Data Package
RCRA Phase I/IB Investigation
Data – 2011/2013

RCRA Facility Lead Program
Celco Plant, Narrows, Virginia

July 2013

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List of Acronyms and Abbreviations

ADI	Allowable Daily Intake
AOC	Area of Concern
AQA/LCP	Analytical Quality Assurance and Laboratory Contract Program
ARCADIS	ARCADIS U.S., Inc.
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
BERA	Baseline Ecological Risk Assessment
BTAG	Biological Technical Assistance Group
CA	cellulose acetate
CAP	Community Advisory Panel
CAS	Chemical Abstract Service
CCME	Council of Ministers of the Environment
Celanese	Celanese Acetate LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chain-of-custody
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CPSL	Closed Process Sludge Landfill
CSF	cancer slope factor
CSM	conceptual site model
11-DCA	1,1-dichloroethane
DCQAPP	Data Collection Quality Assurance Project Plan
DEGS	Duke Energy Generation Systems of Narrows LLC
DNAPL	dense non-aqueous phase liquid
DOCC	Description of Current Conditions
DQO	quality objective
EDD	electronic data deliverable

List of Acronyms and Abbreviations continued

EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESRI	Environmental Systems Research Institute, Inc.
ft msl	feet above mean sea level
GC/MS	gas chromatography/mass spectroscopy
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health and Safety Plan
HHRA	human health risk assessment
HQ	hazard quotient
IDW	investigation-derived waste
IRIS	Integrated Risk Information System
IUR	inhalation unit risks
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LNAPL	light non-aqueous phase liquid
LQR	large quantity generator
MCL	Maximum Contaminant Level
MEO	mesityl oxide
MGD	million gallons per day
ml/min	milliliters per minute
MRL	minimal risk level
MS	matrix spike
MSD	matrix spike duplicate
NCAPS	National Corrective Action Prioritization System
NCP	National Contingency Plan
NFG	National Functional Guidelines
NOAA	National Oceanic and Atmospheric Administration
ORNL	Oak Ridge National Laboratory
PARCC	precision, accuracy, representativeness, completeness, and comparability

List of Acronyms and Abbreviations continued

PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PID	photoionization detector
PPE	personal protective equipment
PPRTV	Peer Reviewed Toxicity Values
PT	performance testing
PVC	polyvinyl chloride
P-W	Parratt-Wolff Inc.
QA	quality assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RfDs	reference doses
RfCs	reference concentrations
RFI	RCRA Facility Investigation
RL	reporting limit
RME	reasonable maximum exposure
RPD	relative percent difference
RSLs	Regional Screening Levels
SDG	sample delivery group
SLERA	Screening Level Ecological Risk Assessment
SMDP	Scientific Management Decision Point
SOP	standard operating procedure
SQuiRT	Screening Quick Reference Tables
STSC	Superfund Technical Support Center
SVOC	semi-volatile organic compound
SWMU	solid waste management unit
T&E	threatened and endangered
TCE	trichloroethene

List of Acronyms and Abbreviations continued

TOC	total organic carbon
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	underground storage tank
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
VPDES	Virginia Pollutant Discharge Elimination System
WWTP	wastewater treatment plant

Executive Summary

Celanese Acetate LLC (Celanese) is performing environmental investigations at the Celco Plant in Narrows, Virginia under a Resource Conservation and Recovery Act (RCRA) Facility Lead Agreement (Agreement) that was signed with the U.S. Environmental Protection Agency, Region III (USEPA) in January 2006. This purpose of this document is to present the results of the initial site-wide comprehensive RCRA Facility Investigation (RFI) field program that was conducted between June 2011 through February 2012 (hereafter known as Phase I) and May 2012 through May 2013 (Phase IB).

The Celco Site is an active production facility that manufactures cellulose acetate (CA) flake and fiber products. The Celco Site is bounded by the New River to the south and east and a local mountain known as Hemlock Ridge to the north, which is part of the Cumberland Mountains of the Valley and Ridge physiographic province. The site encompasses approximately 1315 acres and is divided into two main areas (the Plant and Landfill Areas) separated by a local highway (Route 460). The Plant Area contains administrative, process-contained and/or storage buildings, a wastewater treatment plant (WWTP), aboveground storage tanks (ASTs) for chemicals and/or fuel oils, a rail system for bulk transportation purposes, active fly ash settling ponds, and multiple closed waste disposal areas (WDAs). Water is obtained both from the New River and from groundwater for process operations. A production well network in the Plant Area captures approximately 4 million gallons per day (MGD) of groundwater. The Landfill Area contains permitted non-hazardous landfills with active and closed cells.

The Phase I/IB field program included the installation and development of 12 new monitoring wells and 4 new piezometers; a site-wide round of water-level measurements; collection of over 78 groundwater samples from monitoring wells, on-site production wells, and off-site municipal wells; collection of 8 surface water and 14 sediment samples from on-site tributaries samples; detailed reconnaissance of the New River and collection of 37 off-site surface water samples and 17 sediment samples. In addition, advancement of over 136 environmental borings throughout the Plant Area was completed for lithologic and analytical characterization. Many borings were advanced in suspected waste disposal areas for visual assessment of waste type/thickness in addition to analytical characterization. Overall, over 290 soil samples were collected during the environmental boring program.

The analytical program varied per media and location with one or more of the following analyses performed per sample: volatile organic compounds (VOCs), semi-volatile

organic compounds (SVOCs), polychlorinated biphenyl compounds (PCBs), dioxins/furans, perfluorinated compounds (PFCs), pesticides, herbicides, metals, mercury, cyanide, total petroleum hydrocarbons (TPH), glycols, hexavalent chromium, ammonia, acetic acid, total organic compounds (TOCs), chloride, sulfate, nitrate, nitrite, alkalinity, and toxicity characteristic leaching procedure (TCLP) parameters.

The primary objective of this data package is to focus on identifying data deficiencies (rather than a detailed interpretation of the initial RFI results) so that the need for further site characterization for risk assessment purposes can be assessed. Desktop activities performed and included in this data package include complete validation of analytical data, presentation of current results in tables and figures, initial risk-screening to identify potential chemicals of potential concern (COPCs), preparation of geologic cross-sections, and revisions to the site groundwater model. These data were evaluated to update the conceptual site model (CSM) which demonstrates that groundwater flow is primarily south towards the New River which serves as a regional discharge zone. The CSM recognizes that the Celco production well network is creating a relatively large zone of containment preventing groundwater from discharging to the New River. Groundwater modeling demonstrated that constituents associated with the Celco Site are not migrating in groundwater beneath the New River and would not migrate in groundwater beneath the New River even if the Celco production wells were turned off.

Based on the results of Phase I/IB field program, (1) a soil removal program is being implemented within an area with elevated PCBs in soil (i.e. the former Fire Training Area); and (2) a Phase II data collection is proposed for further site characterization. Proposed Phase II field activities include additional soil/waste borings, soil sampling/analysis, waste sampling/analysis, well/piezometer installation, groundwater sampling/analysis, site-wide water level measurements, continuous water level measurements in selected locations and one sub-slab air sample. The completion of Phase II investigation is expected to provide a site data set sufficient to proceed with the human health and ecological risk assessment.

The schedule that Celanese is currently working under includes the following:

- Phase II field investigation: September through December 2013
- Risk assessment work plan submittal to EPA: November 2013
- RFI Report (including the risk assessment) submittal to EPA: 4Q2014

- Corrective Measures Study Submittal to EPA: 1H2015
- Remedy Selection: December 2015.

1. Introduction

Celanese Acetate LLC (Celanese) is performing a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the Celco Plant located in Narrows, Virginia under a Facility Lead Agreement (Agreement with U.S. Environmental Protection Agency, Region III (USEPA).

1.1 Supporting Documents

1.1.1 Attachments

1.1.1.1 1-1 – Certification Statement

1.2 Purpose and Objectives

The purpose of this document is to present the RFI results for field work completed between June 2010 through February 2011 (here after known as Phase I) and May 2011 through May 2012 (Phase IB) for the Celco Site (Site) RCRA Corrective Action Program. This work was performed in accordance with RFI Work Plan dated August 2011 (**ARCADIS, 2011**) and the Phase IB Scope of Work Letter dated October 2, 2012 (**ARCADIS, 2012**).

The RFI data presentation in this document is focused on identifying data deficiencies such that Phase II investigations can be proposed. The objective of the proposed Phase II investigations is to collect additional site characterization, as needed to proceed with development of a site-wide risk assessment and initiate an evaluation of potential remedial actions for the Site.

1.3 Report Organization

The report is organized into sections as illustrated in the Table of Contents (TOC). The TOC presents a complete list of tables and figures associated with the report. The TOC also includes a complete list of Appendices that contains information applicable to the entire Phase I/IB RFI program such as boring logs, laboratory data, etc. In addition, there are many data attachments that are specific to individual sections of the program. Each report section contains a separate list of Tables, Figures and Attachments that are applicable to that section and each of the Tables, Figure and Attachments can be found in the individual sections to make it easier for the reader to identify and view applicable supporting documents.

1.4 Certification Statement

A signed certification statement (consistent with the Facility Lead Agreement) certifying that the information provided in this report is true, accurate and complete is referenced as **Attachment 1-1** of this Section and will be provided as a separate submittal.

2. Historical Environmental Investigations

Since 1968, there have been numerous environmental investigations and environmental projects performed at the Celco Site. These projects have been performed to investigate specific problem areas (e.g., benzene area release), for routine monitoring purposes (e.g., production well water quality) and/or more recently for site-wide characterization. Some activities were conducted for remediation purposes, such as the investigation and subsequent automated collection of petroleum product from the subsurface at the aboveground tank farm. As part of their overall facility environmental management strategy, most of the projects have been performed proactively by Celanese without regulatory participation or oversight. Some of the environmental activities have been performed under permit and/or in conjunction with regulatory oversight such as the Underground Storage Tanks (UST) closure, aeration/equalization basin RCRA closure and the ongoing Permit 207 landfill groundwater monitoring program.

In 1996, the Celco Site was assessed and ranked by the VDEQ and the USEPA Region III for the RCRA National Corrective Action Prioritization System (NCAPS). An NCAPS ranking was completed in 1996, which listed a total of 39 Solid Waste Management Units (SWMUs). Overall, the Draft NCAPS rating for the facility was listed as low. The NCAPS report concluded that there was the potential for release to groundwater associated with the Equalization /Aeration Basins at the wastewater treatment plant and from the Landfill Cells associated with Celco Landfill Permit No. 207. In light of the finalization of the NCAPS ranking and since Celanese had performed numerous environmental evaluations and corrective actions at the facility, Celanese proactively implemented a program to perform a comprehensive environmental evaluation covering the Plant Area and the Landfill Area.

In 1997, Celanese initiated a Site-Wide Groundwater Assessment to evaluate existing historical groundwater quality data, to collect additional data necessary to address data deficiencies, and to prioritize environmental issues at the site based on potential human health and environmental risk. An Internal Draft Report was issued in May 1999 that focused on several major areas of the facility; the Internal Draft Report was not finalized. In 2003, Celanese performed a subsequent site-wide groundwater sampling event and utilized the results to update the 1999 Internal Draft Site-Wide Assessment Report. In February 2005, an updated Site-Wide Groundwater Assessment Report was completed. Celanese utilized the results of this report to focus their continuing efforts to fully understand site conditions and to perform additional investigations and/or remedial activities where warranted.

As part of their overall facility environmental management strategy, Celanese has proactively pursued the characterization and remediation of the facility conditions with respect to groundwater which is protective of human health and the environment. This management strategy has the objective of evaluating impacts to the two major receptors at the facility; the onsite production wells and the adjacent New River. The onsite production wells, typically producing about four million gallons per day, serve as a containment field to significantly limit the migration of constituents within groundwater to the adjacent New River.

The risk management approach considers the entire facility or subsections of the facility as potential source areas. Risks to human health or the environment will occur only if receptors are exposed to contaminants above established action levels or risk-based concentrations. By taking a global approach (outside-in), Celanese determined the constituent loading to the river and the representative risk posed by these conditions.

Using this Site-Wide Assessment approach, a site characterization was completed in 2005 from a global perspective which evaluated:

1) the nature and extent of contamination,

2) the risk posed by constituents of concern to human health and the environment under the current production well containment strategy, and

3) quantitatively evaluated the risk posed by constituents of concern to human health and environment if the production wells were turned off (i.e., loss of hydraulic containment strategy).

The environmental projects performed at the Celco Site have included, but are not necessarily limited to, the following: chemical sewer upgrades, storm water management improvements, multiple basin closures, use of new technologies (e.g., Biohoch tanks, ketene processing), installation of groundwater monitoring wells, the collection of environmental samples from groundwater, surface water, soil and waste, the measurement of groundwater and surface-water elevations across the site, fate and transport modeling, risk analysis, free-product collection, and bioremediation.

In January 2006, Celanese entered into RCRA Corrective Action governed by the USEPA Facility Lead Program (FLP). Previous investigations are summarized in the Document of Current Conditions (DOCC) Report dated October 2006 (**ARCADIS,**

2006). This RFI data package presents the data collected and results of the FLP Phase I/IB Investigations.

3. Facility Setting and Background

3.1 Supporting Documents

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3.2 Introduction

The Celco Site located in southwestern Virginia, is less than three miles east of the town of Narrows in Giles County. This area lies within the Cumberland Mountains of the Valley and Ridge physiographic province. The Celco property and local physical features are presented on **Figure 3-1**.

The plant has manufactured cellulose acetate (CA) flake and fiber since December 1939 and employs approximately 1000 people (including Celanese employees and contractors). The total Celco Site encompasses approximately 1332 acres, divided into two major areas (the Plant Area and Landfill Area), which are separated by Route 460. Collectively, the Plant Area and the Landfill Area are referred to as the "Celco Site" in this report.

3.3 Site Description, Topography, Property Boundaries and Land-Use

The Celco Site is bounded by the New River to the south and east and a local mountain known as Hemlock Ridge to the north. In the Plant Area, adjacent to the New River, the topography is relatively flat as it is located on a river terrace. The surrounding area on both sides of the New River is characterized by mountains with significant relief. The ground surface of the Plant Area is relatively level with surface elevations ranging from approximately 1580 to 1600 feet above mean sea level (ft msl).

North of Route 460, the Celco property is located on a mountainside of Hemlock Ridge overlooking the New River. This area is referred to as the "Landfill Area" because it is used for land filling of non-hazardous waste in permitted landfills. The Appalachian Trail traverses through wooded areas between Route 460 and the landfills. A portion of the trail is being rerouted north of the Landfill Area as shown on **Figure 3-1**. Topographic relief in the Landfill Area increases steeply on the northeast side of Route 460 from 1600 ft msl to approximately 2600 ft msl along Hemlock Ridge. The general site features and locations of the Plant and Landfill Areas are presented on **Figure 3-2**.

3.4 Historic, Current and Future Land Use

The Celco Site, located in southwestern Virginia, is less than three miles east of the town of Narrows in Giles County **(Figure 3-1).** This area lies within the Cumberland Mountains of the Valley and Ridge physiographic province. The Celco Site is bounded by the New River to the south and east and a local mountain known as Hemlock Ridge to the north. The plant entrance is near the intersection of the Route 460 and the New River.

3.4.1 Historical Land Use

Prior to the start of Celanese activities culminating in the plant startup in 1939 the Celco Plant area was utilized as agricultural land including tilled crops and an apple orchard. During the 2006 DOCC file review, additional information was gathered from Celanese records, which indicated that a portion of the Permit 207 landfill was formerly used by the Virginia Power and Railroad as a landfill. The landfill was primarily used to dispose of fly ash from their power plant. Celanese purchased the land from Virginia Power and Railroad in the late 1950s or early 1960s after they went out of business. A file report indicated that around the same time period, the Virginia Garage disposed of old car parts and miscellaneous material in the same area.

3.4.2 Current Land Use

Most of the Celco Site Plant Area is currently zoned General Industrial District I-1. The Landfill Area is zoned either General Industrial District I-1 or Solid Waste Management Facilities District SWM-1. Areas surrounding the Celco Site are generally a mix of agricultural, residential, conservation district, etc. The current zoning map for the Celco Site area is included in **Attachment 3-1**. Also included in **Attachment 3-1** is the current Giles County Zoning Ordinance Section 613 which states the following:

> "*The primary purpose of this district is to establish areas where the primary land use is for industrial operations, which may create some nuisance, and which are not properly associated with, nor particularly compatible with residential, institutional, and commercial service establishments. The specific intent of this district is to: (a) encourage the construction of and the continued use of the land for industrial purposes; (b) prohibit new residential and new commercial use of the land and to prohibit any other use which would substantially interfere with the development, continuation, or expansion of industrial type uses in the district; (c) encourage the discontinuance of existing uses that would not be permitted as new uses under the provisions of this Ordinance; and (d) encourage industrial parks."*

3.4.3 Future Land Use

The Giles County Planning Commission has developed and maintains a Comprehensive Economic Development Plan (CEDP) which addresses future land use. The most recent five year review of the Giles County Comprehensive Plan was approved on June 6, 2012 and the review specifically focused on future land use of the Celanese property. In that document, Policy 2.1 **(see Attachment 3-1**) states that:

> *"Prime industrial sites, existing and proposed; should be encouraged for industrial uses. ….".*

The Giles County Planning Commission considers the Celco Site to be a top prime industrial site and has included Strategy 2.1.3 in the CEDP which states as a strategy to

> *"Continue to support and participate in Celanese Corporation's Planning Initiative as outlined by the EPA's Resource Conservation and Recovery Act."*

Giles County is supportive of and has included maintaining the Celco Site for Industrial Use as described in their Comprehensive Economic Development Plan. Celanese expects that the Celco Site will remain industrial for the foreseeable future. Celanese is investing more than $150MM in constructing a new gas-fired boiler for plant operations. This financial investment demonstrates Celanese's commitment to continued industrial operations at the Celco Site for decades into the foreseeable future.

3.5 Regional Geology and Hydrogeology

The geologic information presented in this report is based upon interpretations developed from United States Geological Survey (USGS) and Virginia Division of Mineral Resources published literature, from Celanese-archives of historical environmental reports, and from numerous studies performed by ARCADIS on behalf of Celanese. The sources for this information are provided in **Section 22** References. Most of the information presented in the geology and hydrogeology sections was presented in the Description of Current Conditions Report; subsequent submittals associated with Waste Disposal Areas (WDA) 4, 5, and 6, and are presented again in this report for continuity.

Giles County lies within the southern Appalachian segment of the Valley and Ridge province. The geologic structure of this region includes long linear asymmetric folded rocks and southeast dipping thrust faults, which are both complex and difficult to interpret. Major structural features in the area trend approximately North 65^{o} East including the major thrust faults referred to as the Pulaski, the Saltville, the Narrows, and the St. Clair. Each of the Major regional thrust faults and folds have been deformed locally by numerous minor structures.

In Giles County, the New River follows a northeastward course, along strike, and then turns northwestward, past the Celco Site, and cuts across the grain of the Valley and Ridge province approaching the more gently deformed Allegheny Plateau province. The boundary between the Valley and Ridge province and the Allegheny Plateau province is known as the Allegheny Front.

Strata in Giles County form a relatively continuous succession of carbonate platform and clastic basinal deposits from the Lower Cambrian to the Upper Mississippian Periods, creating a composite thickness of about 15,000 ft. Overlying the various carbonate and clastic rock units in many places, particularly along the New River and its tributaries, are Quaternary unconsolidated deposits. Surface structures are well known from outcrops and mapping; however, structures at depth are more problematic and are subject to multiple interpretations.

Karst features, including sinkholes, caves and sinking or underground drainage, are common along the floors of valleys underlain by Cambrian-Ordovician limestone. Collapse of such features can occur, particularly where the water table has been lowered.

The Giles County area is of special interest, because the epicenter of the largest earthquake recorded in Virginia, which occurred in 1897, was near the town of Pearisburg (**Campbell 1898; Hopper and Bollinger 1971, p. 54-66**). Recent work has identified a seismogenic zone within Giles County that may be associated with that event (**Bollinger and Wheeler 1980; 1983**). Minor earthquakes have persisted in Giles County. Although their origin is not well understood, they appear to originate at great depth in basement rocks (**McDowell and Schultz 1989**).

Groundwater flow regimes in northwestern Giles County are controlled primarily by the geologic structures, by local stratigraphic features such as bedding planes, and by the New River which serves as a regional discharge boundary. Saturated conditions occur locally within the river terrace deposits located along the New River valley floor. Saturated conditions within the underlying Cambrian System carbonate rocks vary with depth based on the maturity of karst features within a particular section of the rock.

3.6 Facility Geology

The subsurface in the vicinity of the Plant Area is composed of seven distinct Paleozoic Era clastic rock units and an eighth Paleozoic Era rock unit consisting of the Knox Group Dolomite. Surface deposits along the New River and its stream channels are composed of Quaternary unconsolidated deposits. The major stratigraphic groups, formations, and members within the area are illustrated on **Figure 3-3.** The relatively flat Plant Area is underlain by dolomite bedrock. As one moves north from the Plant Area toward the Landfill Area, the topography becomes steep and the bedrock geology changes from dolomite bedrock (which is intercepted by thrust faults) to folded, overturned, and faulted clastic units.

The Knox Dolomite is composed of a thick sequence of dolomite, much of it cherty, with minor amounts of sparsely fossiliferous limestone and sandstone (**McDowell and Schultz, 1989**). This unit is extremely weathered and fractured, and the bedrock surface is very irregular. Within the dolomite, bedrock fracturing extends to at least 400 ft based on Production Well boring logs. In the Plant Area, the dolomite is encountered between approximately 15 and 85 feet below ground surface (ft bgs).

Overlying the various Paleozoic Era units in many places, particularly along the New River and its tributaries, are four types of Quaternary deposits including colluvium, fan deposits, alluvium, and terrace deposits. Colluvial deposits represent valley wall debris, which has been transported downslope by gravity slides or slump and are found at the base of relatively steep topographic relief. At the Celco Site, colluvial deposits occupy a small percentage of the area and are restricted to a few small areas to the northeast of the landfill and a larger band oriented northeast/southwest located farther up the hillside toward Hemlock Ridge. Fan deposits consist of gravels, sands, silts, and clays, which extend to a depth of less than 200 ft. Alluvial fan deposits are found just to the north of the Plant Area and the deposits continue upward following the relatively small surface channels up the hillside. Terrace deposits occupy areas immediately adjacent to the New River and represent materials deposited by the New River. The terrace deposits consist of gravels, sands, silts and clays and are similar to the alluvial deposits, although they were deposited at a topographically higher position.

3.7 Site Soils

The surface soils across the Celco Site vary and their properties are dependent primarily on the parent material from which they were formed. A mantle of residual soils up to 70 ft thick overlies the Knox Dolomite parent material areas. The residuum is formed from in-situ weathering of the original dolomitic rocks and is composed of brown, red-brown and yellow, stiff to hard, silts and clays. Relict bedding laminae and occasional thin layers of cherty gravel (in a clay matrix) are also present. At depths between 30 and 70 ft, the residuum becomes very hard, and the materials encountered are gray to tan, crumbly clay with silt to gravel-sized rock fragments. This material represents a transitional zone to the dolomite and indicates proximity of the bedrock surface (**Westinghouse, 1991**). Colluvial soils consist of brown, red, and maroon, stiff to very hard, gravel-sized fragments of chert, dolomite and sandstone embedded in a silt and clay matrix. Residual soils formed over the clastic rock units consist of sands, silts, and clays and vary depending on the location and nature of the parent material. Residual soils formed from the Quaternary deposits consist of a mixture of gravels, sand, silts and clays. The proportion of each of these components varies and is dependent on the location and nature of the parent material.

3.8 Landfill Area Geology

Much of the hillside to the north of the Plant Area is underlain by folded clastic units including sandstones, siltstones, and shales. The clastic rock units form an overturned syncline trending northeast-southwest, where the southern limb of this fold makes up Hemlock Ridge. The clastic rock units are found in the subsurface from Hemlock Ridge to the south where they intersect with a northeast-southwest trending thrust fault referred to as the Narrows Fault. The northwestern part of Giles County is traversed by the Narrows Fault. The fault is exposed in a railroad cut along the New River, north of the town of Narrows. The Narrows Fault divides the clastic rocks to the north of the fault and dolomite limestone to the south of the fault.

Several branches of the Narrows Fault cross the Landfill Area, striking northeast-southwest. The reported strike is based on true north as opposed to plant north. The Narrows Fault reportedly has a southeast dip angle that ranges from 24° to 39° degrees with an average dip of 30.5° (**Westinghouse 1991**). Another fault branch is located approximately 500 to 700 ft to the southeast of the Narrows fault and runs roughly parallel to the strike of the Narrows Fault. The southern fault branch is reasonably expected to have a similar dip. This branch rejoins the Narrows Fault in the eastern portion of the site.

3.9 Narrows Fault Zone

The Narrows Fault Zone consists of a narrow region of highly broken, angular, and abraded (brecciated) rock fragments formed through the sliding movement of the opposing thrust blocks past one another. The northern fault branch forms a contact between the Knox Dolomite and various clastic units to the northwest, whereas the southern branch occurs entirely within the Knox Dolomite. The thickness of the fault zone of the northern Narrows Fault has been found to exceed 100 ft in width at a rock coring location in the vicinity of LF056. The fault zone of the southern Narrows Fault was observed to be only a few feet thick, although the actual thickness is expected to be greater (**Westinghouse 1991**). Fault breccia consists of ½-inch to 3-inch angular, abraded clasts of chert and dolomite, which is distinguishable from other chert nodules and fragments weathered out of the Knox Dolomite. The brecciated fragments are contained in a red-orange clay matrix, which is different than the gray mottled clay produced by in-situ weathering of the dolomite.

3.10 Significance of Fault Lines/Zones

During implementation of the WDA 4, 5 and 6 investigations, the USEPA requested additional documentation regarding the depth to the fault lines and significance of fault lines with respect to potentially mobilizing contamination. Celanese responded to USEPA in a letter dated June 25, 2012 with the following information:

> *"The interpreted concern hinted at by this question is whether a "preferential flow pathway" for ground water might exist under WDA 4, 5 and 6 that could allow for a rapid transmittance or preferential flow of groundwater. The geology of the area suggests that this is not the case as described below.*
>
> *The geology of the main plant area (i.e., including WDA 4, 5, and 6) consists of fractured and karstic Knox Dolomite overlain by residual soils and alluvial deposits. Portions of the main plant area are covered by fill materials which are composed of soils similar to the native residual soils. The depth to water in the vicinity of WDA 4, 5, and 6 is typically about 30-ft. below ground surface. The continuous water table is often found at the soil/bedrock interface, although it is not uncommon for fine grained soils to extend deeper and up to 80- to 100-feet below ground surface where the water table is found in soil material as opposed to bedrock.*
>
> *The regional and site specific geologic maps (provided in the DOCC Report) illustrate that the Celanese construction project lies between the northern and southern branch of the Narrows Fault which are oriented in a northeast to southwest direction. In addition, the fault lines within the main plant area are dashed indicating that the presence and significance of the fault in the floodplain is questionable (See* ***Figure 3-3****). The Knox Dolomite is hydraulically connected to the overlying residual soils. Groundwater flow in karst terrains is typified by fracture/conduit flow. Based on work completed by Westinghouse during prior site investigations, the fault zone is composed of fine-grained clay soils, weathered dolomite and breccia. The breccia consists of angular, abraded clasts of chert and dolomite. This material is quite similar to what is observed at depth beneath the main plant in areas outside of the projected fault zones. The water table in the main plant area is relatively shallow*

and is located within either the weathered clay material or the weathered bedrock material. The hydraulic conductivity in both the projected fault zones within the main plant area and the areas outside the fault zones in the main plant area contain similar materials and therefore are expected to have similar, although variable hydraulic conductivities. Therefore, there is no reason to suspect that the projected fault zones in the main plant area are any more likely to potentially mobilize contamination that any other area within the main plant."

3.11 Plant Area Geology

The geology of the Plant Area consists of fractured and karstified Knox Dolomite overlain by residual sediments and river terrace deposits. Some portions of the Plant Area are composed of fill materials. The surface deposits represent poorly-sorted deposits of cobbles, sands, silts, and clays. The unconsolidated material can be generally grouped into two categories: 1) sediments formed in-situ through the weathering of the underlying bedrock, and 2) river terrace deposits transported by the New River from upstream locations. The river terrace deposits extend from the New River up into the facility and thin with distance from the river.

Overlying the terrace deposits, numerous areas of the facility are covered with a veneer of reworked sand and silt materials utilized in historical regrading efforts at the facility. Recognizing distinctions between the residual soils and alluvial deposits in boring log descriptions from within the Plant Area is difficult. The thickness of the residual soils and alluvial deposits ranges from approximately 15 feet adjacent to the New River to approximately 85 feet located inward from the river, as indicated by bedrock surface elevations from borings logs for wells throughout the Plant Area.

The Knox Dolomite is composed of a thick sequence of dolomite, much of it cherty, with minor amounts of sparsely fossiliferous limestone and sandstone (**McDowell and Schultz 1989**). The Knox Dolomite is characterized as a light- to medium-gray and fine- to medium-grained dolomite (**McDowell and Schultz 1989**). Chert is common in the Knox and occurs either as irregular beds in the dolomite or as concentrically banded white, gray or black nodules (**McDowell and Schultz 1989**).

The Knox Dolomite underlying the Plant Area is encountered between approximately 15 and 85 ft bgs. Within the vicinity of Tank Farm**,** the Knox Dolomite is located approximately 40 to 45 ft bgs. Based on the evaluation of bedrock surface elevation, no significant slope to bedrock has been defined in this area. During drilling operations, significant fracture zones and voids were encountered; however, the pattern varies significantly between each borehole location.

The Knox Dolomite is extremely weathered and fractured, and the bedrock surface is very irregular. Within the dolomite, bedrock fracturing extends to at least 400 ft, based on Production Well boring logs. In addition, cavities and voids are present in the dolomite formed by groundwater dissolving the soluble calcium carbonate minerals along existing fractures. Some of the observed cavities are empty, while some appear to be filled with clay/. The irregularity of the bedrock surface and the presence of cavities are characteristic of carbonate bedrock terrain. This type of weathering is commonly referred to as “cutter and pinnacle” weathering. Cutters form due to solutional enlargement of fractures. Adjacent to cutters are pinnacles of more resistant, less fractured bedrock. Isolated sections of bedrock, or “floating boulders”, are also a common feature.

3.12 Surface Hydrology

The New River forms the southern and eastern boundary of the Celco Site. The river is used for recreational purposes as well as industrial water supply. There are no known drinking water supply intakes from the New River within a three-mile radius of the facility. Celanese utilizes a river pump house for once-through cooling water in the cellulose acetate manufacturing process. A typical withdrawal rate from the New River is 54 million gallons per day (MGD). Celanese also withdraws approximately 4.07 MGD water from the five active Production Wells. The New River has an average flow rate of 3199.20 MGD (U.S. Army Corps of Engineers [USACE, 2006]) indicating that it is a quick moving river. Celanese typically discharges an average of 68.24 MGD from five outfalls to the New River authorized under a Virginia Pollutant Discharge Elimination System (VPDES) Permit.

The 100-year floodplain is situated at an elevation of 1,564 ft msl, while the 25-year floodplain is situated at 1,555 ft msl according to USACE. The top of the former equalization basin (closed in 1998) located on the south side of the Plant Area along the New River is at an elevation of approximately 1,555 ft msl, therefore, portions of the Plant Area lie within the 25- and 100-year floodplain. The 100-year floodplain boundary is shown on **Figure 3-2**.

There are three on-site stream channels that convey water perennially; one channel originates as groundwater discharge on the mountain side above the Closed Process

Sludge Landfill (CPSL). This perennial flow eventually infiltrates and dries up approximately 1000 feet downgradient of the CPSL and prior to reaching Route 460. The second channel originates offsite and upgradient of the Plant Area and is known as Stillhouse Branch. This stream channel flows west along the north side of Fly Ash Ponds A, B, and C and then turns south and discharges to the New River. The third channel originates at the Outfall 005 Discharge pipe in the southeastern portion of the Landfill Area. This channel flows south toward the New River and frequently dries up before reaching the New River.

3.13 Habitat and Wetlands

Data from the National Wetlands Inventory (NWI) were reviewed in March 2010 to determine if there were any potential wetlands on-Site or in the vicinity of the Site. Based on this review, it was determined there were no significant wetlands on the Celco property and additional wetlands investigations would be undertaken if RCRA activities were going to potentially impact areas of concern. The nearest wetland area identified on the NWI map is approximately 0.25 miles east of the site property boundary. This relatively small area is located immediately adjacent to the New River and is classified as a freshwater forested shrub wetlands as illustrated on **Figure 3-2.**

An ecological survey of the Celco Site was performed in September 2011 (see **Attachment 3-2)**. **Figure 3-4** of the survey depicts the physical location of the areas of observation, and also illustrates distinct areas of vegetative cover type observed during the ecological survey.

The evaluation consisted of driving or walking the main areas of interest on the site and recording observations of flora and fauna and sign of fauna. Specific areas that were evaluated on foot included Stillhouse Branch, most of the property south of the plant toward the New River, the unnamed tributary that flows from the landfill VPDES Outfall 005 down to the New River. Most of the landfill and active areas of the plant were observed from the vehicle.

Specific projects will require and individual review for potential wetlands impacts. As an example, an April 2013 Plant-wide Surface Water Delineation (**2013, 3E Consulting Inc.**) was completed for the Boiler Construction Project to support obtaining a Clean Water Act Permit for potential impacts to waters of the United States.

3.14 Regional and Local Groundwater Use

Groundwater flow regimes in northwestern Giles County are controlled primarily by the geologic structures, by local stratigraphic features such as bedding planes, and by the New River which serves as a regional discharge boundary. Saturated conditions occur locally within the river terrace deposits located along the New River valley floor. Saturated conditions within the underlying Cambrian System carbonate rocks vary with depth based on the maturity of karst features within a particular section of the rock.

Within Giles County, the Celco Site represents one of the largest users of groundwater resources for manufacturing, utilizing several production wells installed in the Knox Dolomite to depths up to 400 ft. Groundwater is also utilized as a source of potable water for the Celco Site and by nearby communities. The Giles County Public Service Authority (PSA) operates two potable wells; PSA001 and PSA004 which are located across the New River from the Celco facility. Each of these water supply wells are screened within the Knox Group aquifer consisting of highly-productive Middle Ordovician limestone and dolomite. Supply wells extend to a minimum depth of 300 ft bgs. Several privately owned domestic wells are located along Route 641 which traverses around the perimeter of the Landfill Area.

Until 1997, Celanese operated six on-site production wells. In 1997, the facility permit was modified to remove one of the wells (i.e., PW010) from the list. The on-site wells used for plant manufacturing and/or potable supply currently include PW007, PW008, PW009, PW011, and PW012 **(Figure 3-2).** Currently Well PW007 and PW009 are permitted for Potable Use. Both wells PW007 and PW009 are sampled per Virginia Waterworks regulations and the results are submitted to the Virginia Department of Health. VOC results for the potable wells have shown a decreasing trend over the last two decades with respect to contaminants and currently remain below drinking water standards. In 2010, the cumulative total average production well pumping rate was approximately 4.07 MGD which is typical and consistent with previous years.

3.15 Site-Wide Groundwater Flow

Groundwater flow across the facility is controlled by geologic structures, by stratigraphic features such as bedding planes and solution cavities, and by the New River, which serves as the local and regional discharge boundary. In addition, groundwater flow across the facility is controlled in the vicinity of the Plant Area by relatively high pumping rates from plant production wells. During 2010, groundwater was withdrawn from five production wells at a cumulative rate of approximately 4.07 MGD. In 2012, the cumulative rate of withdraw from these wells was 4.10 MGD

Groundwater elevations were measured in most of the Celco Site wells during Fall 2011 **(Table 3-1).** Groundwater elevations were plotted for the fall 2011 period, and inferred groundwater contour elevations are presented on **Figure 3-5.** Inferred groundwater contour elevations indicate that the direction of groundwater flow in the vicinity of the Landfill Area is south toward the New River and the Plant Area. The inferred groundwater contours are relatively steep to the north of the southernmost Narrows Fault Branch and then flatten out to the south of the southernmost Narrows Fault Branch. There is a relatively large cone of depression that covers much of the Plant Area resulting from groundwater withdrawal from the production wells. Groundwater within the cone of depression and many areas outside of the cone of depression are ultimately captured by the production wells. Previous site-wide groundwater elevation data (October 1997) indicated that groundwater was mounding as a result of leakage in the vicinity of Fly Ash Ponds 1, 2 and 4. Since Fly Ash Pond 1 was closed and replaced with lined Fly Ash Ponds A, B and C in the early 2000s, groundwater mounding has been less pronounced. The water level in Pond 2 is controlled by a fixed overflow pipe resulting in a relatively constant water elevation in Pond 2.

A conceptual hydrogeologic cross section is presented as **Figure 3-6.** This figure illustrates the inferred direction of groundwater flow across the Plant Area under both pumping and non-pumping conditions. The figure illustrates that when the Production Wells are on that flow between the production wells and the New River is from the river into the site to the production wells. This figure also illustrates that shallow groundwater is either captured by the production wells when they are pumping or it flows laterally to the New River during non-pumping conditions as opposed to vertically into the deeper bedrock.

3.16 Local Groundwater Flow

3.16.1 Landfill Area Groundwater Flow

Groundwater monitoring wells in the area to the north of the northernmost Narrows Fault Branch are screened in the clastic rock zone. The hydrology of the clastic zone is composed of numerous water-bearing zones, which are either partially or completely isolated from one another. The Millboro Shale reportedly contains at least one, and probably more, water-bearing zones. Another major water-bearing unit in the clastic zone is the Rocky Gap Sandstone. This sandstone can be a productive aquifer due to its porous and weathered nature. Because the primary porosity of much of the clastic zone is low and groundwater flow is primarily by secondary porosity (i.e., fracture zones), the overall hydraulic conductivity of the clastic zone is relatively low. The relatively low hydraulic conductivity of the clastic zone is expressed in the steep inferred groundwater elevation contours presented on **Figure 3-5.**

Groundwater to the south of the northernmost Narrows Fault is either located in the clastic zone or slightly weathered Knox Dolomite, depending on the depth. Saturated conditions within the Knox Dolomite vary with depth based on the maturity of karst features within a particular section of rock. This hydrogeologic area has a somewhat higher hydraulic conductivity than the clastic zone to the north, but does not have as high a hydraulic conductivity as the more highly weathered dolomite that is located to the south and beneath much of the Plant Area along the New River valley floor. As a result, as the southern flowing groundwater approaches the more highly weathered Knox Dolomite, the groundwater elevation contours flatten out as a result of the higher hydraulic conductivity.

3.16.2 Plant Area Groundwater Flow

ARCADIS reviewed sample/core logs, well construction details (specifically screened intervals and depth of wells), water-level data, hydraulic head relationships, and used a three-dimensional, steady-state groundwater flow model to characterize the hydraulic conditions across the Celco Site. The groundwater model was first created in 1999 and recently updated in 2012/2013 as part of the RCRA FLP Phase I to expand the model area to the east and to the south across the New River. A discussion of hydrogeologic conditions in the Plant Area based on this comprehensive review is presented below.

Groundwater flow in the Plant Area is controlled by the geology, the New River, and active plant production wells (i.e., PW007, PW008, PW009, PW011 and PW012). Saturated conditions exist within the alluvial deposits and bedrock. Saturated conditions exist intermittently within the unconsolidated deposits based on the degree and location of production well pumping. Even during production well pumpage, the water levels in the shallow Quaternary wells are similar to the water levels in adjacent wells screened in the dolomite. These similar water levels indicate that the two units are either highly connected or that the shallow zone is acting as a leaky unit and has reached steady-state conditions due to the continuous nature of the production well pumpage. These zones then collectively form a water-table aquifer across the plant area.

Historical water-level data indicate that seasonal changes in groundwater elevations and their relation to the elevation of the New River can have a significant, but localized effect on flow directions. During normal flow within the New River the direction of groundwater flow is typically from the Plant Area toward the New River or from the New River into the Plant Area (due to production well pumpage) depending on the location. During periods where the New River is elevated (e.g. after significant rainfall events), the direction of groundwater flow for a short period of time can be from the New River toward the Plant Area within the area immediately adjacent to (i.e. within 75 feet) the New River. In the event that the amount of and/or configuration of pumping the plant production wells were altered, groundwater flow in the Plant Area would be affected. Under non-pumping conditions, groundwater flow would be primarily south towards the New River.

3.17 Influences on Groundwater Elevations and Flow

Groundwater elevations and direction of flow within the Plant Area at the Celco Site could be influenced by the following factors:

- Production Well Operation;
- Precipitation Events; and,
- New River Stage – for wells immediately adjacent to the New River.

Each of these factors is discussed in the following subsections with respect to why groundwater flow and analytical data being presented is representative of typical conditions. In addition, historic groundwater levels prior to production well operation and groundwater drawdown effects are discussed.

3.17.1 Production Well Operation

The five on-site production wells used since 1997 for plant manufacturing and/or potable supply currently include PW007, PW008, PW009, PW011, and PW012 **(Figure 3-2).** Each of these wells ranges from 300 to 400 feet deep and some have multiple screen sections. Currently Well PW007 and PW009 are permitted for Potable Use.

All production/potable wells (7, 8, 9, 11 and 12) are normally in operation continuously, except for planned maintenance, equipment failure or during unplanned power outages. These large diameter wells produce significant quantities of water. In 2010, the cumulative total average pumping rate was approximately 4.07 MGD. In 2012, the cumulative rate of withdraw from these wells was 4.10 MGD

Planned maintenance includes typically shutting down each well once every 1 to 5 years, depending on the well, for 1-2 days:

- Well 8: ~ once/year
- Wells 11 & 12: Every 1-2 years
- Well 7: Every 3-5 years
- Well 9: Every 2-3 years

Equipment failures are unplanned and typically infrequent. Duration of well outages due to failures varies with what repairs are needed, typically lasting only a few days. Some repairs have required outages of longer duration (several weeks), but this is not the norm.

The only time all wells would be out of service would be during unplanned plant-wide power outages, which are also infrequent, and typically of short duration. The exception to this is the February 2010 and January 2012 outages, in which the wells were down for extended periods. During the plant restarts, the wells are brought back on line at different times, with normal plant operations returning within 2 to 4 weeks. In the January 2012 outage, PW007 was put back into operation within a day or two of the start of the outage using a portable generator to power the well pump.

3.17.2 Precipitation and New River Stage

Precipitation data are collected by Celanese at the Celco Plant on a daily basis; data by day and month for all of 2011 is included as **Table 3-2.** The corresponding New River stream flow data are also included in **Table 3-2.** The purpose of these data is to document precipitation events and river stage levels during sampling events.

During the months leading up to September 2011 precipitation was relatively normal. On September 5 and 6, 2011, the plant recorded a total of 3.84 inches of rainfall associated with a tropical storm that moved up the east coast. Prior to this storm event the New River was running at a relatively low level (approximately 1000-3000 cfs) and immediately following this rainfall event the New River crested at approximately 20,000 cfs and returned to normal flow (i.e., 1000-3000 cfs) by November 13. Surface water and sediment samples were collected in the New River between September 21 and September 27, 2011. The New River had returned to pre-storm flow stage following the tropical storm event a full week before the sampling occurred. No other precipitation events were judged to have any adverse impact on the representativeness of samples collected for any of the media being sampled.

3.18 Plant Processes

The Celco Site has been in operation since December 1939 and manufactures fiber-based products including cellulose-acetate flake and filter tow, which is used to make cigarette filters. Raw materials in the formulation of cellulose acetate are cellulose (wood pulp), acetic anhydride, acetic acid, and sulfuric acid. The production area of the Celco Plant is illustrated on **Figure 3-2** which was also provided in the August 2011 RCRA Phase I Work Plan (**ARCADIS, 2011**).

3.18.1 Waste Management Program

Celanese maintains a waste minimization program, which is an on-going process to identify opportunities where waste generation can be eliminated or prevented. Substitutions for certain chemicals and potential new methods that will decrease waste and/or decrease the use of chemicals are periodically evaluated. Plant area engineers are encouraged to minimize wastes.

A major success of the Celanese waste minimalization program was the elimination of benzene from the manufacturing process in 1994, through process changes including the construction of a new anhydride manufacturing unit as part of the Ketene process.

3.18.2 Solid Waste

Celanese manages its wastes in on-site landfills, wastewater treatment operations, surface impoundments, regeneration/recycling and off-site treatment and disposal facilities Most of the Celanese solid waste is disposed in on-site non-hazardous landfills permitted under the Virginia Solid Waste Regulations. A small portion of their solid waste is shipped off-site for proper disposal.

The Permit 207 Landfill is an unlined non-hazardous landfill with active and closed cells. Active cells receive non-hazardous waste and asbestos. Separate closed cells contain fly ash and process sludge (i.e., the CPSL). The Permit 550 Landfill is a double lined non-hazardous landfill with a leachate collection system, which became operational in 1993. This landfill receives non-hazardous waste from plant operations.

Fly ash from the boiler operations is a generated waste stream. Top fly ash from coal combustion is captured on electrostatic precipitators, sent to a dry ash handling system and is trucked to Roanoke Cement, landfilled on-site or landfilled off-site. Sluiced bottom ash is pumped to fly ash settling basins A, B and C located on the western side of the facility. The bottom ash is periodically dredged from these basins and hauled to the ash landfills located on the Celco Site north of the Plant Area. Older areas of fly ash disposal exist at various locations through the Celco Site as explained below.

There are ten waste disposal sites that have been identified within the Plant Site**.** In June 1998, Celanese interviewed Mr. Euk Boggess regarding past disposal practices at the Celco Plant during his employment from 1959 to 1984. The summary presented below of the ten waste disposal areas is based in part on information obtained from Mr. Boggess and from information identified in plant files and maps which corresponds well with the information presented by Mr. Boggess.

- WDA 1 – Fly Ash Material - Formerly Fly ash Pond #3. Closed in 1975.

- WDA 2 – Fly Ash with Residual Brown Sludge (vaporizer waste) - Area was used to temporarily store Brown Sludge. Brown sludge was then pumped out and transferred to the landfill. The area was filled with fly ash and covered with soil. Closed in late 1960's.

- WDA 3 – Fly Ash and Refuse – Filled in and closed in 1967-1968.

- WDA 4 – White Sludge – Buried and closed prior to 1960. Location is approximate. Current use is material/equipment storage.

- WDA 5 – Fly Ash – Shown on Plant Plot Plan N26A-3100B-46 as closed in 1954. Current use is material/equipment storage.

- WDA 6 – Fly Ash - Shown on Plant Plot Plan N26A-3100B-46 as closed in 1954. Current use is material/equipment storage.

- WDA 7 – White Sludge, Bands, Flake, Burnable Trash – Shown on Plot Plan as closed in 1955 containing burnable trash. Current use is material/equipment storage.

- WDA 8 – Brown Sludge – East end of Area 7. Some brown sludge buried at this end. Closed ~ 1955

- WDA 9 – White Sludge, some Fly Ash – Closed white sludge pond A. Open between 1965 and 1967 and closed in 1968-1969.

- WDA 10 – White Sludge, some Fly Ash – used for disposal of white sludge from Pond B and Pond C. Covered in 1965.

Major waste streams in addition to fly ash and WWTP sludge cake historically included white sludge and brown sludge. White sludge consists of cellulose wood fibers and cellulose acetate fines that were historically disposed within basins adjacent to the New River. An improved method for handling this waste stream was developed so that the white sludge waste material can go directly to the landfill without being stored in ponds. This improvement eliminated the need for White Sludge Pond B. White Sludge Pond B was closed in accordance with a VDEQ approved closure plan. Clean closure was achieved in 2006. Brown Sludge is an acetic acid-based material generated from the cleaning of process vessels. Several areas were used for disposal of brown sludge within the Celco Site and are discussed more specifically in the DOCC (**ARCADIS, 2006**).

Other solid waste streams that go to the onsite permitted non-hazardous landfills include wastewater treatment plant (WWTP) filter cake, filter tow, filter pads and filter dressings, scrap wood, paper, and plastic items. Asbestos waste generated from the removal of asbestos containing material within the plant is routinely disposed of on-site in an asbestos permitted landfill and at times is disposed at off-site landfills. Prior to 1991, all asbestos was disposed of at off-site landfills.

The original treatment system at the WWTP utilized an in-ground concrete-lined surface impoundment, designated as the Equalization Basin, and an unlined surface impoundment designated as the Aeration Basin. The Equalization Basin had a one-million gallon capacity and began operation in 1981. The Aeration Basin, which was used to biologically degrade organic wastewater, had a five-million gallon capacity and began operation in 1970. When the Toxic Characteristics rule was promulgated in March 1990, Celanese's wastewater was considered a hazardous waste due to the presence of benzene, which was used in the manufacturing process. Both units stopped receiving waste in 1994 and were clean closed in conjunction with USEPA, VDEQ and in accordance with federal RCRA guidelines in 1998.

3.18.3 Hazardous Waste

The Celco Site was an existing facility when RCRA Subtitle C program became effective in November 1980, which addresses the treatment, storage, and disposal of hazardous waste. In March 1990, when USEPA promulgated the Toxic Characteristics rule, Celanese's process wastewater became a newly identified characteristic hazardous waste due to the presence of benzene. Benzene was phased out of the manufacturing process during 1994.

The Celco Site is a large quantity generator (LQG) (VA005007679) of hazardous waste. Celanese does not have a permit to treat, store, or dispose of hazardous waste and is subject to the less than 90-day generator requirements. Since the late 1980s, Celanese has stored hazardous waste in drums in a curbed contained building located north of the Acetone Recovery Area and south of Fly Ash Pond 4 (**Feuerbach, 1988**). Since 2009, Celanese stores drums of hazardous waste in the Dope Preparation Department which are destined for recycling in this area. Celanese also stores mesityl oxide, a byproduct waste, in a 3000-gallon aboveground storage tank (AST V-1035) on the southwestern side of Building 2 (**Feuerbach, 1988**).

Previously, former less than 90-day hazardous waste area was located east of the current accumulation area. These areas stopped receiving waste in the late 1980s. In August 1997, clean closure status was granted by VDEQ for the interim status hazardous waste accumulation areas (**Hopkins, 1997**). Closure activities are further discussed in the DOCC (**ARCADIS, 2006**).

3.18.4 Chemical Storage

Chemicals are stored primarily in a raised terrace area known as the Tank Farm, located in the southern portion of the Plant Area. This area contains aboveground storage tanks (ASTs) with secondary containment, which hold chemicals used in the manufacturing process. These chemicals include acetic acid, acetic anhydride, methyl ethyl ketone, isopropyl acetate, and cyclohexane. N-hexane and benzene are no longer stored in the Tank Farm.

Historically, some chemicals were stored in underground storage tanks (USTs) within the raised terraced Tank Farm. Celanese closed all known USTs in the early 1990s. In addition, historically Tank Farm chemicals were conveyed to process areas via underground piping. In approximately 2000, all of the Tank Farm underground piping was closed and all chemicals at that time were conveyed in above ground piping.

3.18.5 Process Areas

3.18.5.1 Wastewater Treatment Operations

Wastewater in the Plant Area is collected through chemical process sewers that underlay the main production area and drain to the WWTP, which began operating in 1970. Primary wastewater contributions are from cellulose acetate manufacturing, acetone recovery, acid recovery, anhydride manufacturing, and spill containment areas. Leachate from the Permit 550 Landfill cell(s) is gravity-fed through piping into the chemical process sewer system and is also treated at the WWTP.

River water is pumped from the New River and groundwater is pumped from a series of deep production wells for manufacturing operations (non-contact and contact) at the Celco Site. The average withdrawal rates are: river water (54.00 MGD) and groundwater (4.07 MGD). The average discharge rate from the outfalls is 68.24 MGD. These rates should be considered estimates and are influenced by surface water contribution, water produced in the manufacturing process and variability associated with the methodology utilized to measure flow quantities within the various inputs and outputs. The WWTP has a current capacity to treat 2.2 MGD. Treated wastewater is discharged to the New River via Outfall 003 under VPDES Permit (VA00002999).

3.18.6 Inactive Processes

Since the Celco Plant became operational in 1939, Celanese has modified their waste storage, usage, and manufacturing processes as part of their commitment to improved environmental management practices. Several processes that are no longer active are described below.

In the late 1970s, Celanese initiated a program to inventory equipment containing polychlorinated biphenyls (PCBs) such as transformers and capacitors. In the mid-1980s, Celanese began replacing and/or upgrading PCB equipment with non-PCB dielectric fluids and arranging off-site disposal for PCB-contaminated waste as needed. By the late 1990s, Celanese had upgraded or replaced most of their PCB equipment.

As of 2003, no equipment remained on site, which contained PCBs (other than light ballasts).

Historically, Celanese utilized benzene in the CA production process. Use of this chemical was terminated in 1994 with the startup of a new acetic anhydride unit that is part of the ketene process.

Prior to 1996, Celanese operated two surface impoundments (aeration and equalization basins) as part of the wastewater treatment process. These units were closed under RCRA and replaced with aboveground BIOHOCH reactors, which are a biological wastewater treatment system.

Previously, three ponds (Fly Ash Ponds 1, 2, and 4) were used to settle fly ash from the boilers. These ponds have been closed. New lined fly Ash Ponds A, B and C were constructed in 2004 to receive water from boiler blowdown, coal pile runoff, and wet bottom boiler seals. Prior to 1993, partially stabilized sludge from the process WWTP was conveyed to the fly ash ponds 1, 2 and 4.

Fly Ash Pond 3 is located in the northwestern portion of the Plant Area between Fly Ash Ponds 2 and C. The pond, which was also used for fly ash settling, was closed in 1975 with approximately 67,000 cubic yards of fly ash.

The Area D Waste Disposal Pit is a small area (less than one acre in size) that was located in the eastern portion of the Permit 207 Landfill. This landfill was reportedly used for disposal of oily wastes until the late 1960s.

This area has been investigated because it was identified as a potential source for low parts per billion (ppb)-levels of chlorinated organic constituents detected in deep production wells located downgradient in the Plant Area. Specifically, Celanese initiated an assessment in 1998 as to the potential source(s) of the chlorinated organic constituents detected in the deep production wells. All of the 60+ monitoring wells located within the Plant Area are installed to a depth of less than 100 feet and no chlorinated organics have been detected (except for MP028 and MP043). A groundwater modeling effort was utilized to identify a potential source area location in the landfill area. This analysis suggested that a potential source could exist in the Landfill Area. Through records review and interviews, it was determined that a small basin or trench (referred to as Area D) had existed in the 1950 through 1970s where "liquid" wastes had been disposed. Disposed liquids may have included lubricants and oils. The identified location of Area D was consistent with the model predicted flow pathline results.

During the 2006 DOCC file review, additional information was gathered from Celanese records, which also supports the previous assessment. This information indicated that a portion of the Permit 207 landfill was formerly used by the Virginia Power and Railroad as a landfill. The landfill was primarily used to dispose of fly ash from their power plant. Celanese purchased the land from Virginia Power and Railroad in the late 1950s or early 1960s after they went out of business. A file report indicated that around the same time period, the Virginia Garage disposed of old car parts and miscellaneous material in the same area.

3.18.7 Power Substations and Transformers

The facility utilizes an on-site power plant that burns bituminous coal to produce steam and electricity. The waste streams are handled through the operation of permitted landfills across Route 460 and a 2.2 MGD capacity WWTP. Coal ash is sold to Roanoke Cement as a fill ingredient or is disposed in the on-site or an off-site landfill.

ARCADIS

4. RFI Phase I/IB Implementation

This section details the Phase I and Phase 1B field work completed during between June 2011 and May 2013.

4.1 Supporting Documents

4.1.1 Tables

4.1.1.1 4-1 Phase I/IB RFI Samples by Area and Media

4.1.1.2 4-2 Phase I/IB Analytical Program

4.1.1.3 4-3 Phase I/IB Sampling and Analysis Program

4.1.1.4 4-4 Phase I/IB Well Inspection Survey

4.1.1.5 4-5 Wells Analyzed for Metals

4.1.2 Figures

4.1.2.1 4-1 Phase I/IB RFI Sample Locations (See Figure Roll)

4.2 Summary of Phase I/IB Work Completed

4.2.1 Phase I Field Program

This section summarizes Phase I and Phase IB scope completed. Investigation locations are illustrated on **Figure 4-1**. Phase I/IB activities were implemented between June 2011 and May 2013.

- A well integrity survey was performed to locate and assess the condition of wells planned for sampling during Phase I activities. The results are summarized in **Table 4-4**. Based on this assessment, the following modifications were made:
    - Several wells could not be located; alternate locations were recommended and approved by EPA for sampling

- Two monitoring wells (MP023A, MP077) were removed from the Phase I monitoring program because they were not accessible (MW023A was not field located, MP77 was damaged and dry); other wells near these locations provide representative data on water quality conditions

- One well previously presumed lost (MP044) was field located and deemed suitable for groundwater sampling

- The large well network in the Plant Area was further expanded to include nine new monitoring wells (MP026D, MP041R, MP042R, MP043R, MP119, MP120, MP121, MP122, and MP124). Originally, 13 monitoring wells were planned for installation during Phase I field program. Of the remaining four wells, two wells were later installed during Phase IB field program (MP118, MP125), one replacement well (MP044R) was deemed not necessary because the original well (MP044) was field located during the well integrity survey. The last planned well – MP123 – was not installed because of difficult drilling conditions (loss of circulation) encountered in the field. A shallower well (MP122) was installed at the same location and sampled during the Phase I field program. The boring logs and well construction diagrams are presented in **Appendix A**. Screen intervals are shown in **Table 4-4**.

- New monitoring wells were developed and included in a geodetic survey. Survey data are presented in **Appendix B**.

- Groundwater samples were collected at a total of 74 wells during Phase I field activities. The final list of wells sampled is presented in **Table 4-3.**

  - 9 new plant monitoring wells

  - 42 existing plant monitoring wells

  - 13 landfill monitoring wells

  - 5 plant production wells

  - 2 off-site municipal wells

- An extensive soil and waste characterization program was completed during the Phase I field program. Samples were collected throughout the plant area and in known waste disposal areas for analytical characterization at depths ranging from

0 to 14 ft bgs. Sample locations are shown in **Figure 4-1** and sample depths and analytical parameters are presented in **Table 4-3**. For this data report, soil/waste related data are organized by geographic area:

- o Waste Disposal Areas (WDA 1 through WDA 10, SB001 through SB010 sample series)
- o Fire Training Area (SB31 sample series, MP124)
- o Chemical Sewers (CSB sample series)
- o Plant General – This includes the remaining samples in Corrective Action Zones outside the Waste Disposal Areas, Fire Training Area, and Chemical Sewers

- In the WDAs, a total of 33 borings with at least 63 samples were collected for characterization. Three well locations were placed proximate to waste areas (MP119, MP120 near WDA 7, and MP122 near WDA 10) and are included in the WDA grouping.

- In the Fire Training Area, a total of five borings with at least 5 samples were collected for characterization. One well (MP124) was installed in the Fire Training Area.

- During the Phase I field program, upgrades to one section of the chemical sewer system were being made by maintenance staff, which allowed brief access to collect soil samples in an area that is normally paved and inaccessible. A total of 11 soil samples (CSB-sample series) were collected between June and September 2011.

- A total of 23 additional borings with at least 29 soil samples were collected throughout the remaining plant area locations, which includes locations where the remaining monitoring wells were installed.

- Some soil samples were not installed due to weather or access concerns during the Phase I field program, but were later collected during Phase IB as discussed in the following section

- A site-wide ecological habitat survey and river reconnaissance survey were performed in September 2011. These activities are summarized in Section 8.0 and a supporting photographic log is presented in **Appendix C.** The river reconnaissance involved the collection of 432 probing locations to assess sediment accumulation/steam depth along 17 river transects

- Off-site surface water and sediment samples (RS series) were collected at 17 locations from a section of the New River that borders the Celco Plant. Based on the river reconnaissance survey, removal of six proposed New River sediment/surface water samples (RS005, RS008, RS015, RS016, RS020 and RS021) was discussed and approved by USEPA in September 2011

- On-site surface water and sediment samples (OC series) were collected from Stillhouse Branch and the Eastern Landfill channel. This program included sediment sampling at 14 locations, and surface water sampling at 8 locations. No surface water was collected at the following locations due to dry conditions (OC001A, OC001B, OC001C, OC0010; in addition, three planned surface water samples at OC005A, B, and C were consolidated to one location – OC005 due to limited flow conditions)

- During the Phase I field program, supplemental surface water samples (SW series) were collected along the shoreline bordering the eastern portion of the plant shoreline (WWTP and areas downgradient of Fly Ash Ponds). These samples were collected at the request of VDEQ for ammonia analysis related to the renewal of the 2013 VPDES permit and are included in the Phase I RFI data set.

- Additional water samples were collected at select locations throughout the site, which are referred to as 'other water samples' including the following:

    - The Landfill LF550 layer was inspected and samples were collected from the Leachate (upper drainage layer) and Witness (lower drainage layer) (LE series).

    - A water sample was collected from the outfall in Fly Ash Pond 2 (FL201 sample).

    - A water sample was collected from the end of a discharge pipe in the Landfill Area (Ammonia Flow Pipe, AF sample).

- A field survey of potential seep locations was performed; however, no seeps were identified for potential sampling.

4.2.2 Phase IB Field Program

This section summarizes Phase IB work completed. Investigation locations are illustrated on **Figure 4-1**. Phase IB was implemented in the fall of 2012 based on Work Plan submitted to USEPA in October 2012. See **Table 4-1** which presents a summary of work completed for Phase IB.

- A total of 13 borings (two in WDA 1, three in WDA 3, five in WDA 9 and three in WDA 10) and a total of 26 samples were collected (two per location).

- One soil boring (MP126) was advanced to collect a surface soil, subsurface soil, and groundwater screening sample for VOCs and 1,4-dioxane analysis. Well MP126 was installed at this location. Water levels were collected in surrounding wells to evaluate direction of groundwater flow relative to fly ash basins.

- A total of 10 soil borings were collected at Power Production Area locations. At four locations (SB020, SB021, SB023 and SB024), surface soil samples were collected. At six locations (SB025, SB035, SB036, SB038, SB039 and SB041), surface and subsurface soil samples were collected. Samples were analyzed for the Phase I analyte list.

- Two surface soil samples (SB026A, SB030A) were collected in the Tank Farm where the historical incinerators operated for dioxins/furans analysis. Samples were previously collected for Phase I analyte parameters at these two locations; however, dioxins/furans analysis was not performed.

- Liquid phase hydrocarbon (LPH) has historically been detected at one well (MP035) in the Tank Farm. A sample of the LPH was collected in August 2012 during other routine monitoring activities and submitted for PCB analysis. The intent of this sampling is to assess the presence/absence of PCBs in the LPH.

- Two groundwater monitoring wells were installed at Phase I locations that were not completed during the 2011 mobilization. The first location is MP118, which is between the Fly Ash Ponds and the New River. Previously at this location, soil sampling was performed, but no well was installed. The second location is MP125 in the Power Production Area. Based on discussions with Celco plant personnel, the original location presented in the Phase I Work Plan is located in an area with many underground utilities which prevent a safe well installation. Consequently, this location was moved 400 ft east near the former cafeteria building as illustrated on **Figure 4-1**. A subsurface soil sample was collected during the installation of MP125 at the revised install location. Originally, this subsurface soil sample/well installation was co-located with a surface soil sample (SB021). The surface soil location was collected at SB021 at the original location. Groundwater samples were collected from MP118 and MP125 and analyzed for the Phase I analyte list.

- During Phase I investigation, elevated PCB concentrations were detected in shallow soils in the Fire Training Area (**Figure 4-3**). Additional sampling was performed during Phase IB. Sampling was on an approximate 9 meter grid spacing to further characterize the extent of PCBs. Soil samples were analyzed for PCB Aroclor Compounds using Method 8082A. In addition, samples were analyzed for VOCs and perfluorinated compounds (PFCs) which were also detected in this area. A total of 25 soil borings (22 new locations and three repeat locations SB031A, SB031B, and SB031C) were performed. At the location of the highest Phase IB PCB concentrations (SB031B/BR), multiple samples were collected to 9.5 ft bgs to delineate the vertical extent of PCB concentration greater than 1 mg/kg. At the remaining borings, at least two samples per location were collected. A total of 70 soil samples were collected during Phase IB. The intent of the Phase IB PCB Sampling was to provide a large grid characterization of the horizontal and vertical extent of contamination. It is anticipated that additional characterization will be required for defining area(s) for potential removal and to satisfy regulatory requirements.

- One sub-slab air sample was planned to be collected from beneath the blue building floor (in the Fire Training Area) and analyzed for TO-15 VOCs. The collection of this sample was deferred by Celanese due to concerns with creating vibrations and tripping electrical circuits within the building that power the plant and thereby creating a “plant shutdown” situation. In addition, significant utilities were discovered beneath the floor of the blue building creating health and safety issues with the collection of this sample.

- A groundwater sample was collected from MP124 in the Fire Training Area and the nearest hydraulically downgradient well (MP028) for PFC analysis.

4.2.3 WDA 456 Field Program

- In April 2012, Celanese implemented a geotechnical boring program related to a construction project requiring the installation of a new gas-fired boiler system to replace the existing coal-fired boiler system. Borings were logged for lithologic descriptions and waste observations at the following locations
    - WDA 4 – 11 geotechnical borings
    - WDA 5 – 2 geotechnical borings
    - WDA 6 – 21 geotechnical borings
- Some sections of WDA 456 will be covered with the new process equipment buildings and/or infrastructure. Therefore Celanese chose to expedite the collection of any additional data that may be needed to fully characterize WDA 456 because access to some of these areas may be limited in the future.
- Celanese and USEPA collaborated to identify any additional data collection needs and to ensure personnel and environmental safety.
- Between July and September 2012, additional environmental borings were advanced and soil/waste samples were collected as part of the Phase IB field program as follows
    - WDA 4 – 3 environmental borings
    - WDA 5 – 6 environmental borings
    - WDA 6 – 3 environmental borings
- In April-May 2013, four piezometers (PZ004A, PZ004B, PZ004C and PZ004D) were installed in WDA 4 to monitor water-levels and assess the separation distance between the bottom of waste and the water table
- Numerous phases of investigation were completed and data packages were submitted to USEPA during the period May 2012 through April 2013. WDA 456 work performed was transmitted to USEPA in numerous data packages which were submitted on the following dates:

- May 30, 2012
- June 1, 2012
- June 27, 2012
- July 20, 2012
- September 20, 2012
- October 1, 2012
- December 3, 2012
- December 21, 2012
- February 2013
- March 2013 – WDA 78
- March 2013 WDA 456 Piezometers
- April 2013 – WDA 456 Well Install/Monitoring Program
- May 2013 – P6R Transducer Install
- June 2013 – WDA 456 Well Install

4.2.4 RFI Analytical Program

Environmental and geotechnical samples collected during the Phase I and Phase IB field program were submitted to Test America (TA) -Pittsburgh for analysis in accordance with the approved work plan (**ARCADIS, 2011**). For some analyses, samples were shipped to other Test America laboratories based on method requirements as follows: TA-Denver (PFCs), TA- Knoxville (dioxins/furans), TA-Savannah (TPH, glycols), ammonia (Pittsburgh or Buffalo), and TA-Mobile (acetic acid).

Level IV data deliverables were provided for RFI analytical data. Electronic copies of analytical reports are presented in **Appendix D**.

Data validation was performed by Laboratory Data Consultants (LDC) in accordance with RFI Work Plan. Electronic copies of validation reports are presented in **Appendix E**. Data quality was assessed through the review and evaluation of field sampling activities and quality control (QC) samples and data associated with the chemical analytical results. Overall, the analytical data for the Site were considered usable for the intended purpose.

4.3 Data Collection Observations

- Environmental data were considered usable for their intended purpose based on independent data validation

- For a limited number of groundwater samples (6 of 74 sampled), only dissolved metals analysis was performed instead of total metals analysis. Four of the six wells have high turbidity even after attempts to “develop” the well so the total metals analysis results, had they been performed, would likely have been adversely affected by the presence of significant suspended solids. The relatively few locations where total metals data was not collected is not expected to have a substantial impact on data quality nor the assessment of risk at the site as a whole (**Table 4-5**).

- Phase I data deficiencies were addressed in Phase IB – missing data from Phase I Work Plan was collected during the Phase IB field program.

- Deeper well at MP123 was not installed due to loss of circulation during attempted well installation during the Phase I field program. Environmental data collected from co-located well MP122 indicates this location is adequately characterized and represents a sufficient location for WDA 10 monitoring purposes. Installation of MP123 is not proposed. MP77 was not sampled due to well damage – this well is hydraulically upgradient/side gradient to WDA10 and would not yield valuable information with respect to potential releases associated with WDA10.

5. Conceptual Site Model (CSM) Information

5.1 Supporting Information

5.1.1 Figures

5.1.1.1 5-1 Groundwater Elevations– Fall 2011(repeat of Figure 3-5) (See Figure Roll)

5.1.1.2 5-2 Celco Production Wells Conceptual Cross-Section (repeat of Figure 3-6)

5.1.1.3 5-3 Aerial View Conceptual Site Model

5.1.1.4 5-4 Conceptual Site Model for Potential HH Receptors – Celco Plant 2013

5.2 CSM Overview

- The Celco Plant is situated on a river terrace of the New River between two ridges with significant topographic relief.

- The New River represents a regional discharge boundary for groundwater discharge. **Figure 5-1** depicts that the direction of groundwater flow as measured in the fall 2011. Groundwater flow on the Celco Side of the New River is primarily south toward the New River. A large portion of groundwater flow is captured by the Celco Production Wells.

- **Figure 5-2** illustrates a cross section view of groundwater flow constructed based on geologic information, measured water levels and the groundwater flow model. **Figure 5-2** illustrates how the Celco production wells and the Giles County municipal wells are believed to be pulling water from the New River in addition to groundwater.

- The current CSM does not indicate that groundwater flow beneath and across the width of the New River is occurring. The potential for groundwater to flow beneath the New River and potentially impact the Giles County municipal wells does not exist during both pumping and non-pumping scenarios.

5.3 Primary Source Areas and Release Mechanisms

- **Figure 5-3** illustrates the location of current and historical source areas that are currently and/or have historically contributed constituents to various environmental pathways.

5.3.1 Plant Area

- Liquid Chemicals are stored in Tank Farm Area
  - Releases to the surface and subsurface have occurred.
  - Storage tanks and distribution pipelines are currently all above ground surface thereby minimizing if not eliminating the potential for significant subsurface spills/releases.
- Manufacturing wastes have been buried in the plant area in unlined areas.
  - Buried materials are not RCRA characteristically hazardous wastes (i.e.>TCLP Limits), with exceptions noted in WDA 3 (benzene) and WDA 9 (benzene).
  - Plant area wastes buried in unlined areas (e.g., WDAs 1, 2, 3, 4, 5, 6, 7, 8 and 10) can interact with infiltrating water which can migrate downward to groundwater. WDA 9 is lined with a thin polyethylene liner.
  - Many waste areas have been in-place & degrading for 50 plus years – materials are weathered and potential release to groundwater is not anticipated to get worse.
  - It is not completely evident without investigative data that ground water remains below the bottom of waste in all the plant landfill cells.
- Historical spills/releases that occurred have been contained and captured in the vast majority of cases.
  - Some releases have gone to the New River.

- Potential for chemical sewer system leakage to the subsurface
    - The original chemical sewer was constructed of terra-cotta pipe with all or some sections of pipe fully encased on concrete, which reduces the potential for releases
    - The sections of the chemical sewers subjected to wear have been replaced with steel pipe or have been lined to reduce the potential for future releases.
    - Groundwater monitoring data do not suggest that there have been significant historical releases from the chemical sewers
- Coal Storage Pile is potential source area – will be removed in near-term following completion of Boiler MACT project.
- Surface runoff is controlled by storm water management systems which are regulated by VPDES discharge permits.
- No evidence that Air emissions have created environmental issues.
- Vapor Intrusion is not anticipated to be a significant issue given the infrequent detections and low concentrations of VOCs observed in Plant Area soils and groundwater.

5.3.2 Landfill Area

- LF550 waste disposal areas under control
    - LF550 is double lined landfill – no release mechanism
- LF207 waste disposal areas are unlined and capped with soil
    - LF207 Cells are built over thick clay sequence preventing downward migration – LF207 is monitored & no releases to groundwater observed.
    - The 24-inch diameter Pipe beneath Area B contains ammonia nitrogen which discharges to storm water basin (Outfall 005) &

drainage channel to New River. The June, 2013 VPDES permit includes an ammonia discharge limit in the permit.

  - LF207 Area D Pit received oil and liquid chemical wastes. Potentially represents historical/current source of CVOCs detected in Celco Production Wells. The Production Wells CVOCs concentrations have been decreasing substantially for the past 20 years indicating that the slug of contaminants placed in area D over 50 years ago has peaked with the tail still present showing sporadic low level detections below drinking water standards in some production wells.

  - CPSL is Corrective Action Module XIV in LF207 Permit – Monitored Natural Attenuation (MNA) is limiting plume migration

5.4 Secondary Source Areas

5.4.1 Plant Area

- Affected groundwater is a secondary source area.

- VOC emissions from soil/waste and/or groundwater is not expected to be major concern given relatively low concentrations of VOCs

- Surface runoff is controlled by storm water management systems which are regulated by VPDES discharge permits

- Plant wastewater is treated (as necessary) and regulated by VPDES discharge permits

5.4.2 Landfill Area

- Permit 207 Landfill

  - Groundwater beneath historical pit in Area D affected

  - Regulated discharge of ammonia in storm water pipe flow has been incorporated into the June, 2013 site VPDES permit.

- Surface runoff is controlled by storm water management systems which are regulated by VPDES discharge permits

5.5 Migration Pathways and Exposure Potential

5.5.1 Soil and Waste Disposal Areas

- Most plant area soil is covered (i.e., macadam, gravel, grass or buildings).
  - o Exposure to surface and subsurface soil is limited under current conditions.
  - o Some waste disposal areas (e.g., WDA 6) have limited areas of waste exposed at surface.
- Limited soil and waste runoff from Plant Area or Landfill Areas to onsite streams or New River is expected
  - o Both Plant Area and LF Area maintain sediment and erosion control features.
- Seepage of water through surface and subsurface soil and waste materials to groundwater does occur, although the downward rate of migration is relatively slow due to the impermeable cover materials (at some locations) and the fine-grained nature of the site soils.

5.5.2 Surface Water / Sediment

- Stillhouse Branch and Eastern landfill channel discharge to New River
  - o Surface water and sediment transport (e.g. to the New River) can occur in these channels.
  - o Contribution of sediment to these two channels from site runoff is minimal.
- Exposure to surface water and sediment can occur.

5.5.3 Groundwater

- Groundwater discharge to Stillhouse Branch is minimal if it even exists
    - Stillhouse branch was rerouted – local subsurface flow (north to south) seeps into Pond 2 which was original direction of flow.
- Groundwater discharge to the onsite landfill channel has not been observed
    - Channel loses groundwater and dries up most of the year
    - Discharge from Outfall 005 controls channel flow
- New River serves as regional groundwater discharge boundary under non-pumping conditions, while under pumping conditions, New River is potential recharge boundary as shown on **Figure 5-2**
- Groundwater does not flow beneath New River under pumping or non-pumping conditions
- Groundwater discharge to New River is primary groundwater flow path from both Landfill and Plant Areas
- Celco Production Wells create cone of depression and capture a large portion of Plant Area groundwater preventing discharge directly to New River.
- Western portion of plant area is not affected by Celco Production Wells.
- Residential wells do not influence the direction of groundwater flow in the plant area, the landfill area, nor on the other side of the New River.
- The Giles County Municipal wells influence direction of groundwater flow locally but do not influence or capture groundwater beneath the Celco Site when Celco Production wells are not pumping or are in operation.

5.6 Site Improvements

- Numerous environmental projects completed in the last 20 years have resulted in an elimination or significant reduction in source areas and contaminant migration pathways.

    - Tank Farm underground tanks were removed/closed, underground chemical distribution lines were closed and all distribution lines are above ground – potential subsurface releases have been eliminated.

    - Chemical sewer integrity inspections have been performed and sections of the chemical sewers subject to wear have been replaced/relined minimizing the potential for subsurface releases.

    - Pond C was lined.

    - Pond B waste material has been removed and the area was cleaned closed under VDEQ direction/oversight.

    - CPSL has been capped and surface migration of leachate has been eliminated.

    - Fly ash from Pond 2 was removed and Pond 2 was clean closed in 2007.

    - Fly ash from Pond 2 was consolidated in Pond 4, which was then capped and closed in 2007.

    - Unlined Pond 1 was replaced with Lined Ponds ABC; Lining of Ponds ABC serves as impermeable cap for Pond 1 fly ash not removed.

    - Coal storage pile will be eliminated when the boiler project is complete

5.7 CSM Data Observations

- Air Media - no subsurface air samples have been collected (during the RFI field work) to demonstrate and confirm lack of Vapor Intrusion Issue

- Deep zone water quality

- Current Production Well Sampling approach (wells turned off) will provide valuable data for assessing deep zone water quality and the potential adverse impact (i.e. contaminant concentration bias) of collecting production well samples while the pumps are operating.

- All likely upgradient sources of contamination have been in existence for multiple decades and are stable or improving.

- Deep zone water quality data would not likely change outcome of groundwater model or risk assessment. – flow/discharge is to New River which is the major risk exposure point.

- Existing and likely final remedy for groundwater (production well pumping) would not likely change with additional deep zone info.

- Regardless of additional deep zone data, discharge still remains the New River which has been characterized and New River does not appear adversely impacted by Celco groundwater.

- New River does not appear adversely impacted by Celco Site, but analysis of risk needs to be completed to verify.

- Water level measurements in the Giles County Municipal wells are planned to be collected as part of Phase II Investigations to verify the groundwater model assumptions. However, actual water level data are not expected to change interpretation of model results.

6. Groundwater Modeling

6.1 Supporting Documents

6.1.1 Attachments (on CD)

6.1.1.1 6-1 2013 Groundwater Model Report

6.1.1.2 6-2 March 22, 2013 USACE Comments on Groundwater Model

6.1.1.3 6-3 April 18, 2017 USEPA Comments on Groundwater Model

6.1.1.4 6-4 July 2013 Response to USEPA Comments on Groundwater Model

6.2 Summary of Work Completed

- The groundwater model was updated during 2012/2013.
  - The Model boundaries were expanded to the south side of New River to include southern recharge to the New River and to the east to include residential wells (**Figure 1** in **Attachment 6-1**)
  - The groundwater Model was deepened to a depth equivalent to the deepest Celco Production Well.
  - The Model was divided into 3 layers, shallow, mid and deep.
    - Layer 1 – 0 to 100 ft. bgs (K= 0.36 to 15 ft/day)
    - Layer 2 – 100 to 186 ft. bgs (K=50 ft/day)
    - Layer 3 – 186 to 411 ft. bgs (K=50 ft/day)
  - Incorporated 2 Giles County “deep” Municipal Wells on south side of New River.
  - Domestic Wells were incorporated on the east side of LF207/550 and on south side of New River.
  - Flow paths were created with pumping and non-pumping scenarios.

6.3 Overview of Groundwater Model Results

- The 2013 groundwater model with expanded boundaries more accurately represents Site conditions compared to the 1999 Draft Groundwater Model.
- A high degree of calibration was achieved for the 2013 groundwater flow model.
- Domestic wells are not affected by the Celco production wells.
- Celco production wells capture groundwater flow over a large portion of the plant during pumping operations.
- Groundwater flow from the Landfill Area is to the mid to deep zone and then to production wells during pumping and to river during non-pumping. Discharge during non-pumping is at the middle of the river up through three model layers.
- Groundwater flow from the plant area is either to the pumping capture zone or New River.
- Flow beneath 1950s waste disposal areas is down through upper and into the middle model layers and into the New River.
- Hydraulic capture analysis for the Celco production wells and Giles County municipal wells indicate that no constituents from the Celco Site are predicted to migrate to the municipal wells irrespective of the operational status of Site production wells.

6.4 Data Observations

- Current information regarding domestic well locations, depths, and status is limited:
    - Existing map prepared by Westinghouse is dated and source of information is not verifiable and Giles County well information from database not useful for identifying and/or locating domestic wells – did not start keeping records until late 1990s.
    - More accurate domestic well information would not change the lack of impact by residential wells

- The groundwater flow model calibration on the south side of the New River could be reinforced by inclusion of water levels from active municipal pumping wells
    - Giles County has recently concluded that municipal wells are accessible for collecting water levels and water levels will be collected as part of Phase II Investigations.
    - Measured water levels would not be expected to change interpretation of model results as it relates to potential for Celco to impact offsite locations under pumping or non-pumping conditions.

6.5 Proposed Phase II Work

- Limited additional groundwater modeling work is proposed.
    - The groundwater model will be updated to include water levels from the Giles County Municipal Wells once they are obtained.
- The County collects transducer data in one well but reportedly this transducer is not calibrated to mean sea level or any documented datum. Celanese will attempt to have this transducer surveyed to the Celco Plant datum, so that real-time water level data can be obtained.

7. Constituent Screening Analysis

7.1 Supporting Documents

7.1.1 Tables

7.1.1.1 7-1 Identification of COPCs and COEPCs - Summary List by Media

7.1.2 Attachments (on CD)

7.1.2.1 7-1 May 2013 Risk Screening Results Memorandum and Tables

7.1.2.2 7-2 May 2013 Risk Screening Level Update Memorandum

7.2 Summary of Work Completed

- All Phase I data screened against USEPA Work Plan approved Human Health and Ecological Screening Criteria using December, 2011 criteria. A memorandum describing screening process and results is included as **Attachment 7-1**.

- **Table 7-1** provides a summary of the COPCs and COPECs by media and/or sample location (based on the Phase I data).

- Screening levels were updated by USEPA in December 2011 and the original August 2011 Work Plan listed screening levels from an earlier version. **Attachment 7-2** provides a summary of the screening level changes since the data were screened using the December 2011 screening levels. This analysis indicates minimal and insignificant impact on the data evaluation and usability with respect to the screening analysis performed and for assessing Phase II data collection needs.

- Phase IB data was screened against criteria, but the **Attachment 7-1** tables and computations and list of COPCs (**Table 7-1**) do not include the Phase IB data screened against criteria.

    - Phase IB data results are quite similar to all other Phase I sample results and are potential COPC differences not judged to be significant for purposes of identifying data deficiencies for Phase II data collection.

  - o The Screening analysis and list of COPCs will be updated to include Phase IB data and most current screening criteria when the site-specific risk analysis work is initiated.

- Screening tables separated by media and divided into Human Health and Ecological

- Evaluation Screening tables and figures separated by media only

7.3 Overview of Screening Results

- A COPC or COPEC is a constituent with one or more detected concentrations exceeding the selected risk-based screening levels.

- Exceedance of a screening level indicates that the COPC/COPEC needs to be carried forward in the site-specific analysis to determine whether an unacceptable risk has been identified.

- Ammonia data were evaluated on a sample by sample basis with each result compared to the VDEQ chronic freshwater ammonia criteria (early life stage fish present) using sample specific temperature. None of the ammonia results for surface water exceeded either the published or calculated (for temperatures above the published values) chronic criteria. These results are discussed in more detail in **Section 11** entitled Ammonia Results.

7.4 Data Observations

- Soils were collected from adequate depths for evaluation of risk estimates for both human receptors (i.e., 0 to 10 feet) and ecological receptors (0 to 0.5 feet). A review of the data indicates that COPCs/COPECs were widely detected above screening levels across the site and were not limited to any particular depth interval. Based on these considerations no apparent data deficiencies for soil have been identified.

- While several inorganic COPCs were identified in groundwater, the number of locations where COPCs were identified was greatly reduced when comparing total exceedances to dissolved exceedances. The number of actual exceedances of identified organic COPCs was very low. An extensive groundwater monitoring well network is already in place at the Site. Based on these considerations no apparent data deficiencies for groundwater have been identified.

- New River – Some COPCs/COPECs in sediment were detected at concentrations above screening levels in all samples collected from the New River including the upstream locations which are considered to be indicative of background conditions. The greatest number of SVOC COPCs and the highest associated detected concentrations were all from RS017 which appears to be well delineated by RS018 and RS019 downstream as well as RS010 - RS014 samples upstream. Additionally, given the nature of the substrate (cobble/rock) and the lack of true sediment, it is unlikely that additional sampling locations could be identified or would provide much value.

- Eastern Unnamed Tributary – COPCs/COPECs in sediment were detected in the samples closest to the confluence with the New River. Very few COPCs were identified in samples collected upgradient. Additionally, given the nature of the substrate (cobble/rock) and the lack of true sediment, it is unlikely that additional sampling locations could be identified or would provide much value.

- Stillhouse Branch – Similar to the Eastern Unnamed Tributary the majority of detected COPCs/COPECs exceedances in sediment were noted in samples closest to the confluence with the New River. A few COPCs/COPECs were however detected in OC010 (all metals) which is the furthest upgradient sampling location. It should be noted that COPCs/COPECs identified in OC010 were limited to a few metals, the concentrations of which appear to be consistent with naturally occurring background/ambient concentrations. Background concentrations are not used for elimination of COPCs/COPECs but can be used to characterize exceedances.

- New River – Very few COPCs/COPECs were identified in the New River surface water. The majority that was identified had low frequency of exceedances or were metals that were also present in sediments and appear to be the result of naturally occurring background concentrations. Based on these considerations no apparent data deficiencies for surface water have been identified.

- Eastern Unnamed Tributary – Only 3 COPCs/COPECs in surface water, all metals, were identified in surface water from the Eastern Unnamed Tributary. The highest concentrations were detected in OC004 which is the furthest upgradient sample. No sampling locations further upgradient of this point were identified during the field reconnaissance. Based on these considerations no apparent data deficiencies for surface water have been identified.

- Stillhouse Branch – Only 2 COPCs/COPECs, all of which were metals, were identified in surface water from Stillhouse Branch. OC009 had the highest detected concentrations. Stillhouse Branch is an intermittent stream that was dry at OC010 which is upgradient of OC009 therefore it is unlikely that additional samples could be collected. Based on these considerations no apparent data deficiencies for surface water have been identified.

8. Surface Water & Sediment Results

8.1 Supporting Documents

Complete analytical results are presented in **Appendix F.**

8.1.1 Tables

8.1.1.1 8-1 Sediment Grain Size Results, Phase I RFI

8.1.1.2 8-2 On-Site Surface Water Detections, Phase I RFI

8.1.1.3 8-3 On-Site Sediment Detections, Phase I RFI

8.1.1.4 8-4 New River Surface Water Detections, Phase I RFI

8.1.1.5 8-5 New River Sediment Detections, Phase I RFI

8.1.2 Figures

8.1.2.1 8-1 Surface Water Screening Results (See Figure Roll)

8.1.2.2 8-2 Sediment Screening Results (See Figure Roll)

8.1.3 Attachments

8.1.3.1 8-1 071712 Sediment & Surface Water Results Memorandum

8.2 Summary of Work Completed

- New River field reconnaissance - early September 2011
- New River surface water/sediment sampling – mid September 2011
- Shoreline surface water sampling (ammonia only) – mid September 2011
- On-Site stream channel surface water/sediment sampling – mid October 2011.

- Sample methodology and results presented in technical memorandum included as **Attachment 8-1**.

8.3 Overview of Sediment/Surface Water Results

8.3.1 General

- The sediment and surface water detections are listed in **Table 5-1.**

- Sediment detections include VOCs, SVOCs, metals, ammonia, and others.

- Surface water detections include VOCs, SVOCs, metals, ammonia and others.

8.3.2 Sediment

- Performed sediment probing at 432 locations.

- Hazardous (i.e., high energy stream flow) areas included approximately 31.4 acres (23.6%) of the investigation area. Due to the high water velocities in these areas, and confirmed by visual observations, it was concluded that no appreciable sediment deposits exist in this area. For health and safety purposes, these areas were deemed inaccessible for further reconnaissance and investigation activities.

- No measureable sediment was observed at 292 of 432 (67.6%) of the probing locations

- Sediment measurements of 0.1 and 0.2 ft were observed at 57 of 432 (13.2%) of the probing locations

- Sediment thickness of 0.5 ft or greater were observed at 82 of 432 (19%) of the probing locations

- The presence and thickness of sediments was more prominent adjacent and closer to the shoreline than in the middle of the river.

- Sediment sampling activities in the New River commenced on September 20 and were completed on September 27, 2011. Surface Water and Sediment samples were successfully collected from all 17 planned sampling locations during that time.

- The screening evaluation identified a number of metals and PAH compounds that exceeded screening levels. This data, along with Ammonia Nitrogen, were further reviewed for spatial trends to evaluate if the elevated concentrations were the result of upstream influences or possible site activities.

- None of the sample locations exceeded the Total PAH concentrations of 4.0 mg/kg which is a common indicator for screening of sediments. However, relatively higher PAH concentrations in sediment at OC009 may indicate site contributions to the New River

- Ammonia Nitrogen (**Figure 11- 3**) was detected in both tributaries bounding the site and in locations adjacent to the site, but not upstream of the site. Metals in sediment are generally consistent upstream downstream and adjacent to site

8.3.3 Surface Water

- Surface water results exhibited more variability in distribution patterns than for sediment – see **Attachment 8-1** for details

8.4 Data Observations

8.4.1 Sediment

- The sediment data set in the vicinity of the Site should be considered complete since it targeted all of the few areas of sediment accumulation identified during the reconnaissance.

8.4.2 Surface Water

- The surface water dataset collected should be considered complete for evaluation purposes. It targeted areas on both sides of the river and along the length of the Site.

- Additional data from upstream of the site as well as discharge information from the Giles County WWTP (surface water and sediment) would be helpful in building an argument for potential non-site related constituents. The need to complete these additional data collection tasks will be considered further pending the results of the Site-Wide Risk Assessment.

- Ammonia in surface water from the landfill is not having a measurable impact on the New River

8.5 Proposed Phase II Work

- Obtain discharge water quality info from Giles County WWTP

9. Groundwater Results

This section presents the groundwater analytical results for the Phase I/IB field program. Chlorinated VOC and ammonia detections in groundwater are also discussed in more detail in Section 10 and 11, respectively.

9.1 Supporting Documents

Complete analytical results are presented in **Appendix F.**

9.1.1 Tables

9.1.1.1 9-1 Groundwater Analytical Detections (pdf only provided on CD)

9.1.1.2 9-2 Groundwater PCB Homolog Detections – Phase I/IB RFI

9.1.2 Figures

9.1.2.1 9-1 Plant Area Groundwater Screening Results Organics (See Figure Roll)

9.1.2.2 9-2 Plant Area Groundwater Screening Results Inorganics/General Chemistry (See Figure Roll)

9.1.2.3 9-3 Landfill Area Groundwater Screening Results Organics (See Figure Roll)

9.1.2.4 9-4 Landfill Area Groundwater Screening Inorganics/General Chemistry (See Figure Roll)

9.2 Summary of Work Completed

- Phase I groundwater sampling was performed between October 2011 and February 2012, including:
    - 71 wells were sampled including 42 Plant monitoring wells, 13 Landfill monitoring wells, 5 on-site production wells, and 2 off-site municipal wells. Additional parameters were included in the analysis at specific locations as noted below.

- Full suite parameters at 70 of 71 locations; VOCs/CVOCs only at LF013.
- PFCs were analyzed at MP124.
- Chlorides were analyzed at several wells near WWTP.
- Glycols were analyzed at several wells near boiler house.
- Pesticides/Herbicides were analyzed at MP119 near fence line.
- TPH GRO/DRO was at several locations near Tank Farm.

- Phase IB groundwater sampling was performed November 2012
  - 3 new monitoring wells (MP118, MP125, and MP126) and 4 existing monitoring wells (MP028, MP117, MP124, and P003R) were sampled for various parameters.
  - Full Suite - MP118, MP125.
  - VOCs/SVOCs only - MP126, MP117, P003R.
  - PFCs only – MP124, MP028.

9.3 Data Observations

9.3.1 Plant Area Monitoring Wells

- Chlorinated VOCs were detected above screening levels in the vicinity of the Fire Training Area and north of WDA 1, which are further discussed in Sections 10 and 16.
- Benzene was detected above the primary MCL of 5 ug/L at MP82 (190 ug/L), which is located in an area with historical but decade long decreasing benzene impacts (**Tables 9-1** and **Figure 9-1).**
- SVOCs were detected above screening levels, primarily PAHs and 1,4-dioxane.

- Low-level detections of PFCs were noted at MP124 in the Fire Training Area, which are discussed separately in Section 16.

- TPH-DRO was detected above the VDEQ groundwater standard of 1 mg/L at three locations close to each other in the tank farm area (MP100 – 71 mg/L, MP067 – 3.9 mg/L, and MP035R – 10 mg/L); separate phase hydrocarbons were observed at MP035 (0.02 ft thickness).

- PCB Homologs were detected at several locations in the vicinity of the Tank Farm. Detections at MP35R and MP100 were greater than the primary MCL of 0.50 ug/L (**Table 9-2** and **Figure 9-1**).

    - Trichlorobiphenyl (1) - 0.93 J ug/L (MP100)

    - Dichlorobiphenyl (2) - 42 ug/L (MP100), 0.61 J ug/L (MP035R)

    - Monochlorobiphenyl (1) - 50 ug/L (MP100)

    - PCB homologs were not detected in separate phase product at MP035

- Several metals were detected at concentrations greater than screening levels and were generally more concentrated in the southeast portion of the Celco Plant (in the vicinity of the Tank Farm and White Sludge Area) (**Table 9-1** and **Figure 9-2**)

    - Arsenic was detected at concentrations greater than the primary MCL of 10 ug/L at 7 locations with a maximum detection of 38.1 ug/L at MP106

    - Detections of barium (3), lead (1), and mercury (1) also exceeded the primary MCL

    - Detections of iron, manganese, and aluminum exceeded secondary MCLs

    - Hexavalent chromium was detected at 8 locations above the Tap water RSL with a maximum concentration of 37.2 ug/L at MP122

- Ammonia was detected above the VDEQ groundwater standard of 0.025 mg/L at several locations in the vicinity of Fly Ash Ponds; the maximum detection was 7.9 mg/L at MP84

- Chloride was detected at 11 locations above the VDEQ SL of 25 mg/L, but no locations were greater than the secondary MCL of 250 mg/L

- Cyanide detected at 6 locations greater than the Tapwater RSL, but concentrations were less than the primary MCL of 200 ug/L

- Glycols were not detected, pesticides/herbicides were not detected at MP119

9.3.2 Landfill Area Monitoring Wells

- Chlorinated VOCs were detected above screening levels, primarily at LF97B;

    - Detections of 11-DCE and methylene chloride exceeded primary MCLs

    - Highest detections were noted for 11-DCA (280 ug/L), which does not have an established MCL

- SVOC detections included PAHs and 1,4-dioxane; low-level PAHs were detected at LF086, which is a hydraulically upgradient background monitoring well

- PCB homologs were not detected

- Iron, manganese, and aluminum were detected above secondary MCLs

- Mercury was detected above the primary MCL at LF90

- Hexavalent chromium was detected above the Tapwater RSL at LF97B (7.2 ug/L)

- Ammonia was detected above the VDEQ groundwater standard of 0.025 mg/L

- Low concentrations of chloride, nitrate, sulfate, and TOC were detected

9.3.3 Celco Production Wells

- PCE was detected at concentrations greater than the primary MCL at PW008 (38 ug/L), and PW011 (5.2 ug/L); trace detections of other chlorinated VOCs (TCE, cis-12-DECE, 11-DCA, 11-DCE) were noted at PW007, PW008, and PW011

- SVOC detections included low concentrations of PAHs (PW011) and 1,4-dioxane (PW008)

- Several metals (arsenic, iron, lead, copper, manganese, and thallium) were detected at concentrations greater than screening levels

  - Lead was above the primary MCL (treatment action level) of 15 ug/L (PW012 – 32.8 ug/L)

  - Manganese was above the secondary MCL of 50 ug/L (PW009 – 146 ug/L)

  - Iron was above the secondary MCL of 300 ug/L (PW008 – 414 ug/L, PW012 – 565 ug/L)

- Ammonia detections were greater than the VDEQ groundwater standard of 0.025 mg/L at PW007 (0.34 mg/L), PW008 (0.65 mg/L), and PW009 (0.43 mg/L)

9.3.4 Giles County Municipal Wells

- All data collected from Giles County Municipal Wells was shared with Giles County.

- No VOCs, PCBs, glycols, hexavalent chromium, or ammonia were detected

- SVOCs, metals, and cyanide were detected, but concentrations were less than primary MCLs

  - Benzo(a)fluoranthene was detected above the Tapwater RSL (0.029 ug/L) at PSA004 (0.46 ug/L)

  - Aluminum was detected above the secondary MCL of 50 ug/L at PSA001 (57.1 ug/L)

  - Cobalt, thallium, and cyanide were detected above the Tapwater RSL at PSA001

9.4 Summary and Data Observations

- Groundwater sampling of plant monitoring wells is representative of shallow to intermediate groundwater quality [with screened intervals ranging from approximately 7 to 12 ft bgs (MP20) to 95 to 100 ft bgs (MP024) across the Celco Plant].

- Groundwater sampling of plant production wells and off-site municipal wells is considered representative of deeper groundwater quality [with screened intervals ranging from 200 to 278 ft bgs (PW012) to 300 to 400 ft bgs (PW008)]. Testing of Production Well sampling with pumps on and pumps off is scheduled to be completed during July 2013 to further evaluate the potential effects of pumping on groundwater quality sampling.

- Celco production wells had a few detections slightly above the primary MCLs (PCE in wells PW008 and PW011; and, lead in PW012)

- Giles County municipal wells had no MCL exceedances

- Very few VOC detections across site suggesting minimal if any Vapor Intrusion issues

- LF097B (LF Area D) could be current/historical source area for plant area CVOCs

    - 2011 results appear higher than 2001

    - Likely variability associated with low producing well that has only been sampled 2 times – resampling is warranted to confirm results at this location

- Highest concentration of metal detections are clustered in Tank Farm and southeast corner of plant

    - Waste material in bottom of WDA 9 is highly acidic

    - Metals could be naturally occurring and/or liberated by organic acids

- CVOCs, Fire Training Area are addressed in more detail in a separate section

- Separate Phase Hydrocarbons continue to be identified and removed from Tank Farm Area well (MP035) although the hydrocarbon layer thickness and recovery has been reduced and is minimal.

- Pesticides/Herbicides and glycols should be removed from future sampling due to non-detects

- Groundwater in western portion of Celco plant discharges to the New River

    - New River sampling results indicated minimal impacts to the New River

    - Groundwater concentrations are expected to improve (not worsen) with time given the age of waste placement

9.5 Proposed Phase II Work

- Sample PW008 during 2013 well shutdown to evaluate deeper aquifer zone concentrations during non-pumping conditions. Sample select other production wells in like manner if feasible.

10. Chlorinated VOCs in Groundwater

This section presents a more-in depth discussion of historical low-level chlorinated VOC detections in the plant production wells and a summary of the extent of chlorinated VOCs detected during the Phase I/IB investigation.

10.1 Supporting Documents

10.1.1 Tables

10.1.1.1 10-1 Historical Groundwater Results – Production Wells (pdf only provided on CD)

10.1.1.2 10-2 Phase I RFI Potable Well Groundwater Results

10.1.1.3 10-3 CVOC and 1,4 Dioxane Detection in Groundwater

10.1.1.4 10-4 LF97 Groundwater Analytical Results (Detected Compounds)

10.1.2 Figures

10.1.2.1 10-1 CVOC Trend Graphs

10.1.2.2 10-2 WDA 123 Select CVOCs and 1,4-Dioxane Detections

10.1.3 Attachments (on CD)

10.1.3.1 11/30/12 Memo to USEPA – PW Results

10.2 Summary of Work Completed

- Chlorinated VOCs have been analyzed in onsite groundwater monitoring wells during various sampling events going back to the mid-1990s.

- Chlorinated VOCs have been analyzed in the onsite Production Wells at a higher frequency (i.e., annually or more often) than site monitoring wells.

- Production wells 7 and 9 have the most sampling events compared to Production Wells 8, 11 and 12.

- All five Production Wells were sampled at surface port in fall 2011 after chlorination system was turned off for minimum 24 hours to purge chlorination chemicals.

10.3 Overview of Results

- Chlorinated VOCs in groundwater have been observed in mainly four areas at the Celco Site (Area D - LF97B), the area north of WDA 1 (MP117, P003R, and MP126), the Fire Training Area (MP124), and the Production Wells.

- Groundwater detections include chlorinated ethenes (PCE, TCE, DCE), chlorinated ethanes (111-TCA, 12-DCA, 11-DCA) and chlorinated methanes (chloroform, and methylene chloride). The composition of chlorinated VOCs and range of detections varied in the four areas (**Table 10-3**).

    - Area D Groundwater: Chlorinated VOCs were greater than 300 ug/L (primarily 11-DCA, 11-DCE, and 111-TCA)

    - Area North of WDA 1 Groundwater: Chlorinated VOCs were greater than 100 ug/L (primarily 111-TCA, and 11-DCE)

    - Fire Training Area Groundwater: Chlorinated VOCs were greater than 50 ug/L (primarily PCE, cis-12-DCE, and TCE)

    - Production Wells: Chlorinated VOCs less than 10 ug/L (primarily PCE)

- One or more detections of three chlorinated VOCs (PCE, 11-DCE, and methylene chloride) have been detected above the primary MCL at the following locations: LF97B, MP79, MP117, MP024, PW008, and PW011

- Landfill Area well LF97B (Area D) – has the highest concentrations relative to other wells

    - 2011 LF97B results of TCE and DCE appear higher for some constituents compared to 2001 results (**Table 10-4**)

- Each of the 5 Celco Production Wells has had past detection of Chlorinated VOCs (**Table 10-1 , Figure 10-1 and Attachment 10-1**)

- The only area where chlorinated VOCs were detected in soils was in WDA 3

  - WDA 3 – VOCs and SVOCs detected. Chlorinated VOCs include:111-TCA, 11-DCA, chloroethane, cis-12-DCE, methylene chloride, PCE, trans-12-DCE, TCE and vinyl chloride.
  - WDAs 9 and 10 have relatively high concentrations of acetone, MEK, acetonitrile, benzene, hexane and ethylbenzene.
  - Other WDA soil/waste samples have few VOCs and at relatively low ppb concentrations

- Several other monitoring wells – LF016, MP079, MP106, MP024, MP043R had low level detects of CVOCs (**Table 10-3**)
  - Locations of other CVOCs in groundwater do not necessarily correspond with potential source areas for CVOCs in soils/waste

- MP117, MP126 and P003R were the only plant area wells where 111-TCA was detected
  - 111-TCA detected in LF097B at 34 ug/L
  - 111-TCA detected at MP117 at 150 ug/L and 110 ug/L
  - 111-TCA detected at MP126 at 4.7 ug/L
  - 111-TCA detected at P003R at 2.6 ug/L and 1.9 ug/L

10.4 Data Observations

- Trend/Graph analysis of Production Wells indicates significant CVOC concentration decreases from early 1990s thru 2012 (**Figure 10-1**).

- Wells PW007 and PW009 had relatively high concentration in early 1990s and are now close to if not non-detect for CVOCs.
  - Data suggests that slug of CVOCs cleared through production wells in mid-1990s

  - Timing is consistent with groundwater model predictions of 50 to 60 year flow time from Area D to the plant area

  - Expect CVOC concentrations in Production Wells to continue to decline.

- Wells PW008, PW011, PW012 – had lower CVOC concentrations compared to PW007 and PW009 in early 1990s and also show significant decline over time.

- Tetrachloroethene was elevated in PW008 in 2011 but still lower than in mid 1990s.

- Tetrachloroethene in PW011 has reduced from early 1990sand is still present

- Area D (i.e., LF097B) is one suspected source of CVOCs in Production Wells

  - Groundwater modeling supports flow from Area D into deep groundwater zone (i.e. model layer 3) to PW007/PW009 under both pumping and non-pumping conditions

  - Presence of CVOCs in PW008, PW011 and PW012 could also be result of Area D migration and variable flow paths towards New River

  - Although other site wells (e.g. MP117) have CVOC concentrations, a high concentration source area has not been identified.

- Site-wide sporadic concentrations of CVOCs could be result of incidental historical spills – sporadic hits; low concentrations do not suggest a source within plant area other than WDA 3 and/or the fire training area.

  - 111-TCA concentrations at MP117 and P003R do not appear to be from WDA 1 because 111-TCA was not detected in soil/waste in WDA 1 (**Figure 10-2**).

  - Upgradient concentration of 111-TCA at MP126 is an order of magnitude lower than MP117 and therefore does not suggest a hydraulically upgradient source of 111-TCA.

   - LF097B was the only other well with 111-TCA, yet it is unlikely that deep groundwater at LF97B concentrations can migrate to shallow groundwater at MP117 location.

- Current CVOC concentrations in production wells are expected to continue to decrease based on 20-year plus historical monitoring trend.

- Production wells capture large portion of affected groundwater and minimize migration to New River.

10.5 Proposed Phase II Work

- Sample PW008 during well shutdown to evaluate deeper aquifer zone concentrations during non-pumping conditions. Sample other production wells in like manner if feasible.

- The proposed piezometer for WDA 1 will be sampled to assist in identifying a potential source area for 111-TCA detected in MP117 and P03R.

11. Ammonia Results

Historically, ammonia has been detected in groundwater and in water discharging from the ammonia pipe near Outfall 005. During the Phase I and IB RFI field program, ammonia analysis was included for all media tested (groundwater, surface water, sediment, soil/waste, and other water). In addition, a task force was formed by Celanese to evaluate potential source(s) of ammonia at the plant based on historical and current operations. This section presents a more-in depth discussion of ammonia results and summarizes the evaluation of the task force.

11.1 Supporting Documents

11.1.1 Tables

11.1.1.1 11-1A Phase I/IB RFI Ammonia Groundwater Results

11.1.1.2 11-1B Phase I/IB RFI Ammonia On-Site Surface Water/Sediment Results

11.1.1.3 11-1C Phase I/IB Ammonia New River Surface Water/Sediment Results

11.1.1.4 11-1D Phase I/IB Ammonia Soil/Waste Results

11.1.1.5 11-2 Ammonia Surface Water/Other Water Detections Phase I RFI

11.1.2 Figures

11.1.2.1 11-1 Soil Ammonia Results (See Figure Roll)

11.1.2.2 11-2 Groundwater Ammonia Results (See Figure Roll)

11.1.2.3 11-3 Sediment, Surface Water & Other Water Ammonia Results (See Figure Roll)

11.2 Summary of Work Completed

- Phase I samples collected in groundwater, surface water sediment, soil, waste and at outfalls. Results are included in **Tables 11-1 and 11-2** and are illustrated on **Figures 11-1, 11-2 and 11-3**.

- A Celanese Ammonia Task Force (ATF) was created to investigate ammonia at the Celco Site and a summary report is being prepared but not ready for distribution at this time.

11.3 Data Observations

11.3.1 Potential Sources of Ammonia

- The ATF identified two primary sources of nitrogen impacting the environment at the Site:
    - Wastewater treatment plant biological sludge containing nitrogen was pumped into unlined ash settling ponds (Ponds 1-4) from 1970 to 1994. The combined ash/biological sludge were periodically removed and disposed in the unlined landfill areas B1 and B2.
    - Cellulose Acetate (CA) manufacturing began in 1943. Raw materials containing nitrogen compounds (e.g., wood pulp) resulted in the generation of wastewater and waste solids containing nitrogen. CA waste solids were disposed in various locations within the main plant area (WDA 2, 4, 7, 8, 9 and 10) and the landfill north of Route 460 (CPSL, Area B1 and B2). Wastewater containing nitrogen was stored in or flowed through various unlined wastewater ponds and/or settling lagoons located on the south side of the plant from 1964 to 1990.
    - These materials contained nitrogen present in various forms, directly as ammonia or those which would be expected to biodegrade to ammonia.
    - All storage and disposal practices as described above have been discontinued. Ammonia/nitrogen levels are expected to be stable or diminishing.
- Other sources of nitrogen containing materials used or present in the plant, but not considered to be a major contributor of nitrogen to the land include coal ash, natural gas, coal, urea, ammonium bisulfite, pesticides, herbicides, fertilizers and other general plant trash.
- Urea was used in WWTP operation - WWTP sludge disposal at multiple locations.

- Celco Plant sampling indicates that wood pulp is not likely a primary source of ammonia.
- Diammonium Phosphate is a major source of raw nitrogen at Celco Plant.
- Clam Chlorination (with ammonium bisulfate) of the Outfall 001 discharge creates ammonia and is permitted.
- Stack emissions are not considered a likely source of ammonia.
- The CPSL contains relatively high ammonia concentrations.
- Historic usage of pesticide/herbicides is not considered a likely source of ammonia.
- Buried wood including woody material deposited near or in the New River is a potential naturally occurring source of ammonia.
- Potential sources outside Celco are possible, but are likely less significant contributors based on locations and frequency of detections.
- The ammonia screening value for groundwater is only 0.25 mg/L.
- Ammonia criteria for surface water can be calculated per VDEQ guidance using pH and temperature.

11.3.2 Soil/Waste

- Ammonia detected in surface soil, subsurface soil and waste at many locations
- Typical detections are in the single digit ppm range – in some cases representative of regional background.
- Highest detections > 100 ppm in waste disposal area samples of waste
- Ammonia detected in soil samples with no waste or release history (e.g., 41/43 locations).
- The higher ammonia detections tend to correlate with waste placement locations.

- Phase IB samples reinforce results from Phase I rather than presenting new information.

- Phase IB results tend to be similar in “raw” concentration to Phase I results that were flagged with a B due to laboratory contamination – see WDA 9 as example.

11.3.3 Groundwater

- Ammonia was detected at many locations across site

- Typical detections are in the single digit to less than 1 ppm range

- Highest detections were observed in western portion of plant area and other select areas

- Soil/waste concentrations of ammonia tend to correlate with groundwater concentrations and are focused on areas of buried waste and/or fly ash storage

11.3.4 Surface Water/Sediment

- Ammonia detected in only a few surface water samples at very low ppm levels.

- Ammonia in surface water just below Outfall 005 and in Outfall 001.

- Ammonia in Outfall 001 correlates well with predicted concentrations allowable by permit for addition of ammonium bisulfate for clam chlorination.

- Ammonia concentrations in surface water follow riverbank from Outfall 001 downstream to Stillhouse Branch Discharge area. Ammonia concentrations correlate well with temperature indicating association with 001 discharge.

- These results will vary based on New River flow conditions – samples were collected during “low flow” conditions.

- Ammonia detected in many sediment samples from single to triple digits

- Ammonia in sediment adjacent to Celco plant appears elevated compared to background samples.

- Ammonia transport in groundwater and accumulation in sediment is possible.

- Ammonia due to anoxic conditions and woody material is possible at locations adjacent to Celco Site.

- Ammonia criteria were calculated for all surface water samples – only exceedances was at OC004 (near outfall 005) discharge location

    - VDEQ issued Ammonia discharge concentration limit of 3.69 mg/L at Outfall 005 in the June, 2013 VPDES permit.

    - None of the New River concentrations exceed calculated ammonia criteria based on VDEQ guidance.

11.3.5 Fate, Transport, Migration of Ammonia

- Ammonia likely migrates from buried wastes into underlying soils/groundwater – elevated ammonia in soil locations correlates to elevated groundwater concentrations.

- Groundwater migrates to containment zone or New River depending on location.

- Current unknown is whether ammonia concentrations in sediment are more related to low stream energy depositional area where sediments are fine-grained, thick sequenced and perhaps more related to woody decomposition or whether groundwater to sediment migration better explains ammonia in sediment adjacent to Celco Site.

- Detection of elevated surface water and sediment ammonia at OC004 supports some water to sediment contribution – groundwater to surface water discharge does not appear to occur in this area.

- Ammonia detected in the eastern unnamed tributary surface water does not reach the New River as the surface water flow dries up prior to reaching the New River and/or the ammonia concentrations decrease to non-detect.

- Data does not indicate ammonia transport from onsite sediment to offsite sediment

11.3.6 Data Quality Assessment

During development of the RFI Work Plan, EPA Method 350.1 was selected for ammonia analysis in order to achieve lower detection limits than Method SM4500, which was run for previous ammonia sampling events. All the RFI ammonia data have been validated and determined to be acceptable for use, but some results were qualified as non-detect due to low-level blank contamination. These results were discussed with the project laboratory (Test America). A summary of this discussion is presented below.

- Both methods SM4500 and 350.1 have been utilize in past sampling events.
- RCRA RFI used 350.1 to achieve lower detection limits.
- Methods SM4500 has the potential to bias results high due to “base” present in samples titrating like ammonia – Knox Dolomite groundwater is basic.
- Many 350.1 lab results were flagged with a B due to lab contamination and thus ammonia is considered “not-present” in many cases
- Lab contamination is typically between the MDL and PQL – part of the issue is that method 350.1 was used for the RFI which has much lower detection limits than SM4500
- Lab performance was “acceptable” for both methods, (i.e., did not violate method requirements or procedures).
- Detects flagged non-detect due to B flags could be real, but likely elevated – cannot define actual contribution from lab contamination.
- Detects not flagged due to lab contamination could have some lab contamination not identified by lab blanks.
- Data set is considered useable and any additional data concerns may depend on analysis of risk.

  - SW concentrations do not appear to be an issue based on comparison to calculated chronic and acute standards based on VDEQ guidance.

- Starting with the Phase I field program, ammonia samples were submitted to TA Buffalo, which specializes in wet chemistry and has additional QA/QC procedures in place to minimize low-level false positive detections.

11.4 Proposed Phase II Work

- No other Phase II sampling is needed to characterize site concentrations of ammonia in media. Future additional sampling needs would be dependent on the results of the risk analysis.

12. Plant General Area Soil Results

This section presents the soil analytical results for soil sample locations in the main portion of the Celco plant (i.e., the plant general area). Soil samples collected associated with chemical sewer upgrades (Section 13), in the WDAs (Sections 14 and 15), and in the Fire Training Area (Section 16), are discussed separately.

12.1 Supporting Documents

Complete analytical results are presented in **Appendix F.**

12.1.1 Tables

12.1.1.1 12-1 Investigation Summary – Plant General

12.1.1.2 12-2 Soil Detections – Plant General (pdf only provided on CD)

12.1.1.3 12-3 Dioxins/Furans TEF Adjustment Calculations – Tank Farm

12.1.2 Figures

12.1.2.1 12-1 Plant General Soil Results (See Figure Roll)

12.2 Summary of Work Completed

- During the Phase I RFI field program, 23 soil borings including 6 new monitoring wells (MP026D, MP041R, MP042R, MP043R, MP118, and MP121) were installed in the Plant General Area. Over 29 soil samples were collected and analyzed for Phase I analytical parameters

- During the Phase IB RFI field program, 14 additional soil borings, including 2 additional wells (MP125, and MP126) were installed in the Plant General Area. Over 21 additional soil samples were analyzed. The majority of the Phase I soil samples were analyzed for the Phase I analytical parameters except for MP126 soil samples (VOCs and SVOCs only) and SB026A/SB030A soil samples (dioxins/furans only).

12.3 Overview of Results

- VOCs were not detected at concentrations greater than the Residential or Industrial RSLs. One detection of PCE at MP124 exceeded the Soil to Groundwater SSL value of 4.4 ug/kg.

- Many SVOCs were detect in plant area soils; most detections were PAHs or DEHP

    - PAHs were detected at 6 locations greater than Industrial RSL (MP042R, SB020, SB24 SB026, SB039, and SB041)

    - Benzo(a)pyrene was the most common constituent that exceeded screening levels

    - Maximum SVOC detections were noted at SB039

- Elevated PCBs were detected in soil samples from the Fire Training Area, which are discussed separately. Outside the Fire Training Area, PCBs were occasionally detected in soils, but only four soil detections were greater than the industrial RSL.

    - SB015 – Aroclor 1254 (1.7 mg/kg)

    - MP042R - Aroclor 1260 (1.2 mg/kg)

    - SB020 – Aroclor 1260 (6 mg/kg)

    - SB038 – Aroclor 1254 (1.5 mg/kg)

- Generally, PCB concentrations were higher in surface soil than in deeper soil. One exception was noted at MP042R where PCBs were detected in soil sample collected from 6 to 10 ft below grade. However, ARCADIS learned during utility clearance that several feet of fill was added to the existing grade within the last few years (associated with road maintenance) so the deeper sample location was likely representative of the historical surface soil conditions.

- Dioxins and furans analysis was performed in the WDA soil samples, which are discussed separately. In the plant area, dioxins and furans analysis was only conducted at two locations (SB026A and SB030A)). One or more dioxins and furans were detected at each location. However, 2378-TCCD TEC values were greater than the Residential and Industrial RSL at SB030A and not at SB0026A.

- TPH-DRO was more frequently detected in plant area soil samples compared to TPH-GRO. DRO was detected at concentrations greater than 100 mg/kg at four locations:
  - SB032 - 610 mg/kg
  - SB035 – 310 mg/kg
  - SB038 -160 mg/kg
  - SB039 – 980 mg/kg
- Arsenic was detected in all soil samples above the Industrial RSL (1.6 mg/kg) with a maximum detection of 15.2 mg/kg at SB032.
- Other metals detected above the Industrial cobalt (SB18 - 68.4 mg/kg)
- Hexavalent chromium was detected in many soil samples throughout the Plant Area, but concentrations were less than the Industrial RSL
  - Most detections were 1 to 3X the Residential RSL of 0.29 mg/kg
  - Non-detect at five locations (SB20, SB21, SB23, SB24, and SB25)
- Ammonia was detected at 4 locations (MP041R, MP043R, MP118, and MP119) at concentrations greater than approximately 10 mg/kg; there is no soil screening level for ammonia

12.4 Data Observations

- No significant VOC impacts were identified in the Plant General Area
- SVOCs (primarily PAHs) were detected in several soil samples; however, these constituents are not widely detected in groundwater. For example, only trace PAHs were detected in groundwater at MP115, which is located near the soil sample with the highest PAH concentrations in soils (in the plant general area).

- PCBs (Aroclor 1254 and 1260) were detected in several soil samples in the Plant General Area. PCB detections decreased with depth and were 25X less than the maximum PCB detections (6 vs. 150 mg/kg) to the Fire Training Area (discussed separately in Section 16). PCBs (Homolog compounds) were also detected in groundwater at several locations in the southeastern portion of the plant (as discussed in Section 9). These groundwater detections were sporadic and did not show a strong correlation with soil detections.

- Arsenic was detected above Industrial RSLs in all soil samples; however, the majority of the arsenic detections were less than 10X the RSL.

- Hexavalent chromium was detected throughout most of the Plant General Area at concentrations slightly above the Residential RSL. No soil detections were above Industrial RSL. Hexavalent chromium was also detected in several groundwater samples in the southeastern portion of the plant. These detections were sporadic and did not show a strong correlation with soil detections.

12.5 Proposed Phase II Work

- A total of 8 additional surface soil samples/shallow borings will be advanced to sample for dioxins/furans near the former incinerator(s) that were located in the Tank Farm

13. Chemical Sewer Soil Sampling

Prior to the start of Phase I field program in September 2011, modifications were made to a portion of chemical sewer system (old pipe removed and replaced), which allowed access to subsurface soils that are normally paved. Celanese voluntarily collected soil samples during sewer line modifications to provide supplemental data for soil characterization in the Plant Area. This section summarizes the results of the Chemical Sewer soil sampling field program, which was performed between June and September 2011.

13.1 Supporting Documents

Complete analytical results are presented in **Appendix F.**

13.1.1 Tables

13.1.1.1 13-1 Summary of Chemical Sewer Soil Sampling Program

13.1.1.2 13-2 Investigation Summary - Chemical Sewers

13.1.1.3 13-3 Soil Detections – Chemical Sewers

13.1.2 Figures

13.1.2.1 13-1Chemical Sewer Soil Sampling Locations

13.1.2.2 13-2 Chemical Sewer Soil Sampling Results (See Figure Roll)

13.2 Summary of Work Completed

- A total of 11 soil samples were collected between June and September 2011 from a portion of the chemical sewer line located between Buildings 5 and 14 (as shown on **Figure 13-1**).

- Chemical sewer line consisted of PVC pipe encased in concrete vault, which was removed and replaced with galvanic protected carbon steel pipe. Soil samples were collected directly below the former concrete vault floor.

- The Phase I work plan was still being finalized when the chemical sewer sampling program was initiated. Samples were analyzed for the majority of the Phase I analytes as shown in **Table 4-2**. Excavated materials were stockpiled and appropriately disposed of based on waste characterization results

13.3 Overview of Results

- Elevated PID readings were detected above 100 ppm at two locations east of manhole P-9 (CSB09, CSB10)

- TPH DRO detected above 100 mg/kg in 4 samples with a maximum detection was 1600 mg/kg (CSB01) PAHs/PCBs detected in several samples; CSB10 detection exceed industrial RSLs for PAHs, no detections exceed industrial RSL for PCBs

- Arsenic detected above industrial RSLs

13.4 Data Observations

- Arsenic detected in all soil samples above Industrial RSL

- PAHs greater than Industrial RSLs at location east of manhole P-9.

- Construction of sewer observed during excavation (i.e., concrete encased) suggest low potential for leakage, yet soils beneath sewer were not “clean”

- Results suggest leakage from sewer has been minimal which is consistent with observation that sewer was encased in concrete and there was no visual evidence of leakage beneath the sewer pipe that was removed.

13.5 Proposed Phase II Work

- No additional sampling is proposed nor warranted based on results

14. Waste Disposal Areas 1, 2, 3, 7, 8, 9 and 10

14.1 Supporting Documents

Complete analytical results are presented in **Appendix F.**

14.1.1 Tables

14.1.1.1 14-1 Investigation Summary - Waste Disposal Areas

14.1.1.2 14-2 Soil/Waste TCLP Results

14.1.1.3 14-3 Soil Analytical Detections - Waste Disposal Areas(pdf only provided on CD)

14.1.1.4 14-4 Comparison of Media Results - Waste Disposal Area 9

14.1.1.5 14-5 Dioxin/Furan TEF Calculations – Waste Disposal Areas

14.1.2 Figures

14.1.2.1 14-1 WDA 123 Soil/Waste Results (See Figure Roll)

14.1.2.2 14-2 WDA 456 Soil/Waste Results (See Figure Roll)

14.1.2.3 14-3 WDA 78 Soil/Waste Results (See Figure Roll)

14.1.2.4 14-4 WDA 910 Soil/Waste Results (See Figure Roll)

14.1.2.5 14-5 Hydrogeologic Cross Section C-C' (See Figure Roll)

14.1.2.6 14-6 Hydrogeologic Cross Sections E-E', D-D' and F-F' (See Figure Roll)

14.1.2.7 14-7 Proposed Phase II Sampling Locations (See Figure Roll)

14.1.3 Attachments (on CD)

14.1.3.1 14-1 WDA 1,2,3,7,8,9,10 Visual Logs

14.2 Summary of Work Completed

- Multiple borings per waste area were advanced to characterize each waste area; shallow and deep samples were collected per boring as summarized in **Table 4-1**.
  - WDA 1 – 5 environmental borings
  - WDA 2 – 3 environmental borings
  - WDA 3 – 6 environmental borings
  - WDA 7 – 6 environmental borings (including two wells)
  - WDA 8 – 2 environmental borings
  - WDA 9 – 8 environmental borings
  - WDA 10 – 7 environmental borings (including one well)
- Samples were analyzed for a full suite of parameters; deeper samples were also analyzed for TCLP for waste characterization
- The subsurface sample interval was based on depth of maximum PID readings.
- Soil borings were advanced until the bottom of the waste was delineated and were at least 10 feet deep.

14.3 WDA 1 Work Completed & Data Observations

- Three borings were advanced during Phase I and two additional borings were advanced during Phase IB to investigate the potential presence of 111-TCA in waste material.
- Waste was observed in all 5 borings (SB001A - SB001E) consisting primarily of fly ash with some gravel and brick at depth (**Table 14-1**).
- All samples were characteristically non-hazardous (i.e., <TCLP) (**Tables 14.1 & 14-2**).

- A few VOCs including acetone and benzene were detected but at low ug/kg concentrations

- Benzo(a)pyrene was detected at one location (SB001C) at concentration above industrial RSL (**Table 14-3**).

- Arsenic, cobalt, manganese and thallium were detected above the Industrial RSL at one or more locations.

- PCBs were detected at several locations at low concentrations below the Industrial and Residential RSL.

- Dioxins/Furans were detected at each location at low concentrations below the Industrial and Residential RSL. 2378-TCCD TEC values were less than Residential and Industrial RSLs at all locations.

- Cover thickness varied from 0.8 ft to 3.8 ft.

- Waste was encountered beginning at 0.8 ft bgs to 11.5 ft bgs.

- **Figure 14-5** illustrates in cross section format the waste thickness and estimated groundwater elevations beneath WDA 1.

- Boring log information in conjunction with groundwater elevation information indicates that a bottom of waste to groundwater separation distance of a few feet to 10 feet likely exists in the southern portion of WDA 1, but in the northern portion of WDA 1, extrapolation of the water table suggests it may be several feet into the waste. Piezometers are proposed for installation to confirm the hydrologic conditions in this area. The proposed screen intervals are shown on **Figure 14-5**.

14.4 WDA 2 Work Completed & Data Observations

- Three borings were advanced during Phase I in WDA 2.

- Waste was observed in 2 of 3 borings (SB002B, SB002C) and consisted of possible fly ash, coal, brick, metal and concrete (**Table 14-1**).

- All samples were characteristically non-hazardous (i.e., <TCLP) (**Table 14-2**).

- Only hexane was detected at one location at 12 ug/kg.

- Numerous SVOCs were detected and all detections were below Industrial RSLs. Benzo(a)pyrene was detected at one location (SB002C) at 200 ug/kg and the Industrial RSL is 210 ug/kg (**Table 14-3**).

- Arsenic, cobalt, manganese and thallium were detected above the Industrial RSL at one or more locations. PCB was detected at one location (SB002C) at a low concentration below the Industrial but just above the Residential RSL.

- Dioxins/Furans were detected at all locations at low concentrations below the Industrial and Residential RSL. 2378-TCDD TEC values were less than Residential and Industrial RSLs at all locations.

- Cover thickness was 0.8 ft at SB002C.

- Waste was encountered beginning at 0.8 ft bgs to 8.7 ft bgs.

- **Figure 14-5** illustrates in cross section format the waste thickness and estimated groundwater elevations beneath WDA 2.

- Boring log information in conjunction with groundwater elevation information indicates that a bottom of waste to groundwater separation distance of 20-plus feet exists at WDA 2.

14.5 WDA 3 Work Completed & Data Observations

- Three borings were advanced during Phase I and three additional borings were advanced during Phase IB to further characterize WDA 3 and to identify potential TCLP exceedance area(s).

- Waste was observed in all six borings and consisted of asphalt, coal, brick, wood, glass, CA fines, concrete, fly ash and construction debris (**Table 14-1**).

- PID readings in WDA 3 ranged from single digits to 371 ppm.

- SB003A had a TCLP concentration for benzene of 0.53 mg/L which just exceeds the TCLP limit of 0.5 mg/L, while the other 5 sample locations did not exceed TCLP limits for any constituents (**Tables 14.1 & 14-2**).

- Numerous VOCs were detected including 111-TCA, 11-DCA, 124-TMB, 135-TMB, MEK, acetone, benzene, chloroethane, chlorobenzene, cis-12-DCE, methylene chloride, ethylbenzene, hexane, PCE, toluene, total xylenes, trans-1,2-DCE, TCE and vinyl chloride. None of the VOC detections exceeded Industrial or Residential RSLs.

- Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, ideno(1,2,3-cd)pyrene and naphthalene were detected at one or more locations at concentrations greater than Industrial RSLs. (**Table 14-3**). In general, concentrations were greater in samples collected at depth as opposed to surface samples.

- Arsenic and lead were detected at one or more locations above the Industrial RSL.

- PCBs were detected at several locations at concentrations exceeding Industrial RSLs. The highest concentration was 30 mg/kg detected at SB003D (5.5-8.7).

- Dioxins/Furans were detected at most locations at low concentrations below the Industrial RSLs. A few detections were found exceeding the residential RSLs. 2378-TCDD TEC values were detected at concentrations greater than Residential and Industrial RSLs at several locations.

- Ammonia nitrogen was detected at most locations with the highest concentration at SB003A (6-10) at 102 mg/kg.

- Cover thickness varied from 0.5 ft to 5.5 ft.

- Waste/Fill was encountered beginning at 0.5 ft bgs to 20 ft bgs.

- **Figure 14-5** illustrates in cross section format the waste thickness and estimated groundwater elevations beneath WDA 3.

- Boring log information in conjunction with groundwater elevation information indicates that a bottom of waste to groundwater separation distance of approximately 15 ft exists at WDA 3.

14.6 WDA 7 Work Completed & Data Observations

- See Section 15 for WDA 4, 5 and 6 discussions.

- Six borings were advanced during Phase I (including MP119 and MP120).

- Waste was observed in 5 of 6 borings and consisted of brick, glass, gray fibrous material, coal and white fibrous pulp (**Table 14-1**).

- All samples were characteristically non-hazardous (i.e., < TCLP) (**Table 14-2**).

- Maximum PID readings were less than 5 ppm.

- VOCs were not detected.

- PAHs/PCBs detected above industrial RSLs at SB007B and SB007C, PCBs only detected above industrial RSLs at SB007A and SB007D. Highest PCB concentration was 7.2 mg/kg. PAHs only were above the Industrial RSL at MP119 (benzo(a)pyrene - 1.1 mg/kg)

- Dioxins/Furans detected at most samples but all detections were below Industrial RSLs; some detections exceeded Residential RSLs. However, 2378-TCDD TEC values were greater than Residential and Industrial RSLs at several locations.

- Elevated ammonia detected at SB007A (> 100 mg/kg), high sulfate in some samples.

- Arsenic, lead, manganese, and mercury were detected above Industrial RSLs in one or more samples.

- Elevated lead noted at SB007A, SB007B, SB007C

- Pesticides detected at several locations but at concentrations below Industrial and Residential RSLs.

- Cover thickness varied from 0.3 ft to 2.2 ft.
- Waste/Fill was encountered beginning at 0.3 ft bgs to 10.5 ft bgs.
- Boring log information in conjunction with groundwater elevation information indicates that a bottom of waste to groundwater separation distance of more than 20 ft exists at WDA 7.

14.7 WDA 8 Work Completed & Data Observations

- Two borings were advanced during Phase I.
- Waste was observed in both 2 borings and consisted of concrete, white fibrous pulp, and possible fly ash (**Table 14-1**).
- All samples were characteristically non-hazardous (i.e., < TCLP) (**Table 14-2**).
- Maximum PID reading was 10.2 ppm.
- Acetone was detected at low ug/kg concentrations (**Table 14-3**).
- Numerous SVOCs were detected at SB008A and benzo(a)pyrene and dibenzo(a,h)anthracene were detected at concentrations greater than the Industrial RSL.
- One PCB was detected at SB008A at concentrations greater than the Industrial RSL.
- Dioxins/Furans were detected at SB008A at concentrations greater than one Industrial RSL; some detections exceeded Residential RSLs. 2378-TCDD TEC values were greater than Residential and Industrial RSLs at SB008A.
- Elevated ammonia was detected at SB008A (120 mg/kg).
- Arsenic was detected above the Industrial RSLs in both locations.
- Cover thickness was 0.6 to 8.7 ft.

- Waste/Fill was encountered beginning at 0.6 ft. bgs to 9.5 ft. bgs.

- Boring log information in conjunction with groundwater elevation information indicates that a bottom of waste to groundwater separation distance of more than 20 ft exists at WDA 8.

14.8 WDA 9 Work Completed & Data Observations

- Three borings were advanced during Phase I and five additional borings were advanced during Phase IB to further characterize WDA 9 and to identify potential TCLP exceedance areas.

- Waste encountered in 8 of 8 borings and consisted of white fibrous material, fly ash and CA fines. (**Table 14-1**).

- Samples from SB009A, SB009E, SB009F and SB009G have benzene concentrations greater than the TCLP limit of 0.5 mg/L. Sample locations SB009B, SB009D and SB009H had benzene concentrations just below the TCLP limit (**Table 14-2**). Several samples had a pH value in the 2 to 3 standard unit range.

- Samples from SB009A and SB009B were 10.6% and 16% acetic acid and were acidic (pH ~3 s.u.), elevated sulfate also noted at both locations

- PID readings were high with a maximum PID reading of 3750 ppm.

- VOCs detected included MEK, acetone, benzene, ethylbenzene, hexane and toluene (**Table 14-3**). Benzene concentrations at several locations exceeded Industrial RSLs.

- Numerous SVOCs were detected but no concentrations were greater than Industrial RSLs.

- One PCB (Aroclor 1254) was detected at two locations (SB009D, SB009E) at concentrations greater than the Industrial RSL.

- Dioxins/Furans were detected at several locations but no concentrations were greater than the Industrial or Residential RSLs. 2378-TCDD TEC values were greater than Residential RLs, but less than Industrial RSLs at several locations.

- Arsenic, cobalt, and thallium, were detected above the Industrial RSLs at one or more locations.

- Cover thickness ranged from 2.5 ft. to 5.2 ft.

- Waste/Fill was encountered beginning at 2.5 ft. bgs to 16.9 ft. bgs.

- **Figure 14-6** illustrates in cross section format the waste thickness and estimated groundwater elevations beneath WDA 9.

- Boring log information in conjunction with groundwater elevation information indicates that a bottom of waste to groundwater separation distance of more than 15 ft exists at WDA 9.

14.9 WDA 10 Work Completed & Data Observations

- Four borings were advanced during Phase I and three additional borings were advanced during Phase IB to further characterize WDA10 and to identify the presence/absence of waste.

- No waste was observed in three Phase I borings (SB10A, SB10B & SB10C), no potential impacts above industrial RSLs except for arsenic. However, waste was identified at MP122, which suggested that the historical waste disposal area boundary may be located further south closer to fence line.

- Waste was encountered in 3 of 3 Phase IB borings and consisted of CA fines. (**Table 14-1**).

- Samples from WDA 10 did not exceed TCLP limits, although benzene values at two locations (SB0010D and SB0010F were only slightly less than the 0.5 benzene TCLP limit (**Table 14-2**).

- Several samples had a pH value in the 3 standard unit range.

- PID readings were high with a maximum PID reading of 101 ppm.

- VOCs detected included acetone, benzene, ethylbenzene, hexane and toluene (**Table 14-3**). Benzene concentration exceeded the Industrial RSLs at SB10E.

- Numerous SVOCs were detected but no concentrations were greater than Industrial RSLs.

- PCBs were detected at 3 of 3 Phase IB borings and concentrations were greater than the RSL at two locations.

- Dioxins/Furans were detected at several locations but no concentrations were greater than the Industrial or Residential RSLs. 2378-TCDD TEC values were less than Residential and Industrial RSLs at all locations except for a slight exceedance of the residential RSL at location SB010E.

- Arsenic was detected above the Industrial RSLs at one or more locations.

- Cover thickness ranged from 1.2 ft to 4.5 ft.

- Waste/Fill was encountered beginning at 1.2 ft bgs to 17.1 ft bgs.

- **Figure 14-6** illustrates in cross section format the waste thickness and estimated groundwater elevations beneath WDA 10.

- Boring log information in conjunction with groundwater elevation information indicates that a bottom of waste to groundwater separation distance of more than 20 ft exists at WDA 10.

14.10 Proposed Phase II Work

- Install piezometers to measure water elevations and determine waste to groundwater separation distance in WDA 1, 2, 3, 9 and 10 to (**Figure 14-7**).

- Monitor groundwater elevations in all WDAs to support evaluation of separation distance between bottom of waste and seasonal high water table elevation.

- Collect groundwater samples from proposed piezometers in WDA 1 and 3 to further characterize water quality in the vicinity of VOC detections at P003R, MP117 and MP126

- Take eight additional soil boring samples in WDA 9 and seven additional soil boring samples in WDA 10 to delineate and further characterize waste.

15. Waste Disposal Areas 4, 5, and 6

In April 2012, Celanese initiated a Boiler MACT project to install a new gas-fired boiler system to replace the existing coal-fired boiler system. Some sections of WDA 456 will be covered with the new process equipment buildings and/or infrastructure. Therefore Celanese in conjunction with EPA, elected to expedite the collection of any additional data that may be needed to fully characterize WDA 456 because access to some of these areas would limited in the future.

Numerous phases of investigation were completed and data packages were submitted to USEPA during the period May 2012 through April 2013 and these are described in more detail in Section 4 of this data package. These investigations included:

- Soil sampling/analysis
- Waste sampling/analysis
- Well Installation
- Groundwater sampling/analysis
- Risk analysis

These data packages were previously submitted to EPA and are therefore not provided again in this data package. Based on the completeness of the investigation data and risk analysis information, EPA elected to pursue the development of a proposed remedy and a Statement of Basis specific to WDA 4, 5 and 6. During the development of a draft Statement of Basis, a decision was made to defer the development of a remedy for WDA 4, 5 and 6 and incorporate WDA 4, 5 and 6 into the site wide FLP.

In response to this decision, Celanese provided EPA with a plan to implement elements of the plan in the interim and a communications plan to address communication of this decision to the public. Interim actions being implemented by Celanese specific to WDA 4, 5 and 6 and the Boiler MACT project include:

- Install new well MP127. (completed June, 2013)
- In 2013 groundwater will be sampled, analyzed and monitored in multiple locations as described in the plan submitted to EPA;

- In 2013 groundwater levels will be measured in multiple locations and a continuous groundwater monitoring transducer will be installed in Well P6R.

- Over the next three years the Boiler project infrastructure (building, pad, etc.) will be constructed over portions of WDA 4, 5, and 6 and serve as an impermeable cap;

- The portions of WDA 4, 5 and 6 not capped by the Boiler Project Infrastructure will be addressed in a future site wide Record of Decision (ROD); and,

- Implementation of a communications plan with the purpose of informing the public of the changes to the timeline for developing a ROD for WDA 4, 5 and 6. (Completed July 12, 2013)

16. Fire Training Area

This section describes the soil and groundwater sampling results for the former Fire Training Brigade Area.

16.1 Supporting Documents

Complete analytical results are presented in **Appendix F.**

16.1.1 Tables

16.1.1.1 16-1 Investigation Summary – Fire Training Area

16.1.1.2 16-2 Soil Analytical Detections – Fire Training Area (pdf only provided on CD)

16.1.1.3 16-3 Summary of CVOC, PCB, and PFC Soil Detections – Fire Training Area

16.1.2 Figures

16.1.2.1 16-1 Fire Training Area Soil Results (See Figure Roll)

16.2 Summary of Work Completed

- Soil sample locations are presented in **Figure 16-1**.
- During Phase I, five soil borings (SB031A through SB031E and one monitoring well were installed (MP124). Surface soil samples were collected at each boring location and deep soil samples were collected at SB031C and MP124. Soil samples were analyzed for Phase I analyte list and PFCs (**Table 4-2**).
- During Phase IB, 22 additional soil borings (SB031F through SB31AA) and 3 repeat borings (SB031AR, SB031BR, and SB031CR) were collected at depths ranging from 2 to 8 feet bgs on 9-meter grid spacing. A minimum of two soil samples were collected per boring, which varied based on PID readings. Soil analysis focused on PCB, VOC, and PFC analysis.

- During Phase I, MP124 was sampled for the Phase I full suite analyte list. During Phase IB, three wells were sampled for PFCs (MP028, MP124, and MP125).

- Between October 2011, and November 2012, over 75 soil samples were collected in the Fire Training Area for the RFI investigation.

16.3 Overview of Results

16.3.1 Soils

- Chlorinated VOCs (111-TCA, 11-DCA, MC, PCE, TCE, cis-12-DCE, and VC) were detected in Fire Training Area soils. The primary chlorinated VOC detected was PCE with a maximum detection of 72 ug/kg at SB031P.

- SVOCs were detected below RSLs

- PCBs (Aroclor 1260) were detected in soils above the Industrial RSL at concentrations higher than in other areas at the plant. PCBs were higher in surface soils with a maximum concentration was 150,000 ug/kg at SB031B.

- PFCs were detected at many locations in the Fire Training Area. The highest concentrations were noted at SB031J (1,074 ug/kg) and SB031P (389 ug/kg); no screening level exists

    - Ammonia was detected above 10 mg/kg at two locations: SB031A (16.8 mg/kg) and SB031D (11 mg/kg); no screening level exists

    - TPH DRO was detected above 100 mg/kg at one location:SB031E (210 mg/kg)

- Arsenic and manganese were detected at concentrations above the Industrial RSL, while hexavalent chromium was detected above Residential RSLs.

    - Arsenic was detected at a maximum concentration of 15.4 mg/kg (SB031E), approximately 15X the Industrial RSL of 1.6 mg/kg.

    - Manganese was detected at a maximum concentration of 3,840 mg/kg (SB031B) approximately 2 to 3X the Industrial RSL value of 1,800 mg/kg.

- Hexavalent chromium was detected at a maximum detection of 0.57 mg/kg, less than 2X the RSL of 0.29 mg/kg

16.3.2 Groundwater

- The primary constituent detected above the MCL was PCE (50 ug/L) at MP124

- Other detections include: 1,4,-dioxane (13 ug/L), other chlorinated VOCs, DRO (0.16 mg/L), GRO (0.13 mg/L), PFOA (0.02 ug/L) and PFOS (0.21 ug/L). PFOA/PFOS was only detected at MP124.

16.4 Data Observations

- Several organic constituents are present in soils and groundwater in the Fire Training Area. Generally, the soil concentrations are higher in surface soil samples. The primary organic constituents are PCBs, PFCs, and to a lesser extent chlorinated VOCs. It is suspected that these impacts may originate from past fire training activities where waste oils potentially containing PCBs, fuel oils, and/or solvents were burned as part of fire training activities.

- The collection of Phase IB soil samples on a 9-meter grid spacing has helped better understand the type of soil impacts in the Fire Training Area and provides a more robust data set for risk evaluation, but future additional sampling to refine the lateral extent of soil contamination may be required for pre-design purposes:

    - The PCB hotspot is centered on SB031B (> 100,000 ug/kg); the lateral extent of PCB contamination is not fully defined to the south toward the Electrical Sub-station/Blue Building

    - The PFC hotspot is centered on SB031J (> 1,000 ug/kg); the lateral extent of PFC contamination is not fully defined to the west, toward the Metal Pan Fire Training Area

    - The chlorinated VOC hotspot is centered on SB031P (> 100 ug/kg) and is largely defined

- PCE appears to have leached to groundwater at concentrations above MCLs. The extent of PCE in groundwater is undefined, but is expected to migrate laterally and then downward and eventually be captured by the hydraulic containment system

- EPA guidance may require a VI evaluation if there are buildings within 100 ft of elevated VOC detections in soil or groundwater.

16.5 Proposed Phase II Sampling

- A Soil Removal Corrective Action associated with the PCB concentrations is warranted and is currently being studied.

- Consideration should be given to sub-slab air sampling within the blue building to address potential VI issues related to VOC concentrations in soil and groundwater. As discussed earlier in this report, sampling of this non-occupied building is complicated by the electrical switchbox equipment within the building and vast array of conduit, etc. directly under the building.

17. Dioxins/Furans

This section provides additional background information on historical incinerator use at the Celco Plant and presents the results of total equivalent concentration (TEC) calculations for 2, 3, 7, 8- tetrachlorodibenzo-p-dioxin (2378-TCDD) based on methods published by Van den Berg, et al. (2006).

17.1 Supporting Documents

Dioxin and furan results were previously presented in Sections 12 and 14 for samples collected during the Phase I and IB RFI field program. Additional supporting documents included in this section are summarized below.

17.1.1 Tables

17.1.1.1 Table 17-1 Summary of 2378-TCDD TEC Results

17.1.2 Figures

17.1.2.1 Figure 17-1 TEC for 2378-TCDD (See Figure Roll)

17.2 Background Information

Celanese completed a review of files to research the historical existence and operation of one or more incinerators at the Celco Plant. This information indicates that Celanese operated an incinerator at the Celco Plant between the periods of 1944 and early 1970s which was located in the southern portion of the Tank Farm, just north of the present day Ketene system.

The September 1991 Part B Permit drawing Figure L-1 SWMU No. 16 has a listing for an incinerator at two locations, one near the Powerhouse and one in the Tank Farm Area. Celanese has no record of an incinerator near the Powerhouse and long-time Celco Plant personnel do not believe that an incinerator was ever located at the Powerhouse and that the 1991 Part B Permit drawing is in error.

Review of Celanese records indicates that the Celco Plant operated two incinerators in roughly the same location in the Tank Farm Area just to the north of the existing Ketene Area. The original incinerator was operated till the late 1960s/early 1970s. A replacement incinerator was installed in the early 1970s but the newer one only operated a short period of time and was taken out of service in the early 1970s, when the waste started being taken up to the landfill area. The newer incinerator was located approximately 100 feet west of the older incinerator. The concrete wall/pad that exists today was part of the newer incinerator. One Celanese report referenced that in 1970 the Celco incinerator facility consisted of a masonry and sheet siding building which was used to burn filter dressings, general refuse and combustible trash.

Dioxins/Furan formation can occur (depending on the waste input and operating conditions) in the post-combustion gases and particulates emitted to the air from older incinerators where air emission controls were limited.

17.3 Summary of Work Completed

- Multiple borings per waste disposal area were advanced to characterize each waste disposal area; shallow and deep samples were collected per boring for dioxin/furan analysis.
    - WDA 1 – 5 environmental borings, 10 soil/waste samples
    - WDA 2 – 3 environmental borings, 6 soil/waste samples
    - WDA 3 – 6 environmental borings, 12 soil/waste samples
    - WDA 4 – 6 environmental borings, 12 soil/waste samples
    - WDA 5 – 5 environmental borings, 10 soil/waste samples
    - WDA 6 – 6 environmental borings, 12 soil/waste samples
    - WDA 7 – 4 environmental borings, 9 soil/waste samples (includes one sample at MP119)
    - WDA 8 – 2 environmental borings, 4 soil/waste samples
    - WDA 9 – 8 environmental borings, 18 soil/waste samples (includes three samples at SB009A and SB009D)
    - WDA 10 – 6 environmental borings, 12 soil/waste samples

- Two additional surface soil samples (SB026A, SB030A) were collected in the Tank Farm at the former incinerator location

- Dioxin/furan analysis was performed using EPA Method 1613B/8290A by Test America's laboratory in Knoxville, Tennessee

17.4 Overview of Results

This section summarizes the data presented on **Table 17-1** and **Figure 17-1** for the 2378-TCDD TEC calculations.

- No 2378-TCDD TEC values exceeded the Residential or Industrial RSL in WDA 1, 2, 4, 5, 6, or 10

- One or more values were greater than the Residential RSL of 4.5 pg/g in WDA 3, 7, 8, 9, and in the Tank Farm

- One or more values were greater than the Industrial RSL of 18 pg/g in WDA 3, 7, and 8 and in the Tank Farm

17.5 Data Observations

- At WDA locations with 2378-TCDD TEC values greater than the RSL, deeper samples generally exhibited higher results than shallow samples

- The highest 2378-TCDD TEC value detected among the deep samples was observed in WDAs 7 and 8:

    - SB007C (1-2): 50.96 pg/g

    - SB008A (1-3): 65.40 pg/g

- The highest 2378-TCDD TEC value detected among shallow samples was observed in the Tank Farm:

    - SB030A (0-0.5): 32.069 pg/g

17.6 Proposed Phase II Work

- Collect additional soil samples near SB030A (foundation area of incinerator site) and radiating out in the two primary wind directions (based on Site wind rose diagram) at the site to further define the extent of dioxin/furan contamination.

- Include dioxin/furan analysis with Phase II borings in WDA 1, 2, 3, 7, 8, 9, and 10.

18. Other Water Sampling

Several water samples were collected during the Phase I RFI field program that are collectively grouped as 'other water samples' and summarized in this section.

18.1 Supporting Documents

Complete analytical results are presented in **Appendix F.**

18.1.1 Tables

18.1.1.1 17-1 Other Water Detections, Phase I RFI

18.2 Summary of Work Completed

- The Landfill LF550 lower 'witness zone' layer was inspected and samples were collected from the upper and lower drainage layers (LE series).
- A water sample was collected from the outfall in Fly Ash Pond 2 (FL201 sample).
- A water sample was collected from the end of a discharge pipe in the Landfill Area (Ammonia Flow Pipe, AF sample).
- A field survey of potential seep locations were performed; however, no seeps were identified for potential sampling.

18.3 Overview of Results

- Landfill LF 550 Water
    - Flow in upper layer was substantial and estimated at greater than 10 gpm. Flow in the lower 'witness zone' layer was barely a trickle and extremely difficult to sample.
    - Only VOC was acetone detected in upper layer – acetone not detected in lower layer (**Table 19-1**).
    - SVOC (benzyl butyl phthalate) detected in both upper and lower layer at similar concentrations

  - Several metals detected in both upper and lower layers with comparable concentrations
  - Ammonia was detected at 97.3 K mg/L in the upper layer and was non-detect in the lower layer
  - Nitrate was detected at 33.8 mg/L in the upper layer and at 3.5 mg/L in the lower layer

- Fly Ash Pond 2 Water
  - Some PAHs and metals (arsenic, barium) were greater than surface water screening levels

- Ammonia Flow Pipe Water
  - A few low ppb range detections of VOCs (acetone) and SVOCs (benzyl butyl phthalate, phenanthrene) were noted
  - Several metals were detected above screening criteria (aluminum, arsenic, barium, iron, and manganese).
  - Ammonia was detected at a concentration of 13.4 mg/L

18.4 Data Observations

- Results of witness zone layer are not conclusive that upper layer has leaked to lower layer
  - Extremely low flow could be result of condensation
  - Lack of acetone and/or ammonia suggest no leakage
  - Presence of metals in numbers similar to upper layer is unexplained, but not conclusive of leakage from upper layer to lower layer.

- Leachate seeps at landfill were not identified and previous surveys have not identified seeps – seeps are not anticipated in the future

18.5 Proposed Phase II Work

- No additional work is proposed.

19. Air Media

19.1 Supporting Information

- No existing data for air media pathway

19.2 Data Observations

- Subsurface air (i.e., vapor) is typically a required pathway for evaluation under RCRA Corrective Action.

- Concern is that VOCs in groundwater or soil will migrate into building (i.e., vapor intrusion) or that VOCs will migrate into outside air where unacceptable exposures will occur.

- VOCs in groundwater and soil were generally detected at low concentrations or not at all.

- Lack of detections and low concentrations suggest that VI is not an issue that needs to be pursued by collecting real-time subsurface gas samples.

- Groundwater/soil to outside air can be evaluated with existing database including soil and groundwater results

- Groundwater/soil to vapor intrusion in building could be evaluated with existing data to support conclusion that real-time subsurface gas samples are not necessary using J&E model; however, USEPA has requested sample from beneath the slab of the blue building adjacent to the former fire training area.

19.3 Proposed Phase II Sampling

- Consideration should be given to sub-slab air sampling within the blue building to address potential VI issues related to VOC concentrations in soil and groundwater. As discussed earlier in this report, sampling of this non-occupied building is complicated by the electrical switchbox equipment within the building and vast array of conduit, etc. directly under the building.

20. Summary of Major Observations & Conclusions

The following sections provide a summary of the key data observations and conclusions identified through the preliminary evaluation of RFI activities conducted. The data observations and issues presented in the sections below may or may not lead to additional data collection or analysis as part of proposed Phase II RFI activities in order to complete a comprehensive database for media at the Celco Site sufficient to prepare a baseline assessment of risk.

1. The Celco Plant Area is located on a floodplain of the New River Valley underlain by karstic dolomite. The Landfill Area is underlain by karstic dolomite that transitions to clastic rocks to the north. The Narrows Fault runs through the site oriented in a northeast to southwest direction.

2. Waste has been historically placed in unlined cells/impoundments which represent primary source areas. Releases to the surface and subsurface have occurred contributing constituents to environmental pathways. Many of the existing unlined waste disposal areas have been in place for many decades suggesting that continued releases will diminish with time.

3. Most soils in the Plant Area are covered with macadam, gravel, grass or buildings thereby limiting the existing potential for exposure to soil. Surface runoff is controlled by storm water management systems which are regulated by VPDES discharge permits. Seepage of water through surface and subsurface soil and waste materials to groundwater does occur, although the downward rate of migration is relatively slow due to the impermeable cover materials (at some locations) and the fine-grained nature of the site soils. Affected groundwater is a secondary source area.

4. Depth to groundwater is relatively deep (i.e., several hundred feet bgs) in the landfill area and varies between 15- and 80-feet bgs in the Plant Area. The direction of groundwater flow is primarily south toward the New River. The New River represents a regional discharge boundary for groundwater discharge. The Celco production wells create a cone of depression and capture a large portion of Plant Area groundwater preventing discharge to New River. The western portion of plant area is not affected by Celco Production Wells. Residential wells do not influence the direction of groundwater flow in the plant area or the landfill area. The current CSM understanding indicates that groundwater flow beneath and across the width of the New River towards the Giles County Municipal Wells is

NOT occurring. Site data and groundwater modeling indicate that the potential for groundwater to flow beneath the New River and potentially impact the Giles County municipal wells does not exist during both pumping and non-pumping scenarios.

5. Numerous environmental projects completed in the last 20 years have resulted in an elimination or significant reduction in source areas and contaminant migration pathways.

    a. Tank Farm underground chemical distribution lines were closed and all distribution lines are above ground – potential subsurface releases have been eliminated.

    b. Chemical sewers have been replace/relined minimizing the potential for subsurface releases.

    c. Pond C was lined.

    d. Pond B waste material has been removed and the area was cleaned closed under VDEQ direction/oversight.

    e. CPSL has been capped and surface migration of leachate has been eliminated.

    f. Fly ash from Pond 2 was removed and Pond 2 was clean closed in 2007.

    g. Fly ash from Pond 2 was consolidated in Pond 4 and Pond 4 was capped and closed in 2007.

    h. Unlined Pond 1 was replaced with Lined Ponds ABC - Lining of Ponds ABC serves as impermeable cap for Pond 1 fly ash not removed.

    i. Coal storage pile will be eliminated when boiler project is complete.

6. Phase I data issues were addressed in Phase IB with missing data from Phase I Work Plan was either collected in Phase IB or are deemed not necessary. Phase I/IB sampling included:

a. Installation of 12 groundwater monitoring wells and 4 Piezometers

b. Collection of 78 groundwater samples

c. Installation of 136 environmental borings

d. Collection of 45 surface water and 31 sediment samples

e. Collection of more than 290 soil and/or waste samples

f. Collection of 4 other water samples

7. Celco production wells had a few detections slightly above the primary MCLs (PCE, lead). Giles County municipal wells had no MCL exceedances. Production Wells have historically had CVOC detections. Trend/Graph analysis of Production Wells indicates significant CVOC concentration decrease from early 1990s to 2012. Current CVOC concentrations in production wells are expected to continue to decrease based on 20-year plus historical monitoring trend. Area D (i.e., LF97B) is one suspected source of CVOCs in Production Wells. Groundwater modeling supports flow from Area D into deep groundwater zone (i.e. model layer 3) towards PW007 and PW009 under both pumping and non-pumping conditions. Additional potential source areas include WDA 3 and the former Fire Training Area.

8. Production well samples represent deep zone water quality (collected under pumping conditions). Proposed Phase II activities include collection of samples from one or more production well(s) (under non-pumping conditions) to provide data for assessing deep zone water quality and the potential biasing impact of collecting production well samples while the pumps are operating.

9. The constituent screening analysis and review of data indicates that no apparent major data deficiencies for groundwater, soil, surface water and sediment exist. Overall constituents and numbers of locations with concentrations exceeding Industrial RSLs was minimal for a large active chemical facility that has been operating for more than 70 years. Some additional Phase II data collection is warranted to provide a site-wide characterization that is sufficient to proceed with the site-specific baseline risk analysis and RFI Report Preparation. Additional data collection should be focused on a specific purpose (such as for risk evaluation or pre-excavation characterization).

10. The sediment data set in the vicinity of the site should be considered complete since it targeted the few areas of sediment accumulation identified during the reconnaissance. The surface water dataset collected should be considered complete for evaluation purposes. It targeted areas on both sides of the river and along the length of the site. The New River does not appear adversely impacted by Celco Site, but analysis of risk needs to be completed to verify.

11. Constituents were detected in soil and groundwater at concentrations greater than Screening Levels:

    a. Arsenic was detected above Industrial RSLs in all soil/waste samples.

    b. Ammonia was detected in many soil and groundwater samples. Potential Sources of Ammonia are well understood. Major sources include historical WWTP sludge and plant waste/wastewater disposed in various locations in Plant and Landfill Areas. Other sources of nitrogen containing materials are used or are present in the plant, but are not considered to be a major contributor of nitrogen to the land includes coal ash, natural gas, coal, urea, ammonium bisulfite, pesticides, herbicides, fertilizers and other general plant trash. Ammonia was detected in only a few surface water samples at very low ppm levels. Ammonia criteria were calculated for all surface water samples – only exceedance was at OC004 (outfall 005) discharge location. A plume of ammonia follows the riverbank from Outfall 001 downstream to Stillhouse Branch Discharge area. These results will vary based on New River flow conditions. None of the New River concentrations exceed VDEQ Ammonia criteria.

    c. SVOCs (primarily PAHs) were detected in many soil samples, although these constituents are not widely detected in groundwater. For example, only trace PAHs were detected in groundwater at MP115, which is located near the soil sample with the highest PAH concentrations in soils (in the Plant General Area).

    d. PCBs, PFCs, and VOCs were detected in the former Fire Training Area. The risk analysis is needed to determine need for any additional data collection. Some soil PCB concentrations were greater than 50 ppm and will likely require mitigation.

e. The highest concentrations of metal detections appear clustered in Tank Farm and southeast corner of plant although concentrations greater than Industrial RSLs are limited.

f. 2,3,7,8-TCDD TEC concentrations were found at low levels not greater than Industrial RSLs in samples from WDAs 1, 2, 4, 5, 6, 9 and 10. 2,3,7,8-TCDD TEC concentrations were found at concentrations greater than Industrial RSLs in samples from WDAs in WDA 3, 7 and 8. Dioxins/Furans were detected at two former Incinerator locations in the Tank Farm. Sample location SB030A detected 2,3,7,8-TCDD TEF concentrations at levels greater than both the residential and industrial RSL. Sample location SB026A detected low levels 2,3,7,8-TCDD TEF concentrations not greater than the RSLs.

g. Separate Phase Hydrocarbons continue to be identified and removed from Tank Farm Area well MP035R although oil thickness and recovery has been reduced and is minimal.

h. 111-TCA concentrations at MP117 and MP3R do not appear to be from WDA 1 because111-TCA was not detected in soil/waste in WDA 1. Upgradient concentration of 111-TCA at MP126 is an order of magnitude lower than MP117 and therefore does not suggest a hydraulically upgradient source of 111-TCA. LF097B was only other well with 111-TCA, yet it is unlikely that deep groundwater at LF097B concentrations can migrate to shallow groundwater at MP117 location.

12. Chemical Sewer system has been upgraded to control potential release mechanism. Results of representative Chemical Sewer Section investigated indicates small potential for historical and future releases. Observations about sewer construction during excavation (i.e., concrete encased) suggest low potential for leakage, yet soils beneath sewer were not “clean”. Results suggest leakage from sewer has been minimal which is consistent with observation that sewer was encased in concrete and there was no visual evidence of leakage beneath the sewer pipe that was removed.

13. Numerous borings have been advanced during both Phase I and Phase IB in all 10 WDAs such that representative chemical data have been collected.

a. Waste types encountered include fly ash, CA fines and construction debris (e.g., brick, concrete, wood, etc.).

b. Chemical signature for the various waste types is comparable across the WDAs.

c. TCLP exceedances for benzene were detected at WDA 3 and WDA 9.

d. Waste disposal area boundaries have not been fully delineated laterally which may become important for corrective action evaluations for alternatives such as capping, treatment and/or removal, if needed. This information will be collected as pre-design data if needed. Approximate boundaries are understood enough to evaluate potential remedial alternatives.

e. All Waste Disposal Areas need to be further evaluated for separation distance between bottom of waste and seasonal high water table. WDA 456 has been fully evaluated and the data indicates that an adequate separation distance between bottom of waste and seasonal high water table exists. Additional water elevation data is being collected to confirm. WDA 1,2,3,7,8,9 and 10 need to be evaluated for bottom of waste to seasonal high water table separation distance. Piezometers and continuous measurement transducers will be installed, as necessary to confirm/verify separation distance

- Leachate seeps were not identified at any locations across the landfill area and previous surveys have not identified seeps – seeps are not anticipated in the future.

- Subsurface air (i.e., vapor) is typically a required pathway for evaluation under RCRA Corrective Action. Concern is that VOCs in groundwater or soil will potentially migrate into building (i.e., vapor intrusion) or that VOCs will potentially migrate into outside air where unacceptable exposures will occur. VOCs in groundwater and soil were generally detected at low concentrations or not at all. Lack of detections and low concentrations suggest that vapor intrusion is not an issue that needs to be pursued by collecting real-time subsurface gas samples. Groundwater/Soil to outside air can be evaluated with existing data. Sub-slab sampling in the former Fire-Training Area where VOCs were detected in groundwater near an existing building was intended to evaluate the vapor intrusion potential at the Site, but the work was not completed due to safety, liability and access concerns. The potential to collect a vapor sample is being addressed as part of the Phase II activities and a sample will be collected if feasible.

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