eliminated the potential for future contamination of the environment and will greatly facilitate the development of a plan to manage the groundwater contamination that still exists beneath the site.

In closing, it is worth noting that Duke is not alone in having to deal with such sites, in fact, most major Universities have at least one similar site on their campus. However, we are one of the first Universities to voluntarily accept our responsibility for past practices and excavate of the original source material.

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Last Updated: *September 15, 1998*
Safety@mc.duke.edu

ATTACHMENT 4

Copies of Media Articles

Co./Dept. NYSDEC	Co./Dept. Cornell
Fax:	Fax:
Phone:	Phone:
Note:	E-Mail:

The Ithaca JOURNAL
April 23, 2001
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Agencies, Cornell to discuss cleanup of site

Public invited to meeting on proposed plan

By MISSY GLOBERMAN
Journal Staff

LANSING — Two state agencies are holding a public meeting at DeWitt Middle School Thursday night to gather input on a proposed cleanup plan for Cornell University's former radiation disposal site in the Town of Lansing.

Officials from Cornell, as well as the state Department of Environmental Conservation and the state Department of Health, will be on hand from 7-9 to discuss the $10 million proposed plan to treat the contaminated groundwater from the site, as well as contain the area to prevent any further release of contamination.

The two-acre site on Snyder Road, north of the Tompkins County Airport, was used from 1956 to 1978 to bury 9,000 cubic yards of radioactive research materials, including animal carcasses, plant matter and other laboratory waste used in laboratory experiments at Cornell. The radioactive waste is considered low level and not lethal by state and federal standards, but traces of toxic and radioactive chemicals have been found in groundwater nearby.

KATE SCHLEE/Journal Staff

A sign warding off entrance hangs at the former Cornell University radiation disposal site on Snyder Road in Lansing. Representatives from Cornell, the New York Department of Environmental Conservation and the Department of Health will meet Thursday to discuss the proposed cleanup plan.

In February 1999, a feasibility study prepared for Cornell by McLaren/Hart Environmental Services was released to the public. It outlined six options for the site's remediation and the potential costs of each.

The option that ranked the highest in the feasibility study, and that Cornell also favored, was selected by the DEC as the proposed remedy. The plan includes containment on the site with a slurry wall of a clay barrier and curtain of grout placed under the slurry layer to ensure the least potential for leakage.

The gaping difference among the options was whether to conduct no further action beyond the current cap on the site and groundwater treatment; leave the radioactive material in its place and remediate its containment at the current site; or excavate the radioactive material and move it to a different site, while also treating the groundwater pollution at the current site.

Though the state will pay

See SITE, 4A

Meeting

A public meeting, sponsored by the New York State Department of Environmental Conservation and the state Department of Health, will be held from 7-9 p.m. on Thursday, April 26, at DeWitt Middle School, located at 560 Warren Road. The meeting is to discuss the proposed remedial action plan for Cornell University's radiation disposal site. Representatives from these agencies and Cornell will be available to answer questions about the site and receive public comment. Public comments also can be submitted in writing until June 13. The same representatives will be available again for another public question and comment session from 4-6 p.m. and from 7-9 p.m. on May 15 at DeWitt Middle School. Additional information on the site can be found at eco.pdc.cornell.edu/DSC/default.htm. Or contact Donna Connory at 255-6572 or Martin Brand, DEC Project Manager, at (518) 457-5637.

Site

(Continued from Page 1A)

some of the bill via Cornell's statutory colleges, the university will be wholly responsible for the $6,904,000 estimated implementation cost, the $2,784,000 capital construction cost, as well as the annual maintenance, operation and monitoring costs, said Donna Connery, project manager for the radiation disposal site in Cornell's environmental compliance office.

Monitored by the state since 1984, the site became the focus of careful examination after the university detected traces of the chemical paradioxane in water and soil samplings near the site in 1993. Paradioxane is a solvent used in radiation experiments and has been found to cause cancer in laboratory animals.

Trace amounts of the radioactive chemical tritium also were found in the groundwater, but at levels far below concerns for health risk, Connery said.

Paradioxane has leaked as far south as 2,500 feet southwest of the site. The nearest homes that draw well water are one-half to three-quarters of a mile away in the opposite direction of the leak.

The DEC said in an assessment in 1997 that the site poses no present danger to public health or safety.

Officials from the DEC did not return repeated calls for comment.

Cornell also had a chemical disposal site located one-third of a mile southeast of the radiation disposal site. Between 1962 and 1977, Cornell operated the chemical site as a landfill for the disposal of chemical wastes from university laboratories. The site is closed and capped. The site groundwater has been recovered and treated through an on-site treatment facility.

Connery said the groundwater recovery and treatment system for the radiation disposal site is in place and, with the proper permits issued, should be up and running in May. The radiation site water will be treated at the same facility for the chemical disposal site.

Cornell completed interim remediation measures in 1997 under an agreement signed with the DEC. An impermeable plastic cap and soil cover over the radiation disposal site were installed in 1996 to prevent any further water from entering into the waste. A fence was erected to expand the secured area by 60 feet in all directions. A leak-proof pipeline also was laid to transport occasional discharges of ground and surface water to a collection and treatment system on the former chemical disposal site.

Documents pertaining to the chemical and radiation disposal site are on file and available to the public at the Tompkins County Public Library, the Lansing Village Hall and Cornell's Environmental Compliance Office in East Hill Plaza.

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APR 30 2001
BUREAU OF CENTRAL REMEDIAL ACTION

CITY & COUNTY

Groups address CU disposal

State departments attempt to allay fears of radiation

By MISSY GLOBERMAN
Journal Staff

ITHACA — About 30 people, including concerned Lansing residents, Tompkins County Environmental Management Council members and Cornell University staff, attended a public meeting with state agency officials Thursday night to listen and comment on a proposed plan to cleanup Cornell's former radiation disposal site.

Representatives from the state Department of Environmental Conservation and the state Department of Health discussed the proposed $10 million plan, and will continue to gather public comment until June 13. The proposed remedy includes treating the contaminated groundwater from the site, as well as contain the area to prevent any further release of contamination.

The two-acre site on Snyder Road, north of the Tompkins County Airport in the Town of Lansing, was used from 1956 to 1978 to bury 9,000 cubic yards of radioactive research materials used in laboratory experiments at Cornell, including animal carcasses, plant matter and other laboratory waste.

The radioactive waste is considered low level and not lethal by state and federal standards, but traces of toxic and radioactive chemicals have been found in groundwater and surface water nearby.

Martin Brand, project manager from the DEC's Division of Environmental Remediation, reassured nearby residents that no drinking water near the site had been affected by the groundwater nor surface water contamination.

The state's proposal recommends the containment on the site be with a slurry, or clay, wall and curtain of grout placed under the slurry layer to ensure the least potential for leakage.

But county Board Rep. Dooley Kiefer (D-Cayuga Heights) said the county environmental council recommended the DEC excavate the radioactive material and move it to a different site on Cornell property, while also treating the groundwater pollution at the current site.

"We really thought that developing state-of-the-art containment designed specifically for this waste makes the most sense," she said.

Other concerns raised by those attending included the method used for sampling wells near the site and for the contamination plume, as well as the impact the contaminated water would have on Cayuga Lake.

Brand said the chemical paradioxane in water and soil samplings was of paramount concern. This was mainly because it was found in the majority of the water and soil samples at levels higher than the state guideline of 50 parts per billion. Paradioxane is a solvent used in radiation experiments and has been found to cause cancer in laboratory animals.

Brand said they would not readily consider sampling more wells since the health and environmental risks of the site's contamination were considered low.

If you go

State agency representatives will be available for a second public question-and-comment session on the site from 4-6 p.m. and 7-9 p.m. on May 15 at Dewitt Middle School, 560 Warren Road, Ithaca.

Additional information on the Radiation Disposal Site can be found at eco.pdc.cornell.edu/DSC/default.htm. Also, contact Donna Connery at 255-6572 or Martin Brand, DEC Project Manager, at (518) 457-5637.

CITY & COUNTY

Lansing officials back CU cleanup

By MISSY GLOBERMAN
Journal Staff

ITHACA — Two Town of Lansing officials Tuesday expressed confidence in a proposed plan by New York state to remediate Cornell University's former Radiation Disposal Site in the Town of Lansing.

The Lansing officials and a handful of other residents attended a public meeting that marked the middle of a public comment period on the $10 million remediation plan. The comment period ends June 12. The plan includes treating contaminated groundwater from the site as well as containing the area to prevent any further release of contamination.

The two-acre site on Snyder Road, north of the Tompkins County Airport, was used from 1956 to 1978 to bury 9,800 cubic yards of radioactive research materials, including animal carcasses, plant matter and other laboratory waste used in experiments at Cornell.

The radioactive waste is considered low-level and not lethal by state and federal standards, but traces of toxic and radioactive chemicals have been found in nearby groundwater and surface water.

Nancy Loncto, a member of the Town of Lansing Planning Board, and Bud Shattuck, a Lansing Town Board member, talked to Martin Brand, project manager from the state Department of Environmental Conservation's Division of Environmental Remediation, about the long-term ramifications of the site on future development.

Shattuck said the board did not have any problems with the state's proposed plan, and that it has never received any formal complaints or concerns about the site.

Loncto, who was not familiar with the site plan, said she felt the studies already conducted and expertise applied to the proposal lent it credibility.

"I'm also reassured that people like me who live near the site can get their wells tested by the health department if they have any other concerns," she added.

At the last public meeting, Brand and other Cornell staff involved with the project reassured residents that there are no drinking water wells located near enough to the contamination to be affected.

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New Internet site maps toxic-waste areas in New York

By ERIKA ROSENBERG
Gannett News Service

ALBANY — A new Internet site unveiled Wednesday allows New Yorkers to find out if their community has toxic-waste sites that are supposed to be cleaned up by a state program that has gone bankrupt.

Trying to pressure lawmakers into action, the New York Public Interest Research Group created the Web site that maps the locations of 864 toxic-waste sites that are part of the state Superfund program, which has run out of money.

Counties with the most sites include Monroe, 33; Niagara, 23; Dutchess, 24; Westchester, 19; and Oneida, 17.

"Almost everybody's affected by this program," said Michael Livermore of the research group. "It's vitally important for New York citizens to become involved and active in letting their representatives know that they want the Superfund refinanced."

The campaign is aimed at breaking the logjam between state leaders over how much money to spend, how stringent clean-up standards should be and other issues. Gov. George Pataki has proposed funding the program for 20 years and changing clean-up standards to take into account how the polluted site will be used in the future. A competing bill by Assemblyman Pete Grannis, D-Manhattan, and Sen. Kenneth LaValle, R-Suffolk County, calls for a 10-year timeline for cleanups and the current standards requiring polluters to try to restore the site to its original state.

People visiting the Web site, www.nypirg.org, can click on "Is there a toxic-waste site in your community" to search for polluted sites in or near their zip code, find out which lawmakers represent the area and e-mail them. The research group has already written e-mail messages urging lawmakers to support the bill that maintains the current cleanup standards.

Sites in Tompkins County

- **Cornell University's Radiation and Chemical Disposal Sites** off Snyder Road in Lansing. Chemical site was capped in 1991, groundwater treatment and collection system installed in 1992. Near radiation site, soil is contaminated in areas covered with buildings and pavement. A proposal for further remediation is available for public comment until June 13.
- **Morse Industrial Corporation** on Route 96B in Ithaca. Contamination detected in late 1980s. All contaminated soils have been removed and disposed off-site. Groundwater extraction system was constructed in 1998.
- **Former New York State Electric and Gas coal tar manufacturing and storage site** on Court Street in Ithaca. Soil is contaminated, in areas covered with buildings and pavement. Groundwater contamination may be migrating off-site from the area of buried tar storage vessels but there are no private potable water supply wells known in the area.

JUNE 6-12, 2001 THE ITHACA TIMES

NEWSLINE

Searched Earth

Public has through June 13 to comment on proposal to isolate radiactive waste

Area residents have until June 13 to comment on Cornell's plan to clean groundwater near its radioactive disposal site and prevent further contamination.

Cornell used the site, located in the Town of Lansing near the Tompkins County Airport, to dispose of low-level radioactive waste leftover from experiments during the 1950s, '60s and '70s. At that time, it was simply dumped in unlined trenches and buried in accordance with regulations of the time, said Donna Connery, Cornell's environmental compliance director.

Since then, paradioxane, a chemical used to detect radioactivity, has been found in nearby groundwater at levels above drinking water standards. If consumed, it can cause liver damage, Connery said. Other chemicals have also been detected, but not in significant amounts, she added.

Now the university, with the approval of the Department of Environmental Conservation, is constructing a wall around the buried waste to prevent further contamination.

When completed, the clay barrier will extend about 15 feet into the ground, surrounding the buried waste and the drinking water underneath it. Below that, a cement wall will isolate the upper surface of the bedrock, going down another 20 feet for a total of 35.

In addition, contaminated groundwater will go through a cleaning process. A series of wells along Snyder Road will capture the water, which will be treated, tested and sent to a holding pond and then a nearby stream. The university has not acquired all the permits for this process yet, Connery said, adding that the process should be operating by the end of this year.

Connery said that after Cornell assessed the risks the site poses to human health, a report with possible plans of action went to the state, which then recommended this particular course. Public opinion could lead the state to alter its decision, she said.

Tompkins County's Environmental Management Council plans to vote on how they prefer to have the site dealt with on June 13, said Mikel Shakarjian, the council's coordinator. Previously, the council had discussed the possibility of Cornell installing a full landfill, Connery said.

In addition to publishing an annual newsletter about the site, the university has held two public forums regarding it this year, one on April 26 and one on May 15. About 15 or 20 people attended each one, Connery said.

"For the number of people that live out there, there weren't that many people who showed up," she said. Concerns of those attending included how the site affected them, whether it could contaminate Cayuga Lake and how it would be monitored in the future, she added.

Full reports on the cleanup plan are available at the Tompkins County Public Library, at the Lansing Village Hall and at Cornell's Environmental Compliance Office, located in the East Hill Plaza.

JESSICA KELTZ

APPENDIX B

Administrative Record Document List

Record of Decision - Cornell University Radiation Disposal Site

Administrative Record
Document List

Dames & Moore. 1994 *Preliminary Environmental Assessment, Cornell University Radioactive Burial Site*

Dames & Moore. 1996 *January and June 1995 Sampling and Analysis Report, Cornell University Radiation Disposal Site*

Dames & Moore. 1996 *Assessment of Scintillation Fluid Compounds, Cornell University Radiation Disposal Site*

Ichthyological Associates, Inc. 1996 - 2001 *Annual Reports for the Biological Monitoring Program at Cornell University's Radiation Disposal Site, Lansing, New York*

McLaren/Hart, Inc. 1997 *Remedial Investigation, Cornell University Radiation Disposal Site, Lansing, New York* (Volumes 1 and II)

McLaren/Hart, Inc. 1997 *RDS Monitoring Plan, Cornell University Radiation Disposal Site, Lansing, New York*

McLaren/Hart, Inc. 1998 *Interim Remedial Measure Final Engineering Report, Appendix N, Operations and Maintenance manual for the Cornell University Radiation Disposal Site, Lansing, New York*

McLaren/Hart, Inc. 1999 *Supplemental Remedial Investigation, Cornell University Radiation Disposal Site, Lansing, New York*

McLaren/Hart, Inc. 1999 *Baseline Human Health Risk Assessment, Cornell University Radiation Disposal Site, Lansing, New York*

McLaren/Hart, Inc. 1999 *Feasibility Study for the Cornell University Radiation Disposal Site, Lansing, New York*

Cornell University 2000 *Plans and Specifications for Drilling and Well Installation Activities for the Cornell University Radiation Disposal Site Groundwater IRM*

Sovereign Consulting, Inc. 2000 *Groundwater IRM Design Submittal Package, Cornell University Radiation Disposal Site, Lansing, New York*

Cornell University 1997-2000 *Cornell University's Radiation Disposal Site Annual Reports*