Chapter
8

Mound Facility

History and Mission

The Miamisburg Environmental Management Project (Mound), previously known as the Mound Laboratory, opened in 1946. Formerly the facility produced detonators for activating explosives in nuclear warheads, recovered and purified tritium from weapons components, and constructed plutonium heat generators for satellites.[1] Mound was the first permanent facility in support of atomic weapons research. Prior to 1996, the plant supplied stable isotopes for the DOE. As of 1997, the removal of tritium components from nuclear weapons ceased. Cleanup of the site began in 1995. Site closure originally scheduled for 2006,[2] has been pushed back to 2010 with a possibility of an even later date.[3] Declared as a Superfund Site, Mound was placed on the National Priorities List in 1989. The current mission entails:

- Environmental decontamination and decommissioning;
- Receipt of scrap metal from other DOE sites;
- The production of heat generators for both commercial and military generators for satellites continues.[4]

Location and Land

Mound is located in Miamisburg, Ohio (population 19,489), 10 miles southwest of Dayton (population 166,179) and 45 miles north of Cincinnati (population 331,285) in southern Montgomery County. (See Figure 1.) Considerable residential, commercial, and industrial development lies within 5 miles of Mound Laboratory. For example, the Mound Golf Course and the Miamisburg Mound State Memorial Park are immediately to the east of the site,5 and residential areas are adjacent to the facility to the west, north, and east.

The 306-acre site is elevated on two hills overlooking Miamisburg and the Great Miami River as well as a valley and a drainage ditch that run between the hills. The northwest high area is known as the Main Hill and is home to most of the buildings, while the southwest high area is known as the Special Metallurgical/Plutonium Processing Facility Hill (SM/PP).6 To the west of the site lies an abandoned section of the historic Miami-Erie Canal. This ditch runs from the site to the Great Miami River, and provides drainage for most of the site into the Great Miami River.[7] BWX Technologies, LLC was the remediation contractor for this site; the current contractor is CH2M Hill.

Number of people living within 50 miles of Mound: Approximately 1,000,000 [8]

Employees at Mound: About 1,000 CH2M Hill employees; 200 DOE employees[9]

For remediation purposes the site was divided into nine Operational Units.[10] Operational Units 1, 2, 4, 5, 6, and 9 require cleanup and restoration from operations onsite. Waste Storage Areas and Waste Treatment Areas (See Figures 2 and 3.)

Potential Release Site 66. An extremely contaminated area that is of greatest concern to the site is Potential Release Site 66 (PRS 66). In this area a steep ravine was located southeast of buildings 29 and 98 and south of building 51. This site was used for the disposal of construction soils and contaminated debris, including 10,000-15,000 empty drums that contained thorium-232, plutonium-238, and polonium-210. The valley that is now PRS 66 was filled, paved over with an asphalt covering in 1984, and is now a parking lot.[11]. (See Figure 4.)

Operational Unit 1. Operational Unit 1 originates from a buried landfill area. This unit includes three plant production wells, an overflow pond, and an old landfill used from 1948 to1974. The overflow pond detains excess storm water runoff, which is then drained via a standpipe.[12] The effluent in the overflow pond is discharged at a rate of up to 600,000 gallons per day and flows via the abandoned section of the Miami-Erie Canal to the Great Miami River.[13]

No detailed records exist regarding what was dumped into the old landfill. This area is adjacent to the current site sanitary landfill. According to rough estimates available, the waste in the old landfill resulted from dumping, burning, moving, reworking, and partially removing and burying wastes throughout the years. The first burial in this area included contaminated steel and metal debris. Shortly thereafter, empty drums containing thorium were also buried. Beneath this area are alluvial aquifers consisting of sand and gravel glacial outwash, sand lenses in glacial till, and artificial fill.[14] "The former waste disposal sites within Operational Unit 1 are concentrated within, beneath, and immediately adjacent to the current site sanitary landfill. These waste disposal sites are the result of long history of dumping, burning, moving, reworking, burying, and partially removing wastes and placing them into the site sanitary landfill."[15] (See Figure 4.)

Operational Unit 2. Operational Unit 2 includes contamination from the Main Hill. In this area, volatile organic compounds and tritium continue to seep into the soil and groundwater.

Operational Unit 4. Operational Unit 4 contains a significant portion of the historic Miami-Erie Canal west of the mound facility. The Miami-Erie Canal in this area contained significant plutonium contamination in sediments filling the canal. Cleanup of Operational Unit 4 was completed in the late 1990s. The central drainage ditch that is found between the two hills also dumps runoff from the site into the canal.

Operational Unit 5. Operational Unit 5 comprises the southern section of the site. In this area, plutonium, thorium and actinium contaminate the soils.

Operational Unit 6. Operational Unit 6 is composed of the buildings that currently await remediation.

Operational Unit 9. Operational Unit 9 focuses on all effects of contamination at MOUND and areas surrounding the site.[16]

Water Sources

Surface Water

The old Miami-Erie Canal bed runs along the western border of MOUND, and the Great Miami River lies 2000 feet west of the site. On-site surface water features consist of drainage ditches, french drains, and an overflow pond. For many years the nearby Great Miami River served as a flushing agent for contaminants from the Mound site. As much as 600,000 gallons per day were released from the site to this river.[17]

Aquifer

Groundwater beneath MOUND is contained in a shallow, highly permeable sandy-gravel layer and flows in the same direction as the Great Miami River.[18] The estimated infiltration into the soil is 5.9 inches per year.[19] Recharge to the aquifer occurs by precipitation and surface water infiltration. Beneath the site is the Great Miami Buried Valley Aquifer, commonly referred to as the Buried Valley Aquifer, extends from north of Dayton to Cincinnati. Wells for the city of Miamisburg are located three miles up gradient from the site, in the Buried Valley Aquifer. This aquifer is also found further south in the same valley, beneath the Fernald Site and in 12 counties of Ohio. It provides 75 % of the region's drinking water, and is designated as a sole source aquifer.[20] Wells connected to the Buried Valley Aquifer can yield as much as 2,500 gallons of water per minute.[21]

Groundwater flow: Southwest at a rate of 100 to 400 feet per day[22]

Average Annual Precipitation: 38 inches per year[23]

A relatively thin zone of fractured bedrock, which serves as an aquifer to transport contaminants on the hillsides, occurs beneath the Main Hill and the SM/PP Hill. Contamination infiltrates from the surface of the site into the ground and is transported down the hillsides into the Buried Valley Aquifer.

Contamination

Major contaminants of concern in the soil and groundwater are tetrachloroethane, trichloroethene, and 1,2,-trans-dichloroethane. Temporary storage of solid and liquid low-level wastes, solid transuranic wastes and explosive wastes, as well as radioactive mixed wastes and hazardous chemical wastes are present on-site due to the past activities at MOUND.

Solid low-level radioactive wastes comprise 95% of the total volume of radioactive waste generated annually. Low-level solid radioactive wastes are shipped off-site, while the liquid low-level wastes are treated on site.[24] Tritiated wastewater was diluted and discharged into the surface water and dumped into the Great Miami River until 1970. Of particular concern is plutonium-238-contaminated soil and debris, which still remains onsite.[25] Plutonium-238 has a half-life of 86 years.

A summary of releases to the environment throughout the years of operation is as follows:

- A pipe break and accompanying heavy thunderstorm that occurred in 1969, near one of the site's treatment of liquid radioactive waste buildings, carried Plutonium-238-contaminated sediment off site into the Miami-Erie Canal.
- From 1960 to 1970 Mound Laboratories released from 100,000 to over 350,000 Curies/year of tritium into the air. The tritiated air plume often reached ground within one mile of the plant, and stayed in contact with the ground for a considerable distance from the plant[26].
- The contents of 200 55-gallon steel drums containing protactinium-231 were deliberately discharged into the Great Miami River. Since no records were kept, the eventual disposition of the contaminated drums is unknown.
- Area 15, also known as "the old cave," leaked radium/actinium to the surrounding soil. The old cave was later entombed in concrete.
- Over 13 gallons of solution containing Thorium-230 were diluted and released to the Great Miami River. Thorium-230 has a half-life of 77,000 years.
- Repacking of 6,000 55-gallon drums that containing thorium-232 sludge at Warehouse 9 and 15, Quonset hut, W Building, G Building, and additional open areas took place in the northeastern portion of the site. They were then stored at either the new storage building or Building 21. Thorium sludge is corrosive and therefore the drums require frequent repacking.
- More than 30,000 gallons of Thorium-232 was released to the Great Miami River. Thorium-232 has a half-life of 14 billion years. Fifteen thousand to 20,000 drums and contaminated soils are buried in Areas 1,2, 3, 7, 8, and 12. A contaminated truck and conveyor belt are also buried at Area 7.
- Tritium has been found in the Buried Valley Aquifer at above permitted levels.[27]

Contaminants travel to the Great Miami River by two routes: by means of an open ditch into the Miami-Erie Canal and through a dedicated pipeline originating onsite, leading directly to the Great Miami River. The pipeline carries sanitary wastewater treatment plant effluents, wastewater treatment facility effluents, and certain permitted cooling waters and softener backwash waters, together with a small amount of storm water runoff. The Plant Drainage Ditch flows down the central valley of the site and discharges directly into the Miami-Erie Canal. After flowing to the Canal, the majority of the site's storm water runoff, as well as other cooling and backwash waters, drain into the Great Miami River. In the past, 660,000 gallons per day were emitted from the site.[28]

During Mound's operation, the majority of the radioactive wastes were shipped offsite for disposal. Approximately 140,000 ft^3 of waste was shipped to the Idaho National Engineering and Environmental Laboratory (INEEL) up until 1988 while 880,000 ft^3 went to other sites.[29] Typically, debris from demolition, used drums, soils contaminated with radium, actinium, or thorium; and cleaning residues were dumped on-site. "Since January 1988, Mound has accumulated approximately 121,000 ft^3 of TRU waste and is storing it on-plant awaiting shipment to INEEL or WIPP."[30]

The area located south of the overflow pond is known as a "hot waste burial" area because it contains a large amount of materials, including 2,000 to 5,000 crushed 55-gallon drums. (See Figure 5.) All waste for this area was buried in an irregular trench and covered with a few feet of soil; it now partially lies underneath the site's sanitary landfill and is believed to

occupy 15,000 ft^2. The area located in the north central part of the site may overlap the chromium trench. Waste buried in this area contains polonium-contaminated sand in at least three 55-gallon drums buried under 30 feet of clean dirt prior to the placement of a parking lot. (Polonium has a half-life of 138.4 days and is non-dangerous by 3.79 years.)

Another area located just south of the chromium trench received disposal of contaminated wastes for many years and is now also covered by a parking lot. A flatbed truck and conveyor belt device, along with 15,000 drums, were buried in this area. The area south of the asphalt-lined pond in the northeast corner of the site contains thorium-contaminated soils from other parts of the site.

Contaminants of potential concern found in the aquifers:
Volatile Organic Compounds:
Arochlor-1248, benzo(a)pyrene, benzo(b)flouranthene, 1,2-cis-dichloroethene, perchloroethylene, tetrachlorethane, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, trichloromethane, 1,2-trans-dichloroethane, and vinyl chloride
Metals:
Cadmium, chromium, and nickel[31]
Radionuclides:
Plutonium-238, radium-226, strontium-90, thorium-232, and tritium[32]

In September 1998, the last shipment of bulk tritium left the site.[33] 25.6 kilograms of plutonium are stored on site in 236 packages, and residual quantities of uranium-233 remain on site as well. Mound is heading toward final remediation.

Remediation

Restoring the site to its background state requires complete characterization and remediation of the site. Removal and excavation has occurred in some areas, but not all. Uranium contamination was found on the floor of Building M, one of the first buildings constructed. As of September 8, 2000 this building was demolished and the cement platform was removed. This area will be developed into a parking lot. Other facilities that were demolished include Building E and the E Annex, Building 21 and Associated Soils, and the PS Building (Paint Shop).[34]

Remediation is further complicated by the location of a lined landfill over a portion of the site.[35] This makes access to contaminated areas extremely difficult. A Record of Decision was filed in June of 1995 requiring pump-and-treat remediation to reduce concentration of contaminants in the Buried Valley Aquifer.[36] Removal of 1.3 million cubic feet (29,055 cubic meters) of plutonium contaminated soil from the Miami-Erie Canal began in October 1996, and this soil was then transported offsite. In 1997 alone, 680,400 cubic feet (19,267 cubic meters) of contaminated soil was shipped offsite, which is only 25% of the total waste on site requiring remediation. Thus far, 30 million gallons of contaminated water have been chemically treated.

Initially the Mound Plant was placed on the National Priorities List under the Comprehensive Environmental Response, Compensation, and Liability Act in 1989 due to volatile organic compound contamination. As initial cleanup began, it was soon realized that a

new decision making process was needed for the site. Mound 2000 is the initiative set forth by the DOE and regulators to expedite the cleanup of Mound by characterizing the problems. The Department of Energy hopes to transfer the site to the city of Miamisburg once remediation is complete.[37]

This plan consists of three sections:

1. Potential Release Site (PRS) Evaluation Process
2. Building Disposition Process
3. Methodology for evaluating residual risk. This entails de-listing the site from the National Priorities List and selling the site.

Among other challenges, a study is yet to be completed for the assurance of the neighbors of the plant and future industries that the spread of contamination will cease.[38]

Challenges

Radionuclides are not stable in the subsurface; instead the contaminants can be transported over great distances. Plutonium processing at several locations spread contamination throughout the site, and offsite in the Miami-Erie Canal. Characterization of the contaminated waste must be complete prior to the start of cleanup. Mound chose pump-and-treat as the baseline groundwater remediation technology. With this treatment, contaminated water is pumped out of the Buried Valley Aquifer and then re-injected *after* treatment into the aquifer. This technology does not remove radionuclides of which the greatest concerns are plutonium and tritium. This method only affects the aquifer and not the unsaturated zones that have existed for over 20 years.

Testing for contamination in Potential Release Site 66 provided results that the contamination is deeper than expected. In addition, seeps of water are present creating a need for alterations to the monitoring and testing plans. This water flows directly into the drainage ditch, which in turns flows west across the site. Remediation of the Potential Release Sites is needed imminently. Ditches leading from these sites as well as other routes carry contamination from the source, spreading it further into the environment. Drainage from contaminated areas will eventually reach the Buried Valley Aquifer unless contained and removed permanently.

A constant challenge to complete remediation involves decreases in the budget allotted by the DOE for cleanup. As the budget is cut, the length of time required for complete restoration of the site is prolonged enabling the contaminants to spread further into the environment. Current estimates are that the remediation may not be completed until 2010 or possibly later.

The contamination from Mound has the potential to affect all drinking water for the city of Miamisburg as well as the outlying areas with the spread of contaminated materials offsite. With contamination caused by years of careless disposal and the lack of record keeping, the area surrounding the site may be unsafe and needs immediate attention. Considering the alarming quantities of radioactive wastes and other contaminants of concern that have been disposed of and released into the air at Mound, monitoring and testing is required to determine the widespread distance the contaminants have traveled thus far. Remediation must be immediate in order to protect the health and safety of employees and neighbors of the site, as well as the residents of the cities close to the plant.

[1] Coyle et al. *Deadly Defense: Military Radioactive Landfills,* 1988: 64.
[2] US DOE. "Closure Site Fact Sheets", <http://apps.em.doe.gov/closure/Documents/FactSheets/Mound.pdf>.
[3] Sandlin, S. "Mound Corporation Wants to Take Over Cleanup Effort", <http://MWCNews.com>, 2001.
[4] US EPA. "Radiation: Mound Plant, Miamisburg, OH Inspection Report", August 19-22, 1996: <http://www.epa.gov/ARD-R5/radiatio/mound2.htm>.
[5] US EPA. "Record of Decision", EPA/ROD-RO5-95/292, June 12, 1995.
[6] US DOE. "Charting the Course: The Future Use Report", April 1996: 62.
[7] US DOE. "Charting the Course: The Future Use Report", April 1996: 62.
[8] Estimated from the US Census 2000. <http://factfinder.census.gov/servlet/BasicFactsServlet>.
[9] US DOE. "US Nuclear Forces", <http://www.fas.org/nuke/guide/usa/facility/mound.htm>.
[10] Babcock & Wilcox. Workplan for Environmental Restoration of the DOE Mound Site, the Mound 2000 Approach", February 1999: 2.3
[11] US DOE. "ITRD Year End Report FY2000 – Final Draft", 31.
[12] Shearer, V. *Research Project on Water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection: A Stewardship in Process*, June/July 2000: 34.
[13] US EPA. "Record of Decision", EPA/ROD-RO5-95/292, June 12, 1995.
[14] US DOE. "ITRD Year End Report FY2000 – Final Draft", 31.
[15] US EPA. "Record of Decision", EPA/ROD-RO5-95/292, June 12, 1995.
[16] US DOE. "Baseline Environmental Management Report", 1996.
[17] US DOE. "Vadose Zone Fact Sheet, Mound Plant", September 2000, <http://www.em.doe.gov/vadose/contents.html>.
[18] US DOE. "Baseline Compliance Assessments (Tiger Team) Database", DOE/EH-0117, December 1, 1989, 3.5.4.1.
[19] US DOE. "Vadose Zone Fact Sheet, Mound Plant", September 2000, <http://www.em.doe.gov/vadose/contents.html>.
[20] Miami Conservancy District. "Groundwater Trail", <www.miamiconservancy.org/gw2000/tour/gw101/GMBVA.htm >.
[21] US DOE. "Baseline Compliance Assessments (Tiger Team) Database", DOE/EH-0117, December 1, 1989, 3.5.4.1.
[22] Coyle et al. *Deadly Defense: Military Radioactive Landfills*, 1988: 65.
[23] US DOE. "Vadose Zone Fact Sheet, Mound Plant", September 2000, <http://www.em.doe.gov/vadose/contents.html>.
[24] Shearer, V. *Research Project on Water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection: A Stewardship in Process*, June/July 2000: 28.
[25] US EPA. "Region 5 NPL Fact Sheet", November 2000, <http://www.epa.gov/R5Super/npl/ohio/OH6890008984.htm>.
[26] US DOE. "RI/FS (Remedial Investigation/Feasibility Study) Site-Wide Work Plan", May 1992.
[27] Shearer, V. *Research Project on Water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection": A Stewardship in Process*, June/July 2000: 17
[28] US DOE. "Baseline Compliance Assessments (Tiger Team) Database", DOE/EH-0117, February 1, 1990, 3.5.3.1.
[29] Shearer, V. *Research Project on water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection: A Stewardship in Process*, June/July 2000: 39, 40.
[30] Shearer, V. *Research Project on water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection: A Stewardship in Process*, June/July 2000: 39, 40.
[31] Babcock & Wilcox. "Workplan for Environmental Restoration of the DOE Mound Site, the Mound 2000 Approach", February 1999: 3.3.2.
[32] Shearer, V. *Research Project on Water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection: A Stewardship in Process*, June/July 2000: 18.
[33] US DOE. "Mound Environmental Management Update", October 1998. <http://www.doe-md.gov/moundinfo/New%20Directions/newdir1098.htm>.

[34] Shearer, V. *Research Project on Water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection: A Stewardship in Process*, June/July 2000: 41-48.
[35] US DOE. "ITRD Year End Report FY2000 – Final Draft", 27.
[36] US DOE. "Charting the Course: Future Use Report", April 1996: 63.
[37] Shearer, V. *Research Project on water Protection around the Mound Facility at Miamisburg, Ohio. The Reality of Water Protection: A Stewardship in Process*, June/July 2000: 57.
[38] Ibid : 42, 43.

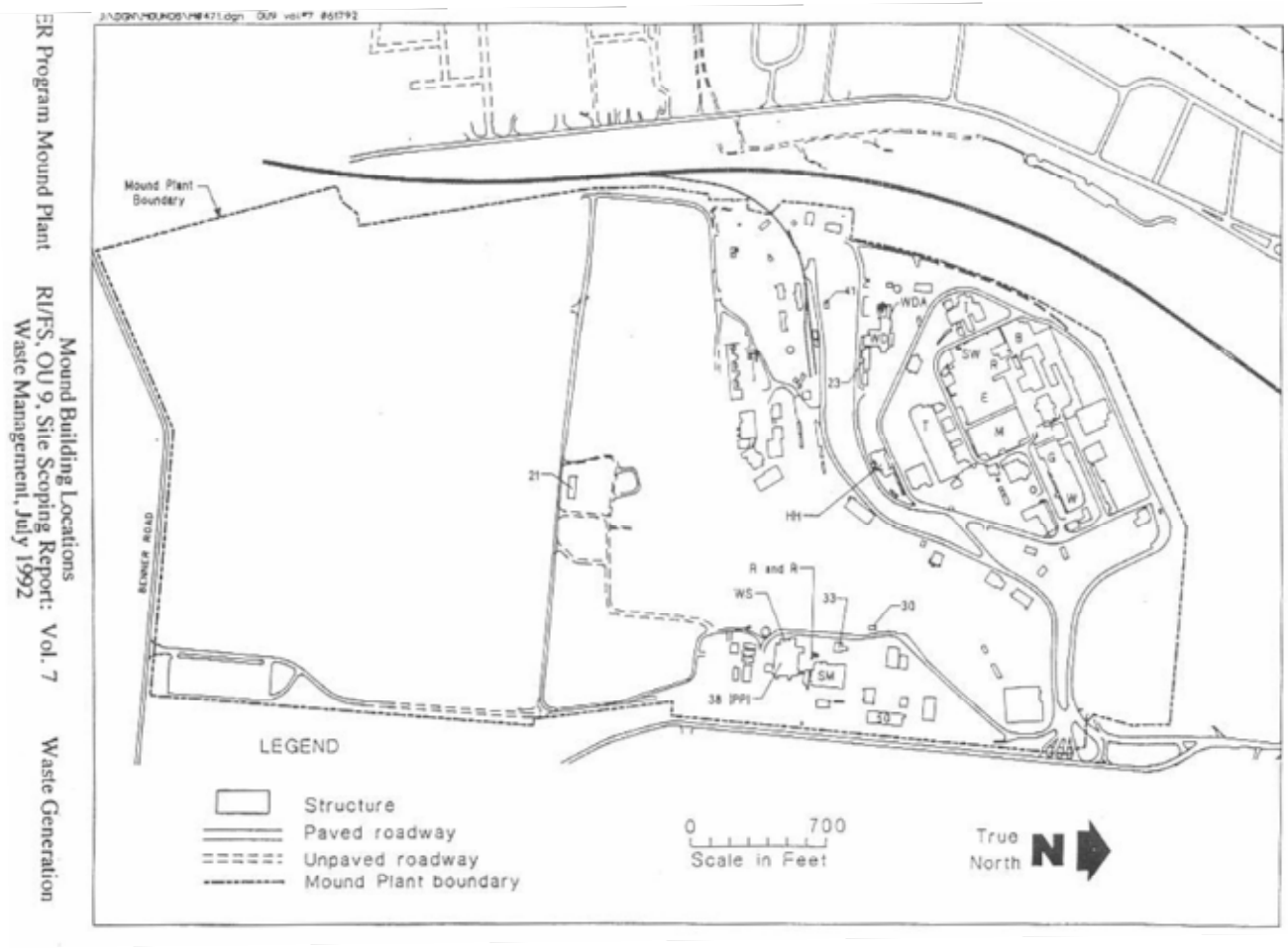

Figure 1: Mound Site Location and Map Source
www.ohio.doe.gov/oh_seb/docs/wd_f.pdf

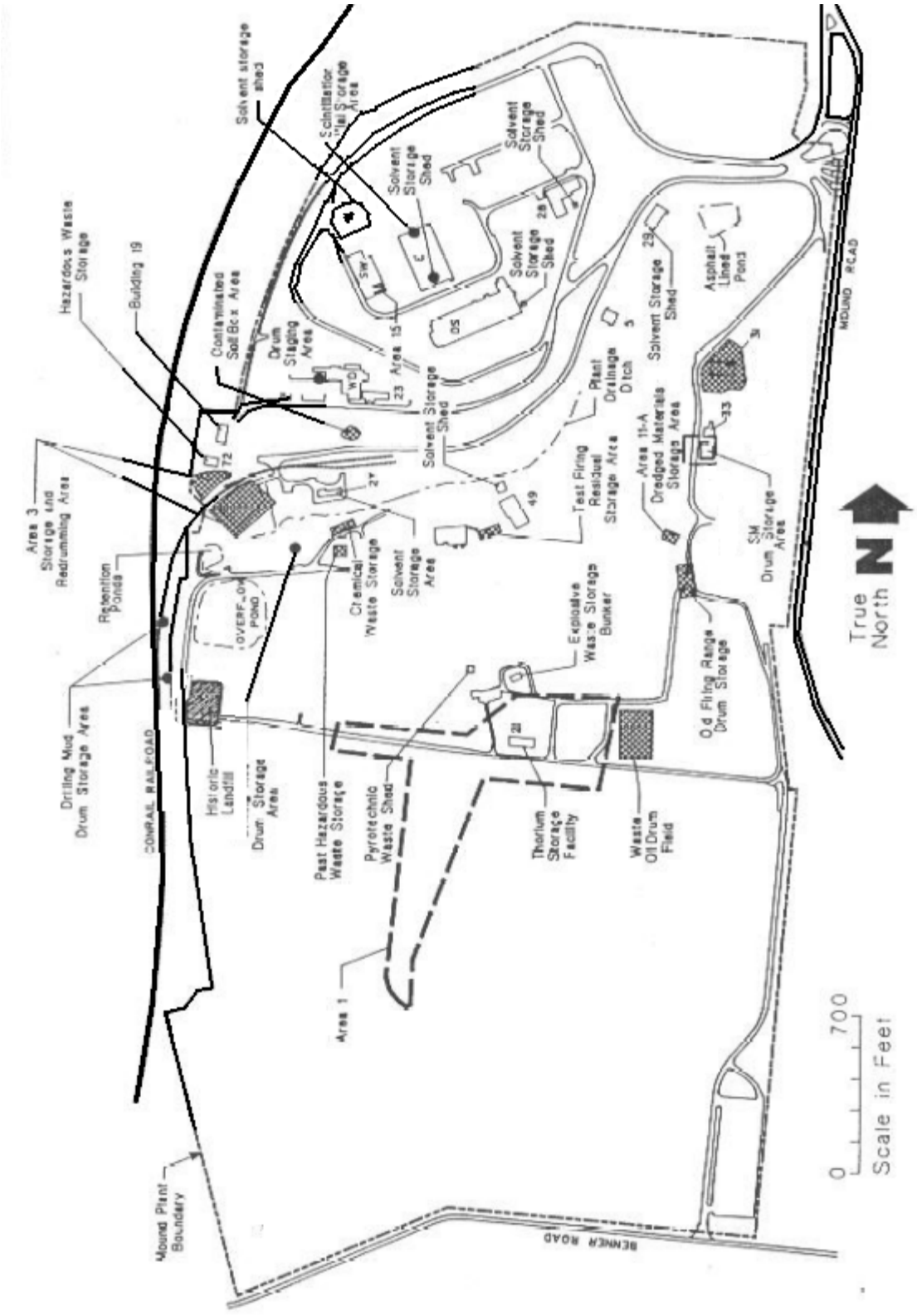

Figure 2: Waste Storage Areas at Mound Laboratory

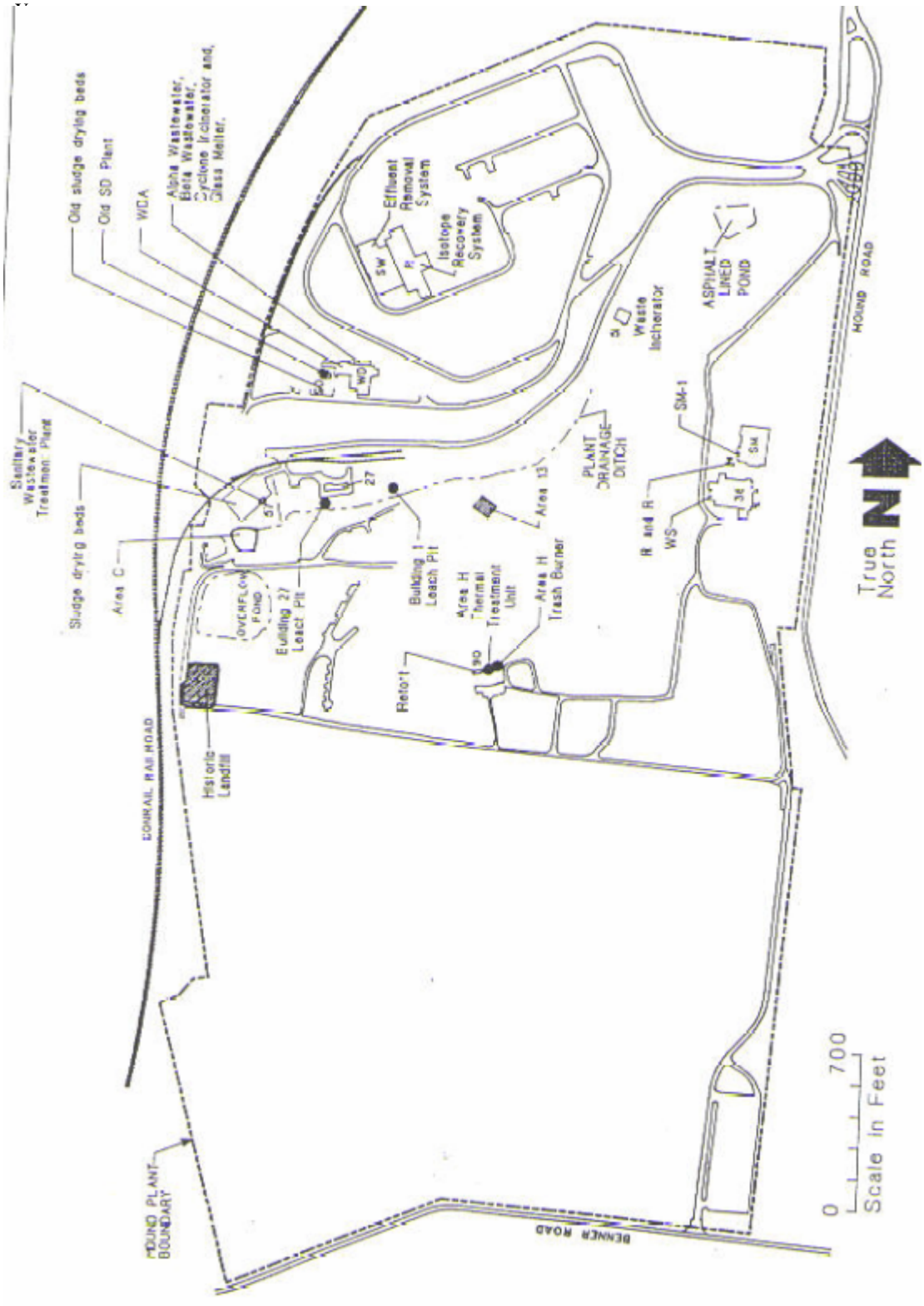

Figure 3: Waste Treatment Areas at Mound Laboratory

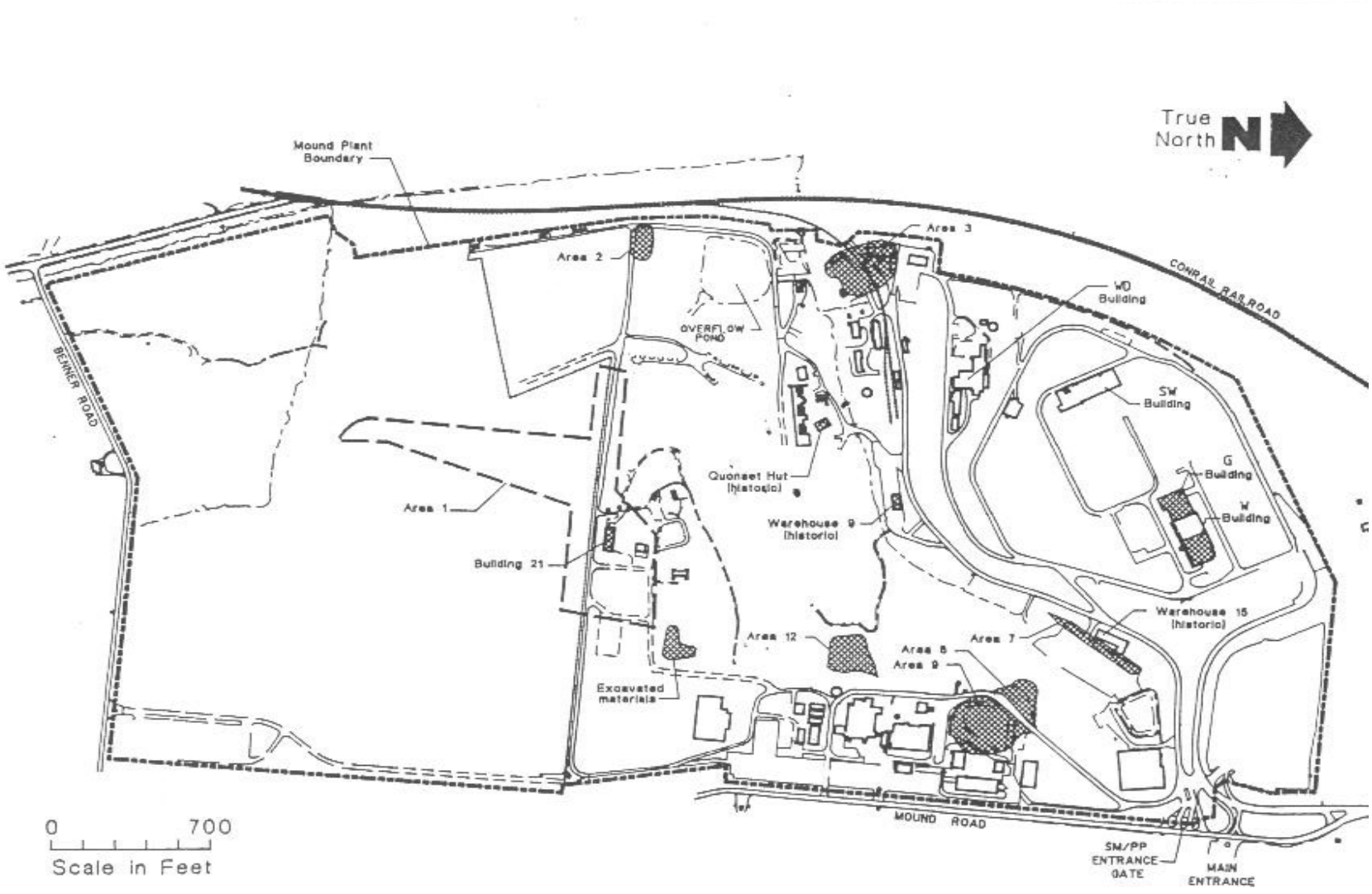

Figure 4: Thorium Ore Storage, Disposal, and Redrumming Areas at Mound

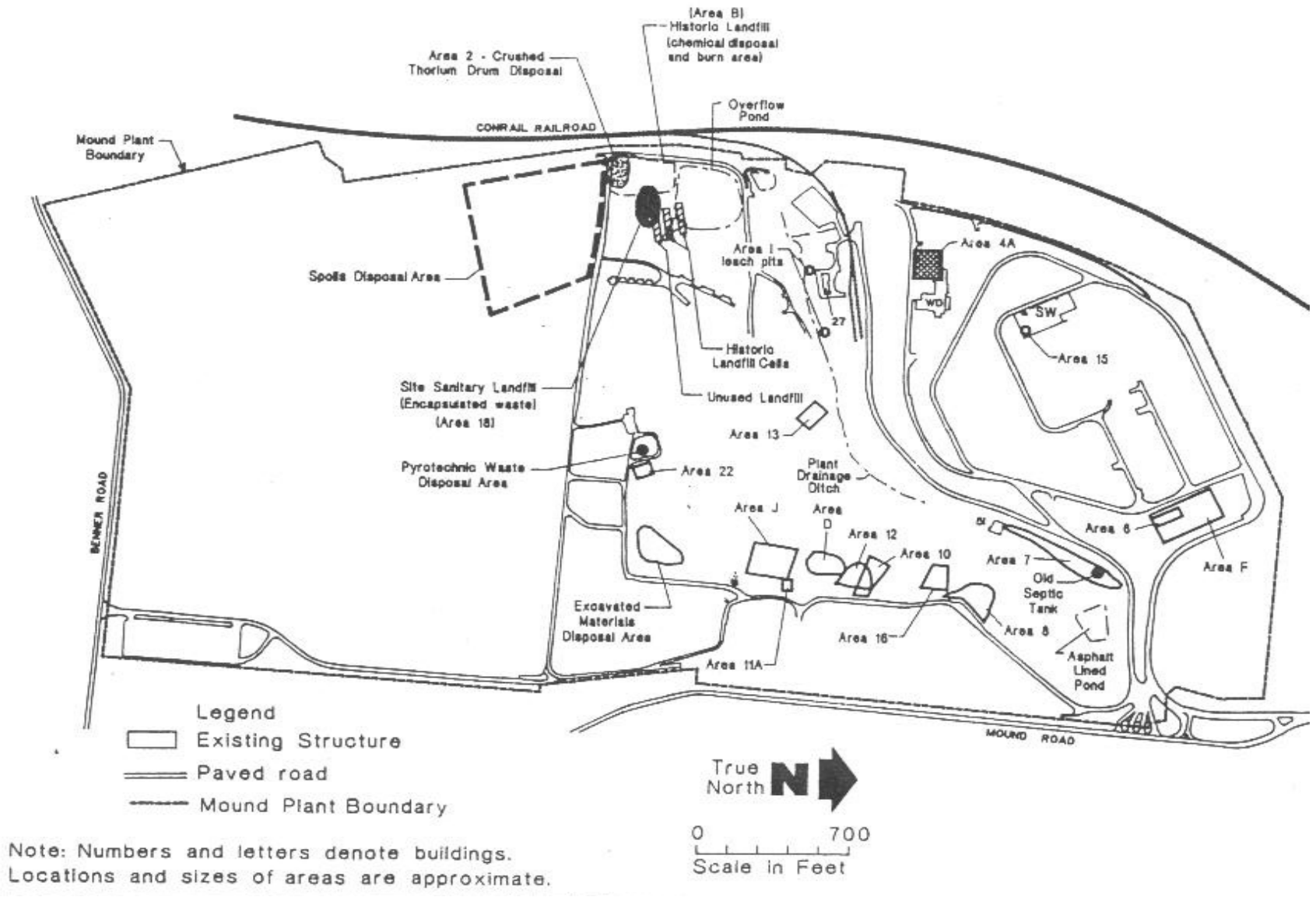

Figure 5: On-Site Waste Disposal Facilities at Mound