CDM

Remedial Investigation / Feasibility Study Work Plan

Former Philip Services Corporation Site
Rock Hill, South Carolina

Prepared For: **South Carolina Department of Health & Environmental Control**

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Work Plan

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Section 1 Introduction

The Philip Services Corporation (PSC) site in Rock Hill, South Carolina is a former RCRA hazardous waste treatment, storage, and disposal facility. Operations began at the site in 1966 and continued until the bankruptcy of PSC in December 2003. Several previous investigations at the site have identified chemical releases to soil and groundwater, and some remediation has been performed.

The purpose of the Remedial Investigation/Feasibility Study (RI/FS) for the PSC site is to further refine the information regarding the nature and extent of contamination, assess potential human health and ecological risks, and identify remedial action alternatives. This work plan describes the technical approach, data collection activities, and methods that will be employed during the RI/FS to satisfy this objective.

The RI section of this work plan discusses the data collection activities required to adequately characterize the site for risk assessment purposes and to identify and evaluate potential remedial alternatives during the FS. Two field investigation phases (Phase I and Phase II) are proposed for the RI to allow Phase I data to be incorporated into the planning of Phase II. The two-phased approach will help ensure that data collection activities are not only appropriately focused, but also conclusive.

The FS discussion in this work plan focuses on those activities necessary to identify and evaluate potential remedial action alternatives that are protective of human health and the environment. Because the complexity of the FS depends upon the results of the RI, the work plan describes FS activities in more general terms than the RI activities.

This work plan has been prepared in general accordance with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Although the PSC site is not a National Priority List site under the U.S. Environmental Protection Agency's Superfund program, the RI/FS will observe Superfund guidance (CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act), as appropriate.

Section 2 of this work plan describes the site, previous investigations, remedial activities, and environmental setting. It also presents a preliminary site conceptual exposure model. Based on the information in Section 2, data gaps are identified to focus the objectives of the RI. Section 3 describes the RI technical approach, quality assurance/quality control procedures, risk assessments, and reporting. Section 4 describes the FS in general terms, and Section 5 includes the RI/FS schedule. References are included in Section 6. The site-specific health and safety plan is included in **Appendix A**. Additional documents necessary to complete the RI are the Field Sampling Plan and Quality Assurance Project Plan, which are included by reference in this work plan.

Section 2
Project Background Summary

2.1 Site Description and Background[1]

The PSC Site is a former hazardous waste transportation, storage, and disposal facility. In 1966, Quality Drum Company and Industrial Chemical Company began operations consisting of waste storage, treatment, and recycling. The facility received spent solvents from offsite facilities, stored the solvents on site in drums and tanks, and recovered these solvents through distillation. Until 1980, wastes from the distillation process (still bottoms) were sent to a local landfill. In 1980, a hazardous waste incinerator was installed for still bottoms treatment.

In May 1983, Stablex Inc. acquired the facility. At that time, approximately 26,000 drums and 200,000 gallons of bulk liquid waste (stored in tanks) were present on site. In 1986, ownership of the property was transferred to NUKEM, who changed its company name to ThermalKEM in 1987. ThermalKEM operated as a hazardous waste incinerator and storage facility under RCRA interim status. PSC took over operation and management of the site in November 1995 and ceased operation of the incinerator one month later. The South Carolina Department of Health and Environmental Control (SCDHEC) took over the site following the bankruptcy of PSC in December 2003.

Through the years of operation, the site has sustained two large structural fires. The site also previously experienced a subsurface diesel fuel release, with the quantity of fuel spilled estimated to be greater than 200,000 gallons. Based on several investigations and groundwater sampling, an extraction and treatment system was installed at the site in 1988. Additional extraction components (extraction wells 2 and 3 and the interceptor trench) were installed in the mid 1990s.

The incinerator was dismantled after it was shutdown, and a pit was excavated into soil beneath its footprint. This work was performed prior to SCDHEC management of the site. In 2004, the excavation pit was backfilled and the incinerator building was demolished under the direction of SCDHEC. Upgrades to the treatment system were also completed in 2005.

Figure 2-1 presents a current site map. The site consists of approximately 44.5 acres of industrial property on the west side of Wildcat Creek and approximately 108 acres of undeveloped woodland on the east side of Wildcat Creek. Robertson Road borders the industrial portion of the property to the northeast, and the Norfolk Southern Railroad forms the northwestern boundary. Wildcat and Fishing Creeks border the industrial property on the southeast and southwest, respectively.

The site is immediately surrounded by undeveloped land and commercial/industrial properties. Osmose Wood Preserving Inc. is located directly across the railroad to the northwest. Low-density residential properties and a high school are located in the

[1] Much of the information presented in this section originates from the RCRA Facility Investigation Part 1 Report (PSC, August 1999).

vicinity of the site. Higher density residential areas are located to the southeast and northeast, towards the City of Rock Hill.

2.2 Previous Investigations and Remedial Activities

Several previous investigation and remedial activities have occurred at the PSC site. The timeline of events, as presented in Section 2.3 of the RCRA Facility Investigation Part 1 Report (PSC, August 1999), is shown in the following table.

Table 2-1
Timeline of Investigations, Remedial Activities, and Other Events
PSC Site – RI/FS Work Plan
Rock Hill, South Carolina

Date(s)	Activity
Prior to 1983	Six monitoring wells existed on site.
June 1983 to March 1984	Excess drum inventory was brought under permitted storage capacity, and contaminated surface soil was removed.
June 1983 to September 1984	Old tanks were cleaned out, and tanker trucks were removed and cleaned out.
1983	Burn pit soil was excavated.
	Groundwater monitoring was initiated.
	A soil investigation was conducted identifying soil type and general geotechnical conditions.
	Six additional monitoring wells were installed throughout the site.
October	The Containment Ditch was removed and cleaned.
1984	A hydrogeologic study revealed "solvent-like odors" in borings slightly downgradient of the Containment Ditch.
	Borings were completed as monitoring wells to assess groundwater quality in the vicinity of the Containment Ditch.
	A quarterly groundwater quality monitoring program was initiated voluntarily.
1985	A geophysical investigation was conducted to search for buried materials at the site. The Burn Pits were identified and soil in this area was excavated.
1985 and 1986	Additional hydrogeologic investigations were performed to assess groundwater quality in the vicinity of the Containment Ditch.

Date(s)	Activity
November 1986	Water identified in the Incinerator Building Sump during EPA's RCRA Facility Assessment was removed. The leak found to be the source of water was repaired.
1986 and 1987	Studies were conducted to design an extraction well (EW-1) to contain and remediate groundwater at the Containment Ditch.
1988	Well BP-1A installed in the area of the former Burn Pits.
July	Extraction well EW-1 was installed and connected along with production well PW-1 to the plant groundwater treatment system. Pump and treat remediation of groundwater began.
	RCRA Part B hazardous waste incinerator and storage permit SCD04444233 was issued but appealed by a local citizen's group.
	An aquifer performance test was conducted at extraction well EW-1.
June 1990	Diesel fuel was detected in piezometer P-2 during the routine measurement of water level elevations.
1991	An investigative study and remediation feasibility study was conducted for the diesel fuel area.
February	The Preliminary RFI on the diesel fuel area was submitted to EPA.
1992	Pumping of production well PW-1 was discontinued because volatile organic compound (VOC) concentrations at MW-100 had decreased to below detection limits.
January	An additional product delineation investigation was conducted in the diesel fuel area.
March	A lineament study of regional fracture traces was conducted.
January and July	ENSR conducted field investigations in support of the RFI Work Plan to be submitted in August 1992. Five saprolite wells and three bedrock wells were installed, including three well points in the bed of Wildcat Creek.
July 1993	Diesel fuel was detected in EW-1. The pumping rate was decreased to between 10 – 25 gallons per minute (gpm).
September and October 1994	Extraction wells EW-2 and EW-3 were installed.
August to	The diesel fuel interceptor trench was installed.

Date(s)	Activity
October 1995	
December 1995	Operation of the incinerator ceased and a revised Part B Permit Application was submitted.
February and March 1996	EW-2, EW-3, and the interceptor trench were connected to the groundwater treatment system. The trench sump pump was also connected to an oil/water separator unit.
April to June 2004	Additional investigations were conducted by CDM and SCDHEC involving groundwater sampling, surface water sampling, surface soil sampling, and a test pit investigation.
September – October 2005	Upgrades were completed for the extraction and treatment system consisting of replacing equipment and adding instrumentation and automation.

Through the RCRA Part B Permit Corrective Action process at the PSC site, four solid waste management units (SWMUs) and seven areas of concern (AOCs) were identified and included in the permit. The SWMUs and AOCs, as listed in the RFI Part 1 Report, and a brief description of the wastes managed/disposed in each area are presented below:

- ***Incinerator Building Sump (SWMU 8)*** – contained incinerator ash and water from the incinerator water seals.
- ***Container Storage Area (SWMU 11)*** – large drum storage area on ground surface containing drums of spent halogenated and non-halogenated solvents.
- ***Truck Washing Station and Sump (SWMU 19)*** – wastes managed included wash water, residue, and soil from trucks carrying spent halogenated and non-halogenated solvents.
- ***Burn Pits* (SWMU 41)** – previous disposal area of solvent distillation still bottoms by open pit burning.
- ***Containment Ditch Area of Concern*** – spill and leakage from tank trucks and the tank farm migrated to this area via stormwater runoff.
- ***Fuel Oil Area of Concern*** – suspected diesel fuel leaks from underground piping associated with three underground storage tanks and from diesel fuel delivery piping to the incinerator.
- ***Drum Repacking Area Fire Area of Concern*** – this building housed spent halogenated and non-halogenated solvents in lab pack form and drums of

solids and sludges from spent solvents. The building was destroyed by fire in 1995 and rebuilt the same year.

- ***Blend Tank Overflow Area of Concern*** – tank farm where liquids containing spent halogenated and non-halogenated solvents were blended for incineration prior to 1995. After 1995, solvents were blended with diesel fuel in this area.

- ***Scrubber Containment Overflow Area of Concern*** – wastes managed at this location included caustic solutions of scrubber water with particulate matter from incineration.

- ***Boiler Explosion Area of Concern*** – the boiler was used as a backup steam supply for the scrubber and was replaced after it exploded in March 1991. No wastes were managed here but approximately 50 gallons of diesel fuel would have exploded with this boiler.

- ***Stormwater Outflows Areas of Concern*** – collection and outflow areas for stormwater runoff from the site and treatment, storage, and disposal areas.

These SWMUs and AOCs are described further in the RFI Part 1 Report and are graphically shown on **Figure 2-2**. This figure also identifies additional areas of concern for this RI/FS, including the Stablex Materials Area, other drum storage and management areas, and a stormwater pond. The Stablex Materials Area has been identified in historical photographs, and a geophysical survey conducted by SCDHEC indicates that there are subsurface anomalies in the area. While the Stablex Materials Area was planned for use as a disposal area, it is unknown whether any wastes were deposited there.

The RI scope presented in Section 3 is designed to characterize and/or further define the nature and extent of contamination across these SWMUs and AOCs. The RI data are also necessary to perform the risk assessments and the FS.

2.3 Environmental Setting

2.3.1 Topography and Drainage

The PSC site is located in the Piedmont Physiographic Province of South Carolina. This province is characterized by gently rolling hills and ridges intersected by stream and river valleys. Within the vicinity of the site, land surface elevations range from about 650 feet east of the site down to about 480 feet on Fishing Creek south of the site (**Figure 2-3**). Elevation on site averages about 510 feet to 530 feet.

Two surface water features are adjacent to the site. Fishing Creek flows from the northwest to form the south boundary of the site and continues to flow to the south downstream of the site. Wildcat Creek flows from the north to form the east boundary of the operations area of the former facility. Wildcat Creek flows into Fishing Creek along the south boundary of the site. Most surface drainage from the operations area of the former facility is directed to the east into Wildcat Creek through several stormwater controls. One stormwater control also directs surface runoff from the southwest corner of the operations area to Fishing Creek.

Although the topographic relief is relatively subtle in the site vicinity, topographic patterns do exist that may provide additional insight into subsurface conditions. **Figure 2-4** provides a visual aid for evaluating the topography and geomorphology of the site vicinity. It should be recognized that this figure has a vertical exaggeration of about 5 to 1. Vertical exaggeration is necessary to discern the topographic patterns. With regard to elevation and slope, three distinct patterns are discernable from the figure. The most striking pattern exists east of the site where elevations are the highest and surface slopes the steepest. This east geomorphic area is likely to be underlain by rock that has undergone less weathering than the other two geomorphic areas that have been eroded to lower elevations with low slopes. This is particularly true of the southwest geomorphic area, which has very subtle slopes and the lowest elevations in the site vicinity. This geomorphology indicates that the underlying rock is more weathered than the rock beneath the other two areas. The north geomorphic area has moderate elevations/slopes compared to the other two areas, and the underlying rock is likely moderately weathered.

Wildcat Creek follows the apparent contact between the north and east geomorphic areas. Prior to its confluence with Wildcat Creek, Fishing Creek follows the contact between the north and the southwest geomorphic areas. Below Wildcat Creek, Fishing Creek follows the contact between the east and southwest geomorphic areas. These geomorphic expressions and related surface water flow patterns have additional implications to the regional geology and hydrogeology, as discussed below.

2.3.2 Geology and Hydrogeology

The geology of the Piedmont Physiographic Province of South Carolina includes crystalline bedrock of metamorphic and igneous origin. The metamorphic rocks range from coarsely-crystalline, weather-resistant gneiss to easily weathered mica schist and the finer-grained form called phyllite. Igneous rock, referred to as gabbro, reportedly exists beneath the site. Gabbro is a crystalline rock that is dark in color and contains minerals that are moderately susceptible to weathering processes. It is probable that this gabbro has been subjected to some degree of metamorphism and may be more appropriately classified as a meta-gabbro. Although the mineral composition may not be significantly altered by the regional metamorphism, it could have imparted structural changes in the rock such as development of regional fracture systems. If regional metamorphism has not affected the rock, stress-relief fractures are expected in this unaltered rock type.

The east geomorphic area is likely underlain by a rock more resistant to weathering than the rock beneath the site. This rock is also likely to be igneous in origin based on the uniformly radial drainage pattern that has developed in this area. This indicates that fractures having strong directional characteristics do not likely exist in the east area.

The regional nomenclature applied to aquifer systems in the Piedmont Province is to classify the system as the Piedmont Aquifer regardless of the depth zone. Groundwater in Piedmont Aquifer systems typically occurs in three zones of interest. In descending order these zones include the regolith zone, the transition zone between bedrock and the regolith, and the bedrock zone.

The regolith zone at the site consists primarily of saprolite, the unconsolidated weathering product of the underlying parent rock that retains the relic structure of the parent rock. The regolith zone also includes the recent stream alluvium deposits associated with Fishing Creek and Wildcat Creek. The regolith thickness at the site ranges from 15 feet to 35 feet. The saprolite and the alluvium are fully connected hydraulically and behave as a single groundwater zone. However, it is probable that the permeability of the alluvium (primarily sand with silt) is higher than the permeability of the saprolite (primarily silt with sand and clay size materials). The depth to groundwater in the regolith measured at the site ranges from 5 feet near the streams to 20 feet at the higher elevations.

Groundwater flow in the regolith zone is from areas of topographic highs to areas of topographic lows. Recharge to this zone occurs at all elevations from precipitation, and this recharge represents a driving force for groundwater flow. Where the land surface intersects the elevation of the saturated zone in the regolith (such as along streams), groundwater discharge occurs creating a groundwater migration pattern toward the nearest surface stream. Some quantity of groundwater in the regolith zone also migrates downward to recharge the transition zone and the bedrock zone.

The transition zone between the regolith and bedrock zones consists of partially weathered bedrock and primarily of rock fragments, boulder-size rocks, and fractured bedrock that is in full hydraulic connection with the overlying regolith zone. Wells typically cannot be installed through the transition zone using auger techniques, and rotary techniques are required.

Groundwater flow in the transition zone follows similar patterns to the regolith zone. However, because of groundwater flow through fractures, the flow path of least resistance may differ in this zone, and the permeability is typically much higher than the regolith zone. Some quantity of groundwater in the transition zone migrates downward to recharge the bedrock zone. Lateral groundwater flow in the transition zone is toward discharge points such as streams. Groundwater in the transition zone may migrate in the downstream direction of stream flow before the vertical gradient effectively causes it to discharge.

Groundwater in the gabbro bedrock beneath the site occurs in the primary pore space of the rock and in fractures developed in the rock. The primary porosity of the gabbro is likely very low and not significant for groundwater migration. However, the primary porosity may contain site-related constituents that could be slowly released to groundwater migrating through fractures over a long period of time.

The bedrock may include fractures developed from historic deformation events. These types of fractures are usually directional in nature, and a primary direction of fracture orientation can be discerned along with an antecedent fracture direction that tends to be about 60^{o} from the primary direction. These fractures can exist at great depths in the Piedmont, and production wells can be successful at depths of over 500 feet. Stress relief fractures may also be present. These fractures develop as the weight of overlying rock is removed by weathering and the rock expands creating a fracture. Stress relief fractures are horizontal more so than deformations fractures and are usually rare below a depth of 200 feet.

Groundwater migration in the bedrock rock follows the same general rules as the other two zones and migrates from topographic high areas of recharge to topographic low areas of discharge such as streams. However, features of a more regional scale, such as major drainage basin divides and rivers, rather than features of a site-specific scale, such as Wildcat Creek, may influence groundwater flow patterns in deep bedrock. Furthermore, the groundwater flow paths of least resistance in the bedrock zone are along fractures. Based on potential fracture directions, the regional groundwater migration in bedrock ranges from southeast to southwest.

2.4 Preliminary Site Conceptual Exposure Model

The site conceptual exposure model (SCEM) is a common tool used to identify and evaluate potential risks associated with sites based on the constituents present, their disposition and distribution in the environment, their migration and fate characteristics, and potential human and environmental exposure points. Based on the extensive historical data collection activities, a preliminary SCEM has been prepared for this RI/FS work plan to identify pertinent data gaps to be addressed during implementation of the RI.

The process of developing the SCEM involves assessing the constituent characteristics, environmental setting, land use, and migration and fate characteristics of the chemicals of concern in the site-specific environmental setting. This assessment ultimately allows the identification of potential human and ecological exposure points. These potential exposure points, and the assumptions required to complete the preliminary model, identify data gaps that must be filled to finalize the SCEM and subsequently proceed with the risk assessment portion of the RI. For the sake of efficiency, the RI scope of work also considers the FS engineering data needs in prescribing the technical approach for filling risk-based data gaps.

In support of the SCEM development, and building on the environmental setting presented in Section 2.3, **Figures 2-5** and **2-6** present the estimated shallow/intermediate and deep groundwater flow directions, respectively.

Specifically, Figure 2-5 presents the shallow groundwater flow directions and groundwater VOC plume status based on available data from CDM's 2004 Investigation. Most of the groundwater flow at the site is to the southeast toward Wildcat Creek although more detailed mapping in the southwest area could indicate a flow divide with a portion of the groundwater flowing toward Fishing Creek. The groundwater recovery system generally appears to contain the highest constituent concentrations in groundwater in the shallow aquifer system.

Data interpretation for the rock aquifer (Figure 2-6) is may not be conclusive because of an apparent lack of consistency in rock well construction and depth intervals represented. While shallow rock aquifer data should generally correlate with conditions in the shallow aquifer (flow direction and constituent distribution), deeper rock zones are more likely under the influence of regional features of larger scale (regional topography, hydraulic base level to the south, and regional fracture patterns).

Figure 2-7 presents the preliminary SCEM. The SCEM is intentionally conservative in nature as offsite pathways are included for evaluation while offsite contamination has not been detected to date. The SCEM schematic begins with an identification of source and release mechanisms. The migration mechanisms are described as being primary or secondary. Primary migration routes have a higher probability of occurring than secondary routes because this migration occurs in closer physical association with the source materials. Similarly, affected media are identified as originating from a primary or secondary pathway. The bottom table of the figure shows the complete and potential exposure routes for receptors to affected media. Current and future land uses are included as well as ecological receptors.

2.5 Data Gaps

Based on the preliminary SCEM and a review of historical data, several data gaps have been identified. Addressing these data gaps will help finalize the SCEM, support the risk assessments, and allow feasibility analyses of potential remedial alternatives. The identified data gaps are as follows:

- Minimal sediment data have been collected in the past and these data will be required to assess risks to human and ecological receptors associated with exposure to sediments and to perform the FS.

- Similarly, limited soil data have been collected in the past. Soil sampling was intended to be performed during Part 2 of the RFI. However, this phase was never completed. Additional soil data will be needed to assess the nature and extent of soil contamination and to support the risk assessments and FS. Groundwater VOC concentrations indicate that there may be additional areas of soil contamination that have not been identified, and the scope of work presented in Section 3 is designed to identify and characterize these sources.

- Groundwater data for wells across Wildcat Creek in the undeveloped portion of the site reveal few detected constituents and at low concentrations. However, surface soil data have not been collected in this area. These data will be required to support the risk assessments and potential redevelopment of that area separate from the main industrial property. The operational history of the facility indicates that risks should not be expected in this undeveloped area. This work is intended to demonstrate the suitability of this property for future use.

- Several wells have been installed at the site, and the geographic well coverage is good, particularly for shallow/intermediate groundwater zones. However, additional shallow wells will be needed to fill gaps and potentially determine concentrations in source areas identified from the soil sampling. As presented in Section 3, these areas are primarily in and around the main building.

- Additional bedrock wells will also be needed in some areas to evaluate the vertical migration of constituents in groundwater and determine the potential for offsite migration in the bedrock zone.

- Other data collection activities are planned for the RI to support remedial alternative comparisons and decisions during the FS. These activities include completing an aquifer hydraulics evaluation and collecting biochemical and geochemical data. While the current extraction system appears to provide good containment, the aquifer hydraulics evaluation will help determine whether this system's performance can be optimized. The biochemical and geochemical data will allow evaluations of remediation technologies, such as biological remediation and chemical oxidation.

Section 3
Remedial Investigation

3.1 Introduction

This section presents the technical approach for the RI. As previously mentioned, the RI will consist of a phased approach designed to optimize data collection and provide the necessary data to support the risk assessments and FS. This section provides the necessary detail to guide the field investigation activities and should be used in conjunction with the health and safety plan (Appendix A), Field Sampling Plan (FSP), and Quality Assurance Project Plan (QAPP). The FSP provides specific data collection procedures, and the QAPP identifies the protocols that will be employed to ensure data quality. These documents were submitted separate from this work plan.

3.2 Technical Approach

The technical approach for the RI consists of data collection activities necessary to fill the data gaps previously mentioned in Section 2.5. The two-phased approach presented here will allow the ability to make quick decisions during the field investigation and modify the remaining scope as necessary to satisfy the RI objectives.

3.2.1 Phase I Investigation

Phase I of the RI will include sediment sampling, soil sampling, and groundwater sampling. Each of these tasks is described further below. No surface water sampling is proposed as part of the RI because a sufficient surface water sampling program was conducted in 2004 by CDM for SCDHEC and revealed little to no water quality issues in the creeks associated with the site.

3.2.1.1 Sediment Sampling

Sediment sampling will be conducted at seven locations along Wildcat and Fishing Creeks, as shown in **Figure 3-1**. Two of these locations (RISD-WCBKG and RISD-FCBKG) are intended to represent background conditions upstream of the site. The remaining locations are intended to be immediately downgradient of the scour areas for Outflows 1, 2, 3, and 4 and for the former burn pits. Sediment samples will also be collected from approximately four stormwater catch basins/collection areas. Figure 3-1 shows locations preliminarily identified by CDM. These locations will be verified and modified as necessary during the RI, and other discovered locations may be added. The purpose of the creek and catch-basin samples will be to characterize potential impacts to sediment from site-related activities.

Each creek sediment sample will be collected from a depth of 0 to 6 inches using a hand auger. Catch-basin samples will be collected from a composite of sediment (if present) in the basin using either a stainless steel spoon or hand auger. Additional details are provided in the FSP. Collected samples will be sent to Analytical Services Inc. (ASI) in Norcross, Georgia for analysis of EPA's Target Compound List (TCL) of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs).

Samples will also be analyzed for EPA's Target Analyte List (TAL) of metals. Contract Laboratory Program (CLP) formatted reports will be requested for 10 percent of all environmental samples collected for laboratory analyses during the RI. **Table 3-1** presents a sampling summary.

3.2.1.2 Soil Sampling

Soil samples will be collected at approximately 54 locations during Phase I, as shown on Figures 3-1 and **3-2**. The objectives of the soil sampling include:

- Characterizing the soil associated with site-related activities, particularly in previously identified SWMUs, AOCs, and waste operations/storage areas where limited or no soil samples have previously been obtained.
- Identifying potential sources of constituents in groundwater and determining the nature and extent of these sources.
- Evaluating potential surface and near surface soil exposure risks.
- Providing sufficient data to support the human health and ecological risk assessments and to support the FS.
- Assessing surface soil risks for the undeveloped portion of the site east of Wildcat Creek. While there was no known waste management in this area, the soil sampling results will be used to help assess potential airborne migration of constituents associated with the former incinerator.

Soil sampling is necessary to fill data gaps primarily associated with potential risks to human receptors and to identify potential groundwater source areas. As a result, the soil sample collection locations must cover all areas of potential waste storage/release and the vicinity where constituents are known to exist in groundwater. Constituents in groundwater apparently exist adjacent to the building that housed the Drum Repackaging Area, the Drum Management Areas, and the Incinerator Sump. Because locations upgradient of the constituents in groundwater adjacent to the building are beneath the footprint of the building, it is necessary to sample these areas as potential groundwater sources and delineate the extent of constituents in groundwater.

Borings will be advanced using direct-push techniques on the industrial portion of the site at the locations identified in Figure 3-1. These borings will be terminated 10 feet below the estimated water table or at refusal, whichever occurs first. Groundwater is expected to be encountered at 10-20 feet below surface in most borings.

Soil samples will be collected in each boring from the surface (0-1 feet) and at 2-foot intervals thereafter up to the groundwater table (or refusal). Each sample will be screened on site using Color-Tec methods as an early indication of volatile chlorinated ethenes. Based on the Color-Tec readings for both surface and subsurface samples, subsequent boring locations may be modified or added to meet the RI objectives.

Results will be relayed to the SCDHEC and CDM onsite managers. They will then discuss and determine if modifications are appropriate. Changes will also be communicated to the CDM project manager in Atlanta.

The use of Color-Tec for all samples may be reduced at the discretion of SCDHEC based on field observations. For example, if VOCs are not being detected in any surface soil sample or if readings are consistent in several borings across a 4-foot interval instead of a 2-foot interval, it may be appropriate to modify the approach. Any changes will be discussed among the onsite managers.

Color-Tec screening samples will be split and submitted to ASI for laboratory analysis. Split samples will be collected from all surface soil samples and from the subsurface sample from each boring that reveals the highest Color-Tec reading. In the absence of Color-Tec detections for subsurface samples, the split sample will be collected from the depth approximately half-way to the groundwater table or refusal. As detailed in Table 3-1, all split samples will be analyzed for TCL VOCs, TCL SVOCs, and TAL metals. Split samples collected from locations immediately adjacent to the incinerator and drum storage areas will also be analyzed for polychlorinated biphenyls (PCBs).

In addition to the borings, two background surface soil samples (0-1 foot) and subsurface soil samples (3-4 feet) will be collected with a hand auger within a 1-mile radius of the site. These locations are not shown on Figure 3-1 and will be determined during Phase I by SCDHEC and CDM's onsite manager. Locations will be selected based on similarity to the soil types observed on the PSC site. Background soil samples will be analyzed for TCL VOCs, TCL SVOCs, and TAL metals.

Ten surface soil samples will also be collected across Wildcat Creek in the undeveloped and wooded area, as shown on Figure 3-2. This quantity of samples (~1 for every 10 acres) is intended to provide sufficient data for statistical analysis, should this be required later in the project. It is also intended to allow accurate representation of the entire undeveloped area. The locations were selected by segregating the 108-acre area into 5-acre subdivisions and then randomly selecting approximately 50% of these subdivisions as sample locations. Samples will be collected as a 3-point composite sample across each subdivision. Points will be located with a global positioning system (GPS) using the coordinates shown on Figure 3-2. As shown in Table 3-1, collected samples will be analyzed for TCL SVOCs and TAL metals.

3.2.1.3 Groundwater Sampling

Groundwater samples will also be collected during Phase I for the purposes of further characterizing the nature and extent of constituents in groundwater and identifying well installation locations for Phase II. This task coincides with the soil sampling task described above as groundwater samples will be collected from select soil boreholes constructed using direct-push technology. Therefore, if an additional soil source area is discovered, groundwater concentrations in the immediate area of that source can be evaluated.

Groundwater samples will be collected from the boreholes to be identified by SCDHEC and CDM based on field observations and soil Color-Tec readings. For selected boreholes, a sample will be obtained when groundwater is first encountered and at a depth of 10 feet into groundwater (or refusal if 10 feet cannot be reached). Each sample will be screened on site using Color-Tec. Based on the Color-Tec results, subsequent boring locations may be modified or added to meet the RI objectives. Additionally, select samples will also be split and submitted to ASI for analysis of TCL VOCs based on the Color-Tec readings.

During Phase I, CDM will also complete a well inventorying task consisting of reviewing available boring logs, construction details, and analytical data for each well. The purpose of this task will be to develop a better understanding of well construction and usability. For example, some bedrock wells were constructed as open holes while others were double-cased. The results of this evaluation will ultimately lead to developing the groundwater sampling scope for Phase II. Wells that are identified as redundant or not recommended for use will potentially be recommended for abandonment and will not be included in the Phase II scope.

3.2.2 Phase II Investigation

Phase II of the RI will be conducted to fill remaining data gaps identified from the Phase I results. Investigations to fill these gaps are anticipated to include:

- Areas of shallow groundwater where Phase I soil samples indicate a potential source to shallow groundwater.
- Vertical extent of constituents in groundwater and bedrock groundwater migration.
- Potential focused sediment and/or soil sampling to further characterize and/or bound the extent of constituents.
- Data specific to evaluating remedial technologies.

Phase II will also include an additional round of groundwater sampling from permanent monitor wells to evaluate recent concentration trends, assess the current distribution of constituents, and provide a current data set for the human health risk assessment.

The full extent of the Phase II Investigation will not be determined until Phase I is completed. However, the anticipated activities are discussed below. Additionally, well installation and other associated procedures are included in the FSP.

3.2.2.1 Sediment Sampling

No sediment samples are expected to be collected during Phase II unless additional characterization is required based on the Phase I results.

3.2.2.2 Soil Sampling

Soil samples are only expected during Phase II if it is necessary to bound the extent of constituents or focus on a potential source area to support the FS. For example, a small source area could be identified during Phase I, and the actual size of the area could be inconclusive for FS purposes based on the sample locations from Phase I. Additional samples and analyses may be collected during Phase II to support the FS for that area. If the extent of constituents is of the scale anticipated (e.g., several larger areas around and underneath the main building), additional samples are not anticipated to support the FS. That is, the Phase I data should be sufficient to support decisions among remedial alternatives.

3.2.2.3 Groundwater Sampling

An estimated five shallow wells will be installed during Phase II. The approximate locations are shown by the boxed areas on **Figure 3-3**. Final locations will be selected after evaluation of the Phase I results. Additionally, the number of wells may be modified based on the Phase I findings. As shown on the figure, an additional well (RIMW-1) will be installed upgradient of existing well W-1 to bound constituents detected near the northern boundary and assess the source of these constituents. Shallow wells for Phase II will be completed into the shallow aquifer and screened at intervals to be determined based on the Phase I results.

An estimated five bedrock wells will also be installed during Phase II. The actual number of wells and the locations for these wells will be determined after evaluation of the Phase I results. These wells will be completed into competent bedrock using air drilling techniques.

After well installation, a round of site-wide groundwater sampling will be completing using the wells identified from the Phase I well inventory task and the newly installed wells. The new wells will be sampled at least two weeks after installation, in accordance with SCDHEC requirements. The estimated number of wells for sampling is expected to be 50-60.

Sample analysis parameters will also be determined during the Phase I inventorying task. Reduced parameter lists will be proposed for certain wells based on an evaluation of previously detected constituents for each well. For example, pesticides and PCBs will not be analyzed for wells where these constituents have not been detected historically. Samples for all newly installed wells will be analyzed by ASI for TCL VOCs, TCL SVOCs, TAL metals, and TCL pesticides.

Phase II is also expected to include discrete depth sampling in up to five bedrock wells for the purpose of assessing concentrations by depth. Sampling will be conducted with diffusion samplers or packers, and depth intervals will be determined after Phase I. Some wells may require rehabilitation before sampling due to reported silt build-up and inconsistent open intervals.

3.2.2.4 Additional Data Collection

Additional data will be collected as necessary during Phase II to support remedial action comparisons and decisions during the FS. The additional activities will include an aquifer hydraulics evaluation and collection of biochemical and geochemical data. The aquifer hydraulics evaluation will involve monitoring water levels and flow rates in response to shutting down the extraction system. Sequencing startup and shutoff may be employed for this evaluation. Also, aquifer transmissivity will be calculated with the monitoring data. The biochemical and geochemical data will be collected to evaluate the potential use of in situ remedial technologies (e.g., biological remediation and chemical oxidation).

3.2.3 Quality Assurance/Quality Control

This section identifies the Data Quality Objectives (DQOs) and quality assurance/quality control (QA/QC) samples that will be collected during the RI. Details regarding additional quality procedures are provided in the QAPP and FSP.

The DQOs for data collection during the RI activities at the PSC Site are intended to ensure that the laboratory analytical data generated are of sufficient quality to support their respective intended uses. EPA Contract Laboratory Program reporting packages to achieve the highest data quality, DQO Level IV, will be performed for 10% of the total number of environmental samples. The remaining 90% of laboratory analyzed data will achieve DQO Level III. The remedial investigation conclusions, risk assessment, and FS will utilize DQO Level III and Level IV data. In addition, DQO Level II and DQO Level I data may be used to support remedial investigation conclusions and the FS. The Color-Tec screening data are considered to be DQO Level II data. However, the Color-Tec data’s primary purpose is to provide real time information that can be used to maximize the efficiency of laboratory sample selection.

Field duplicate samples will be collected at a frequency of 10% of all environmental samples during the RI and submitted to the laboratory as blind duplicates. Additionally, trip blanks will be submitted and analyzed at a frequency of one per cooler (VOC samples only). Equipment blanks will be collected at a frequency of one per day from sample contacting equipment, including bowls used for sediment sampling, hand augers, etc.

3.3 Risk Assessment

A human health risk assessment will be conducted for this project in accordance with the most recent version of EPA’s Risk Assessment Guidance for Superfund (RAGS). This process will include the major components of Data Evaluation, Exposure

Assessment, Toxicity Assessment, Risk Characterization, and Uncertainty Analyses. During the initial screening of chemicals of potential concern (COPCs), chemicals with concentrations above EPA Region III risk-based concentrations and two times background will be identified as a COPC. These COPCs will then be carried through the RAGS process.

A screening level ecological risk assessment (SERA) will be conducted for this project following EPA's most recent Ecological Risk Assessment Guidance for Superfund (ERAGS). The SERA includes the first three steps of the ERAGS process:

1. Preliminary Problem Formulation and Ecological Effects Evaluation.

2. Preliminary Exposure Estimate and Risk Calculation

3. Problem Formulation: Assessment Endpoint Selection and Formulation of Testable Hypotheses.

If risks to ecological receptors are likely based on the results of the SERA, a baseline ecological risk assessment (BERA) will be completed. The BERA will include the remaining five steps of the ERAGS process.

Both risk assessments will utilize the offsite laboratory data collected as part of this investigation. Onsite screening data (e.g., Color-Tec) will not be used for risk assessment purposes, nor will historical analytical data unless they fill a specific data gap not covered by this RI.

3.4 Technical Memorandum and Remedial Investigation Report

Following Phase I of the investigation, a technical memorandum will be created presenting the results of Phase I and final recommendations for Phase II. This memo will include a discussion of deviations from the work plan, tabular data summaries, sample location figures, and details for proposed Phase II activities. Phase II will be initiated upon approval the Phase I technical memorandum by SCDHEC.

Following Phase II of the investigation, an RI Report will be prepared. This report will document the results of the RI and detail the human health and ecological risk assessments. Data collected in both phases of the RI will be presented in tables and figures and interpreted in the text of the report. The report will include or reference the supporting data, information, and publications used in preparing the report.

Section 4
Feasibility Study

4.1 Introduction

The FS discussion in this work plan focuses on those activities necessary to develop and evaluate remedial action alternatives that are protective of human health and the environment. Because the complexity of the FS depends upon the results of the RI, this work plan describes FS activities in more general terms than the RI activities. Described below are the procedures that will be utilized in determining remedial goals and Applicable or Relevant and Appropriate Requirements (ARARs); the technical approach for identifying and screening remedial technologies for the media of concern; and the technical approach for conducting the analysis of remedial alternatives. These procedures are consistent with NCP guidance.

4.2 Remedial Goals and Applicable or Relevant and Appropriate Requirements

The ultimate goals to be fulfilled by remediation at the site will be developed to be consistent with the general corrective action performance standards set forth under the NCP. Specifically, the remedy will:

1. Be protective of human health and the environment.

2. Control the sources of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment.

3. Attain media clean-up standards.

Protection of Human Health and the Environment

The preliminary SCEM, prepared as part of this work plan, assesses the potential migration and exposure pathways. Specific remedial action objectives will be directed toward protecting human health and the environment based on those exposure pathways considered to be the highest priority.

Source Control

If necessary, source control will be evaluated to reduce or eliminate, to the extent practicable, further constituent loading to groundwater that may pose a threat to human health and the environment. The source control measures could include soil remediation or soil capping to minimize infiltration, thereby reducing constituent loading to groundwater.

Media Clean-Up Standards

Media clean-up standards are potentially applicable to soil, sediment, groundwater, and surface water for the site. The cleanup standards will be evaluated based on results from the RI.

ARARs

Remedial action objectives will be established based on ARARs. ARARs are classified according to whether they are chemical-specific, action-specific, or location specific.

- *Chemical-specific* ARARs are usually health or risk based numerical values or methodologies that when applied to site-specific conditions, result in the establishment of numerical values.

- *Action-specific* ARARs are usually technology or activity based requirements or limitations on actions to be taken with respect to hazardous wastes. The requirements are triggered by particular remedial activities that are selected to accomplish a remedy. Action-specific ARARs do not determine the remedial alternative but are used to establish the minimum requirements that must be achieved.

- *Location-specific* ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in locations such as wetlands, specific habitats, etc.

In addition to ARARs, other policies, criteria, and guidance or "To be Considered" information will be evaluated and used where necessary to ensure protectiveness.

4.3 Identification and Screening of Technologies

Soil, groundwater, and potentially sediment remedial technologies and process options will be identified and screened. The following general response actions are typically utilized for soil, sediment, and groundwater at similar sites:

- No-Action
- Institutional Actions
- Containment
- Removal
- Treatment
- Disposal

Each of these general response actions is discussed in more detail below.

No-Action

The no-action response will be identified for the purpose of establishing a baseline against which other general response actions are compared. This response action is required as a remedial alternative according to the NCP guidance. No preventive or corrective actions are taken as a result of the no-action response; however, monitoring would be prescribed.

Institutional Controls

Institutional controls, including actions that control direct human contact with the media will be evaluated. These actions may be physical, such as fences or barriers, or legal, including relocation, zoning or security restricted access, deed restrictions or notices upon resale or transfer of title, and notices given to current or prospective owners or renters. New construction permit applicants in the area can be warned that groundwater in the vicinity is not suitable for use. Groundwater monitoring to track migration of site constituents is also considered an institutional control.

Containment

Containment will be evaluated as an alternative to prevent risk to human health and the environment by restricting migration in soil, water, or air pathways. A number of technologies and different materials are available for use in establishing migration barriers. There are two principal means: containment through physical methods and through hydraulic methods. Physical methods include capping, vertical barriers such as slurry walls, grout curtains, or sheet piling. Hydraulic containment includes wells or subsurface interceptor trenches, or underdrains to collect groundwater before it migrates off the site. The site currently has an interim hydraulic containment measure consisting of two active extraction wells, an interceptor trench, and a treatment system.

Removal

Removal actions, which involve physically removing the media, will be evaluated. As a result of removal, site risks are reduced. Technologies such as collection of groundwater by wells or subsurface interceptor drains can also be considered a removal response action.

Treatment

Treatment actions that involve reduction of concentrations in the media or alteration of the constituents, rendering them innocuous, will be identified and evaluated. The result is a reduction in mobility, volume, and/or toxicity of the constituents.

During the initial technology development and screening process, specific technologies will be identified for each general response action. Each technology may have several process options, which refer to the specific material, equipment, or method used to implement a technology.

In the initial phase of technology screening, process options will be screened on the basis of technical feasibility, which is based mainly on their compatibility with site characteristics (e.g., physical features of the site), chemical characteristics of the constituents, the characteristics of the waste, and overall effectiveness. Process options considered infeasible or inappropriate for the site will be eliminated. Process options surviving initial screening will be considered potentially applicable to the formulation of remedial alternatives.

4.4 Detailed Analysis of Alternatives

A detailed analysis of alternatives will be conducted on three to five viable approaches to remedial action determined during the initial screening described above. Corrective action alternatives will be evaluated on the basis of the nine criteria expressed in the NCP. These include overall protection of human health and the environment; compliance with ARARs; long-term effectiveness; reduction in toxicity, mobility, or volume of waste; short-term effectiveness; implementability; relative cost; state acceptance; and community acceptance. These criteria are described in more detail below.

Protection of Human Health and the Environment

Each alternative will be assessed to determine whether it adequately protects human health and the environment from unacceptable risks posed by the contaminants on site in both the short and long-term.

Compliance with ARARs

As mentioned in Section 4.2, the alternatives will be assessed to determine whether they comply with identified ARARs.

Long-Term Reliability and Effectiveness

Alternatives will be evaluated on the basis of long-term effectiveness in protecting human health and the environment and in satisfying one or more of the remedial objectives. Effectiveness pertains to the overall degree of protection provided by the technology. The evaluation of effectiveness will include:

- Ability of an alternative to handle the estimated volume of soil and to control the release of site contaminants.
- Degree of protection of human health and the environment during construction and operation.
- Ability of an alternative to meet regulatory criteria established by ARARs.
- Reliability and performance with respect to specific site conditions.
- Reduction in toxicity, mobility, or volume of wastes.

Alternatives that are capable of eliminating or substantially reducing the inherent potential for wastes or other contaminated media to cause future releases or other risks to human health and the environment should be preferred. To evaluate this aspect of an alternative, relative estimates of how much the corrective action measure will reduce the waste toxicity, mobility, or volume may have to be developed. This may be done through a comparative analysis of the initial site conditions with expected post corrective action measure conditions.

Reduction in Toxicity, Mobility, or Volume of Waste

The degree to which the alternatives reduce toxicity, mobility, or volume will be evaluated for each alternative including how treatment will be used to address the principal threats posed by the site.

Short-Term Effectiveness

In a manner similar to the long-term effectiveness evaluation detailed above, an analysis of short-term effectiveness will also be conducted. Short-term effectiveness may be particularly relevant when remedial activities will be conducted in densely populated areas, or where waste characteristics are such that risks to workers or to the environment are high and special protective measures are appropriate. Possible factors to consider include fire, explosion, exposure to hazardous substances, and potential threats associated with treatment, excavation, transportation, and disposal or containment of waste material.

Implementability

Implementability pertains to the practical aspects of remedial construction and will be considered in terms of technical and institutional feasibility. The evaluation of implementability will consider:

- Constructability under site conditions.
- Ability of the alternative to be permitted.
- Potential for successful implementation, time to implement the process option, and time required to achieve beneficial results.

Cost

Relative cost will be used to screen out an alternative option only if it was considered significantly higher than other options and relative effectiveness and implementability were not significantly different. Cost screening will consider general capital and operating and maintenance (O&M) costs for alternatives. The FS will include preparing detailed cost estimates.

4.5 Feasibility Study Report

Following the completion of the feasibility study, an FS Report will be produced and submitted to SCDHEC. The FS Report will summarize the results of the RI and the human health and ecological risk assessments. Additionally, it will describe and present the results of the remedial alternatives development, the preliminary screening task, and the detailed analysis of alternatives. All supporting data, information, and publications used in preparing the report will be referenced.

Section 5
Schedule

Figure 5-1 presents the proposed schedule for the RI/FS. The schedule assumes that no major weather delays will be experienced during the field work activities and that comments for major documents (e.g., RI Report, FS Report, etc.) will be provided by SCDHEC within three weeks of submittal. The schedule will be monitored throughout the RI/FS and updated as appropriate.

Section 6
References

CDM, 2006a. *Quality Assurance Project Plan – PSC Site, Rock Hill, SC*. Atlanta, GA. May 2006.

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Philip Services Corp. *Petro-Chem SC SCD 044 442 333 RCRA Facility Investigation Part 1 Report*. Columbia, IL. August 23, 1999.

U.S. EPA, 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final*. Office of Solid Waste and Emergency Response, Washington, D.C. June 1997.

U.S. EPA, 2001. *Risk Assessment Guidance for Superfund*. Office of Solid Waste and Emergency Response, Washington, D.C. December 2001.

Figures

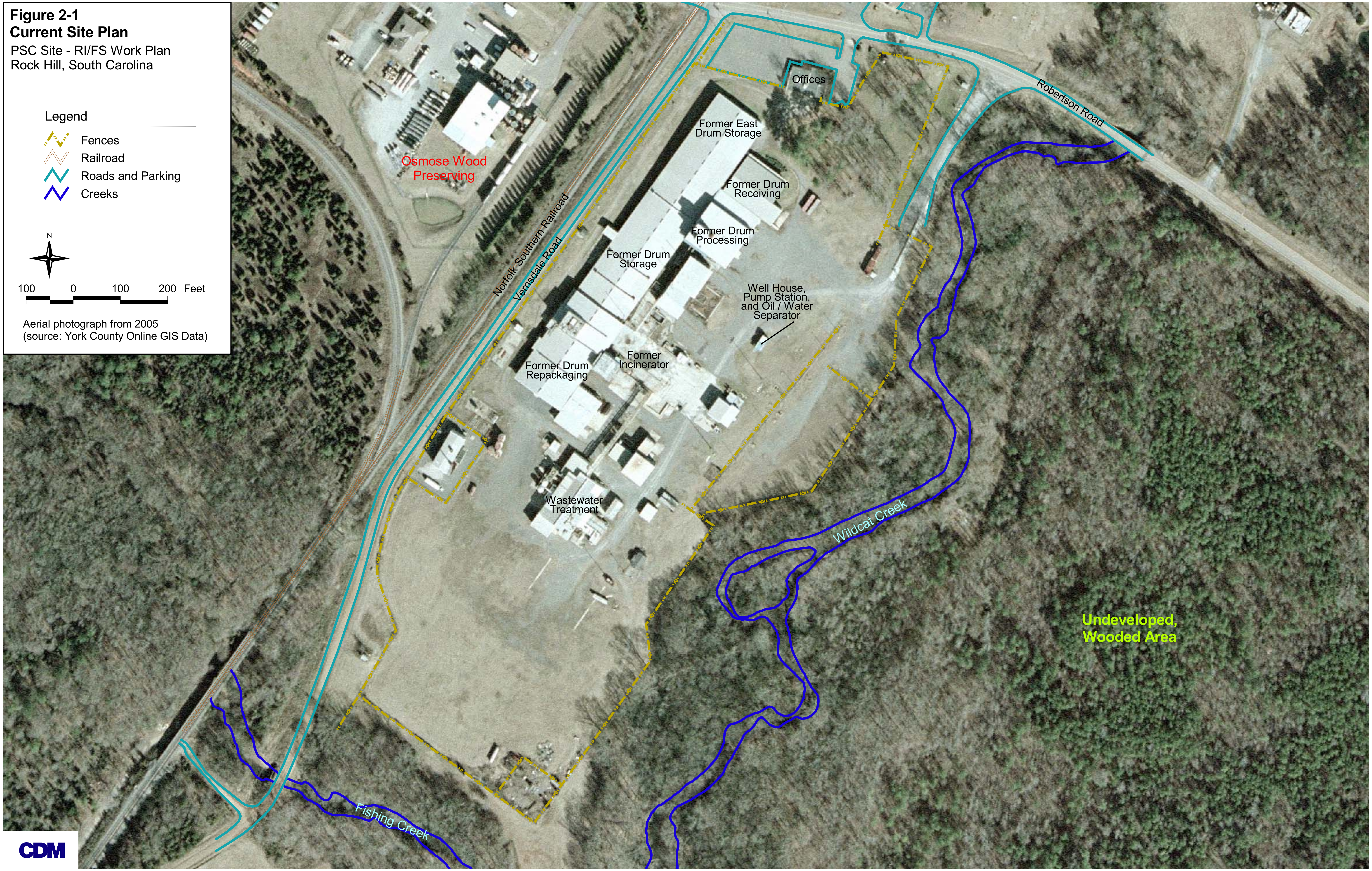

Figure 2-1
Current Site Plan
PSC Site - RI/FS Work Plan
Rock Hill, South Carolina