URS

FIVE YEAR REVIEW

RISK ASSESSMENT REPORT
FOR
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

SEPTEMBER 2006

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RISK ASSESSMENT ACRONYMS DEFINED

Acronym	Definition
1,2-DCA	1,2-dichloroethane
ARAR	Applicable or Relevant and Appropriate Requirements
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BERA	Baseline Ecological Risk Assessment
BGS	Below Ground Surface
BHHRA	Baseline Human Health Risk Assessment
C	Maximum Concentration reported from non-background samples
CCME	Canadian Council of Ministers of the Environment
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CRA	Conestoga-Rovers & Associates
CSF	Cancer Slope Factor
CT	Central Tendency
DF	Detection frequency
EE	Environmental Evaluation
ER-L	Effects Range-Low
ER-M	Effects range-Moderate
ESV	Ecological Screening Value
FS	Feasibility Study
HI	Hazard Index
IAC	Indiana Administrative Code
IDEM	Indiana Department of Environmental Management
IRIS	Integrated Risk Information System
LE	Leading Edge (refers to well location in plume)
LEL	Lethal Effects Level
LTGWM	Long Term Ground Water Monitoring
M	Meter
MCL	Maximum Contaminant Level (pg 9 1st occurrence)
mg/L	Milligrams per Liter
MNA	Monitored Natural Attenuation
MOEE	Ministry of Environment and Energy
MW	Monitoring Well
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service (NOAA)
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulations
NSDWR	National Secondary Drinking Water Regulations
OMA	Office of Marine Assessment (NOAA)
OU1	Operable Unit One - Landfill Cap
OU1 BHHRA	Risk Assessment for other media (air, sediment/surface soils, surface water) was previously submitted to IDEM as Appendix J of the OU1 RI

	report ("Human Health Risk Assessment, Appendix J *to* OU1 Remedial Investigation [RI] Report") (CRA, 1996c)
OU1 Groundwater BHHRA	The Risk Assessment for the groundwater on-Site was previously submitted as "Source-Area Groundwater Risk Assessment Technical Memorandum" (CRA, 1996a)
OU1 RI	OU1 Remedial Investigation
OU2	Operable Unit Two – Groundwater
OU2 BHHRA	OU2 Baseline Human Health Risk Assessment
PEL	Probable Effects Level
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RA	Remedial Action
RAGS	Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System
RAL	Removal Action Level
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RD/RA	Remedial Design/Remedial Action
RfD	Reference Dose or dose believed to not produce adverse effects even after long-term exposure
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RW	Residential Well
SF	Slope Factor
SQC	Sediment Quality Criteria
TBC	To Be Considered
U.S. EPA	United States Environmental Protection Agency
UCL	Upper Confidence Limit
ug/L	Microgram per Liter
VOC	Volatile Organic Compound
WQC	Water Quality Criteria

1.0 INTRODUCTION

The purpose of a five-year review is to determine whether the selected remedy at the Four County Landfill is or will be protective of human health and the environment. This review of the Baseline Human Health Risk Assessments (BHHRAs) and Baseline Ecological Risk Assessment (BERA) is divided into two main sections that focus on the human health risk assessment (Section 3 – Questions A1 to A5A) and the ecological risk assessment (Section 4 – Questions B1 to B4).

Each review outlines the exposure areas and exposure scenarios that were evaluated in the risk assessment, and then answers a series of specific questions about changes in the exposure assumptions, screening criteria, and toxicity values that were employed in the risk assessment. The degree to which the changes increase (or decrease) estimated risks and thereby affect the protectiveness of the established remediation goals, and whether remediation goals need to be modified to maintain protectiveness are evaluated.

As part of the technical review of the remedy, a review of the Baseline Human Health Risk Assessments (BHHRAs) is required primarily to address the following questions:

- In the time since the BHHRA was prepared, have there been changes in the site conditions, site setting, or the existing or anticipated land uses at the site? If so, do the changes require that additional pathways or receptor groups be evaluated or that any pathway be re-evaluated using more protective exposure input assumptions in order to avoid underestimating potential risks?
- Have there been changes in the Applicable or Relevant and Appropriate Requirements (ARARs) or To Be Considered (TBC) values that were used for screening purposes in the Chemical of Potential Concern (COPC) selection process for the BHHRA? If so, do the changes include lower screening values that lead to the identification of additional COPCs in any of the exposure media? Are risks associated with newly identified COPCs greater than acceptable target levels?
- For COPCs identified and evaluated in the BHHRA, have new toxicity values been introduced or have the original toxicity values been revised in the direction of greater toxicity (i.e., to higher cancer slope factors or to lower reference doses)? If so, are estimated risks associated with a newly introduced toxicity value or the increases in risk associated with a revised toxicity value significant (i.e., greater than the selected target risk level)?
- Are the existing remediation goals (presented in the feasibility study) still adequately protective of human health or should new remediation goals be developed in light of the additional risks associated with newly identified COPCs or revision of toxicity values?

2.0 BASELINE HUMAN HEALTH RISK ASSESSMENT REVIEW

The Four County Landfill began operations in August 1972, initially accepting only sanitary waste, which was disposed of in unlined pits and covered with backfill. Over time, additional types of waste were accepted and eventually, the site was accepting hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA).

In 1973, the Indiana State Board of Health ordered the cessation of disposal of barrels of solvents at the site. The State Board of Health approved the disposal of industrial wastes including plating sludge, asbestos, and liquids at the facility.

The Four County Landfill operated under interim status under RCRA, 42 U.S.C. #6901-6991 requirements from November, 1980 to March, 1989, when the U. S. District Court for the Northern District of Indiana ruled that the landfill operations had violated requirements applicable to landfills and ordered the owners and operators to immediately cease receiving hazardous wastes, to implement a closure plan for the facility, and to implement a facility investigation and corrective action.

In 1991, the owners and operators filed bankruptcy petitions. The Indiana Department of Environmental Management (IDEM) then pursued the Potentially Responsible Parties (PRPs) under the Indiana State Cleanup Law and entered into an Agreed Order to conduct site maintenance activities, identify the nature and extent of contamination, and provide alternatives for cleanup. In 1998, a group of PRPs entered into an agreed Order with IDEM to perform the Remedial Design/Remedial Action (RD/RA) for the first Operable Unit (OU1 – Landfill Cap) at the site.

2.1 Summary of the OU1 Risk Assessment

Construction of the OU1 RA was completed in December 1999. The RA consisted of construction of a geocomposite cap, with a flexible membrane liner (FML), geonet, clay and topsoil layers over former landfill cells, to isolate contaminants from rainwater percolating through the cells. In addition to cap construction, an area of contaminated soils was identified west of the landfill proper (CRA, November, 2000c). The most highly contaminated soils were excavated from this area in 1999, transported to the landfill, and covered by the clay cap. Soils with lesser amounts of contamination were left in place.

The RD/RA Plan for OU2 (Groundwater) was approved in 2001. Six remediation alternatives and variants were considered for OU2. The selected alternative consisted of Monitored Natural Attenuation (MNA) in association with the OU1 landfill cap as the source control. Monitored Natural Remediation (MNA) was selected on the basis of the OU1 Remedial Investigation (RI) which indicated adequate evidence that natural biodegradation was taking place at the site. The RI indicated that a narrow plume of Volatile Organic Compounds (VOCs) had migrated approximately 900 feet north/northeast from the northern landfill boundary. The major VOC contaminant was identified as 1,2-dichloroethane (1,2-DCA). Other VOCs in the plume included benzene, carbon tetrachloride, and vinyl chloride.

An Environmental Evaluation (EE) Report, completed for the Four County Landfill site by CRA in 1995, had the objective of presenting a qualitative evaluation of the actual or potential ecological impact poised by COPCs on the ecosystem or parts of the ecosystem around the vicinity of the site. A landscape environmental evaluation (Christopher B. Burke Engineering, 1995) was prepared as Appendix A to the EE.

The Baseline Human Health Risk Assessment (BHHRA) for OU1 was included as Appendix J to the OU1 Remedial Investigation Report. The specific guidance utilized in the development of the OU1 BHHRA included:

1. United States Environmental Protection Agency (U.S. EPA) Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (RAGS) (Interim Final, EPA/540/1-89/002, December 1989 (US EPA, 1989b),
2. RAGS Volume II: Environmental Evaluation Manual (Interim Final, EPA/540/1-89/001, March, 1989 (1989a), and
3. IDEM direction to assess the risk associated with a potential construction worker's exposure to perched water present in Unit A in close proximity to the landfill, in addition to potential risk resulting from the use of Unit B and C groundwater within the landfill as a potable and irrigation source water.

Environmental media covered in the OU1 BHHRA included source-area groundwater, sediment, surface water, and air.

Human health exposure pathways evaluated in the OU1 BHHRA were the following:

- Sediments
  - Dermal contact by workers, occasional visitors or off-Site residents, and
  - Incidental ingestion of sediments by workers, occasional visitors, or off-Site residents.
- Groundwater
  - Ingestion – drinking water – off-Site residents
  - Dermal contact – off-Site residents,
  - Inhalation of volatiles – off-Site residents,
  - Ingestion – home grown fruits and vegetables – off-Site residents
  - Ingestion – incidental pooled water – on-Site construction worker,
  - Dermal contact – on-Site construction worker, and
  - Inhalation of volatiles – on-Site construction worker.
- Air
  - Potential inhalation of volatiles by on-Site workers, and adults and children residing immediately adjacent to the perimeter of the site.

The evaluation and selection of potential routes of exposure assumed that future on-Site potable wells would be eliminated by deed restrictions, so that exposure to groundwater could either be through breaching of the landfill cap or migration of groundwater from the Site.

The following (Table A1-1) were selected as COPCs for OU1 (CRA, July, 1996b):

Table A1-1
OU1 Chemicals of Potential Concern (COPCs)
Four County Landfill
Fulton County, Indiana
(from CRA, 1996b)

GROUNDWATER			SEDIMENTS	AIR
Current		Future		
Unit A	Units B and C	Units B and C		
VOCs Acetone Benzene 2-Butanone Carbon Tetrachloride Chloroethane Chloroform Dichloromethane 1,1-Dichloroethane 1,2-Dichloroethane 4 Methyl-2-pentanone 1,1,2-trichloroethene Tetrachloroethene Toluene Trichloroethene	VOCs Dichloromethane 1,2-Dichloroethane Vinyl Chloride	VOCs Benzene Chloroform 1,2-dichloroethane Dichloromethane Trichloromethane Vinyl Chloride	VOCs	VOCs Acetone 1,1-Dichloroethene
Metals Arsenic Antimony Barium Beryllium Cadmium Chromium Cobalt Copper Lead Manganese Mercury Nickel Selenium Silver Vanadium Zinc	Metals Arsenic Barium Chromium Copper Lead Manganese Nickel Vanadium Zinc	Metals Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Lead Manganese Mercury Nickel Silver Vanadium Zinc	Metals Antimony Beryllium Nickel	Metals

All chemicals detected in Unit A groundwater were listed as Chemicals of Concern (COPCs) due to the restricted number of samples. All chemicals occurring in more than 5% of samples for Units B and C were evaluated as COPCs.

In surface water and sediment, all chemicals reported in at least one sample in each media were evaluated as COPCs. Chemicals that contributed one (1) percent or greater to the total score for either carcinogens or non-cargcinogens met the toxicity criteria. Chemicals considered to have relatively low carcinogenic or non-carcinogenic scores (i.e., those contributing less than one percent of the total carcinogenic or non-carcinogenic toxicity scores) were excluded from the risk assessment. For sediments, a chemical had to be reported as present in at least one sample at a concentration greater than twice the concentration reported in the Site-related background samples for the same media (consistent with selection procedures identified in U.S. EPA (1989b).

For surface water and sediments the carcinogenic score was computed as:

Score = DF*C*CSF, where:

DF = Detection frequency (# detections/# of Samples)
C = Maximum Concentration reported from non-background samples
CSF = Cancer Slope Factor

The CSFs were determined from US EPA (1986, 1989b).

For surface water and sediments the non-carcinogenic score was computed as:

Score = DF*(C/RfD), where:

DF = Detection frequency (# detections/# of Samples)
C = Maximum Concentration reported from non-background samples
RfD = Reference Dose or dose believed to not produce adverse effects even after long-term exposure

The RfD was determined from US EPA (1989b).

COPCs evaluated in air included all chemicals detected in collected air samples from the Site during the RI.

Human Health risks associated with OU1 groundwater were evaluated for both current and future impacts. Current impacts for Unit A were evaluated on the basis of concentrations from the entire Unit A data set. Potential current exposures to Units B and C were based on concentration data at the property line. In order to evaluate potential future exposure from Units B and C for off-Site residents, the entire on-Site data set for Units B and C was used, since there was no off-Site data available. .

The OU1 BHHRA report determined that there are potential human health risks from contact with contaminated groundwater, with 1,2-Dichloroethane (1,2-DCA) driving over 90% of the estimated risk. In addition to the MNA, private residential water wells have been monitored since approximately 1998. At the time of the OU1 implementation, none of the private wells had shown VOC impacts.

2.2 Summary of the OU2 Risk Assessment

The RD/RA Plan for OU2 (Groundwater) was approved in 2001. Six remediation alternatives and variants were considered for OU2. The selected alternative consisted of Monitored Natural Attenuation in association with the OU1 landfill cap as the source control (CRA, 1996b). Monitored Natural Remediation (MNA) was selected on the basis of the OU1 Remedial Investigation (RI) which indicated adequate evidence that natural biodegradation was taking place at the site. The RI indicated that a narrow plume of Volatile Organic Compounds (VOCs) had migrated approximately 900 feet north/northeast from the northern landfill boundary. The major VOC contaminant was identified as 1,2-dichloroethane (1,2-DCA). Other VOCs in the plume included benzene, carbon tetrachloride, and vinyl chloride.

A site-specific "Off-Site Groundwater Risk Assessment" was performed for OU2 by CRA (2000b) as Appendix L of the OU2 Remedial Investigation report. This "Off-Site Groundwater Risk Assessment" was intended to characterize potential current and future

impacts to human health associated with chemicals of potential concern in groundwater off-Site. This report constituted the primary OU2 human health risk assessment and is hereinafter referred to as the OU2 Baseline Human Health Risk Assessment (OU2 BHHRA).

A Risk Assessment for other media (air, sediment/surface soils, surface water) was previously submitted to IDEM as Appendix J of the OU1 RI report ("Human Health Risk Assessment, Appendix J *to* OU1 Remedial Investigation [RI] Report") (CRA, 1996c). The Risk Assessment for the groundwater on-Site was previously submitted as "Source-Area Groundwater Risk Assessment Technical Memorandum" (CRA, 1996a). These documents will be referred to as the OU1 BHHRA and the OU1 Groundwater BHHRA respectively in this report.

In the OU1 RI report, CRA (1996b) divided the groundwater under the site into three identifiable units (Units A, B, and C). Unit A was identified as the uppermost water bearing unit in the glacial tills, insufficient to supply potable water. Units B and C were identified as deeper units capable of producing potable supplies. CRA also prepared the Environmental Evaluation (EE) report for the site in 1995.

The specific guidance utilized in the development of the OU2 BHHRA ("Off-Site Groundwater Risk Assessment") included:

1. United States Environmental Protection Agency (U.S. EPA) Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (RAGS) (Interim Final, EPA/540/1-89/002, December 1989; and
2. Additional guidance, criteria, and reference documents, as applicable.

Four major segments comprised the OU2 BHHRA document:

1. Selection of Chemicals of Potential Concern (COPCs),
2. Exposure Assessment,
3. Toxicity Assessment, and
4. Risk Characterization.

The OU2 BHHRA identified the following potential human exposure pathways for off-Site groundwater.

- Ingestion of drinking water – off-Site residents,
- Dermal exposure while showering/bathing – off-Site residents,
- Inhalation of volatiles while showering/bathing – off-Site residents,
- Inhalation of volatile emissions from a large-scale irrigation system – agricultural workers,
- Ingestion of home grown fruits and vegetables irrigated with groundwater – off-Site residents, and
- Ingestion of meat (beef, pork, and poultry) obtained from animals watered with groundwater – off-Site residents.

The OU2 BHHRA was structured to evaluate risk in the following three separate off-Site areas:

- Upgradient Sector (areas west and south of the site to represent baseline groundwater quality conditions),
- East Downgradient Sector, and
- North Downgradient Sector.

Hazard indices and added cancer risks were not calculated in the OU2 BHHRA for the Upgradient Sector, since there was no exposure to potential COPCs from the site, and no lifetime cancer risks were developed for the East Downgradient Sector since there were no carcinogenic COPCs identified in this sector. For all exposure pathways, the OU2 BHHRA hazard indices for the East Downgradient Sector were below the U.S. EPA target of 1.0, the level of potential concern.

The results of the OU2 BHHRA indicated that lifetime excess cancer risks were higher than the U.S. EPA target risk levels for future residents living in the North Downgradient Sector, assuming groundwater is used for potable purposes. The chemical 1,2-DCA contributed over 90% of the total estimated risks. The additional COPCs, including benzene, carbon tetrachloride, and vinyl chloride, all had individual estimated lifetime cancer risks within the U.S. EPA target risk range of 10^{-6} to 10^{-4}. The hazard indices for future residents in the North Downgradient Sector also were above the 1.0, the level of potential concern, with 1,2-DCA comprising over 90% of the total hazard index.

The OU2 BHHRA noted that there currently was no excess risk associated with groundwater exposure north of the site. Only two potential groundwater exposure locations were present in the North Downgradient Sector area north of the site (King Lake Baptist Church and a cottage north of the wetland area), and there was only very limited potential for future residences due to the presence of a large wetland. Groundwater monitoring to that date had indicated that COPC concentrations were limited to the lower portion of the Unit C aquifer at depths greater than 100 feet. Well records from the area indicated that abundant potable water supplies were available at 60 to 80 feet below ground surface (bgs), so it would be unlikely that future residential wells would be installed at greater depths.

The OU2 BHHRA concluded that the hazard indices and excess cancer risk for an agricultural worker operating a large-scale irrigation system in the North Downgradient Sector were slightly above the non-cancer hazard level of potential concern and U.S. EPA's cancer target risk range. However, the presence of the large wetland, wooded areas, and multiple small plots of land made operation of a large-scale irrigation system unlikely in this sector.

The following assumptions were made and/or uncertainties were identified in the OU2 BHHRA:

- Actual exposure to homegrown fruit and uptake of chemical by fruit was unknown and conservatively estimated,
- Exposure of agricultural workers to volatile emissions from irrigation systems was unknown and assumptions were made,
- Future land use and conditions were assumed to remain the same,

- COPC concentrations in groundwater were assumed to be at a steady state over time with no natural decrease,
- 100% absorption of ingested chemicals was assumed,
- Unacceptable carcinogenic risks for carcinogenic chemicals was assumed to be several orders of magnitude below their respective hazard indices, so lack of RfDs for some carcinogenic chemicals was not considered an issue,
- Dose-response uncertainties may result from CSFs and RfDs derived from animal studies, but assumptions were believed to be conservative in nature, and
- Uncertainty concerning synergistic and additive effects.

3.0 FIVE YEAR BHHRA REVIEW

3.1 Question A1

A1. In the time since the BHHRA was prepared, have there been changes in the site conditions, site setting, or the existing or anticipated land uses at the site? If so, do the changes require that additional pathways or receptor groups be evaluated or that any pathway be re-evaluated using more protective exposure input assumptions in order to avoid underestimating potential risks?

3.1.1 Land Use Status

The current conditions and land uses within the Four County Landfill site have remained essentially unchanged from conditions described in the OU2 BHHRA. According to Robert Minarik, a nearby resident of the Site, there are no anticipated or reasonably foreseeable changes in land use or conditions within the site that would affect the conclusions from the OU2 BHHRA.

In the five years since the OU2 BHHRA, land use within OU2 and the area surrounding the Four County Landfill site has also remained essentially unchanged. Specific local changes have included the following:

- Addition of one new residential/recreational trailer unit down gradient of the site, on the east side of Highway 17 in the vicinity of MW-122. This unit appears to be used only on weekends and is believed not to have a residential well.
- Addition of a second residential trailer unit down gradient of the site on the east side of County Road 1000 W in the vicinity of MW-125, approximately 1,200 feet north of the Four County Landfill site.
- Increased efforts by a nearby up gradient landowner, west of the Site, to increase wildlife habitat and wildlife utilization and enhance property for outdoor recreational purposes.

The establishment of a privately developed wildlife refuge or management area is not considered to significantly alter the human health routes of exposure developed in the OU2 BHHRA. The addition of one additional residential unit within the vicinity likewise does not result in a change in the routes of exposure.

3.1.2 Groundwater Conditions

Table A1-2 lists the maximum concentrations of monitored chemicals found in on-Site and off-Site monitoring wells through the first eight quarters of MNA Monitoring. Table A1-3 summarizes all chemicals that have been detected in the on-Site and off-Site wells during the RI/FS, Long Term Ground Water Monitoring (LTGWM) program, and OU2 MNA monitoring periods. The LTGWM program CRA, 2003) was carried out in 2001 and 2002 to provide additional data prior to establishing the MNA program. A total of 30 wells were sampled eight times between October 2000 and August 2002 during the LTGWM program. An additional well was sampled twice. Not all parameters were sampled in each period at each well, but VOCs were generally sampled during each event. The LTGWM program was conducted after the OU2 BHHRA and the Baseline Ecological Risk Assessment (BERA) were completed. Results from the LTGWM program are included with the MNA data in Table A1-3. Because metals concentrations remained low and detections of most heavy metals were at less than 5 percent of total samples in the LTGWM program, metals were dropped from the sampling list during the MNA monitoring. Thus the RI/FS data used in the OU1 Groundwater BHHRA and the LTGWM data remain the only metals data for the groundwater. Results of the LTGWM have been incorporated and considered in this BHHRA review in addition to the RI/FS data.

Several VOCs that were detected in the RI/FS and considered in the OU2 BHHRA have not been detected during the eight quarters of MNA monitoring. These are acetone, bromodichloromethane, bromomethane, 2-butanone, carbon disulfide, chloroethane, dichloromethane, ethyl benzene, and xylenes. One chemical, 1,1,2-trichloroethane, has been detected in the MNA monitoring, but was not reported during the RI/FS sampling.

The MNA groundwater monitoring results since the OU2 BHHRA have indicated that the plume of groundwater contaminated with VOCs has increased in extent, with the plume now extending to MW-130, approximately 1,400 feet northeast of the site boundary (Figure 1). Under current conditions, this may increase the potential receptor wells by one or two wells and represents a slight change in potential receptors. Continued expansion of the contaminant plume could result in potential incremental effects on the affected population and on the magnitude of the groundwater residential ingestion/dermal/inhalation route of exposure.

In order to monitor the plume, five additional wells (SC-1, SC-2, SC-3, LE-1, and LE-2) were installed in June 2004 because of indications that the plume was expanding beyond the originally defined bounds. SC-1 was a dry hole and was not developed as a well. Based on monitoring data from these new wells, the plume is now believed to extend approximately 1,400 feet northeast of the site. The information indicates that the plume is very narrow, with continuing exceedances of MCLs for benzene, carbon tetrachloride, 1,2-dichloroethane and vinyl chloride.

The verified extent of the plume also is beginning to approach pasture and cultivated land in the vicinity of wells MW-130 and LE-2 northeast of the site. To date, the agricultural worker and agricultural products pathway scenarios have been generally hypothetical in nature, since there were no active agricultural land uses in the immediate down gradient vicinity of the site. Current data from the MNA network indicates that the plume is now

extending under cultivated land north of the site and may underlie pasture land northeast of the site. However, since the agricultural worker and agricultural products pathway scenarios were assessed in the OU2 BHHRA, this does not result in the addition of a new route of exposure.

Since the potentially affected aquifer in the North Downgradient Sector may now extend farther to the northeast than at the time of the OU2 BHHRA, the additional area of exposure currently may affect one to two additional residential wells. If the plume continues to expand to the northeast, the future scenario could include effects on one to two additional residential wells. A greater number of residential users could be affected if agricultural land were converted to residential. However, there are no indications that such a conversion will occur in the foreseeable future.

3.1.3 Residential Wells

Approximately twelve residential wells are present within the North Downgradient Sector and approximately 2 wells are present within the East Downgradient sector within 1 mile of the Site. The OU2 BHHRA made the assumption that the primary zone of contamination was Unit C of the aquifer at depths greater than 80 feet and that wells in this vicinity of the Site were generally no deeper than 80 feet. However, subsequent information (personal communication, W. Wieringa to R. Schlukebir, February 17, 2006) indicates that three of four wells for which information is available have depths greater than 80 feet. Thus, the site setting should be reconsidered on the basis that greater potential residential exposure is possible than anticipated in the OU2 BHHRA.

To date, monitoring data indicates that only one residential well is affected. Nine samples were collected by URS in June 2004. These included unfiltered samples from eight wells and one sample from one of these wells after it had passed through a filter. Additional samples have been collected quarterly from between two and five residential wells per quarter from September 2004 through March 2006 during the MNA period. A total of 36 unfiltered samples and 5 filtered samples have thus been analysed during the MNA period. Residential well 39 (RW-39 at 525 N. Prairie Drive) is the only well in which chemicals have been detected. Furthermore, vinyl chloride and 1,2-dichloroethane have been the only chemicals detected. All detections are shown in Table A1-4. RW-39 is located in a cottage in the wooded area approximately 600 feet north of the north Site boundary and is used on an occasional basis. RW-39 was renumbered as RW-58 in June 2005. It was installed in 1999 to a depth of 122 feet (personal communication, W. Wieringa to R. Schlukebir, February 17, 2006).

The Four County Landfill Potential Responsible Party (PRP) group has installed a filter system on residential well R-39. Post-filter samples were also analyzed during the residential well sampling. All of the post-filter samples were non detect for all monitored contaminants, indicating that filtering and periodic monitoring of wells may be sufficient to eliminate ingestion as an active residential pathway.

In summary, the potential for additional new residential potable water wells does not require that additional pathways or receptor groups be evaluated or that any pathway be re-evaluated using more protective exposure input assumptions in order to avoid underestimating potential risks. Although more wells may be affected than originally estimated, there appear to have been no significant changes in demographics or off-Site

land uses since the original OU2 BHHRA and no anticipated changes; consequently the assumptions and variables used in the original OU2 BHHRA remain valid with the exception of the premise that residential wells are unlikely to penetrate contaminated portions of the aquifer.

3.2 Question A2

A.2. Have there been changes in the Applicable or Relevant and Appropriate Requirements (ARARs) or To Be Considered (TBC) values that were used for screening purposes in the Chemicals of Potential Concern (COPC) selection process for the BHHRA? If so, do any of the changes include lower screening values that lead to the identification of additional COPCs in any of the exposure media? Are risks associated with newly identified COPCs greater than acceptable target levels?

3.2.1 BHHRA COPC Selection

In the OU2 BHHRA, various screening criteria were used to identify COPCs for the off-Site groundwater. The screening criteria were either risk-based concentrations or regulatory criteria considered to be health protective. Generally, if the maximum detected concentration of a chemical in the groundwater was greater than its screening criteria, the chemical was identified as a COPC. If not, it was screened out. In some cases, chemicals with concentrations exceeding the screening criteria were eliminated because the detection frequency was low, the concentrations were similar to background levels, or the chemical was not site-related.

The OU2 BHHRA COPCs for off-Site groundwater were selected consistent with the OU1 Source Area Groundwater Risk Assessment (CRA, 1996a) and U.S. EPA RAGS (U.S. EPA, 1989a). Analytes were selected as COPCs if the following criteria were met:

- The analyte was detected in greater than five (5) percent of the total number of samples, indicating that the detection was not sporadic or occasional,
- For inorganics, the calculated mean concentrations exceeded two times the mean background concentration,
- The calculated mean concentrations exceeded the U.S. EPA drinking water Maximum Contaminant Levels (MCLs), and
- The analyte had a published toxicity factor that could be evaluated quantitatively in the OU2 BHHRA.

The OU2 BHHRA generally followed the guidance provided in the US EPA RAGS (US EPA, 1998). For calculating mean background concentrations, non-detects were treated as one-half the detection limit and were included in the assessment only for chemicals that were detected in more than 5% of the samples for the sector.

Chemicals considered to be essential human nutrients and toxic only at very high concentrations were eliminated as COPCs for the OU2 BHHRA. These included calcium, magnesium, potassium, and sodium. Although vinyl chloride was not detected in over 5% of samples, it was included as a COPC based on professional judgment and due to its status as a Group A human carcinogen.

3.2.2 Changes in ARARs and TBC Values

In the time since the OU2 BHHRA was completed, some of the risk-based screening values have been revised and some regulatory criteria have changed. Changes in the screening criteria and effects on COPC selections are described below.

There have been no changes in the site location specific ARARs since the OU2 BHHRA. Based on the selected remedial plan, none of the potential action specific ARARs presented in Table 4.4 of the FS report is currently applicable to the selected plan. The action specific ARAR for Construction Activity (under 327 IAC 15-5) has changed to the effect that the minimal area of land disturbance subject to National Pollutant Discharge Elimination System (NPDES) Rule 5 permitting has been reduced (to 1 acre). This change will not affect activities under the current OU2 remedial plan.

In the time since the OU2 BHHRA was completed, there have been changes in some of the regulatory standards used as ARARs and in some risk-based screening values. Table A2-1 lists the chemical specific ARARs for the Four County Landfill OU2 BHHRA for all chemicals detected during the RI/FS and MNA groundwater monitoring. Table A2-1 also compares current ARAR standards to those in effect at the time of the OU1 and OU2 BHHRAs.

Current EPA guidelines for screening chemicals (U.S. EPA, 2003) indicate that the following hierarchy for screening chemicals should be employed:

1. National Primary Drinking Water Regulations (NPDWR) MCL values
2. EPA Superfund Removal Action Levels (RALs)
3. EPA Preliminary Remediation Goals (PRGs).

The OU2 BHHRA utilized the NPDWS MCLs as ARARs and the National Secondary Drinking Water Regulations (NSDWR) as TBCs for screening purposes. RALS and PRGs were not considered in the initial screening. PRGs represent additional quantifiable screening criteria that were not available for the OU2 BHHRA.

The OU2 BHHRA utilized validated analytical data for off-Site groundwater collected as part of the OU2 and supplemental investigations from March through June 1999. The monitoring wells were grouped by Sector. The North Downgradient Sector includes the area west of State Highway 17 and east of the wooded area north of the Site. The East Downgradient Sector includes all monitoring wells east of the Site and east of State Highway 17. All other wells are included in the Upgradient Sector. In addition to the permanent monitoring wells, the OU2 BHHRA utilized data from five screening borings (GS-1, GS-2, GS-6, GS-7, and GS-10) downgradient of MW-124. COPCs were identified separately for the North Downgradient Sector and the East Downgradient Sector.

Tables 2.2 and 2.3 in the OU2 BHHRA (Appendix A) list the COPC screening criteria and occurrence factors for the East Downgradient and North Downgradient sectors from the OU2 BHHRA, including the rationale for determining COPCs.

Table A2-1 lists the federal and state chemical specific ARARs and TBCs for groundwater as of April 2006 for all of the chemicals detected in groundwater during

either the OU1 RI or OU2 MNA monitoring studies. The most restrictive of the applicable groundwater or tap water criteria are shown in bold type.

Table A2-2 updates the COPC screening process by incorporating changes in ARARs (i.e. revised arsenic MCL) and using the updated groundwater data from the MNA and LTGWM programs. When only these ARARs are used for screening, no groundwater COPCs are identified for the Upgradient (Background) and East Downgradient Sectors. Vinyl chloride and 1,2-dichloroethane are the only COPCs for on-Site conditions. Carbon tetrachloride, chloroform, 1,2-dichloroethane, and vinyl chloride are COPCs for the North Downgradient Sector. Aluminum, manganese, and nickel are flagged from the RI/FS data set because they were more than twice the background concentration, but would not be flagged based on only the LTGWM data set, because concentrations are below two times the background concentrations.

Table A2-3 provides a more rigorous screening for COPCs by incorporating not only changes in ARARs (i.e. arsenic MCL) but also additional TBCs (RALs, PRGs) not considered in the OU2 BHHRA. The screening PRGs are based on the US EPA Region 9 published PRG Table, are current as of April 2006, and represent the most stringent of the EPA regional PRGs. The PRGs are based on evaluation of risk factors under default conditions. In this table, the PRGs represent the most restrictive screening criteria for several of the chemicals.

Inclusion of previously unconsidered PRGs and RALs (see Table A2-1) substantially increases the number of COPCs to be considered. Chloroform, carbon tetrachloride, and vinyl chloride would be added as East Downgradient Sector COPCs and benzene would be added for the North Downgradient Sector. Bromomethane, 4-methyl-2-pentenone, and carbon disulfide would be dropped due to lack of detection in the MNA data set.

The OU2 BHHRA eliminated several chemicals from the candidate COPC list prior to calculation of risk factors. In Table A2-2, the COPC selection process has been reviewed in light of the new or revised ARARs/TBCs (MCLs, NSDWRs, PRGs, RALs) for all of the chemicals and metals detected during the LTGWM period (2000-2002) and the MNA monitoring period (2004-2006) and also for metals as contained in the RI/FS monitoring period. VOCs, chloride, nitrate, and sulfate have been reviewed based on revised detection and concentration data from the MNA monitoring period, since this data set is more extensive than the original RI/FS data set. The data set for metals from the OU2 BHHRA has been retained and reviewed in light of the revised criteria. More recent metals data from the LTGWM program were also included. Table A2-2 summarizes detection and concentration data from the eight quarters of the MNA program. The data is summarized for the Upgradient (background) Sector, On-Site Sector, East Downgradient Sector, and North Downgradient Sector

3.2.3 Additional COPCs and Associated Risks

The following represent the results of the screening process review for individual chemicals.

Upgradient (Backgradient Sector)

For this review, a screening analysis was performed for the Upgradient Sector to determine if the more recent data or screening criteria would identify any potential

COPCs or potential risk factors for this area. Inclusion of the PRG values made no difference in results for this Sector. No COPCs were identified for the Upgradient Sector in either screening scenario.

On-Site Sector

A groundwater screening analysis also was performed for on-Site VOCs, even though this area was originally considered as a part of OU1 and not included in the OU2 BHHRA. Based on the MNA data, 1,2-dichloroethane and vinyl chloride currently would be considered COPCs for on-Site groundwater. Benzene, carbon tetrachloride, chloroform, and 1,1,2-trichloroethane would be added as COPCs if the PRG table were included as a screening criteria.

East DownGradient Sector

Carbon disulfide and bromomethane were identified as the only COPCs for the East Downgradient Sector in the OU2 BHHRA. However, neither compound has been detected in any of the MNA monitoring wells over eight quarterly samples. Based upon the MNA data, carbon disulfide and bromomethane can be dropped from further considerations as COPCs.

Comparison of the MNA-detected chemicals against the original screening criteria used in the OU2 BHHRA identified no COPCs for the East Downgradient Sector. However, when the Region 9 PRGs are included as screening factors, chloroform, 1,2-dichloroethane, and vinyl chloride are identified as COPCs. Chloroform was not identified as a COPC in any of the OU2 BHHRA screenings, so it represents a new COPC based on revised screening criteria.

No other changes in COPCs result for the East Downgradient Sector as a result of revised ARARs and TBCs.

North Downgradient Sector

Utilizing the same screening criteria as the OU2 BHHRA for the MNA data set for the North Downgradient Sector, carbon tetrachloride, chloroform, 1,2-dichloroethane, and vinyl chloride are identified as COPCs. All of these except chloroform were identified as COPCs in the OU2 BHHRA.

Benzene, carbon tetrachloride, 1,2-dichloroethane, and vinyl chloride continue to exceed MCLs and are retained as COPCs for this review. Benzene is identified as a current COPC when the PRGs are included as screening criteria.

Benzene was identified on the basis of the PRG, but would not be identified as a COPC on the basis of the MCL. The difference from the OU2 BHHRA is because the mean concentration has been lower (0.6 ug/L) in the MNA period than during the RI/FS period (25.6 ug/L). This difference may be due to inclusion of more wells farther from the source. However, the maximum concentration in the MNA period (23 ug/L) is substantially less than recorded in the OU2 BHHRA (460 ug/L), indicating that the difference may be due to decreasing concentrations in the Sector.

Although 4-methyl-2-pentanone and carbon disulfide were COPCs in the OU2 BHHRA, there were no detections of these chemicals in the North Downgradient Sector during the MNA monitoring. Thus, they are no longer identified as COPCs for this sector.

Metals

Aluminum, manganese, and nickel were identified as COPCs for the North Downgradient Sectors in the OU2 BHHRA, based on mean concentrations being over twice the background mean concentration and on the frequency of detection screening criteria, although they were not present insufficient concentrations to exceed any ARARs.

No additional metals data have been collected in the MNA monitoring period, although limited new data are available from the LTGWM . Therefore, the metals data from the OU2 BHHRA were carried forward to the updated review and aluminum, manganese, and nickel have been retained for risk assessment purposes.

In the LTGWM period, arsenic, barium, calcium, chromium, iron, magnesium, manganese, and sodium were sampled from both the B and C aquifer units. Zinc and mercury were sampled in the C Unit only. The LTGWM metals data has been reviewed and evaluated using the OU2 BHHRA COPC screening criteria. Iron in the North Downgradient Sector was the only metal that was present at greater than twice the mean background concentration. Since there is no MCL for iron, it has not been identified as a COPC. None of the other metals have been identified as COPCs based on the LTGWM program, due to non exceedance of the baseline concentration criterion.

Aluminum and Nickel

Neither aluminum nor nickel were detected in the 54 groundwater samples analysed in the LTGWM program at detection limits of 0.2 mg/L for aluminum and 0.04 mg/L for nickel. Since aluminum and nickel were not detected in more than 5% of the samples and there are no MCLs for these metals, these two metals would not qualify as COPCs based on the 2000-2002 LTGWM data. Consequently, it may be appropriate to eliminate aluminum and nickel as COPCs at this time.

Arsenic

The maximum concentrations of arsenic detected in the RI/FS in the North Downgradient Sector and the East Downgradient Sector were equal to or very slightly greater than the revised arsenic MCL of 0.1 mg/L. However, concentrations equal to the MCL were detected in only one sample in each sector and the highest mean concentration (0.00359 mg/L) of any sector (North Downgradient) was lower than the background mean concentration (0.00385 mg/L) as well as the MCL.

In the LTGWM period, arsenic was detected at greater than 0.01 mg/L in all four samples collected in the single East Downgradient well sampled (MW-107) and in one (MW-112) of 12 samples from North Downgradient wells. All downgradient detections were in the C Unit. Exceedances of the MCL were slight (0.010 to 0.016 mg/L). However, concentrations in the Upgradient wells equaled or exceeded the MCL in eight of 15 samples, with a high of 0.013 mg/L in Unit C at MW-101. Because the arsenic mean concentration for both the East Downgradient and North Downgradient Sectors was near or below the background (Upgradient) mean concentration in both the RI/FS and LTGWM data, arsenic has not been identified as a COPC for OU2.

Arsenic is the only chemical for which one of the OU2 BHHRA ARARs has been revised. Since the OU2 BHHRA was prepared, the MCL for arsenic has been reduced from 0.05 mg/L to 0.01 mg/L. Total arsenic was detected at maximum concentrations

greater than 0.01 mg/L, with a mean of 0.004 mg/L in the North and East Downgradient Sectors during the RI/FS and at a maximum concentration of 0.016 mg/L and mean concentrations of 0.010 and 0.005 mg/L (East and North Downgradient Sectors) during the LTGWM.

The OU2 BHHRA mean concentration for arsenic in these sectors was near or below the background mean concentration and the maximum was below the MCL (0.05 mg/L) at that time. Therefore arsenic was not considered a COPC in the OU2 BHHRA. Based on the revised MCL (0.1 mg/L), arsenic still does not meet the criteria for inclusion as a COPC. An argument could be made to add arsenic as a COPC, since the maximum was slightly above the new MCL. However, based on the higher concentrations in background samples, there is little indication that the site is contributing to risks at these levels, so there is no strong argument to add arsenic as a COPC because of the revised MCL.

Manganese

Manganese was identified as a COPC in the OU2 BHHRA on the basis of the RI/FS data. During the subsequent LTGWM period, the recorded manganese maximum concentration (0.48 mg/L) was about half that (0.94 mg/L) from the RI/FS period. The mean concentrations in the East Downgradient Sector and the North Downgradient Sector remained less than twice the background mean concentration. On this basis, an argument could be made to remove manganese as a COPC for the North Downgradient Sector. However, the mean concentration in the North Downgradient Sector remains above the mean background concentration and the North Downgradient Sector mean concentration remains about three times higher than the SMCL. Therefore, it may be appropriate to retain manganese on the North Downgradient COPC list at this time.

3.2.4 Summary of COPC Selection Process

The MNA monitoring data indicates that there has been little change in the plume in the East Downgradient Sector, but the plume appears to be migrating farther to the north in a narrow band. Therefore, in anticipation of potential future migration, a conservative approach based on mean concentrations within the plume, rather than mean values from the leading edge wells, appears appropriate for risk assessment purposes.

Based upon the most current inorganic data (RI/FS and LTGWM) and the updated VOC data from the LTGWM and MNA monitoring, the chemicals in the following list (Table A2-4) are noted as updated COPCs by sector, assuming the revision of the MCL for arsenic and the inclusion of PRGs as additional screening criteria. Chemicals which are identified as COPCs only on the basis of PRG values that are lower than MCLs or NDWSR are noted in *italics*:

Table A2-4
Proposed Updated Chemicals of Potential Concern (COPCs) for OU2
Four County Landfill
Fulton County, Indiana

SECTOR	CURRENT COPC	DROPPED COPC
On-Site	*Benzene* *Carbon tetrachloride* *Chloroform* 1, 2-Dichloroethane *1,1,2-trichloroethane* Vinyl chloride	
East Downgradient Sector	*Chloroform* *1,2-dichloroethane* Vinyl Chloride	4-methyl-2-pentenone Bromomethane
North Downgradient Sector	*Benzene* Carbon tetrachloride Chloroform 1,2-Dichloroethane Vinyl Chloride Manganese	Carbon disulfide 4-methyl-2-pentenone Aluminum Nickel
Upgradient Sector	None	

Based upon the more recent and more extensive MNA groundwater data, a more stringent revision in existing ARARs (arsenic MCL), and addition of the US EPA Region 9 PRGs as TBC screening values, the COPC list therefore has changed from that of the OU2 BHHRA with the addition of chloroform for the North Downgradient Sector and the addition of chloroform, 1,2-dichloroethane, and vinyl chloride for the East Downgradient Sector.

Of these, chloroform represents the only new COPC for OU2 as a unit. The MNA monitoring data indicates that bromomethane and 4-methyl-2-pentanone no longer meet the screening criteria as COPCs.

3.3 Question A3

A.3. For COPCs identified and evaluated in the BHHRA, have new toxicity values been introduced or have the original toxicity values been revised in the direction of greater toxicity (I.E., to higher cancer slope factors or to lower reference doses)? If so, are estimated risks associated with a newly introduced toxicity value or the increases in risk associated with a revised toxicity value significant (i.e., greater than the selected target risk level)?

3.3.1 Toxicity Value Revisions

Tables A3-1 and A3-2 summarize the current Reference Dose (RfD) and Cancer Slope Factors (SF) in relation to the values used for the OU2 BHHRA. Bolded entries in each table highlight values that have been revised in the direction of greater toxicity.

For the Reference Dose values (Table A3-1), the oral and dermal RfDs for 1,2-dichloroethane have decreased from 3.00E-02 to 2.00E-02, although the revised values remain provisional values and are only slightly reduced.

The oral and dermal cancer SFs for benzene (Table A3-2) have been revised towards greater toxicity, as have the dermal cancer SFs for carbon tetrachloride and chloroform. The inhalation cancer SF for vinyl chloride has been slightly increased.

Tables A3-3 through A3-8 show the revised non-cancer hazard indices and cancer risks calculated on the basis of the updated MNA VOC data using updated RfDs and SFs for benzene, carbon tetrachloride, chloroform, 1,2-dichloroethane, and vinyl chloride.

The residential exposure to groundwater via ingestion and bathing (Tables A3-2 and A3-3) are based on utilizing the same assumptions and parameters used in the OU2 BHHRA. The values and equations used for the daily intake calculations are shown in Table A3-9.

In addition to the updated values shown in Tables A3-1 and A3-2 and used in the revised calculations, there are several other chemicals for which dermal RfD and SF values have changed since the OU2 BHHRA. However, based on the concentrations in the MNA monitoring period, these chemicals are no longer identified as COPCs and they are not included in Tables A3-1 and A3-2 or the updated hazard indices and cancer risks calculations. These chemicals are carbon disulfide, 4-methyl-2-pentanone, and bromomethane.

Chloroform and 1,1,2-trichloroethane were not identified as COPCs in the OU2 BHHRA. They have been identified as COPCs based on the MNA monitoring. Thus the RfD and SF values in Tables A3-1 and A3-2 are presented as new toxicity values added since the OU2 BHHRA.

3.3.2 Revised Risk Assessment Methods and Assumptions

Residential Exposure to Groundwater

The risk assessment was run separately for the East Downgradient Sector and the North Downgradient Sector, based on the Central Tendency and Reasonable Maximum Exposure (RME) scenarios as described in the OU2 BHHRA and consistent with US EPA RAGS (US EPA, 1989a) guidance and US EPA supplemental guidance (US EPA, May, 1992). The Central Tendency (CT) is an estimate of the most likely expected

conditions, using the mean of the data for each chemical and assumptions based on average input parameters. The RME scenario represents a more conservative approach. For chemical concentrations, the RME utilizes the 95% upper confidence limit of the mean (UCL) of the MNA data set for each sector. The data set for each sector consists of all monitoring results from each of the wells in that sector

Use of all wells within a sector was chosen to represent the range and mean of conditions within that sector. This approach was chosen over the use of leading edge well data only (as used in the OU2 BHHRA) in order to characterize current and future conditions.

In general the input values used in the OU2 BHHRA are consistent with currently utilized default parameters and with the RAGS Part D Exhibit 4-1 standard default factors. The OU2 BHHRA modified the standard default daily ingestion and inhalation rates, using a slightly lower value for the Central Tendency, but using a slightly higher value for the RME scenario, effectively providing a more conservative estimate of risks under the RME scenario.

A full description of assumptions and input parameters is provided in the OU2 BHHRA. The values used for that assessment were deemed to be suitable for the site specific conditions and reasonable consistent with standard default factors. Therefore the updated risk assessment utilized the same input parameters as the OU2 BHHRA. Only chemical concentrations and reference doses and cancer slope factors (as applicable) were changed from the OU2 BHHRA methods.

As a check, the hazard indices and cancer risks were calculated using the on-line Risk Assessment Information System (RAIS) model supported by the Oak Ridge National Laboratory, with information and parameters updated to April 2006 (http://risk.lsd.ornl.gov). The On-Site Residential Exposure to Groundwater scenario was run using the Central Tendency and Reasonable Maximum Exposure concentrations for the Four County Landfill MNA data.

Residential Exposure to Groundwater via Ingestion of Homegrown Foods

The OU2 BHHRA evaluated the effects of uptake of fruits and vegetables irrigated with contaminated groundwater and the ingestion of meats, such as beef, pork, and poultry. To update this ingestion route for the five-year review, the RAIS Agricultural Exposure Pathway was selected as appropriate. This pathway evaluates the ingestion of homegrown fruits and vegetables, beef from cattle that graze and drink contaminated water, and milk from dairy cows. The standard default input parameters and variables of the RAIS on-line model were used. A complete listing of variables and equations used in this model can be found at http://risk.lsd.ornl.gov/homepage/tm/for_ag.shtml. Appendix A contains lists of the values used for daily intake calculations from the OU2 BHHRA (OU2 BHHRA Tables 4-2 to 4-4).

Agricultural Worker Exposure to Volatilized Emissions from Irrigation Systems

The OU2 BHHRA evaluated the potential effects of exposure of agricultural workers to emissions released from large-scale irrigation systems. The OU2 BHHRA assumed an irrigation area of 183 m by 18.3 m and varied the daily emission times and number of days of exposure (Table 4-3 in Appendix A). The OU2 BHHRA utilized the SCREEN3 air dispersion model to estimate maximum ground level concentrations of volatile

emissions. To update this ingestion route for the five-year review, the RAIS Industrial Worker Exposure Inhalation Pathway was utilized. The SCREEN3 model was also used to estimate maximum ground level air concentrations, based on an Area emission source of 183 m by 18.3 m, an emission source 2 m above ground level and a receptor at 1.5 m above ground surface. Other variables were unchanged from the OU2 BHHRA assumptions. The standard default input parameters and variables of the RAIS on-line model were used. A complete listing of variables and equations used in this model can be found at http://risk.lsd.ornl.gov/homepage/tm/for_ind.shtml.

3.3.3 Updated Pathways Analysis

Table A3-10 summarizes the hazard indices and cancer risks for each of the exposure routes, comparing updated values with those used in the OU2 BHHRA.

Residential Exposure to Groundwater via Consumption and Showering/Bathing – Current and Future Conditions

East Downgradient Sector

In both the Central Tendency and RME scenarios, the estimated total HI across all routes remains below 1.0 for both children and adults (Table A3-3b). In addition, the total HI has decreased since the OU2 BHHRA for all scenarios. Under the CT scenarios, vinyl chloride now contributes 68% to 69% of the total non-cancer HI under all Central Tendency and RME scenarios (Table A3-4). The total HIs are below 1.0, the level of potential concern.

No carcinogenic COPCs were identified for the East Downgradient Sector in the OU2 BHHRA. In this review, chloroform, 1,2-dichloroethane, and vinyl chloride have been identified as carcinogenic COPCs based on updated MNA data and updated cancer slope factors. The lifetime cancer risks associated with potential residential direct groundwater exposure range from 1.7E-03 to 3.6E-03 for the East Downgradient Sector (Table A3-4b), with vinyl chloride contributing about 50% of the risk and the rest spread fairly evenly among the other COPCs. These estimated lifetime cancer risks are above the US EPA target cancer risk range of 1.0E-06 to 1.0E-04. The lifetime cancer risks for 1,2-dichloroethane, chloroform and vinyl chloride are all greater than 1.0E-04.

North Downgradient Sector

The estimated hazard index for residential exposure to groundwater has increased for both children and adults in the North Downgradient Sector. The HI in all scenarios remains above 1.0 for both children and adults for the North Downgradient Sector (Table A3-3a).

The primary driver for the HI values is inhalation of manganese and ingestion and inhalation of carbon tetrachloride, which are sufficient in themselves to exceed the level of concern. If manganese were not included in the risk assessment, the total hazard index for the Central Tendency scenarios would decrease to below 1.0. The total HI for the Reasonable Maximum Exposure scenarios remains above 1.0, due to the influence of carbon tetrachloride. The contribution for carbon tetrachloride is about one order of magnitude greater than the other VOCs for all scenarios. Based on the MNA monitoring data and current reference doses, carbon tetrachloride now contributes over 90% of the VOC portion of the North Downgradient Sector total HIs. The contribution of benzene

has dropped from about 33% in the OU2 BHHRA to less than 10% based on updated assessment.

The lifetime cancer risks associated with potential residential direct groundwater exposure were identified as above the US EPA target cancer risk range of 1.0E-06 to .0E-04 in the OU2 BHHRA and remain above the target risk range based on the updated review (Table A3-4a). Current levels are indicated as 1.4E-01 and 2.1E-01 respectively for the child and adult CT scenarios and 3.0E-01 and 4.3E-01 respectively for the child and adult RME scenarios.

Lifetime cancer risks now appear to be approximately two to three orders of magnitude greater than indicated in the OU2 BHHRA. The total cancer risk for all COPCs across all routes was greater than the US EPA target cancer risk range of 1.0E-06 to 1.0E-04 for all scenarios for the North Downgradient Sector, East Downgradient Sector, and on-Site area.. The total cancer risk related to VOCs also remains above the target cancer risk range, even if manganese is not included in the analysis. All of the VOC COPCs contribute significantly to the total risks.

Residential Exposure to Groundwater via Consumption of Homegrown Fruits, Vegetables, Beef and Milk – Current and Future Conditions

East Downgradient Sector

In both the Central Tendency and RME scenarios, the estimated total HI across all routes remains below 1.0 for both children and adults (Table A3-10). However, unlike direct exposure to groundwater, the total HI has increased since the OU2 BHHRA for all scenarios. Under the CT scenarios, vinyl chloride now contributes 82% (RME) to 87% (CT) of the total non-cancer HI (Table A3-5b). In all cases, almost 100% of the total HI is contributed through the ingestion of fruits and vegetables.

No carcinogenic COPCs were identified for the East Downgradient Sector in the OU2 BHHRA. In this review, chloroform, 1,2-dichloroethane, and vinyl chloride have been identified as carcinogenic COPCs based on updated MNA data and updated cancer slope factors. The lifetime cancer risks associated with potential residential ingestion of homegrown fruits, vegetables, beef, and milk range from 1.5E-05 to 5.4E-05 for the East Downgradient Sector, with vinyl chloride contributing over 80% of the total cancer risk (Table A3-6b). These estimated lifetime cancer risks are within the US EPA target cancer risk range of 1.0E-06 to 1.0E-04.

North Downgradient Sector

Benzene, carbon tetrachloride, chloroform, 1,2-dichloroethane, and vinyl chloride are the COPCs for the North Downgradient Sector. Almost all of the total HI for all food ingestion exposure for this sector is through the ingestion of homegrown fruits and vegetables (Table A3-10).

The estimated total HI for residential exposure through homegrown fruits, vegetables, beef, and milk has increased for adults and generally remained constant for children in both the CT and RME scenarios in the North Downgradient Sector. In the Central Tendency scenario, the HI for adults has increased from 8.9E-03 to1.8E-02 and in the RME has increased from 6.9E-02 to 2.9E-01 1 for adults (Table A3-5a). The total HIs remain below 1.0, the level of potential concern.

In the OU2 BHHRA, the lifetime cancer risks associated with residential ingestion of homegrown foods were identified as within the US EPA target cancer risk range of 1.0E-06 to 1.0E-04 in the OU2 BHHRA. However, based on the updated review, they appear to be substantially above the target risk range.

Current levels are indicated as 2.5E-02 and 1.8E-02 respectively for the child and adult CT scenarios and 4.0E-01 and 2.9E-01 respectively for the child and adult RME scenarios (Table A3-6a). Almost all of the total estimated lifetime cancer risk for all food ingestion exposure for this sector is through the ingestion of homegrown fruits and vegetables irrigated with groundwater.

The OU2 BHHRA calculated total cancer risks on the basis of bromomethane and 4-methyl-2-pentanone, which were identified as the only carcinogenic COPCs in the North Downgradient sector. These two chemicals have not been found in groundwater during the MNA monitoring period, but chloroform, 1,2-dichloroethane, and vinyl chloride have been found sufficient to meet the screening criteria as COPCs.

Lifetime cancer risks now appear to be approximately one order of magnitude greater than indicated in the OU2 BHHRA. Benzene, carbon tetrachloride, chloroform, 1,2-dichloroethane, and vinyl chloride all have individual cancer risks across all routes greater the US EPA target cancer risk range of 1.0E-06 to 1.0E-04 for all scenarios.

Agricultural Worker Exposure to Groundwater via Volatilization of Groundwater Used for Irrigation – Current and Future Conditions

East Downgradient Sector

The non-cancer HIs for the East Downgradient Sector (2.5E-03 for Central Tendency and 7.8E-03 for RME) remain well below 1.0, the level of potential concern Tables A3-7b and A3-10). Cancer risk factors were also calculated for the five-year review, although they were not calculated during the OU2 BHHRA because no carcinogenic COPCs were identified at that time. The cancer risk factors (1.1E-06 for Central Tendency and 1.3E-05 for RME) are both within the US EPA target risk ranges (Table A3-8a).

Although the five-year review has identified two new carcinogenic COPCs for the East Downgradient Sector, the concentrations are not sufficient to result in significant human health impacts based on the risk assessment.

North Downgradient Sector

The OU2 BHHRA indicated that the RME HI was 3.0E+00 (above 1.0, the level of concern). The five-year review, based on the MNA data, indicates that the HI has decreased to the current 8.7E-01 (Table A3-7a). This appears to be due largely to a decrease in the 1,2-dichloroethane concentration in groundwater.

The estimated potential lifetime cancer risks for agricultural worker exposure to volatile emissions from groundwater ranges from 1.5E-06 for the Central Tendency to 4.9E-04 for the RME (Table A3-8a). The potential risk under the RME scenario is slightly above the US EPA target cancer risk range of 1.0E-06 to 1.0E-04. 1,2-dichloroethane continues to be the primary contributor to the potential cancer risk, contributing approximately 80% of the lifetime estimated cancer risk. The 1,2-dichloroethane cancer risk under the RME scenario is greater than the target risk range.

3.4 Question A4

A.4. Are the existing remediation goals (presented in the feasibility study) still adequately protective of human health or should new remediation goals be developed in light of the additional risks associated with newly identified COPCs or revision of toxicity values?

Existing remediation goals are based on the MCLs for benzene, carbon tetrachloride, 1,2-dichloroethane, and vinyl chloride. Since the primary effects are through groundwater, the current drinking water MCLs for these chemicals appear to be adequately protective of human health. There is currently no MCL for chloroform. The maximum concentration of chloroform recorded in the MNA data set is substantially higher than the US EPA Region 9 PRG, but less than the Superfund RAL for chloroform. Establishment of a chloroform remediation goal based on the RAL appears to be sufficient to provide adequate protection for human health.

Based upon the human health risk assessment approach, the only concerns in the East Downgradient Sector involve residential exposure to groundwater through direct ingestion and bathing/showering. Cancer risks are above respective target levels, largely as a result of vinyl chloride concentrations. Attainment of the vinyl chloride MCL remediation goal of 2 ug/L remains adequate to reduce the vinyl chloride cancer risk to within US EPA target concentrations and would be sufficient to reduce the total cancer risk to within US EPA target concentrations.

The North Downgradient Sector currently exceeds US EPA target concentrations for non-cancer HIs for residential ingestion and bathing/showering with groundwater and also the cancer risk target range for residential ingestion/bathing and agricultural worker exposure to volatilization of irrigation water.

Much of the cancer risk for the North Downgradient Sector is driven by inhalation risk for manganese. However, this metal is found in concentrations similar to the background average levels and perhaps should not be considered as relating to the Four County Landfill as a source. However, even if manganese is not included in the analysis, the Cancer risk would be higher than the US EPA target concentrations based on several VOCs. Attainment of current remediation goals for benzene, carbon tetrachloride, 1,2-dichloroethane, and vinyl chloride would result in reducing the HI and cancer risks for these chemicals to within or close to target concentration ranges.

3.5 Question A5 BHHRA Review Summary

A.5. BHHRA Review Summary

As of the five-year review period, there have been no significant changes in current or anticipated land uses that would have affected the original assumptions and projections of the OU2 BHHRA. A few additional residential wells may continue to be constructed in the vicinity of the landfill, but these do not represent significant or unanticipated changes.

The OU2 BHHRA assumed that there was no current excess risk for agricultural workers since the plume was beneath a swampy non-arable area with small parcels. However, the contaminated groundwater plume now is beginning to extend under active agricultural lands to the northeast of the site. Some of these lands are currently used for large-scale

production of field crops and pasture, but with no large-scale irrigation. The extension of the plume into these farming areas could potentially challenge those assumptions and lead to exposure of agricultural workers if irrigation systems are used in the future. However, no changes in land use or in agricultural practices, including irrigation, are indicated for the immediate future. In addition, since the OU2 BHHRA considered the potential for agricultural exposure to volatized emissions from irrigation systems, agricultural irrigation does not represent a change of future conditions.

The additional groundwater data from eight quarterly monitoring periods indicates that the contaminant plume in groundwater occurs in both the Unit B and Unit C portions of the aquifer, although these units appear to have sufficient connectivity to be considered as a single unit. The plume now appears to be relative narrow in extent, but is increasing in distance from the point of origin. The plume currently extends approximately 1,400 feet to the northeast in the direction of groundwater monitoring wells MW-30 and LE-2.

There appear to be no significant applicable changes in site-specific ARARs that would affect the remediation process. The MCL for arsenic has been lowered from 0.05 mg/L to 0.01 mg/L. This change in the arsenic MCL does not affect the status of arsenic in relation to COPCs since the mean concentrations found in the original RI/FS, the only available source for metals data, were below the new MCL as well as the old MCL.

The OU2 BHHRA indicated that contamination was probably confined to the deeper Unit C and residential wells in the vicinity probably only extended into the shallower Unit B aquifer. Additional information from boring logs and information on residential well depths indicates that many wells extend into the contaminated zone. Thus, it is possible that continuation of the plume may affect more wells than originally anticipated. However, due to the scarcity of residences and the narrow width of the plume, the total number may not be sufficiently large to affect the remedial goals and actions for the site.

Updated reviews of potential human health conditions based on revised toxicity values and on the eight quarters of groundwater monitoring data from 2004 to 2006 were used to update the conditions of the OU2 BHHRA. The updated review indicates no exceedances of the non-cancer total hazard index for any pathway in the East Downgradient Sector. The cancer risk factor target range in the East Downgradient Sector is exceeded for direct residential exposure to groundwater via ingestion and bathing for all scenarios evaluated. The direct residential exposure to groundwater non-cancer hazard indices for the North Downgradient Sector remain above 1.0 in all scenarios. The non-cancer hazard indices for residential food consumption and exposure of agricultural workers to volatilized emissions from irrigation water are below 1.0. All applicable cancer risk factors for the North Downgradient Sector, except residential consumption of homegrown foods, exceed the target cancer risk range of 1.0E-06 to 1.0E-04.

The summary of all human health receptor risks and hazards is shown in Table A3-10. A summary of all exposure routes and scenarios currently exceeding the target hazard and risk factors is shown below in Table A5-1.

Table A5-1
Summary of Updated Cancer Risks and Non-Cancer Hazard Quotients
Four County Landfill
Fulton County, Indiana

Area/Scenario	OU2 BHHRA	5-Year
Groundwater Consumption		
North Downgradient Sector		
Residential Exposure - CT		
Child Non-cancer HI	3.6E+01	3.3E+03
Cancer Risk	4.4E-04	3.0E-01
Adult Non-cancer HI	1.3E+01	1.2E+03
Cancer Risk	4.4E-04	4.4E-01
Residential Exposure - RME		
Child Non-cancer HI	8.6E+01	6.0E+03
Cancer Risk	2.9E-03	5.0E-01
Adult Non-cancer HI	3.2E+01	2.2E+03
Cancer Risk	2.9E-03	7.4E-01
East Downgradient Sector		
Residential Exposure - CT		
Child Cancer Risk	Not Calculated	1.7E-03
Adult Cancer Risk	Not Calculated	2.4E-03
Residential Exposure - RME		
Child Cancer Risk	Not Calculated	2.5E-03
Adult Cancer Risk	Not Calculated	3.6E-03
Agricultural Worker		
North DownGradient Sector		
Adult - RME		
Non-cancer HI	3.0E+00	7.8E-03
Cancer Risk	1.3E-04	4.9E-04

Changes in risk factors since the OU2 BHHRA are largely driven by changes in identification of COPCs and concentrations in groundwater during the more recent MNA monitoring program. Several of the chemicals identified in the RI/FS sampling (2-

butanone, 4-methyl-2-pentanone, bromomethane, and carbon disulfide) have not been found during the MNA monitoring. However, chloroform has been found during the MNA monitoring and higher concentrations of carbon tetrachloride and vinyl chloride have been found. In addition, some chemicals, such as benzene, have decreased significantly. Since both maximum and mean benzene concentrations have decreased, the benzene decrease appears to be related to natural attenuation, rather than choice of monitoring wells.

Remedial goals, based on MCLs, have been set for benzene, carbon tetrachloride, 1,2-dichloroethane, and vinyl chloride. The MCLs for these chemicals generally represent the PRGs applicable from risk assessment approaches. Overall, these four chemicals have the most significant contributions to the OU2 hazard indices and risk factors. As such, the remedial goals for these chemicals appear to remain adequately protective of human health. Chloroform is a chemical that appears to contribute to the total hazard indices and risk factors, based on the MNA data set. It was not identified as a COPC in the OU2 BHHRA. It may be appropriate to add chloroform as a COPC for the East Downgradient Sector and the North Downgradient Sector. No MCL has been set for chloroform, so an alternative, such as the Superfund RAL, may be an appropriate target level.

Residential well monitoring has been conducted at eighteen private wells in the vicinity of the Four County Landfill. Contaminants have been detected in only one well (R-38 at 525 N. Prairie Drive) located directly over the plume area about 600 feet north of the Site. The PRP Group has installed and the Trustee is currently maintaining a filter on this well. Analysis of pre-filtered and filtered water samples from this well indicates that the filter has reduced all monitored contaminants to below detection limits. The July 16, 2001 Record of Decision (ROD) for OU2 includes development of a residential water treatment contingency plan that included the use of proven physical and/or chemical treatment options to reduce site-related contaminant levels in residential water supplies that monitoring found to exceed MCLs. The filter system appears to date to be satisfying this requirement of the ROD. To data, installation of filters appears to be an appropriate level of additional contingency response for the Four County Landfill remedial action.

4.0 FIVE YEAR BERA REVIEW

4.1 Baseline Ecological Risk Assessment (BERA) Review

A Baseline Ecological Risk Assessment (BERA) was not conducted specifically for OU2. The Record of Decision Summary for OU2, Four County Landfill State Cleanup Site (RIDEM, 2001) references the Environmental Evaluation (EE) Report completed for OU1 by CRA (May 3, 1995). The ROD further states (page 15) that reported concentrations of COPCs in sediments and surface water were below background and/or available federal and state criteria. The OU2 Remedial Investigation Report (CRA. May, 2000a) appears to incorporate by reference (page 66) the EE as the BERA for OU2, and also incorporates the findings of the EE for OU2. The OU2 Remedial Investigation Report concludes that there is no functional pathway from on-Site and off-Site groundwater to ecological receptors and thus no route of exposure or potential effects on ecological systems.

The EE contained an ecological risk characterization for the Four County Landfill site, based on comparison of OU1 Chemicals of Potential Concern (COPCs) in surface water and sediments to federal and state regulatory criteria and guidelines. Applicable criteria and sources included:

- Indiana Ambient Water Quality Criteria (AWQC) (IAC, Water Pollution Control Board, 11/09/1993),
- U.S. EPA Quality Criteria for Water, EPA 440/5-86-001, May 1986, updated September 1987,
- National Oceanic and Atmospheric Administration (NOAA) Sediment Quality Criteria (SQC),Technical Memorandum NOS OMA 52, August 1991
- Ontario Ministry of Environment and Energy (MOEE) Guidelines for the Protection and Management of Aquatic Sediment Quality, August 1993),
- U. S. EPA Integrated Risk Information System (IRIS), July, 1994,

The ecological effects assessment consisted of a comparison of site concentrations to literature based background concentrations and criteria. The EE used the NOAA ER-L (Effects Range-Low) and ER-M (Effects range-Moderate) and the MOEE LEL and SEL criteria for sediment and the federal and Indiana AWQCs for surface water as the screening criteria to identify COPCs. The surface water AWQC criteria consisted of the Indiana Minimum Surface Water Quality Standards (Water Pollution Control Board, Title 327 IAC 2-1-6, November 9, 1993) and EPA Quality Criteria for Water (1986, EPA 440/5-86-01 May 86, 51 Federal Register 43665, Update September, 1997).

The EE found that all organic chemicals detected in sediments and surface water samples during the OU1 RI were below applicable the federal and state criteria used for screening. The report concluded that reported concentrations of on-Site inorganic chemicals were below levels expected to cause a potential severe impact to benthic organisms based on a literature-based toxicity review. Silver and zinc were identified as being slightly higher than screening criteria, but not sufficiently high to pose significant ecological effects. The report also concluded that on-Site surface waters were insufficient in volume and permanency to sustain fish. Therefore no ecological impacts were projected for on-Site surface waters and sediments. Some off-Site sediments and surface waters were reported to contain higher concentrations of chemicals than on-Site samples. With infrequent exceptions, no chemicals were reported at concentrations projected to cause ecological impacts for ecological receptors exposed to off-Site surface waters and sediments.

The EE identified three features as potential receptors of surface water drainage from the site. These were: 1) a wetland basin north of and adjacent to the Site (North Off-Site Sector), 2) forested wetlands and King Lake east of the Site (East Off-Site Sector), and 3) a series of connected wetlands and an unnamed stream south and west of the site (South Off-Site Sector). On-Site runoff is collected in retention basins in the northeast and southwest portions of the site and is then discharged toward the wetland north of the Site in accordance with a National Pollutant Discharge Elimination System (NPDES) permit. This wetland and the small streams draining the south perimeter of the Site eventually discharge to the Tippecanoe River, approximately one mile north of the Site.

The EE identified three potential sources for Site-related COPCs. These were: 1) drainage from the northeast retention pond which flows to the forested wetland in the North Off-Site Sector, storm event releases from the northeast pond into a road ditch parallel to Highway 17 which flows toward King Lake (East Off-Site Sector), and runoff from the southwest part of the Site to the stream to the south (West Off-Site Sector).

The EE defined COPCs on the following criteria:

- For inorganics, the substance had to be reported from at least one sample at a concentration greater than twice the mean background concentration,
- For organics, substances were evaluated on the basis of frequency of detection, concentration, toxicity, environmental persistence, and bioaccumulation potential.

No organic chemicals were identified as COPCs in the EE for surface water or sediments. Inorganic COPCs were identified as the following (Table B1-1):

Table B1-1

Ecological Risk Assessment Chemicals of Potential Concern (COPCs)
Identified for OU1 in the EE Report (CRA, 1995).
Four County Landfill
Fulton County, Indiana

ON-SITE		OFF-SITE	
Surface Water	**Sediment**	**Surface Water**	**Sediment**
Silver	Beryllium	Silver	Aluminum
Sodium	Calcium	Sodium	Antimony
Zinc	Chromium	Zinc	Beryllium
	Cobalt		Cadmium
	Copper		Calcium
	Iron		Chromium
	Magnesium		Cobalt
	Nickel		Copper
	Potassium		Iron
	Sodium		Magnesium
	Zinc		Nickel
			Potassium
			Thalium
			Zinc

The EE included an assessment of the uses and occurrence, environmental concentrations, environmental fate, and toxicity of each of these COPCs. The principle references consulted included ATSDR (1991, 1992), Carson, et al. (1986), CCME (1993), Long and Morgan (1991), Friberg, et al. (1979), (Kabata-Pendias and Pendias (1985), Shacklette and Boerngen (1984), McKee and Wolf (1963), and Goyer and Mehlman (1977), U. S. EPA (1980)

Exposure pathways evaluated in the EE were:

- Direct contact with affected surface water and sediment,
- Ingestion of surface water,
- Ingestion of sediments with food materials or during grooming,
- Ingested of affected plants and animals.

4.2 Question B1

B.1. In the time since the BERA was prepared, have there been changes in the site conditions, site setting, or the existing or anticipated land uses at the site? If so, do the changes require that additional pathways or receptor groups be evaluated or that any pathway be re-evaluated using more protective exposure input assumptions in order to avoid underestimating potential risks?

The Site is maintained in grass and is mowed approximately monthly, resulting in no significant wildlife habitat. At the time of the EE, the site contained an approximately 350-ft by 200-ft pond in the northeast portion and a smaller triangular detention pond in the southwest corner of the site. Construction of the landfill cap in 1998 and 1999 changed the drainage pathways, reducing flows to the northeast pond. There have been no significant changes in the overall size of these on-site retention basins, but the northeast basin rarely retains any water and the southwest pond is smaller in size, resulting in a decrease of potential habitat available to aquatic based wildlife. Wildlife habitat is thus very limited on the site. The cap has decreased the degree of interaction between surface water and ground water, presumably resulting in a decrease potential for transport of contaminants to surface waters and habitats. No noticeable increases in On-Site wildlife utilization have been noted by the MNA monitoring personnel during the most recent eight quarters of monitoring.

The forested and wetland area north of the Site is thought to be utilized by wildlife, but no changes in utilization have been documented since the ROD. There have been no significant changes in conditions in the Off-Site North Downgradient or East Downgradient Sectors that constitute a significant alteration of wildlife habitats or ecological conditions

A potentially significant change in wildlife habitat is occurring west of the Site, on the west side of County Road 1000 E. Soil for the landfill cap was excavated from this property in approximately 2000, resulting in a new lake and wetland area. The property owner has been planting trees, stocking with fish, placing nesting boxes, and attempting to improve habitat on this property. However, this area is generally up-gradient from the Site (Figure 2). Sentinel monitoring wells MW-115 and MW-116 are between the Site and this lake area. Neither well has detected any chemicals in eight quarters of MNA monitoring from March 2004 to March 2006.

It is conceivable that the presence of this habitat feature could result in greater wildlife utilization of the area immediately surrounding the landfill. This could especially be true with respect to waterfowl and wading birds that may be attracted to the lake. However, the EE concluded that exposure levels to wildlife from On-Site and Off-Site sediments

and surface water were not sufficient to pose an ecological risk. There have been no changes in surface or groundwater pathways since the EE. Construction of the OU1 landfill cap has been completed. Thus, the potential for migration of contaminants from the on-Site source should be reduced.

Due to its up-gradient location and the shallow nature of the created lake (less than 10 foot depth), groundwater does not appear to represent a potential transport pathway to this habitat area. Thus, there is no potential for transport of COPCs to the created lake down-gradient of the Site. Thus, consideration of groundwater transport to the lake as a pathway is not required at this time.

Groundwater was not identified as an affected media or as a part of any ecological pathway in the EE. Surface water and sediments were identified as potential routes of exposure to ecological systems. No assessment was made of potential interactions of groundwater and surface water.

Although there is no detailed information relating to exchange between the aquifers and surface waters available for the Site, the potential appears to be very low for a direct pathway from Units B and C of the aquifer to surface water in the near vicinity of the Site. Although it is possible that interactions could occur at farther distances from the site due to elevation changes or other factors, concentrations of contaminants likely would substantially lower than in the Site vicinity, due to natural attenuation and dilution over a larger area. Mixing of groundwater and surface water would also occur, further reducing concentrations affecting potential receptor organisms.

Available data also indicates that the shallow aquifer (A unit) is a perched unit within sand and gravel stringers in denser till material. It is largely discontinuous and off-Site transport in this aquifer may be limited to small quantities in the near vicinity of the Site. This would not result in an extensive exposure to the regional populations.

No additional site specific information or additional chemical concentration data has been collected for the Site for surface water, sediments, or the shallow Unit A aquifer since the RI/FS. Thus no additional assessment can be attempted using newer data. The data used for the EE remains the best available source data.

In summary, there have been no changes in Site conditions, setting, or land uses that require re-evaluation of ecological pathways.

4.3 Question B2

B.2. Have there been changes in the ARARs or TBC values that were used for screening purposes in the COPC selection process for the BERA? If so, do the changes include lower screening values that lead to the identification of additional COPCs in any of the exposure media? Are risks associated with newly identified COPCs greater than acceptable target levels, requiring the establishment of new remediation goals?

The EE made a generic identification of pathways and potential receptors and compared surface water and sediment concentrations to published standards and criteria. No evaluation was made for groundwater. The EE included a characterization of potential

impacts to fish and wildlife based on literature review. The review covered environmental fate and toxicity effects for inorganic chemicals.

No ARARs or TBCs were identified for groundwater in the EE. The ARARS used for surface water included the Indiana Minimum Surface Water Quality Standards (Water Pollution Control Board, Title 327 IAC 2-1-6, November 9, 1993) and EPA Quality Criteria for Water (1986, EPA 440/5-86-01 May 86, 51 Federal Register 43665, Update September, 1997). ARARs were presented only for three inorganic chemicals.

The focus of this five year review is on OU2 and the effects of groundwater, primarily on off-Site receptors due to migration of contaminated groundwater from the site. Exposure of aquatic organisms and wildlife assumes the presence of a complete pathway to appropriate receptors. Although no complete pathway is believed to exist for off-Site groundwater, a screening comparison has been performed to evaluate the potential for ecological risks if such a pathway were present.

Table B2-1 compares the mean and maximum concentration of chemicals to several current screening criteria, including US EPA criteria and Indiana AWQC for protection of aquatic life. The listed concentrations for non-metallic inorganics and VOCs are from the MNA monitoring period. These values include all wells on the Site and in the North Downgradient Sector and the East Downgradient Sector since potential ecological effects could be evidenced down-gradient of any of these wells. Metals data is from the RI/FS sampling period and includes the mean and maximum concentrations presented in the OU2 BHHRA. Any higher mean and maximum metals concentrations values from the LTGWM program are shown in place of the RI/FS data, as applicable.

For comparison to the screening criteria, the groundwater concentrations shown in Table B2-1 were divided by a factor of 10 before comparison to the screening criteria. This was done to account for dilution and attenuation during transport and for dilution when and if the groundwater enters and mixes with surface water. The factor of 10 is used by NOAA for groundwater (NOAA, 1999) and is considered by NOAA to be a very conservative factor. The use of the maximum concentration is also a very conservative approach for evaluating potential effects, especially when groundwater is being considered as a potential route to surface water.

Based on these very conservative screening factors, none of the screening criteria are exceeded by the mean concentrations of any chemical. Based upon maximum concentrations, only aluminum exceeds any of the screening concentrations, which is an exceedance of the US EPA chronic WQC. No other screening criteria exceedances occur.

Aluminum might be considered as a COPEC based on the very conservative assumptions using the maximum reported concentrations from the RI/FS study. However, aluminum was not detected in any well during the subsequent LTGWM period from 2000 to 2002, and, when mean concentrations in groundwater are considered, none of the chemicals exceeds any of the potential ARAR screening criteria. Since the potential for a groundwater to surface water pathway of ecological exposure appears slight, the associated risks do not appear sufficient to warrant adding any chemical as a COPEC for the site.

4.4 Question B3

B.3. For COPCs identified and evaluated in the BERA, have new chemical-specific factors or toxicity values been introduced or have the original values been revised in the direction of greater toxicity (i.e., to greater transfer values or lower reference toxicity values)? If so, are estimated risks associated with a newly introduced value or the increases in risk associated with a revised value significant (i.e., lead to exceedance of the target risk level)? Is it necessary to develop new remediation goals or revise existing remediation goals for any medium as a result of the increases in toxicity estimates?

No ecological COPCs or COPECs were identified in the EE or the applicable BHHRA or RI/FS documents for OU2. It is not necessary to develop new remediation goals or revise existing remediation goals for any medium as a result of the increases in toxicity estimates.

4.5 Question B4 BERA Review Summary

B.4. BERA Review Summary

No BERA was actually developed for the Four County Landfill OU2. An EE Report was developed for OU1, which evaluated potential effects of on-Site sediments, soils, and surface water. The OU1 EE did not present a full ecological risk assessment, having concluded that concentrations of organic chemicals in sediment and surface water were below federal and state criteria (AWQCs for surface water; NOAA and MOEE criteria for sediments) and that concentrations of inorganic chemicals were below concentrations expected to cause a potential severe impact to benthic organisms. Silver and zinc were the only chemicals in off-Site surface water reported above applicable screening criteria.

Because silver and zinc surface water concentrations were only slightly above screening criteria and because the EE concluded that surface waters in on-Site and off-Site wetlands were not sufficient to support fish, the EE did not identify these as COPECs. Because all chemical concentrations were below the MCLs, expected to protect mammalian species, the EE concluded that no effects would occur for avian species as well.

Additional data on metals has been developed in the LTGWM program since the EE report. The review of potential metals effects from groundwater for this review utilizes both the RI/FS data set used in the EE and the LTGWM data. This review utilized concentrations of organic chemicals from the more recent and more extensive MNA monitoring data.

Due to the depth of the Units B and C aquifer, the potential for interaction of groundwater with ecological receptors remains very slight. Potential interactions could occur if groundwater were to mix with surface water. Situations in which such interactions could occur might include upwelling and seepage of groundwater into shallow surface waters of wetlands, intersection of groundwater with a water body that is sufficiently deep to intersect the aquifer, or if groundwater were pumped to the surface and allowed to remain on ground surface or to mix with a water body.

Based on current site conditions, none of these interactions is anticipated to be reasonably applicable in the foreseeable future. Consequently, a completed pathway of exposure is not a reasonably expected condition.

In the event that a pathway was present, concentrations of organic and inorganic chemicals in groundwater have been compared to several current screening criteria based on US EPA and State of Indiana based ARARs. Mean and maximum concentrations were compared to screening criteria, using a conservative assumption that groundwater concentration is divided by a factor of 10 at the exposure point, based on attenuation and dilution in groundwater and dilution upon mixing with surface water. Based on mean concentrations, all chemicals in groundwater are below or sufficiently close to screening criteria to present no significant risk to ecological receptors. Based upon the highest maximum concentration of either on-Site or off-Site sectors (from RI/FS data), aluminum would slightly exceed one screening criterion. However, given the low potential for completion of the exposure pathway and the non-detection of aluminum in the subsequent LTGWM program, the risks do not appear sufficient to identify aluminum as a COPEC.

Based on this review, no chemicals in groundwater have been identified as COPECs. It is not necessary to develop new remediation goals or revise existing remediation goals for any ecological receptors.

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FIGURES

Figure 1

SITE MAP OF MONITORING AND RESIDENTIAL WELLS
FOUR COUNTY LANDFILL SITE
Fulton County, Indiana

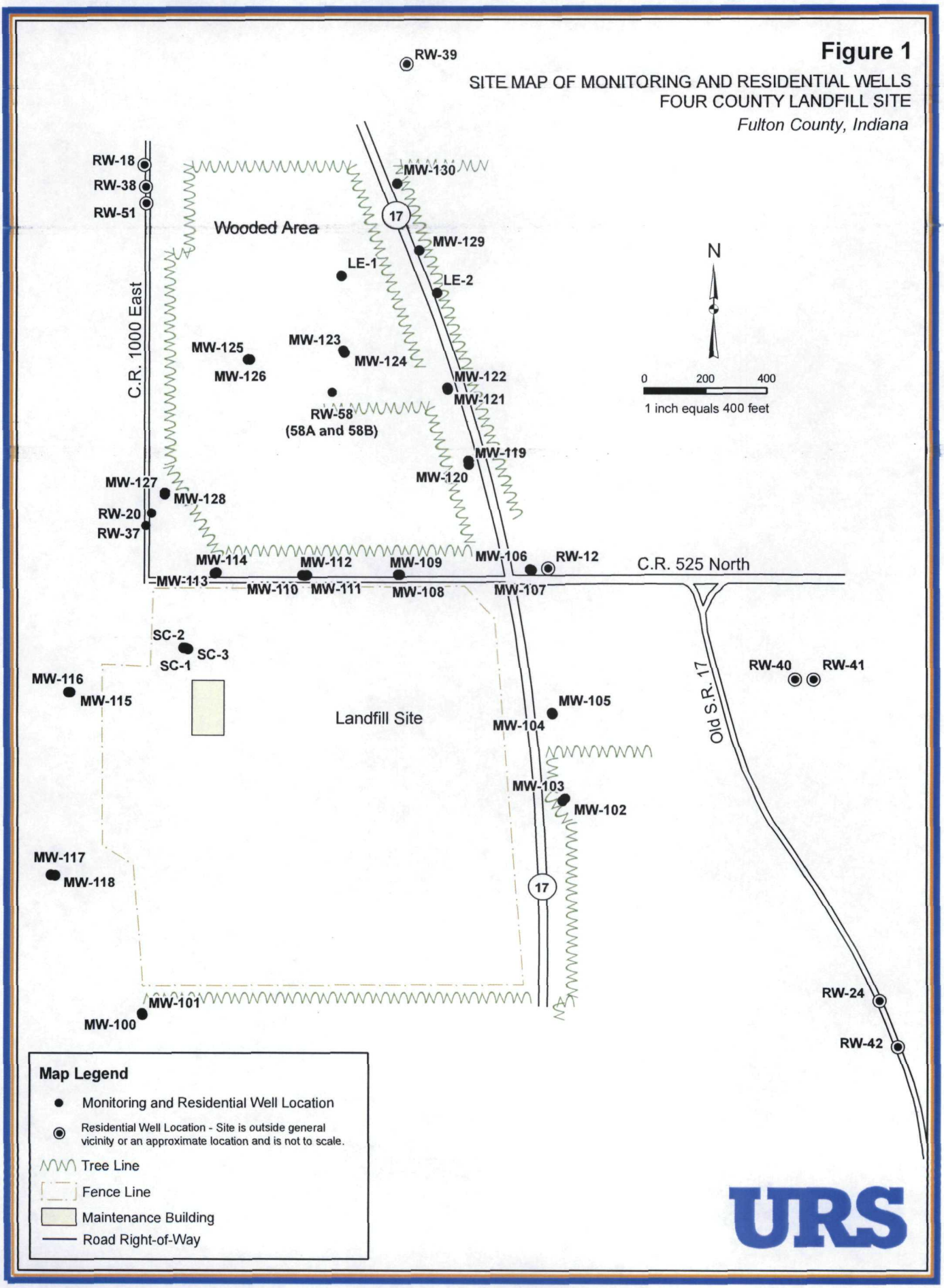

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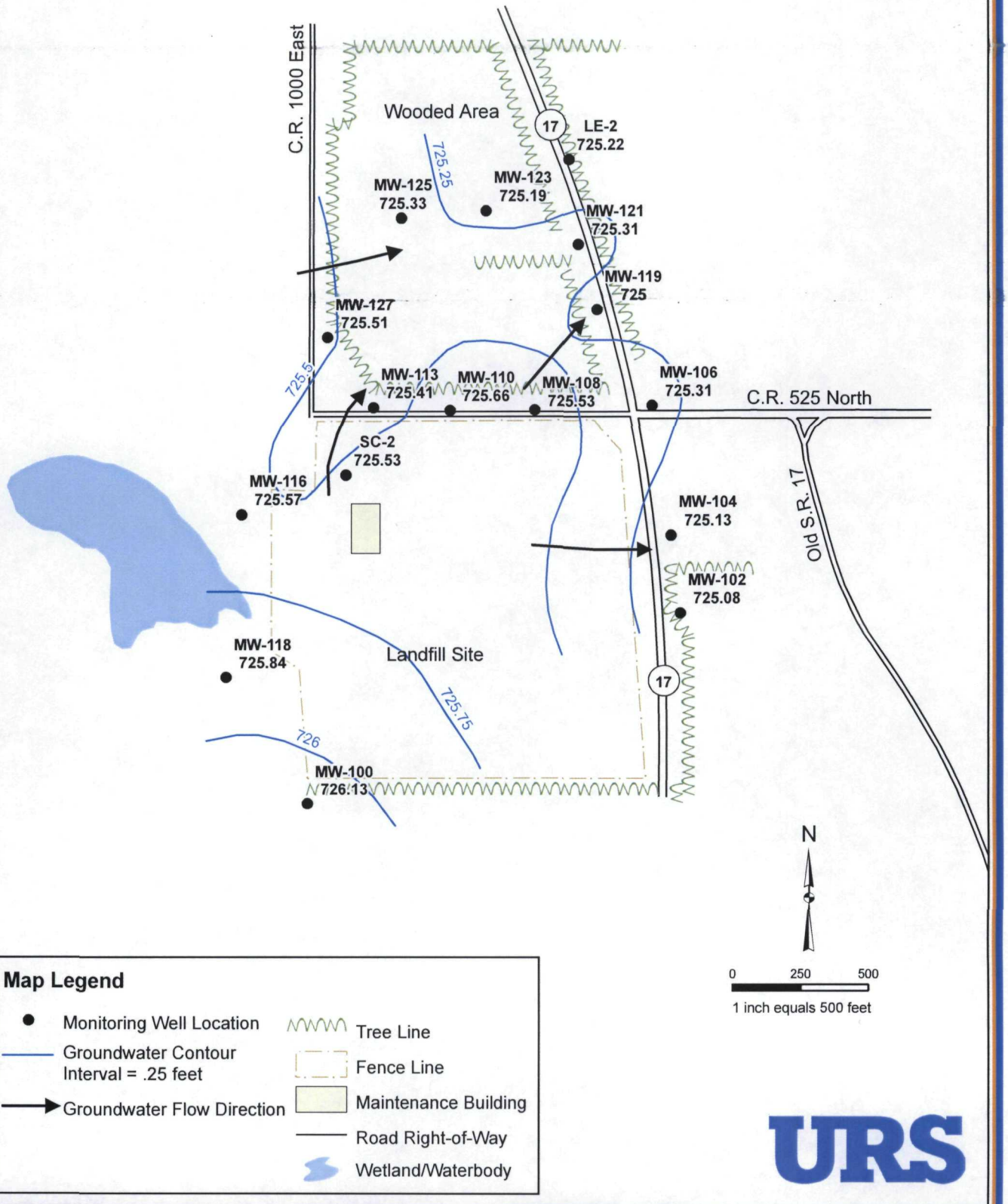
Figure 2

Adjacent Lake and Wetland in Relation to Groundwater Flow
FOUR COUNTY LANDFILL SITE

Fulton County, Indiana



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Appendix 1

Appendix Tables

Table A1-2
Summary of Groundwater Analytical Results
Q1 through Q8
MNA Monitoring Well Network Sampling
Four County Landfill Site
Fulton County, Indiana

CHEMICAL PARAMETER	SAMPLING DATE OF HIGHEST CONC.	ON-SITE WELL WITH HIGHEST CONC.	MAXIMUM CONCENTRATION IN ON-SITE WELL (ug/L)	SAMPLING DATE OF HIGHEST CONC.	OFF-SITE WELL WITH HIGHEST CONC.	MAXIMUM CONCENTRATION IN OFF-SITE WELL (ug/L)
Volatile Organic Compounds (ug/L) (Highest Detected Concentrations)						
Benzene	12-16-2006	SC-2	1.5	3-16-2006	MW-114	23
Carbon Tetrachloride	6-26-2004	SC-2	4.6	9-16-2004	MW-113	600
Chloroethane			ND(2) U			ND(2) U
Chloroform	6-26-2004	SC-2	6.2	3-17-2005	MW-113	80
Chloromethane			ND(2) U			ND(2) U
1,1-Dichloroethane			ND(1) U			ND(1) U
1,2-Dichloroethane	3-16-2006	SC-2	620	9-16-2004	MW-124	2,100
1,1-Dichloroethene			ND(1) U			ND(1) U
cis-1,2-Dichlorothene			ND(1) U	6-24-2004	LE-2	1.2
trans-1,2-Dichloroethene			ND(1) U			ND(1) U
Ethylbenzene			ND(1) U			ND(1) U
Methylene Chloride			ND(2) U			ND(2) U
1,1,1,2-Tetrachloroethane			ND(2) U			ND(2) U
1,1,2,2-Tetrachloroethane			ND(1) U			ND(1) U
Tetrachloroethene			ND(1) U			ND(1) U
Toluene			ND(1) U			ND(1) U
1,1,1-Trichloroethane			ND(1) U			ND(1) U
1,1,2-Trichloroethane	12-16-2005	SC-2	2.1			ND(1) U
Trichloroethene			ND(1) U			ND(1) U
Vinyl Chloride	12-16-2005	SC-2	25	6-25-2004	MW-124	11
Xylenes			ND(1) U			ND(1) U
Monitored Natural Attenuation Parameters (Range of Values)						
Alkalinity (mg/L)	Varied	SC-2/SC-3	100 – 490	Varied	Varied	170-470

Table A1-2
Summary of Groundwater Analytical Results
Q1 through Q8
MNA Monitoring Well Network Sampling
Four County Landfill Site
Fulton County, Indiana

CHEMICAL PARAMETER	SAMPLING DATE OF HIGHEST CONC.	ON-SITE WELL WITH HIGHEST CONC.	MAXIMUM CONCENTRATION IN ON-SITE WELL (ug/L)	SAMPLING DATE OF HIGHEST CONC.	OFF-SITE WELL WITH HIGHEST CONC.	MAXIMUM CONCENTRATION IN OFF-SITE WELL (ug/L)
Chloride (mg/L)	12-16-2005	SC-3/SC-2	4.5 - 66	6-14-2004	MW-109/MW-121	ND – 470
Nitrate (mg/L)	6-17-2004	SC-2/SC-2	ND – 0.12	Varied	Varied/MW-121	ND – 0.93
Sulfate (mg/L)	3-15-2005	SC-3/SC-2	47 - 110	9-14-2005	Varied//MW-116	ND – 170
Total Organic Carbon (mg/L)	9-17-2004	SC-3/SC-2	1.3 – 14.2	Varied	Varied/MW-108	ND – 19.2
Dissolved Gases (Range of Values)						
Carbon Dioxide (mg/L)	12-16-2005	SC-2/SC-2	ND - 48	12-15-2005	Varied/MW-125	ND – 100
Ethane (ng/L)	Varied	SC-3/SC-2	ND – 1,200	6-14-2004	Varied/LE-2	ND –6,600
Ethene (ng/L)	3-15-2005	SC-3/SC-2	0.046 – 13,000	3-15-2005	Varied/MW-124	ND – 5,400
Methane (ug/L)	Varied	SC-2/SC-3	ND – 94	12-16-04	MW-121/MW-129	0.017 – 6,000
Dissolved Hydrogen (nM)	12-15-2004	SC-3/SC-2	ND – 2,700	6-15-2004	Varied//MW-126	ND – 21

Notes:
ND = Not detected at the Reporting Limit
(value) = Detection Limit
U = Result was not at or above the Detection Limit
mg/L = milligrams per liter
J = Estimated – Detected below laboratory reporting limit
ug/L = micrograms per liter
ng/L = nanograms per liter M = nanomoles per liter
* Q2 and Q3 Vinyl Chloride results were obtained from the laboratory QA/QC Raw Data documentation. These results were reported by the laboratory as ND (2) U, not detected at or below the previously established laboratory reporting limit of 2.0 ug/L. The laboratory reporting limit for Vinyl Chloride has been modified from 2.0 ug/L to 1.0 ug/L as of the Fourth Quarter sampling event.

Table A1-3
Chemicals Detected in Groundwater during the RI/FS and OU2 LTGWM and MNA Sampling Periods
Four County Landfill
Fulton County, Indiana

Detected Chemical	RI/FS Sampling Period			LTGWM Sampling Period			MNA Sampling Period		
	Aquifer Units In Which Found [1]	Sampling Period Max Conc.	Well with Highest Conc.	Aquifer Units In Which Found [1]	Sampling Period Max. Conc.	Well with Highest Conc.	Aquifer Units In Which Found [1]	Sampling Period Max. Conc.	Well with Highest Conc.
Inorganics (mg/L)									
Aluminum	**B***	1.7	MW-125	-	ND	-	-	NA	-
Antimony	**B**, C	0.042, 0.035	MW-116, MW-109	-	ND	-	-	NA	-
Arsenic	**B**, C	0.011, 0.01	MW-102	B, **C**	0.025, 0.13	MW-101	-		-
Barium	**B, C**	0.15, 0.15	MW-110, MW-118, MW-126	**B**, C	0.66, 0.14	MW-116	-		-
Cadmium	-	ND	-	--	ND	-	-	N	-
Calcium	**B**, C	150, 110 J	MW-119	**B**, C	160, 120 J	MW-110	-		-
Chromium	-	ND	-	**B**	0.034	MW-110	-		-
Iron	**B**, C	25 , 5.3	MW-108	**B**, C	26, 3.8	MW-108	-		-
Magnesium	**B**, C	65, 52	MW-102	**B**, C	70, 58	MW-102	-		-
Manganese	**B**, C	0.94, 0.13	MW-125	**B**, C	0.48 J, 0.073	MW-108	-		-
Mercury	-	ND	-	**C**	0.00032	MW-114	-	NA	-
Nickel	**B**	0.017	MW-121	-	ND	-	-	NA	-
Potassium	**B**, C	5.4, 3.6	MW-103	-	ND	-	-	NA	-

Detected Chemical	RI/FS Sampling Period			LTGWM Sampling Period			MNA Sampling Period		
	Aquifer Units In Which Found [1]	Sampling Period Max Conc.	Well with Highest Conc.	Aquifer Units In Which Found [1]	Sampling Period Max. Conc.	Well with Highest Conc.	Aquifer Units In Which Found [1]	Sampling Period Max. Conc.	Well with Highest Conc.
Sodium	**B**, C	85, 14	MW-119	**B**, C	52, 6.5	MW-102	-		-
Vanadium	-	ND	-	-	ND	-	-	N	-
Zinc	-	ND	-	**C**	0.032	MW-114	-	NA	-
Chloride	**B**, C	200, 58	MW-119	**B**, C	200, 28	MW-102	**B**, C	98, 82	MW-121
Nitrate	**B**	1.2	MW-121	**B**, C	0.66, 0.65	MW-118	**B**, C	0.72, 0.23	MW-125
Sulfate	**B**, C	88.9, 82	MW-113	**B**, C	88, 72	MW-113	**B**, C	170, 75	MW-116
Volatile Organic Compounds (VOCs) (ug/L)									
Acetone	**B**, C	58 J, 10	MW-113	-	ND	-	-	NA	
Benzene	B, **C**	3.4 J, 460	MW-114	B, **C**	2.4, 160	MW-114	**C**	23	MW-114
Bromodichloromethane	**B**	1.2	GS-6	-	ND	-	-	N	-
Bromomethane	**C**	0.93 J	GS-2	-	ND	-	-	N	-
2-Butanone	**C**	19	MW-114	-	ND	-	-	NA	-
Carbon Disulfide	**B**	19 J	MW-113	**B**	1.5	MW-113	-		-
Carbon tetrachloride	**B**	340 J	MW-113	**B**, C	600, 4	MW-113	**B**	600	MW-113
Chloroethane	**C**	1.8	MW-124	**C**	2.0	MW-124	-		-
Chloroform	**B**	83	MW-113	**B**	94	MW-113	**B**	80	MW-113
1,2-Dichloroethane	B, **C**	4.4 J, 2,000	MW-114	B, **C**	11, 1,900	MW-124	B, **C**	33, 1,300	MW-124
Cis-1,2-dichloroethene	-	ND	-	-	NA	-	**B**	1.2	LE-2
Dichloromethane	B, **C**	2.0 J, 2.8	MW-124	-	NA	-	-	NA	-
Ethylbenzene	**C**	0.75 J	GS-128	**C**	2.8	MW-117	-	ND	-
4-methyl-2-pentanone	**B**, C	16, 13	GS-128	**C**	2.8	MW-117	-		-
Toluene	B, **C**	1.1 J, 10	MW-126	**B**	0.77	MW-127	-		-
1,1.2-Trichloroethane	-	NA	-	-	ND	-	**B**	2.1	SC-2

Detected Chemical	RI/FS Sampling Period			LTGWM Sampling Period			MNA Sampling Period		
	Aquifer Units In Which Found [1]	Sampling Period Max Conc.	Well with Highest Conc.	Aquifer Units In Which Found [1]	Sampling Period Max. Conc.	Well with Highest Conc.	Aquifer Units In Which Found [1]	Sampling Period Max. Conc.	Well with Highest Conc.
Vinyl chloride	**C**	8.7	MW-124	**C**	12 J	MW-124	**B**, C	25, 7.5	SC-2
m, p-Xylenes	B, **C**	0.91, 1.5	GS-128	-	ND	-	-	ND	-
o-Xylenes	**C**	0.87 J	GS-128	-	ND	-	-	ND	-
Dissolved Gases (ug/L)									
Ethane	**B**, C	5.1, 1.2	MW-121	**B**	0.18 J	MW-110	**B**	1.2	SC-2
Ethene	**C**	14	MW-109	**C**	8.6	MW-124	**B**	13	SC-2
Methane	**B**, C	1,800, 14	MW-108	**B**, C	10,000, 2,300	MW-110	**C**	6,000	MW-129

(1) Unit B Aquifer is described as intermediate zone from 40 to 80 feet bgs; Unit C Aquifer is deep zone greater than 80 ft bgs.

* Bold letters indicate aquifer unit in which maximum concentration was found, when it occurred in both aquifers during that sampling program.

NA Chemical not analyzed during monitoring program.

ND Chemical not detected at laboratory detection limit during monitoring perio.

- Unit or we l not applicable because chemical not found or analyzed in monitoring period.

Table A1-4
Residential Well Chemical Concentration Summary
OU2 MNA Monitoring Network
Four County Landfill Site
Fulton County, Indiana

RESIDENTIAL WELL	ADDRESS	DATE	CHEMICAL	CONCENTRATION (ug/L)
RW-39A	525 N. Prairie Dr.	6-22-2004	1,2-dichloroethane	200
RW-39A	525 N. Prairie Dr.	8-16-2004	1,2-dichloroethane	160
RW-39A	525 N. Prairie Dr.	9-13-2004	1,2-dichloroethane	150
RW-39A	525 N. Prairie Dr.	12-6-2004	1,2-dichloroethane	68
RW-39A	525 N. Prairie Dr.	6-22-2004	Vinyl chloride	1.39 J
RW-39A	525 N. Prairie Dr.	9-13-2004	Vinyl chloride	1.04
RW-39A	525 N. Prairie Dr.	12-06-2004	Vinyl chloride	0.43
RW-39B	525 N. Prairie Dr.	6-22-2004	1,2-dichloroethane	59
RW-58A (RW-39B)	525 N. Prairie Dr.	6-13-2005	1,2-dichloroethane	11
RW-58A (RW-39A)	525 N. Prairie Dr.	9-12-2005	1,2-dichloroethane	7.8

Table A2-1
Potentially Applicable Chemical Specific Federal and State ARARS as of April 2006
Groundwater Routes of Exposure
Four County Landfill
Fulton County, Indiana

CHEMICAL	CAS #	ARARs				TBC Guidance				
		Human Health WQC for Aquatic Organisms Only (ug/L)	**Human Health WQC for Aquatic Organisms and Drinking Water (ug/L)**	**Primary Drinking Water MCLGs (ug/L)**	**Primary Drinking Water MCLs (ug/L)**	**Proposed Primary Drinking Water MCLs (ug/L)**	**Proposed Primary Drinking Water MCLGs (ug/L)**	**Secondary Drinking Water SMCLs (ug/L)**	**US EPA Region 9 Tap Water Preliminary Remediation Goals (PRGs) (ug/L) [1]**	**Superfund Removal Action Level (RAL) (ug/L)**
CITATION		CWA 304(a)	CWA 304(a)	40 CFR 141	40 CFR 101	40 CFR 300	40 CFR 300	40 CFR 143		
Inorganics (ug/L)										
Aluminum	742905							50-200	**36** (nc)	
Antimony	7440360	640	5.6	6	6				**0.015** (nc)	15
Arsenic	7440382	0.14	0.018	0	10				**0.000045** (ca)	50
Barium	7440393		1,000	2,000	2,000				**7.3** (nc)	2,000
Cadmium	7440439			5	5				**0.018** (nc)	5
Calcium	7440702									
Chromium	7440473			100	100				**0.011** (nc)	200
Iron	7439896		300					300	**11** (nc)	
Magnesium	7439954									
Manganese	7439965	100	50					50	**0.73** (nc)	200
Nickel	7440020	4,600	610						**0.73** (nc)	500
Potassium	7440097									
Sodium	7440235									
Vanadium	7440622									**250**
Chloride	16887006							**250,000**		
Nitrate	14797558		10,000	**10,000**	**10,000**				58,000 (nc)	**10,000**
Sulfate										**250,000**
Volatile Organic Compounds (VOCs) (ug/L)										
Acetone	67641								5,500 (nc)	**3,500**
Benzene	71432	51	2.2	0	5				**0.35** (ca)	100
Bromodichloromethane	75274	17	0.55						**0.18** (ca)	60

Table A2-1
Potentially Applicable Chemical Specific Federal and State ARARS as of April 2006
Groundwater Routes of Exposure
Four County Landfill
Fulton County, Indiana

CHEMICAL	CAS #	ARARs				TBC Guidance				
		Human Health WQC for Aquatic Organisms Only (ug/L)	Human Health WQC for Aquatic Organisms and Drinking Water (ug/L)	Primary Drinking Water MCLGs (ug/L)	Primary Drinking Water MCLs (ug/L)	Proposed Primary Drinking Water MCLs (ug/L)	Proposed Primary Drinking Water MCLGs (ug/L)	Secondary Drinking Water SMCLs (ug/L)	US EPA Region 9 Tap Water Preliminary Remediation Goals (PRGs) (ug/L) [1]	Superfund Removal Action Level (RAL) (ug/L)
Bromomethane	74839								**8.7** (nc)	40
2-Butanone	78933								**7,000** (nc)	21,000
Carbon Disulfide	75150								**1,000** (nc)	
Carbon tetrachloride	56235	1.6	0.23	0	5				**0.17** (ca)	30
Chloroethane	75003								**4.6** (ca)	
Chloroform	67663	470	5.7						**0.17** (ca)	100
1,2-Dichloroethane	107062	37	0.38	0	5				**0.12** (ca)	40
Cis-1,2-dichloroethene	156592			70	70				**61**	400
Dichloromethane	75092								**4.3** (ca)	500
Ethylbenzene	100414	2,100	530	700	700			**30**	1,300 (ca)	1,000
4-methyl-2-pentanone	108101									
Toluene	108883	15,000	1,300	1,000	1,000			**40**	720 (nc)	2,000
1,1,2-Trichloroethane	79005	16	0.59	3	5				**0.2** (ca)	30
Vinyl chloride	75014	2.4	0.025	0	2				**0.02** (ca)	20
m, p-Xylenes	1330207			10,000	10,000				**210** (nc)	40,000
o-Xylenes	1330207			10,000	10,000			**20**	210 (nc)	40,000

(1) Region 3 Risk Based Concentration (RBC) Table, as of 4/7/2006.
ARARs to left of double line applicable only to surface water uses
Lowest applicable ARAR or TBC is noted in bold
(nc) Based on non-cancer risk factors (Non-cancer risks greater than cancer risks)
(ca) Based on cancer risk factors (Cancer risks greater than non cancer risks)
Sources: Risk Assessment Information System (RAIS), http://risk.lsd.ornl.gov/cgi-bin/guide/GUID_9709
US EPA, Region 9, PRG Table, Version 3, October 2004.
US EPA OSWER Directive 9360.1-02, Oct. 25, 1993

Table A2-2a
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
Primary ARARs and TBCs Only [1]
On-site Area
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	1.5	1.5	ug/L	SC-2 (B)	1/16	1.0	5 (M)		BSC
56235	Carbon tetrachloride	4.6	4.6	ug/L	SC-2 (B)	1/16	0.76	5 (M)		BSC
67663	Chloroform	2.4	6.2	ug/L	SC-2 (B)	2/16	0.98	5.7 (A)		BSC
107062	1,2-Dichloroethane	58	620	ug/L	SC-2 (B)	8/16	213	5 (M)	x	ASC, FD
156592	cis-1,2-Dichloroethene	ND	ND	ug/L	---	0/16	---	70 (M)		IFD
79005	1,1,2-Trichloroethane	1.1	2.1	ug/L	SC-2 (B)	2/16	0.6	5 (M)		BSC
75014	Vinyl Chloride	2.7	25	ug/L	SC-2 (B)	7/16	5.2	2 (M)	x	ASC, FD
General Chemistry (MNA Data Set)										
16887006	Chloride	4.5	66	mg/L	Various	16/16	28.28	250 (S)		BSC
14797558	Nitrate	0.05	0.12	mg/L	Various	1/16	0.054	10 (M)		BSC
14808798	Sulfate	47	110	mg/L	Various	16/16	63.83	---		
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	---	---	mg/L				50 (S)		
7440360	Antimony	---	---	mg/L				6 (M)		
7440382	Arsenic	---	---	mg/L				10 (M)		
7440393	Barium	---	---	mg/L				2,000 (M)		
7440439	Cadmium	---	---	mg/L				5 (M)		
7440473	Chromium	---	---	mg/L				100 (M)		
7439896	Iron	---	---	mg/L				300 (S)		
7439965	Manganese	---	---	mg/L				50 (S)		
7440020	Nickel	---	---	mg/L				---		
7440622	Vanadium	---	---	mg/L				---		

Table A2-2b
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
Primary ARARs and TBCs Only [1]
East Downgradient Sector
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	ND	ND	ug/L	---	0/23	---	5 (M)		IFD
56235	Carbon tetrach oride	ND	ND	ug/L	---	0/23	---	5 (M)		IFD
67663	Chloroform	1.4	1.4	ug/L	LE-2 (B)	1/23	0.5	5.7 (A)		BSC
107062	1,2-Dichloroethane	1.4	8.3	ug/L	MW-130 (C)	4/23	1.2	5 (M)		BSC
156592	cis-1,2-Dichloroethene	1.2	1.2	ug/L	LE-2 (B)	1/23	0.5	70 (M)		BSC, IFD
79005	1,1,2-Trichloroethane	ND	ND	ug/L	---	0/23	---	5 (M)		IFD
75014	Vinyl Chloride	1.2	2.4	ug/L	MW-130 (C)	11/23	0.9	2 (M)		BSC
General Chemistry (MNA Data Set)										
16887006	Chloride	2.5	40	mg/L	Various	23/24	11.9	250 (S)		BSC
14797558	Nitrate	0.05	0.18	mg/L	Various	11/22	0.07	10 (M)		BSC
14808798	Sulfate	1.4	63	mg/L	Various	23/23	36.9	---		
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	ND	ND	mg/L		0	---	50 (S)		IFD, BBC
7440360	Antimony	ND	ND	mg/L		0	---	6 (M)		IFD, BBC
7440382	Arsenic	0.01	0.016	mg/L	MW-107	5/12	0.010	10 (M)		BSC, BBC
7440393	Barium	0.01	0.66	mg/L	MW-107	11/12	0.106	2,000 (M)		BSC, BBC
7440439	Cadmium	ND	ND	mg/L		0	---	5 (M)		IFD, BBC
7440473	Chromium	ND	ND	mg/L		0	---	100 (M)		IFD, BBC
7439896	Iron	0.02	26	mg/L	MW-108	24/25	3.08	300 (S)		BSC, BBC
7439965	Manganese	0.021	0.12	mg/L	MW-102	19/23	0.0567	50 (S)		BBC
7440020	Nickel	ND	ND	mg/L		0	---	---		IFD, BBC
7440622	Vanadium	ND	ND	mg/L		0	---	---		IFD, BBC

Table A2-2c
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
Primary ARARs and TBCs Only [1]
North Downgradient Sector
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	2	23	ug/L	MW-114 (C)	9/102	0.6	5 (M)		BSC
56235	Carbon tetrachloride	390	600	ug/L	MW-113 (B)	8/102	39.95	5 (M)	x	ASC, FD
67663	Chloroform	55	80	ug/L	MW-113 (B)	8/102	5.96	5.7 (A)	x	ASC, FD
107062	1,2-Dichloroethane	1.4	1,300	ug/L	MW-124 (C)	32/102	142.8	5 (M)	x	ASC, FD
156592	cis-1,2-Dichloroethene	ND	ND	ug/L	----	0/102	---	70 (M)		IFD
79005	1,1,2-Trichloroethane	ND	ND	ug/L	---	0/102	---	5 (M)		IFD
75014	Vinyl Chloride	1.9	11	ug/L	MW-124 (C)	15/102	1.4	2 (M)	x	ASC
General Chemistry (MNA Data Set)										
16887006	Chloride	0.55	470	mg/L	Various	90/100	24.4	250 (S)		BSC
14797558	Nitrate	0.05	1.1	mg/L	Various	22/98	0.15	10 (M)		BSC
14808798	Sulfate	1.6	780	mg/L	Various	84/92	49.9	---		
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	0.09 (J)	1.7	mg/L	MW-125	5/32	0.194	50 (S)	x	ABC
7440360	Antimony	0.035	0.035	mg/L	MW-109	1/15	0.0163	6 (M)		BSC, IFD
7440382	Arsenic	0.005	0.01	mg/L	MW-126	6/33	0.005	10 (M)		BSC
7440393	Barium	0.005	0.15	mg/L	MW-110	27/33	0.088	2,000 (M)		BSC
7440439	Cadmium	ND	ND	mg/L		0	---	5 (M)		IFD
7440473	Chromium	0.005	0.034	mg/L	MW-110	2/33	0.007	100 (M)		BSC
7439896	Iron	0.062 (J)	26	mg/L	MW-108	51/58	6.44	300 (S)		BSC
7439965	Manganese	0.0051 (J)	0.94	mg/L	MW-125	47/53	0.171	50 (S)		BBC
7440020	Nickel	0.017	0.017	mg/L	MW-121	1/15	0.0058	---	x	ABC
7440622	Vanadium	ND	ND	mg/L		0	---	---		IFD

Table A2-2d
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
Primary ARARs and TBCs Only [1]
Upgradient (Background) Sector
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	ND	ND	ug/L	---	0/16	---	5 (M)		IFD
56235	Carbon tetrachloride	ND	ND	ug/L	---	0/16	---	5 (M)		IFD
67663	Chloroform	ND	ND	ug/L	---	0/16	---	5.7 (A)		IFD
107062	1,2-Dichloroethane	ND	ND	ug/L	---	0/16	---	5 (M)		IFD
156592	cis-1,2-Dichloroethene	ND	ND	ug/L	---	0/16	---	70 (M)		IFD
79005	1,1,2-Trichloroethane	ND	ND	ug/L	---	0/16	---	5 (M)		IFD
75014	Vinyl Chloride	ND	ND	ug/L	---	0/16	---	2 (M)		IFD
General Chemistry (MNA Data Set)										
16887006	Chloride	1.5	10	mg/L	Various	40/40	4.8	250 (S)		BSC
14797558	Nitrate	0.05	0.14	mg/L	Various	1/40	0.05	10 (M)		BSC
14808798	Sulfate	33	170	mg/L	Various	40/40	63.8	---		
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	0.18	0.18	mg/L	MW-116	1/48	0.083	50 (S)		BSC, IFD
7440360	Antimony	0.042	0.042	mg/L	MW-116	1/42	0.0195	6 (M)		BSC, IFD
7440382	Arsenic	0.0053	0.013	mg/L	MW-101	16/42	0.0045	10 (M)		BSC, IFD
7440393	Barium	0.015	0.18	mg/L	MW-118	30/42	0.134	2,000 (M)		BSC, IFD
7440439	Cadmium	ND	ND	mg/L		0/36	---	5 (M)		IFD
7440473	Chromium	ND	ND	mg/L		0/36	---	100 (M)		IFD
7439896	Iron	0.59 (J)	5.3	mg/L	MW-101	44/52	3.06	300 (S)		BSC, IFD
7439965	Manganese	0.025	0.25	mg/L	MW-116	40/48	0.0939	50 (S)		BSC
7440020	Nickel	ND	ND	mg/L		0/36	---	---		IFD
7440622	Vanadium	ND	ND	mg/L		0/36	---	---		IFD

Table A2-2d

Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
Primary ARARs and TBCs Only [1]
Upgradient (Background) Sector
Four County Landfill
Fulton, Indiana

(1) Based only upon current NPDWR MCLs and NSDWR Secondary Standards
(2) Number of detections/Number of MNA samples
(3) Screening Criteria used is the lowest of (M) NPDWR MCL Standard, (S) NSDWR Secondary Standard.
(4) Number of detections and samples for metals is based on combined RI/FS and LTGWM sampling events.
(5) Mean screening concentration for metals is based on the higher of the mean of the RI/FS or LTGWM sampling programs.
ASC Above Selection Criteria
BSC Below Selection Criteria
ABC Above 2X background concentration
BBC Below 2X background concentration
INF Infrequent Detections
FD Frequent Detections
KHC Known Human Carcinogen

Table A2-3a
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
All Potentially Applicable ARARs and TBCs [1]
On-Site Area
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	1.5	1.5	ug/L	SC-2 (B)	1/16	1.0	0.35 (P)	x	ASC, KHC
56235	Carbon tetrachloride	4.6	4.6	ug/L	SC-2 (B)	1/16	0.76	0.17 (P)	x	ASC
67663	Chloroform	2.4	6.2	ug/L	SC-2 (B)	2/16	0.98	0.17 (P)	x	ASC, FD
107062	1,2-Dichloroethane	58	620	ug/L	SC-2 (B)	8/16	213	0.12 (P)	x	ASC, FD
156592	cis-1,2-Dichloroethene	ND	ND	ug/L	---	0/16	---	61 (P)		IFD
79005	1,1,2-Trichloroethane	1.1	2.1	ug/L	SC-2 (B)	2/16	0.6	0.2 (P)	x	ASC, FD
75014	Vinyl Chloride	2.7	25	ug/L	SC-2 (B)	7/16	5.2	0.02 (P)	x	ASC, FD, KHC
General Chemistry (MNA Data Set)										
16887006	Chloride	4.5	66	mg/L	Various	16/16	28.28	36 (P)		BSC
14797558	Nitrate	0.05	0.12	mg/L	Various	1/16	0.054	10 (M, P)		BSC
14808798	Sulfate	47	110	mg/L	Various	16/16	63.83	250 (R)		BSC
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	---	---	mg/L				36 (P)		
7440360	Antimony	---	---	mg/L				0.015 (P)		
7440382	Arsenic	---	---	mg/L				0.000045(P)		
7440393	Barium	---	---	mg/L				7.3 (P)		
7440439	Cadmium	---	---	mg/L				0.018 (P)		
7440473	Chromium	---	---	mg/L				0.011 (P)		
7439896	Iron	---	---	mg/L				11 (P)		
7439965	Manganese	---	---	mg/L				0.7 (P)		
7440020	Nickel	---	---	mg/L				0.73 (P)		
7440622	Vanadium	---	---	mg/L				0.037 (P)		

Table A2-3b
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
All Potentially Applicable ARARs and TBCs [1]
East Downgradient Sector
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	ND	ND	ug/L	---	0/23	---	0.35 (P)		IFD
56235	Carbon tetrachloride	ND	ND	ug/L	---	0/23	---	0.17 (P)		IFD
67663	Chloroform	1.4	1.4	ug/L	LE-2 (B)	1/23	0.5	0.17 (P)	x	ASC
107062	1,2-Dichloroethane	1.4	8.3	ug/L	MW-130 (C)	4/23	1.2	0.12 (P)	x	ASC, FD
156592	cis-1,2-Dichloroethene	1.2	1.2	ug/L	LE-2 (B)	1/23	0.5	61 (P)		BSC, IFD
79005	1,1.2-Trichloroethane	ND	ND	ug/L	---	0/23	---	0.2 (P)		IFD
75014	Vinyl Chloride	1.2	2.4	ug/L	MW-130 (C)	11/23	0.9	0.02 (P)	x	ASC, FD, KHC
General Chemistry (MNA Data Set)										
16887006	Chloride	2.5	40	mg/L	Various	23/24	11.9	36 (P)		BSC
14797558	Nitrate	0.05	0.18	mg/L	Various	11/22	0.07	10 (M, P)		BSC
14808798	Sulfate	1.4	63	mg/L	Various	23/23	36.9	250 (R)		BSC
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	ND	ND	mg/L	---	0	---	36 (P)		IFD
7440360	Antimony	ND	ND	mg/L	---	0	---	0.015 (P)		IFD
7440382	Arsenic	0.011	0.016	mg/L	MW-107	5/12	0.010	0.000045(P)		BBC
7440393	Barium	0.016	0.66	mg/L	MW-107	11/12	0.106	7.3 (P)		BSC, BBC
7440439	Cadmium	ND	ND	mg/L	---	0	---	0.018 (P)		IFD
7440473	Chromium	ND	ND	mg/L	---	0	---	0.011 (P)		IFD
7439896	Iron	0.02	26	mg/L	MW-108	24/25	3.08	11 (P)		BSC, BBC
7439965	Manganese	0.021	0.12	mg/L	MW-102	19/23	0.0567	0.73 (P)		BSC, BBC
7440020	Nickel	ND	ND	mg/L	---	0	---	0.73 (P)		IFD
7440622	Vanadium	ND	ND	mg/L	---	0	---	0.037 (P)		IFD

Table A2-3c
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
All Potentially Applicable ARARs and TBCs [1]
North Downgradient Sector
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	2	23	ug/L	MW-114 (C)	9/102	0.6	0.35 (P)	x	ASC FD, KHC
56235	Carbon tetrachloride	390	600	ug/L	MW-113 (B)	8/102	39.95	0.17 (P)	x	ASC, FD
67663	Chloroform	55		ug/L	MW-113 (B)	8/102	5.96	0.17 (P)	x	ASC, FD
107062	1,2-Dichloroethane	1.4	1,300	ug/L	MW-124 (C)	32/102	142.8	0.12 (P)	x	ASC, FD
156592	cis-1,2-Dichloroethene	ND	ND	ug/L	----	0/102	---	61 (P)		IFD
79005	1,1,2-Trichloroethane	ND	ND	ug/L	---	0/102	---	0.2 (P)		IFD
75014	Vinyl Chloride	1.9	11	ug/L	MW-124 (C)	15/102	1.4	0.02 (P)	x	ASC, FD, KHC
General Chemistry (MNA Data Set)										
16887006	Chloride	0.55	470	mg/L	Various	90/100	24.4	36 (P)		BSC
14797558	Nitrate	0.05	1.1	mg/L	Various	22/98	0.15	10 (M, P)		BSC
14808798	Sulfate	1.6	780	mg/L	Various	84/92	49.9	250 (R)		BSC
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	0.09 (J)	1.7	mg/L	MW-125	5/32	0.194	36 (P)	x	ABC
7440360	Antimony	0.035	0.035	mg/L	MW-109	1/15	0.0163	0.015 (P)		BSC, IFD, BBC
7440382	Arsenic	0.005	0.01	mg/L	MW-126	6/33	0.005	0.000045 (P)		BBC
7440393	Barium	0.005	0.15	mg/L	MW-110	27/33	0.088	7.3 (P)		BSC,BBC
7440439	Cadmium	ND	ND	mg/L		0	---	0.018 (P)		IFD, BBC
7440473	Chromium	0.005	0.034	mg/L	MW-110	2/33	0.007	0.011 (P)		BSC, BBC
7439896	Iron	0.062 (J)	26	mg/L	MW-108	51/58	6.44	11 (P)		BSC, BBC
7439965	Manganese	0.0051 (J)	0.94	mg/L	MW-125	47/53	0.171	0.73 (P)	x	ABC
7440020	Nickel	0.017	0.017	mg/L	MW-121	1/15	0.0058	0.73 (P)	x	ABC
7440622	Vanadium	ND	ND	mg/L	---	0	---	0.037 (P)		IFD

Table A2-3d
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
All Potentially Applicable ARARs and TBCs [1]
Upgradient (Background) Sector
Four County Landfill
Fulton, Indiana

CAS Number	Chemical	Minimum Detected Conc.	Maximum Detected Conc.	Units	Location of Maximum Conc. Well (Unit)	Detection Frequency (2, 4)	Mean Conc. Used for Screening (5)	Screening Criteria (3)	COPC Flag	Rationale
Volatile Organic Compounds (VOCs) (MNA Data Set)										
71432	Benzene	ND	ND	ug/L	---	0/16	---	0.35 (P)		IFD
56235	Carbon tetrachloride	ND	ND	ug/L	---	0/16	---	0.17 (P)		IFD
67663	Chloroform	ND	ND	ug/L	---	0/16	---	0.17 (P)		IFD
107062	1,2-Dichloroethane	ND	ND	ug/L	---	0/16	---	0.12 (P)		IFD
156592	cis-1,2-Dichloroethene	ND	ND	ug/L	---	0/16	---	61 (P)		IFD
79005	1,1,2-Trichloroethane	ND	ND	ug/L	---	0/16	---	0.2 (P)		IFD
75014	Vinyl Chloride	ND	ND	ug/L	---	0/16	---	0.02 (P)		IFD
General Chemistry (MNA Data Set)										
16887006	Chloride	1.5	10	mg/L	Various	40/40	4.8	36 (P)		BSC
14797558	Nitrate	0.05	0.14	mg/L	Various	1/40	0.05	10 (M, P)		BSC
14808798	Sulfate	33	170	mg/L	Various	40/40	63.8	250 (R)		BSC
Metals (RI/FS and LTGWM Data Sets)										
7442905	Aluminum	0.18	0.18	mg/L	MW-116	1/48	0.083	36 (P)		BSC, IFD
7440360	Antimony	0.042	0.042	mg/L	MW-116	1/42	0.0195	0.015 (P)		BSC, IFD
7440382	Arsenic	0.0053	0.013	mg/L	MW-101	16/42	0.0045	0.000045 (P)		BSC, IFD
7440393	Barium	0.015	0.15	mg/L	MW-118	3042	0.134	7.3 (P)		BSC, IFD
7440439	Cadmium	ND	ND	mg/L	---	0/36	---	0.018 (P)		IFD
7440473	Chromium	ND	ND	mg/L	---	0/36	---	0.011 (P)		IFD
7439896	Iron	0.59 (J)	5.3	mg/L	MW-101	44/52	3.06	11 (P)		BSC, IFD
7439965	Manganese	0.025	0.25	mg/L	MW-116	40/48	0.0939	0.73 (P)		BSC
7440020	Nickel	---	---	mg/L	---	0	---	0.73(P)		IFD
7440622	Vanadium	---	---	mg/L	---	0	---	0.037 (P)		IFD

Table A2-3d
Updated Review (2004 – 2006 Monitoring Data)
Occurrence, Distribution, and Selection of Chemicals of Potential Concern in Groundwater
All Potentially Applicable ARARs and TBCs [1]
Upgradient (Background) Sector
Four County Landfill
Fulton, Indiana

(1) Includes current NPDWR MCLs, NSDWR Secondary Standards, Region 3 RBC Table tap water PRGs, and Superfund RALs
(2) Number of detections/Number of MNA samples
(3) Screening Criteria used is the lowest of (M) NPDWR MCL Standard, (S) NSDWR Secondary Standard, (P) US EPA Region 3 RBC Table PRG for tap water, (R) Superfund Removal Action Level (RAL).
(4) Number of detections and samples for metals is based on combined RI/FS and LTGWM sampling events.
(5) Mean screening concentration for metals is based on the higher of the mean of the RI/FS or LTGWM sampling programs.
ASC Above Selection Criteria
BSC Below Selection Criteria
ABC Above 2X background concentration
BBC Below 2X background concentration
INF Infrequent Detections
FD Frequent Detections
KHC Known Human Carcinogen

Table A3-1
Non-Cancer Toxicity Data
Updates for Oral, Dermal, and Inhalation RfD Values
Four County Landfill
Fulton County, Indiana

COPC	Original Oral RfD Value (mg/kg-d)	Current RfD Value (mg/kg-d)	Original Dermal RfD Value (mg/kg-d)	Current Dermal RfD Value (mg/kg-d)	Original Inhalation RfD Value (mg/kg-d)	Current Inhalation RfD Value (mg/kg-d)	Source of Current RfD	Date of Current RfD
Inorganics								
Aluminum	1.00E+00	1.00E+00	1.00E+00	1.00E-01	1.00E-03	1.4E-03	PPRTV	
Antimony	NC	4.00E-04	NC	8.00E-06	NC	---	IRIS	02/01/1991
Arsenic	NC	3.00E-04	NC	1.23E-04	NC	---	IRIS	02/01/1993
Barium	NC	2.00E-01	NC	1.40E-02	NC	1.4E-04	IRIS/HEAST	07/11/2005
Cadmium	NC	5.00E-04	NC		NC	---	IRIS	02/01/1994
Manganese	4.67E-02	4.67E-02	4.67E-02	**5.60E-03**	1.43E-05	1.4E-05	IRIS	05/01/1996
Manganese	1.40E-01	1.40E-01	1.40E-01	NC	NC	NC	IRIS	05/01/1996
Nickel	2.00E-02	2.00E-02	2.00E-02	**5.40E-03**	NC	---	IRIS	12/01/1996
Volatile Organic Compounds (VOCs)								
Benzene	3.00E-03	4.00E-03	3.00E-03	3.88E-03	1.70E-03	8.60E-03	IRIS, RC	04/17/2003
Bromomethane	1.40E-03	1.40E-03	1.40E-03	**1.12E-03**	1.40E-03	1.40E-03	IRIS	07/01/1991
Carbon Disulfide	1.00E-01	1.00E-01	1.00E-01	**6.30E-02**	2.00E-01	2.0E-01	IRIS	09/01/1990
Carbon tetrachloride	7.00E-04	7.00E-04	7.00E-04	4.55E-04	5.71E-04	7.00E-04	IRIS	06/01/1991
Chloroform	NC	1.00E-02	NC	2.00E-03	NC	1.40E-02	IRIS	10/19/2001
1,2-Dichloroethane	3.00E-02 (1)	**2.00E-02** (1)	3.00E-02 (1)	**2.00E-02**	1.40E-03	1.40E-03	NCEA	10/07/1999
Cis-1,2-dichloroethene	NC	1.00E-02	NC	1.00E-02	NC	1.00E-02	PPRTV, RC	
4-methyl-2-pentanone	8.00E-02	8.00E-02	8.00E-02	---	2.00E-02	---	HEAST	
1,1,2-Trichloroethane	NC	3.00E-03	NC	---	NC	3.00E-02	IRIS, RC	02/01/1995
Vinyl chloride	NC	3.00E-03	NC	3.00E-03	NC	2.90E-02	IRIS	08/07/2000

NA – Not Applicable, NC = Not Considered, UA = Unavailable
(1) = Provisional Value from NCEA Regional Support, Region III Risk-Based-Concentration table, Oct. 7, 1999
IRIS = U. S. EPA Integrated Risk Information System
SHRTSC = Superfund Health Risk Technical Support Center
HEAST = *Health Effects Assessment table, 9200.6-303m (95-2), EPA/540-R-95-142, July 1997*
NCEA = National Center for Environmental Assessment
PPRTV = Provisional Peer Reviewed Toxicity Values, US EPA OSWER Office of Superfund Remediation Technology Innovation
RC = Route Extrapolation calculation from US EPA, Region 9 PRG Table.
Bold entries are values that have been revised in the direction of greater toxicity since the BHHRA.

Table A3-2
Cancer Toxicity Data
Updates for Oral and Inhalation Slope Factors
Four County Landfill
Fulton County, Indiana

COPC	Carcinogen Class	Original Oral Cancer Slope Factor	Current Oral Cancer Slope Factor	Original Dermal Adjusted Cancer Slope Factor	Current Dermal Adjusted Cancer Slope Factor	Original Inhalation Cancer Slope Factor	Current Inhalation Cancer Slope Factor	Source of Current Slope Factors	Date of Current Slope Factor
Inorganics									
Arsenic	A	NC	1.5E+00	NC	3.66E+00	NC	1.51E+00	IRIS	04/10/1998
Cadmium	B1	NC	---	NC	---	NC	6.3E+00	IRIS	06/01/1992
Volatile Organic Compounds (VOCs)									
Benzene	A	2.90E-02	**5.5E-02**	2.90E-02	**5.67E-02**	2.90E-02	2.7E-02	IRIS, RC	01/09/2000
Carbon tetrachloride	B2	1.30E-01	1.3E-01	1.30E-01	**2.00E-01**	5.30E-02	5.30E-02	IRIS, RC	06/01/1991
Chloroform	B2	NC	1.0E-02	NC	**3.05E-02**	NC	8.10E-02	IRIS, RC	10/19/2001
1,2-Dichloroethane	B2	9.10E-02	9.10E-02	9.10E-02	9.10E-02	9.10E-02	9.10E-02	IRIS, RC	01/01/1991
1,1,2-Trichloroethane	C	NC	5.7E-02	NC	---	NC	5.60E-03	IRIS, RC	02/01/1994
Vinyl chloride (child)	A	1.90E+00	1.50E+00	1.90E+00	1.50E+00	3.00E-02	3.00E-02	IRIS, RC	08/07/2000
Vinyl chloride (adult)	A	NC	7.2E-01	NC	1.50E+00	NC	1.5E-02	IRIS, RC	08/07/2000

NA = Not Applicable
NC = Not Considered
UA = Unavailable
--- = Not Determined
IRIS = U. S. EPA Integrated Risk Information System
RC = Route Extrapolation calculation from US EPA, Region 9 PRG Table.
Bold values represent upward revisions in cancer slope factors since the BHHRA.

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3a
Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	---	3.70E-05	mg/kg-day	4.00E-03	mg/kg-day	9.25E-03
(child)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	4.79E-05	mg/kg-day	7.00E-04	mg/kg-day	6.84E-02
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	4.10E-05	mg/kg-day	1.00E-02	mg/kg-day	4.10E-03
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	1.50E-04	mg/kg-day	2.00E-02	mg/kg-day	7.52E-03
	Vinyl Chloride	5.00E-01	ug/L	5.00E-04	mg/L	NA	---	2.78E-05	mg/kg-day	3.00E-03	mg/kg-day	9.27E-03
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	9.51E-03	mg/kg-day	2.00E-02	mg/kg-day	4.76E-01
	Total											5.74E-01
Dermal	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	2.10E-02	cm/hr	1.95E-06	mg/kg-day	3.88E-03	mg/kg-day	5.02E-04
(child)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	2.20E-02	cm/hr	2.64E-06	mg/kg-day	4.55E-04	mg/kg-day	5.80E-03
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	8.92E-03	cm/hr	9.14E-07	mg/kg-day	2.00E-03	mg/kg-day	4.57E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	5.30E-03	cm/hr	1.99E-06	mg/kg-day	2.00E-02	mg/kg-day	9.97E-05
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	7.30E-03	cm/hr	5.08E-07	mg/kg-day	3.00E-03	mg/kg-day	1.69E-04
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	1.00E-03	cm/hr	2.38E-05	mg/kg-day	5.60E-03	mg/kg-day	4.25E-03
	Total											1.13E-02
Inhalation	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	---	1.85E-04	mg/kg-day	8.60E-03	mg/kg-day	2.15E-02
(child)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	2.39E-04	mg/kg-day	5.00E-04	mg/kg-day	4.79E-01
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	2.05E-04	mg/kg-day	1.40E-02	mg/kg-day	1.46E-02
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	7.52E-04	mg/kg-day	7.00E-01	mg/kg-day	1.07E-03
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	NA	---	1.39E-04	mg/kg-day	2.80E-02	mg/kg-day	4.97E-03
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	4.76E-02	mg/kg-day	1.43E-05	mg/kg-day	3.33E+03
	Total											3.33E+03
									Total Hazard Index Across All Exposure Routes/Pathways			3.33E+03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3a

Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion (adult)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	----	1.28E-05	mg/kg-day	4.00E-03	mg/kg-day	3.19E-03
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	1.65E-05	mg/kg-day	7.00E-04	mg/kg-day	2.36E-02
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	1.41E-05	mg/kg-day	1.00E-02	mg/kg-day	1.41E-03
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	5.18E-05	mg/kg-day	2.00E-02	mg/kg-day	2.59E-03
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	NA	---	9.59E-06	mg/kg-day	3.00E-03	mg/kg-day	3.20E-03
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	3.28E-03	mg/kg-day	2.00E-02	mg/kg-day	1.64E-01
	Total											1.98E-01
Dermal (adult)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	2.10E-02	cm/hr	8.62E-07	mg/kg-day	3.88E-03	mg/kg-day	2.22E-04
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	2.20E-02	cm/hr	1.17E-06	mg/kg-day	4.55E-04	mg/kg-day	2.57E-03
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	8.92E-03	cm/hr	4.05E-07	mg/kg-day	2.00E-03	mg/kg-day	2.02E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	5.30E-03	cm/hr	8.83E-07	mg/kg-day	2.00E-02	mg/kg-day	4.42E-05
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	7.30E-03	cm/hr	2.25E-07	mg/kg-day	3.00E-03	mg/kg-day	7.50E-05
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	1.00E-03	cm/hr	1.05E-05	mg/kg-day	5.60E-03	mg/kg-day	1.88E-03
	Total											4.99E-03
Inhalation (adult)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	---	6.84E-05	mg/kg-day	8.60E-03	mg/kg-day	7.95E-03
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	8.84E-05	mg/kg-day	5.00E-04	mg/kg-day	1.77E-01
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	7.56E-05	mg/kg-day	1.40E-02	mg/kg-day	5.40E-03
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	2.78E-04	mg/kg-day	7.00E-01	mg/kg-day	3.97E-04
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	NA	---	5.14E-05	mg/kg-day	2.80E-02	mg/kg-day	1.83E-03
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	1.76E-02	mg/kg-day	1.43E-05	mg/kg-day	1.23E+03
	Total											1.23E+03
										Total Hazard Index Across All Exposure Routes/Pathways		1.23E+03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Residen
Receptor Age: Children and Adults

Table A3-3a

Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	NA	---	**1.46E-04**	mg/kg-day	4.00E-03	mg/kg-day	3.65E-02
(child)	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	NA	---	**2.53E-03**	mg/kg-day	7.00E-04	mg/kg-day	3.62E+00
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	NA	---	**4.10E-04**	mg/kg-day	1.00E-02	mg/kg-day	4.10E-02
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	NA	---	**7.76E-03**	mg/kg-day	2.00E-02	mg/kg-day	3.88E-01
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	NA	---	**1.57E-04**	mg/kg-day	3.00E-03	mg/kg-day	5.23E-02
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	NA	---	**2.93E-02**	mg/kg-day	2.00E-02	mg/kg-day	1.47E+00
	Total											5.61E+00
Dermal	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	2.10E-02	cm/hr	**1.53E-05**	mg/kg-day	3.88E-03	mg/kg-day	3.95E-03
(child)	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	2.20E-02	cm/hr	**2.79E-04**	mg/kg-day	4.55E-04	mg/kg-day	6.13E-01
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	8.92E-03	cm/hr	**1.83E-05**	mg/kg-day	2.00E-03	mg/kg-day	9.14E-03
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	5.30E-03	cm/hr	**2.06E-04**	mg/kg-day	2.00E-02	mg/kg-day	1.03E-02
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	7.30E-03	cm/hr	**5.72E-06**	mg/kg-day	3.00E-03	mg/kg-day	1.91E-03
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	1.00E-03	cm/hr	**1.47E-04**	mg/kg-day	5.60E-03	mg/kg-day	2.62E-02
	Total											6.64E-01
Inhalation	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	NA	---	**4.23E-04**	mg/kg-day	8.60E-03	mg/kg-day	4.92E-02
(child)	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	NA	---	**7.35E-03**	mg/kg-day	5.00E-04	mg/kg-day	1.47E+01
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	NA	---	**1.19E-03**	mg/kg-day	1.40E-02	mg/kg-day	8.49E-02
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	NA	---	**2.25E-02**	mg/kg-day	7.00E-01	mg/kg-day	3.22E-02
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	NA	---	**4.55E-04**	mg/kg-day	2.80E-02	mg/kg-day	1.62E-02
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	NA	---	**8.51E-02**	mg/kg-day	1.43E-05	mg/kg-day	5.95E+03
	Total											5.97E+03
										Total Hazard Index Across All Exposure Routes/Pathways		5.97E+03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3b
Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	3.00E-05	mg/kg-day	1.00E-02	mg/kg-day	3.00E-03
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	3.99E-05	mg/kg-day	2.00E-02	mg/kg-day	2.00E-03
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	7.04E-05	mg/kg-day	3.00E-03	mg/kg-day	2.35E-02
	Total											2.85E-02
Dermal (Child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	8.92E-03	cm/hr	6.69E-07	mg/kg-day	2.00E-03	mg/kg-day	3.35E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	5.30E-03	cm/hr	5.29E-07	mg/kg-day	2.00E-02	mg/kg-day	2.65E-05
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	7.30E-03	cm/hr	1.29E-06	mg/kg-day	3.00E-03	mg/kg-day	4.29E-04
	Total											7.90E-04
Inhalation (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	1.50E-04	mg/kg-day	1.40E-02	mg/kg-day	1.07E-02
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	2.00E-04	mg/kg-day	7.00E-01	mg/kg-day	2.85E-04
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	3.52E-04	mg/kg-day	2.80E-02	mg/kg-day	1.26E-02
	Total											2.36E-02
										Total Hazard Index Across All Exposure Routes/Pathways		5.28E-02

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3b
Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	1.03E-05	mg/kg-day	1.00E-02	mg/kg-day	1.03E-03
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	1.38E-05	mg/kg-day	2.00E-02	mg/kg-day	6.88E-04
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	2.43E-05	mg/kg-day	3.00E-03	mg/kg-day	8.10E-03
	Total											9.82E-03
Dermal (Adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	8.92E-03	cm/hr	2.96E-07	mg/kg-day	2.00E-03	mg/kg-day	1.48E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	5.30E-03	cm/hr	2.34E-07	mg/kg-day	2.00E-02	mg/kg-day	1.17E-05
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	7.30E-03	cm/hr	5.70E-07	mg/kg-day	3.00E-03	mg/kg-day	1.90E-04
	Total											3.50E-04
Inhalation (Adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	5.54E-05	mg/kg-day	1.40E-02	mg/kg-day	3.95E-03
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	7.37E-05	mg/kg-day	7.00E-01	mg/kg-day	1.05E-04
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	1.30E-04	mg/kg-day	2.80E-02	mg/kg-day	4.65E-03
	Total											8.71E-03
										Total Hazard Index Across All Exposure Routes/Pathways		1.89E-02

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3b
Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion (child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	5.99E-05	mg/kg-day	1.00E-02	mg/kg-day	5.99E-03
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	NA	---	1.49E-04	mg/kg-day	2.00E-02	mg/kg-day	7.44E-03
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	1.45E-04	mg/kg-day	3.00E-03	mg/kg-day	4.82E-02
	Total											6.16E-02
Dermal (Child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	8.92E-03	cm/hr	2.67E-06	mg/kg-day	2.00E-03	mg/kg-day	1.34E-03
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	5.30E-03	cm/hr	3.94E-06	mg/kg-day	2.00E-02	mg/kg-day	1.97E-04
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	7.30E-03	cm/hr	5.28E-06	mg/kg-day	3.00E-03	mg/kg-day	1.76E-03
	Total											3.29E-03
Inhalation (child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	1.74E-04	mg/kg-day	1.40E-02	mg/kg-day	1.24E-02
	1,1,2-Trichloroethane	5.00E-01	ug/L	5.00E-04	mg/L	NA	---	0.00E+00	mg/kg-day	4.00E-03	mg/kg-day	0.00E+00
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	4.19E-04	mg/kg-day	2.80E-02	mg/kg-day	1.50E-02
	Total											2.74E-02
										Total Hazard Index Across All Exposure Routes/Pathways		9.23E-02

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3b
Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion (adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	2.05E-05	mg/kg-day	1.00E-02	mg/kg-day	2.05E-03
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	NA	---	5.10E-05	mg/kg-day	2.00E-02	mg/kg-day	2.55E-03
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	4.96E-05	mg/kg-day	3.00E-03	mg/kg-day	1.65E-02
	Total											2.11E-02
Dermal (Adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	8.92E-03	cm/hr	9.74E-07	mg/kg-day	2.00E-03	mg/kg-day	4.87E-04
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	5.30E-03	cm/hr	1.44E-06	mg/kg-day	2.00E-02	mg/kg-day	7.19E-05
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	7.30E-03	cm/hr	1.92E-06	mg/kg-day	3.00E-03	mg/kg-day	6.41E-04
	Total											1.20E-03
Inhalation (Adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	6.42E-05	mg/kg-day	1.40E-02	mg/kg-day	4.59E-03
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	NA	---	1.59E-04	mg/kg-day	7.00E-01	mg/kg-day	2.28E-04
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	1.55E-04	mg/kg-day	2.80E-02	mg/kg-day	5.53E-03
												1.03E-02
										Total Hazard Index Across All Exposure Routes/Pathways		3.27E-02

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3c

Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
On-Site Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion (child)	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	---	2.98E-05	mg/kg-day	4.00E-03	mg/kg-day	7.45E-03
	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	3.19E-05	mg/kg-day	7.00E-04	mg/kg-day	4.56E-02
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	3.59E-05	mg/kg-day	1.00E-02	mg/kg-day	3.59E-03
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	7.31E-04	mg/kg-day	2.00E-02	mg/kg-day	3.65E-02
	1,1,2-Trichloroethene	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	3.20E-05	mg/kg-day	3.00E-03	mg/kg-day	1.07E-02
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	1.45E-04	mg/kg-day	3.00E-03	mg/kg-day	4.84E-02
	Total											1.52E-01
Dermal (child)	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	2.10E-02	cm/hr	1.57E-06	mg/kg-day	3.88E-03	mg/kg-day	4.04E-04
	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	2.20E-02	cm/hr	1.76E-06	mg/kg-day	4.55E-04	mg/kg-day	3.87E-03
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	8.92E-03	cm/hr	8.02E-07	mg/kg-day	2.00E-03	mg/kg-day	4.01E-04
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	5.30E-03	cm/hr	9.69E-06	mg/kg-day	2.00E-02	mg/kg-day	4.85E-04
	1,1,2-Trichloroethene	5.75E-01	ug/L	5.75E-04	mg/L	6.43E-03	cm/hr	5.14E-07	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	7.30E-03	cm/hr	2.66E-06	mg/kg-day	3.00E-03	mg/kg-day	8.85E-04
	Total											6.04E-03
Inhalation (child)	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	---	1.49E-04	mg/kg-day	8.60E-03	mg/kg-day	1.73E-02
	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	1.60E-04	mg/kg-day	5.00E-04	mg/kg-day	3.19E-01
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	1.79E-04	mg/kg-day	1.40E-02	mg/kg-day	1.28E-02
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	3.65E-03	mg/kg-day	7.00E-01	mg/kg-day	5.22E-03
	1,1,2-Trichloroethene	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	1.60E-04	mg/kg-day	4.00E-03	mg/kg-day	3.99E-02
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	7.26E-04	mg/kg-day	2.80E-02	mg/kg-day	2.59E-02
	Total											4.21E-01
										Total Hazard Index Across All Exposure Routes/Pathways		5.79E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3c

Non cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
On-Site Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	----	1.03E-05	mg/kg-day	4.00E-03	mg/kg-day	2.57E-03
(adult)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	1.10E-05	mg/kg-day	7.00E-04	mg/kg-day	1.57E-02
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	1.24E-05	mg/kg-day	1.00E-02	mg/kg-day	1.24E-03
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	2.52E-04	mg/kg-day	2.00E-02	mg/kg-day	1.26E-02
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	1.10E-05	mg/kg-day	3.00E-03	mg/kg-day	3.67E-03
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	5.01E-05	mg/kg-day	3.00E-03	mg/kg-day	1.67E-02
	Total											5.25E-02
Dermal	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	2.10E-02	cm/hr	6.93E-07	mg/kg-day	3.88E-03	mg/kg-day	1.79E-04
(adult)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	2.20E-02	cm/hr	7.79E-07	mg/kg-day	4.55E-04	mg/kg-day	1.71E-03
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	8.92E-03	cm/hr	3.55E-07	mg/kg-day	2.00E-03	mg/kg-day	1.77E-04
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	5.30E-03	cm/hr	4.29E-06	mg/kg-day	2.00E-02	mg/kg-day	2.15E-04
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	6.43E-03	cm/hr	2.28E-07	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	7.30E-03	cm/hr	1.18E-06	mg/kg-day	3.00E-03	mg/kg-day	3.92E-04
	Total											2.67E-03
Inhalation	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	---	5.50E-05	mg/kg-day	8.60E-03	mg/kg-day	6.40E-03
(adult)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	5.90E-05	mg/kg-day	5.00E-04	mg/kg-day	1.18E-01
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	6.63E-05	mg/kg-day	1.40E-02	mg/kg-day	4.74E-03
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	1.35E-03	mg/kg-day	7.00E-01	mg/kg-day	1.93E-03
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	5.90E-05	mg/kg-day	4.00E-03	mg/kg-day	1.48E-02
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	2.68E-04	mg/kg-day	2.80E-02	mg/kg-day	9.59E-03
	Total											1.55E-01
									Total Hazard Index Across All Exposure Routes/Pathways			2.11E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3c

Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure

Reasonable Maximum Exposure

On-Site Area

Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	6.31E-05	mg/kg-day	4.00E-03	mg/kg-day	1.58E-02
(child)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	1.03E-04	mg/kg-day	7.00E-04	mg/kg-day	1.47E-01
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	1.31E-04	mg/kg-day	1.00E-02	mg/kg-day	1.31E-02
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	1.29E-02	mg/kg-day	2.00E-02	mg/kg-day	6.45E-01
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	7.47E-05	mg/kg-day	3.00E-03	mg/kg-day	2.49E-02
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	5.86E-04	mg/kg-day	3.00E-03	mg/kg-day	1.95E-01
	Total											1.04E+00
Dermal	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	2.10E-02	cm/hr	6.63E-06	mg/kg-day	3.88E-03	mg/kg-day	1.71E-03
(child)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	2.20E-02	cm/hr	1.14E-05	mg/kg-day	4.55E-04	mg/kg-day	2.50E-02
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	8.92E-03	cm/hr	5.84E-06	mg/kg-day	2.00E-03	mg/kg-day	2.92E-03
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	5.30E-03	cm/hr	3.42E-04	mg/kg-day	2.00E-02	mg/kg-day	1.71E-02
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	6.43E-03	cm/hr	2.40E-06	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	7.30E-03	cm/hr	2.14E-05	mg/kg-day	3.00E-03	mg/kg-day	7.13E-03
	Total											5.38E-02
Inhalation	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	1.83E-04	mg/kg-day	8.60E-03	mg/kg-day	2.13E-02
(child)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	2.99E-04	mg/kg-day	5.00E-04	mg/kg-day	5.99E-01
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	3.80E-04	mg/kg-day	1.40E-02	mg/kg-day	2.71E-02
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	3.74E-02	mg/kg-day	7.00E-01	mg/kg-day	5.35E-02
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	2.17E-04	mg/kg-day	4.00E-03	mg/kg-day	5.42E-02
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	1.70E-03	mg/kg-day	2.80E-02	mg/kg-day	6.07E-02
	Total											8.16E-01
										Total Hazard Index Across All Exposure Routes/Pathways		1.91E+00

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-3c

Non Cancer Hazards for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
On-Site Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Quotient (HQ)
Ingestion	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	2.16E-05	mg/kg-day	4.00E-03	mg/kg-day	5.41E-03
(adult)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	3.54E-05	mg/kg-day	7.00E-04	mg/kg-day	5.06E-02
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	4.49E-05	mg/kg-day	1.00E-02	mg/kg-day	4.49E-03
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	4.43E-03	mg/kg-day	2.00E-02	mg/kg-day	2.21E-01
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	2.56E-05	mg/kg-day	3.00E-03	mg/kg-day	8.54E-03
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	2.01E-04	mg/kg-day	3.00E-03	mg/kg-day	6.70E-02
	Total											3.57E-01
Dermal	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	2.10E-02	cm/hr	2.42E-06	mg/kg-day	3.88E-03	mg/kg-day	6.23E-04
(adult)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	2.20E-02	cm/hr	4.14E-06	mg/kg-day	4.55E-04	mg/kg-day	9.10E-03
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	8.92E-03	cm/hr	2.13E-06	mg/kg-day	2.00E-03	mg/kg-day	1.07E-03
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	5.30E-03	cm/hr	1.25E-04	mg/kg-day	2.00E-02	mg/kg-day	6.24E-03
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	6.43E-03	cm/hr	8.76E-07	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	7.30E-03	cm/hr	7.80E-06	mg/kg-day	3.00E-03	mg/kg-day	2.50E-03
	Total											1.96E-02
Inhalation	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	6.76E-05	mg/kg-day	8.60E-03	mg/kg-day	7.86E-03
(adult)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	1.11E-04	mg/kg-day	5.00E-04	mg/kg-day	2.21E-01
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	1.40E-04	mg/kg-day	1.40E-02	mg/kg-day	1.00E-02
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	1.38E-02	mg/kg-day	7.00E-01	mg/kg-day	1.98E-02
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	8.01E-05	mg/kg-day	4.00E-03	mg/kg-day	2.00E-02
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	6.28E-04	mg/kg-day	2.80E-02	mg/kg-day	2.24E-02
	Total											3.01E-01
										Total Hazard Index Across All Exposure Routes/Pathways		6.78E-01

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4a

Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	---	3.17E-06	mg/kg-day	5.50E-02	mg/kg-day	5.77E-05
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	4.10E-06	mg/kg-day	1.30E-01	mg/kg-day	3.16E-05
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	3.51E-06	mg/kg-day	1.00E-02	mg/kg-day	3.51E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	1.29E-05	mg/kg-day	9.10E-02	mg/kg-day	1.42E-04
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	NA	---	5.93E-06	mg/kg-day	1.40E+00	mg/kg-day	4.24E-06
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	8.15E-04	mg/kg-day	1.40E+00	mg/kg-day	5.82E-04
	Total											1.17E-03
Dermal (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	2.10E-02	cm/hr	1.67E-07	mg/kg-day	5.67E-02	mg/kg-day	2.94E-06
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	2.20E-02	cm/hr	2.26E-07	mg/kg-day	2.00E-01	mg/kg-day	1.13E-06
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	8.92E-03	cm/hr	7.83E-08	mg/kg-day	3.05E-02	mg/kg-day	2.57E-06
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	5.30E-03	cm/hr	1.71E-07	mg/kg-day	9.10E-02	mg/kg-day	1.88E-06
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	7.30E-03	cm/hr	1.08E-07	mg/kg-day	1.50E+00	mg/kg-day	7.21E-08
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	1.00E-03	cm/hr	2.04E-06	mg/kg-day	1.50E+00	mg/kg-day	1.36E-06
	Total											9.94E-06
Inhalation (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	---	1.58E-05	mg/kg-day	2.70E-02	mg/kg-day	5.87E-04
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	2.05E-05	mg/kg-day	5.30E-02	mg/kg-day	3.87E-04
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	1.75E-05	mg/kg-day	8.10E-02	mg/kg-day	2.16E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	6.43E-05	mg/kg-day	9.10E-02	mg/kg-day	7.07E-04
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	NA	---	2.96E-05	mg/kg-day	3.00E-02	mg/kg-day	9.87E-04
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	4.07E-03	mg/kg-day	3.00E-02	mg/kg-day	1.33E-01
	Total											1.33E-01
										Total Cancer Risk Across All Exposure Routes/Pathways		1.40E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4a

Cancer Risks for Residential Exposure to Groundwater - Direct Exposure

Central Tendency

North Downgradient Area

Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	----	4.38E-06	mg/kg-day	5.50E-02	mg/kg-day	7.96E-05
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	5.66E-06	mg/kg-day	1.30E-01	mg/kg-day	4.35E-05
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	4.84E-06	mg/kg-day	1.00E-02	mg/kg-day	4.84E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	1.78E-05	mg/kg-day	9.10E-02	mg/kg-day	1.95E-04
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	NA	---	8.18E-06	mg/kg-day	1.40E+00	mg/kg-day	5.84E-06
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	1.12E-03	mg/kg-day	1.40E+00	mg/kg-day	8.03E-04
	Total											1.61E-03
Dermal	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	2.10E-02	cm/hr	2.95E-07	mg/kg-day	5.67E-02	mg/kg-day	5.20E-06
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	2.20E-02	cm/hr	4.00E-07	mg/kg-day	2.00E-01	mg/kg-day	2.00E-06
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	8.92E-03	cm/hr	1.39E-07	mg/kg-day	3.05E-02	mg/kg-day	4.54E-06
	1,2-Dichloroethane	1.24E+00	ug/L	1.24E-03	mg/L	5.30E-03	cm/hr	1.92E-07	mg/kg-day	9.10E-02	mg/kg-day	2.11E-06
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	7.30E-03	cm/hr	1.92E-07	mg/kg-day	1.50E+00	mg/kg-day	1.28E-07
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	1.00E-03	cm/hr	3.61E-06	mg/kg-day	1.50E+00	mg/kg-day	2.41E-06
	Total											1.64E-05
Inhalation	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	NA	---	3.70E-05	mg/kg-day	2.70E-02	mg/kg-day	1.37E-03
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	NA	---	3.03E-05	mg/kg-day	5.30E-02	mg/kg-day	5.71E-04
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	NA	---	2.59E-05	mg/kg-day	8.10E-02	mg/kg-day	3.20E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	NA	---	9.51E-05	mg/kg-day	9.10E-02	mg/kg-day	1.04E-03
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	NA	---	4.37E-05	mg/kg-day	3.00E-02	mg/kg-day	1.46E-03
	Manganese	1.71E-01	mg/L	1.71E-01	mg/L	NA	---	6.01E-03	mg/kg-day	3.00E-02	mg/kg-day	2.00E-01
	Total											2.05E-01
										Total Cancer Risk Across All Exposure Routes/Pathways		2.07E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4a

Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	NA	---	1.25E-05	mg/kg-day	5.50E-02	mg/kg-day	2.27E-04
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	NA	---	2.17E-04	mg/kg-day	1.30E-01	mg/kg-day	1.67E-03
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	NA	---	3.51E-05	mg/kg-day	1.00E-02	mg/kg-day	3.51E-03
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	NA	---	6.65E-04	mg/kg-day	9.10E-02	mg/kg-day	7.31E-03
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	NA	---	1.34E-05	mg/kg-day	1.40E+00	mg/kg-day	9.60E-06
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	NA	---	2.52E-03	mg/kg-day	1.40E+00	mg/kg-day	1.80E-03
	Total											1.45E-02
Dermal (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	2.10E-02	cm/hr	1.31E-06	mg/kg-day	5.67E-02	mg/kg-day	2.31E-05
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	2.20E-02	cm/hr	2.39E-05	mg/kg-day	2.00E-01	mg/kg-day	1.19E-04
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	8.92E-03	cm/hr	1.56E-06	mg/kg-day	3.05E-02	mg/kg-day	5.13E-05
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	5.30E-03	cm/hr	1.76E-05	mg/kg-day	9.10E-02	mg/kg-day	1.93E-04
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	7.30E-03	cm/hr	4.90E-07	mg/kg-day	1.50E+00	mg/kg-day	3.26E-07
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	1.00E-03	cm/hr	1.26E-05	mg/kg-day	1.50E+00	mg/kg-day	8.37E-06
	Total											3.96E-04
Inhalation (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	NA	---	3.62E-05	mg/kg-day	2.70E-02	mg/kg-day	1.34E-03
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	NA	---	6.29E-04	mg/kg-day	5.30E-02	mg/kg-day	1.79E-02
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	NA	---	1.02E-04	mg/kg-day	8.10E-02	mg/kg-day	1.26E-03
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	NA	---	1.93E-03	mg/kg-day	9.10E-02	mg/kg-day	2.72E-02
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	NA	---	3.89E-05	mg/kg-day	3.00E-02	mg/kg-day	1.30E-03
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	NA	---	7.28E-03	mg/kg-day	3.00E-02	mg/kg-day	2.43E-01
	Total											2.80E-01
										Total Cancer Risk Across All Exposure Routes/Pathways		2.95E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4a

Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	NA	---	1.71E-05	mg/kg-day	5.50E-02	mg/kg-day	3.12E-04
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	NA	---	2.98E-04	mg/kg-day	1.30E-01	mg/kg-day	2.29E-03
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	NA	---	4.82E-05	mg/kg-day	1.00E-02	mg/kg-day	4.82E-03
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	NA	---	9.13E-04	mg/kg-day	9.10E-02	mg/kg-day	1.00E-02
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	NA	---	1.84E-05	mg/kg-day	1.40E+00	mg/kg-day	1.52E-05
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	NA	---	3.45E-03	mg/kg-day	1.40E+00	mg/kg-day	2.46E-03
	Total											1.99E-02
Dermal (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	2.10E-02	cm/hr	1.91E-06	mg/kg-day	5.67E-02	mg/kg-day	3.37E-05
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	2.20E-02	cm/hr	3.48E-05	mg/kg-day	2.00E-01	mg/kg-day	1.74E-04
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	8.92E-03	cm/hr	2.28E-06	mg/kg-day	3.05E-02	mg/kg-day	7.48E-05
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	5.30E-03	cm/hr	2.57E-05	mg/kg-day	9.10E-02	mg/kg-day	2.82E-04
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	7.30E-03	cm/hr	7.14E-07	mg/kg-day	1.50E+00	mg/kg-day	4.76E-07
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	1.00E-03	cm/hr	1.83E-05	mg/kg-day	1.50E+00	mg/kg-day	1.22E-05
	Total											5.77E-04
Inhalation (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	NA	---	5.35E-05	mg/kg-day	2.70E-02	mg/kg-day	1.98E-03
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	NA	---	9.30E-04	mg/kg-day	5.30E-02	mg/kg-day	1.75E-02
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	NA	---	1.50E-04	mg/kg-day	8.10E-02	mg/kg-day	1.86E-03
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	NA	---	2.85E-03	mg/kg-day	9.10E-02	mg/kg-day	3.13E-02
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	NA	---	5.75E-05	mg/kg-day	3.00E-02	mg/kg-day	1.92E-03
	Manganese	3.06E-01	mg/L	3.06E-01	mg/L	NA	---	1.08E-02	mg/kg-day	3.00E-02	mg/kg-day	3.59E-01
	Total											4.13E-01
										Total Cancer Risk Across All Exposure Routes/Pathways		4.34E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-4b
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	2.57E-06	mg/kg-day	1.00E-02	mg/kg-day	2.57E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	3.42E-06	mg/kg-day	9.10E-02	mg/kg-day	3.76E-05
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	6.04E-06	mg/kg-day	1.40E+00	mg/kg-day	4.31E-06
	Total											2.99E-04
Dermal (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	8.92E-03	cm/hr	5.74E-08	mg/kg-day	3.05E-02	mg/kg-day	1.88E-06
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	5.30E-03	cm/hr	4.54E-08	mg/kg-day	9.10E-02	mg/kg-day	4.99E-07
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	7.30E-03	cm/hr	1.10E-07	mg/kg-day	1.50E+00	mg/kg-day	7.36E-08
	Total											2.45E-06
Inhalation (Child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	1.28E-05	mg/kg-day	8.10E-02	mg/kg-day	1.59E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	1.71E-05	mg/kg-day	9.10E-02	mg/kg-day	1.88E-04
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	3.02E-05	mg/kg-day	3.00E-02	mg/kg-day	1.01E-03
	Total											1.35E-03
										Total Cancer Risk Across All Exposure Routes/Pathways		1.65E-03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-4b
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	3.54E-06	mg/kg-day	1.00E-02	mg/kg-day	3.54E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	4.72E-06	mg/kg-day	9.10E-02	mg/kg-day	5.18E-05
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	8.33E-06	mg/kg-day	1.40E+00	mg/kg-day	5.95E-06
	Total											4.12E-04
Dermal (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	8.92E-03	cm/hr	1.02E-07	mg/kg-day	3.05E-02	mg/kg-day	3.33E-06
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	5.30E-03	cm/hr	8.04E-08	mg/kg-day	9.10E-02	mg/kg-day	8.83E-07
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	7.30E-03	cm/hr	1.95E-07	mg/kg-day	1.50E+00	mg/kg-day	1.30E-07
	Total											4.34E-06
Inhalation (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	NA	---	1.90E-05	mg/kg-day	8.10E-02	mg/kg-day	2.34E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	NA	---	2.53E-05	mg/kg-day	9.10E-02	mg/kg-day	2.78E-04
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	NA	---	4.46E-05	mg/kg-day	3.00E-02	mg/kg-day	1.49E-03
	Total											2.00E-03
										Total Cancer Risk Across All Exposure Routes/Pathways		2.42E-03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-4b
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	5.14E-06	mg/kg-day	1.00E-02	mg/kg-day	5.14E-04
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	NA	---	1.27E-05	mg/kg-day	9.10E-02	mg/kg-day	1.40E-04
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	1.24E-05	mg/kg-day	1.40E+00	mg/kg-day	8.85E-06
	Total											6.63E-04
Dermal (child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	8.92E-03	cm/hr	2.29E-07	mg/kg-day	3.05E-02	mg/kg-day	7.51E-06
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	5.30E-03	cm/hr	3.38E-07	mg/kg-day	9.10E-02	mg/kg-day	3.71E-06
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	7.30E-03	cm/hr	4.52E-07	mg/kg-day	1.50E+00	mg/kg-day	3.02E-07
	Total											1.15E-05
Inhalation (Child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	1.49E-05	mg/kg-day	8.10E-02	mg/kg-day	1.84E-04
	1,1,2-Trichloroethane	5.00E-01	ug/L	5.00E-04	mg/L	NA	---	3.70E-05	mg/kg-day	9.10E-02	mg/kg-day	4.06E-04
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	3.59E-05	mg/kg-day	3.00E-02	mg/kg-day	1.20E-03
	Total											1.79E-03
										Total Cancer Risk Across All Exposure Routes/Pathways		2.46E-03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-4b
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	7.04E-06	mg/kg-day	1.00E-02	mg/kg-day	7.04E-04
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	NA	---	1.75E-05	mg/kg-day	9.10E-02	mg/kg-day	1.92E-04
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	1.70E-05	mg/kg-day	1.40E+00	mg/kg-day	1.21E-05
	Total											9.09E-04
Dermal (adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	8.92E-03	cm/hr	3.34E-07	mg/kg-day	3.05E-02	mg/kg-day	1.10E-05
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	5.30E-03	cm/hr	4.93E-07	mg/kg-day	9.10E-02	mg/kg-day	5.41E-06
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	7.30E-03	cm/hr	6.60E-07	mg/kg-day	1.50E+00	mg/kg-day	4.40E-07
	Total											1.68E-05
Inhalation (adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	NA	---	2.20E-05	mg/kg-day	8.10E-02	mg/kg-day	2.72E-04
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	NA	---	5.46E-05	mg/kg-day	9.10E-02	mg/kg-day	6.00E-04
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	NA	---	5.31E-05	mg/kg-day	3.00E-02	mg/kg-day	1.77E-03
												2.64E-03
										Total Cancer Risk Across All Exposure Routes/Pathways		3.57E-03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4c
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
On-Site Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	---	3.17E-06	mg/kg-day	5.50E-02	mg/kg-day	5.77E-05
(child)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	4.10E-06	mg/kg-day	1.30E-01	mg/kg-day	3.16E-05
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	3.51E-06	mg/kg-day	1.00E-02	mg/kg-day	3.51E-04
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	1.29E-05	mg/kg-day	9.10E-02	mg/kg-day	1.42E-04
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	9.25E-04	mg/kg-day	5.70E-02	mg/kg-day	1.62E-02
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	8.15E-04	mg/kg-day	1.40E+00	mg/kg-day	5.32E-04
	Total											1.74E-02
Dermal	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	2.10E-02	cm/hr	6.77E-07	mg/kg-day	5.67E-02	mg/kg-day	1.19E-05
(child)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	2.20E-02	cm/hr	3.27E-07	mg/kg-day	2.00E-01	mg/kg-day	1.63E-06
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	8.92E-03	cm/hr	2.07E-05	mg/kg-day	3.05E-02	mg/kg-day	6.77E-04
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	5.30E-03	cm/hr	1.08E-05	mg/kg-day	9.10E-02	mg/kg-day	1.19E-04
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	6.43E-03	cm/hr	0.00E+00	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	7.30E-03	cm/hr	5.80E-08	mg/kg-day	1.50E+00	mg/kg-day	3.87E-08
	Total											8.10E-04
Inhalation	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	---	4.08E-03	mg/kg-day	2.70E-02	mg/kg-day	1.51E-01
(child)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	1.38E-04	mg/kg-day	5.30E-02	mg/kg-day	2.61E-03
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	0.00E+00	mg/kg-day	8.10E-02	mg/kg-day	0.00E+00
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	0.00E+00	mg/kg-day	9.10E-02	mg/kg-day	0.00E+00
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	0.00E+00	mg/kg-day	5.60E-02	mg/kg-day	0.00E+00
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	0.00E+00	mg/kg-day	3.00E-02	mg/kg-day	0.00E+00
	Total											1.54E-01
										Total Cancer Risk Across All Exposure Routes/Pathways		1.72E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwa er
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4c
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Central Tendency
On-Site Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	----	2.16E-05	mg/kg-day	5.50E-02	mg/kg-day	3.93E-04
(adult)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	3.54E-05	mg/kg-day	1.30E-01	mg/kg-day	2.72E-04
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	4.49E-05	mg/kg-day	1.00E-02	mg/kg-day	4.49E-03
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	4.43E-03	mg/kg-day	9.10E-02	mg/kg-day	4.86E-02
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	2.01E-04	mg/kg-day	5.70E-02	mg/kg-day	3.53E-03
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	0.00E+00	mg/kg-day	1.40E+00	mg/kg-day	0.00E+00
	Tota											5.73E-02
Dermal	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	2.10E-02	cm/hr	2.42E-06	mg/kg-day	5.67E-02	mg/kg-day	4.26E-05
(adult)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	2.20E-02	cm/hr	4.14E-06	mg/kg-day	2.00E-01	mg/kg-day	2.07E-05
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	8.92E-03	cm/hr	2.13E-06	mg/kg-day	3.05E-02	mg/kg-day	6.99E-05
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	5.30E-03	cm/hr	1.25E-04	mg/kg-day	9.10E-02	mg/kg-day	1.37E-03
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	6.43E-03	cm/hr	7.80E-06	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	7.30E-03	cm/hr	0.00E+00	mg/kg-day	1.50E+00	mg/kg-day	0.00E+00
	Tota											1.50E-03
Inhalation	Benzene	5.36E-01	ug/L	5.36E-04	mg/L	NA	---	6.76E-05	mg/kg-day	2.70E-02	mg/kg-day	2.50E-03
(adult)	Carbon tetrachloride	5.74E-01	ug/L	5.74E-04	mg/L	NA	---	1.11E-04	mg/kg-day	5.30E-02	mg/kg-day	2.09E-03
	Chloroform	6.45E-01	ug/L	6.45E-04	mg/L	NA	---	1.40E-04	mg/kg-day	8.10E-02	mg/kg-day	1.73E-03
	1,2-Dichloroethane	1.31E+01	ug/L	1.31E-02	mg/L	NA	---	1.38E-02	mg/kg-day	9.10E-02	mg/kg-day	1.52E-01
	1,1,2-Trichloroethane	5.75E-01	ug/L	5.75E-04	mg/L	NA	---	6.28E-04	mg/kg-day	5.60E-02	mg/kg-day	1.12E-02
	Vinyl Chloride	2.61E+00	ug/L	2.61E-03	mg/L	NA	---	0.00E+00	mg/kg-day	3.00E-02	mg/kg-day	0.00E+00
	Total											1.70E-01
									Total Cancer Risk Across All Exposure Routes/Pathways			2.28E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4c
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
On-Site Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	5.86E-04	mg/kg-day	5.50E-02	mg/kg-day	1.07E-02
(child)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	0.00E+00	mg/kg-day	1.30E-01	mg/kg-day	0.00E+00
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	0.00E+00	mg/kg-day	1.00E-02	mg/kg-day	0.00E+00
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	0.00E+00	mg/kg-day	9.10E-02	mg/kg-day	0.00E+00
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	1.03E-05	mg/kg-day	5.70E-02	mg/kg-day	1.30E-04
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	1.10E-05	mg/kg-day	1.40E+00	mg/kg-day	7.37E-06
	Total											1.09E-02
Dermal	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	2.10E-02	cm/hr	2.14E-05	mg/kg-day	5.67E-02	mg/kg-day	3.78E-04
(child)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	2.20E-02	cm/hr	0.00E+00	mg/kg-day	2.00E-01	mg/kg-day	0.00E+00
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	8.92E-03	cm/hr	0.00E+00	mg/kg-day	3.05E-02	mg/kg-day	0.00E+00
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	5.30E-03	cm/hr	0.00E+00	mg/kg-day	9.10E-02	mg/kg-day	0.00E+00
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	6.43E-03	cm/hr	6.93E-07	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	7.30E-03	cm/hr	7.79E-07	mg/kg-day	1.50E+00	mg/kg-day	5.19E-07
	Total											3.78E-04
Inhalation	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	1.70E-03	mg/kg-day	2.70E-02	mg/kg-day	6.30E-02
(child)	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	0.00E+00	mg/kg-day	5.30E-02	mg/kg-day	0.00E+00
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	0.00E+00	mg/kg-day	8.10E-02	mg/kg-day	0.00E+00
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	0.00E+00	mg/kg-day	9.10E-02	mg/kg-day	0.00E+00
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	5.50E-05	mg/kg-day	5.60E-02	mg/kg-day	9.33E-04
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	5.90E-05	mg/kg-day	3.00E-02	mg/kg-day	1.97E-03
	Total											6.59E-02
									Total Cancer Risk Across All Exposure Routes/Pathways			7.72E-02

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal, Inhalation
Receptor Population: Resident

Table A3-4c
Cancer Risks for Residential Exposure to Groundwater - Direct Exposure
Reasonable Maximum Exposure
On-Site Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Permeability Constant (PC)	PC Units	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Cancer Risk
Ingestion (adult)	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	0.00E+00	mg/kg-day	5.50E-02	mg/kg-day	0.00E+00
	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	0.00E+00	mg/kg-day	1.30E-01	mg/kg-day	0.00E+00
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	0.00E+00	mg/kg-day	1.00E-02	mg/kg-day	0.00E+00
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	0.00E+00	mg/kg-day	9.10E-02	mg/kg-day	0.00E+00
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	0.00E+00	mg/kg-day	5.70E-02	mg/kg-day	0.00E+00
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	0.00E+00	mg/kg-day	1.40E+00	mg/kg-day	0.00E+00
	Total											0.00E+00
Dermal (adult)	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	2.10E-02	cm/hr	0.00E+00	mg/kg-day	5.67E-02	mg/kg-day	0.00E+00
	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	2.20E-02	cm/hr	0.00E+00	mg/kg-day	2.00E-01	mg/kg-day	0.00E+00
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	8.92E-03	cm/hr	0.00E+00	mg/kg-day	3.05E-02	mg/kg-day	0.00E+00
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	5.30E-03	cm/hr	0.00E+00	mg/kg-day	9.10E-02	mg/kg-day	0.00E+00
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	6.43E-03	cm/hr	0.00E+00	mg/kg-day	---	mg/kg-day	---
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	7.30E-03	cm/hr	0.00E+00	mg/kg-day	1.50E+00	mg/kg-day	0.00E+00
	Total											0.00E+00
Inhalation (adult)	Benzene	6.58E-01	ug/L	6.58E-04	mg/L	NA	---	0.00E+00	mg/kg-day	2.70E-02	mg/kg-day	0.00E+00
	Carbon tetrachloride	1.08E+00	ug/L	1.08E-03	mg/L	NA	---	0.00E+00	mg/kg-day	5.30E-02	mg/kg-day	0.00E+00
	Chloroform	1.37E+00	ug/L	1.37E-03	mg/L	NA	---	0.00E+00	mg/kg-day	8.10E-02	mg/kg-day	0.00E+00
	1,2-Dichloroethane	1.35E+02	ug/L	1.35E-01	mg/L	NA	---	0.00E+00	mg/kg-day	9.10E-02	mg/kg-day	0.00E+00
	1,1,2-Trichloroethane	7.79E-01	ug/L	7.79E-04	mg/L	NA	---	0.00E+00	mg/kg-day	5.60E-02	mg/kg-day	0.00E+00
	Vinyl Chloride	6.12E+00	ug/L	6.12E-03	mg/L	NA	---	0.00E+00	mg/kg-day	3.00E-02	mg/kg-day	0.00E+00
	Total											0.00E+00
									Total Cancer Risk Across All Exposure Routes/Pathways			0.00E+00

Scenario Timeframe: Current, Future
Medium: Groundwater - Irrigation Use
Exposure Medium: Fruits, Meat, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5a
Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	---	7.94E-06	mg/kg-day	4.00E-03	mg/kg-day	1.99E-03
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	---	6.75E-06	mg/kg-day	7.00E-04	mg/kg-day	9.64E-03
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	---	9.48E-06	mg/kg-day	1.00E-02	mg/kg-day	9.48E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	---	5.44E-05	mg/kg-day	2.00E-02	mg/kg-day	2.72E-03
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	---	2.79E-05	mg/kg-day	3.00E-03	mg/kg-day	9.30E-03
	Total										2.46E-02
Beef (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	3.10E-06	9.02E-11	mg/kg-day	4.00E-03	mg/kg-day	2.26E-08
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	1.60E-05	6.02E-10	mg/kg-day	7.00E-04	mg/kg-day	8.60E-07
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	2.50E-06	8.04E-11	mg/kg-day	1.00E-02	mg/kg-day	8.04E-09
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	7.90E-07	9.32E-11	mg/kg-day	2.00E-02	mg/kg-day	4.66E-09
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	6.30E-07	3.41E-11	mg/kg-day	3.00E-03	mg/kg-day	1.14E-08
	Total										9.07E-07
Milk (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	9.90E-07	2.38E-09	mg/kg-day	4.00E-03	mg/kg-day	5.95E-07
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	5.00E-06	1.55E-08	mg/kg-day	7.00E-04	mg/kg-day	2.21E-05
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	7.90E-07	2.10E-09	mg/kg-day	1.00E-02	mg/kg-day	2.10E-07
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	2.50E-07	2.44E-09	mg/kg-day	2.00E-02	mg/kg-day	1.22E-07
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	2.00E-07	8.96E-10	mg/kg-day	3.00E-03	mg/kg-day	2.99E-07
	Total										2.34E-05
									Total Hazard Index Across All Exposure Routes/Pathways		2.46E-02

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5a

Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	---	5.72E-06	mg/kg-day	4.00E-03	mg/kg-day	1.43E-03
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	---	4.86E-06	mg/kg-day	7.00E-04	mg/kg-day	6.94E-03
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	---	6.83E-06	mg/kg-day	1.00E-02	mg/kg-day	6.83E-04
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	---	3.92E-05	mg/kg-day	2.00E-02	mg/kg-day	1.96E-03
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	---	2.01E-05	mg/kg-day	3.00E-03	mg/kg-day	6.70E-03
	Total										1.77E-02
Beef	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	3.10E-06	2.07E-10	mg/kg-day	4.00E-03	mg/kg-day	5.18E-08
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	1.60E-05	1.38E-09	mg/kg-day	7.00E-04	mg/kg-day	1.97E-06
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	2.50E-06	1.84E-10	mg/kg-day	1.00E-02	mg/kg-day	1.84E-08
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	7.90E-07	2.14E-10	mg/kg-day	2.00E-02	mg/kg-day	1.07E-08
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	6.30E-07	7.83E-11	mg/kg-day	3.00E-03	mg/kg-day	2.61E-08
	Total										2.08E-06
Milk	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	9.90E-07	2.20E-10	mg/kg-day	4.00E-03	mg/kg-day	5.50E-08
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	5.00E-06	1.44E-09	mg/kg-day	7.00E-04	mg/kg-day	2.06E-06
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	7.90E-07	1.94E-10	mg/kg-day	1.00E-02	mg/kg-day	1.94E-08
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	2.50E-07	2.25E-10	mg/kg-day	2.00E-02	mg/kg-day	1.13E-08
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	2.00E-07	8.28E-11	mg/kg-day	3.00E-03	mg/kg-day	2.76E-08
	Total										2.17E-06
									Total Hazard Index Across All Exposure Routes/Pathways		1.77E-02

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5a

Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	---	1.81E-05	mg/kg-day	4.00E-03	mg/kg-day	4.53E-03
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	---	2.07E-04	mg/kg-day	7.00E-04	mg/kg-day	2.96E-01
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	---	5.50E-05	mg/kg-day	1.00E-02	mg/kg-day	5.50E-03
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	---	1.63E-03	mg/kg-day	2.00E-02	mg/kg-day	8.15E-02
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	---	3.67E-05	mg/kg-day	3.00E-03	mg/kg-day	1.22E-02
	Total										3.99E-01
Beef (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	3.10E-06	2.06E-10	mg/kg-day	4.00E-03	mg/kg-day	5.15E-08
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	1.60E-05	1.85E-08	mg/kg-day	7.00E-04	mg/kg-day	2.64E-05
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	2.50E-06	4.67E-10	mg/kg-day	1.00E-02	mg/kg-day	4.67E-08
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	7.90E-07	2.80E-09	mg/kg-day	2.00E-02	mg/kg-day	1.40E-07
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	6.30E-07	4.49E-11	mg/kg-day	3.00E-03	mg/kg-day	1.50E-08
	Total										2.67E-05
Milk (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	9.90E-07	5.43E-09	mg/kg-day	4.00E-03	mg/kg-day	1.36E-06
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	5.00E-06	4.77E-07	mg/kg-day	7.00E-04	mg/kg-day	6.81E-04
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	7.90E-07	1.22E-08	mg/kg-day	1.00E-02	mg/kg-day	1.22E-06
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	2.50E-07	7.31E-08	mg/kg-day	2.00E-02	mg/kg-day	3.66E-06
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	2.00E-07	1.18E-09	mg/kg-day	3.00E-03	mg/kg-day	3.93E-07
	Total										6.88E-04
									Total Hazard Index Across All Exposure Routes/Pathways		4.00E-01

Scenario Timeframe: Current.
Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5a

Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	---	1.31E-05	mg/kg-day	4.00E-03	mg/kg-day	3.28E-03
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	---	1.49E-04	mg/kg-day	7.00E-04	mg/kg-day	2.13E-01
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	---	3.96E-05	mg/kg-day	1.00E-02	mg/kg-day	3.96E-03
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	---	1.18E-03	mg/kg-day	2.00E-02	mg/kg-day	5.90E-02
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	---	2.64E-05	mg/kg-day	3.00E-03	mg/kg-day	8.80E-03
	Total										2.88E-01
Beef (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	3.10E-06	4.72E-10	mg/kg-day	4.00E-03	mg/kg-day	1.18E-07
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	1.60E-05	4.23E-08	mg/kg-day	7.00E-04	mg/kg-day	6.04E-05
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	2.50E-06	1.07E-09	mg/kg-day	1.00E-02	mg/kg-day	1.07E-07
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	7.90E-07	6.41E-09	mg/kg-day	2.00E-02	mg/kg-day	3.21E-07
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	6.30E-07	1.03E-10	mg/kg-day	3.00E-03	mg/kg-day	3.43E-08
	Total										6.10E-05
Milk (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	9.90E-07	5.03E-10	mg/kg-day	4.00E-03	mg/kg-day	1.26E-07
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	5.00E-06	4.41E-08	mg/kg-day	7.00E-04	mg/kg-day	6.30E-05
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	7.90E-07	1.13E-09	mg/kg-day	1.00E-02	mg/kg-day	1.13E-07
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	2.50E-07	6.76E-09	mg/kg-day	2.00E-02	mg/kg-day	3.38E-07
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	2.00E-07	1.09E-10	mg/kg-day	3.00E-03	mg/kg-day	3.63E-08
	Total										6.36E-05
									Total Hazard Index Across All Exposure Routes/Pathways		2.88E-01

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5b
Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	---	6.94E-06	mg/kg-day	1.00E-02	mg/kg-day	6.94E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	---	1.45E-05	mg/kg-day	2.00E-02	mg/kg-day	7.25E-04
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	---	2.86E-05	mg/kg-day	3.00E-03	mg/kg-day	9.53E-03
	Total										1.10E-02
Beef (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	2.50E-06	5.89E-11	mg/kg-day	1.00E-02	mg/kg-day	5.89E-09
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	7.90E-07	2.48E-11	mg/kg-day	2.00E-02	mg/kg-day	1.24E-09
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	6.30E-07	3.50E-11	mg/kg-day	3.00E-03	mg/kg-day	1.17E-08
	Total										1.88E-08
Milk (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	7.90E-07	1.54E-09	mg/kg-day	1.00E-02	mg/kg-day	1.54E-07
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	2.50E-07	6.47E-10	mg/kg-day	2.00E-02	mg/kg-day	3.24E-08
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	2.00E-07	9.17E-10	mg/kg-day	3.00E-03	mg/kg-day	3.06E-07
	Total										4.92E-07
								Total Hazard Index Across All Exposure Routes/Pathways			1.10E-02

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5b
Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	---	5.00E-06	mg/kg-day	1.00E-02	mg/kg-day	5.00E-04
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	---	1.04E-05	mg/kg-day	2.00E-02	mg/kg-day	5.20E-04
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	---	2.06E-05	mg/kg-day	3.00E-03	mg/kg-day	6.87E-03
	Total										7.89E-03
Beef (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	2.50E-06	1.35E-10	mg/kg-day	1.00E-02	mg/kg-day	1.35E-08
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	7.90E-07	5.68E-11	mg/kg-day	2.00E-02	mg/kg-day	2.84E-09
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	6.30E-07	8.02E-11	mg/kg-day	3.00E-03	mg/kg-day	2.67E-08
	Total										4.31E-08
Milk (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	7.90E-07	1.42E-10	mg/kg-day	1.00E-02	mg/kg-day	1.42E-08
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	2.50E-07	5.99E-11	mg/kg-day	2.00E-02	mg/kg-day	3.00E-09
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	2.00E-07	8.48E-11	mg/kg-day	3.00E-03	mg/kg-day	2.82E-08
	Total										4.55E-08
								Total Hazard Index Across All Exposure Routes/Pathways			7.89E-03

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5b
Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables (child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	---	8.05E-06	mg/kg-day	1.00E-02	mg/kg-day	8.05E-04
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	---	3.13E-05	mg/kg-day	2.00E-02	mg/kg-day	1.57E-03
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	---	3.40E-05	mg/kg-day	3.00E-03	mg/kg-day	1.13E-02
	Total										1.37E-02
Beef (child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	2.50E-06	6.83E-11	mg/kg-day	1.00E-02	mg/kg-day	6.83E-09
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	7.90E-07	5.35E-11	mg/kg-day	2.00E-02	mg/kg-day	2.68E-09
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	6.30E-07	4.16E-11	mg/kg-day	3.00E-03	mg/kg-day	1.39E-08
	Total										2.34E-08
Milk (child)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	7.90E-07	1.78E-09	mg/kg-day	1.00E-02	mg/kg-day	1.78E-07
	1,1,2-Trichloroethane	5.00E-01	ug/L	5.00E-04	mg/L	2.50E-07	1.40E-09	mg/kg-day	2.00E-02	mg/kg-day	7.00E-08
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	2.00E-07	1.09E-09	mg/kg-day	3.00E-03	mg/kg-day	3.63E-07
	Total										6.11E-07
										Total Hazard Index Across All Exposure Routes/Pathways	1.37E-02

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-5b
Non Cancer Hazards for Residential Exposure to Groundwater - Food Consumption
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Non-Cancer Intake (CDI)	CDI Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Fruits & Vegetables (adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	---	8.05E-06	mg/kg-day	1.00E-02	mg/kg-day	8.05E-04
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	---	3.13E-05	mg/kg-day	2.00E-02	mg/kg-day	1.57E-03
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	---	3.40E-05	mg/kg-day	3.00E-03	mg/kg-day	1.13E-02
	Total										1.37E-02
Beef (adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	2.50E-06	6.83E-11	mg/kg-day	1.00E-02	mg/kg-day	6.83E-09
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	7.90E-07	5.35E-11	mg/kg-day	2.00E-02	mg/kg-day	2.68E-09
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	6.30E-07	4.16E-11	mg/kg-day	3.00E-03	mg/kg-day	1.39E-08
	Total										2.34E-08
Milk (adult)	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	7.90E-07	1.78E-09	mg/kg-day	1.00E-02	mg/kg-day	1.78E-07
	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	2.50E-07	1.40E-09	mg/kg-day	2.00E-02	mg/kg-day	7.00E-08
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	2.00E-07	1.09E-09	mg/kg-day	3.00E-03	mg/kg-day	3.63E-07
											6.11E-07
										Total Hazard Index Across All Exposure Routes/Pathways	1.37E-02

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6a

Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	---	2.64E-06	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	1.45E-07
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	---	2.25E-06	mg/kg-day	1.30E-01	$(mg/kg-day)^{-1}$	2.93E-07
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	---	3.15E-06	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.92E-08
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	---	1.81E-05	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	1.65E-06
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	---	9.28E-06	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.39E-05
	Total										1.60E-05
Beef (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	3.10E-06	7.87E-11	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	4.33E-12
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	1.60E-05	5.25E-10	mg/kg-day	1.30E-01	$(mg/kg-day)^{-1}$	6.83E-11
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	2.50E-06	7.01E-11	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	4.28E-13
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	7.90E-07	8.13E-11	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	7.40E-12
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	6.30E-07	2.98E-11	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	4.47E-11
	Total										1.25E-10
Milk (child)	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	9.90E-07	2.80E-10	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	1.54E-11
	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	5.00E-06	1.83E-09	mg/kg-day	1.30E-01	$(mg/kg-day)^{-1}$	2.38E-10
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	7.90E-07	2.47E-10	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.51E-12
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	2.50E-07	2.86E-10	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	2.60E-11
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	2.00E-07	1.05E-10	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.58E-10
	Total										4.38E-10
										Total Cancer Risk Across All Exposure Routes/Pathways	1.60E-05

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6a

Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	---	2.64E-06	mg/kg-day	5.50E-02	$(mg/kg\text{-}day)^{-1}$	1.45E-07
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	---	2.25E-06	mg/kg-day	1.30E-01	$(mg/kg\text{-}day)^{-1}$	2.93E-07
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	---	3.15E-06	mg/kg-day	6.10E-03	$(mg/kg\text{-}day)^{-1}$	1.92E-08
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	---	1.81E-05	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	1.65E-06
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	---	9.28E-06	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	1.39E-05
	Total										1.60E-05
Beef	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	3.10E-06	7.87E-11	mg/kg-day	5.50E-02	$(mg/kg\text{-}day)^{-1}$	4.33E-12
(adult)	*Carbon tetrachloride*	*8.61E-01*	*ug/L*	*8.61E-04*	*mg/L*	*1.60E-05*	*5.25E-10*	*mg/kg-day*	*1.30E-01*	$(mg/kg\text{-}day)^{-1}$	*6.83E-11*
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	2.50E-06	7.01E-11	mg/kg-day	6.10E-03	$(mg/kg\text{-}day)^{-1}$	4.28E-13
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	7.90E-07	8.13E-11	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	7.40E-12
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	6.30E-07	2.98E-11	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	4.47E-11
	Total										1.25E-10
Milk	Benzene	6.66E-01	ug/L	6.66E-04	mg/L	9.90E-07	2.80E-10	mg/kg-day	5.50E-02	$(mg/kg\text{-}day)^{-1}$	1.54E-11
(adult)	Carbon tetrachloride	8.61E-01	ug/L	8.61E-04	mg/L	5.00E-06	1.83E-09	mg/kg-day	1.30E-01	$(mg/kg\text{-}day)^{-1}$	2.38E-10
	Chloroform	7.36E-01	ug/L	7.36E-04	mg/L	7.90E-07	2.47E-10	mg/kg-day	6.10E-03	$(mg/kg\text{-}day)^{-1}$	1.51E-12
	1,2-Dichloroethane	2.70E+00	ug/L	2.70E-03	mg/L	2.50E-07	2.86E-10	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	2.60E-11
	Vinyl Chloride	1.24E+00	ug/L	1.24E-03	mg/L	2.00E-07	1.05E-10	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	1.58E-10
	Total										4.38E-10
									Total Cancer Risk Across All Exposure Routes/Pathways		1.60E-05

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6a

Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	---	6.03E-06	mg/kg-day	5.50E-02	$(mg/kg\text{-}day)^{-1}$	3.32E-07
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	---	6.89E-05	mg/kg-day	1.30E-01	$(mg/kg\text{-}day)^{-1}$	8.96E-06
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	---	1.83E-05	mg/kg-day	6.10E-03	$(mg/kg\text{-}day)^{-1}$	1.12E-07
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	---	5.43E-04	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	4.94E-05
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	---	1.22E-05	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	1.83E-05
	Total										7.71E-05
Beef (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	3.10E-06	1.80E-10	mg/kg-day	5.50E-02	$(mg/kg\text{-}day)^{-1}$	9.90E-12
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	1.60E-05	1.60E-08	mg/kg-day	1.30E-01	$(mg/kg\text{-}day)^{-1}$	2.08E-09
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	2.50E-06	4.07E-10	mg/kg-day	6.10E-03	$(mg/kg\text{-}day)^{-1}$	2.48E-12
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	7.90E-07	2.44E-09	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	2.22E-10
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	6.30E-07	3.91E-11	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	5.87E-11
	Total										2.37E-09
Milk (child)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	9.90E-07	6.38E-10	mg/kg-day	5.50E-02	$(mg/kg\text{-}day)^{-1}$	3.51E-11
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	5.00E-06	5.60E-08	mg/kg-day	1.30E-01	$(mg/kg\text{-}day)^{-1}$	7.28E-09
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	7.90E-07	1.43E-09	mg/kg-day	6.10E-03	$(mg/kg\text{-}day)^{-1}$	8.72E-12
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	2.50E-07	8.59E-09	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	7.82E-10
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	2.00E-07	1.38E-10	mg/kg-day	1.50E+00	$(mg/kg\text{-}day)^{-1}$	2.07E-10
	Total										8.31E-09
									Total Cancer Risk Across All Exposure Routes/Pathways		7.71E-05

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6a

Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	---	6.03E-06	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	3.32E-07
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	---	6.89E-05	mg/kg-day	1.30E-01	$(mg/kg-day)^{-1}$	8.96E-06
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	---	1.83E-05	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.12E-07
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	---	5.43E-04	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	4.94E-05
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	---	1.22E-05	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.83E-05
	Total										7.71E-05
Beef (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	3.10E-06	1.80E-10	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	9.90E-12
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	1.60E-05	1.60E-08	mg/kg-day	1.30E-01	$(mg/kg-day)^{-1}$	2.08E-09
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	2.50E-06	4.07E-10	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	2.48E-12
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	7.90E-07	2.44E-09	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	2.22E-10
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	6.30E-07	3.91E-11	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	5.87E-11
	Total										2.37E-09
Milk (adult)	Benzene	1.52E+00	ug/L	1.52E-03	mg/L	9.90E-07	6.38E-10	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	3.51E-11
	Carbon tetrachloride	2.64E+01	ug/L	2.64E-02	mg/L	5.00E-06	5.60E-08	mg/kg-day	1.30E-01	$(mg/kg-day)^{-1}$	7.28E-09
	Chloroform	4.27E+00	ug/L	4.27E-03	mg/L	7.90E-07	1.43E-09	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	8.72E-12
	1,2-Dichloroethane	8.10E+01	ug/L	8.10E-02	mg/L	2.50E-07	8.59E-09	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	7.82E-10
	Vinyl Chloride	1.63E+00	ug/L	1.63E-03	mg/L	2.00E-07	1.38E-10	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	2.07E-10
	Total										8.31E-09
										Total Cancer Risk Across All Exposure Routes/Pathways	7.71E-05

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6b
Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	---	2.31E-06	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.41E-08
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	---	4.81E-06	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	4.38E-07
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	---	9.50E-06	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.43E-05
	Total										1.47E-05
Beef (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	2.50E-06	5.13E-11	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	3.13E-13
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	7.90E-07	2.11E-11	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	1.92E-12
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	6.30E-07	3.05E-11	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	4.58E-11
	Total										4.80E-11
Milk (child)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	7.90E-07	1.81E-10	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.10E-12
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	2.50E-07	7.60E-11	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	6.92E-12
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	2.00E-07	1.08E-10	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.62E-10
	Total										1.70E-10
										Total Cancer Risk Across All Exposure Routes/Pathways	1.47E-05

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6b
Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	---	2.31E-06	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.41E-08
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	---	4.81E-06	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	4.38E-07
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	---	9.50E-06	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.43E-05
	Total										1.47E-05
Beef (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	2.50E-06	5.13E-11	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	3.13E-13
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	7.90E-07	2.11E-11	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	1.92E-12
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	6.30E-07	3.05E-11	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	4.58E-11
	Total										4.80E-11
Milk (adult)	Chloroform	5.39E-01	ug/L	5.39E-04	mg/L	7.90E-07	1.81E-10	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.10E-12
	1,2-Dichloroethane	7.17E-01	ug/L	7.17E-04	mg/L	2.50E-07	7.60E-11	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	6.92E-12
	Vinyl Chloride	1.27E+00	ug/L	1.27E-03	mg/L	2.00E-07	1.08E-10	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.62E-10
	Total										1.70E-10
										Total Cancer Risk Across All Exposure Routes/Pathways	1.47E-05

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6b
Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Reasonable maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	---	2.68E-06	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.63E-08
(child)	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	---	1.04E-05	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	9.46E-07
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	---	1.13E-05	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.70E-05
	Total										1.79E-05
Beef	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	2.50E-06	5.95E-11	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	3.63E-13
(child)	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	7.90E-07	4.67E-11	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	4.25E-12
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	6.30E-07	3.62E-11	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	5.43E-11
	Total										5.89E-11
Milk	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	7.90E-07	2.09E-10	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.27E-12
(child)	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	2.50E-07	1.64E-10	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	1.49E-11
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	2.00E-07	1.09E-10	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.64E-10
	Total										1.80E-10
									Total Cancer Risk Across All Exposure Routes/Pathways		1.79E-05

Scenario Timeframe: Current, Future
Medium: Groundwater
Exposure Medium: Fruits, Beef, Milk
Exposure Point: Ingestion
Receptor Population: Resident
Receptor Age: Children and Adults

Table A3-6b
Cancer Risks for Residential Exposure to Groundwater - Food Consumption
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	Transfer Factor	Cancer Intake (CDI)	CDI Units	Cancer Slope Factor (SF)	Cancer Slope Factor Units	Exposure Risk
Fruits & Vegetables	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	---	2.68E-06	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.63E-08
(adult)	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	---	1.04E-05	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	9.46E-07
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	---	1.13E-05	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.70E-05
	Total										1.79E-05
Beef	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	2.50E-06	5.95E-11	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	3.63E-13
(adult)	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	7.90E-07	4.67E-11	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	4.25E-12
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	6.30E-07	3.62E-11	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	5.43E-11
	Total										5.89E-11
Milk	Chloroform	6.25E-01	ug/L	6.25E-04	mg/L	7.90E-07	2.09E-10	mg/kg-day	6.10E-03	$(mg/kg-day)^{-1}$	1.27E-12
(adult)	1,2-Dichloroethane	1.55E+00	ug/L	1.55E-03	mg/L	2.50E-07	1.64E-10	mg/kg-day	9.10E-02	$(mg/kg-day)^{-1}$	1.49E-11
	Vinyl Chloride	1.51E+00	ug/L	1.51E-03	mg/L	2.00E-07	1.09E-10	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.64E-10
	Total										1.80E-10
									Total Cancer Risk Across All Exposure Routes/Pathways		1.79E-05

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigation
Receptor Population: Agricultural Worker
Receptor Age: Adults

Table A3-7a
Non Cancer Hazards for Agricultural Worker Exposure to Groundwater
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for hazard Calculation (1)	Non-Cancer Intake CDI	Intake Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Inhalation	Benzene	6.66E-01	ug/L	1.98E-01	mg/m^3	R	1.88E-05	mg/kg-day	8.57E-03	mg/kg-day	2.19E-03
(adult)	Carbon tetrachloride	8.61E-01	ug/L	2.56E-01	mg/m^3	R	2.43E-05	mg/kg-day	---	mg/kg-day	0.00E+00
	Chloroform	7.36E-01	ug/L	2.19E-01	mg/m^3	R	2.07E-05	mg/kg-day	---	mg/kg-day	0.00E+00
	1,2-Dichloroethane	2.70E+00	ug/L	8.02E-01	mg/m^3	R	7.61E-05	mg/kg-day	---	mg/kg-day	0.00E+00
	Vinyl Chloride	1.24E+00	ug/L	3.68E-01	mg/m^3	R	3.49E-05	mg/kg-day	2.86E-02	mg/kg-day	1.22E-03
	Total										3.41E-03
										Total Hazard Index Across All Exposure Routes/Pathways	3.41E-03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigation
Receptor Population: Agricultural Worker
Receptor Age: Adults

Table A3-7a
Non Cancer Hazards for Agricultural Worker Exposure to Groundwater
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for hazard Calculation (1)	Non-Cancer Intake CDI	Intake Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Inhalation	Benzene	1.52E+00	ug/L	4.52E-01	mg/m^3	R	2.25E-04	mg/kg-day	8.57E-03	mg/kg-day	2.63E-02
(adult)	Carbon tetrachloride	2.64E+01	ug/L	8.84E+00	mg/m^3	R	3.91E-03	mg/kg-day	---	mg/kg-day	0.00E+00
	Chloroform	4.27E+00	ug/L	1.27E+00	mg/m^3	R	6.32E-04	mg/kg-day	---	mg/kg-day	0.00E+00
	1,2-Dichloroethane	0.00E+00	ug/L	2.41E+01	mg/m^3	R	1.20E-02	mg/kg-day	---	mg/kg-day	0.00E+00
	Vinyl Chloride	1.63E+00	ug/L	4.83E-01	mg/m^3	R	2.41E-02	mg/kg-day	2.86E-02	mg/kg-day	8.43E-01
	Total										8.69E-01
										Total Hazard Index Across All Exposure Routes/Pathways	8.69E-01

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigation
Receptor Population: Agricultural Worker
Receptor Age: Adults

Table A3-7b

Non Cancer Hazards for Agricultural Worker Exposure to Groundwater
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for Hazard Calculation (1)	Non-Cancer Intake CDI	Intake Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Inhalation	Chloroform	5.39E-01	ug/L	1.60E-01	mg/m^3	R	3.40E-05	mg/kg-day	---	mg/kg-day	0.00E+00
(adult)	1,2-Dichloroethane	7.17E-01	ug/L	2.13E-01	mg/m^3	R	4.04E-05	mg/kg-day	---	mg/kg-day	0.00E+00
	Vinyl Chloride	1.27E+00	ug/L	3.77E-01	mg/m^3	R	7.16E-05	mg/kg-day	2.86E-02	mg/kg-day	2.50E-03
	Total										2.50E-03
										Total Hazard Index Across All Exposure Routes/Pathways	2.50E-03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigation
Receptor Population: Agricultural Worker
Receptor Age: Adults

Table A3-7b

Non Cancer Hazards for Agricultural Worker Exposure to Groundwater
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for hazard Calculation (1)	Non-Cancer Intake CDI	Intake Units	Reference Dose (RFD)	Reference Dose Units	Hazard Index (HI)
Inhalation	Chloroform	6.25E-01	ug/L	1.86E-01	mg/m^3	R	9.25E-05	mg/kg-day	---	mg/kg-day	0.00E+00
(adult)	1,2-Dichloroethane	1.55E+00	ug/L	4.61E-01	mg/m^3	R	2.29E-04	mg/kg-day	---	mg/kg-day	0.00E+00
	Vinyl Chloride	1.51E+00	ug/L	4.48E-01	mg/m^3	R	2.23E-04	mg/kg-day	2.86E-02	mg/kg-day	7.80E-03
	Total										7.80E-03
										Total Hazard Index Across All Exposure Routes/Pathways	7.80E-03

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigatic r
Receptor Population: Agricultural Work r
Receptor Age: Adults

Table A3-8a
Cancer Risks for Agricultural Worker Exposure to Groundwater
Central Tendency
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for hazard Calculation (1)	Cancer Intake	Intake Units	Cancer Slope factor (SF)	Cancer Slope Factor Units	Cancer Risk
Inhalation	Benzene	6.66E-01	ug/L	1.98E-01	mg/m^3	R	2.41E-06	mg/kg-day	2.73E-02	$(mg/kg\text{-}day)^{-1}$	6.58E-08
(adult)	Carbon tetrachloride	8.61E-01	ug/L	2.56E-01	mg/m^3	R	3.12E-06	mg/kg-day	5.25E-02	$(mg/kg\text{-}day)^{-1}$	1.64E-07
	Chloroform	7.36E-01	ug/L	2.19E-01	mg/m^3	R	2.67E-06	mg/kg-day	8.05E-02	$(mg/kg\text{-}day)^{-1}$	2.15E-07
	1,2-Dichloroethane	2.70E+00	ug/L	8.02E-01	mg/m^3	R	9.78E-06	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	8.90E-07
	Vinyl Chloride	1.24E+00	ug/L	3.68E-01	mg/m^3	R	4.49E-06	mg/kg-day	3.08E-02	$(mg/kg\text{-}day)^{-1}$	1.38E-07
	Total										1.47E-06
										Total Cancer Risk Across All Exposure Routes/Pathways	1.47E-06

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigati on
Receptor Population: Agri cultural Work er
Receptor Age: Adults

Table A3-8a
Cancer Risks for Agricultural Worker Exposure to Groundwater
Reasonable Maximum Exposure
North Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for hazard Calculation (1)	Cancer Intake	Intake Units	Cancer Slope factor (SF)	Cancer Slope Factor Units	Cancer Risk
Inhalation	Benzene	1.52E+00	ug/L	4.52E-01	mg/m^3	R	8.03E-05	mg/kg-day	2.73E-02	$(mg/kg\text{-}day)^{-1}$	2.19E-06
(adult)	Carbon tetrachloride	2.64E+01	ug/L	8.84E+00	mg/m^3	R	1.39E-03	mg/kg-day	5.25E-02	$(mg/kg\text{-}day)^{-1}$	7.30E-05
	Chloroform	4.27E+00	ug/L	1.27E+00	mg/m^3	R	2.26E-04	mg/kg-day	8.05E-02	$(mg/kg\text{-}day)^{-1}$	1.82E-05
	1,2-Dichloroethane	0.00E+00	ug/L	2.41E+01	mg/m^3	R	4.28E-03	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	3.89E-04
	Vinyl Chloride	1.63E+00	ug/L	4.83E-01	mg/m^3	R	8.61E-05	mg/kg-day	3.08E-02	$(mg/kg\text{-}day)^{-1}$	2.65E-06
	Total										4.85E-04
										Total Cancer Risk Across All Exposure Routes/Pathways	4.85E-04

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigation
Receptor Population: Agricultural Worker
Receptor Age: Adults

Table A3-8b
Cancer Risks for Agricultural Worker Exposure to Groundwater
Central Tendency
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for hazard Calculation (1)	Cancer Intake	Intake Units	Cancer Slope factor (SF)	Cancer Slope Factor Units	Cancer Risk
nhalation	Chloroform	5.39E-01	ug/L	1.60E-01	mg/m^3	R	3.91E-06	mg/kg-day	8.05E-02	$(mg/kg\text{-}day)^{-1}$	3.15E-07
adult)	1,2-Dichloroethane	7.17E-01	ug/L	2.13E-01	mg/m^3	R	5.20E-06	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	4.73E-07
	Vinyl Chloride	1.27E+00	ug/L	3.77E-01	mg/m^3	R	9.20E-06	mg/kg-day	3.08E-02	$(mg/kg\text{-}day)^{-1}$	2.83E-07
	Total										1.07E-06
										Total Cancer Risk Across All Exposure Routes/Pathways	1.07E-06

Scenario Timeframe: Current Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Inhalation from Irrigation
Receptor Population: Agricultural Worker
Receptor Age: Adults

Table A3-8b
Cancer Risks for Agricultural Worker Exposure to Groundwater
Reasonable Maximum Exposure
East Downgradient Area
Four County Landfill, Fulton County, Indiana

Exposure Route	Chemical	Medium EPC Value (Mean)	Medium EPC Units	Route EPC Value (CM)	Route EPC Units	EPC Selected for hazard Calculation (1)	Cancer Intake	Intake Units	Cancer Slope factor (SF)	Cancer Slope Factor Units	Cancer Risk
Inhalation	Chloroform	6.25E-01	ug/L	1.86E-01	mg/m^3	R	3.30E-05	mg/kg-day	8.05E-02	$(mg/kg\text{-}day)^{-1}$	2.66E-06
(adult)	1,2-Dichloroethane	1.55E+00	ug/L	4.61E-01	mg/m^3	R	8.19E-05	mg/kg-day	9.10E-02	$(mg/kg\text{-}day)^{-1}$	7.45E-06
	Vinyl Chloride	1.51E+00	ug/L	4.48E-01	mg/m^3	R	7.98E-05	mg/kg-day	3.08E-02	$(mg/kg\text{-}day)^{-1}$	2.46E-06
	Total										1.26E-05
										Total Cancer Risk Across All Exposure Routes/Pathways	1.26E-05

Table A3-9a
Values Used for Daily Intake Calculations - Residential Exposure
BHHRA Calculations
Four County Landfill
Fulton County, Indiana

Exposure Route	Parameter Code	Parameter Definition	UNITS	Central Tendency Value	CT Reference	RME Value	RME Reference	Intake Equation
Ingestion	CW	Chem. Conc. In GW	mg/L	Chemical Specific	Data Tables	Chemical Specific	Data Tables	
	IR-child	Ingestion Rate	L/day	0.87	EPA, 1997	1.5	EPA, 1997	CDI (mg/kg-day) =
	IR-Adult	Ingestion Rate	L/day	1.4	EPA, 1997	2.4	EPA, 1997	(CW*IR*EF)/(BW*AT)
	EF	Exposure Frequency	days/yr	350	EPA, 1991	350	EPA, 1991	
	ED-Child	Exposure Duration	years	6	EPA, 1991	6	EPA, 1991	
	ED-Adult	Exposure Duration	years	24	EPA, 1991	24	EPA, 1991	
	BW-Child	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	BW-Adult	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (cancer)	days	25,550	EPA, 1989	25,590	EPA, 1989	
	AT-N-child	Averaging time (non cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	
	AT-N-adult	Averaging time (non cancer)	days	8,760	EPA, 1989	8,769	EPA, 1989	
Dermal	CW	Chem. Conc. In GW	mg/L	Chemical Specific	Data Tables	Chemical Specific	Data Tables	
	SA-Child	Skin Area for Contact	cm2	6,600	EPA, 1997	7,500	EPA, 1997	CDI (mg/kg-day) =
	SA-Adult	Skin Area for Contact	cm2	18,000	EPA, 1997	22,000	EPA, 1997	(CW*SA*CF*PC*ET)/(BW*AT)
	CF	Conversion Factor	L/cm3	0.001	EPA, 1991	0	EPA, 1991	
	ET-Child	Exposure Time	hours/day	0.33	EPA, 1991	1	EPA, 1991	
	ET-Adult	Exposure Time	hours/day	0.25	EPA, 1991	1	EPA, 1991	
	EF	Exposure Frequency	days/yr	350	EPA, 1991	350	EPA, 1991	
	ED-Child	Exposure Duration	years	6	EPA, 1991	6	EPA, 1991	
	ED-Adult	Exposure Duration	years	24	EPA, 1991	24	EPA, 1991	
	BW-Child	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	BW-Adult	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (cancer)	days	25,550	EPA, 1989	25,590	EPA, 1989	
	AT-N-child	Averaging time (non cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	
	AT-N-adult	Averaging time (non cancer)	days	8,760	EPA, 1989	8,769	EPA, 1989	
	PC	Permeability Constant	cm/hr	Chemical Specific	EPA, 1992	Chemical Specific	EPA, 1992	
Inhalation	CW	Chem. Conc. In GW	mg/L	Chemical Specific	Data Tables	Chemical Specific	Data Tables	
	INR-Child	Inhalation Rate	m3/day	8.7	EPA, 1997	8.7	EPA, 1997	CDI (mg/kg-day) =
	INR-Adult	Inhalation Rate	m3/day	15	EPA, 1997	15	EPA, 1997	(CW*INR*K*EF*ED)/(BW*AT)
	K	Volatilization Factor	L/m3	0.5	EPA, 1991	1	EPA, 1991	
	EF	Exposure Frequency	days/yr	350	EPA, 1991	350	EPA, 1991	
	ED-Child	Exposure Duration	years	6	EPA, 1991	6	EPA, 1991	
	ED-Adult	Exposure Duration	years	24	EPA, 1991	24	EPA, 1991	
	ED-NC	Exposure Duration	years	6	EPA, 1991	6	EPA, 1991	
	BW-Child	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	BW-Adult	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (cancer)	days	25,550	EPA, 1989	25,590	EPA, 1989	
	AT-N-child	Averaging time (non cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	
	AT-N-adult	Averaging time (non cancer)	days	8,760	EPA, 1989	8,769	EPA, 1989	

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1; Human Health Evaluation Manual, Part A OERR, EPA/540-1-89-002

EPA, 1991: Risk Assessment Guidance for Superfund. Vol. 1; Human Health Evaluation Manual - Supplemental Guidance Exposure Factors, Interim Final. OSWER Directive 9285.6-03

EPA, 1991A. Risk Assessment Guidance for Superfund. Part B, Development of Risk-Based Preliminary Remediation Goals, Publ. # 9285.7-01B, December, 1991

EPA, 1992: Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B, January, 1992

EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002F, August, 1997

Table A3-10
Summary of Receptor Risks and Hazards for Existing and Potential New COPCs in Groundwater
Four County Landfill OU2
Fulton County, Indiana

Exposure Route	Sector	Receptor	Central Tendency		Reasonable Maximum Exposure	
			Original	Updated	Original	Updated
Non Carcinogenic Hazard Indices						
Residential Exposure to Groundwater Via Consumption and Showering/ Bathing	North Downgradient	Child	**3.6E+01**	**3.3E+03**	**8.6E+01**	**6.0E+03**
		Adult	1.3E+01	**1.2E+03**	**3.2E+01**	**2.2E+03**
	East Downgradient	Child	2.0E-01	5.3E-02	2.2E-01	9.2E-02
		Adult	7.3E-02	1.91E-02	8.2E-02	3.3E-02
Residential Exposure to Groundwater by Consumption of Homegrown Fruits, Vegetables, Meat, and Milk	North Downgradient	Child	2.6E-02	2.5E-02	2.0E-01	4.0E-01
		Adult	8.9E-03	1.8E-02	6.9E-02	2.9E-01
	East Downgradient	Child	3.3E-04	1.1E-02	2.8E-03	1.4E-02
		Adult	1.1E-04	7.9E-03	9.5E-04	1.4E-02
Agricultural Worker Exposure to Volatile Emissions from Groundwater during Operation of Irrigation System	North Downgradient	Adult	2.8E-01	3.4E-03	**3.0E+00**	8.7E-01
	East Downgradient	Adult	6.1E-04	2.5E-03	1.8E-02	7.8E-03
Cancer Risks						
Residential Exposure to Groundwater Via Consumption and Showering/ Bathing	North Downgradient	Child	**4.4E-04**	**1.4E-01**	**2.9E-03**	**3.0E-01**
		Adult	**4.4E-04**	**2.1E-01**	**2.9E-03**	**4.3E-01**
	East Downgradient	Child	None *	**1.7E-03**	None*	**2.5E-03**
		Adult	None *	**2.4E-03**	None *	**3.6E-03**
Residential Exposure to Groundwater by Consumption of Homegrown Fruits, Vegetables, Meat, and Milk	North Downgradient	Child	1.2E-06	1.60E-05	1.9E-05	7.71E-05
		Adult	1.2E-06	1.60E-05	1.9E-05	7.71E-05
	East Downgradient	Child	None *	1.47E-05	None *	1.79E-05
		Adult	None *	1.47E-05	None *	1.79E-05
Agricultural Worker Exposure to Volatile Emissions from Groundwater during Operation of Irrigation System	North Downgradient	Adult	4.4E-06	1.5E-06	**1.3E-04**	**4.9E-04**
	East Downgradient	Adult	None *	1.1E-06	None *	1.3E-05

*No carcinogens were identified as COPCs for this Sector in the BHHRA
Values exceeding a total hazard index of 1 across all exposure pathways for non carcinogens or the US EPA target risk range of 1.0E-06 to 1.0E-4 for carcinogens are shown in bold type.

Table B2-1
Ecological Screening Values (ESVs) for Direct Exposures to Water
Groundwater to Surface Water Routes of Exposure
Four County Landfill
Fulton County, Indiana

CHEMICAL	CAS #	Groundwater Screening Conc.		ARARs						
		Mean Value – All Wells (ug/L) [1]	Maximum Value (ug/L) [1]	Indiana WQC for Aquatic Life (AAC) (ug/L)	Indiana WQC for Aquatic Life (CAC) (ug/L)	US EPA Region 5 Ecological Screening Levels (ug/L)	US EPA Region 4 Freshwater Surface Water Screening Values (ug/L)	US EPA Region 4 Freshwater Surface Water Screening Values (ug/L)	US EPA Fresh Water Water Quality Criteria - (ug/L)	US EPA Fresh Water Water Quality Criteria - (ug/L)
Averaging Period				Acute	Chronic		Acute	Chronic	Acute	Chronic
Inorganics (ug/L)										
Aluminum	742905	194	1,700						750	*87*
Antimony	7440360	16.3	42			80	1,300	160		
Arsenic	7440382	9.0***	16***	360	190	148	360	190	340	150
Barium	7440393	106***	180***			220				
Cadmium	7440439			10-21*	2.0-3.4*	0.15	1.79	0.66	2	0.25
Calcium	7440702	102,000	150,000							
Chromium	7440473	6.4	26	16**	11**	42	16	11	16**	11**
Iron	7439896	38	250					1,000	1,000	
Magnesium	7439954	34,000	50,000							
Manganese	7439965	171	940							
Nickel	7440020	5.8	17	3,600-5,500*	400-610*	28.9	789	87.7	470	52
Potassium	7440097	2,240	5,400							
Sodium	7440235	12,000	85,000							
Vanadium	7440622					12				
Chloride	16887006	187,000	470,000	860,000	230,000		860,000	230,000	860,000	230,000
Nitrate	14797558	104	1,100							
Sulfate	14808798	50,800	780,000							
Volatile Organic Compounds (VOCs) (ug/L)										
Acetone	67641					1,700				
Benzene	71432	1.2	23			114	530	53		
Bromodichloromethane	75274									
Bromomethane	74839									
2-Butanone	78933									
Carbon Disulfide	75150					15				
Carbon tetrachloride	56235	2.8	600			240	3,520	352		
Chloroethane	75003									

Table B2-1

Ecological Screening Values (ESVs) for Direct Exposures to Water
Groundwater to Surface Water Routes of Exposure
Four County Landfill
Fulton County, Indiana

CHEMICAL	CAS #	Groundwater Screening Conc.		ARARs						
		Mean Value – All Wells (ug/L) [1]	Maximum Value (ug/L) [1]	Indiana WQC for Aquatic Life (AAC) (ug/L)	Indiana WQC for Aquatic Life (CAC) (ug/L)	US EPA Region 5 Ecological Screening Levels (ug/L)	US EPA Region 4 Freshwater Surface Water Screening Values (ug/L)	US EPA Region 4 Freshwater Surface Water Screening Values (ug/L)	US EPA Fresh Water Water Quality Criteria - (ug/L)	US EPA Fresh Water Water Quality Criteria - (ug/L)
Chloroform	67663	3.5	80				2,890	289		
1,2-Dichloroethane	107062	99.1	2,100			910	11,800	2,000		
Cis-1,2-dichloroethene	156592	0.51	1.2							
Dichloromethane	75092									
Ethylbenzene	100414					14	4,530	453	30	
4-methyl-2-pentanone	108101					170				
Toluene	108883					253	1,750	175	40	
1,1,2-Trichloroethane	79005	1.8	2.1			500	3,600	940		
Vinyl chloride	75014	0.50	25			930				
m, p-Xylenes	1330207									
o-Xylenes	1330207					27			20	

[1] Dilution Factor of 10x used for comparison to screening criteria to represent dilution in transport.

* Dependent Upon Hardness. Values estimated based upon site alkalinity range of 270 to 400 mg/L and hardness estimated at 1.5X to 2X alkalinity. Range also includes values that would result from using the formula "Hardness = 2.497(Ca)+4.116(Mg)" and RI/FS site concentrations of 93.1 to 102 mg/L for Ca and 34 to 42.6 mg/L for Mg.

** Assumes all chromium is Chromium IV.

Groundwater screening concentrations for inorganics are the higher of either the RI/FS study data or the LTGWM program mean and maximum concentrations.

*** Starred values are from LTGWM program; all other inorganic values are from the RI/FS study.

Groundwater screening concentrations for organic compounds are the mean and maximum concentrations from the MNA monitoring period.

Screening Values exceeded by Mean conc./10 are noted in bold

Screening Values exceeded by Max. conc./10 are noted in italics

Sources: US EPA, Region 4, Water Management Division, Screening List - http://www.epa.gov/region4/waste/ots/ecolbul.htm

US EPA, Region 5, Ecological Screening Levels, August 23 2003.

US EPA Current National Recommended Water Quality Criteria – http://www.epa.gov/waterscience/criteria/wqcriteria.html

NOAA Screening Quick Reference Tables (SQuiRTS), updated September, 1999

Appendix 2

Tables from Feasibility Study Report

TABLES

(Note: These tables are numbered as they were originally presented in the FS Report.)

TABLE 4.1

SUMMARY OF PRELIMINARY REMEDIATION GOALS FOR VOLATILE ORGANIC COMPOUNDS OFF-SITE GROUNDWATER FOUR COUNTY LANDFILL SITE FULTON COUNTY, INDIANA

Analyte[1]	*Preliminary Remediation Goal for Groundwater (micrograms per Liter)*[2]
Benzene	5.0
Carbon tetrachloride	5.0
1,2-Dichloroethane	5.0
Vinyl chloride	2.0

1. Represents volatile organic compounds detected above primary Maximum Contaminant Levels (MCLs) in off-Site groundwater samples.
2. Represents primary MCLs promulgated as of September 2000.

TABLE 4.2

POTENTIAL CHEMICAL-SPECIFIC ARARS
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Potential Chemical Specific Requirements	*Citation*
Water Quality Standards (Indiana)	327 IAC 2
Groundwater Protection Standard	40 CFR 264.92
National Primary and Secondary Drinking Water Regulations	40 CFR 141
National Secondary Drinking Water Regulations	40 CFR 143
Public Water Supply; Drinking Water Standards	327 IAC 8-2

TABLE 4.3

POTENTIAL FEDERAL AND STATE LOCATION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Location	*Requirement*	*Citation*	*Applicable, Appropriate or Relevant*
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to prevent washout.	40 CFR 264.18(b); 329 IAC 3.1[2]	NA
Within floodplain	Action must avoid adverse effects, minimize potential harm, and if necessary, restore and preserve natural and beneficial values of the floodplain.	Executive Order 11988, Floodplain Management, (40 CFR 6, Appendix A)	NA
Within floodplain in Indiana	Action must avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values of the floodplain. Construction of abodes or residences is prohibited and prior approval of the IDNR is required for other types of construction, excavation, or filling in or on a floodway. This includes but is not limited to construction of a fence, water treatment facility, dredging, and/or dewatering in a floodway.	Indiana Flood Control Act (13-2-22)	NA
Wetland	Action must minimize the destruction, loss, or degradation of wetlands and to preserve the value of wetlands.	Executive Order 11990, Protection of Wetlands, (40 CFR 6, Appendix A)	Yes
	Discharge of dredged or fill material into wetlands without permit is prohibited. Water quality certification may also be required from IDEM.	Clean Water Act, Sections 401 and 404; 40 CFR Parts 230, 231	

TABLE 4.3

POTENTIAL FEDERAL AND STATE LOCATION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Location	*Requirement*	*Citation*	*Applicable, Appropriate or Relevant*
Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of Interior	Endangered Species Act of 1973 (16 USC 1531 et. Seq.); 50 CFR Part 200; 50 CFR Part 402 Fish and Wildlife Coordination Act (16 USC 661 et. seq.); 33 CFR Parts 320-330.	NA[3]
Near a coastal zone	Protect land and waters of coastal zones.	Coastal Zone Management Act, 16 USC 1451	NA
Near a designated coastal barrier	Minimize the damage to fish, wildlife and other natural resources associated with the coastal barriers.	Coastal Barrier Resources Act, 16 USC 3501	NA
Near a Federally-owned area designated as a wilderness area	Protect and preserve Federally designated areas as "wilderness areas".	Wilderness Act, 16 USC 1131	NA
Near a National Wildlife Refuge System	Conservation of fish and wildlife including species that are threatened.	Wildlife Refuge, 16 USC 668 dd; 50 CFR 27	NA

Notes:

[1]Modified from Exhibit 1-2 of USEPA's Draft Guidance CERCLA Compliance With Other Laws (August 1988).

[2]As of February 1992, Indiana adopted new hazardous waste rules titled 329 IAC 3.1, which adopt by reference the Code of Federal Regulations (40 CFR 260 through 270). The State rules generally only cover the administrative procedures while the federal rules cover the standards for RCRA generators and treatment, storage, and disposal facilities.

[3]The National Heritage Program identified a species of mudpuppy listed as a State rare species in a wetland in the vicinity of the landfill.

TABLE 4.4

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	*Requirement*	*Citation*
Air stripping	Design system to provide odor-free operation.	CAA Section 101[2]
	Total organic emissions from air strippers be reduced below 1.4 kg/hour or 2.8 Mg/year (3 pounds/hr. or 3.1 tons/year); or that organic emissions be reduced 95 percent by weight	40 CFR 264 AA
	Register with Commissioner of the State of Indiana to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2-1-2
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm: Emissions standards for Hazardous Air Pollutants (HAPs)	40 CFR 61; 326 IAC 14
	Reduce VOC emissions using best available control technology (BACT) for facilities potentially producing emissions of 25 tons or more per year	326 IAC 8-1-6
	Verify facility specific MACT determination for sources of Hazardous Air Pollutants greater than 10 tons per year.	326 IAC 2-1-3-4
	Prevent significant deterioration using best available control technology, air quality analysis, and an analysis on visibility, soils, and generation for emissions greater than 25 tons per year (TPY) of particulate matter, 20 TPY for particulate <10 microns, 40 TPY VOCs, and 0.6 TPY lead.	40 CFR 131
	Follow RCRA generator standards for manifesting, handling, record keeping, and accumulation times for waste water, if determined to be hazardous.	40 CFR 262.10-262.44; 329 IAC 3.1-7[3]
Construction Activity	Stormwater runoff associated with construction activity.	327 IAC 15-5
	Fugitive dust emissions during construction activity	326 IAC 64
Direct discharge of treatment system effluent	Applicable federal water quality criteria for the protection of aquatic life must be complied with when environmental factors are being considered.	50 CFR 30784

TABLE 4.4

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	*Requirement*	*Citation*
Direct discharge of treatment system effluent (continued)	Applicable federally approved state water quality standards must be complied with. These standards may be in addition to or more stringent than other federal standards under the CWA.	CWA Sections 301, 302, 303, 307, 318 and 405; 40 CFR 122.44 and state regulations approved under 40 CFR 131; 327 IAC 5-2-10; 327 IAC 2
	The discharge must be consistent with the requirement of a Water Quality Management Plan approved by EPA under Section 208(b) of the Clean Water Act.	CWA Section 208(b); 327 IAC 5-2-10[4]
	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology-based effluent limitations may be determined on a case-by-case basis. In some cases, the permit limit for a conventional pollutant may be more stringent than BCT.	40 CFR 122.44(a) 327 IAC 5-5-2
	Discharge limitations must be established for all toxic pollutants that are or may be discharged at levels greater than those that can be achieved by technology-based standards.	40 CFR 122.44(e)
	Discharge of pollutants must conform to basic NPDES requirements	327 IAC 5-2-2
	Discharge must be monitored to assure compliance. Discharger will monitor: The mass of each pollutant limited in the permit discharged; The volume of effluent discharged from each outfall; and Frequency of discharge and other measurements as appropriate.	40 CFR 122.44(i); 327 IAC 5-2-13
	The following records must be maintained: Date, place, and time of sampling or measurements; Person(s) who performed sampling or measurement; Date(s) analyses were performed;	

TABLE 4.4

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	*Requirement*	*Citation*
Direct discharge of treatment system effluent (continued)	Person(s) who performed analyses; Analytical techniques or methods used; and Results for measurements and analyses.	327 IAC 5-2-14; 40 CFR 122.41(j)
	The discharge monitoring reports (DMRs) must be submitted to IDEM as required by the permit (at least annually).	327 IAC 5-2-15
	Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided. Permit application information must be submitted, including a description of activities, listing of environmental permits, etc.	40 CFR 122.44(i); 40 CFR 136; 327 IAC 5-2-13(c) 40 CFR 122.21(f)
	Comply with additional permit conditions such as:	40 CFR 122.41; 327 IAC 5-2-8
	Duty to mitigate any adverse effects of any discharge; Report to IDEM violations of maximum daily discharge for certain pollutants within 24 hours; and Proper operation and maintenance of treatment systems.	
	Develop and implement a Best Management Practices (BMP) program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters.	40 CFR 125.100; 327 IAC 5-9
	The BMP program must:	40 CFR 125.104
	Establish specific objectives for the control of toxic and hazardous pollutant spills; Include a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure; and Prescribe sample preservation procedures, container materials, and maximum allowable holding times.	40 CFR 136.1-136.4; 327 IAC 5-2-13(c)

TABLE 4.4

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	*Requirement*	*Citation*
Discharge to POTW	Pollutants that pass through the POTW without treatment, interfere with POTW operation, or contaminate POTW sludge are prohibited.	40 CFR 403.5; 327 IAC 5-11-1
Discharge to POTW	Specific prohibitions preclude the discharge of pollutants to POTWs that: Create a fire or explosion hazard in the POTW; Are corrosive (pH<5.0); Result in the presence of toxic gases, vapors or fumes in a quantity that may cause health and safety problems; Obstruct flow resulting in interference; Are discharged at a flow rate and/or concentration that will result in interference; and/or Increase the temperature of wastewater entering the treatment plant that would result in interference, or raise the POTW influent temperature above 104°F (40°C).	40 CFR 403.5(b); 327 IAC 5-12-2(b)
	Determine acceptable degree of pretreatment for certain industrial wastewater prior to discharge into a POTW	326 IAC 2-1-3-4
	Discharge must comply with local POTW pretreatment program, including POTW-specific pollutants, spill prevention program requirements, and reporting and monitoring requirements.	40 CFR 403.5, 40 CFR 403.8 and local POTW regulations
	RCRA permit-by-rule requirements may be applicable to discharges of RCRA hazardous wastes to POTWs by truck, rail, or dedicated pipe.	40 CFR 264.71; 40 CFR 264.72; 40 CFR 262; 40 CFR 270.60(C); 40 CFR 264.1; 40 CFR 261.3(A)(2)(IV); CWA Section 402 or 307(b); 329 IAC 3.1-7[3]
Operation and maintenance (O&M)	Post-closure care to ensure that site is maintained and monitored.	40 CFR 264.118 (RCRA Subpart G); 329 IAC 3.1[3]
	Develop Contingency Plan and Emergency Procedures to minimize potential hazards from fires, explosions or any unplanned release during closure and post-closure status.	40 CFR 264 (Subpart D)

TABLE 4.4

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	*Requirement*	*Citation*
Security	Sites should be secured in accordance with this rule which: 1) Requires prevention of unknowing and unauthorized entry of persons or livestock if physical contact with the waste, etc. could cause injury or, if disturbance of the waste, etc. would cause a violation. 2) The facility must have either: A 24 hour surveillance system which continuously monitors and controls entry or an artificial or natural barrier which completely surrounds the active portion and a means to control entry (i.e., a lock) at all times, through the gates or other entrances to the active portion. 3) "Danger - Unauthorized Personnel Keep Out" signs are required at each entrance and other locations sufficient to be seen from any approach, legible from a distance of at least 25 feet.	40 CFR 264.14 329 IAC 3.1-9
Slurry wall	Excavation of soil for construction of slurry wall may trigger cleanup or land disposal restrictions.	See Excavation in this table.
Surface water control and discharge	Prevent run-on, and control and collect runoff from a 24-hour, 25-year storm during closure and post-closure status.	40 CFR 264.301(f)(g)(h)(i); 329 IAC 3.1[3]
	Management of stormwater run-off associated with Construction Activity, and stormwater run-off associated with industrial activity.	327 IAC 15-5 327 IAC 15-6
Treatment	Prepare fugitive and odor emission control plan for this action.	CAA Section 101[2]; 40 CFR 52[2]
	Establish procedures for review of construction and operation of any source that has the potential to emit criteria air pollutants. Register with Commissioner of the State to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2
	Verify through emission estimates and dispersion modeling that hydrogen sulfide emissions do not create an ambient concentration greater than or equal to 0.10 ppm: Emissions Standards for Hazardous Air Pollutants (HAPs)	40 CFR 61[2]; 326 IAC 14

TABLE 4.4

POTENTIAL FEDERAL AND STATE ACTION-SPECIFIC ARARs[1]
FOUR COUNTY LANDFILL SITE
FULTON COUNTY, INDIANA

Actions	*Requirement*	*Citation*
Excavation	Develop fugitive and odor emission control plan for this action if existing site plan is inadequate.	CAA Section 101[2]; 40 CFR 52[2]
	Particulate emissions from earth moving and material handling activities must be controlled, such that no visible emissions cross the property line and the increase in upward/downward total suspended particulate concentration is limited to 50 $\mu g/m^3$.	326 IAC 6-4
	Register with Commissioner of the State to include estimation of emission rates for each pollutant expected.	40 CFR 52[2]; 326 IAC 2-1-2

Notes:

1 Modified from Exhibit 1-3 of USEPA's Draft Guidance CERCLA Compliance With Other Laws (August 1988) and Exhibit 1-3 of CERCLA Compliance With Other Laws, Part II (August 1989).

2 All of the Clean Air Act ARARs that have been established by the Federal government may be covered by matching State regulations. The State may have the authority to manage these programs through the approval of its implementation plans (40 CFR 52).

3 As of February 1992, Indiana adopted new hazardous waste rules titled 329 IAC 3.1, which adopt by reference the federal regulations 40 CFR 260 through 270. Therefore, any reference to these CFR citations implies coverage under the State rules. The State rules generally only cover the administrative procedures while the federal regulations cover the standards for RCRA generators and TSD facilities.

4 Tank storage requirements are for the storage of RCRA hazardous waste. A generator who accumulates or stores hazardous waste on site for 90 days or less in compliance with 40 CFR 262.34(a)(1-4) is not subject to the full RCRA storage requirements.

Key:

CAA = Clean Air Act
CFR = Code of Federal Regulations
CWA = Clean Water Act
IAC = Indiana Administrative Code
TSD = Treatment, Storage, and Disposal

Tables from Baseline Human Health Assessment Report

URS Corporation 9/26/2006

TABLE 4.2
VALUES USED FOR DAILY INTAKE CALCULATIONS - GROUNDWATER RESIDENTIAL IRRIGATION USE SCENARIO
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

Scenario Timeframe: Current/ Future
Medium: Groundwater for Irrigation Use
Exposure Medium: Fruits/Vegetables
Exposure Point: Ingestion
Receptor Population: Residential
Receptor Age: Children and Adults

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CW	Chemical Concentration in Groundwater	mg/L	See Section 3 Tables	See Section 3 Tables	See Section 3 Tables	See Section 3 Tables	CDI (mg/kd-day) =
	IR_{fruit} - child	Ingestion Rate for Fruit	kg/meal	0.294	EPA, 1997	0.108	EPA, 1997	(CW x % IRR x MC) x CF x (IR_{fruit}+ IR_{veg}) x FI x EF x ED x 1/BW x 1/AT
	IR_{fruit} - adult	Ingestion Rate for Fruit	kg/meal	0.305	EPA, 1997	0.092	EPA, 1997	
	IR_{veg} - child	Ingestion Rate for Vegetables	kg/meal	0.240	EPA, 1997	0.111	EPA, 1997	EPA, 1989
	IR_{veg} - adult	Ingestion Rate for Vegetables	kg/meal	0.549	EPA, 1997	0.254	EPA, 1997	
	FI	Fraction Intake	unitless	0.4	EPA, 1991	0.4	EPA, 1991	
	CF	Conversion Factor	L/kg	1	EPA, 1991	1	EPA, 1991	
	EF	Exposure Frequency	meals/year	350	EPA, 1991	350	EPA, 1991	
	ED (child)	Exposure Duration	years	6	EPA, 1991	6	EPA, 1991	
	ED (adult)	Exposure Duration	years	24	EPA, 1991	3	EPA, 1991	
	BW - child	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	BW - adult	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N (child)	Averaging Time (non-cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	
	AT-N (adult)	Averaging Time (non-cancer)	days	8,760	EPA, 1989	1,095	EPA, 1989	
	% IRR	Percent Irrigation	%/100	0.50	Professional Judgement	0.15	Professional Judgement	
	MC	Moisture Content of Fruits/Vegetables	%/100	0.9	EPA, 1997	0.9	EPA, 1997	

Sources :
EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002F, August 1997.

TABLE 4.3
VALUES USED FOR DAILY INTAKE CALCULATIONS - WORKER EXPOSURE TO VOLATILE EMISSIONS FROM IRRIGATION SYSTEM
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

Scenario Timeframe: Current/ Future
Medium: Groundwater
Exposure Medium: Ambient Air
Exposure Point: Inhalation
Receptor Population: Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CA	Modelled Concentration in Air	mg/m3	Appendix A	Appendix A	Appendix A	Appendix A	CDI (mg/kd-day) =
	INR	Inhalation Rate	m3/hour	3.5	EPA, 1997	1.3	EPA, 1997	CW x INR x ET x EF x ED x 1/BW x 1/AT
	ET	Exposure Time	hours/day	4	Professional Judgement	2	Professional Judgement	
	EF	Exposure Frequency	days/year	90	Professional Judgement (1)	45	Professional Judgement (1)	EPA, 1989
	ED	Exposure Duration	years	25	EPA, 1991	9	EPA, 1991	
	BW	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (non-cancer)	days	9,125	EPA, 1989	3,285	EPA, 1989	

(1) Professional judgment. Based on local agricultural information, growing season could extend to a maximum length of 180 days in any given year. However, this scenario assumes a worker irrigating crops only during the dry summer season which is assumed to be 90 days. Therefore, it is assumed that irrigation occurs daily during the dry summer months or 90 days (RME), and every other day during the dry summer months or 45 days (CT).

Sources :

EPA, 1989: Risk Assessment Guidance for Superfund. Vol. I: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol. I: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002F, August 1997.

TABLE 4.4
VALUES USED FOR DAILY INTAKE CALCULATIONS - EXPOSURE TO CONTAMINATED MEAT
USING GROUNDWATER AS ANIMAL WATER SOURCE
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

Scenario Timeframe: Current/ Future
Medium: Groundwater as Animal Water Source
Exposure Medium: Beef/Pork/Poultry
Exposure Point: Ingestion
Receptor Population: Farmers
Receptor Age: Children and Adults

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Ingestion	C_{meat}	Chemical Concentration in Meat	mg/kg	(1)	(1)	(1)	(1)	CDI (mg/kd-day) =
	IR_{meat} - child	Ingestion Rate for Meat	kg/day	0.120	EPA, 1997	0.057	EPA, 1997	$C_{meat} \times IR_{meat} \times FI \times EF \times ED \times 1/BW \times 1/AT$
	IR_{meat} - adult	Ingestion Rate for Meat	kg/day	0.282	EPA, 1997	0.137	EPA, 1997	
	FI	*Fraction Intake*	*unitless*	*0.44*	EPA, 1994	*0.44*	EPA, 1994	EPA, 1989
	EF	Exposure Frequency	meals/year	350	EPA, 1991	350	EPA, 1991	
	ED - C (child)	Exposure Duration	years	6	EPA, 1991	6	EPA, 1991	
	ED - C (adult)	Exposure Duration	years	24	EPA, 1991	3	EPA, 1991	
	ED - NC	Exposure Duration	years	6	EPA, 1991	6	EPA, 1991	
	BW - child	Body Weight	kg	15	EPA, 1991	15	EPA, 1991	
	BW - adult	Body Weight	kg	70	EPA, 1991	70	EPA, 1991	
	AT-C	Averaging Time (cancer)	days	25,550	EPA, 1989	25,550	EPA, 1989	
	AT-N	Averaging Time (non-cancer)	days	2,190	EPA, 1989	2,190	EPA, 1989	

1) Volatile COCs are not considered bioaccumulative and therefore, will not be evaluated. Qualitative discussions are provided in the main text of the risk assessment.

Source :
EPA, 1989: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A OERR. EPA/540-1-89-002.
EPA, 1991: Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.
EPA, 1994: Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities, EPA 530-R-94-021, Solid Waste and Emergency Response.
EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002F, August 1997.

TABLE 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER
EAST DOWNGRADIENT SECTOR
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

Scenario Timeframe: Current/ Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal and Inhalation

CAS Number	Chemical	Minimum (1,2) Detected Concentration	Minimum Qualifier	Maximum (1,2) Detected Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection (2)	Mean Concentration Used for Screening (2)	Mean (3) Background Concentration	Screening Criteria (4)		COPC Flag	Rationale for (5) Contaminant Deletion or Selection
	VOCs														
108-10-1	4-Methyl-2-Pentanone	6.5	J	7.4	J	ug/L	GS-6 (GS-SC-13)	2/27	6.5 J - 7.4 J	5.14	--	NA	D	x	FD
71-43-2	Benzene	1.1		1.9		ug/L	MW-102 (GW-SC-152)	2/27	1.1 - 1.9	0.574	--	5	A		BSC
75-27-4	Bromodichloromethane	0.72	J	1.2		ug/L	GS-6 (GS-SC-13)	2/27	0.72 J - 1.2	0.534	--	100	B2		BSC
74-83-9	Bromomethane	0.55	J	0.93	J	ug/L	GS-2 (GS-SC-12)	2/27	0.55 J - 0.93 J	0.518	--	NA	D	x	FD
67-66-3	Chloroform	0.85	J	4.1	J	ug/L	GS-6 (GS-SC-13)	2/27	0.85 J - 4.1 J	0.711	--	100	B2		BSC
100-41-4	Ethylbenzene	0.64	J			ug/L	GS-6 (GS-SC-13)	1/27	0.64 J	0.505	--	700	D		BSC, IFD
1330-20-7	m,p-Xylenes	0.91	J			ug/L	GS-6 (GS-SC-13)	1/27	0.91 J	0.516	--	10000	D		BSC, IFD
108-88-3	Toluene	0.54	J	0.65	J	ug/L	GS-7 (GS-SC-21)	2/27	0.54 J - 0.65 J	0.511	--	1000	D		BSC
	Total Metals														
7440-38-2	Arsenic	0.011				mg/L	MW-102 (GW-SC-152)	1/6	0.011	0.00392	0.00385	0.05	A		BSC, BBC
7440-39-3	Barium	0.026		0.14		mg/L	MW-107 (GW-SC-162)	6/6	0.026 - 0.14	0.081	0.109	2	D		BSC, BBC
7440-70-2	Calcium	55		140	J	mg/L	MW-102 (GW-SC-56)	14/14	55 - 140 J	93.1	95.3	NA	D		BBC, NTX, NUT
7439-89-6	Iron	0.9	J	4.8	J	mg/L	MW-129 (GW-SC-82)	16/16	0.9 J - 4.8 J	2.77	3.06	NA	D		BBC
7439-95-4	Magnesium	31		65		mg/L	MW-102 (GW-SC-56)	14/14	31 - 65	42.6	35.2	NA	D		BBC, NTX, NUT
7439-96-5	Manganese	0.021		0.12		mg/L	MW-102 (GW-SC-152)	14/14	0.021 - 0.12	0.0545	0.0607	NA	D		BBC
7440-09-7	Potassium	1		3.8		mg/L	MW-103 (GW-SC-151)	6/6	1 - 3.8	1.85	1.9	NA	D		BBC, NTX, NUT
7440-23-5	Sodium	3		67		mg/L	MW-102 (GW-SC-56)	14/14	3 - 67	12.9	7.62	NA	D		BBC, NTX, NUT
	Dissolved Metals														
7440-38-2	Arsenic	0.006		0.012		mg/L	MW-102 (GW-SC-152)	2/6	0.006 - 0.012	0.0052	0.00396	0.05	A		BSC, BBC
7440-39-3	Barium	0.027		0.14		mg/L	MW-107 (GW-SC-162)	6/6	0.027 - 0.14	0.0833	0.119	2	D		BSC, BBC
7440-70-2	Calcium	60		140		mg/L	MW-102 (GW-SC-152)	6/6	60 - 140	93	94.8	NA	D		BBC, NTX, NUT
7439-89-6	Iron	0.89		4.8	J	mg/L	MW-129 (GW-SC-82)	14/14	0.89 - 4.8 J	2.7	2.89	NA	D		BBC
7439-95-4	Magnesium	32		65		mg/L	MW-102 (GW-SC-152)	6/6	32 - 65	44.2	35.5	NA	D		BBC, NTX, NUT
7439-96-5	Manganese	0.022		0.13		mg/L	MW-102 (GW-SC-152)	14/14	0.022 - 0.13	0.0579	0.0606	NA	D		BBC
7440-09-7	Potassium	1.1		4.2		mg/L	MW-103 (GW-SC-151)	6/6	1.1 - 4.2	2.02	2	NA	D		BBC, NTX, NUT
7782-49-2	Selenium	0.008				mg/L	MW-103 (GW-SC-151)	1/6	0.008	0.00305	ND	0.05	D		BSC
7440-23-5	Sodium	4.4		39		mg/L	MW-102 (GW-SC-152)	6/6	4.4 - 39	11.9	9.63	NA	D		BBC, NTX, NUT

(1) Minimum/maximum detected concentration.
(2) Based on data collected from Off-Site sampling location : MW-102, MW-103, MW-104, MW-105, MW-106, MW-107, MW-129, MW-130, GS-1, GS-2, GS-6, GS-7.
(3) Mean background concentration based on data collected from locations in the upgradient sector (see Table 2.1)
(4) USEPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141-143, July 1999.
(5) Rationale Codes Selection Reason: Above Screening Criterion (ASC)
Above 2 times the Mean Background Concentration (ABC)
Frequent Detection (FD)
Deletion Reason: Below Screening Criterion (BSC)
Below 2 times the Mean Background Concentration (BBC)
Infrequent Detection (IFD)
No Toxicity Data (NTX)
Essential Nutrient (NUT)

A = Known Human Carcinogen
B1 = Probable Human Carcinogen with limited evidence in humans
B2 = Probable Human Carcinogen with sufficient evidence in animals
C = Possible Human Carcinogen with limited evidence in animals
D = Not Classified as to Human Carcinogenicity
J = Associated value is estimated.
NA = Not Available
ND = Not Detected
-- = Not Applicable

TABLE 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN FOR GROUNDWATER
NORTH DOWNGRADIENT SECTOR
FOUR COUNTY LANDFILL
FULTON COUNTY, INDIANA

Scenario Timeframe: Current/ Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Ingestion, Dermal and Inhalation

CAS Number	Chemical	Minimum (1,2) Detected Concentration	Minimum Qualifier	Maximum (1,2) Detected Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection (2)	Mean Concentration Used for Screening (2)	Mean (3) Background Concentration	Screening Criteria (4)		COPC Flag	Rationale for (5) Contaminant Deletion or Selection
	VOCs														
107-06-2	1,2-Dichloroethane	1.3		2000		ug/L	MW-114 (GW-SC-167)	15/49	1.3 - 2000	118	--	5	B2	x	ASC, FD
108-10-1	4-Methyl-2-Pentanone	1.5	J	16	J	ug/L	GS-128 (GS-SC-40)	3/49	8.5 J - 16	8.47	--	NA	D	x	FD
67-64-1	Acetone	10		58	J	ug/L	MW-113 (GW-SC-165)	2/43	10 - 58 J	9.72	--	NA	D		IFD
71-43-2	Benzene	1.2		460		ug/L	MW-114 (GW-DS-222)	10/49	1.2 - 460	25.6	--	5	A	x	ASC, FD
75-15-0	Carbon Disulfide	2.8	J	19		ug/L	MW-113 (GW-KD-07)	3/49	2.8 J - 19	1.41	--	NA	NA	x	FD
56-23-5	Carbon Tetrachloride	2.5		340	J	ug/L	MW-113 (GW-SC-88)	5/49	2.5 - 340 J	12.5	--	5	B2	x	ASC, FD
75-00-3	Chloroethane	1.8				ug/L	MW-124 (GW-SC-91)	1/49	1.8	0.828	--	NA	NA		IFD
67-66-3	Chloroform	0.81	J	86		ug/L	MW-113 (GW-KD-07)	10/49	0.81 J - 86	6.52	--	100	B2		BSC
75-09-2	Dichloromethane	1.1		2	J	ug/L	MW-113 (GW-SC-168)	4/49	1.1 - 2 J	0.866	--	5	B2		BSC
100-41-4	Ethylbenzene	0.75	J			ug/L	GS-128 (GS-SC-48)	1/49	0.75 J	0.806	--	700	D		BSC, IFD
1330-20-7	m,p-Xylenes	0.55	J	1.5		ug/L	GS-128 (GS-SC-48)	2/23	0.55 J - 1.5	0.546	--	10000	D		BSC
95-47-6	o-Xylene	0.87	J			ug/L	GS-128 (GS-SC-48)	1/23	0.87 J	0.516	--	10000	D		BSC, IFD
108-88-3	Toluene	1.1	J	10		ug/L	MW-126 (GW-DS-201)	2/49	1.1 J - 10	1.01	--	1000	D		BSC, IFD
75-01-4	Vinyl Chloride	0.65	J	8		ug/L	MW-124 (GW-SC-91)	5/49	0.65 J - 8	1.19	--	2	A	x	BSC (6)
	General Chemistry														
14797-55-8	Nitrate	0.02		1.2		mg/L	MW-121 (GW-DS-215)	9/37	0.02 - 1.2	0.0648	ND	10	NA		BSC
1594-56-5	Nitrite	0.0378	J	0.579	J	mg/L	MW-108 (GW-SC-75)	2/17	0.0378 - 0.579	0.0804	ND	1	NA		BSC
	Total Metals														
7429-90-5	Aluminum	0.09	J	1.7		mg/L	MW-125 (GW-DS-202)	5/32	0.09 J - 1.7	0.194	0.083	NA	D	x	ABC, FD
7440-36-0	Antimony	0.035				mg/L	MW-109 (GW-SC-164)	1/15	0.035	0.0163	0.0195	0.006	D		BBC
7440-38-2	Arsenic	0.006		0.01		mg/L	MW-126 (GW-DS-201)	3/15	0.006 - 0.01	0.00359	0.00385	0.05	A		BSC, BBC
7440-39-3	Barium	0.015		0.15		mg/L	MW-110 (GW-SC-172)	15/15	0.015 - 0.15	0.0757	0.109	2	D		BSC, BBC
7440-70-2	Calcium	78	J	150		mg/L	MW-119 (GW-DS-218)	32/32	78 J - 150	102	95.9	NA	D		BBC, NTX, NUT
7440-47-3	Chromium	0.026				mg/L	MW-121 (GW-DS-215)	1/15	0.026	0.0064	ND	0.1	D		BSC
7439-89-6	Iron	0.062	J	25		mg/L	MW-108 (GW-SC-165)	36/37	0.062 J - 25	3.8	3.06	NA	D		BBC
7439-92-1	Lead	0.011				mg/L	MW-119 (GW-DS-218)	1/15	0.011	0.00907	ND	0.015	B2		BSC
7439-95-4	Magnesium	18		50		mg/L	MW-119 (GW-DS-218)	32/32	18 - 50	34	35.2	NA	D		BBC, NTX, NUT
7439-96-5	Manganese	0.0051	J	0.94		mg/L	MW-125 (GW-SC-87)	32/32	0.0051 J - 0.94	0.171	0.0807	NA	D	x	ABC, FD
7440-02-0	Nickel	0.017				mg/L	MW-121 (GW-DS-215)	1/15	0.017	0.0058	ND	NA	D	x	ABC, FD
7440-09-7	Potassium	0.94		5.4		mg/L	MW-113 (GW-SC-168)	15/15	0.94 - 5.4	2.24	1.9	NA	D		NTX, NUT
7440-23-5	Sodium	1.5	J	85		mg/L	MW-119 (GW-DS-218)	32/32	1.5 J - 85	12	7.62	NA	D		NTX, NUT