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State of Ohio Environmental Protection Agency

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Certified Mail

Re: ***Emerald Hilton Davis***
U.S. EPA I.D. No.: OHD 004 240 313
Statement of Basis

January 25, 2010

Mr. Terry Lee
NPEC Inc.
3800 Dewey Ave #317
Rochester, NY 14616-2579

Dear Mr. Lee:

Ohio EPA, Division of Hazardous Waste Management (DHWM) staff have reviewed the Proposed Corrective Measures for the Emerald Hilton Davis facility located at 2235 Langdon Farm Road, Cincinnati, Ohio. It is the recommendation of the staff that the director issue a Statement of Basis for Hilton Davis since the preferred recommendations for remediation of wastes or constituents appear to comply with applicable hazardous waste rules. Therefore, I have enclosed a Statement of Basis which identifies Ohio EPA's preferred recommendations and welcomes public comment. Ohio EPA will select the final remedies only after the public comment period has ended and the comments received have been reviewed.

A public notice concerning the issuance of the Statement of Basis will appear on January 26, 2010 in the Cincinnati Enquirer newspaper. Ohio EPA will hold a public meeting on February 25, 2010, at the Pleasant Ridge Recreation Center, 5915 Ridge Avenue, Cincinnati, Ohio 45213 beginning at 6:00 p.m. Ohio EPA will also host an open house from 5:00 to 6:00 p.m. Everyone who wants to comment will be allowed to speak. Ohio EPA will accept written comments relevant to the Statement of Basis until March 12, 2010. Written comments should be submitted before the close of the public comment period by mailing comments to Ohio EPA, Division of Hazardous Waste Management, Attn: Regulatory and Information Services Section, P.O. Box 1049, Columbus, Ohio, 43216-1049, (614) 644-2977.

After carefully considering public comments, Ohio EPA will issue a final decision document for site remediation.

If you have any questions concerning the Statement of Basis, please call Brian Gitzinger of Ohio EPA's Southwest District Office at (937) 285-6357.

Sincerely,

Jeremy A. Carroll, P.E.
Manager, Regulatory and Information Services Section
Division of Hazardous Waste Management

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cc: Edwin Lim, ERAS, DHWM, CO
Harold O'Connell, DHWM, SWDO
Brian Gitzinger, DHWM, SWDO
Tracy Wright, Emerald Hilton Davis
file

PUBLIC NOTICE

Hamilton County

OHIO EPA ISSUES DRAFT STATEMENT OF BASIS FOR CORRECTIVE MEASURES

On January 25, 2010, Ohio EPA issued a Statement of Basis for the Hilton Davis facility (now called Emerald Hilton Davis) located at 2235 Langdon Farm Road, Cincinnati Ohio 45237-4712. The EPA Identification Number for this facility is OHD004240313.

Why does the Hilton Davis facility need a Statement of Basis?
NPEC (a wholly owned subsidiary of Kodak) is addressing the contaminated soil and ground water at the Hilton Davis facility. The Statement of Basis (SB) identifies Ohio EPA's preferred remedies, explains the reasons for the selection of the remedies, solicits public review and comments, and provides information on how the public can be involved in the remedy selection process.

How can I tell Ohio EPA what I think about this Statement of Basis?
You can attend the public meeting and present your comments in person or submit written comments that are clear, concise, and well documented. Or, you are welcome to do both. Everyone who wants to comment at the public meeting will be allowed to speak. You should limit your presentation to five minutes and, if possible, submit a written copy of your comments to Ohio EPA at the meeting.

When and where will Ohio EPA hold a Public Meeting?
Ohio EPA will hold a public meeting on Thursday, February 25, 2010 at the Pleasant Ridge Recreation Center, 5915 Ridge Avenue, Cincinnati, Ohio 45213. Ohio EPA will host an open house from 5:00 to 6:00 PM, with the public meeting beginning at 6:00 PM.

When and how do I submit written comments?
You can submit written comments anytime between **January 26 and March 12, 2010**. Send your comments to Ohio EPA, Division of Hazardous Waste Management, Attn: Regulatory and Information Services Section, P.O. Box 1049, Columbus, Ohio 43216-1049, telephone number (614) 644-2977, fax number (614) 728-1245, e-mail: dhwmcomments@epa.state.oh.us.

Where can I review the Statement of Basis and supporting documents?
You can review these at one of the following locations:

Public Library of Cincinnati and Hamilton County, Bond Hill Branch, 1703 Dale Road, Cincinnati, Ohio 45237, tel.: (513) 369-4445;

Ohio EPA - Southwest District Office, 401 East Fifth Street, Dayton Ohio 45402, tel.: (937) 285-6357; and,

Ohio EPA, Division of Hazardous Waste Management, 50 West Town Street, Suite 700, Columbus, Ohio 43215, (614) 644-2917.

What will Ohio EPA do with the comments?
After carefully considering public comments, Ohio EPA will reconsider the SB, making any necessary changes, and issue a final decision. Ohio EPA will issue a "response to public comments," specifying any changes made to the SB. If you commented on the SB, Ohio EPA will send you copies of the "response to public comments" and the final decision.

Statement of Basis for Corrective Measures at

Hilton Davis

Cincinnati, Ohio

Hamilton County
OHD 004 240 313

prepared by

The Ohio Environmental Protection Agency

January 25, 2010

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EXECUTIVE SUMMARY

The Ohio Environmental Protection Agency (Ohio EPA) prepared this Statement of Basis (SB) for the Hilton Davis facility located at 2235 Langdon Farm Road in Cincinnati, Ohio. The purpose of this SB is to provide the public with information and solicit comments on the remedial alternatives Ohio EPA is proposing to select prior to taking a final action. An opportunity for the public to provide comments on Ohio EPA's proposed remedial alternatives extends from January 26, 2010 to March 12, 2010.

On October 20, 1986, responsible parties for the Hilton Davis site and Ohio EPA entered into a consent decree filed with the Hamilton County Court of Common Pleas. The overriding objective of this decree was to provide a process for investigating, evaluating and addressing contamination caused by past industrial activities which occurred at this site and were found to pose either short-term or long-term threats to human health and the environment.

Products made at the plant beginning in 1927 have included dyes, food colors, pigments, brighteners and pharmaceutical intermediates. Emerald Performance Materials currently owns and operates the facility (buildings and structures) at the site. Their manufacturing operation now employs approximately 175 workers who produce specialty chemicals such as dyes, food colors and pigment dispersions. North Pastoria Environmental Company, Inc. (NPEC) owns the real property (land) of the site. NPEC, as a wholly owned subsidiary of Kodak, has retained the historical environmental liability for the site and is currently assuming responsibility for addressing the provisions within the 1986 consent decree.

Local residents within the community organized to form a group called "Citizens Concerned about Hilton Davis" (CCHD) and have maintained involvement and provided input to those corrective action activities performed at the site. In addition, representatives of Golf Manor, Pleasant Ridge and the City of Cincinnati have remained actively engaged and interested in activities required by the consent decree. During the course of all consent decree-related activities, Ohio EPA has solicited input from the above-noted stakeholders. In addition to the general public, Ohio EPA is currently soliciting their comments on the proposed remedial alternatives for the Hilton Davis site.

The initial phase of the consent decree required a thorough and complete Remedial Investigation (RI) of the site to determine the nature and extent of contamination within ground water, soil/sediment, surface water and air. In performing RI activities, NPEC (site representatives) identified "Areas of Interest" (AOIs) at the site where hazardous wastes "are or have been placed" during the course of historical site operations. The RI was completed and a final report with the findings was prepared by NPEC which was approved by Ohio EPA on June 8, 2001.

During the course of conducting RI activities and developing preliminary risk estimates for the site, facility representatives began implementing short-term actions, referred to as "Interim Measures" (IM), to control or abate threats to human health and/or the

environment posed by contaminants. In general, site-specific IMs implemented to date include removal of contaminant source materials and installation of covers, along with intercepting, extracting and collecting contaminated ground water in order to prohibit it from migrating off-site.

The findings of the RI revealed that the geology at the site consists of fill, glacial overburden and underlying bedrock. The overburden is predominately glacial till deposits made up of silty clay with isolated sand and silty sand lenses. The underlying bedrock is limestone and shale, which are not sufficiently porous to contain large quantities or a high quality of ground water, therefore, ground water beneath the site is not used for drinking water purposes and the site and surrounding areas are supplied with drinking water by the City of Cincinnati.

Alternate Concentration Limits (ACLs) were developed as standards for protecting ground water underlying the site. The ACLs, which are risk-based standards, primarily consider off-site exposures due to vapor intrusion. These standards were developed and subsequently approved by Ohio EPA on March 21, 2003. The approved ground water monitoring program established the point of compliance for ACLs to be the site property boundary; ground water monitoring wells have generally not been observed to exceed the established ACLs. However, at two locations, sand layers at AOI G (MW-37 Area) and AOI C-Main Area (Ravine Landfill) interior to the site, ACLs are exceeded. NPEC has implemented IMs which are designed to extract and prevent off-site migration of contaminated ground water from these interior locations.

Once the RI activities were completed the consent decree required that a second phase of activities, known as a Corrective Measures Study (CMS), be performed in order “to develop and evaluate corrective action alternatives and to recommend the corrective action(s) to be taken at Hilton Davis Chemical Company,” as prescribed within the consent decree.

Within the CMS both ecological and human health risk considerations were evaluated by NPEC. As to ecological risk, the majority of the site is used for industrial purposes. However, a limited portion of the site, consisting of a seven acre tract of land located southeast of and adjacent to the site, was found to contain suitable habitat for hosting ecological receptors. Ohio EPA required NPEC to perform an ecological field survey of this area of the site, the results of which did not reveal known or suspected threatened, endangered or special concern species or associated habitat. Therefore, no further demonstrations or actions related to ecological risk assessment were required.

A Human Health Risk Assessment (HHRA) provides an evaluation of the threat or potential threat to human health associated with release or potential release of contaminants. The methodology is used to identify all exposure pathways of concern, perform a toxicity assessment for each contaminant found, conduct an exposure assessment for each route of exposure, and conclude with a determination as to whether or not adverse effects on human health are likely to occur. The outcome of the HHRA identifies particular constituents of concern (COC), appropriate receptors and

associated exposure pathways which may contribute most substantially to risk posed at the site. With this information it is possible to evaluate remedial alternatives which target specific COC and exposures at the site.

In summary, the findings of the HHRA identify six (6) AOIs requiring remedial measures or continuing operation and maintenance of interim measures (IMs) currently in place at the site. The six areas are: the AOI C-Main Ravine Landfill, AOI G (MW-37 Area), AOI C-West, AOI 59-Slit Trenches, AOI 59-Slit Trench H and AOI 104.

The HHRA considered site-specific input values and exposures. Specifically, in the case of AOI C-Main Ravine Landfill, AOI G (MW-37 area), and AOI 59-Slit Trenches, the HHRA considered the cover systems currently in place and the results indicate that risk criteria are not exceeded. Furthermore, the ground water monitoring program demonstrates that no exceedances of risk-based standards (i.e., ACLs) are occurring at or beyond the site property boundary.

In the case of AOI 59-Slit Trench H, AOI C-West and AOI 104, the HHRA indicates minimal exceedances of risk criteria for the on-site outdoor worker due to exposures to organic and inorganic contaminants present within both surface and subsurface soils.

The criteria used for evaluation of the appropriate remedial alternatives are stipulated within the consent decree. In addition, recent U.S. EPA guidance for addressing sites subject to RCRA Corrective Action requirements was also consulted by Ohio EPA when evaluating the proposed remedial alternatives. The following table provides a summary of the preferred alternatives identified by NPEC compared to those proposed for selection by Ohio EPA:

NPEC's Preferred Alternatives vs. Ohio EPA's Proposed Alternatives

AOI	NPEC's Preferred Alternative(s)	Ohio EPA's Proposed Alternative(s)
AOI C-Main Ravine Landfill	• Containment: use existing clay/soil cover • PGCS and Interim Engineering Controls (IEC) • Ground water monitoring	• Containment: use of existing cover system • PGCS and IEC • Ground water monitoring • Soil gas monitoring program
AOI G (MW-37 Area)	• Containment: use existing asphalt cover. Construct new clay/soil cover where needed; • PGCS and IEC • Ground water monitoring	• Containment: use of existing cover system. Construct new clay/soil cover where needed. • PGCS and IEC • Ground water monitoring

AOI C-West.	• Containment: use existing asphalt/concrete cover. Construct new clay/soil cover where needed	• Containment: use of existing cover system. Construct new clay/soil cover where needed
AOI 59-Slit Trenches	• Containment: use existing clay/soil cover and existing asphalt cover	• Partial Excavation
AOI 59-Slit Trench H	• Containment: Construct asphalt cover	• Containment: Construct cover system
AOI 104	• Containment: Construct asphalt cover	• Containment: Construct cover system
Site-wide Controls	• Environmental Covenant • Soils Management Plan (SMP) • Perimeter Ground Water Collection System (PGCS) • Ground Water Monitoring Program	• Environmental Covenant • Soils Management Plan (SMP) • Perimeter Ground Water Collection System (PGCS) • Ground Water Monitoring Program

Ohio EPA's proposed remedial alternatives, similar to NPEC's *preferred remedies*, utilize a containment strategy consisting of cover systems (either current or newly constructed), ground water extraction, ground water monitoring and institutional controls. The one exception is that rather than employing a cover system at AOI 59-Slit Trenches, Ohio EPA is proposing further excavation to remove remaining residual contaminated soil.

The rationale for requiring additional excavation at AOI 59-Slit Trenches rather than the NPEC's preferred alternative of using the current cover, is that the exceedance of risk is caused by residual contaminants found in post-excavation confirmation samples indicating further excavation is necessary at 2 of the 13 slit trenches. NPEC's preferred remedial approach recommends using the current cover over the entire AOI 59-Slit Trenches area, which would require long-term maintenance and a land use restriction.

Ohio EPA agrees that a Soil Management Plan (SMP) may be utilized to control and monitor exposures, both on and off-site, which could occur as a result of on-site excavation activity. In addition, the Perimeter Ground Water Control System (PGCS) and the Ground Water Compliance Monitoring Plan (GWCMP) may be used to control and monitor ground water in order to prevent off-site exposures. Ohio EPA will require that an Environmental Covenant be established in order to ensure that any institutional controls (such as limiting land use to industrial) are enforceable and perpetual.

STATEMENT OF BASIS FOR
Hilton Davis
Cincinnati, Ohio

1.0 INTRODUCTION

On October 20, 1986, responsible parties for the Hilton Davis site and Ohio EPA reached a consent agreement which was filed with the Hamilton County Court of Common Pleas. Since 1986 the "consent decree" has provided the structure and served as a process guide for conducting and managing each element of the investigation and cleanup action at the Hilton Davis site. The process in the 1986 consent decree includes the following major steps: Remedial Investigation (RI), Interim Measures (IM) and Corrective Measures Study (CMS). The purpose of the Remedial Investigation (RI) is to define the nature and extent of contamination at the facility. Interim Measures (IM) are actions taken to control or abate immediate or ongoing risks prior to selection and implementation of final site remedies. The Corrective Measures Study (CMS) quantifies the risk posed to either human health or the environment from site contaminants, along with evaluating the array of appropriate remedial alternatives in order to arrive at a recommended approach proposed by site representatives for addressing those contaminants at the site which pose an unacceptable risk.

The Statement of Basis (SB) draws from and summarizes more extensive information contained within reports which were previously reviewed and approved by Ohio EPA during both the RI and the CMS phases of the corrective action process, as specified within the consent decree for the Hilton Davis site. Although this SB provides a preview of those remedial alternatives proposed for the site by Ohio EPA's technical staff, as well as our rationale for choosing these, Ohio EPA's final remedial alternatives will not be selected until after considering public comments. Ohio EPA may modify the proposed remedial alternatives or choose other remedial alternatives based on public comments. Ohio EPA will then select final remedies and communicate this decision within a document which will accompany any final action taken by the Director.

2.0 PUBLIC PARTICIPATION

Local residents within the community have maintained a longstanding and vigilant watch over activities performed at the site. Residents organized to form a group known as Citizens Concerned about Hilton Davis (CCHD) with the objective of ensuring that their concerns about the site were known to site representatives and those regulatory agencies responsible for monitoring the site's compliance with applicable environmental regulations. Additional public entities involved in these discussions have included representatives of the City of Cincinnati, Pleasant Ridge, and the Village of Golf Manor.

During the negotiation of the consent decree local citizens and their counsel petitioned the court to ensure that any final agreement between the State of Ohio and site representatives involved a process for providing ample opportunities for local citizens to have input into those RI and CMS activities incorporated into the consent decree.

During the course of the RI/CMS activities Ohio EPA and site representatives have solicited input from CCHD and their technical consultant. Ohio EPA has solicited and received formal written comments from CCHD on each draft of the RI, CMS Work Plan, and all three drafts of the CMS report. Ohio EPA has provided written responses to CCHD's comments which are available as part of the public record. Ohio EPA has in certain instances shared CCHD's concerns and communicated these in Notices of Deficiency, such as in the case of requiring further investigation and additional corrective measures study of AOI G (MW-37 Area) and the Ravine Landfill. In other instances Ohio EPA has not shared CCHD's concerns and has provided the Agency's position in writing to all stakeholders.

Ohio EPA is currently soliciting community input on the proposed corrective action and associated selection of remedial alternatives for the Hilton Davis site as contained within this Statement of Basis. Ohio EPA has scheduled a public comment period of 45 days, extending January 26, 2010 to March 12, 2010 in order to encourage public participation in the remedy selection process. During the public comment period, Ohio EPA will accept written comments on the proposed remedial alternatives.

The administrative record, which contains documents relevant to the proposed remedial alternatives, is available at the following locations:

Public Library of Cincinnati & Hamilton County
Bond Hill Branch
1703 Dale Road
Cincinnati, Ohio 45237
(513) 369-4445

or

Ohio EPA, Southwest District Office
401 East 5th Street
Dayton, Ohio 45402
(937) 285-6357

and

Ohio EPA, Central Office
Division of Hazardous Waste Management
Lazarus Government Center
50 W. Town Street Suite 700
Columbus, Ohio 43215
(614) 644-2917

After Ohio EPA considers the public comments, such comments will be summarized and responded to in writing within a document referred to as a responsiveness summary.

This document will be drafted at the conclusion of the public comment period and will be incorporated into the administrative record. The public is encouraged to send written comments to Ohio EPA and to request further information.

Written comments may be submitted before the end of the comment period to:

Ohio EPA, Central Office
Division of Hazardous Waste Management
Regulatory and Information Services Section
P.O. Box 1049
Columbus, Ohio 43216-1049
e-mail Address: dhwmcomments@epa.state.oh.us

3.0 FACILITY OWNERSHIP & OPERATIONS

Currently a company called North Pastoria Environmental Company, Inc. (NPEC) owns the real property (land) of the site. A separate company called Emerald Performance Materials owns and operates the facility (buildings and structures) at the site. NPEC, as a wholly owned subsidiary of Kodak, has retained the historical environmental liability for the site and is currently assuming responsibility for addressing the provisions within the 1986 consent decree.

Products made at the plant over the span of time summarized below have included dyes, food colors, pigments, brighteners and pharmaceutical intermediates. Raw materials used at the plant have included acids, bases, amines, organic solvents and inorganic compounds. Manufacturing operations at the site currently conducted by Emerald Performance Materials produce specialty chemicals such as dyes, food colors and pigment dispersions. The plant employs approximately 175 employees.

The chronology of facility owners and operators over the course of manufacturing operations which have occurred at the site over time is listed below:

- 1927: the company was privately owned and operated as the “Hilton-Davis Chemical Co.” (Hilton-Davis) and was formally incorporated in 1936;
- January 1945: Hilton-Davis was purchased by Sterling Drug Inc. (SDI), and was operated as the “Hilton-Davis Company, a Division of Sterling Drug Inc.” (Hilton-Davis – Sterling);
- December 1983: SDI transferred Hilton-Davis – Sterling to its subsidiary The Hilton-Davis Chemical Co.;
- October 1986: H.D. Acquisition Corporation acquired The Hilton-Davis Chemical Co.;
- December 1986: The Hilton-Davis Chemical Co. changed its name to The SDI Divestiture Corp.;
- January 1987: SDI Divestiture Corp. was purchased by PMC, Inc. (PMC) and was operated as the “Hilton-Davis Company” (Hilton-Davis – PMC). As part of

the purchase agreement with PMC, SDI retained responsibility under the Consent Decree;

- February 1988: SDI was purchased by Eastman Kodak Company (Kodak);
- October 1991: SDI changed its name to Sterling Winthrop Inc. (SWI);
- September 1993: Hilton-Davis – PMC was purchased by Freedom Chemical (Freedom) and was operated as the Hilton-Davis Company (Hilton-Davis – Freedom). As part of this transaction in September 1993, SWI purchased the real property from Hilton Davis – PMC;
- August 1994: SWI was purchased by SmithKline Beecham (SKB). As part of the purchase agreement, 360 North Pastoria Environmental Corporation (NPEC) retained management of certain environmental matters at this Hilton-Davis Site, including responsibility under the Consent Decree;
- September 1996: SWI changed its name to STWB Inc. (STWB);
- March 1998: Hilton-Davis – Freedom was purchased by B.F. Goodrich Company and was operated as BF Goodrich – Hilton-Davis;
- February 2001: BF Goodrich sold the Hilton-Davis facility to Noveon, Inc. and was operated as Noveon Hilton Davis, Inc. (Noveon);
- March 2003: North Pastoria Environmental Company, Inc. (NPEC) purchased the real property (land) from SDI;
- June 2004: Lubrizol Corporation (Lubrizol) purchased Noveon and operates as Noveon Hilton Davis, Inc.
- May 2006: Sun Capital Partners, Inc. purchased certain assets of Lubrizol, including Noveon Hilton Davis, Inc. and operates as Emerald Performance Materials, LLC (Emerald).

4.0 LOCATION & LAND USE

The site, located at 2235 Langdon Farm Road within the City of Cincinnati, is approximately 81 acres and is about 2 miles east of Interstate 75, 1.5 miles west of Interstate 71 and 1.5 miles north of State Route 562 (Figure 1, Location Map). The facility operates 24 hours per day and is completely surrounded by chain link fence with 24-hour security which allows only authorized entry.

Properties situated adjacent to the site are used for a variety of industrial, commercial, residential and recreational purposes. The northern property boundary abuts Langdon Farm Road beyond which is a residential community and the Village of Golf Manor. Along the eastern boundary of the site, the northern half of which is bordered by a residential community called Pleasant Ridge, the southern half of which is bordered by industrial property hosting operations conducted by Fusite, a division of Emerson Electric Corporation. Along the entire southern boundary is a railroad right-of-way, beyond which on the eastern half is an undeveloped wooded area consisting of 7.0 acres enclosed by chain link fence which is also owned and maintained by NPEC. Beyond the southern property boundary, the western half is a public recreational area called Fenwick Park and further south beyond the wooded area and park is a residential community situated within the City of Norwood. The southern property boundary curves

from Fenwick Park toward the northwestern corner which is bordered by mostly industrial properties located within the City of Cincinnati.

Land use is a key consideration to Ohio EPA when determining the degree of site remediation which is necessary to assure protectiveness. Ohio EPA's practice is that both current and reasonably anticipated future site land use, along with the corresponding exposure assumptions for appropriate receptors, be considered in the evaluation, selection and timing of remedial actions. Land use in the RCRA Corrective Action remedy selection process is summarized in U.S. EPA's May 1, 1996 Advanced Notice of Proposed Rulemaking (ANPR) Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities, page 19452. U.S. EPA's policy is that "current and reasonable expected future land use and corresponding exposure scenarios should be considered in both the selection and timing of remedial actions." Specifically, U.S. EPA stated that:

"Reasonable future land use assumptions should be assessed when developing remedial goals for any given facility and used to focus all aspects of the corrective action process; however, EPA cautions against automatically restricting assumptions of future land use to extrapolation of the current use or relying only on designated zoning or industrial use codes to establish land use assumptions. A large industrial facility could include office areas, parking areas, a child care area or on-site residences. Highly industrial sites are sometimes located adjacent to residential properties. All of these factors should be considered when making land use assumptions EPA recognizes the complexities associated with developing reasonably anticipated land use assumptions and the need for caution when basing remedial decisions on assumptions of future use; however, the Agency believes that non-residential land use assumptions are appropriate for many corrective action facilities. When remedies based on non-residential exposure scenarios involve a combination of treatment and engineering or institutional controls, program implementors and facility owner/operators should use currently available tools to ensure that the remedy continues to achieve its objectives over time and the land use assumptions remain valid." (61 FR 19452, May 1, 1996).

The ANPR also refers to additional U.S. EPA guidance on incorporating reasonable future land use assumptions in remedial decision-making in the guidance document "Land Use in the CERCLA Remedy Selection Process" (OSWER Directive No. 9355.7–04, May 25, 1995). The 1995 OSWER directive was developed primarily to address land use considerations under the CERCLA program; however, the principle of early and complete involvement of stakeholder groups to develop realistic land use assumptions is equally applicable to the RCRA corrective action program. U.S. EPA recognizes that RCRA facilities are often industrial properties that are actively managed, rather than the abandoned sites typically addressed under CERCLA. Because of this consideration, the directive stated that non-residential use considerations might be especially appropriate at many RCRA corrective action facilities (see ANPR at 61 FR 19439, May 1, 1996, and 1995 OSWER Directive 9355.7-04 pages 4 through 6).

Ohio EPA's initial step during the development of the CMS Work Plan was to involve the various site stakeholders in the examination of potential future land use scenarios. Beginning in 2001, a series of meetings and discussions were held involving Ohio EPA, NPEC, CCHD, along with representatives from the City of Cincinnati in order to gather information and develop reasonable assumptions involving future land use at the site. Agency personnel took into consideration the site's current industrial land use, along with the site's location in proximity to other adjacent areas within the community and their corresponding land use designations (e.g., industrial, commercial, and residential) which are subject to local zoning codes. Also factored into consideration was the current local land-use plan and corresponding zoning requirements formulated by the City of Cincinnati, which predicts that the site land use will continue to be utilized for industrial purposes. In addition, the vulnerability of ground water underlying the site to contaminants, whether critical habitats of endangered species were present at the site, along with the location of well head protection areas and public water supply wells, were also viewed as relevant factors for consideration by the various stakeholders who participated in these discussions.

In conjunction with referencing the above-noted land use guidance, Ohio EPA factored into consideration all site specific information supplied by the stakeholders and subsequently determined it to be appropriate to rely on the assumption that future land use at the site would continue to host industrial activities, as was subsequently acknowledged within the Agency's approval of the CMS Work Plan on July 11, 2002. Based on projected the future land use designation of industrial activity at the site, the CMS Work Plan established the array of types of receptors (e.g., site, construction and utility workers) and associated exposure pathways (e.g., inhalation, vapor intrusion, ingestion) which would need to be considered within the site-specific human health risk assessment to be conducted within the CMS.

The subsequent CMS Report contains a comprehensive evaluation of all appropriate remedial alternatives for those six (6) Areas of Interest (AOIs), one of which is the Ravine Landfill, which pose an unacceptable risk to human health and the environment, based on industrial exposure assumptions corresponding with future land use being designated to remain industrial. The evaluation of the array of remedies contained within the CMS Report is based on a final cleanup standard which assumes that future land use will be restricted to industrial activities, consistent with past, current and future land use scenarios reasonably anticipated to occur at this property.

Such limitations on future land use at the site will require long-term institutional controls (e.g., deed restriction, use and activity limitations) enforceable by Ohio EPA. Within the Agency's selection of the final remedy, or host of remedies, Ohio EPA will ensure that the land use restrictions which are put in place will be upheld through the execution of an 'Environmental Covenant,' which requires both current and future property owners to adhere to those land use restrictions imposed. In conjunction with any long-term land use restrictions, a current restriction is already in place for a portion of the site, that being in the form of an already approved post-closure plan requiring long-term care, maintenance and monitoring of the location where the lagoons were formerly operated.

5.0 ENVIRONMENTAL SETTING

5.1 Topography

The site is located in an upland area with approximate ground surface elevations from 600 to 680 feet above mean sea level (AMSL), 100 to 180 feet above the elevation of Mill Creek and 50 to 130 feet above the ground surface elevation of the Norwood Lateral. The low elevation of the site (600 feet AMSL) occurs along the center line of part of the former ravine, located in the southwestern portion of the site. The highest elevation (680 feet AMSL) occurs midway along the eastern property line. Historically, the site was bisected by a ravine called Bloody Run Creek. Topographic contours indicate that the ravine had a centerline elevation of approximately 650 feet AMSL at the northeastern property line and 600 feet AMSL at the southwestern property line. The ravine was as deep as 30 feet and as wide as 150 feet. A comparison of 1948 and 1995 topographic contours indicates that land-filling has occurred within the former ravine. The site is relatively flat to the north of the former ravine. A second valley exists south of the site in the public recreational area called Fenwick Park, which has a centerline elevation of 635 feet AMSL at the eastern end and 600 feet AMSL at the western end.

5.2 Wetlands and Surface Water Features

The site is located approximately 4 miles north of the Ohio River, 2 miles west of the Little Miami River and 2 miles east of Mill Creek but is not located within the floodplains of any of these rivers. There are no permanent, flowing surface water features or classified wetlands within 1 mile of the site. Within the southeastern wooded area there is a seasonal intermittent stream and locations of high water table (A1, A2 sands) which historically has produced surface seeps. There is also a swale which becomes a seasonal stream as it runs from east to west within the southeastern wooded area, then enters a culvert at the boundary of Fenwick Park. In about 1982 surface seeps were found to outcrop (A1 Sand) on the hillside between the southern boundary of the site and Fenwick Park. The seeps were addressed by the installation of a French drain system (Fenwick Park collection system), which to date has proven to be effective in preventing further occurrences of uncontrolled ground water seepage. Ohio EPA's proposed final correction action includes a requirement to monitor and assess each area where seeps had been observed to verify there is no recurrence. Storm-water runoff from the site is controlled by a facility storm water management program.

6.0 GEOLOGY/HYDROGEOLOGY

6.1 Site Geology

The geology at the site consists of fill, glacial overburden and underlying bedrock. The overburden materials have been defined from data gathered during field investigations (borehole and monitoring well installations), hydrogeologic testing and grain size distribution analyses.

The overburden of the site is predominantly a complex glacial till deposit made of silty clay with isolated sand and silty sand lenses. Other unconsolidated materials include the uppermost fill unit, an upper silty clay unit and basal silty clay unit. Within the silty clay overburden, there are water bearing sand zones which are further described within Section 6.4.

Overburden and Fill

The overburden at the site consists of inter-bedded glacial till, glaciolacustrine silty clay, and glacial outwash sand, but is predominantly silty clay. Thickness of the overburden ranges from 10 feet in the east-central portion of the site, where the overburden is located over the bedrock high, to 110 feet where bedrock slopes to a lower elevation. Fill has been placed in many areas of the site including the former ravine, the MW-37 Area, and the former lagoon area. The fill is generally a silty clay soil that has similar physical characteristics to the surficial silty clay soil at the site, and is believed to consist of relocated or reworked native soils.

Upper Clay Unit

The upper clay unit beneath the site extends from the base of the fill or the ground surface to the top of the uppermost water-bearing sand zones. The weathered portion of this unit is described as brown clay with some fine sand and a trace of gravel and occurs approximately 0 to 15 feet below ground surface (bgs). The unweathered portion of the unit consists of a gray to gray-brown, silty clay, with some sand and angular fossiliferous limestone gravel; and varies in thickness from 5 to 21 feet.

Basal Clay Unit

The basal clay unit is of lacustrine origin and is described as gray to light brown calcareous silty clay with occasional thin interbeds of fine sand, silt or peat, and trace fossiliferous limestone gravel. The upper basal till is found throughout the site.

Bedrock Unit

The underlying bedrock at the site was defined using information from borehole and monitoring well installations and a seismic refraction survey. The site is underlain by the Kope Formation, which is a gray to greenish-gray calcareous shale inter-bedded with ¼- to 6-inch beds of fossiliferous limestone. The shale is thinly bedded and contains many fossils. The fossiliferous limestone beds are generally light gray and comprise 10 to 20 percent of the formation encountered on site. Under some areas of the site, the shale is highly weathered at the top of the formation exhibiting a clayey texture, which becomes more competent and mildly fissile with depth.

6.2 Ground water Use

In general, the limestones and shales underlying the site are not sufficiently porous to contain large quantities of ground water. The ground water in these formations is unsatisfactory for municipal supplies including potable and industrial usage. Therefore, ground water beneath the site is not used for drinking water purposes. The City of Cincinnati Water Works system supplies the plant and surrounding areas with water that is obtained from the Ohio River. The City of Cincinnati municipal code prohibits the

issuance of a building permit for structures that are designed for human occupancy, that are not connected to the municipal water supply or an alternate source approved by the local Health Department. In addition, no well head protection areas have been delineated in the vicinity of the site. No ground water use occurs within ½ mile of the site and the site is not located within a well head protection zone.

In order to determine the ground water usage in the vicinity of the site, all water well records on file were obtained from the Ohio Department of Natural Resources (ODNR) and the United States Geological Survey (USGS) and are presented in the Comprehensive Remedial Investigation CRI Report (1998). The closest water supply well is located approximately 3,000 feet to the south of the site. This water supply well is installed within a separate aquifer system (the main Norwood trough), is 211 feet deep and is used for industrial purposes. Based on the local ground water flow pattern, this water supply well is upgradient of and separated from the site by an upland area. There are no industrial properties immediately downgradient of the facility that use ground water for industrial purposes based on the available information.

6.3 Development of Alternate Concentration Limits (ACLs)

The 1986 Consent Decree required development of Alternate Concentration Limits (ACLs) for ground water. Ohio EPA refers to these regulatory standards to determine if ground water contamination exceeds limits protective of human health. The final ACLs were approved by Ohio EPA on March 21, 2003. Since the ground water in the area is not used for potable purposes, nor are the formations beneath the site capable of producing yields suitable for potable use, risk-based ACLs were developed considering off-site exposures due to vapor intrusion and trespasser exposures to shallow ground water (surface seeps). Off-site exposures which may occur during underground utility work were also considered. ACLs exist for constituents of concern (COC) including certain VOCs, SVOCs and metals. The point of compliance for the ACLs is the perimeter boundary of the site. Both historically and currently, ground water concentrations at the site perimeter wells do not exceed ACLs. There are two locations interior to the site that have exceedances of the ACLs which are within AOI G (MW-37 Area), and within the AOI C-Main Area Ravine Landfill. Since 1999 there has been an interim engineering control (IEC) ground water extraction system removing contaminated ground water from the sand zones underlying both of these areas.

6.4 Hydrogeology

The hydrostratigraphic units identified beneath the site include the following water-bearing zones: A0 Sand; A1 Sand; A2 Sand; A3 Sand; and Bedrock. The sand horizons are consistent with the regional geologic setting in which locally continuous glaciofluvial sands occur separated by clay or till units. Each of the four sand zones and the bedrock are stratigraphically separated from each other by a layer of lower permeability clay (aquitard) (Figure 6, Geological Cross Sections). Hydraulic monitoring of the five water-bearing zones has been undertaken from 1979 to the present. The hydraulic conductivities of the hydrostratigraphic units have been determined from previous investigations and are provided below. In general, ground water flow in each

of the five water-bearing horizons under the site is radially away from the east central portion of the site where a bedrock high is located.

Hydrogeological details for the major geologic and hydrogeologic units at the site are as follows:

6.4.1 Overburden and Fill

The fill is the uppermost horizon over the developed site area and is not one of the water-bearing zones.

6.4.2 A0 Sand

The A0 Sand is encountered below the upper clay unit in the northern area of the site. The A0 Sand consists of silty to clayey, medium to fine grained sand with little gravel and is inter-bedded with layers of silt or clay in some areas. It is generally encountered at an elevation between 620 and 645 feet AMSL (approximately 1 to 40 feet bgs). The A0 Sand ranges from less than 1 foot thick near (MW-37-A0) to 18 feet thick near (MW-48-A0). Figure 2 shows the MW-37 Area and A0 Sand. The hydraulic conductivity of the A0 Sand is approximately 6×10^{-4} cm/sec. Ground water flow in this unit is to the northwest, and the horizontal ground water flow velocity is estimated to be approximately 66 ft/year. Vertical gradients between the A0 Sand and A1 Sand are generally downward. Pump tests indicate that a cumulative, sustained pumping rate of 1.5 gpm can be achieved from wells in the MW-37 Area.

6.4.3 A1 Sand

The A1 Sand is encountered in all areas of the site except for an area running east to west in the central region of the site. In this area the bedrock surface is above the elevation of the A1 Sand or where the A1 Sand was eroded by surface water flow in the former ravine. The A1 Sand is generally encountered at an elevation of between 600 and 630 feet AMSL (approximately 1 to 65 feet bgs). The A1 Sand outcrops on the valley wall or on the valley floor in Fenwick Park and on the Hilton Davis property south of the railway tracks. The A1 Sand varies in texture from sandy silt with clay to sand with gravel, but generally consists of silty sands. Figure 3 shows the Ravine Landfill and A1 Sand. The hydraulic conductivity of the A1 Sand is approximately 3×10^{-4} cm/sec. Ground water flow is toward the northwest in the northern portion of the site, and to the southwest in the southern portion of the site. The horizontal ground water flow velocity is estimated to be approximately 26 ft/year in the northern portion of the site and 72 ft/year in the southern portion of the site. Vertical flow direction between the A1 Sand and A2 Sand is downward. The ground water yield from the one extraction well in the vicinity of the Ravine Landfill area is about 1.5 gpm.

6.4.4 A2 Sand

The A2 Sand is encountered in the southern portion of the site, which includes the area south of the railway tracks. The A2 Sand is encountered at elevations between 585 and 605 feet AMSL (approximately 12 to 72 feet bgs) and ranges in thickness from 2.5 to 20 feet. The A2 Sand consists of gray or gray-brown sandy silt or silty sand (Figure 4, A2 Sand). The hydraulic conductivity of the A2 Sand is approximately 7×10^{-5} cm/sec.

Ground water flow in this unit is to the southwest, and the horizontal ground water flow velocity is estimated to be approximately 12 ft/year. The vertical gradient between the A2 Sand and A3 Sand is upwards at the only location measured.

6.4.5 A3 Sand

The A3 Sand is present in the southern portion of the site, which includes the area south of the railway tracks. The A3 Sand is generally found at elevations between 560 and 580 feet AMSL (approximately 40 to 75 feet bgs) and ranges from 2 to 10 feet in thickness. The A3 Sand typically consists of clayey silt inter-bedded with fine sand. (Figure 5, A3 Sand). The hydraulic conductivity of the A3 Sand is approximately 1×10^{-4} cm/sec. Ground water flow in this unit is expected to be to the southwest, consistent with flow in the A1 and A2 Sand. The horizontal hydraulic conductivities range from 6.98×10^{-5} to 4.33×10^{-4} cm/sec, with a geometric mean of 1.74×10^{-4} cm/sec. Since only two wells are completed in the A3 Sand, the average horizontal hydraulic gradient and an associated linear velocity for the A3 Sand could not be calculated. Vertical gradients between the A3 Sand and the bedrock are generally downward.

6.4.6 Bedrock

The site is underlain by the Kope Formation, which is a gray to greenish-gray calcareous shale inter-bedded with ¼- to 6-inch beds of fossiliferous limestone. The shale is thinly bedded and contains many fossils. The fossiliferous limestone beds are generally light gray and comprise 10 to 20 percent of the formation encountered on site. Under some areas, the shale is highly weathered at the top of the formation exhibiting a clayey texture, which becomes more competent and mildly fissile with depth. The hydraulic conductivity of the bedrock is 1×10^{-3} cm/sec. Ground water flow in this unit is radially outward from the bedrock topographic high in the east-central portion of the site, and the horizontal ground water flow velocity is estimated to be approximately 448 ft/year. Vertical gradients between the sand units (A0, A1, A2, and A3) are generally downward. The regional bedrock consists of inter-bedded Ordovician shales and limestones. The limestones and shales are not sufficiently porous to contain large quantities of ground water.

6.5 Man-made Influences Affecting Ground water Flow

Several man-made structures are present on or near the site, which may locally impact ground water flow patterns. Where sewers and underground utilities are located below the water table (A0 or A1 sand), localized infiltration to the sewers/utilities and associated bedding is expected. The Fenwick Park collection system, located southwest of the main plant, intercepts ground water from the A1 Sand and has resulted in the steepening of the hydraulic gradients in the A1 Sand in the southwestern portion of the site (Figure 8, A1 Sand PGCS, A1 Sand Extraction Wells and A2 Extraction Well). The installation in 1997 of Fusite's Source Control Interim Measure, a dual-phase vacuum extraction system, likely impacts the local flow regime in the A1 Sand southeast of the site. Ground water contours in the northern and southern portions of the site are affected and controlled by operation of the 1999 site Interim Engineering Controls (IEC) Extraction System that was completed in the AOI C-Main Ravine Landfill area and the AOI G (MW-37) area of the site. The perimeter ground water collection system (PGCS),

which was installed in 2005, is designed to intercept ground water along its alignments along the northern property line within the A0 sand and along the southern property line within the A1 sand (Figure 9, A0 Sand Extraction Points and A0 Sand PGCS).

7.0 SUMMARY OF REMEDIAL INVESTIGATION (RI)

The consent decree required that in performing RI activities site representatives were to conduct a comprehensive survey of all areas at the facility at which hazardous wastes "are or have been placed," in addition to "areas at which other wastes have been placed if such wastes are causing or are threatening to cause contamination of the soils or waters of the state." The RI conducted for the Hilton Davis site determined the nature and extent of contamination in site ground water, soil/ sediment, surface water and air. The RI was completed and a final report of the associated findings was approved by Ohio EPA on June 8, 2001. The approved RI Report is comprised of the following three documents; December 18, 1998 *Draft Comprehensive Remedial Investigation Report*, May 14, 2000 *Area of Interest Work Plan* (AOIWP); May 29, 2001 *Comprehensive Remedial Investigation Addendum Report*.

The RI activities resulted in a comprehensive examination of a total of 111 Areas of Interest (AOIs) located across the site. AOIs are generally defined as areas where on-site waste or product chemical management activities occurred, resulting in either the potential for, or actual releases, impacting human health and the environment. Of the 111 AOIs investigated during RI activities only 70 were found to have contamination which exceeded screening criteria that had been developed for the RI. The following chart summarizes the type of contaminated environmental media (i.e. soil, ground water, surface water, air) which exceeded screening criteria within the RI at the 70 AOIs along with noting the associated contaminants of concern (COC).[1]

TABLE1
SUMMARY OF CONTAMINATED MEDIA WHICH EXCEEDED SCREENING CRITERIA IN THE RI

Contaminated Media Which Exceeded Screening Criteria	Contaminants of Concern (COC)
Surface soils- site wide encompassing 70 AOIs (defined as soil horizon 0 -2 ft below ground surface)	lead, arsenic, toluene, methylene chloride, and benzo(a)pyrene.
Subsurface soils- site wide encompassing 70 AOIs (defined as soil horizon deeper than 2 ft continuing to top of saturated zone)	lead, benzene, toluene, chlorobenzene, methylene chloride, trichloroethylene, tetrachloroethylene, 1,2 dichloroethane, vinyl chloride, and nitrobenzene.
A0 Sand – uppermost saturated zone at northern half of site.	benzene,toluene,chloroform,chlorobenzene, trichloroethylene, tetrachloroethylene, 1,1-dichloroethene,1,2-dichloroethane,and vinyl chloride.
A1 Sand – uppermost saturated zone southern part of site.	benzene,toluene,chloroform, chlorobenzene,trichloroethylene, tetrachloroethylene,1,1-dichloroethene, 1,2-dichloroethane, and vinyl chloride.
A2 Sand – saturated zone southern part of site	vinyl chloride
Bedrock unit- saturated zone near ravine landfill	benzene, benzo(a)anthracene

[1]Information contained in this Table was obtained from Figures 10.2, 10.3, 10.4,10.5, 10.6, 10.7 of the *Draft Comprehensive Remedial Investigation Report* dated December 18,1998.

8.0 INTERIM MEASURES

During the course of conducting RI activities and developing preliminary risk estimates for the site facility representatives began implementing what are known as “interim” measures. Interim measures (IMs) are short-term actions taken to control or abate threats to human health and/or the environment from releases and/or to prevent or minimize the further spread of contamination while long-term remedies are pursued. In general, the objectives associated with the site-specific IMs implemented to date include removal of contaminant source materials and installation of covers, along with intercepting, extracting and collecting contaminated ground water in order to prohibit it from migrating off site. Details associated with those interim measures initiated by facility representatives during the course of conducting RI/CMS activities at the site are provided below.

8.1 CURRENT COVER ON RAVINE LANDFILL

NPEC states that around 1980 a cover was placed on the ravine (CMS Appendix AB, page AB-1). NPEC estimates this cover is over 12-inches thick (Appendix AX, Memorandum July 13, 2007) page 2 of 3. Ohio EPA is not aware of any records which document any design plans or specifications for this cover, nor are there any documents indicating reviews or approvals of the cover. At the time of the slit trench removal project (2004), in order to restore the work area of the project, NPEC distributed clean clay cover over the area of the slit trenches including part of the Ravine Landfill (*Slit trench Interim Measures Completion Report*, September 2004, p. 22). The limits of the cover were surveyed and are presented in Fig 3.5 of that document. The document estimates that this effort resulted in providing a minimum thickness of 6 inches of clean clay to the area (p. 25).

Appendix AU of the CMS provides further documentation related to the cover material placed at the Ravine Landfill in 2004 during restoration of the work area after the slit trench removal project. Attachment AU.3 estimates thickness of the cover based on the weight of clay imported divided by the area it was spread upon and estimates 0.9 feet of clay cover and 0.5 feet of topsoil cover for a total of 1.4 feet of cover placed on the Ravine Landfill. Figures AU1 and AU2 of the CMS show the results of topographical surveys of the area in 1999 and after the slit trench removal project in 2004. The implementation of this IM has resulted in reduced potential for on-site workers to incur exposures related to contaminants within wastes and soils underlying the installed cover.

8.2 FENWICK PARK COLLECTION SYSTEM

This French drain style ground water collection system was installed in 1984 to prevent seeps discovered in 1982 emanating from the hillside between the southern property boundary of the facility and Fenwick Park. The system effectively captures ground water in A1 Sand layer, thereby preventing additional seep outbreaks at the hillside location adjacent to Fenwick Park. The implementation of this IM has prevented further seeps of contaminated ground water within Fenwick Park.

8.3 LAGOON CLOSURE PROJECT

The former lagoons were located in the southeastern corner of the site and encompassed an area of approximately 8.85 acres. While in operation the lagoons were responsible for holding and treating waste water generated from chemical manufacturing operations at the site. The final remediation of the lagoons (closure) involved removing and treating the liquids, bottom sludges, portions of the contaminated bottom liners, along with constructing a clay cover and providing long term post-closure care for this area. A closure plan detailing this approach was approved by Ohio EPA on August 2, 1994. Closure activities were completed and certified by site representatives on May 19, 1999. The location of the former lagoons is currently subject to post-closure care as detailed within the post-closure plan approved by Ohio EPA on December 23, 2002, which consists of ground water monitoring in the area, maintenance and inspection of the cover and honoring a deed restriction prohibiting certain uses of this area.

8.4 INTERIM ENGINEERING CONTROL (IEC)

This system was installed in 1999 and is designed to address contaminated ground water associated with AOI G (MW-37 Area) near the north property boundary and contaminated ground water associated with AOI C-Main Ravine Landfill. The system consists of a ground water pump and treat system with three (3) extraction points within AOI G and two (2) extraction points within AOI C-Main Ravine Landfill. Contaminated ground water is extracted then treated within the on-site wastewater treatment plant operations conducted by Emerald prior to being discharged to the sanitary sewer owned and operated by the City of Cincinnati. This system was installed in 1999 and continues to operate to date. The implementation of this IM has removed contaminated ground water from the above source areas.

8.5 SLIT TRENCH REMOVAL PROJECT AT AOI 59-SLIT TRENCHES

This IM involved excavation and off-site disposal of contaminated soil which was originally deposited in several trenches, each trench being approximately 20-ft wide by 100-ft long. The group of slit trenches encompasses an area of approximately 1.3 acres. These slit trenches were located between the Ravine Landfill and the southern boundary of the site. The project activities associated with this IM were implemented from April to July of 2004. The project removed approximately 4,000 cubic yards of visibly contaminated soil which was sent off-site for disposal. The empty trenches were subsequently filled with clean low permeability clay, along with providing an additional layer of clay over the area (*Slit Trench Interim Measures Completion Report*, September 2004, p. 22). The limits of the cover were surveyed and are presented in Fig 3.5 of that document. The document estimates that this effort resulted in providing a minimum thickness of 6 inches of clean clay cover for the area (p. 25).

Appendix AU of the CMS provides further documentation related to the cover material placed at AOI 59-Slit Trenches in 2004 during restoration of the work area. Figures AU1 and AU2 show topographical surveys of the area in 1999 and after the slit trench removal project 2004. The implementation of this IM has resulted in the removal of contaminant source materials and reduced the potential for on-site worker exposures to residual contaminants within soils underlying the installed cover.

8.6 PERIMETER GROUND WATER COLLECTION SYSTEM (PGCS)

This ground water system consists of an underground horizontal perforated pipe designed to intercept and collect ground water along the site boundaries to prevent it from migrating off-site. The collection system network extends along the majority of the northern property boundary within the A0 sand formation, as well as along the majority of the southern property boundary within the A1 sand formation. The system installation was completed in June of 2005 and remains operational. A report documenting the installation was submitted to Ohio EPA in February of 2006. To date all monitoring data associated with operation of the PGCS indicates that the system is providing hydraulic influence of ground water in the A0 Sand along the northern perimeter of the site and in the A1 sand along the southern perimeter of the site, thereby controlling migration of contaminated ground water.

Four of the above-noted six interim measures (#2- Interim Engineering Control (IEC), #3 AOI 59-Slit Trench Removal, #4 Perimeter Ground Water Collection System (PGCS), and #6 Current Cover on the Ravine Landfill) are NPEC's preferred final remedial alternatives for the site. Two of the interim measures are not proposed as preferred final remedial alternatives by NPEC. The Lagoon Closure project #1 has been completed and is now regulated under an approved post-closure plan. The Fenwick Park Collection System #5 is down gradient of the PGCS, therefore NPEC has not proposed it as a final remedy.

9.0 SUMMARY OF CORRECTIVE MEASURES STUDY (CMS) ACTIVITIES

The primary objective of corrective action activities, similar to those prescribed within the consent decree, is to reduce, eliminate or otherwise manage a risk posed by contamination at a site. As stated in Appendix A of the consent decree, the purpose of the Corrective Measures Study (CMS) is: "to develop and evaluate corrective action alternatives and to recommend the corrective action(s) to be taken at Hilton Davis Chemical Company." The scope of the CMS, as stated in Appendix A of the Consent Decree, consists of the following eight tasks:

- Task 9 Description of Current Situation;
- Task 10 Work Plan;
- Task 11 Development of Alternatives;
- Task 12 Initial Screening of Alternatives;
- Task 13 Detailed Analysis of Alternatives;
- Task 14 Draft Corrective Measures Study Report;
- Task 15 Final Corrective Measures Study Report; and
- Task 16 Evaluation and Selection of Preferred Alternative.

In accordance with Task 9, based on the findings of the RI, a CMS Work Plan was developed. Prior to the development of the work plan numerous technical discussions involving all stakeholders to the decree were held. These discussions focused on how those elements of Tasks 11 (Development of Alternatives), 12 (Initial Screening of Alternatives), and 13 (Detailed Analysis of Alternatives) were represented within the work plan in preparation for performing the CMS. The resulting CMS Work Plan prepared by site representatives and their consultant proposed a methodology for evaluating those risks posed by contaminants present at the site, along with describing how remedial alternatives were to be identified, developed, screened and subsequently evaluated within the CMS. The findings of the CMS would later be detailed within both draft and final reports, as stipulated within Tasks 14 and 15 of the consent decree. An initial draft of the CMS Work Plan was prepared by site representatives and submitted to Ohio EPA for review on July 19, 2001. Ohio EPA's review of the initial plan revealed deficiencies which were communicated to site representatives within a Notice of Deficiency (NOD) dated January 14, 2002. In response to the NOD, site representatives prepared a Revised CMS Work Plan which was submitted to Ohio EPA on March 19, 2002. Ohio EPA's review of the Revised CMS Work Plan noted that all

deficiencies within previous versions of the document had been sufficiently addressed within the revised submittal, and the document was subsequently approved by Ohio EPA within correspondence dated July 11, 2002.

Based upon those activities and associated methodologies contained with the approved CMS Work Plan site representatives began compiling the appropriate information in order to perform the CMS. In accordance with Task 14 (Draft Corrective Measures Study Report) three subsequent draft versions of the CMS Report were submitted to Ohio EPA and CCHD representatives for review. The first draft was submitted September 30, 2004, and Ohio EPA's review resulted in an NOD dated July 8, 2005. The second draft was submitted October 24, 2005, and resulted in the issuance of an NOD dated August 18, 2006, and the third draft was submitted November 20, 2006, which resulted in the issuance of an NOD dated March 20, 2008. On May 5, 2008, and in response to Ohio EPA's March 20, 2008, NOD, site representatives submitted addendums to the draft CMS Report which addressed Ohio EPA's final comments.

Therefore with a letter dated July 8, 2008, Ohio EPA approved the Final CMS Report as described in Task 15 of the consent decree. In summary, each of the three draft CMS reports and the final CMS Report contain an evaluation of the risk posed by contaminants observed at each of the AOIs, along with providing an analysis of appropriate remedial alternatives to address contamination observed at each AOI posing unacceptable risk. These reports were organized as follows:

Executive Summary
Section 1.0 Introduction
Section 2.0 Description of Current Situation
Section 3.0 Human Health Risk Assessment
Section 4.0 Development of Alternatives
Section 5.0 Initial Screening of Alternatives
Section 6.0 Detailed Analysis of Alternatives
Section 7.0 References

10.0 RISK ASSESSMENT

A Human Health Risk Assessment (HHRA) provides an evaluation of the threat or potential threat to human health associated with the release or potential release of contaminants. The methodology is used to identify all exposure pathways of concern, conduct a toxicity assessment for each contaminant found, along with conducting an exposure assessment for each route of exposure, and concludes with a determination as to whether or not adverse effects on human health under current conditions are likely to occur. In addition, an HHRA can be used to determine where remedial measures are necessary because it indicates the particular COCs, exposure pathways and affected media which are the primarily drivers of risk exceedance. With this knowledge it is possible to design remedial alternatives which target specific COCs, exposure pathways or media.

The purpose of the Human Health Risk Assessment (HHRA) as performed within the CMS was to assist in determining those areas of the site where contaminants are observed in concentrations posing unacceptable risk to human receptors and determine which contaminants and exposures routes were the primary causes of unacceptable risk. The risk goals for the site are not to exceed a cancer risk greater than 1×10^{-5} (probability of one cancer per 100,000 persons) or exceed a target hazard index (HI) greater than 1.0 (exposure should not result in adverse non-cancer effects based on cumulative risk for all constituents of concern).

These risk goals were proposed within a CMS Work Plan and are based on Ohio EPA guidance. An excess lifetime cancer risk of $1x10^{-5}$ indicates that an individual has a 1 in 100,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer that individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in four. U.S. EPA considers excess cancer risks that are below 1 chance in 1,000,000 (1×10^{-6}) to be so small as to be negligible, and risks above $1x10^{-4}$ to be sufficiently large that some sort of remediation is desirable. Excess cancer risks that range between $1x10^{-6}$ and $1x10^{-4}$ are generally considered to be acceptable (see Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions (Memorandum from D. R. Clay, OSWER 9355.0-30, April 1991), although this is evaluated on a case-by-case basis and EPA may determine that risks lower than $1x10^{-4}$ are not sufficiently protective and warrant remedial action.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to which should not have a negative effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). A HQ less than 1.0 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely.

Exposure assessment is one part of risk assessment which identifies potential exposure pathways which exist at a site. An exposure pathway is a mechanism by which a receptor (human or other) and a contaminant come in contact. Exposure pathways may be considered complete or incomplete. A complete exposure pathway must have the following four elements present: a source of contaminant, a probable route of migration (from one environmental media to another), an exposure point (contact with environmental media), and a route of entry to the receptor (inhalation, ingestion, etc.). If one of the four elements is not present, such as an exposure point (no way of contacting the contaminant), then an exposure pathway may be considered incomplete.

The methodology of risk assessment formulated within the approved CMS work plan served as the basis for determining the receptors and exposure pathways which were to be evaluated. Based upon this methodology the future human receptor exposure scenarios for the site are to remain consistent with current land use and zoning, that

being industrial-use. Off-site exposures by adult and child receptors within the residential neighborhoods adjacent to the site, as well as off-site utility workers, were also evaluated within the HHRA. Detailed descriptions about each receptor, exposure frequency and duration may be referenced within the approved CMS work plan. Receptors and exposures controlled by the ground water compliance monitoring plan (GWCMP) and soil management plan (SMP) were not assessed within the HHRA. The following table summarizes the receptors, pathways, and environmental media which were evaluated in the HHRA.

TABLE 2
SUMMARY OF RECEPTORS, EXPOSURES, MEDIA EVALUATED IN THE HHRA

Receptor	Exposures	Media
On-site outdoor worker	Incidental soil ingestion Incidental dermal contact Inhalation of particulate Inhalation of volatile Inhalation of volatile	Surface soil [1] Subsurface soil [2]
On-site indoor worker	Vapor intrusion to indoor air Vapor intrusion to indoor air Incidental soil ingestion	Ground water Subsurface soil Surface soil
Off-site resident- both adult and child	Inhalation of particulate Inhalation of volatile Inhalation of volatile Vapor intrusion to indoor air	Surface soil Subsurface soil Ground water
Off-site utility worker	Incidental dermal contact Incidental ingestion	Seep water

[1] Surface soils are soils at depth of 0-2 ft below ground surface
[2] Subsurface soils are soils at depth greater than 2 feet below ground surface

10.1 Exposures Not Evaluated in the HHRA

Several exposure pathways were not evaluated in the HHRA as they are proposed to be managed by another means or they are currently monitored. For instance the following exposure pathways are proposed to be controlled by a Soils Management Plan (SMP), and ground water exposures are currently assessed by the ongoing ground water compliance monitoring plan (GWCMP). These exposure pathways are shown here.

TABLE 3
EXPOSURES PROPOSED TO BE MANAGED BY A SOIL MANAGEMENT PLAN (SMP)

Receptor	Exposure	Media
Off-site resident both adult and child	Inhalation of particulate and volatile during construction activity	Surface soil, subsurface soil
On-site Construction worker	Inhalation of particulate and volatile during construction activity, incidental dermal contact Incidental dermal contact water	Surface soil, subsurface soil Ground water

The proposed SMP is contained within the CMS as Appendix B. The SMP will ensure that potential off-site exposures of residents to contaminated soil during excavation activities (i.e., grading) at the site will be effectively managed by requiring that a project specific risk assessment and risk management plan be completed in accordance with applicable guidance and subject to Ohio EPA review and approval prior to commencement of excavation activity (CMS Appendix B, page B-2).

TABLE 4
EXPOSURES CURRENTLY MONITORED UNDER THE GROUND WATER COMPLIANCE MONITORING PROGRAM (GWCMP)

Currently, these exposure pathways do not exceed target risk criteria and are continually monitored within the GWCMP.

Receptor	Exposure	Media
Off-site child trespasser	Incidental ingestion Incidental dermal contact Inhalation of volatile	seep water
Off-site adult and child resident	Vapor intrusion	Ground water
Off-site Utility worker	Dermal contact Inhalation	Ground water, seep water

10.2 Ecological Risk Assessment

The majority of the site is used for industrial purposes; however a limited portion of the site consisting of a 7-acre tract of land located adjacent to the southeast corner of the site contains suitable habitat for hosting ecological receptors. Therefore, Ohio EPA required an ecological field survey for this facility in order to identify existing habitat which was suitable for species of special concern. The result of the ecological survey demonstrated that there is no known or suspected presence of threatened, endangered or special concern species or habitat associated with the site. Based on Ohio EPA's review of the reports associated with the ecological survey, no further demonstrations or actions related to ecological risk assessment are required. Further information

associated with the ecological survey conducted can be referenced within Appendix C of the CMS.

11.0 RESULTS OF RISK ASSESSMENT AND AREAS OF INTEREST (AOIs) REQUIRING EVALUATION OF REMEDY ALTERNATIVES IDENTIFIED IN THE CMS REPORT

The contents of this section summarize the overall results of NPEC's risk assessment of the site, as represented in greater detail within the approved *Corrective Measures Study (CMS) Report*. The methodologies employed in performing the HHRA were contained within the proposed *Corrective Measure Study (CMS) Work Plan* which was approved by Ohio EPA on July 11, 2002.

A total of 70 AOIs had contamination above screening levels and were required to be evaluated within the HHRA. Several of the original 70 AOIs had similar contaminants and were situated in close proximity to each other. Therefore Ohio EPA and NPEC agreed that some of these could be grouped together for the purpose of conducting the HHRA. As a result, a total of 35 HHRAs were conducted to evaluate risk at 21 "individual AOIs" and 14 "grouped AOIs." Exposures to lead were modeled separately since the constituent doesn't lend itself to traditional risk assessment methodology as performed for other contaminants. Consistent with those assumptions contained within the approved CMS work plan, hypothetical exposures which could occur during future construction activities were not evaluated as it was determined that such exposures would be addressed by a Soils Management Plan (SMP) at the time of future construction activities. Exposure to vapor intrusion for existing buildings was assessed using soil and ground water data as inputs to the Johnson and Ettinger soil vapor model. Surface soils were considered to be those observed at 0-2 ft below ground surface and subsurface soils were considered to be those greater than 2 ft below ground surface (bgs).

The Human Health Risk Assessments (HHRA) for the site were conducted using a tiered approach. A baseline HHRA (Tier I) was conducted initially for each AOI using conservative input values and exposure assumptions. If the AOI did not exceed risk criteria during Tier I (i.e., target cancer risk of 1×10^{-5} or non-cancer hazard quotient of 1.0), no further evaluation was required. However if the Tier I indicated that an AOI did exceed risk criteria, a more refined HHRA (Tier II) was conducted using site-specific input values and exposure assumptions.

Of the 35 AOIs for which Tier I HHRA were conducted, 6 AOIs were identified as requiring some type of remedy or corrective measure. These AOIs are identified as:

- AOI C-Main Ravine Landfill;
- AOI G (MW-37 Area);
- AOI C-West;
- AOI 59-Slit Trenches;

- AOI 59-Slit Trench H; and
- AOI 104.

The findings of the Tier I HHRA indicate that the primary risks are to on-site outdoor workers who may be exposed to organic contaminants from subsurface soils via the inhalation exposure pathway, or exposures to inorganic contaminants in surface soils via direct contact. In addition, ground water contamination associated with AOI C-Main Ravine Landfill and AOI G (MW-37 area) was found to pose a potential threat to on-site and off-site receptors due to the vapor intrusion exposure pathway.

Tier II HHRAs were then conducted to consider site-specific input values and exposures. In the case of AOI C-Main Ravine Landfill, AOI G (MW-37 area), and AOI 59-Slit Trenches, when factoring into consideration the current cover systems in place as IMs, the Tier II HHRA results indicate that risk criteria are not exceeded. Furthermore, the ground water monitoring program demonstrates that no exceedances of risk-based standards (i.e., ACLs) are occurring at or beyond the site property boundary.

In the case of AOI 59-Slit Trench H, AOI C-West, and AOI 104 the HHRA indicates minimal exceedances of risk criteria for the on-site outdoor worker due to exposures to organic and inorganic contaminants present within both surface and subsurface soils.

The complete results of the HHRA are contained within the CMS report. The narrative and associated tables which follow provide a summary of the results of HHRAs for the 6 AOIs which require corrective measures. Also included is a brief description of each AOI, the human health exposure pathway of exceedance, the medium of concern and the COC causing exceedance.

11.1 AOI C-Main Ravine Landfill

The original topography of the site included a ravine which ran from the northeast corner through the site to the southwest, parts of which are still apparent. In some places the ravine was 30-feet deep and at the surface was as wide as 150 feet, the bottom contained a tributary to Mill Creek known as Bloody Run. From the early days of operation up until 1980 a variety of waste and fill from site operation were placed into a part of the ravine near the middle and southwest area of the site. This AOI is designated as AOI C-Main Ravine Landfill. The surface area of this AOI is approximately 6.46 acres and its volume is approximately 100,000 cubic yards. Extensive investigation of the ravine has been conducted to determine the nature and extent of its contents and its surrounding geology and hydrogeology. Ground water in the A1 Sand which migrates southward is contaminated above ACLs; however ACLs are being met at the point of compliance (downgradient at the site perimeter).

The results of the initial Tier I HHRA (Table 5) determined that without considering the present clean clay soil cover the ravine would exceed the cancer and non-cancer risk criteria for the on-site outdoor worker. The pathway of concern for the risk to human health is inhalation of volatile contaminants within ambient air from subsurface soils.

The contaminants which contribute the majority of risk are VOCs (chlorobenzene, toluene, 1,2-dichloroethane), SVOCs (2,4-dinitrotoluene, 3,3-dichlorobenzidine), pesticides and PCBs. Subsurface VOC and lead contamination would also present a risk to the construction worker during excavation activities.

TABLE 5
AOI C-MAIN RAVINE LANDFILL - RESULTS OF INITIAL TIER I HHRA

Receptor	Exposure	Media	Contaminants	Risk
On-site Outdoor worker	Inhalation of volatile	Subsurface soil	VOC(chlorobenzene,toluene,1, 2-Dichloroethane) SVOC(2,4-Dinitrotoluene, 3,3-Dichlorobenzidine) Pesticide, and PCB	Cancer 2.58 $x10^{-5}$ Non-cancer HI=6.75
Construction worker		Subsurface soil	Lead – Exceeds 800 mg/kg	

11.2 AOI C-Main Ravine Landfill - Results of Revised Tier II HHRA

The initial HHRA for the Ravine Landfill did not consider the clean soil and clay cover now in place which has the effect of reducing emissions of volatile organic compounds, thus minimizing exposures. A revised Tier II HHRA utilizing USEPA's Shen's Emission Model was conducted considering this exposure pathway and the effect of a clean cover consisting of 6 inches of clay and 3 inches of topsoil to determine if the current cover would reduce risk to below criteria and would be an effective remedy. The results of the revised HHRA which are provided below determined that with such a cover there is no exceedance of non-cancer risk criteria (1.0) or cancer risk criteria ($1.0x10^{-5}$) for the on-site outdoor worker and the off-site resident (both adult and child). The construction worker exposures were not considered as these are to be managed by the SMP. Table 6 lists the results of the revised HHRA for AOI C-Main Ravine Landfill.

TABLE 6
AOI C-MAIN RAVINE LANDFILL - RESULTS OF REVISED TIER II HHRA

Receptor	Exposure	Media	Non-Cancer risk	Cancer Risk
On-site outdoor worker	Inhalation of volatile	Soil	$9.36x10^{-2}$	$5.04x10^{-7}$
Off-site resident Adult	Inhalation of volatile	Soil	$3.74x10^{-2}$	$2.41x10^{-7}$
Off-site resident Child	Inhalation of volatile	Soil	$8.72\ x10^{-2}$	$1.13x10^{-7}$

NPEC has conducted further analysis to determine what minimum thickness of clean cover must be in place to reduce the risk to acceptable levels of $1.0\ x10^{-5}$ and a HI of 1. A summary of this analysis is provided in Appendix AX, Attachment AX-3, and shows

that only 1.6 inches of clean cover would be necessary to maintain risk of 1.0 x10^{-5} and HI of 1.

11.3 AOI G (MW-37 Area)

This AOI is near the northern perimeter of the site and was historically used as a drum storage area. It is approximately 1.42 acres and is presently covered with an asphalt parking lot. Both ground water and soil in the area have been thoroughly investigated but these investigations have never revealed any distinct, concentrated contaminant source areas within soils. Instead, only widespread lower levels of contamination have been observed throughout this AOI. The RI revealed that surface soils and subsurface soils are contaminated with VOCs and lead. The RI also indicates that ground water in the saturated zone (A0 Sand) which is approximately 15 ft below ground surface is contaminated with VOCs above ACLs; however, ACLs are being met at the point of compliance (site boundary). The results of the initial Tier I HHRA conclude that a combined exposure to all COCs (VOCs, SVOCs and metals) in both surface soil and subsurface soils would cause an exceedance of non-cancer risk criteria (HI = 1.53) for the on-site outdoor worker. Also one SVOC constituent (nitrobenzene) in subsurface soils volatilizing to ambient air would cause a non-cancer inhalation exceedance of target risk (HI = 1.78) for the off-site child receptor. Lead in surface soils causes a non-cancer risk exceedance for the on-site outdoor worker (HI = 3.76). Lead in subsurface soil exceeds the industrial screening level of 800 mg/kg.

TABLE 7
AOI G (MW-37 AREA) - RESULTS OF INITIAL TIER I HHRA

Receptor	Exposure	Media	Contaminants	Risk
On-site outdoor worker	Combined exposures	Surface soils, Subsurface soils	VOC,SVOC, metals	Non-cancer HI=1.53
Off-site resident child	Inhalation of volatile	Subsurface soils	SVOC-nitrobenzene	Non-cancer HI=1.78
On-site outdoor worker	Incidental ingestion	Surface soils	Lead	Non-cancer HI=3.76
Construction worker		Subsurface soils	Lead- exceeds 800 mg/kg	

11.4 AOI G (MW-37 Area) - Results of Revised Tier II HHRA

The initial HHRA for the MW-37 Area did not consider the asphalt cover which is now in place on top of the area which would reduce the modeled effects of volatile and particulate emissions as well as prevent direct contact exposures to soil by on-site outdoor workers. A revised HHRA considering the asphalt cover which is now in place at AOI G was conducted to determine if the current cover would be an effective remedy and to determine if risk criteria are currently exceeded. The results of the Tier II HHRA indicate that there is no exceedance of cancer or non-cancer risk criteria for the on-site

outdoor worker and the off-site resident (both adult and child) considering the current cover. Construction worker exposures were not considered as risk may be managed by the SMP. Table 8 lists potential receptors, exposure routes and the results of the Tier II HHRA.

TABLE 8
AOI G (MW-37 AREA) - RESULTS OF REVISED TIER II HHRA

Receptor	Exposure	Media	Non-cancer risk	Cancer Risk
On-site Outdoor worker	Inhalation of volatile	Surface and Subsurface Soil	6.38×10^{-1}	1.0×10^{-6}
Off-site Resident Adult	Inhalation of particulate & volatile	Surface and Subsurface soil	1.82×10^{-3}	5.36×10^{-9}
Off-site resident Child	Inhalation of particulate & volatile	Surface and Subsurface soil	4.24×10^{-3}	2.50×10^{-9}

11.5 AOI C-West

This AOI is considered to be a small landfill cell which was formed in the early years of operation by filling part of the former ravine near the southwestern property boundary. It is approximately 0.8 acres and its volume is estimated to be 20,000 cubic yards.

Although it contains VOCs, the reason it exceeds target risk is that lead in surface soils would present an exceedance of non-cancer risk (HI = 2.15) for the outdoor worker and subsurface soils exceed the screening number for lead of 800 mg/kg presenting a risk to the construction worker. From depictions in the *Comprehensive Remedial Investigation Report* there appears to be an association between this AOI and the saturated zone in the area (A2 sand layer) but contamination levels are well below ACLs.

TABLE 9
AOI C-WEST - RESULTS OF TIER I HHRA

Receptor	Exposure	Media	Contaminant	Risk
On-site outdoor worker	Incidental ingestion	Surface soil	Lead	Non-cancer HI =2.15
Construction worker		Subsurface soil	Lead– exceeds 800 mg/kg	

11.6 AOI 59-Slit Trenches

This AOI consists of 13 trenches that were created and filled with waste generated on site during the 1940s and 50s. Each trench was approximately 12 to 15 ft wide, less than 100 ft long, and less than 10 ft deep. The total area encompassing this AOI is 1.3 acres. In 2004 NPEC conducted a removal effort by excavating and disposing off-site of all visibly contaminated waste within the slit trenches. Confirmation samples taken from the sidewalls and bottoms of the trenches after excavation were used as input values for the HHRA.

The initial Tier I HHRA indicates that both cancer and non-cancer target risk are exceeded for the on-site outdoor worker. The chemicals that account for the risk exceedance through an inhalation pathway are benzene, chlorobenzene, and xylene. The pathway, media and results of the HHRA are listed in Table 10.

TABLE 10
AOI 59-SLIT TRENCHES - RESULTS OF INITIAL TIER 1 HHRA

Receptor	Exposure	Media	Contaminants	Risk
On-site outdoor worker	Inhalation of volatile	Subsurface soils	benzene, chlorobenzene, xylene	Cancer-1.36×10^{-5} Non-cancer HI=1.61

11.7 AOI 59-Slit Trenches - Results of Revised Tier II HHRA

The initial Tier I HHRA for the Slit Trenches did not consider the clean fill cover placed on top of this area as part of the slit trench removal project in 2004. A revised Tier II HHRA utilizing USEPA's Shen's Emission Model was conducted to evaluate this exposure pathway and the effect of the current clean cover, which consists of 6 inches of clay and 3 inches of topsoil. The results of the revised Tier II HHRA determined that with the current clean clay and soil cover there is no exceedance of cancer or non-cancer risk criteria for the on-site outdoor worker and the off-site resident (both adult and child). Table 11 presents the routes of exposure and the results of the revised Tier II HHRA for this AOI.

TABLE 11
AOI 59-SLIT TRENCHES - RESULTS OF REVISED TIER II HHRA

Receptor	Exposure	Media	Non-cancer risk	Cancer Risk
On-site Outdoor Worker	Inhalation of volatile	Subsurface Soil	1.63×10^{-2}	7.66×10^{-7}
Off-site Resident Adult	Inhalation of volatile	Subsurface soil	1.01×10^{-3}	5.69×10^{-8}
Off-site resident Child	Inhalation of volatile	Subsurface soil	2.36×10^{-3}	2.66×10^{-8}

NPEC has conducted further analysis to determine what minimum thickness of clean cover must be in place to reduce the risk to acceptable levels of 1.0 $x10^{-5}$ and a HI of less than 1.0. A summary of this analysis is provided in Appendix AX, Attachment AX-3 and shows that only 4.4 inches of clean cover would be necessary to maintain risk of 1.0 $x10^{-5}$ and HI of less than1.0.

11.8 AOI 59-Slit Trench H

Slit Trench H was considered separately from the rest of the Slit Trenches for the purpose of the HHRA within the CMS. This AOI is the remaining portion of Slit Trench H which could not be removed due to its proximity to an electrical power transmission tower. This remaining area is approximately 50 ft long, 10-15 wide and 5-10 ft deep with an estimated volume of 150 cubic yards. The sidewalls and bottom of the trench are native clay soil. A utility easement prevents excavation within 25 ft of the tower or base. A revised Tier II HHRA which considered the current cover of 6 inches of clay and 3 inches of top soil indicates that the cancer target risk is still exceeded for the on-site outdoor worker. The risk to the off-site resident adult and child receptors does not exceed the target risk criteria. Inhalation of benzene, toluene, methylene chloride, and 4-chloroaniline volatilizing from sub-surface soils to ambient air was identified as the exposure pathway that contributed significantly to the risk exceedance identified within the HHRA. However, this exposure scenario assumes that an on-site outdoor worker would remain near this small area for the duration of 8 hrs/day, 250 days/year which is unlikely. Table 12 illustrates the route of exposure and the results of the Tier II HHRA.

TABLE 12
AOI 59-SLIT TRENCH H - RESULTS OF TIER II HHRA

Receptor	Exposure	Media	Contaminants	Risk
On-site Outdoor Worker	Inhalation of volatile contaminants	Subsurface Soils	benzene,toluene, methylene chloride SVOC- 4-chloroaniline	Cancer- 2.48 $x10^{-5}$

NPEC has conducted further analysis to determine what minimum thickness of clean cover must be in place to reduce the risk to acceptable levels of 1.0 $x10^{-5}$ and a HI of less than 1.0. A summary of this analysis is provided in Appendix AX, Attachment AX-3 and shows that 2.4 ft or 28.6 inches of clean cover would be necessary to maintain risk of 1.0 $x10^{-5}$ and a HI of less than 1.0.

11.9 AOI 104

This AOI was identified by a stain indicating a potential release on a concrete surface below a former tank. This AOI is next to a former building 24 which is located in close proximity to the Slit Trenches. The volume of this AOI is estimated to be 56 cubic yards; however the volume of contaminated soil underlying this AOI may be more extensive due to the presence of only one soil sample associated with the investigation of this AOI within the RI. The Tier I HHRA determined that the non-cancer risk to the on-site outdoor worker is exceeded. The exposure pathway of concern is inhalation of ambient

air from VOC (chlorobenzene) contaminated subsurface soils by the on-site outdoor worker. Table 13 illustrates this exposure route and the results of the HHRA.

TABLE 13
AOI 104 - RESULTS OF TIER I HHRA

Receptor	Exposure	Media	Contaminant	Risk
On-site Outdoor Worker	Inhalation	Subsurface soils	Chlorobenzene	Non-cancer HI=1.25

12.0 CRITERIA USED TO EVALUATE REMEDIAL ALTERNATIVES

The overarching objective of corrective action activities, similar to those prescribed within the consent decree, is to reduce, eliminate or otherwise manage risk posed by contamination at the site. In developing the array of those alternatives represented within the CMS Report Task #16 ("Evaluation and Selection of Preferred Alternative"), the consent decree states that the following considerations shall be used as the basis for Ohio EPA's selection of their preferred alternative(s):

a) Reliability. Alternatives that minimize or eliminate the potential for release of hazardous wastes and constituents into the environment will be considered more reliable than other alternatives. For example, recycling of waste and off-site incineration would be considered more reliable than land disposal. Institutional concerns such as management requirements can also be considered as reliability factors.

b) Implementability. The requirements for implementing the alternatives will be considered, including phasing alternatives into operable units and segmenting alternatives into project areas on the site. The requirements for permits, zoning restrictions, rights of way and public acceptance are examples to be considered.

c) Effects of the Alternative. The alternative posing the greatest improvement to (and least negative impact on) public health, welfare and environment will be favored.

d) Safety Requirements. The alternatives with the lowest adverse safety impacts will be favored.

e) Whenever two or more alternatives are identified as meeting the Remedial Response Objectives, established under Task 11(a), above, the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, safety, or the environment will be the selected alternative. Total cost includes implementation of the alternative and the operation and maintenance of the proposed alternative.

In addition to the criteria above, Ohio EPA considered Chapter 4, Section II., E, 'Evaluation of a Final Corrective Measure Alternative' within U.S. EPA's "RCRA Corrective Action Plan" OSWER Directive 9902.3-2A, May 1994 which provides guidance for selecting remedial alternatives at corrective action sites. According to this guidance a final remedial alternative must meet five criteria. The first four have become known as the "threshold criteria." The fifth criteria has, in usage, become known as the "balancing criteria" and is used to assist in selecting one of several remedies which meet the threshold criteria. The elements of each of these criteria are listed below.

Criteria for Evaluation of Corrective Measures (or Remedial Alternatives)

1. Protect human health and the environment
"Corrective measures must be protective of human health and the environment. Remedies may include those measures that are needed to be protective but are not directly related to media cleanup standards, source control, or management of wastes. An example would be a requirement to provide alternative drinking water supplies in order to prevent exposures to releases from an aquifer used for drinking water purposes. Another example would be a requirement for the construction of barriers or for other controls to prevent harm arising from direct contact with waste management units. Therefore, the Permittee/Respondent shall include a discussion on what types of short term remedies are appropriate for the particular facility in order to meet this standard. This information should be provided in addition to a discussion of how the other corrective measure alternatives meet this standard."

2. Attain Media Cleanup Standards Set by the Implementing Agency
"Remedies will be required to attain media cleanup standards set by the implementing agency which may be derived from existing state or federal regulations (e.g. ground water standards) or other standards. The media cleanup standards for a remedy will often play a large role in determining the extent of and technical approaches to the remedy. In some cases, certain technical aspects of the remedy, such as the practical capabilities of remedial technologies, may influence to some degree the media cleanup standards that are established."

"As part of the necessary information for satisfying this requirement, the Permittee/Respondent shall address whether the potential remedy will achieve the preliminary remediation objective as identified by the implementing agency as well as other, alternative remediation objectives that may be proposed by the Permittee/Respondent. The Permittee/Respondent shall also include an estimate of the time frame necessary for each alternative to meet these standards."

3. Control the Sources of Releases
"A critical objective of any remedy must be to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to clean up releases may be ineffective or, at best, will essentially involve a perpetual cleanup.

Therefore, an effective source control program is essential to ensure the long-term effectiveness and protectiveness of the corrective action program."

"The source control standard is not intended to mandate a specific remedy or class of remedies. Instead, the Permittee/Respondent is encouraged to examine a wide range of options. This standard should not be interpreted to preclude the equal consideration of using other protective remedies to control the source, such as partial waste removal, capping, slurry walls, in-situ treatment/stabilization and consolidation."

" *[Note: When evaluating potential alternatives, further releases from sources of contamination are to be controlled to the extent practicable. This qualifier is intended to account for the technical limitations that may in some cases be encountered in achieving effective source control. For some very large landfills, or large areas of widespread soil contamination, engineering solutions such as treatment or capping to prevent further leaching may not be technically practicable, to eliminate further releases above health-based contamination levels. In such cases, source controls may need to be combined with other measures, such as plume management or exposure controls, to ensure an effective and protective remedy.]* "

"As part of the CMS Report, the Permittee/Respondent shall address the issue of whether source control measures are necessary, and if so, the type of actions that would be appropriate. Any source control measure proposed should include a discussion on how well the method is anticipated to work given the particular situation at the facility and the known track record of the specific technology."

<u>4. Comply With Any Applicable Standards for Management of Wastes</u>
"The Permittee/Respondent shall include a discussion of how the specific waste management activities will be conducted in compliance with all applicable state or federal regulations (e.g., closure requirements, land disposal restrictions)."

<u>5. Other Factors (Balancing Criteria)</u>
"There are five general factors that will be considered as appropriate by the implementing agency in selecting/approving a remedy that meets the four standards listed above. These factors represent a combination of technical measures and management controls for addressing the environmental problems at the facility. The five general factors include:"

a. Long-term Reliability and Effectiveness
"Demonstrated and expected reliability is a way of assessing the risk and effect of failure. The Permittee/Respondent may consider whether the technology or a combination of technologies have been used effectively under analogous site conditions, whether failure of any one technology in the alternative would have an immediate impact on receptors, and whether the alternative would have the flexibility to deal with uncontrollable changes at the site (e.g., heavy rain storms, earthquakes, etc.). Most corrective measure technologies, with the exception of destruction, deteriorate with time. Often, deterioration can be slowed through proper system operation and

maintenance, but the technology eventually may require replacement. Each corrective measure alternative should be evaluated in terms of the projected useful life of the overall alternative and of its component technologies. Useful life is defined as the length of time the level of effectiveness can be maintained."

b. Reduction in the Toxicity, Mobility or Volume of Wastes
"As a general goal, remedies will be preferred that employ techniques, such as treatment technologies, that are capable of eliminating or substantially reducing the inherent potential for the wastes in SWMUs (and/or contaminated media at the facility) to cause future environmental releases or other risks to human health and the environment. There may be some situations where achieving substantial reductions in toxicity, mobility or volume may not be practical or even desirable. Examples might include large, municipal-type landfills, or wastes such as unexploded munitions that would be extremely dangerous to handle, and for which the short-term risks of treatment outweigh potential long term benefits. Estimates of how much the corrective measures alternatives will reduce the waste toxicity, volume, and/or mobility may be helpful in applying this factor. This may be done through a comparison of initial site conditions to expected post-corrective measure conditions."

c. Short-term Effectiveness
"Short-term effectiveness may be particularly relevant when remedial activities will be conducted in densely populated areas, or where waste characteristics are such that risks to workers or to the environment are high and special protective measures are needed. Possible factors to consider include fire, explosion, exposure to hazardous substances and potential threats associated with treatment, excavation, transportation, and re-disposal or containment of waste material."

d. Implementability
"Implementability will often be a determining variable in shaping remedies. Some technologies will require state or local approvals prior to construction, which may increase the time necessary to implement the remedy. In some cases, state or local restrictions or concerns may necessitate eliminating or deferring certain technologies or remedial approaches from consideration in remedy selection. Information to consider when assessing implementability may include:

The administrative activities needed to implement the corrective measure alternative (e.g., permits, rights of way, off-site approvals, etc.) and the length of time these activities will take;

The constructability, time for implementation and time for beneficial results;

The availability of adequate off-site treatment, storage capacity, disposal services, needed technical services and materials; and

The availability of prospective technologies for each corrective measure alternative."

e) Cost
"The relative cost of a remedy may be an appropriate consideration, especially in those situations where several different technical alternatives to remediation will offer equivalent protection of human health and the environment, but may vary widely in cost. However, in those situations where only one remedy is being proposed, the issue of cost would not need to be considered. Cost estimates could include costs for: engineering, site preparation, construction, materials, labor, sampling/analysis, waste management/disposal, permitting, health and safety measures, training, operation and maintenance, etc."

Ohio EPA required that NPEC apply the Threshold and Balancing criteria when performing the evaluation of remedial alternatives and provide the outcome of their evaluation within the CMS Report. The following corrective measures were considered by NPEC and subjected to evaluation using the above-noted criteria within the CMS Report.

13.0 REMEDIAL ALTERNATIVES CONSIDERED

The following remedial alternatives were considered by NPEC and Ohio EPA to address AOIs which exceeded risk criteria.

1. Soil Vapor Extraction (SVE): this technology involves placing extraction wells into the unsaturated zone (soil) and pulling air through the soil pores to remove VOCs from the soil. This is the presumptive remedy for areas where soils are contaminated with VOCs.
2. Dual Phase Extraction (DPE): this technology is similar to SVE but the extraction wells also extend into the saturated zone and this technology is designed to remove VOCs from both soil and ground water. This is the presumptive remedy for areas where both soil and ground water is contaminated with VOCs.
3. Partial Excavation and Off-Site Disposal: this alternative requires removing soil contamination to achieve remediation goals.
4. Complete Excavation and Off-Site Disposal: this alternative requires removing all contaminated soils from a unit or area.
5. On-Site RCRA Landfill: this alternative involves creating an engineered landfill on-site, to dispose of contaminated soils excavated at the site.
6. Engineered Cover: this is a cover or cap for a former waste management unit with a design plan and specifications meeting performance criteria in guidance. The cover may be required to prevent direct contact, prevent release to the atmosphere and prevent infiltration of precipitation.
7. In-situ Solidification/Stabilization: this alternative involves mixing a stabilizing agent with contaminated soil to bind contaminants to the soil in order to reduce contaminant mobility.
8. In-Situ Treatment Via Soil Solvent Flushing: applying water or water containing an additive to enhance contaminant solubility to the soil to raise the water table

into the contaminated soil zone. Contaminants are leached into the ground water which is then extracted and treated.

9. Ex-Situ Treatment Via Slurry Phase Biological Treatment: creating an aqueous slurry by combining soil with water and other additives then mixing to keep solids suspended and microorganisms in contact with contaminants. The treated slurry is dewatered and returned to the excavation.
10. Institutional Controls: these are land use restrictions which may be recorded as a deed restriction or become part of an environmental covenant between the facility and the regulatory agency, the purpose of which is typically to manage or limit human exposures at the site.
11. Soil Management Plan (SMP): this is a written plan describing management and work procedures which will be followed prior to and during excavation activities occurring at the site in order to prevent or manage on-site and off-site exposures to contaminated soils or ground water.
12. Ground Water Compliance Monitoring Program: a program which involves monitoring a network of ground water wells. The findings are summarized and reported in a format which can be evaluated to determine trends in conditions as well as performance of treatment systems, etc.
13. Containment: A combination of engineering and administrative controls to prevent further migration or release of contamination and to prevent potential exposures to contamination.

14.0 NPEC'S PREFERRED REMEDIAL ALTERNATIVES FOR EACH AOI AND RATIONALE FOR SELECTION

The criteria used in evaluating alternatives were based on both the consent decree, as well as U.S. EPA guidance for addressing RCRA corrective action requirements. The outcome of NPEC's application of the above-noted criteria within their evaluation of the alternatives resulted in their identification of "preferred" alternatives for each AOI determined to pose an unacceptable risk:

TABLE 14
NPEC's PREFERRED REMEDIAL ALTERNATIVES FOR EACH AOI

AOI	NPEC's Preferred Alternative(s)
AOI C-Main Ravine Landfill	• Containment: use existing clay/soil cover • PGCS and IEC • Ground water monitoring
AOI G (MW-37 Area)	• Containment: use existing asphalt cover. Construct new clay/soil cover where needed; • PGCS and IEC • Ground water monitoring
AOI C-West	• Containment: use existing asphalt/concrete cover. Construct new clay/soil cover where needed
AOI 59-Slit Trenches	• Containment: use existing clay/soil cover and existing asphalt cover
AOI 59 -Slit Trench H	• Containment: construct asphalt cover
AOI 104	• Containment: construct asphalt cover
Site-Wide Controls	• Environmental Covenant • Soils Management Plan (SMP) • Perimeter Ground Water Collection System (PGCS) • Ground Water Monitoring Program

The remaining portions of this section provides additional detail as to the array of remedial alternatives evaluated by NPEC in performing the CMS, along with their supporting rationale as to how the preferred alternatives were determined within the CMS Report.

14.1 AOI C-Main Ravine Landfill

NPEC evaluated the following remedial alternatives in the CMS Report to address the unacceptable risk levels posed at AOI C-Main Ravine Landfill:

- No Action;
- Limited Action: access restrictions;
- Containment: asphalt cover;
- Containment: clay/soil cover;
- Containment: concrete cover;
- Containment: RCRA cover;
- In situ treatment: soil/ solvent flushing;
- In situ treatment: soil vapor extraction;
- Ex situ treatment: slurry phase biological treatment;
- Ex situ treatment: soil vapor extraction;
- Ex situ treatment: excavation and off-site disposal;

- Ex situ treatment: excavation and incineration; and
- Ex situ treatment: excavation and thermal desorption.

The company's preferred alternative identified within the CMS Report was:

- Containment: use existing clay/soil cover
- PGCS and IEC
- Ground water monitoring

NPEC's evaluation concluded that use of the existing clay/soil cover system is the preferred remedy for contaminated soils at the Ravine Landfill for three reasons: it would require less time to implement than the amount of time required to implement other technologies, would result in the least exposures during implementation than that of other technologies, and would require less time to become effective than other technologies. Additionally, it was recognized as the least expensive remedial alternative. NPEC's evaluation did note that cover systems are less reliable in the long term than a treatment or removal technology such as SVE or partial excavation, and that these treatment or removal technologies also would have the advantage of reducing toxicity and mobility of contaminants. The remedial technologies of SVE and partial excavation ranked as second choices to the clay soil cover. The rationale for not selecting these technologies is provided in Section 15, Ohio EPA's proposed remedial alternatives and rationale for selection.

In addition the following remedial alternatives were considered for contaminated ground water associated with AOI C-Main Ravine Landfill.

- PGCS and IEC
- Ground water monitoring

NPEC provided a demonstration that the existing PGCS and IEC are capable of meeting U.S. EPA's threshold criteria which are protecting human health and the environment, attaining media cleanup standards (ACLs at the boundary), controlling the source of release and complying with applicable standards. Therefore. Ohio EPA did not require additional ground water remedial alternatives to be evaluated.

14.2 AOI G (MW-37 Area)

NPEC evaluated the following remedial alternatives within the CMS Report in order to address the unacceptable risk levels posed at AOI G:

- No Action;
- Limited Action: access restrictions;
- Containment: asphalt cover;
- Containment: clay/soil cover;
- Containment: concrete cover;

- Containment: RCRA cover;
- In situ treatment: soil vapor extraction;
- In situ treatment: solidification/stabilization; and
- Ex situ treatment: excavation and off-site disposal.

In addition the following remedial alternatives were considered for contaminated ground water associated with AOI G (MW-37 Area):

- Ex situ treatment: partial excavation and off-site disposal and clay/ soil cover;
- In situ treatment: dual phase vapor extraction;
- In situ treatment: biological;
- In situ treatment: chemical oxidation; and
- PGCS and IEC.

The preferred alternative identified within the CMS Report was:

- Containment: use existing asphalt cover, construct new clay/soil cover where needed
- PGCS and IEC
- Ground water monitoring

NPEC's evaluation concluded that use of the existing asphalt cover system was the preferred remedy for two reasons: it would require less time to implement than other technologies due to simplicity of design and any required reviews and secondly, it would result in the least disturbance of contaminated soils. Additionally, it was estimated to be the least expensive alternative. NPEC's evaluation did note that a cover system would not be as effective in reducing mobility of contamination as partial or complete excavation and also determined that partial or complete excavation would offer better long term reliability and effectiveness. Therefore partial excavation (est. $1,100,000) or complete excavation (est. $10,000,000) was ranked as the second choice after a cover system. In-situ stabilization/solidification was also considered but ranked low because it could not address VOC contamination as well as inorganics, both of which are present.

Although ground water contamination in the AOI G (MW-37 Area) is currently addressed by the IEC and PGCS, CCHD and Ohio EPA recognized that additional technologies may also be applied. Therefore, Ohio EPA required NPEC to perform additional detailed analysis within the CMS Report of the following technologies to determine if they could be effectively applied at AOI G (MW-37 Area): dual phase extraction, bioremediation and chemical oxidation. The rationale for not selecting these technologies is provided in Section 15, Ohio EPA's proposed remedial alternatives and rationale for selection.

14.3 AOI C-West

NPEC evaluated the following remedial alternatives within the CMS Report in order to address the unacceptable risk levels posed by AOI C-West:

- No Action;
- Limited Action: access restrictions;
- Containment: asphalt cover;
- Containment: clay/soil cover;
- Containment: concrete cover;
- Containment: RCRA cover;
- In-Situ Treatment: solidification/stabilization;
- Ex-Situ Treatment: soil washing; and
- Ex-Situ Treatment: excavation and off-site disposal.

The preferred alternative identified within the CMS Report was:

- Containment: use existing clay/soil cover and asphalt/concrete cover, construct new clay/soil cover where needed

NPEC's evaluation concluded that use of the existing cover, along with construction of a new cover where needed, was the preferred remedy for two reasons: it would require less time to implement than other technologies due to simplicity of design and any required reviews as compared to in-situ solidification/stabilization or ex-situ soil washing, and secondly, a cover system would require less handling of contaminated soil as compared to other technologies. Additionally, it was estimated to be the least expensive alternative. NPEC's evaluation did note that a cover system would not be as effective in reducing mobility of contamination or long term reliability and effectiveness as solidification/ stabilization, soil washing or excavation.

14.4 AOI 59-Slit Trenches

NPEC evaluated the following remedial alternatives within the CMS Report in order to address the unacceptable risk levels posed by AOI 59:

- No Action;
- Limited Action: access restrictions;
- Containment: asphalt cover;
- Containment: clay/soil cover;
- Containment: concrete cover;
- Containment: RCRA cover;
- Ex-Situ Treatment: slurry phase biological treatment;
- Ex-Situ Treatment: excavation and off-site disposal;
- Ex-Situ Treatment: excavation and incineration; and
- Ex-Situ Treatment: excavation and thermal.

The preferred alternative identified within the CMS Report was:

- Containment: use existing clay/soil cover and asphalt cover

NPEC's evaluation concluded that use of the existing clay/soil cover system was the preferred remedy for three reasons: they are not subject to the permitting requirements of thermal treatment; they require less disturbance as compared to the ex-situ technologies; and a clay/soil cover system was estimated to be the least expensive alternative ($389,000).

While NPEC's evaluation did find that treatment technologies would be more effective in reducing the mobility of contaminants, along with offering more long-term reliability and effectiveness than that of cover systems, such ex-situ treatment alternatives were also estimated to be much more costly (i.e., 8, 7, 34, and 22 million dollars respectively) than reliance on covers systems as a preferred alternative.

14.5 AOI 59-Slit Trench H

NPEC evaluated the following remedial alternatives within the CMS Report in order to address the unacceptable risk levels posed by AOI 59-Slit Trench H:

- No Action;
- Limited Action: access restrictions;
- Containment: asphalt cover;
- Containment: clay/soil cover;
- Containment: concrete cover;
- Containment: RCRA cover;
- In situ treatment: soil/solvent flushing; and
- In situ treatment: soil vapor extraction.

The preferred alternative identified within the CMS Report was:

- Containment: construct asphalt cover

NPEC's evaluation determined that in-situ SVE and solvent flushing technologies were not feasible due to the low permeability of the clay material within Slit Trench H and that excavation was not feasible due to a utility easement. The evaluation determined that cover systems were the only feasible alternatives and ranked asphalt cover as the preferred alternative over concrete and a RCRA cover because it was the quickest to implement and would present less difficulty as compared to the concrete or RCRA cover considering the use of required equipment near the electrical tower. The RCRA cover was rated the best alternative for reduction in mobility and toxicity of waste and long term reliability and effectiveness.

14.6 AOI 104

NPEC evaluated the following remedial alternatives within the CMS Report in order to address the unacceptable risk levels posed by AOI 104:

- No Action;
- Limited Action: access restrictions;
- Containment: asphalt cover;
- Containment: clay/soil cover;
- Containment: concrete cover;
- Containment: RCRA cover;
- In-Situ Treatment: soil/solvent flushing;
- In-Situ Treatment: soil vapor extraction;
- Ex-Situ Treatment: slurry phase biological treatment;
- Ex-Situ Treatment: soil vapor extraction;
- Ex-Situ Treatment: excavation and off-site disposal;
- Ex-Situ Treatment: excavation and incineration; and
- Ex-Situ Treatment: excavation and thermal desorption.

The preferred alternative identified within the CMS Report was:

- Containment: construct asphalt cover

NPEC's evaluation concluded that in-situ technologies and ex-situ SVE were not able to be applied due to the low permeability of the native clays at this AOI. Cover systems were ranked highest with an asphalt cover as the preferred remedy for the following reasons: it is easier to implement because it is not subject to permitting requirements as excavation followed by thermal treatment and can be implemented more quickly, and it is more reliable and effective in the short term because it does not require disturbance of contaminated soils. NPEC's evaluation recognized excavation and off-site disposal as the next best technology because it reduces toxicity and mobility and is reliable and effective in the long term.

14.7 Remedial Alternatives Proposed to be Applied Site-Wide

In addition to proposing preferred alternatives for individual AOIs within the CMS report NPEC proposed two preferred remedial alternatives to address site-wide contamination. NPEC proposes to address site-wide ground water contamination with the existing Perimeter Ground Water Control System (PGCS) and continue to monitor any exposures related to ground water with the Ground Water Compliance Monitoring Plan (GWCMP). NPEC proposes to address any exposures which may occur as a result of on-site excavation by means of a Soil Management Plan (SMP).

15.0 OHIO EPA'S PROPOSED REMEDIAL ALTERNATIVES AND RATIONALE FOR SELECTION

This section describes Ohio EPA's evaluation of the remedial alternatives examined within the CMS Report, along with describing Ohio EPA's proposed remedial alternatives and the rationale for selection for each AOI. Table 15 below summarizes Ohio EPA's proposed remedial alternatives for the site.

TABLE 15
OHIO EPA'S PROPOSED REMEDIAL ALTERNATIVES

AOI	Ohio EPA's Proposed Alternatives
AOI C-Main Ravine Landfill	• Containment: use existing cover system • PGCS and IEC • Ground water monitoring • Soil gas monitoring program
AOI G (MW-37 area)	• Containment: use of existing cover system. Construct new clay/soil cover where needed. • PGCS and IEC • Ground water monitoring
AOI C-West.	• Containment: use of existing cover system. Construct new clay/soil cover where needed.
AOI 59-Slit Trenches	• Partial Excavation
AOI 59-Slit Trench H	• Containment. Construct cover system.
AOI 104	• Containment. Construct cover system.
Site-wide Controls	• Environmental Covenant • Soils Management Plan (SMP) • Perimeter Ground Water Collection System (PGCS) • Ground Water Monitoring Program

Ohio EPA proposes to select containment as the final remedy for most AOIs including use of a cover system. Ohio EPA will require each containment system to be monitored and maintained so that it remains effective.

15.1 AOI C-Main (Ravine Landfill)

As indicated in Section 11.1 the results of the initial Tier I HHRA have determined that without considering the current cover, the Ravine Landfill would exceed the cancer and non-cancer risk criteria for the on-site outdoor worker due to the inhalation exposure pathway. In addition there is ground water contamination (VOCs) within the saturated zone (A1 sand and bedrock) associated with the ravine which must be controlled to minimize migration and to prevent off-site exposures.

The revised Tier II HHRA contained within the CMS demonstrates that the current cover system at the Ravine Landfill, which consists of 6 inches of clay and 3 inches of

top soil, reduces the release of VOCs to ambient air and prevents unacceptable exposures due to the inhalation pathway.

To assist in evaluating alternatives for the Ravine Landfill, the following guidance was considered: "A Guide to Principal Threat and Low Level Threat Wastes" Superfund Publication 9380.3-06FS, November 1991. In this document U.S. EPA articulates an expectation to use treatment to address the principal threats posed by a site whenever practicable and cost effective. Contamination that represents principal threats for which treatment is most likely to be appropriate includes contamination that is highly toxic, highly mobile, or cannot be reliably contained, and that would present a significant risk to human health and the environment should exposure occur. Additionally, U.S. EPA expressed its expectation for the use of engineering controls, such as containment, for wastes and contaminated media which can be reliably contained, pose relatively low long-term threats, or for which treatment is impracticable. It is also appropriate to use a combination of methods (e.g., treatment, engineering and institutional controls), to achieve protection of human health and the environment. Finally, U.S. EPA concluded that selection of an appropriate remedy is determined solely through the remedy selection process outlined in the NCP (i.e., all remedy selection decisions are site-specific and must be based on a comparative analysis of the alternatives).

Long term ground water monitoring associated with the Ravine Landfill indicates that migration and release has been limited and that the ground water contamination is not highly mobile and may be reliably contained. Ohio EPA has also noted that because the contents of the Ravine Landfill are of low permeability and high organic content, and due to the mass being so large (100,000 cubic yards), treatment is impractical. For such sites the above guidance recommends engineering controls such as containment as the remedial alternative.

Ohio EPA also considered the following directive related to remedial alternatives for landfills when evaluating remedies for the Ravine Landfill: U.S. EPA Directive No. 9355.0-49FS, EPA 540-F-93-035 "Presumptive Remedy for CERCLA Municipal Landfill Sites". The directive states that "containment" is U.S. EPA's presumptive remedy for municipal landfill sites where remedial action is necessary. Presumptive remedies are remedies which U.S. EPA prefers for common categories of sites based on historical patterns of remedy selection and U.S. EPA's scientific and engineering evaluation of performance data on the technologies' implementation. This directive also states that a containment remedy for landfills should include the following five elements:

- Landfill cap
- Source area ground water control to contain plume
- Leachate collection and treatment
- Landfill gas collection and treatment and/or
- Institutional controls to supplement engineering controls

Ohio EPA considers that the Ravine Landfill is similar to a municipal landfill in that the contents are heterogeneous and include solid waste, associated hazardous constituents and clay fill. The large volume of waste and its heterogeneous nature render the possibility of treatment of its contents impractical. Accordingly, a containment strategy coupled with long-term monitoring is a more appropriate remedy for a large land based unit such as the Ravine Landfill.

For this AOI Ohio EPA proposes to utilize a containment strategy, which would include consideration of the following design, maintenance and monitoring elements:

- Require NPEC to monitor and maintain the existing cover system;
- Continue IEC pump and treat system in the landfill to remove contaminated ground water;
- Require a soil gas assessment and monitoring plan to show if the landfill is generating soil gas which presents a risk due to vapor intrusion at existing on-site buildings situated in close proximity to this AOI ;
- Continued operation of the PGCS at the southern property boundary to prevent further migration of contaminated ground water from the source and to capture migrating contamination prior to leaving the site;
- Modifications to the GWCMP including piezometers so that the performance of the existing IEC and PGCS extraction systems can be measured, demonstrated and optimized; and
- Initiation of an Environmental Covenant to address the following use restrictions at the site:
    - A deed restriction which prevents future habitable structures from being constructed on AOI C-Main Ravine Landfill;
    - Site-wide Soil Management Plan (SMP) to manage any exposures due to future excavation within AOI C-Main Ravine Landfill; and
    - Survey and legal description of the location of AOI C-Main (Ravine Landfill).

Ohio EPA's proposed remedy is protective of human health and the environment because it prevents all human health exposures which are associated with AOI C-Main Ravine Landfill. The HHRA has shown that the existing cover system prevents unacceptable exposures due to inhalation of VOCs and prevents direct contact exposures by human receptors to surface and subsurface soils. Exposures which could occur during future on-site construction activity may be managed by the SMP. The

PGCS currently prevents any off-site exposures to ground water contaminated with COCs above the ACLs, and ground water monitoring shows that ACLs are being met at the site boundary. This alternative is considered reliable because historical ground water monitoring indicates that migration and release of VOC contaminants to ground water has been limited.

In addition to a containment strategy which includes use of the current cover, the IEC, and PGCS, Ohio EPA evaluated several remedial alternatives for this AOI including, partial excavation, soil vapor extraction, an on-site RCRA landfill and containment including a new engineered cover system. Ohio EPA's rationale for not selecting these remedial alternatives is provided below.

1. **Partial Excavation -** Partial excavation of areas within the Ravine Landfill which have elevated levels of lead. This remedy would only address direct contact exposures to lead within subsurface soils which would occur if excavation or utility work is performed on-site. It is notable that this alternative does not address the most obvious exposure pathway of concern which causes an exceedance of risk criteria (volatilization to ambient air from VOCs in subsurface soil).

2. **Soil Vapor Extraction -** A detailed analysis of SVE was undertaken for the AOI and Ohio EPA has concluded that the following characteristics of the fill material prevalent throughout AOI C-Main Ravine Landfill would prevent SVE technology from being effective: high moisture content, high organic carbon content, heterogeneous nature and low permeability. Results of the geotechnical sampling and analysis which determined the characteristics of the fill material within the Ravine Landfill as well as an additional detailed study to determine if SVE should be applied at the Ravine Landfill are located within Appendix AY of the approved CMS Report.

3. **On-Site RCRA Landfill -** A RCRA Subtitle C minimum technology designed landfill system has the perceived benefit of providing maximum containment and was evaluated as a remedial alternative within the CMS. However, the current landfill system has also been shown to be reliable in limiting the migration of contamination (based on many years of ground water monitoring). Additional factors which make this alternative less attractive are that it would be more difficult to implement and would present safety hazards for on-site and off-site receptors during construction, in addition to resulting in additional cost as compared to the proposed method of containment.

4. **Engineered Cover System-** Ohio EPA considered requiring a new cover be designed and constructed to meet standards of new covers, including to prevent infiltration of rain water. Ohio EPA decided this was not necessary because the HHRA shows that the existing cover is effective in preventing the exposure due to inhalation, ACLs for ground water are being met at the point of compliance, and the IEC and PGCS prevent the off-site migration of contaminated ground

water. Additionally, the requirements for new covers are not directly applicable to a corrective action unit, would require additional cost and would result in safety and exposures associated with construction activity.

15.2 AOI G (MW-37 Area)

The initial HHRA for this AOI indicated that exposures to contaminants within both surface and subsurface soils present unacceptable exposure scenarios. Specifically, within subsurface soils the migration of nitrobenzene to ambient air poses a potential risk to receptors via the inhalation route. In addition, the inorganic contaminant lead was determined to be present in surface and subsurface soils at concentrations above acceptable criteria. The revised Tier II HHRA considering use of the existing cover system indicates that risk criteria are within acceptable requirements for both an on-site outdoor worker and off-site resident (both adult and child). The RI also indicates that ground water in the saturated zone (A0 sand) approximately 15 ft below ground surface is contaminated with VOCs above ACLs; however, ACLs are being met at the point of compliance (site boundary).

For this AOI Ohio EPA proposes to select a containment strategy which includes consideration of the following design, maintenance and monitoring elements within a subsequent Corrective Measures Implementation Work Plan to be prepared by NPEC:

- Maintain existing asphalt cover system;
- Require NPEC to construct new clay/soil cover where needed;
- Require NPEC to monitor the existing cover system to ensure it is maintained in accordance with the established performance criteria;
- Utilize the SMP to manage any excavation or construction activity;
- Continue operation of the ground water extraction system, PGCS and GWCMP; and
- Survey and provide a legal description of this area.

This remedy is protective of human health and the environment as it prevents direct contact exposures with soils and reduces particulate and volatile emissions so that there are no unacceptable exposures, along with attaining media cleanup standards (ACLs at point of compliance) and controlling releases to air and ground water. This remedy is considered reliable because the results of historical ground water monitoring indicate that migration and release of contaminants to the saturated zone has been limited most likely due to the lower permeability of the clay and A0 sand in this area. This remedy controls the source of release by extracting contaminated ground water at its source, covering to prevent releases to air and extracting ground water down gradient at the perimeter to prevent releases off-site.

The following remedial alternatives were also evaluated by Ohio EPA to address AOI G (MW-37) Area but are not proposed as selected alternatives based on the corresponding rationale supplied below:

1. **Dual Phase Extraction -** This remedial technology was studied in detail because both the ground water (A0 Sand) and soil are contaminated with VOCs and SVOCs. However, upon evaluation in the CMS it was determined that this technology would not be effective for the SVOC nitrobenzene, which is the COC responsible for risk exceedance. In addition, the low permeability of the clay-rich unsaturated zone would prevent this technology from being effective.

2. **Full or Partial Excavation -** Excavation, either partial or complete removal of contaminated soil, is a potential remedial alternative because it would prevent exposures to surface soils. However, this remedy was not proposed by Ohio EPA because direct contact exposures are currently prevented by the existing asphalt cover system. Direct contact exposures which could occur during construction and excavation scenarios may be managed by the SMP and volatilization is prevented by the asphalt cover. In addition, this remedy was not selected as it would be more difficult to implement and be more costly than the proposed remedy but would not result in additional reduction of risk. Furthermore, partial excavation would require demolition and reconstruction of the current cover resulting in additional safety concerns associated with exposures during such activity.

15.3 AOI C-West

The remedy for this AOI must prevent direct contact with lead-contaminated surface and subsurface soils. NPEC has indicated that part of the surface is currently covered by a concrete slab and used as a storage area for operations. Part of the area is not covered.

For this AOI Ohio EPA proposes a containment strategy which primarily relies on use of a cover system to mitigate human health risk. The only other alternate remedy considered by Ohio EPA to address AOI C-West was that of conducting partial excavation, which was determined to result in similar risk reduction at more substantial cost than that of the proposed alternative.

This remedial alternative would include consideration of the following design, maintenance and monitoring elements:

- Require NPEC to construct new clay/soil cover where needed;
- Require NPEC to monitor the cover system to ensure it is maintained;
- Application of the site SMP to manage any exposures incurred during on-site excavation or construction activities; and
- Survey and legal description of the unit.

This proposed remedial alternative is protective of human health and the environment as it prevents all exposures related to direct contact with surface soils or subsurface soils. This remedy is considered reliable because it does not require complicated operation or maintenance activities. In addition, use of an environmental covenant will restrict future land use activities which can occur at the site. The proposed remedial alternative is not difficult to implement and was determined by Ohio EPA to be the least costly when compared to the other alternatives which also achieve the remedial response objectives.

The only alternate remedy considered by Ohio EPA to address AOI C-West was that of conducting partial excavation, which was determined to result in similar risk reduction at more substantial cost than that of the proposed alternative.

15.4 AOI 59-Slit Trenches

Review of the initial Tier I HHRA indicates that the majority of the risk at this AOI is attributed to exposures posed from emissions of volatile organic compounds (benzene, chlorobenzene, xylene) from residual contaminants within subsurface soils observed at 2 of 13 slit trench locations. For this AOI Ohio EPA proposes to select the remedial alternative of further partial excavation which would include consideration of the following design, maintenance and monitoring elements:

- Preparation of a Corrective Measures Implementation (CMI) Work Plan for performing additional excavation at the bottom of Slit Trenches F and I.

This alternative is protective of human health and the environment as it would eliminate the risk exceedance due to inhalation of VOCs.

The only other remedial alternative considered by Ohio EPA to address AOI 59-Slit Trenches was NPEC's preferred remedy which is utilizing the current cover over the entire area of the Slit Trenches. The revised Tier II HHRA considering 9 inches of clay cover over the area encompassed by all trenches shows that the current cover would prevent volatilization and no on or off-site exposures would exceed risk. The rationale for requiring additional excavation at AOI 59-Slit Trenches rather than the preferred alternative of using the current cover is that the exceedance of risk is caused by residual contamination found in confirmation samples at only 2 of 13 trenches indicating that limited additional excavation is necessary. NPEC's preferred remedial approach recommending use and maintenance of the current cover over all the entire area encompassing all 13 trenches requires long term maintenance and use restriction of 1.3 acres.

15.5 AOI 59-Slit Trench H

The initial HHRA indicates that both cancer and non-cancer target risk are exceeded for the on-site outdoor worker due to inhalation of volatiles from soil to ambient air. Furthermore, a revised Tier II HHRA indicated that even with a clay cover that cancer risk criteria is exceeded for the on-site outdoor worker but off-site adult or child resident risk criteria are not exceeded in this scenario. Risk remains for the construction worker

during excavation. The remaining portion of Slit Trench H which causes exceedance of risk is approximately 50 ft long, 10-15 wide and 5-10 ft deep with an estimated volume of 150 cubic yards. The sidewalls and bottom surrounding of the trench are clay material.

Since remedial alternatives requiring disturbance of soil in this area are not possible due to the restricted access zone which overlies this location and prohibits excavation within 25 feet of the electrical tower, Ohio EPA proposes to select a containment strategy for this AOI which includes consideration of the following design, maintenance and monitoring elements within a subsequent Corrective Measures Implementation Work Plan to be prepared by NPEC:

- Design /construct cover system;
- Monitor and maintain the constructed cover system;
- Survey location and provide legal description of unit; and
- Notify the power company of contamination and associated hazards in writing.

The only other remedial alternative evaluated by Ohio EPA to address this AOI was use of soil vapor extraction (SVE) technology to reduce VOC concentrations within underlying soils. Further evaluation of the site suitability for applying this technology was conducted by Ohio EPA and geotechnical analysis conducted in October 2007 (CMS Appendix AY) indicates that the permeability of the fill material in Trench H is too low to effectively apply this technology there.

15.6 AOI 104

The HHRA indicates that an exceedance of the hazard index of 1.0 (1.25) for the on-site outdoor worker would result from exposure to VOCs via inhalation of VOCs from subsurface soils to ambient air. However, the exposure scenario assumes an on-site outdoor worker will spend 250 days/year, 8 hours/day at this location, which may be overly conservative and unrealistic. Since the HHRA relies upon a single sample which was deemed representative and adequate by Ohio EPA at the time of approval of the RI, the risk exceedance is minimal, the exposure scenario is unrealistic and because the area of the AOI is so small (reported as .01 acre), the proposed remedy for this AOI is:

- Containment; design/construct cover system;
- Monitor and maintain cover system; and
- Survey location and provide legal description of unit.

15.7 Remedial Alternatives Proposed to be Applied Site-Wide

Ohio EPA proposes to select the following remedial alternatives to address site-wide ground water contamination and to address site-wide exposures occurring during excavation activities and would include consideration of maintenance and operation plans within a subsequent Corrective Measures Implementation Work Plan to be prepared by NPEC:

- Site-wide ground water contamination may be addressed by the PGCS in order to prevent any off-site exposures;

- Site-wide exposures occurring during on-site construction and excavation activity may be addressed by a SMP;

- Site-wide ground water contamination will be monitored by a revised GWCMP; in case ACLs would be exceeded at the point of compliance, additional corrective measures would need to be proposed for implementation; and

- Implement a vapor intrusion employee awareness program at the site.

ACRONYMS AND ABBREVIATIONS

ACL	Alternate Concentration Limit
AMSL	Above mean sea level
AOI	Area of interest
AOIWP	Area of Interest Work Plan
bgs	Below ground surface
CCHD	Citizens Concerned about Hilton Davis
cm/sec	Centimeter per second
CMS	Corrective measures study
COC	Contaminant of concern
CRI	Comprehensive Remedial Investigation
ERA	Ecological risk assessment
gpm	Gallons per minute
GWCMP	Ground water compliance monitoring plan
HHRA	Human health risk assessment
HI	Hazard Index
IEC	Interim Engineering Control
IM	Interim measures
MCL	Maximum contaminant level
NPEC	North Pastoria Environmental Company, Inc.
NOD	Notice of Deficiency
ODNR	Ohio Department of Natural Resources
Ohio EPA	Ohio Environmental Protection Agency
PCB	Polychlorinated biphenyls
PGCS	Perimeter ground water control system
PRG	Preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RTC	Response to comments
SB	Statement of basis
SMP	Soil Management Plan
SVOC	Semi-volatile organic compound
U.S. EPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile organic compound
WMU	Waste management unit

GLOSSARY

Administrative record - A collection of all documents that the Ohio EPA considers when selecting corrective measures for a Resource Conservation and Recovery Act (RCRA) facility.

Area of Interest (AOI) – Areas of the site at which hazardous wastes "are or have been placed," in addition to "areas at which other wastes have been placed if such wastes are causing or are threatening to cause contamination of the soils or waters of the state."

Bedrock - The solid rock that underlies gravel, soil or other unconsolidated surficial material.

Corrective measures study (CMS) - An evaluation of alternatives for cleanup of a facility contaminated with hazardous waste or hazardous constituents.

Facility - All contiguous land and structures, other appurtenances and improvements at a site under a given owner's or operator's control. The facility includes any solid or hazardous waste management area present.

Ground water - Water found beneath the earth's surface in a saturated zone. Ground water fills pores between materials such as sand, soil and gravel as well as cracks in bedrock.

Hazardous constituents - Constituents listed in the Appendix to Ohio Administrative Code (OAC) Rule 3745-51-11 and in the Appendix to OAC Rule 3745-54-98.

Hazardous waste - Waste as defined in OAC Rule 3745-51-03.

Hydraulic conductivity - The rate at which ground water can move through a subsurface soil unit.

Institutional Control - Controls that do not involve engineering or construction, such as land use restrictions, easements, covenants, zoning, deed notices and advisories.

Lacustrine - Geologic deposits that have been accumulated in lake-water areas.

Organics - Chemicals that contain carbon (for example, methane or CH_4).

Point of compliance (POC) - The defined location at which a cleanup level is required to be met.

RCRA - A law authorizing a regulatory program for treatment, storage and disposal of hazardous waste. The law includes corrective action provisions that authorize the federal government to respond directly to releases of hazardous waste that may pose a

threat to public health or the environment. Ohio EPA is responsible for implementing RCRA corrective action activities in Ohio.

RCRA closure - Closure of a hazardous waste management unit that meets the performance standards in OAC Rule 3745-55-11.

RCRA cover - Layers of clay and/or other low permeability material that minimizes entry of rainwater and production of leachate and that meets the requirements of OAC Rule 3745-57-10.

Remedial Investigation - An investigation to determine the nature and extent of contamination at a facility and the problems that the contamination may cause. The RI is performed prior to a CMS, which identifies and analyzes cleanup alternatives for the facility.

Risk assessment - An evaluation of existing conditions at a facility with respect to protection of human health, the environment, or both. This evaluation estimates, either qualitatively or quantitatively, the potential for adverse human health or ecological effects associated with potential contamination at a facility. Examples of risk assessments include human health risk assessment (HHRA) and ecological risk assessment (ERA).

Saturated zone - Zone below the unsaturated zone in which all the voids are filled with water.

Stabilization/solidification-Physical or chemical treatment that solidifies contaminated material (for example, soil or sludge) and reduces the mobility of contaminants.

Statement of basis (SB) - A public document that explains the corrective measures proposed by Ohio EPA to remediate contamination at a RCRA corrective action facility. The SB is based on technical information generated during the RI and CMS.

Till - Glacial drift composed of an unconsolidated, heterogeneous mixture of clay, sand, pebbles, cobbles and boulders.

Unsaturated zone - The uppermost zone below the earth's surface in which the cavities are filled with both water and air

Waste management unit (WMU) - Any discernible unit at which solid waste, hazardous waste, infectious waste (as those terms are defined in ORC Chapter 3734), construction and demolition debris (as defined in ORC Chapter 3714), industrial waste, or other waste (as those terms are defined in ORC Chapter 6111) has been placed at any time, irrespective of whether the unit was intended for the management of waste or hazardous waste. Such units include any area at a facility at which wastes have been routinely and systematically released. The term "waste management unit" is generally equivalent to the term "solid waste management unit." Examples of WMUs include

landfills, surface impoundments, waste piles, land treatment units, incinerators, injection wells, tanks (including 90-day accumulation tanks), container storage areas, transfer stations and waste recycling operations.

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Figure 1

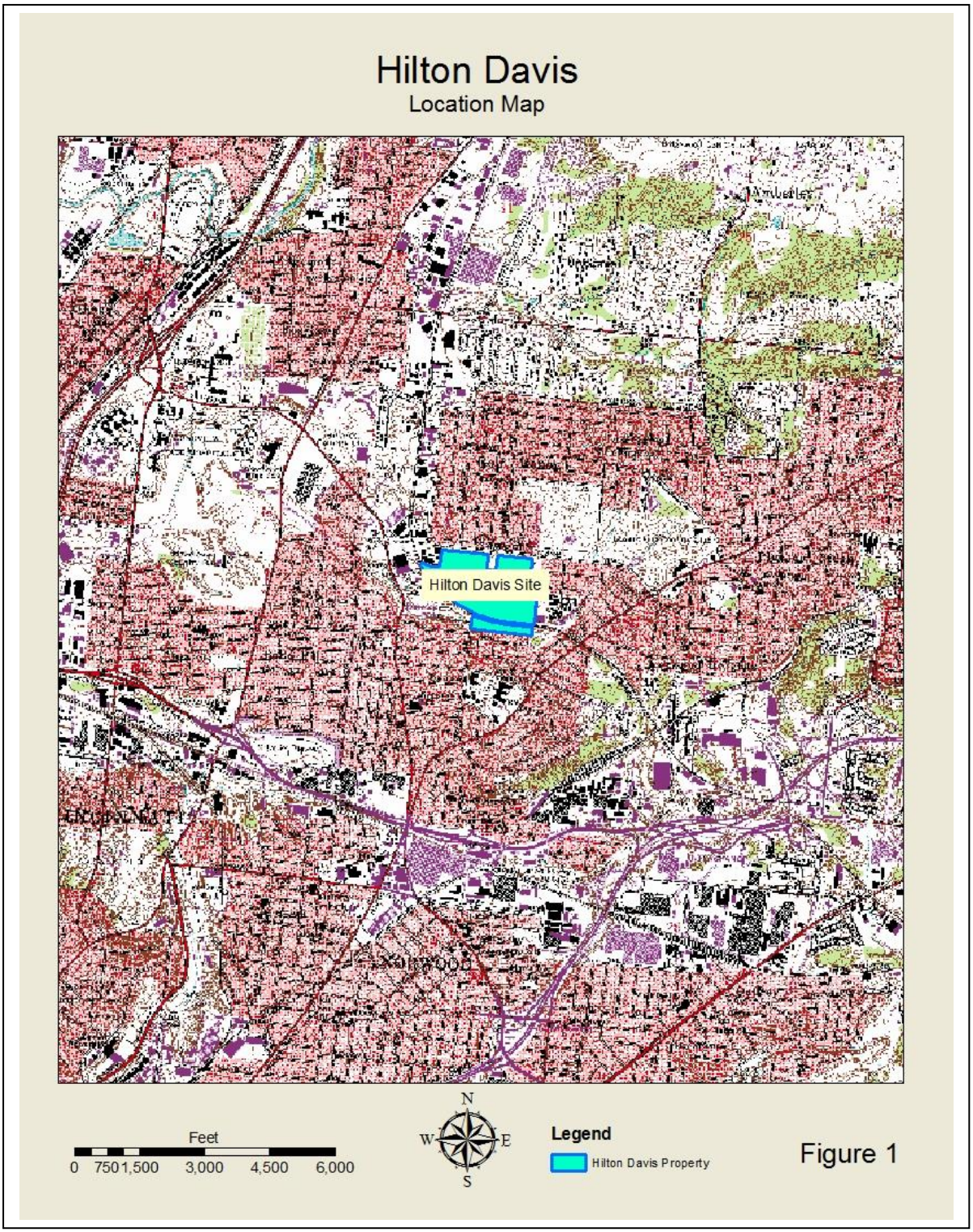
Hilton Davis
Location Map
Hilton Davis Site
Feet
0 750 1,500 3,000 4,500 6,000
N
W
E
S
Legend
Hilton Davis Property
Figure 1

Figure 2

Hilton Davis
MW37 Area and A0 Sand
MW37 Area
MW37 Area
A0 Sand
Hilton Davis Site
Fenwick Park
Southeastern Wooded Area
Feet
0 125 250 500 750 1,000
N
W
E
S
Legend
General Groundwater Flow
Hilton Davis Property
A0 Sand Zone
MW37 Area
Figure 2

Figure 3

Hilton Davis
Ravine Landfill and A1 Sand
A1 Sand
Hilton Davis Site
AOI C-Main (Ravine Landfill)
Fenwick Park
Southeastern Wooded Area
A1 Sand
Feet
0 125 250 500 750 1,000
N
W
E
S
Legend
General Groundwater Flow
Hilton Davis Property
A1 Sand Zone
Ravine Landfill
Figure 3

Figure 4

Hilton Davis
A2 Sand
Hilton Davis Site
Fenwick Park
A2 Sand
Southeastern Wooded Area
Feet
0 125 250 500 750 1,000
N
W
E
Legend
Hilton Davis Property
A2 Sand Zone
Figure 4

Figure 5

Hilton Davis
A3 Sand
Hilton Davis Site
Fenwick Park
A3 Sand
Southeastern Wooded Area
Feet
0 125 250 500 750 1,000
N
W
E
S
Legend
Hilton Davis Property
A3 Sand Zone
Figure 5

Figure 6

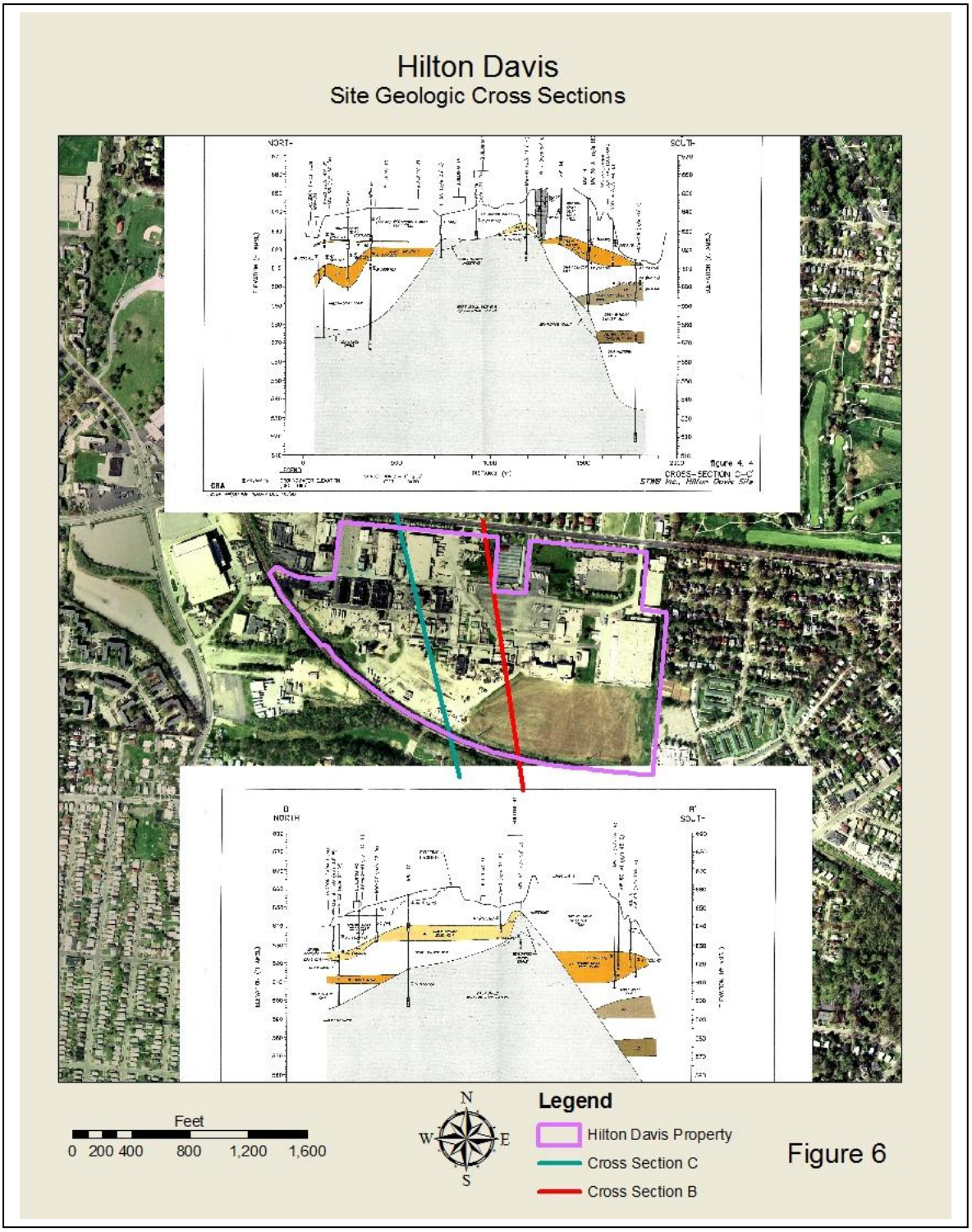
Hilton Davis
Site Geologic Cross Sections
NORTH
SOUTH
NORTH
SOUTH
Feet
0 200 400 800 1,200 1,600
N
W
E
S
Legend
Hilton Davis Property
Cross Section C
Cross Section B
Figure 6

Figure 7

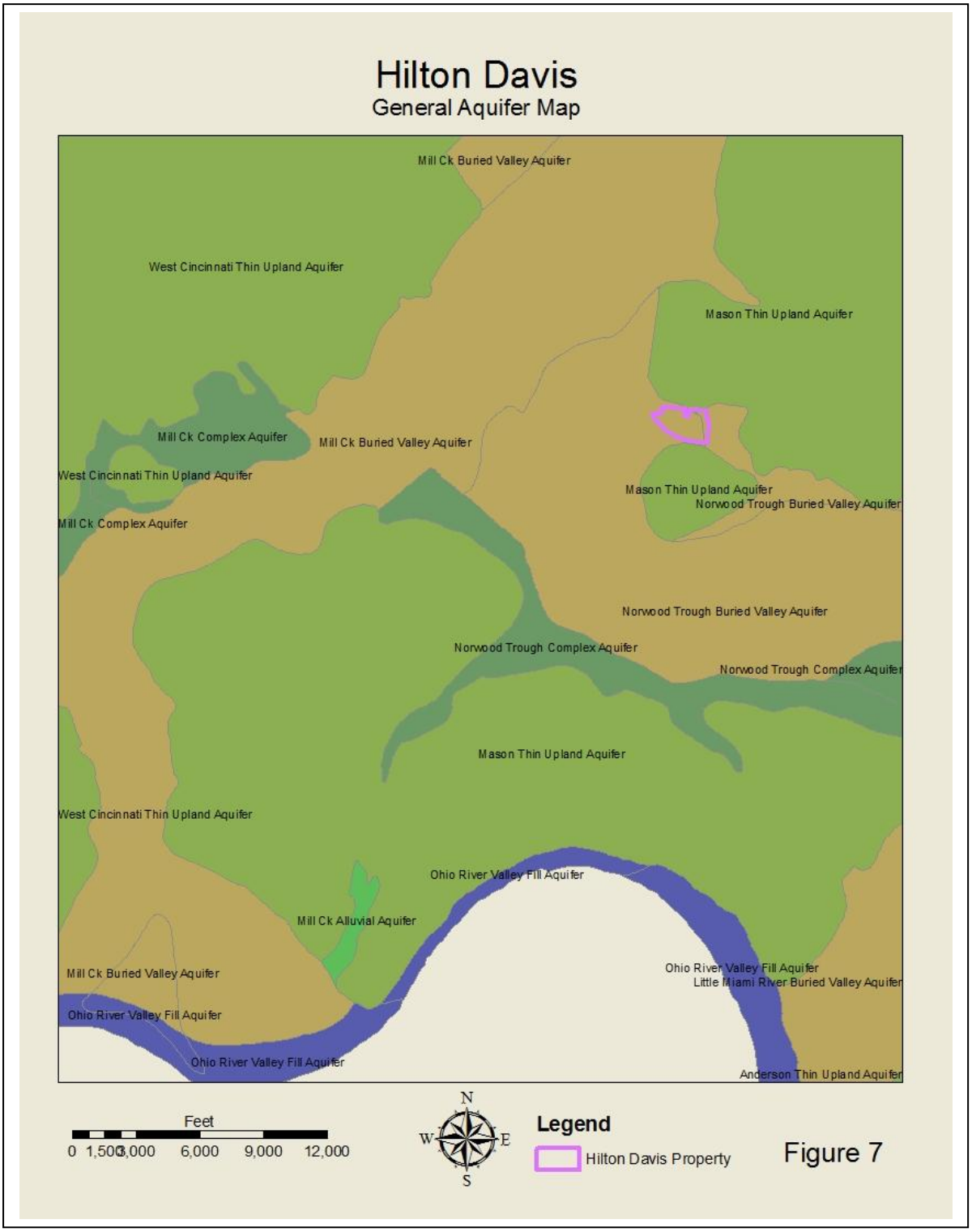
Hilton Davis
General Aquifer Map
Mill Ck Buried Valley Aquifer
West Cincinnati Thin Upland Aquifer
Mason Thin Upland Aquifer
Mill Ck Complex Aquifer
Mill Ck Buried Valley Aquifer
West Cincinnati Thin Upland Aquifer
Mill Ck Complex Aquifer
Mason Thin Upland Aquifer
Norwood Trough Buried Valley Aquifer
Norwood Trough Buried Valley Aquifer
Norwood Trough Complex Aquifer
Norwood Trough Complex Aquifer
Mason Thin Upland Aquifer
West Cincinnati Thin Upland Aquifer
Ohio River Valley Fill Aquifer
Mill Ck Alluvial Aquifer
Mill Ck Buried Valley Aquifer
Ohio River Valley Fill Aquifer
Little Miami River Buried Valley Aquifer
Ohio River Valley Fill Aquifer
Ohio River Valley Fill Aquifer
Anderson Thin Upland Aquifer
Feet
0 1,500 3,000 6,000 9,000 12,000
N
W
E
S
Legend
Hilton Davis Property
Figure 7

Figure 8

Hilton Davis
A1 Sand PGCS, A1 Sand Extraction Wells, and A2 Extraction Well
A1 Sand
EW-4-A2
EW-2-A1
Hilton Davis Site
EW-3-A1
Fenwick Park
A1 Sand
Southeastern Wooded Area
Feet
0 120 240 480 720 960
N
W
E
S
Legend
Hilton Davis Property
A1 Sand Zone
A2 Extraction Points
Ravine Landfill
A1 Extraction Points
A1 Sand PGCS
Figure 8

Figure 9

Hilton Davis
A0 Sand Extraction Points and A0 Sand PGCS
MW-57-A0
EW-1-A0
MW-37-A0
A0 Sand
Hilton Davis Site
Fenwick Park
Southeastern Wooded Area
Feet
0 125 250 500 750 1,000
N
W
E
S
Legend
A0 Sand PGCS
MW37 Area Extraction Points
Hilton Davis Property
A0 Sand Zone
MW37 Area
Figure 9