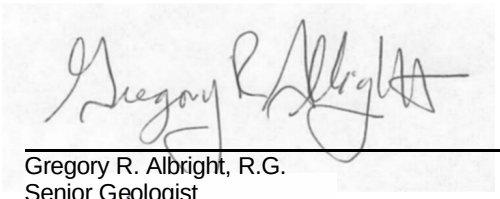

Gregory R. Albright, R.G.
Senior Geologist

Erich Zimmerman, P.E.
Project Manager

Plan for the Investigation of the Ringwood Mines/Landfill Site

Investigation of the Cannon Mine Pit area

Prepared for:
Ford Motor Company

Prepared by:
ARCADIS U.S., Inc.
1 International Boulevard
Suite 406
Mahwah, New Jersey 07495
Tel 201 684 1410
Fax 201 684 1420

Our reference:
NJ000604.0021 Task 0001

Date:
August 30, 2007

Table of Contents

Figures

Appendices

1. Introduction

ARCADIS G&M, Inc. (ARCADIS), on the behalf of Ford Motor Company (Ford), has prepared this Investigation of the Cannon Mine Pit area (Work Plan) as part of the comprehensive investigation work plan (CIWP) required by the Administrative Order of Consent (AOC) for Investigative Work, dated September 21, 2005 for the investigation of the Ringwood Mines/Landfill Site (Site). The Site is located in Ringwood, New Jersey. The objective of this Work Plan is to characterize waste materials in the Cannon Mine Pit area, and evaluate the groundwater flow characteristics and quality in the former mine/waste disposal area.

The Site is located in the northwestern corner of Passaic County, New Jersey within the southeastern extension of the Highlands of the New England Physiographic Province. The Site was utilized for the mining of magnetite ore from the 1700s until the 1940s. Ringwood Realty (a former subsidiary of Ford Motor Company) purchased the Site in 1965. The majority of the Site was donated to the Borough of Ringwood in 1970, including the area that is covered by this Work Plan. The general site location is shown on Figure 1.

A more detailed discussion of the Site and its history is provided in the Plan for the Investigation of the Ringwood Mines/Landfill Site: Work Plan for the Field Reconnaissance Survey (ARCADIS, November 2004).

As described in Section 4 (Scope of Work), this Work Plan has been prepared to augment previous investigation of the former Cannon Mine Pit area, located in a portion of the Site that had been the location of several historical mine pits. As explained in more detail below, Mine Safety Section records and aerial photographs indicate that all of the former mine pits in this area, except for the Cannon Mine Pit and a smaller pit known as the Hard Mine Pit were filled to grade by 1966. As documented in Section 1.3, below, contemporaneous documents indicate that the Borough of Ringwood used the Cannon Mine Pit for the disposal of municipal and commercial

waste materials from Borough customers, and from the Town of West Milford, in the 1960s and into the 1970s. A Ford contractor, O'Connor Trucking and Haulage Corporation, used the Cannon Mine Pit for a limited time prior to O'Connor's termination in 1971; most of the waste materials handled by O'Connor were disposed of in the Peters Mine Pit area, and the O'Connor Disposal Area, which are the subject of separate investigations.

1.1 Description of the Cannon Mine Pit Area

The Cannon Mine Pit was one of a group of mine pits and shafts in the southwestern portion of the Site where significant magnetite iron ore mining operations were conducted from the mid-1700s until the early 1900s. The mines and pits in this area included the Cannon/London, New London, Hard, Red, Mule, Blue and Little Blue Mine Pits. (See Abandoned Iron Mines of Ringwood, Wanaque, West Milford Townships, New Jersey Department of Labor (1992) (hereinafter "Abandoned Mines Report")).

The former Cannon Mine Pit was located approximately 1,500 feet west of Peters Mine Road, 50 feet south of Van Dunk Lane, and 400 feet north of Horse Shoe Bend Road. Records show that the Cannon Mine Pit was adjacent to, and eventually merged with, the London Mine Pit. The former New London Mine Pit was located 50 feet northwest of the Cannon Mine Pit.

The Cannon Mine Pit (in some earlier documents referred to as the London Mine Pit) was an open pit mine, excavated from 140 feet to as much as 200 feet below grade. The mined ore bodies pitched northeast at an angle of about 45 degrees. A shaft extended from the base of the pit and connected to underground mine workings. At the surface, the combined Cannon Mine and London Mine Pit opening was irregular in shape, and approximately 200 feet long and 140 feet wide. Shafts extending from the Cannon Mine Pit and some of the smaller pits in this area connected with the vertical, 500-feet deep Cannon Mine shaft, located

approximately 500 feet east of the Cannon Mine Pit. The extent of the surface workings of the Cannon Mine/London Mine Pit, the other pit mines in the Cannon Mine Pit area, and the Cannon Mine shaft are shown in the 1961 aerial photograph reproduced as Figure 2.

The Hard, Mule, Red, Blue, and Little Blue Mine Pits were situated approximately 300 feet southeast and east of the Cannon Mine Pit, south of the present location of Van Dunk Lane. The Hard Mine Pit and Blue Mine Pit also had shafts extending to subsurface mine workings.

1.2 Pit Filling and Shaft Closure History

Historical records concerning the filling of abandoned mine pits and the closing of mine shafts at the Site were reviewed in preparation of this work plan. The records reviewed include the New Jersey Department of Labor and Industry Mine Safety Section files on the Ringwood Mines (reviewed by ARCADIS in November 2004), and aerial photographs from 1961, December 1966, and 1974 (obtained at ARCADIS' direction by its photogrammetery subcontractor GEOD). Photocopies of documents from the Mine Safety Section files are attached as Appendix 1. The 1961 (Figure 2) and 1967 (Figure 3) aerial photographs also are attached to this work plan.

The Mine Safety Section files include correspondence from February 1964 pertaining to an ordinance issued by the Borough of Ringwood ordering Pittsburgh Pacific Company – the owner of the property at that time – to close abandoned mine openings on the Site, as well as several memos to the file prepared by Albert J. Getz, Chief Mine Safety Engineer, Bureau of Mine Safety, correspondence to and from Mr. Getz, and reports prepared by Mr. Getz. The files also contain an eight page report dated April 9, 1965 titled, "Inspection of Abandoned Pits and Shafts, Ringwood Mines, Borough of Ringwood, Passaic County" (hereinafter "Inspection Memo"). A March 30, 1965 memo to file documented a meeting regarding plans to close the openings and

discussed the use of drilling and blasting for sealing the shafts and eliminating the steep banks of the large open pits.

The Inspection Memo described the condition (in 1965) of the various mines in Ringwood, and noted that "[m]any of the pits have been used by the public as dumping grounds for garbage, old cars and other debris." The Inspection Memo also made recommendations for the closure and filling of the abandoned mines. Recommendations for the Cannon Mine Pit area were presented on pages 5-7 of the Inspection Memo. The Inspection Memo briefly described each of the mines in the Cannon Mine Pit area (the Cannon Mine Pit is referred to as the London Pit; the location of each pit is shown on Figure 2 attached to this work plan) and made the following recommendations: filling the New London (Cannon), Red and Little Blue Mine Pits with rock and gravel to grade; exposing the shaft opening and sealing the shaft in the Blue Mine Pit; and blocking the London (Cannon) and Hard Mine Pit shaft openings with ledge rock and blasting; and capping the vertical Cannon Mine shaft (500 feet east of the Cannon Mine Pit) with reinforced concrete.

Ringwood Realty purchased the Site in 1965 from Pittsburgh Pacific Company and it subsequently implemented the program to fill mine pits and close the mine shaft openings under the direction and oversight of the Mine Safety Section of the New Jersey Department of Labor and Industry, Bureau of Engineering and Safety. Contemporaneous news accounts indicate that the program commenced approximately six months after Ringwood Realty acquired the property in January 1965. Some additional closure activities were performed after 1965.

Memos by Mr. Getz to the file dated September 21, 1965, October 6, 1965, and December 13, 1965 documented inspections, progress, and completion of the closure of the mine openings. The memos documented the following with regard to the Cannon Mine Pit area:

- September 21, 1965: Ten "test pits" and openings in the New London-Cannon Mine Pit area had been filled with overburden and rock. A blast in the New London Pit blocked the stope opening with "massive rock." Junk cars were being removed from "a number of mine holes."

- October 6, 1965: Two small mine pits northeast of the Hard Mine were filled in.

- December 13, 1965: New London Pit had been completely filled to grade. Blasting had successfully sealed the shaft openings in the Cannon Mine Pit, and "[n]o more work will be done in the Cannon Pit in the near future." The Blue (Vein) Pit and a pit to the northwest of the Blue Pit had been filled to grade. The contractor stated with certainty that the Blue Pit shaft had been blocked during the blasting of the pit. However, because the shaft had not been located at the time the pit was filled, the inspector could not confirm this.

A letter dated August 5, 1966 from Mr. Getz to the Ringwood Police Department confirmed that the Blue Mine Pit had been "completely filled in" with some signs of settlement "because of a shaft at the bottom of the pit." See also, Abandoned Mines Report at p. 12 (confirming that the mine was "blasted closed and leveled at the direction of the Safety Section in 1965"). The 1992 Abandoned Mines Report also confirmed that the Little Blue Mine Pit was "leveled in 1965," but experienced some settling due to subsidence in 1979.

The 1992 Abandoned Mines Report stated that "[d]uring December of 1965, the New London and Cannon Pits, in addition to the Cannon vertical shaft, were blasted and backfilled to the surface, all under the direction of the Mine Safety Section." The report added that "[s]igns of subsidence at the pit have been observed over the years, subsequent to the blasting work," and that [r]ock and solid waste have been used for filling the depressions at various times during the intervening years."

Examination of the 1966 aerial photograph (Figure 3) reveals that by 1966, all pits in the Cannon Mine Pit area except for the Cannon Mine and Hard Mine Pits had been filled to grade. The photograph also shows that the side slope of the Cannon Mine Pit had been reduced. The 1974 aerial photograph shows the Cannon Mine Pit filled to grade. The Hard Mine Pit appears to be diminished in depth and to contain what appears to be recently placed fill.

Mine Safety Section documents do not confirm whether the vertical Cannon Mine shaft, located adjacent to and south of the intersection of the present Van Dunk Lane and Milligan Drive, was completely sealed in 1965. A February 1973 landfilling agreement between Housing Operation With Training Opportunity, Inc. ("HOWTO") and the Borough of Ringwood, which required the Borough to "securely cap" the Cannon shaft, infers that it had not been fully sealed. In June 1974, HOWTO complained in writing that the Borough had failed to implement its agreement to securely cap the Cannon Mine shaft opening. (The shaft opening reaches the surface adjacent to Van Dunk Lane, some distance east of the Cannon Mine Pit.)

1.3. Waste Disposal in the Cannon Mine Pit Area

The Cannon Mine Pit area was used as a depository for waste materials for many years. As noted above, an Inspection memo prepared by State authorities described the condition (in 1965) of the various mines in Ringwood, and noted that "[m]any of the pits have been used by the public as dumping grounds for garbage, old cars and other debris." This condition was also confirmed through contemporaneous newspaper accounts of Ringwood Realty's efforts, in 1965, to remove junked vehicles from the area. See "Junked Cars in Mine Impede Development," Paterson Morning Call (7/21/1965) (indicating more than 300 abandoned cars were encountered in one Cannon Mine shaft [Note: press and other accounts frequently incorrectly refer to the pits in the Ringwood areas as "shafts."]); Third Annual Report 1965 Planning Board of the Borough of Ringwood (noting that more than 500 abandoned vehicles had been removed from the mines) (Appendix 2).

Ringwood Realty took ownership of the Site in 1965. In December 1965, Ringwood Realty contracted with Monroe Carting and Transfer Systems, Inc. to allow Monroe to dispose of non-hazardous materials including "non-combustible waste including furniture, logs, tree stumps and trimmings, and grass cuttings, but excluding any garbage or residue" in the Cannon Mine Pit. Monroe's contract was terminated in December 1967. Round Lake Sanitation also had a contract with Ringwood Realty to dispose of refuse, which was terminated in November 1967. No documents suggest that Monroe or Round Lake hauled waste materials from Ford's Mahwah plant to the Site.

On December 1, 1967, O'Connor Trucking and Haulage Corp. entered into a contract with Ringwood Realty to conduct landfilling operations at the Site, pursuant to which O'Connor disposed of certain wastes from Ford's former assembly plant in Mahwah, New Jersey. The Cannon Mine Pit was one of three designated areas specified by contract for the disposal of those wastes; the other two areas were the Peters Mine Pit area, and the so-called O'Connor Disposal Area. According to testimonial evidence, O'Connor disposed of waste from the former Mahwah assembly plant primarily at the Peters Mine Pit until 1970, when the pit was filled to grade. See Affidavit of Russell Kerestes (Appendix 2). O'Connor then used the Cannon Mine Pit for several months in 1970, until a fire occurred, at which time Ford-based disposal activities were shifted to the O'Connor Disposal Area. An April 1970 letter from O'Connor to the New Jersey Department of Health states that O'Connor had discontinued its operations in the Cannon Mine Pit area, but that the Borough of Ringwood and Township of West Milford were continuing to use the Cannon Mine Pit at the time to dispose of "heavy trash."

Documentary evidence and contemporaneous news accounts confirm that the Borough of Ringwood used the Cannon Mine Pit for waste disposal. Indeed, historic documents disclose that the Borough hauled approximately 100 tons of mixed municipal and commercial waste per day to the Site and made arrangements with the Town of West

Milford to dispose of municipal waste in this area. See "Ringwood Mine Area Getting a Face Lifting," Paterson Evening News (7/22/65) (noting that a mine shaft (pit) "had been used for many years by the borough as a garbage dump"); "Kulik Wants Town to Buy Mine Area," Suburban Trends (9/16/70) (noting that "[a]t present, Ringwood has a dumping arrangement with West Milford, whereby extraordinary refuse is dumped in West Milford for land fill, and other refuse is dumped in Ringwood's Mine Holes"); "Mine Area's Prominence Greatest in War Time," The Herald-News (7/3/72) (noting that the Ringwood Solid Waste Management Authority processed 100 tons of Borough refuse weekly); June 16, 2005 correspondence from David J. Hayes, Esq. to Virginia Curry, Esq. (describing the Borough's use of the Site) (Appendix 2). The Borough of Ringwood used the Cannon Mine Pit area as a disposal site for municipal and commercial waste that it picked up and disposed of at the Site in the 1960s, and through at least 1972, when the Borough established another landfill (the "Borough Landfill") approximately 700 feet east of the Cannon Mine Pit area. During this period the Borough was cited for numerous violations of State waste disposal regulations for its use of the Cannon Mine Pit area.

In November 1970, the Borough of Ringwood took title to the Cannon Mine Pit area. As explained above, O'Connor was no longer using the Cannon Mine Pit area for Ford-based wastes by the time that the Borough took ownership of the majority of the Ringwood Site, including the Cannon Mine area. In connection with the transfer, the Borough indicated its intention to continue waste disposal operations, and it appears that the Borough continued to use the Cannon Mine Pit area for the disposal of wastes until at least 1972, when it opened another landfill on the Site. See Appendix 2 for letters and other documents referenced above; November 4, 1971 Minutes of the Ringwood Solid Waste Management Authority (RSWMA member Leidy noting Ringwood's and West Milford's use of a "completely enclosed hole" with a sealed shaft in the Horseshoe Bend Road area).

2. Previous Investigation and Sampling

2.1 Results of Previous Test Pitting Activities

As part of the 1984-1988 Ringwood Mines/Landfill Remedial Investigation (RI), three test pits (TP-3, TP-19, and TP-20) were excavated in the Cannon Mine Pit area to depths of 5-6 feet below ground surface and one test pit (TP-4) was excavated in the area of the Blue Pit. Trash, debris, and/or yard waste were found in all four test pits. Volatile organic compounds benzene, toluene and ethyl benzene were detected in the TP-3 sample at 34 micrograms per kilogram (ug/kg or parts per billion), 510 ug/kg, and 140 ug/kg, respectively. Methylene chloride, a compound frequently associated with laboratory-induced contamination was detected at a concentration of 36 ug/kg in a single sample. Each of these concentrations is below the current New Jersey Residential Contact concentrations for soil. No volatile organic compounds were detected in samples for TP-19 and TP-20.

2.2 Results of Previous Groundwater Sampling Activities

Groundwater quality in the vicinity of the Cannon Mine Pit, the nearby smaller pits, and the Cannon Mine shaft was investigated as part of the 1984-1988 Remedial Investigation. Seven groundwater monitoring wells (OB-2, OB-3, OB-4, OB-5, OB-12, OB-13, and RW-2) were installed in this area of the site as part of the RI. The OB-series wells range between 23 and 60 feet in depth. RW-2 is 503 feet deep. Existing monitoring wells are shown on Figure 5.

With the exception of OB-4 and OB-5, which were drilled through fill materials, granitic gneiss bedrock was encountered at each well within 10 feet of the ground surface. All wells were constructed to monitor bedrock groundwater. (Groundwater was not encountered in the unconsolidated fill materials above bedrock during drilling.)

Each of these wells was positioned to be hydraulically downgradient from the mine pits.

Groundwater in each well was sampled two to seven times between 1984 and 1990 (as part of and following the RI). Lead was detected on one occasion each in two wells – OB-13 and RW-2. Benzene was detected on one occasion in one well – RW-2. Toluene and xylene were not detected in any well on any occasion.

Each well was most recently sampled in October/November 2004. Methyl tert butyl ether (MTBE) and toluene were the only volatile organic compounds (VOC) detected in the groundwater samples (Table 1). Lead was also detected in well RW-2 during this sampling round.

A synoptic round of water-level measurements was collected from the seven existing monitoring wells in the Cannon Mine Pit area on May 10, 2005. The resulting depth-to-water measurements were converted into groundwater elevations and the results were plotted on the topographic contour base map and a groundwater contour map (Figure 5) was prepared for the site.

The groundwater contour map shows that groundwater elevations are a subdued replica of surface topography. The former Cannon Mine Pit is near the crown of a low ridge. From the ridge crest, the ground surface descends to the west, east, and south. Each groundwater contour line shown on Figure 2 represents a line of equal groundwater elevation. Groundwater, in fractured gneissic bedrock, flows through connected fractures in the direction perpendicular to the contour lines from areas of higher elevation to areas of lower elevation. The groundwater elevations and contours indicate that groundwater in the vicinity of the Cannon Mine Pit flows radially west, south, and east from the ridge crest.

Review of the topography in the immediate vicinity of the former pit indicates that the former Cannon Mine Pit is situated west of the ridge crest. ARCADIS projects that groundwater within the pit will flow west from the Pit.

2.3 Results of Recent Geophysical/Vibration Testing

Vibra-Tech Engineers, Inc. (Vibra-Tech) performed a geophysical investigation within the vicinity of the Cannon Mine Pit during the period from July 26 through July 28, 2006. This work was conducted in response to questions raised by the U.S. Environmental Protection Agency (USEPA) regarding the possible presence of unseen voids within fill materials at the Cannon Mine and New London Pit areas. Due to the heterogeneous nature of fill materials within the pits, both resistivity and seismic surveys were conducted to better evaluate subsurface conditions.

The resistivity survey detected seven main anomalies at locations corresponding to the presence of fill materials within the New London Pit and the Cannon Mine Pit. The results of the seismic survey generally also confirmed the extent of the New London and Cannon Mine Pits as shown on historic aerial photographs and previous ARCADIS submittals, and did not identify additional pits within this area.

Vibratech subsequently performed a vibration study within the vicinity of the Cannon Mine area in response to questions raised by residents and the USEPA, asking whether there might be a relationship between the formation of sink holes and the performance of site investigation and removal activities. Vibra-Tech performed the vibration study on October 25 and 26, 2006. A total of four vibration monitoring points were established at the Cannon Mine Pit and along Van Dunk Lane. During the test, heavy equipment was used to excavate a test pit to the bedrock surface while monitoring equipment recorded vibration levels generated at the point of excavation and along Van Dunk Lane.

The results of the vibration monitoring study indicated that the vibrations generated by heavy equipment during excavation activities were significantly lower than those that would cause damage to homes or instabilities in unconsolidated fill or soil[1]. The results of this study also reinforced the conclusions drawn during two previous vibration studies at the site, which indicated that drilling and/or excavation activities did not cause vibration levels of concern.

Based on the results of geophysical work conducted in the vicinity of the Cannon Mine Pit, ARCADIS modified the scope of investigative activities presented within this work plan to avoid areas where potential voids could affect the safety of the workers implementing this work plan. The scope of these activities is presented within Section 4 below.

3. Objectives

The objectives of this investigation are to:

- Catalogue and characterize the fill and wastes in the Cannon Mine Pit;
- Confirm the groundwater flow direction(s) in the Cannon Mine Pit area; and
- Characterize the quality of groundwater in the Cannon Mine Pit area.

4. Scope of Work

The scope of work for this investigation includes the following activities:

- Surface Soil Characterization

[1] Vibratech Engineers, Inc., October 2006; Geophysical Investigation, Ringwood Mines/Landfill Site, Cannon Mine area, Ringwood, New Jersey – October 11, 2006

- Waste material characterization
    - Drilling and coring program
- Groundwater characterization
    - Installation and development of additional monitoring wells;
    - Groundwater elevation monitoring;
    - Monitoring well sampling and analysis;
- Preparation of a Technical Memorandum.

Provided below are details of each task.

4.1 Surface Soil Characterization

A total of 10 surface soil samples will be obtained from within, and in the immediate vicinity of, the Cannon Mine Pit. Sample locations will be determined in the field and confirmed with the USEPA and NJDEP after the field work area has been cleared. Anticipated surface soil sampling locations are identified on Figure 6.

Soil samples will be obtained from a depth of 0-6 inches below ground surface at each location using stainless steel trowels or spoons, submitted to an NJDEP-certified laboratory, and analyzed for Target Compound List (TCL) organic compounds, Target Analyte List (TAL) metals, polychlorinated biphenyls (PCBs), and petroleum hydrocarbons. Leaf litter and/or other miscellaneous surface debris will be removed prior to sampling to limit potential impacts from airborne deposition of constituents.

All samples will be screened in the field using a photoionization detector (PID), visually inspected for the presence of paint sludge or chips, and physically described in a field log. Locations will subsequently by photo-documented and entered into a hand-held Global Positioning Unit (GPS). All work will be completed in accordance with the approved site-specific Health & Safety Plan (HASP).

4.2 Waste Material Characterization

4.2.1 Characterization of Fill Materials within and Surrounding the Cannon Mine Pit

Twelve test pits will be excavated to a depth of 15 feet or refusal (whichever is first encountered) to characterize the fill materials within and around the suspected perimeter of Cannon Mine Pit. Four test pits will be excavated within the suspected footprint of the Cannon Mine Pit to assess shallow fill materials within the pit (see Figure 6), and eight test pits will be excavated along the suspected perimeter of the Pit to delineate the edge of the Pit and assess the nature of fill materials in this area. Test pits will be excavated to a depth sufficient to encounter native soils/tailings or bedrock, unless they are found to be deeper than 15 feet.

Waste materials will be field screened with a PID for characterization information. It is anticipated that this work will be performed using Level D health and safety protocols. All work will be completed in accordance with the approved Site-Specific HASP.

The chemical composition of paint sludge has been well documented in earlier Site work; however, up to three representative samples of each type of paint sludge encountered during this work will be collected for analysis. Other wastes will be compared to known, previously analyzed wastes. If the wastes are not consistent with those previously found at the Site, a sample of each new waste encountered will be collected for analysis for TAL metals and TCL organic compounds. All laboratory testing will be completed in accordance with the approved Quality Assurance Project Plan (QAPP).

Field observations will be noted in bound log books and/or electronic data loggers used in conjunction with GPS units. All activities will be photo-documented. Locations of any paint sludge or drum remnants will be logged by GPS, in accordance with the procedures described in the Plan for the Investigation of the Ringwood Mines/Landfill Site: Work Plan for the Field Reconnaissance Survey (ARCADIS, November 2004). Drums or drum remnants encountered during test trenching will be temporarily stored

on site and removed with other remnants collected from the site. Material excavated from the test trenches will otherwise be returned to the trench.

Fill materials near the top of the hillside in the vicinity of paint sludge removal area SR-6 will be delineated by the excavation of test pits associated with paint sludge removal activities pursuant to the EPA-approved Paint Sludge and Drum Remnant Removal Work Plan.

4.2.2 Waste Characterization Borings within the Cannon Mine Pit

Three directional borings will be advanced to the base of the Cannon Mine Pit (estimated to be between 140 and 200 feet deep) or refusal to characterize waste visually and with field screening techniques. The proposed boring locations are shown on Figure 6. The borings will be advanced with a rotosonic drilling rig, capable of advancing a boring at up to a 60^{o} angle (from vertical). Given a set back from the edge of the Pit of approximately 10 feet, drilling at an angle of approximately 25-30 degrees will evaluate waste over nearly the entire thickness, without intercepting the opposing sidewall. The final boring angle and depth will be calculated based on the actual drilling point and pit setback chosen in the field in order to penetrate the anticipated total thickness of the fill in the deepest part of the Pit. Three borings will be successfully completed through the waste at the locations indicated on Figure 6, with success defined as completion of the borehole within 20 feet of the base of the Pit. If the first attempt does not penetrate the waste to within 20 feet of the base, one to two more borings will be attempted. The boring program will be terminated after the third unsuccessful attempt or sooner if the technology fails to successfully penetrate the waste. In the event that the directional boring program is not successful, ARCADIS, in consultation with EPA and NJDEP, will consider other options to complete this aspect of the investigation.

The rotosonic rig will advance three 6-inch diameter borings via a rotary, vibro-sonic technology. A 4-inch diameter core barrel is advanced first to sample the waste at 10-

foot intervals, followed by advancement of a 5.5-inch outer steel casing to stabilize the borehole for recovery of the core and advancement of the next core section. Core barrel and outer casing are advanced dry, or with high pressure water, where coring is difficult. The drilling system will recover 10-foot length cores in a single stroke, through a variety of materials, including steel, with an individual 5-foot length core capable of being encased in a clear Lexan container for preservation, observation and testing.

As cores are recovered, ARCADIS will visually inspect the cores and describe wastes present, in terms of type of waste, waste thickness, and waste structure (degree of decay). Samples will be field screened with a PID.

It is anticipated that the borings will be advanced at a Level D health and safety level of protection. Down-hole drilling equipment will be decontaminated at a designated location on site, with waste materials collected and temporarily stored on site for disposal. Core material not saved for later observation will be staged for offsite disposal.

ARCADIS will collect a sample, where possible, from each 10-foot core recovered during the advancement of borings within the pit. Materials to be sampled will include not only waste materials, but also mine tailings and/or soil if present within the core. Samples will be collected based on visual appearance, and screening for volatile organic compounds using a photoionization detector. If paint sludge is recognized in cored waste, then laboratory analytical samples will not be collected of this material, as identification of the paint sludge can be accurately determined visually. All samples will be analyzed for TAL metals and TCL organic compounds in accordance with the Quality Assurance Project Plan (QAPP).

Following completion of the borings, one of the borings will be converted to a water table monitoring well, as described below in Section 4.2. Following construction, the well location and elevation will be surveyed by a New Jersey licensed surveyor.

4.3 Monitoring Well Installation and Sampling

Four additional monitoring wells will be installed as part of this scope of work. As described above, one well will be completed in the upper-most portion of one of the directional borings completed to characterize water quality within the waste. The well will be completed as a 2-inch inside diameter, Schedule 40 PVC water table well, with 15 feet of screen placed across the water table (five feet above; ten feet below). The screen will be sand packed to two feet above the screen, topped with a bentonite seal and grouted to grade in accordance with the requirements specified within N.J.A.C. 7:9D-2.9.

Two bedrock monitoring wells will be installed immediately west and southeast of the Cannon Mine Pit (referred to herein as the west and southeast wells, respectively) (see Figure 6), and one bedrock monitoring well will be installed south of the Hard Pit. The proposed bedrock borehole depths will be based on the depth to the bottom of the Cannon Mine Pit, which literature indicates is approximately 200 feet below grade, but which will be confirmed through the boring activity described above. The scope of drilling, testing, and installation of the two new bedrock wells will be as follows:

- 6-inch borehole drilling to 220 feet below ground surface (bgs) for two wells at the Cannon Mine Pit (approximately 20 feet below the elevation of the base of the pit);
- 6-inch borehole drilling to 200 feet bgs for one well south of the Hard Mine Pit;
- Geophysical testing;
- Inflatable packer discrete fracture zone groundwater sampling and analysis;
- Well installation and development;
- Groundwater sampling,

- Water level monitoring.

The three bedrock wells will be drilled, constructed and developed in accordance with New Jersey Department of Environmental Protection Monitoring Well Specifications for Bedrock and Unconsolidated and Confined Aquifers (NJDEP, May 1992a). An ARCADIS scientist will inspect all well drilling and installation, visually describe and record formation lithology, groundwater occurrence, and screen groundwater with a PID.

The bedrock well boreholes will be drilled with an air rotary drilling rig using an air-percussion hammer system. The wells will be drilled following completion of the Cannon Mine slant borings, under a later mobilization. A 10-inch diameter borehole will be advanced at least five feet into competent bedrock. Six-inch, inside diameter steel casing equipped with a drive shoe will be seated into the bedrock and grouted to grade prior to advancing the borehole to completion. A 6-inch diameter borehole will be advanced to the total depth. Once drilled, the borehole will be air developed to assist removal of fines prior to testing and well building.

Following completion of the borehole, borehole geophysical testing and potentially packer interval sampling will overlap drilling to compliment drilling information with respect to bedrock structure and water-bearing zone occurrence and groundwater hydraulics and quality. The following suite of geophysical tests will be performed:

- Caliper – borehole diameter and void presence,
- Temperature – water bearing fracture,
- Fluid resistively – water bearing fracture,
- Spontaneous potential,
- Formation resistance,
- Optical/acoustic televiewer – fracture occurrence, density and orientation,
- Flow meter (impeller), and

- Natural gamma.

Geophysical logs will be reviewed in the field to identify water bearing fractures and determine the necessity and scope of discrete fracture sampling via an inflatable packer system. If packer testing is performed, up to four fracture zones will be isolated with an inflatable straddle packer assembly equipped with a submersible pump, to facilitate collection of groundwater samples. Packer testing will also allow measurement of fracture specific hydraulic head and conductivity, to determine vertical hydraulic gradient relationships. During packer testing, the water level in the newly installed waste well and other surrounding wells, as appropriate, will be measured to potentially determine hydraulic interconnection of the waste and bedrock groundwater. Following sample collection, one or more of the intervals may be elected to be pumped at a higher flow rate to better evaluate hydraulic interconnection.

The packed interval will be purged at a low flow rate (< 5 gallons per minute (gpm)) to remove three packer interval volumes, while field parameters pH, temperature, specific conductivity, oxidation-reduction potential, and dissolved oxygen are monitored in the discharge stream. One groundwater sample will be collected directly from the discharge stream for laboratory analysis of the following parameters:

- Target compound list (TCL) volatiles and semivolatiles
- Target analyte list (TAL) metals (total and dissolved)
- Chloride
- Sodium
- Total dissolved solids (TDS)
- Nitrate
- Ammonia
- Total organic carbon

Wastes, partially decayed, will potentially present an associated water quality signature similar to landfill leachate, driving the above parameter list. Samples will be submitted

to the laboratory for 48-hour turn-around of results. Discharge water will be contained on site for characterization and off site disposal with other wastes being generated through other waste removal activities elsewhere on Site.

Following receipt of packer analytical data, the final monitoring well completion depths and/or number of wells will be determined and the drilling rig will be remobilized to the site to complete the wells. Bedrock wells will be completed as multi-level wells or well pairs if it is determined appropriate to monitor multiple zones at a given location.

The wells will be constructed from 2-inch ID Schedule-40 PVC riser and screen. Well construction details, including the intervals for slotted casing, will be finalized in consultation with the USEPA and NJDEP, and be based on the results of geophysical logging and packer testing. The screen will be sand packed to two feet above the screen, topped with a bentonite seal and grouted to grade in accordance with the requirements outlined within N.J.A.C. 7:9D-2.9.

Following installation, the wells will be developed with a submersible pump until water is near sediment free, or for 60 minutes, which ever occurs first. Development water will be temporarily contained, as need be based on packer water quality, and disposed accordingly as a consequence of the ongoing paint sludge activities.

The well casing elevations and locations will subsequently be surveyed by a New Jersey licensed surveyor. For quality assurance, an existing monitoring well will be resurveyed to assure the relative accuracy of the current survey to the historical wells.

Two weeks following installation, the four new wells and the six existing OB wells in the Cannon Mine Pit area will be sampled in accordance with the NJDEP Field Sampling Procedures Manual (May 1992b) and analyzed for the same parameters identified above. Sampling will be performed in accordance with techniques described in the Post-Environmental Monitoring Program Sampling Work Plan (ARCADIS, July

2004). Quality Assurance/Quality Control (QA/QC) sampling, sample management, analytical techniques, data validation and other procedures will be performed in accordance with the Quality Assurance Project Plan prepared for this project (ARCADIS, July 2004). Water generated from development and sampling will be contained on-site for disposal. All activities associated with the installation and development of monitoring wells and the sampling of the surface and groundwater will be performed in accordance with the updated Site-specific Health and Safety Plan (ARCADIS, August 2005).

The respective groundwater elevations in the four new wells will be evaluated to determine whether the west and southeast wells are hydraulically downgradient of the Cannon Mine Pit. These wells will be sampled a second time, after three months, to confirm the original results.

4.4 Vibration Monitoring During Investigative Activities

ARCADIS proposes to install vibration monitors at three locations between the Cannon Mine Pit and nearby residences to monitor subsurface vibrations potentially generated by the operation of equipment during investigative activities. Proposed vibration monitoring locations are shown on Figure 7.

Vibration Monitoring Point (VMP) 1 is located at the northwest corner of the cul-de-sac at the top of Van Dunk Lane, close to the nearest residential property. VMP 2 is located to the south of Van Dunk Lane between the Cannon Mine Pit and the Little Blue Pit, and VMP 3 is located at the top of Horseshoe Bend Road near the fire hydrant.

Vibration monitoring will begin just prior to the start of investigative activities, and continue throughout the period of work. Vibrations will be monitored on a continuous basis, and recorded on digital seismographs for regular downloading and processing. The equipment will be configured to provide site workers with a visible and/or audible

alarm if vibration levels exceed 0.2 in/sec. This action level is an order of magnitude less than the vibration levels identified through studies done by Seed[2] which indicated vibration levels in excess of 2.0 inches/second can cause liquefaction and/or settlement of certain soil types.

If work activities exceed this level, work will cease and the cause of the vibrations will be evaluated. Work will not resume until Ford and EPA concur on an approach to control potential vibration generation.

5. Reporting

Details of the investigation activities and findings, along with summaries of all field data and analytical results will be provided in a Technical Memorandum that provides a summary of the investigation findings to the USEPA and NJDEP. These results will also be incorporated into the appropriate section(s) a Supplemental Investigation (SI) Report to be provided to the USEPA pursuant to the AOC. The SI Report will include summary tables of the validated analytical data and figures indicating the locations of all samples. A discussion of the findings and conclusions, as well as any proposed additional activities, will be included in the appropriate section(s) of the report.

6. Schedule

The proposed schedule for implementing this work is provided as Figure 8. ARCADIS will initiate activities within 14 days of EPA approval of this work plan and provide 14-day advance notice to the EPA to provide sufficient time for EPA to arrange for oversight of the fieldwork and split sample collection, if desired. Please note that the

[2] Seed, H.B., (1979). Soil Liquefaction and Cyclic Mobility Evaluation for Level Ground During Earthquakes. *Journal of Geotechnical Engineering, Division of ASCE*, February 1979, pp. 201-255.

schedule provided is contingent upon the duration of public review and comment, EPA review approval, and upon NJDEP permitting constraints

ARCADIS will provide a draft Technical Memorandum to the USEPA and NJDEP within 45 days of the completion of field investigation activities.

7. References

Affidavit of Russell J. Kerestes, March 1, 2005

ARCADIS, July 2004; Post-Environmental Monitoring Program Sampling Work Plan, Ringwood Mines/Landfill Site, Ringwood, New Jersey- July 26, 2004

ARCADIS, November 2004; Plan for the Investigation of the Ringwood Mines/Landfill Site, Module 1: Work Plan for the Field Reconnaissance Survey-23 November 2004

ARCADIS, December 2004; Paint Sludge and Drum Remnant Removal Work Plan, Ringwood Mines/Landfill Site, Ringwood, New Jersey - December 14, 2004

ARCADIS, April 2005; Health and Safety Plan, Ringwood Mines/Landfill Site, Ringwood, New Jersey- April 15, 2005

Vibratech Engineers, Inc., October 2006; Geophysical Investigation, Ringwood Mines/Landfill Site, Cannon Mine area, Ringwood, New Jersey – October 11, 2006

Vibratech Engineers, Inc., November 2006; Vibration Monitoring Report for the Ringwood Mines/Landfill Site – November 28, 2006

New Jersey Department of Environmental Protection and Energy, May 1992a Field Sampling Procedures Manual, Appendix 7-1

New Jersey Department of Environmental Protection and Energy, May 1992b Field Sampling Procedures Manual, Chapter 7-F, 7-H

Files of the Mine Safety Section of the New Jersey Department of Labor and Industry, Bureau of Engineering and Safety.