STATEMENT OF BASIS
U.S. ENVIRONMENTAL PROTECTION AGENCY

DuPont East Chicago Facility
Western Portion/Industrial Area
East Chicago, Indiana

EPA ID: IND 005 174 354

November 2017

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Acronyms List - Defined Terms

ACE -------------------- U.S. Army Corps of Engineers

AOC -------------------- Area of Contamination

CAO -------------------- Corrective Action Objective(s)

CFR--------------------- Code of Federal Regulations

CMS -------------------- Corrective Measures Study

COC -------------------- Constituent(s) of Concern

Conceptual Site Model--Establishes the complete pathways that will be evaluated in the risk assessment

EPA--------------------- U.S. Environmental Protection Agency

ERA -------------------- Ecological Risk Assessment

FWS -------------------- U.S. Fish and Wildlife Service

HI ---------------------- Hazard Index: The sum of two or more hazard quotients for multiple substances and/or multiple exposure pathways

HQ --------------------- Hazard Quotient: The ratio of a single substance exposure level over a specified period to a reference dose for that substance derived from a similar exposure period

IDEM------------------- Indiana Department of Environmental Management

IDNR ------------------- Indiana Department of Natural Resources

In-Situ Stabilization -- Contaminant treated in place by chemical, microbe, or gas injection

IRM-------------------- Interim Remedial Measures

MCL-------------------- Maximum Contaminant Levels are EPA's Safe Drinking Water Act standards that limit the amount of a substance allowed in public water systems.

MNA ------------------- Monitored Natural Attenuation

OM&M ---------------- Operations, Maintenance and Monitoring

RBRC ------------------ Risk-Based Reference Concentration

RCRA ------------------ Resource Conservation and Recovery Act, 42 U.S.C. §2001 *et seq.*

RFI--------------------- RCRA Facility Investigation

SWMU ---------------- Solid Waste Management Unit

SB---------------------- Statement of Basis

TNC ------------------- The Nature Conservancy

TRV ------------------- Toxicity Reference Value

UNITS OF MEASUREMENT

Soil Concentrations:

ppm - part per million
ppb - part per billion

Chemical concentrations in soil are reported as parts per million (ppm) or parts per billion (ppb). Parts per million and parts per billion may be converted from one to the other using this relationship: 1 part per million = 1,000 parts per billion. For soil, 1 ppm = 1 mg/kg of contaminant in soil, and 1 ppb = 1 ug/kg.

Water Concentrations:

mg/L- milligrams per liter
ug/L - micrograms per liter

Chemical concentrations in water are reported as milligrams (mg) (parts per million) or micrograms (ug) (parts per billion) per volume of liter of water (l).

Parts per million and parts per billion may be converted from one to the other using this relationship: 1 part per million = 1,000 parts per billion. For water, 1 ppm = approximately 1 mg/L of contaminant in water, and 1 ppb = 1 ug/l.

Statement of Basis for the Proposed Remedy at the Western Portion of the DuPont East Chicago Facility Located in East Chicago, Indiana

INTRODUCTION

This Statement of Basis (SB) presents the proposed remedy to address contaminated soil and groundwater located in the western portion of the former E.I. DuPont Nemours (DuPont) chemical manufacturing facility in East Chicago, Indiana (*see Figure 1 for land use at DuPont East Chicago Facility*). The entire DuPont East Chicago facility is approximately 440 acres. This SB focuses on the 265-acre western portion of the facility that contains an existing solid waste landfill surrounded by open land, the former industrial property available for redevelopment, and leased industrial property. The eastern portion contains the 172-acre Natural Area and adjacent 23-acre Buffer Zone. This SB does not address the eastern portion of the facility containing the Natural and Buffer Zone Areas, which were handled under a separate EPA-issued 2013 corrective action decision document and a long-term monitoring program.

This SB is issued by the U.S Environmental Protection Agency (EPA) as part of its public participation responsibilities under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §2001 *et seq.* This SB summarizes the investigations and the potential remedial alternatives evaluated for the western portion of the DuPont facility. This information can be found in greater detail in plans and reports contained in the RCRA Administrative Record for the DuPont East Chicago Facility – Western Portion. An Index to the Administrative Record is attached.

EPA encourages the public to review these documents to gain a more comprehensive understanding of the RCRA corrective action activities to be conducted at the western portion of the DuPont facility. EPA will select a final remedy after a 30-day public comment period and consideration of all substantive public comments. EPA may modify the proposed remedy or select another remedy based on new information or public comments.

The Administrative Record supporting this proposed remedy is available at the East Chicago Public Library, 1008 W. Chicago Avenue, East Chicago, Indiana 46312 and the EPA, Region 5 Record Center (7th Floor), 77 West Jackson Boulevard, Chicago, Illinois 60604.

EPA PROPOSED REMEDY

Results from a RCRA Facility Investigation (RFI), conducted from 2002 to 2005, and other previous investigations conducted by DuPont indicate arsenic, lead, zinc, and cadmium are the primary constituents of concern (COCs) in the soil (from about 0 to 10 feet below ground surface [bgs]). Arsenic is considered the primary COC in groundwater at the facility, due to its widespread presence in the soil and groundwater at elevated concentrations.

Based on a comparative analysis of alternatives, EPA proposes the following remedy for public comment to address contaminated soil and groundwater at the western portion of the DuPont East Chicago facility.

- *Soil: Soil covers and on-site landfill.*

  Across the facility, maintain existing pavement or other surface soil barriers (e.g., parking lots or building foundations) and where pavement or other barrier is not present, install a 1-foot-thick permeable soil cover to mitigate direct human contact to achieve a residual target cancer risk of one additional cancer case out of 100,000 people (expressed exponentially as 1×10^{-5}). Install a 2-foot-thick soil cover where needed to reduce potential ecological risks (see Figure 2). Where highly contaminated soil may be a source of groundwater contamination, excavate such "source areas" (~ 61,780 cubic yards) and then backfill the excavations with clean soil. The excavations and backfill will extend to the depth of the saturated zone (where the soil is saturated with groundwater) to remove a significant fraction (close to 50%) of the arsenic mass at the facility. Removing this mass of contamination will negate the potential for human exposure where concentrations are highest, and reduce arsenic leaching to groundwater. The excavated soils would be treated and disposed of in the on-site solid waste landfill.

  In the southwest corner of the facility which DuPont leased to the chemical manufacturers, W.R. Grace and Co. and Grace Davison, EPA proposes to excavate ~ 14,000 cubic yards of lead-contaminated surface soils. In addition, other existing pavement or barriers (e.g., parking lots or building foundations) will be maintained. These actions will mitigate direct human contact to achieve a residual target cancer risk of 1×10^{-5} and a lead Hazard Index exposure factor of less than 1.0 over portions of the leased property, referred to in the document as the "Leased Area." The excavated soil would be treated and disposed of in the on-site solid waste landfill. Deeper saturated soil with elevated arsenic concentrations at the bottom of the excavations would be treated by mixing with in-situ stabilization treatments.

- *Groundwater: Two types of treatment: In-situ chemical fixation (ISCF) via enhanced microbial sulfate reduction injections and a bio-wall trench.*

  An enhanced sulfate reduction bio-barrier comprised of a trench backfilled with materials required to stimulate microbial sulfate reduction and chemically trap arsenic near the Grand Calumet River will be used to significantly reduce or eliminate arsenic migration beyond the southern property boundary. Enhanced microbial sulfate reduction injection treatment zones transecting the northern and southern arsenic plumes will intercept and sequester arsenic migrating in groundwater to more rapidly reduce arsenic concentrations and extend the life of the bio-barrier.

- *Institutional Controls: Record, implement and maintain EPA-approved institutional controls to ensure the facility's land use remains consistent with the remedial endpoints and risk assessments.*

  This facility must record, implement and maintain institutional controls that prohibit non-industrial uses of the property inconsistent with the exposure assumptions that the risk assessments were based upon, prohibit the installation of on-site drinking water supply wells, require maintenance of paved and soil barriers, maintain and install security fences, require permits for non-potable groundwater production wells, and require all property owners to implement health and safety plans to protect construction, utility and maintenance workers from exposure to contaminated soils or groundwater, require notice of the potential presence of underground pipe and other obstructions, and require notice to any future owners, developers or tenants of the potential for vapor intrusion risks in new buildings. These restrictions will be embodied in a recorded, EPA-approved environmental restrictive covenant and deed restriction that runs with the land and will be provided to IDEM's Institutional Controls Registry and Virtual File Cabinet.

- *Financial Assurance: Provide funds to complete the remedy including long-term OM&M.*

  The total estimated cost of EPA's proposed remedy is approximately $22.68 million. Financial assurance is required to ensure that the proposed remedy can be implemented over its expected lifetime, with an expected minimum of 30 years. The facility owner and/or Chemours and/or DuPont will provide an updated cost estimate for implementation of the final remedy to EPA for approval pursuant to 40 CFR §§ 264.142 and 264.144, including the construction and long-term operation, maintenance, and monitoring (OM&M) activities. Upon EPA approval of the updated cost estimate, the current facility owner, Chemours, and/or the former owner of the facility, DuPont shall provide financial assurance using the option(s) allowed in 40 CFR § 264.143 and § 264.145.

- *Five-Year Remedy Reviews*:

  Implemented to update the Conceptual Site Model, evaluate remedy efficacy, update Financial Assurance timelines, and make adjustments if needed.

- *Enter into a corrective action implementation order to ensure compliance with the final clean up decision.*

FACILITY BACKGROUND

The DuPont East Chicago facility is a former manufacturing facility located at 5215 Kennedy Avenue in East Chicago, Lake County, Indiana. The approximately 440-acre property is bounded to the south by the East Branch of the Grand Calumet River, to the east and north by residential and commercial areas, and to the west by industrial areas *(see Figure 1)*. In 1892, the Grasselli Corporation constructed a facility to produce various chloride, ammonia, and zinc products and inorganic agricultural chemicals. The Grasselli development was primarily restricted to the western portion of the property where the land surface was initially leveled with soil, iron mill slag, and other materials. E.I. du Pont Nemours and Company (DuPont) operated the facility for the Grasselli Corporation from 1927 through 1936, at which time DuPont then acquired ownership. In 1948, DuPont began manufacturing organic chemicals, consisting primarily of trichlorofluoromethane or Freon® products. The wastes from those processes included acids, boron, arsenic, chromium, lead, and antimony pentachloride. DuPont continued chemical production and hazardous waste storage and disposal activities. In 1980, DuPont applied for a RCRA Large Quantity Generator permit to generate and store RCRA-regulated hazardous wastes at its East Chicago facility. DuPont also manufactured inorganic chemicals at the facility, including sodium silicate and colloidal silica. During the 1980's and 1990's, DuPont's East Chicago operations contracted significantly. Then, in 2000, DuPont transferred the last of its chemical manufacturing operations at the East Chicago facility to W.R. Grace, another chemical company who had leased property at the DuPont facility.

In June 1997, DuPont entered into a RCRA Corrective Action Order (Order) with EPA. A comprehensive evaluation of soil and groundwater conditions at the facility was performed as part of the RCRA corrective action process. In the Order, DuPont agreed among other things, to conduct a RFI to determine the nature and extent of any releases of hazardous waste and/or hazardous waste constituents at or from the facility. The Order also required DuPont to implement certain Interim Measures and conduct a Corrective Measures Study (CMS) to identify and evaluate alternatives for the corrective action necessary to prevent or mitigate migration of contaminants. Subsequent investigations included the preparation of initial environmental site assessments and development of the Phase I (2002) and Phase II (2005) RFIs. This facility was used for chemical manufacturing for over 100 years. The RFI's and Interim Measures involved extensive review of information about prior manufacturing activities and thousands of subsurface soil samples. Given the length and extent of manufacturing activities, however, it is possible some underground piping was not identified or encountered. This possibility underscores the importance of the institutional controls on the use of the property to protect construction, utility, and maintenance workers.

In 2015, DuPont implemented a corporate restructuring that included the DuPont East Chicago facility. On February 1, 2015, DuPont transferred title of the East Chicago facility to Chemours Company FC LLC (Chemours), then a newly-created, wholly-owned subsidiary of DuPont. On July 1, 2015, the spinoff of the former Chemours subsidiary was completed. DuPont and Chemours are now two separate companies. Chemours is the current title owner of the DuPont East Chicago facility including the Leased Area, in the southwest corner of facility.

DuPont's development of the East Chicago property was largely limited to its western portion. The southern section of the developed area was used for chemical manufacturing purposes, while the northwestern section and northeastern edge of the western portion were used for waste management. Most of the previously active manufacturing areas, however, have been decommissioned, and the production facilities have been removed. For the purposes of describing the hazardous waste investigations and proposed cleanup approaches, the DuPont East Chicago facility has been divided into the following five areas (*see Figure 1*):

- Redevelopment Area: This area occupies approximately 155 acres and encompasses the former manufacturing areas located in the central and western portions of the property. The former manufacturing facilities have been removed. Future industrial and/or commercial use is planned for the Redevelopment Area. The Redevelopment Area is included in this SB.

- Open Area: This former manufacturing and waste management area occupies approximately 50 acres and includes an approximately 30-acre existing solid waste landfill. A vegetative grass cover is currently maintained over the landfill. Any future plans to further consolidate the landfill may require additional financial assurance and possible modifications to the SB. The portion of the Open Area that is not part of the landfill has natural herbaceous/shrub cover regrowth, with intermixed patches of shrubs and trees. Natural re-vegetation with an emphasis on native and pollinator-friendly species is encouraged in the Open Area and should be chosen in coordination with The Nature Conservancy. The former manufacturing facilities have been removed. Aside from landfilling/landfill consolidation, currently no active future industrial and/or commercial use is planned for the Open Area. The Open Area is included in this SB.

- Leased Area: DuPont has leased this 30-acre active manufacturing area to W.R. Grace & Co. and Grace Davison since early 2000, but Chemours maintains ownership. The leased facility manufactures a colloidal silica product (Ludox®) and a sodium silicate solution. These products are used in x-ray film; photographic paper; pigments; nonslip coatings; low phosphate detergents; and metal castings for aerospace, medical, and recreational products. The Leased Area is included in this SB.

- Buffer Zone Area: This area is located directly east of the Open and Redevelopment Areas and separates these areas from the adjacent Natural Area. The Buffer Zone Area is a 200-foot-wide strip of land that extends across the width of the property, occupying approximately 20 acres. The purpose of the Buffer Area is to provide additional protection to the Natural Area. Vegetation and habitat will be managed appropriately to maintain the buffer zone. The Buffer Zone area was included in a separate SB and a final decision document that was issued by EPA on September 30, 2014. Therefore, the Buffer Zone Area is not part of this SB.

- Natural Area: This undeveloped Natural Area occupies approximately 172 acres and contains original plains/dunes geomorphology and associated plant communities. DuPont established the Natural Area by transferring a conservation easement to the Indiana

Department of Natural Resources (IDNR) in accordance with a federal consent decree involving the restoration of the Grand Calumet River. The Natural Area section of the facility is currently managed by The Nature Conservancy for habitat preservation and is anticipated to continue as such in the future. The Natural Area was included in a separate SB and a final decision document that was issued by EPA on September 30, 2014, therefore, the Natural Area is not part of this SB.
See: https://www3.epa.gov/region5/cleanup/rcra/dupont/pdfs/sta-basis-2014.pdf

RCRA Facility Investigation Results

From 2002 to 2005, DuPont conducted the RFI to fully characterize the nature and extent of contamination at the DuPont East Chicago facility. Results from the RFI and other previous investigations indicate arsenic, lead, zinc, and cadmium are the primary COCs in the soil (from about 0 to 10 feet below ground surface [bgs]). Arsenic is considered the primary COC in groundwater, based on its widespread distribution and elevated concentrations.

In 2002, as an Interim Remedial Measure, DuPont installed two (2) 2,000-foot-long permeable reactive barrier (PRB) walls along the northern property boundary to passively treat concentrations of arsenic above the action level migrating off-site in groundwater. Completion of the RFI and an Interim Remedial Measure led to the preparation of an initial CMS and later a Supplemental CMS Investigation Work Plan to address additional data gaps. The Supplemental CMS Investigation Work Plan was later revised and investigation activities were completed in 2009 and 2010. During the spring and summer of 2012, a supplemental soil and groundwater investigation was performed to delineate groundwater plumes of arsenic originating from two main source areas. In addition, another Interim Remedial Measure was performed in the Buffer Zone Area that separates the former manufacturing and waste disposal areas from the Natural Area to protect the Natural Area by decreasing potential contaminant migration via surface water runoff into sensitive habitat and by extending coverage of existing high-quality habitat to the Buffer Zone. Long-term performance monitoring of the Natural Area is ongoing as part of EPA's final corrective action remedy.

SUMMARY OF FACILITY RISKS

(See Figures 2 and 3 for areas exceeding risk criteria and areas requiring remediation)

Soil

Human Health Risk: The Human Health Risk Assessment (HHRA) results indicate that arsenic, lead, zinc, and cadmium are the primary COCs in soil (from about 0 to 5 feet below ground surface [bgs]) across the facility. Cancer risk is expressed as a theoretical probability, which can be thought of in terms of additional cancer cases where *everyone* in a population would get the same dose of the same chemical *every* day over their entire 70-year lifetime. For example, a cancer risk of one in one million means that in a population of one million people, not more than one additional person would be expected to develop cancer as a result of the exposure to the substance causing that risk. The "acceptable" health risk values for carcinogens used by EPA substance causing that risk. The "acceptable" health risk values for carcinogens used by EPA ranges from one person in one million (expressed exponentially as 1×10^{-6}) to one hundred per million (1×10^{-4}) or, expressed differently, one in ten thousand persons. At this facility, the appropriate benchmark for evaluated cancer risk estimates in soil was determined to be 1×10^{-5} (one additional cancer in 10,000 persons) cancer risk.

If the contaminants are noncancerous but could cause other health problems, then a hazard index quotient is used. To be acceptable to the EPA, the Hazard Index (HI) quotient for all contaminants must be less than one (<1.0). The Hazard Index is the ratio of the concentration of a contaminant to its human health screening value. On-site receptors, which include construction workers, utility workers, redevelopment workers, industrial workers, landscapers, trespassers, and restoration workers, were evaluated for exposure to soil, the primary medium of interest, along with groundwater, the other medium of interest. Further, as part of the Superfund investigation of the nearby USS Lead site, EPA has investigated lead and arsenic contamination in the residential areas north of the DuPont facility and certain responsible parties are currently undertaking EPA-ordered cleanup actions in those neighborhoods. For more information on the USS Lead Site Superfund cleanup activities see: https://www.epa.gov/uss-lead-superfund-site.

Ecological Risk: Exposure to surface soil (0 to 2 feet bgs) was evaluated for direct exposure of plant and soil invertebrates and dietary exposure of nine representative wildlife species as part of an ecological risk assessment (ERA). Wildlife exposure was calculated as a daily dose based upon the COCs concentration in food items estimated from soil concentration using empirical soil-to-biota transfer factors. Hazard Quotients (HQs) were calculated as the ratio of exposure concentrations and reference values indicative of potential adverse effects. HQs greater than 1.0 are indicative of a potential ecological risk. Overall, a number of metals in surface soil (particularly antimony, arsenic, cadmium, chromium, copper, lead, selenium, vanadium and zinc) were identified as having a potential for adverse effects on ecological receptors.

Groundwater

Description: Arsenic is the primary COC in groundwater based upon its widespread distribution and elevated concentrations. Elevated arsenic concentrations in shallow groundwater (> 1 milligrams per liter [mg/L]) are present in two potential source areas (a former insecticide land disposal area designated as Solid Waste Management Unit 4 (SWMU 4) and another area south of a PRB installed as an interim remedial measure in 2002) where elevated soil arsenic concentrations are present and extend below the water table. Based on these spatial relationships, arsenic is likely leaching from shallow soil to groundwater in both the SWMU 4 and PRB areas. Dissolved arsenic has migrated with groundwater and partitioned with saturated soil beneath the water table along two arsenic plumes as described below:

1. An east-west trending groundwater divide resulting from a groundwater mound runs through the facility. On the north side of the divide, groundwater flows north toward Riley Park, a residential neighborhood. Elevated arsenic concentrations are present in shallow groundwater to the south of the PRB extending towards the northern property boundary where it is present in deep groundwater. Riley Park residents are connected to the East

Chicago public water supply and do not get potable water from any residential wells. Previous RCRA investigations found no unacceptable risks to the Riley Park residents from exposure to groundwater in sumps. Further, as part of the investigation of the USS Lead Superfund site, EPA is investigating the groundwater north of the DuPont facility and, if necessary to protect human health and the environment, will take or require a responsible party to take appropriate response actions.

2. On the south side of the groundwater mound, groundwater flows south towards the Grand Calumet River where it discharges. Elevated arsenic concentrations, immediately south of the divide, are present in shallow groundwater within the SWMU 4 source area extending south towards the River where elevated arsenic is present in deep groundwater.

Human Health Risk: Direct contact with groundwater was evaluated in the HHRA. The complete human exposure pathways that were evaluated were construction, utility, maintenance and redevelopment workers contacting groundwater COCs during site activities. The maximum contaminant levels (MCLs) are proposed as the cleanup goal for the COCs present in groundwater for the Northern facility boundary. The MCLs are standards that are set by EPA for drinking water quality. The MCL is the legal threshold limit on the amount of a substance that is allowed in public water systems under the Safe Drinking Water Act. The Indiana Surface Water Quality Standards for the protection of aquatic life, applicable to the Great Lakes, are proposed as the cleanup goals for the southern facility boundary.

Ecological Risk: Groundwater quality was characterized using data from seven monitoring wells located along the East Branch Grand Calumet River within the former industrial portion of the facility. Two exposure scenarios were evaluated, one for an aquatic organism exposure to groundwater taking into account an estimated in-stream mixing, and a second scenario for exposure to groundwater prior to mixing with stream water. Based on in-stream concentrations, all calculated hazard quotients (HQs) were less than 1.0, indicating that no adverse effects on water column organisms would be expected following groundwater in-stream mixing. In contrast, calculated HQs were greater than 1.0 for a number of metals when undiluted groundwater values are used as exposure concentrations.

Therefore, the only complete ecological exposure pathway to aquatic biota, including at the groundwater/surface water interface, is through arsenic contaminated groundwater discharging to the Grand Calumet River.

Surface Water

Human Health Risks: Direct contact with surface water was evaluated and risks to human health were considered negligible due to the concentrations detected along with ephemeral nature of the water accumulation areas and their small size.

Ecological Risks: Amphibian species were used as an indicator of potential adverse effects on semi-aquatic organisms in four small water accumulation areas seasonally present within the East Chicago facility. Based on maximum water concentrations and amphibian toxicity data, possible exception of manganese and zinc in some of those areas. The potential for adverse effects was qualified as low for these two COCs because of the ephemeral nature of the water accumulation areas, their size (typically less than 0.1 acre), and location within formerly developed, low-quality habitat areas.

SCOPE OF CORRECTIVE ACTION

Corrective measures are necessary at the DuPont East Chicago facility to address potential risks associated with metals contamination present in soil and groundwater. The HHRA and baseline ecological risk assessment (ERA) determined that:

Potential Human Health Risks

- Based on the current and future land use for the western portion of the DuPont facility, receptors potentially exposed to groundwater are construction, utility, maintenance and redevelopment workers who may incidentally ingest or have dermal contact with constituents in groundwater during excavation work.
- Existing data show that the levels of volatile organic compounds (VOCs) are not of concern at this time, but the potential for vapor intrusion exists in portions of the Redevelopment Area if new buildings are constructed where volatile constituents are present in soil or groundwater.
- The primary potential exposure route for facility workers is direct contact with arsenic, lead, antimony, thallium, and cadmium contaminated soils.

Potential Ecological Risks

- The migration of arsenic-contaminated groundwater into the Grand Calumet River is a potential exposure route to aquatic biota including at the groundwater/surface water interface.
- The primary potential exposure route for ecological receptors is direct contact with arsenic, lead, antimony, thallium, cadmium, barium, chromium, cobalt, copper, manganese, selenium, silver, vanadium, and zinc contaminated soils.

The overarching corrective action objectives (objectives) for the facility include:

- Protection of human health, based on current and reasonably anticipated land uses;
- Attainment of approved groundwater protection standards;
- Controlling the source of release(s) so as to reduce or eliminate, to the maximum extent practical, further releases of COCs into the environment that may further pose a threat to human health or the environment;
- Compliance with appropriate and relevant standards; and
- Use of best management practices of EPA's Green Remediation concepts to reduce the demands placed on the environment.

For soils, short- and long-term cleanup goals have been developed based on the protection of human health and the environment. These goals include potential future use, long-term goals of reducing contamination and soil concentrations at the facility, and preventing COCs releases from soil to groundwater. These goals are summarized below:

- Minimize direct contact exposure to surficial soils;
- Achieve $1x10^{-5}$ residual risk from direct contact with soils, and a noncancer Hazard Index <1 across entire redevelopment area;
- Achieve a lead exposure factor of less than 1.0 in the Leased Area to reduce residual risk from direct contact with soils; and
- Remediate identified soil-to-groundwater source areas with arsenic >1,000 milligrams per kilogram (mg/kg) in the northern and southern portions of the facility to remove a significant fraction (close to 50%) of the arsenic mass to reduce arsenic leaching to groundwater.

For groundwater, cleanup goals have been identified based on potential future facility uses and the long-term goals of reducing contamination and groundwater concentrations at facility boundaries. These goals are summarized below.

- **Short Term** (~ 1-5 years)
    - Mitigate potential groundwater contribution/influence on the water quality in the Grand Calumet River.
    - Demonstrate measurable groundwater quality improvement close to source areas and monitor for arsenic reductions at the property boundaries.
- **Long Term** (5 + years)
    - Meet the Drinking Water Standard MCL for arsenic (0.01 mg/L) at the northern property boundary and the Surface Water Quality Standard (0.148 mg/L) at the southern property boundary near the point of discharge to the Grand Calumet River.

SUMMARY OF POTENTIAL REMEDIAL ALTERNATIVES

(See Table 1 for the Comparative Analysis of Corrective Measures Alternatives)

The five potential remedial alternatives evaluated to address contaminated soil and groundwater are presented below. These alternatives are discussed in more detail in the March 2015 CMS. The five potential remedial alternatives are:

Alternative 1: Existing (Baseline) Measures. Monitoring and institutional controls.

Alternative 2: Monitoring and institutional controls with a permeable soil cover.

Alternative 3:

- **Soil**: Permeable soil cover.
- **Groundwater**: ISCF via enhanced microbial sulfate reduction injections and bio-wall(s) trenches. Excavated soil treatment with on-site management.

Alternative 4:

- **Soil**: Permeable soil cover, source area soil excavation, in-situ stabilization of saturated soils and excavated soil treatment with on-site management.
- **Groundwater**: ISCF via enhanced microbial sulfate reduction injections and bio-wall(s) trenches.

Alternative 5:

- **Soil:** Permeable soil cover, source area soil excavation, in-situ stabilization of saturated soils, and excavated soil treatment with on-site management.
- **Groundwater:** Extraction with treatment and filtration (i.e., pump and treat).

EVALUATION OF THE POTENTIAL REMEDIAL ALTERNATIVES AND THE EPA PROPOSED REMEDY

Threshold criteria for evaluating remedial alternatives include protection of human health and the environment, attainment of media cleanup standards, controlling the sources of releases, and complying with applicable standards for waste management. Alternatives that successfully meet the threshold criteria are then evaluated against balancing criteria. Balancing criteria include long-term reliability and effectiveness, reduction in the toxicity, mobility or volume of wastes, short-term effectiveness, implementability, cost, and sustainability.

Alternative 1. Baseline Measures

This alternative includes groundwater monitoring and maintaining institutional controls including industrial or commercial zoning, security guards, intrusive activity permits, and recorded environmental covenant restrictions to prohibit non-industrial uses, to prevent the installation of on-site drinking water supply wells in the future, and to require notification of any future developers of the potential for vapor intrusion risks in new buildings. Should future construction or maintenance activities require disturbance of the soil, disposal of any soils must meet all hazardous waste management requirements and all remedial and construction staff must wear personal protective equipment. In addition, five-year remedy reviews will be implemented to update the Conceptual Site Model, evaluate remedy efficacy, update the Financial Assurance timeline and make adjustments if needed. Currently, the facility has a security fence and access is permitted only through a single manned security gate. Groundwater monitoring and maintenance of the above controls are expected to be required for a minimum of 30 years.

Protective of Human Health and the Environment

Alternative 1 would not comply with the CAOs established for the protection of human health and the environment. This baseline alternative would allow contamination to remain in place and have no effect on arsenic mass, concentrations, or mobility within soil and groundwater. Residual risk to human health and the environment under future conditions would remain unchanged under this alternative with the exception of the above additional controls.

Attain Media Cleanup Standards
Contaminated soil and groundwater that currently exceeds cleanup standards would remain under Alternative 1.

Control the Sources of Release
No source area treatment or remediation would be performed under Alternative 1. This alternative does not include any measures to mitigate arsenic contaminated groundwater.

Comply with Any Applicable Standards for Management of Wastes
No waste would be managed under Alternative 1.

Long-term Reliability and Effectiveness
Alternative 1 would not entail any active removal, treatment, or containment technologies. Natural attenuation is not effective for arsenic at this facility. Arsenic would continue to migrate beyond compliance points.

Reduction in Toxicity, Mobility, or Volume of Wastes
Since contaminated soil and groundwater would remain in place and untreated under Alternative 1, no reduction in toxicity, mobility, or volume of waste would occur other than that which would result from natural attenuation.

Costs
The estimated cost for implementing Alternative 1, including annual monitoring and maintaining administrative and institutional controls for 30 years is $1.54M.

Sustainability
No remedial action would be taken under this alternative; therefore, sustainability is not applicable.

Alternative 2. Monitoring and Institutional Controls with a Permeable Soil Cover
This alternative expands on the baseline alternative by installing a 1-foot-thick permeable soil cover in addition to other barriers such as asphalt (e.g., a parking lot) or concrete (e.g., building foundations) over much of the Redevelopment Area to mitigate direct human contact to achieve a target cancer risk of $1x10^{-5}$ with a 2-foot-thick permeable ecological risk soil cover in the unfenced portion of the Redevelopment Area. A total of 164,400 cubic yards (CY) of soil cover may be required. A permeable soil cover would help mitigate the potential for changing the redox conditions. The soil cover would be monitored and maintained to prevent erosion. This alternative includes the long-term monitoring with institutional and administrative controls detailed for Alternative 1.

Protective of Human Health and the Environment
A permeable cover would significantly reduce the potential for human and ecological contact with contaminated soils. This alternative would allow contamination to remain in place and have no effect on the contaminant mass within soil and groundwater. This alternative would not accelerate restoration of groundwater and would not meet the CAO of preventing arsenic

migration to surface water. Alternative 2 would therefore not comply with the CAOs identified in Section 3, established for the protection of human health and the environment.

Attain Media Cleanup Standards
Arsenic contaminated groundwater that currently exceeds cleanup goals would remain under Alternative 2.

Control the Sources of Release
No source area treatment or remediation would be performed under Alternative 2. This alternative does not include measures to improve groundwater quality.

Comply with Any Applicable Standards for Management of Wastes
No waste would be managed under Alternative 2.

Long-term Reliability and Effectiveness
Alternative 2 would not entail any active removal, treatment, or containment technologies. Arsenic mass coupled with the slow leaching of arsenic will maintain arsenic in groundwater above CAOs for long periods of time. Therefore, this alternative would not be reliable or effective in the long term.

Reduction in Toxicity, Mobility, or Volume of Wastes
Since contaminated soil and groundwater would remain in place and untreated under Alternative 2, no reduction in toxicity, mobility, or volume of waste would occur other than that which would result from natural attenuation.

Short-Term Effectiveness
Alternative 2 would not be effective in the short term because it would not comply with the short-term CAOs identified in Section 3, established for the protection of human health and the environment.

Implementability
Installation of a soil cover could easily be implemented at the facility.

Cost
The estimated cost for implementing Alternative 2, including annual monitoring for 30 years and maintaining administrative and institutional controls for 30 years is $9.17M.

Sustainability
In terms of sustainability, Alternative 2 has the following advantages over Alternative 1:

- No remediation-generated waste, reduced potential for cross-media transfer of contaminants, and reduced risk of on-site worker exposure to contaminants with soil cover;
- Less environmental intrusion and smaller treatment-process footprints on the environment, and
- Potentially lower remediation costs compared to aggressive treatment technologies.

When compared to aggressive treatment systems, the potential disadvantages of Alternative 2 include:

- Continued contamination migration or renewed contaminant mobility caused by hydrologic or geochemical changes;
- Longer periods needed to achieve remediation objectives, and more extensive performance monitoring (with associated energy consumption);
- Longer-term institutional controls to ensure long-term protectiveness; and
- More public outreach to gain acceptance.

Alternative 3. Soil: Permeable Cover; Groundwater: In-situ Chemical Fixation via Sulfate Reduction Injections and a Bio-Wall Trench

This alternative includes a soil cover to mitigate direct contact with contaminated surface soil as detailed and evaluated to be effective in Alternative 2. Groundwater is treated in Alternative 3 by enhanced microbial sulfate reduction injections and a bio-wall to sequester arsenic in place.

Protective of Human Health and the Environment

This alternative is protective of human health and the environment. A soil cover would negate the risk for direct contact with contaminated soil. Groundwater treatment, using enhanced microbial sulfate reduction implemented along the plume flow paths would accelerate restoration of the aquifer. Groundwater treatment at the northern and southern property lines with enhanced sulfate reduction would improve groundwater quality at compliance points.

Attain Media Cleanup Standards

Groundwater treatment using enhanced microbial sulfate reduction can meet the cleanup goals for groundwater based on site-specific laboratory treatability test results and on-site pilot tests.

Control the Sources of Release

In this alternative, source areas are not remediated to reduce arsenic leaching into groundwater. However, enhanced microbial sulfate reduction implemented in the saturated zone would intercept arsenic migrating from source areas.

Comply with Any Applicable Standards for Management of Wastes

This alternative will comply with all applicable standards for waste management for implementation of groundwater treatment. Soil removed during implementation of the bio-wall would be treated and managed in the on-site landfill. All waste streams would be analyzed and disposed in compliance with specified waste management standards and in accordance with federal, state, and local regulations. No waste would be managed with the installation of the soil cover.

Long-term Reliability and Effectiveness

Not remediating source areas soils (> 1,000 mg/kg arsenic) would place increased demand on groundwater arsenic treatment zones over the long-term and increase the risk of exceeding the capacity of the treatment zones to sequester arsenic.

Reduction in Toxicity, Mobility, or Volume of Wastes
The total quantity of arsenic is not decreased in this alternative. Enhanced microbial sulfate reduction injections and bio-walls in the saturated zone would reduce arsenic mobility and accelerate restoration of groundwater quality along the plumes.

Short-Term Effectiveness
Soil cover and/or building foundations would result in the immediate protection of human and ecological receptors from direct contact with contaminated soil. A sulfate reduction bio-wall near the southern property line would result in rapid improvement of groundwater quality at compliance points.

Implementability
All of the individual technologies of this alternative can be implemented with standard techniques and equipment.

Cost
The estimated cost for implementing Alternative 3, including annual monitoring for 30 years, maintaining administrative and institutional controls for 30 years, installing the soil cover, and groundwater treatment is $14.86M.

Sustainability
The sustainability of Alternative 3 addresses the separate component of source area removal with on-site treatment and disposal. The ISCF groundwater treatment occurring within the facility relies on naturally-occurring microorganisms to consume and break down chemical contaminants through metabolic processes. This phenomenon has been well-documented and is effective in addressing COCs. ISCF incorporates several key elements of sustainable remediation:

- Eliminates transfer of contamination present in other approaches;
- Uses natural processes, thereby minimizing human intervention and excessive energy use;
- Is safe, reduces environmental stress, minimizes ground disturbances;
- Reduces construction, materials used, and waste generated; and
- Can be effectively used as the primary treatment method or in conjunction with other remediation approaches in a very cost-effective manner.

The natural processes that drive ISCF can be enhanced to increase the effectiveness and reduce time required to meet cleanup objectives by:

- Adjusting/optimizing in-situ conditions through addition/manipulation of nutrients and introduction of additional microbes; and
- Providing a sustainable remedial alternative, reducing air emissions associated with conventional pump-and-treat systems.

Alternative 4. Soil: Permeable Cover and Source Area Soil Excavation, In-Situ Stabilization of Saturated Soil, and Excavated Soil Treatment with On-site Management; Groundwater: In-situ Chemical Fixation via Sulfate Reduction Injections and a Bio-Wall Trench

This alternative includes the same soil cover and sulfate reduction injections and bio-wall trench developed for Alternative 3. Alternative 4 expands on Alternative 3 by excavating arsenic source areas (with treatment and on-site management in the landfill) to decrease the source of arsenic to groundwater. Based on the arsenic fate and transport conceptual model and modeling results, source area remediation to reduce arsenic leaching into groundwater coupled with in-situ groundwater treatment is most likely to achieve short- and long-term goals. The removal of soil containing arsenic at concentrations greater than 1,000 mg/kg is predicted to result in decreased arsenic concentrations in groundwater and decreased arsenic loading to groundwater treatment zones as described below. Alternative 4 also includes the excavation of approximately 14,000 cubic yards of lead-contaminated surface soils over portions of the Leased Area for on-site management. The addition of other barriers such as asphalt (e.g., a parking lot) or concrete (e.g., building foundations) mitigate direct human contact to achieve a residual target cancer risk of $1x10^{-5}$ and a lead exposure factor of less than 1.0 over portions of the Leased Area. Because the soil cover and groundwater treatment approach in Alternative 4 is the same as Alternative 3, these components are not discussed further below. However, it is important to recognize that excavations in the source area will result in the removal of the highest concentrations of arsenic-contaminated soils to depths of greater than 4 feet bgs. This reduces the overall risk of direct contact where concentrations are highest. This, in combination with facility security, fencing, and institutional controls, reduces reliance on the soil cover to mitigate contact with contaminated surface soil.

Protective of Human Health and the Environment

This alternative is considered protective of human health and the environment. The combination of source area remediation, soil cover, and groundwater treatment would significantly reduce the potential for exposure and improve groundwater quality.

Attainment of Media Cleanup Standards

This alternative is intended to meet all of the CAOs including cleanup goals.

Control the Sources of Release

SWMU 4 source area; less than 50% in the PRB area) and a significant amount of lead-contaminated soil would be removed, treated, and managed in the on-site landfill. Any future plans to further consolidate the landfill may require additional financial assurance and possible modifications to the SB. Saturated soil at depths too deep to excavate would be treated by mixing with an arsenic treatment media and/or cement. Enhanced microbial sulfate reduction injections in the saturated zone immediately downgradient of the source areas and along the arsenic plumes would intercept arsenic migrating from remaining sources.

Comply with Any Applicable Standards for Management of Wastes

This alternative complies with all applicable standards for waste management for implementation of groundwater and soil treatments. All waste would be analyzed and disposed in compliance with specified waste management standards and in accordance with federal, state, and local regulations. For the on-site disposal option, it is anticipated that soils contaminated above hazardous Subtitle C characteristic criteria (per 40 CFR 261.24) will be treated in accordance with the RCRA area of contamination policy and placed on the surface of the existing solid waste landfill. The contaminated soil would be covered with two feet of compacted clay.

Long-term Reliability and Effectiveness
The combination of source area remediation and enhanced microbial sulfate reduction is intended to increase long-term reliability and effectiveness by significantly decreasing arsenic flux to the groundwater treatment zones at the northern and southern property lines. Enhanced microbial sulfate reduction will likely result in the fixation of arsenic to permanent forms. The soil cover is expected to mitigate the exposure routes for all soil COCs, and would be monitored and maintained to prevent erosion.

Reduction in Toxicity, Mobility, or Volume of Wastes
The combination of soil cover, source area remediation, and groundwater treatment will result in reductions in toxicity, mobility, and volume of wastes. The soil cover will immediately reduce the potential for direct contact with surface soil. A significant amount of the arsenic mass and co-located COCs in soil at the facility would be removed with the source area excavations. Treatment of the excavated soil with arsenic stabilization agents prior to management in the on-site landfill reduces the potential for arsenic mobility. Model simulations indicate that removal of soil containing greater than 1,000 mg/kg arsenic will reduce leaching to groundwater resulting in decreases arsenic concentrations in groundwater near the source areas expanding downgradient. In-situ stabilization (ISS) treatment of saturated soil at the bottom of the excavations will further decrease arsenic mobility in the source areas. Sulfate reduction injections near source areas would be used to prevent or limit arsenic migration from remaining sources of arsenic and result in the sequestration of arsenic in stable forms. Sulfate reduction bio-walls installed near compliance points would prevent off-site migration. Another advantage of the sulfate reduction approach is that other metals, such as zinc, cadmium, and lead, should remain immobilized because of their affinity for sulfide sequestration as observed in the laboratory treatability study and on-site pilot tests.

Short-Term Effectiveness
Source soil removal, soil cover, and/or building foundations would result in the immediate protection of human health and ecological direct contact with contaminated soil. Modeling results indicate that source area soil remediation will result in short-term decreases in arsenic concentrations in groundwater at the source areas, and over time (4-5 years), at the Grand Calumet River. Groundwater treatment zones (sulfate reduction injections and bio-walls) near the northern and southern property lines are intended to result in rapid improvement of groundwater quality at compliance points.

Implementability
All of the individual technologies utilized as part of Alternative 4 can be implemented with standard techniques and equipment. Phased implementation is required for optimizing the full-scale design of this alternative.

Cost

The estimated cost for this alternative, including annual monitoring for 30 years, maintaining administrative and institutional controls for 30 years, source removal and installing the soil cover, and groundwater treatment is $22.68M.

Sustainability

The sustainability of Alternative 4 addresses the separate component from the previous alternatives of source area removal with on-site treatment and disposal. The source removal and on-site management of contaminated soil occurring within the facility relies on heavy equipment, manpower, and other significant resources. Source removal technology may provide a few key elements of sustainable remediation:

- Eliminates transfer of contamination off-site, which reduces emissions and potential additional resources for managing accidental releases;
- Use heavy equipment with cleaner fuels such as ultra-low sulfur diesel; and
- Modify field operations through combined activity schedules as well as reducing equipment idle.

Alternative 5. Soil: Permeable Cover and Source Area Soil Excavation, In-Situ Stabilization of Saturated Soil, and Excavated Soil Treatment with On-site Management; Groundwater: Pump and Treat

This alternative includes the same soil cover and excavation of arsenic source areas (with treatment and on-site management in the landfill) to decrease the source of arsenic to groundwater as Alternative 4. Alternative 5 includes groundwater extraction at the property and treatment (pump and treat) with a greensand filtration unit. Treated groundwater is discharged to surface waters.

Protective of Human Health and the Environment

This alternative is considered protective of human health and the environment. The combination of source area remediation, soil cover, and groundwater treatment would eventually reduce the potential for exposure and improve groundwater quality. Groundwater remediation approaches have historically employed groundwater extraction and ex-situ treatment (i.e., pump-and-treat). Unfortunately, pump-and-treat alone may not significantly improve groundwater quality, even over time. The limited performance of most pump-and-treat systems stems largely from the inability to significantly clean the groundwater because of the ongoing source of arsenic coming from its presence in the soil.

Attainment of Media Cleanup Standards

This alternative is intended to meet all of the CAOs, including cleanup goals. However, the combination of long-term arsenic desorption from saturated soil and the low arsenic cleanup goal at the northern property line would result in exceptionally long periods of groundwater extraction and post-extraction treatment - potentially even after source removal. Model results predict that removal of SWMU 4 source soils would result in decreased arsenic concentrations downgradient, but long periods of time would be required to achieve the 0.148 mg/L arsenic cleanup goal at the river.

Control the Sources of Release
A significant quantity of the arsenic at the facility (approximately 50% of the arsenic in the SWMU 4 source area; less than 50% in the PRB area) would be removed, treated, and disposed of in the on-site solid waste landfill. As in Alternative 4, saturated soil at depths too deep to excavate would be treated by mixing with an arsenic treatment media and/or cement. Extraction of contaminated groundwater along the arsenic plumes would intercept arsenic migrating from remaining sources.

Comply with Any Applicable Standards for Management of Wastes
This alternative will comply with all applicable standards for waste management for implementation of groundwater and soil treatments. All wastes would be analyzed and disposed in compliance with specified waste management standards and in accordance with federal, state, and local regulations. For the on-site disposal option, it is anticipated that soils contaminated above hazardous Subtitle C characteristic criteria (per 40 CFR 261.24) will be treated in accordance with the RCRA area of contamination policy and placed on the surface of the former landfill. The contaminated soil disposed of in the onsite solid waste landfill would be covered with two feet of compacted clay. Extracted groundwater would be treated to surface water discharge criteria into the Grand Calumet River (i.e., arsenic at or below 148 mg/L). Treatment sludge residues are anticipated to be hazardous and are expected to be managed as hazardous waste and in accordance with applicable RCRA requirements and disposed of off-site.

Long-term Reliability and Effectiveness
The combination of source area remediation and groundwater pump-and-treat is intended to increase long-term reliability and effectiveness by containment of contaminated groundwater treatment zones at the northern and southern property lines. The existing pavement cover and additional soil cover is expected to mitigate the exposure routes for all soil COCs, and both would be monitored and maintained to prevent erosion. With groundwater recovery, the low hydraulic gradient and fluctuating water levels may result in flow reversals from the river to groundwater. A groundwater extraction system near the river may result in the collection and treatment of large volumes of river water.

Reduction in Toxicity, Mobility, or Volume of Wastes
The combination of existing pavement cover, added soil covers, source area remediation, and groundwater treatment will result in reductions in toxicity, mobility, and volume of wastes. The existing pavement cover and additional soil cover will immediately reduce the potential for direct contact with surface soil. A significant amount of the arsenic mass and co-located soil COCs at the facility would be removed with the source area excavations. Treatment of the excavated soil with arsenic stabilization agents prior to management in the on-site landfill reduces the potential for arsenic mobility. Model simulations indicate that removal of soil containing greater than 1,000 mg/kg arsenic will reduce leaching into groundwater and decrease downgradient expansion of arsenic concentrations in groundwater near the source areas over time. ISS treatment of saturated soil at the bottom of the excavations will further decrease arsenic mobility in the source areas. Groundwater pump and treatment systems installed near compliance points would prevent off-site migration.

Short-Term Effectiveness
Soil removal, soil covers, existing pavement and/or building foundations would result in the immediate protection of human health and ecological direct contact with contaminated soil. Modeling results indicate that source area soil remediation will result in short-term decreases in arsenic concentrations in groundwater at the source areas, and over time (4 to 5 years), at the Grand Calumet River. However, model simulations indicate that, even after removal of contaminated soils in the source areas, the long-term groundwater CAOs would not be achieved for a very long period of time (more than 100 years). The limited groundwater flow caused by low hydraulic gradient and limited drainage area contributes to this slow depuration of arsenic. Also, there is a substantial amount of arsenic adsorbed to solids in the saturated zone between the source areas and compliance points; as source levels fell, it would slowly desorb and buffer arsenic concentrations above the cleanup goals. This implies that if groundwater extraction and treatment and discharge (pump-and-treat) were selected as the general response action, this process would need to continue indefinitely. While groundwater extraction and treatment is a well-established technology, the cost and potential for failure both increase due to the relative inefficiency of the process.

Implementability
All of the individual technologies of this alternative can be implemented with standard techniques and equipment.

Cost
The estimated cost for Alternative 5, including annual monitoring, maintaining administrative and institutional controls for 30 years, source removal and installing a soil cover, and operating a groundwater pump-and-treat system is $35.02M.

Sustainability
Alternative 5 does not use green remediation best management practices because of the significant resources used in the groundwater extraction and treatment.

EPA Proposed Remedy
Based on the comparative analysis of alternatives presented above, the recommended corrective measure based on the available information is **Alternative 4:**

- **Soil:** Permeable soil cover, source area soil excavation, ISS of saturated soils and excavated soil treatment with on-site management.
- **Groundwater**: ISCF via sulfate reduction injections and a bio-wall trench located along the southern property line upgradient of the river and within the northern source areas of the facility.

The recommended corrective measures with respect to the site conceptual model and remedial action objectives are summarized as follows:

- Control direct contact with contaminated soil by maintaining existing pavement and foundation barriers, installation and maintenance of a permeable soil cover.

- The excavation, treatment, and on-site management of soil with greater than 1,000 mg/kg arsenic from source areas removes and stabilizes a significant portion of the arsenic at the Facility (approximately 50% of the arsenic in the SWMU 4 source area; less than 50% in the PRB area) that is contributing arsenic to groundwater. Modeling predicts that this removal will result in decreased arsenic concentrations in groundwater in the source areas and downgradient.

- The excavation, treatment, and on-site management of lead contaminated soil in the Leased Area in addition to other barriers such as asphalt (e.g., a parking lot) or concrete (e.g., buildings) mitigates direct human contact, and achieves a residual target cancer risk of $1x10^{-5}$ and a lead exposure factor of less than 1.0.

- In-situ treatment of soil below the water table within the source area excavations where saturated soil concentrations warrant treatment will further reduce the arsenic source to groundwater.

- Enhanced sulfate reduction injection treatment zones along the plume flow paths and a bio-barrier located near the river will intercept arsenic along the plumes and reduce or eliminate additional arsenic migration beyond compliance points. The combination of source area remediation and treatment zones transecting plume flow paths will significantly reduce arsenic migration to the bio-barrier and sulfate reduction injection treatment zone located at the southern and northern property lines, respectively.

- Enhanced microbial sulfate reduction injections to treat the saturated zone extending from the SWMU 4 and northern sources to the compliance points. This is intended to rapidly reduce arsenic in groundwater, reduce the flux of arsenic to the bio-barriers to extend their longevity, and to convert existing forms of arsenic in saturated soils into forms that do not continue to supply arsenic to groundwater.

- Estimate and set aside financial assurance for necessary remediation including long-term OM&M. Any future plans to further consolidate the landfill may require additional financial assurance and possible modifications to the SB.

- Record, implement and maintain EPA-approved institutional controls to ensure protection of workers and ensure that the facility's land use remains consistent with the remedial endpoints and risk assessments. These restrictions will be embodied in a recorded environmental restrictive covenant and deed restriction that runs with the land and will be provided to IDEM's Institutional Controls Registry and Virtual File Cabinet.

- Timely issue a corrective action implementation order to assure compliance with the SB.

The combination of source area remediation via excavation, a soil cover, and groundwater treatment would negate potential for exposure and improve groundwater quality. This alternative is therefore considered protective of human health and the environment.

The recommended corrective measures address the corrective action objectives:
Soil

- Minimize direct contact exposure to surficial soils
- Achieve $1x10^{-5}$ residual risk from direct contact with soils
- Achieve a noncancer Hazard Index<1 across entire redevelopment area
- Remediate identified soil-to-groundwater source areas of arsenic >1,000 mg/kg
- Remediate identified soil source areas of lead to an exposure factor of less than 1.0.

Groundwater

- Short Term (~ 1 to 5 years)
  - Demonstrate measurable groundwater quality improvement close to source areas and monitor for arsenic reductions at the property boundaries
- Long Term (5+ years)
  - Meet the Drinking Water Standard MCL for arsenic (0.01 mg/L or lower) at the northern property boundary and the Surface Water Quality Standard (0.148 mg/L or lower) at the southern property boundary by the river
  - Mitigate potential groundwater contribution/influence on the water quality into the Grand Calumet River

Based on information currently available, EPA's proposed remedy provides balance with respect to the standards described above. EPA believes that the proposed remedy is protective of human health and the environment, and will effectively control human and environmental exposure to contaminants in soil and groundwater. All applicable standards regarding surface water protection, worker protection, and onsite/offsite waste management will be addressed and complied with during implementation of the remedy.

PUBLIC PARTICIPATION

EPA seeks input from the local community on its proposed remedy to address contaminated soil and groundwater at the DuPont East Chicago facility. There will be a 30-day comment period for the public to participate in selecting the final remedy. EPA will schedule a public meeting to answer questions and accept comments. The Administrative Record supporting this SB is available online at https://www.epa.gov/in/hazardous-waste-cleanup-dupont-facility-east-chicago-indiana and at the following locations:

East Chicago Public Library 1008 W. Chicago Avenue East Chicago, Indiana 46312	and	EPA Region 5 RCRA Records Center 77 West Jackson Boulevard, 7th Floor Chicago, Illinois 60604-3590 (312) 886-0902 Hours: Mon-Fri, 9:00 a.m. - 4:00 p.m.

After consideration of public comments on the proposed remedy, EPA will select a final remedy and document its selection in a Final Decision and Response to Comments. In addition, EPA will summarize public comments and provide responses. The Final Decision and Response to comments will be drafted at the conclusion of the public comment period and incorporated into the Administrative Record.

To request information on the public comment period for the proposed remedy at the DuPont facility, please contact:

Mr. Rafael Gonzalez
Community Relations Coordinator
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Land and Chemicals Division, LP17J
Chicago, Illinois 60604-3590
(312) 886-4188
E-mail: gonzalez.rafaelp@epa.gov

To send written comments or request technical information, please contact:

Ms. Jennifer Dodds
EPA Project Manager
U.S. Environmental Protection Agency, Region 5
77 West Jackson Boulevard
Corrective Action Section, LU-16J
Chicago, Illinois 60604-3590
(312) 886-1484
E-mail: dodds.jennifer@epa.gov

Index to the Administrative Record
EPA Proposed Remedy for the Industrial Area at the DuPont Facility Located in East Chicago, Indiana
EPA ID: IND 005 174 354

Document Number	Date	Author/Description
DuPont – 001	2/1990	CH2M Hill. Phase I Groundwater Assessment
DuPont – 002	8/1991	CH2M Hill. Phase II Groundwater Assessment
DuPont – 003	1992	DuPont Environmental Remediation Services. Phase III Groundwater Assessment
DuPont – 004	6/17/97	RCRA Corrective Action Order for the DuPont East Chicago facility is effective.
DuPont – 005	10/1997	DuPont. Current Conditions Report
DuPont – 006	10/2002	DuPont. Final Phase I RFI Report
DuPont – 007	4/2004	DuPont. Phase II RFI Report
DuPont – 008	12/2004	DuPont. Current Human Exposures under Control (CA750)
DuPont – 009	2/2005	Migration of Contaminated Groundwater Under Control (CA750)
DuPont – 010	10/2006	DuPont. Corrective Measures Study
DuPont – 011	10/2007	DuPont. Supplemental Corrective Measures Investigation Work Plan
DuPont – 012	10/2009	Parsons. Sampling Plan - Revised CMS
DuPont – 013	3/2011	Parsons. Technical Memorandum: Summary of Air Monitoring Results
DuPont – 014	3/2011	Parsons. Scoping Document for Human Health Risk Assessment

The Administrative Record for DuPont East Chicago is found at these locations.

U.S. EPA, Region 5
77 W. Jackson Blvd.
Chicago, IL 60604
7th Floor Record Center

East Chicago Public Library
Robert A. Pastrick Branch
1008 W. Chicago Ave.
East Chicago, IN 46312

Index to the Administrative Record

EPA Proposed Remedy for the Industrial Area at the DuPont Facility Located in East Chicago, Indiana
EPA ID: IND 005 174 354

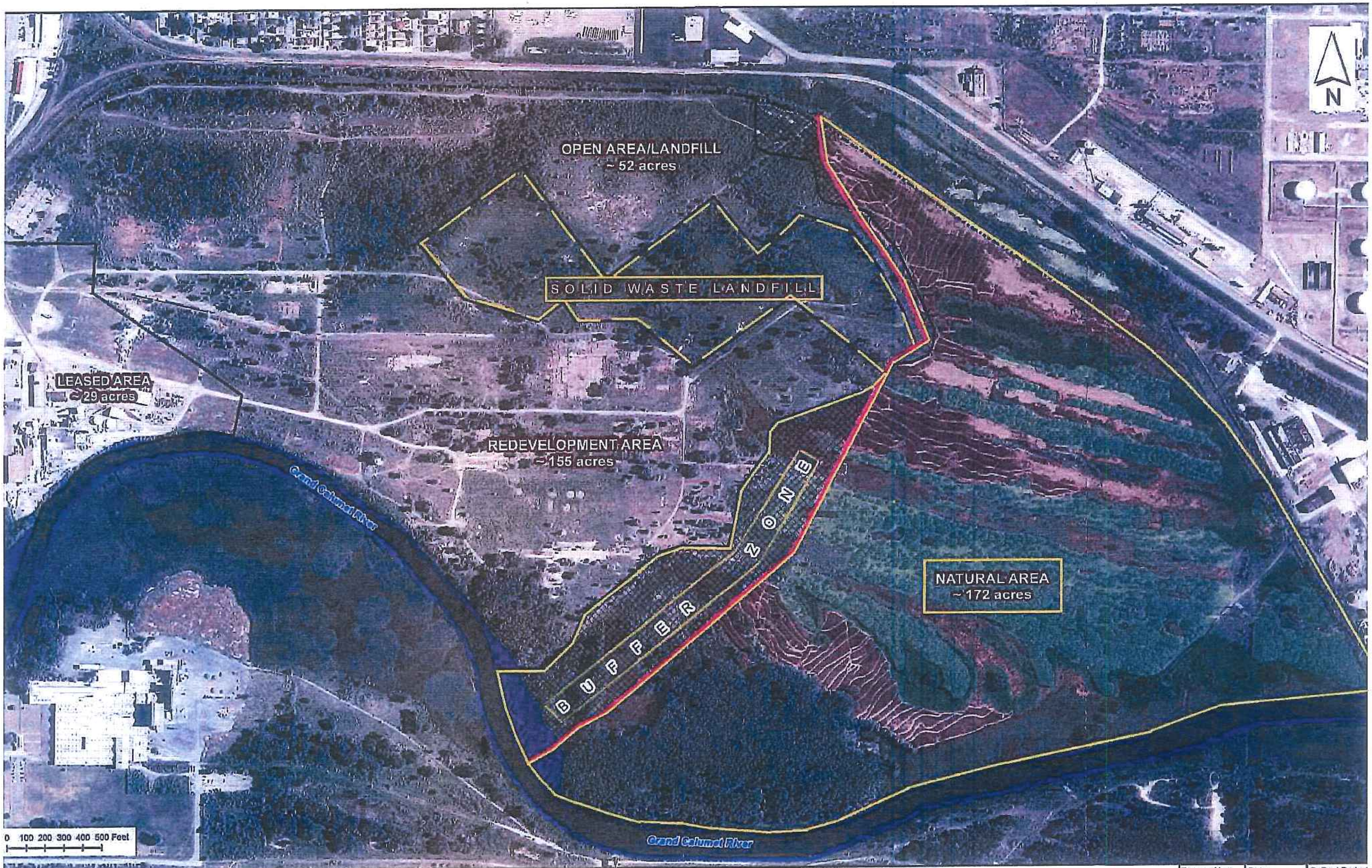
Document Number	Date	Author/Description
DuPont – 015	7/2011	Parsons. Screening Level Ecological Risk Assessment
DuPont – 016	2/2012	PIONEER Technologies Corporation. Human Health Risk Assessment
DuPont – 017	2013	Parsons. Groundwater Evaluation
DuPont – 018	5/2013	Parsons. Baseline Ecological Risk Assessment
DuPont – 019	7/2013	Parsons. Natural Area Evaluation, Risk Assessment and Monitoring Plan
DuPont – 020	4/2014	Parsons. Technical Memorandum: Focused Remedial Technology Screening Update
DuPont – 021	6/2014	Parsons. Draft Landfill Evaluation
DuPont – 022	7/2014	CH2MHill. Bench-Scale Study Report.
DuPont – 023	11/2014	Parsons. Pilot Test Work Plan
DuPont – 024	9/30/14	EPA. Final Decision Document for the DuPont Facility Natural Area and Buffer Zone
DuPont – 025	1/20/2015	Parsons. Technical Memorandum Off-Site Soil Investigation. Railroad Right-of Way.
DuPont – 026	3/2015	Parsons. Corrective Measures Study.
DuPont – 027	6/2015	Parsons. Interim Remedial Measures 2015 Excavations and Soil Treatment Workplan.
DuPont – 028	10/2016	Parsons. Addendum to Corrective Measures Study for Grace Parcel.
DuPont – 029	12/2016	Parsons. Interim Remedial Measures Completion Report.

The Administrative Record for DuPont East Chicago is found at these locations.

U.S. EPA, Region 5
77 W. Jackson Blvd.
Chicago, IL 60604
7th Floor Record Center

East Chicago Public Library
Robert A. Pastrick Branch
1008 W. Chicago Ave.
East Chicago, IN 46312

Figures



PARSONS
Parsons Commercial Technology Group
10 S. Riverside Plaza
Chicago, IL

DUPONT

Figure 1
Natural Area Ridge and Swale Vegetation

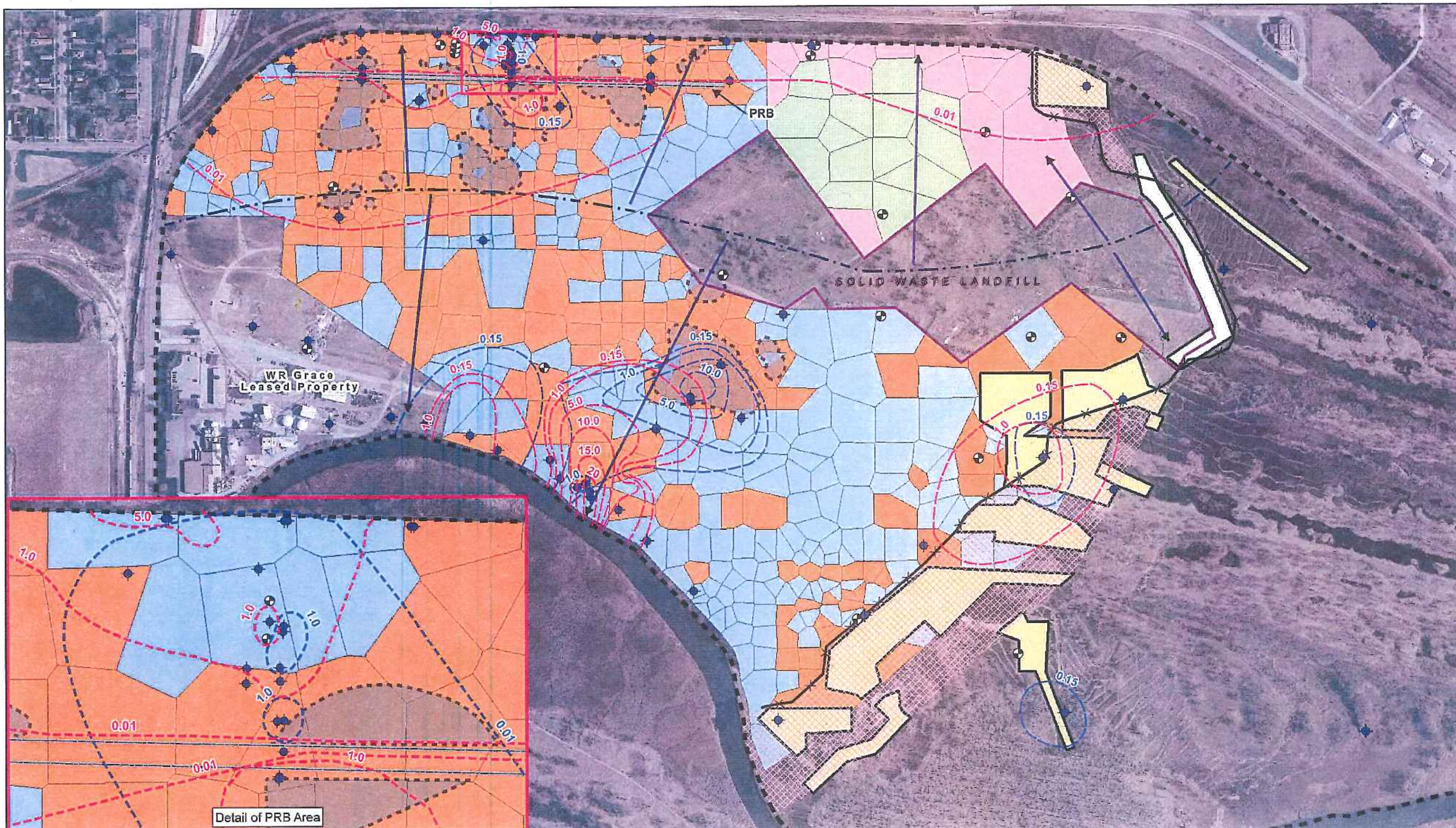
Natural Area Evaluation and Management Plan
DuPont East Chicago Facility
East Chicago, Indiana

Current Easement Boundary
New Fence
Extended Buffer Zone (~23 acres)
Future GCR-SRP Shelf Wetlands

Plant Community Mapping
Swale (Wetland)
Dune/Ridge - Mesic Prairie
Dune/Ridge - Oak Barrens

River
Property Boundary

Prepared by: Garner Peterson	Date: 6/3/2013	DuPont Project 507942
Reviewed by: Carlos Victoria	Figure	PARSONS Proj 446650



PARSONS

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10 S. Riverside Plaza
Chicago, IL

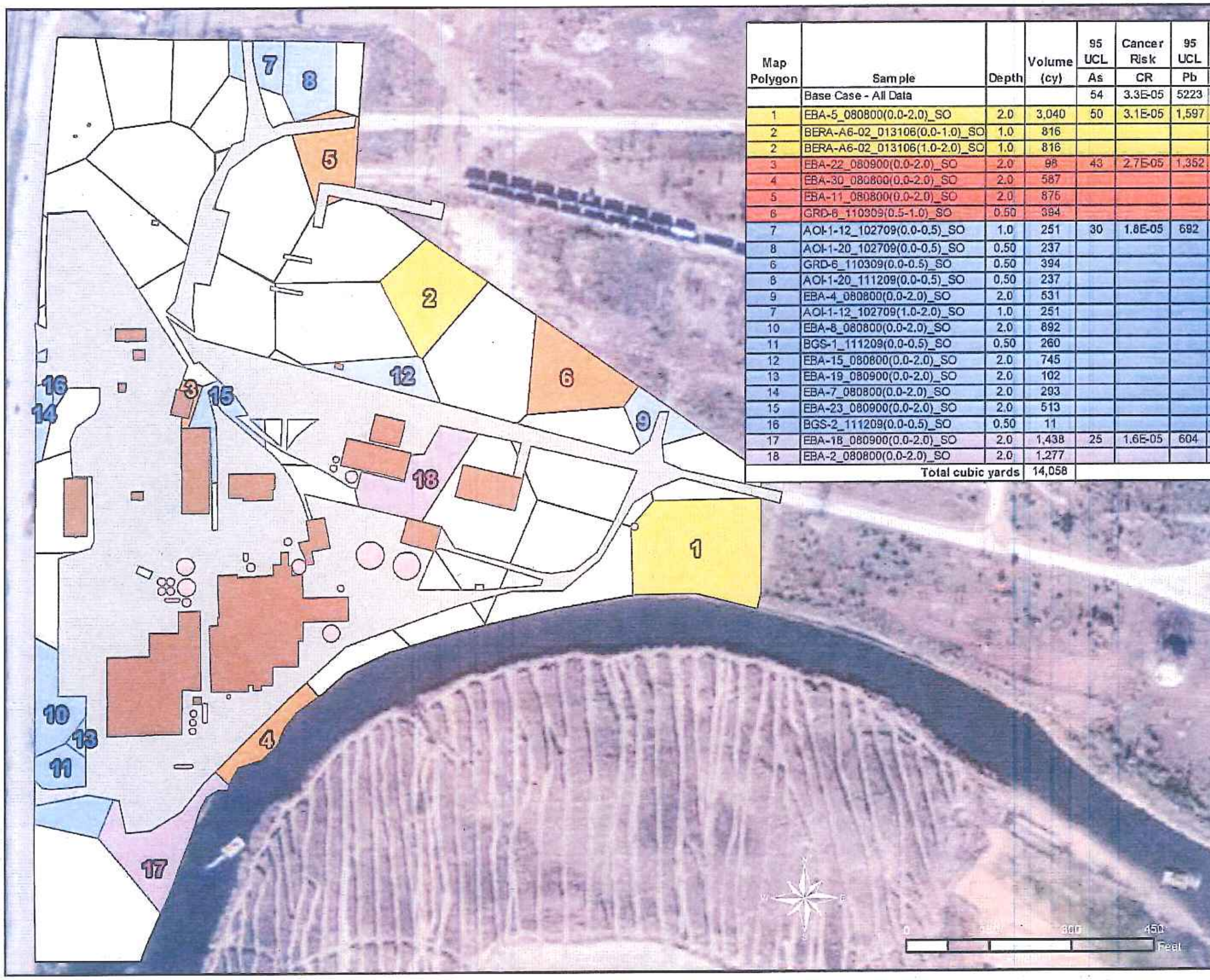
DUPONT

Figure 2
Site Conceptual Model

DuPont East Chicago Facility
East Chicago, Indiana

Document Path: J:\DuPont East Chicago\GIS\East_Chicago_Projects\CMS\MXD\SiteConceptualModel.mxd

Map Polygon	Sample	Depth	Volume (cy)	95 UCL As	Cancer Risk CR	95 UCL Pb	Lead EF EF	Removed Concentration (mg/kg) As	Removed Concentration (mg/kg) Pb	Clean Fill Concentration (mg/kg) As	Clean Fill Concentration (mg/kg) Pb	Truncation and Replacement Round
	Base Case - All Data			54	3.3E-05	5223	8.2					
1	EBA-5_080800(0.0-2.0)_SO	2.0	3,040	50	3.1E-05	1,597	2.3	19	42,500	8.4	7.2	Round 1
2	BERA-A6-02_013106(0.0-1.0)_SO	1.0	816					62	6,600	8.4	7.2	
2	BERA-A6-02_013106(1.0-2.0)_SO	1.0	816					109	16,200	8.4	7.2	
3	EBA-22_080900(0.0-2.0)_SO	2.0	98	43	2.7E-05	1,352	2.0	227	1,540	8.4	7.2	Round 2
4	EBA-30_080800(0.0-2.0)_SO	2.0	587					213	824	8.4	7.2	
5	EBA-11_080800(0.0-2.0)_SO	2.0	875					147	1,450	8.4	7.2	
6	GRD-6_110309(0.5-1.0)_SO	0.50	394					111	5,610	8.4	7.2	
7	AOI-1-12_102709(0.0-0.5)_SO	1.0	251	30	1.8E-05	692	1.0	109	1,460	8.4	7.2	Round 3
8	AOI-1-20_102709(0.0-0.5)_SO	0.50	237					100	2,390	8.4	7.2	
6	GRD-6_110309(0.0-0.5)_SO	0.50	394					44	6,470	8.4	7.2	
8	AOI-1-20_111209(0.0-0.5)_SO	0.50	237					46	1,130	8.4	7.2	
9	EBA-4_080800(0.0-2.0)_SO	2.0	531					45	847	8.4	7.2	
7	AOI-1-12_102709(1.0-2.0)_SO	1.0	251					44	536	8.4	7.2	
10	EBA-8_080800(0.0-2.0)_SO	2.0	892					44	747	8.4	7.2	
11	BGS-1_111209(0.0-0.5)_SO	0.50	260					44	4,520	8.4	7.2	
12	EBA-15_080800(0.0-2.0)_SO	2.0	745					56	727	8.4	7.2	
13	EBA-19_080900(0.0-2.0)_SO	2.0	102					49	620	8.4	7.2	
14	EBA-7_080800(0.0-2.0)_SO	2.0	293					46	582	8.4	7.2	
15	EBA-23_080900(0.0-2.0)_SO	2.0	513					42	343	8.4	7.2	
16	BGS-2_111209(0.0-0.5)_SO	0.50	11					42	763	8.4	7.2	
17	EBA-18_080900(0.0-2.0)_SO	2.0	1,438	25	1.6E-05	604	0.88	83	1,630	8.4	7.2	Round 4
18	EBA-2_080800(0.0-2.0)_SO	2.0	1,277					74	1,750	8.4	7.2	
	Total cubic yards		14,058									



Legend

- No Removal
- Remove for EF < 3
- Remove for EF < 2
- Remove for EF < 1
- Remove for EF < 1; CR < 1.6E-05

Impervious Features

- Building
- Concrete, Roadway, Parking
- Structure
- Tank

PIONEER TECHNOLOGIES CORPORATION

Excavation Evaluation
Grace Property
East Chicago Site

Figure 3

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Table

Table 1
Comparative Analysis of Corrective Measures Alternatives

	STANDARDS				OTHER FACTORS				
Corrective Measures Alternative	**Overall Protection of Human Health and the Environment**	**Attain Media Cleanup Standards**	**Control the source(s) of release to reduce or eliminate further releases**	**Comply with any applicable standards for waste management**	**Long-Term Effectiveness and Sustainability**	**Reduction in TMV of Wastes**	**Short-Term Effectiveness**	**Implementability**	**Total Present Value** [1]
1 Monitoring and Institutional Controls (Baseline)	Not protective of human health or environment	Does not achieve CAO	Does not control leaching to groundwater or arsenic migration	No waste would be managed	Not effective	Does nothing to reduce TMV beyond natural processes which are not effective at the Site	Not effective	Readily implementable (no actions required)	$1,541,000
2 Monitoring and Institutional Controls with a Permeable Soil Cover	Not protective of human health and environment	Does not achieve CAO	Does not control leaching to groundwater or arsenic migration	No waste would be managed	Not effective Leaching of arsenic to groundwater will sustain concentrations above CAOs for a very long period of time Arsenic migration at compliance points is not controlled Residual risk to human health is low because cover will prevent contact with impacted soil and groundwater is not used on-site or in the surrounding area for drinking water	Does nothing to reduce TMV beyond natural processes which are not effective at the Site	Not effective for groundwater	Readily implementable (uses well established technologies)	$9,170,600
3 Soil: Permeable Cover Groundwater: in-situ chemical fixation (ISCF) via sulfate reduction injections and a bio-wall trench	Protective of human health and environment	Achieves current and future CAO	Intercepts arsenic migrating from source areas but does not eliminate or remediate the source areas	Yes, complies with applicable standards for waste management	Questionable Absence of source area soil remediation results in high demand for treating arsenic in the saturated zone and increased duration required to maintain arsenic treatment in the saturated zone.	Reduces TMV in groundwater and saturated soil through treatment	Immediately reduces or eliminates the potential for human and ecological contact with impacted soil. Rapid restoration of groundwater quality at compliance points with improving groundwater quality along the plume over time.	*Soil Cover*: Readily implementable (uses well established technologies) *ISCF*: Readily implemented	$14,862,750

Table I' (*continued*)
Comparative Analysis of Corrective Measures Alternatives

	STANDARDS				OTHER FACTORS				
Corrective Measures Alternative	**Overall Protection of Human Health and the Environment**	**Attain Media Cleanup Standards**	**Control the source(s) of release to reduce or eliminate further releases**	**Comply with any applicable standards for waste management**	**Long-Term Effectiveness**	**Reduction in TMV of Wastes**	**Short-Term Effectiveness**	**Implementability**	**Total Present Value (1)**
4 Soil: Permeable soil cover and source area soil excavation with on-site management Groundwater: In-situ chemical fixation (ISCF) via sulfate reduction injections and a bio-wall trench	Protective of human health and environment.	Achieves current and future CAO.	Removes contaminated soil in source areas and treats groundwater migrating from the source areas	Yes, complies with applicable standards for waste management	Effective over long-term. Source area excavations reduce arsenic migration to groundwater treatment zones.	Reduces TMV through: 1) removal and treatment of soil from the source areas, 2) application of a soil cover mitigates direct contact, and 3) source area excavations and 4) groundwater treatment reduces concentrations and mobility in groundwater.	Immediately reduces or eliminates the potential for human and ecological contact with impacted soil. Eventual restoration of groundwater quality at compliance points with improving groundwater quality along the plume over very long period of time.	Individual technologies can be readily implemented.	$22,683,522
5 Soil: Permeable soil cover and source area soil excavation with on-site management Groundwater: recovery through extraction wells and treatment of extracted groundwater with ion exchange resins and filtration followed by discharge to surface waters	Protective of human health and environment	Achieves current and future CAOs for soil. Unlikely to achieve long term groundwater clean-up goals.	Removes contaminated soil in source areas	Yes, complies with applicable standards for waste management	Unlikely to achieve long term groundwater clean-up goals but off-site migration is controlled. Minimally multiple decades of groundwater extraction required.	Reduces TMV through: 1) removal and treatment of soil from the source areas, 2) application of a soil cover mitigates direct contact, 3) source area excavations, and 4) off-site migration of impacted groundwater is prevented.	Immediately reduces or eliminates the potential for human and ecological contact with impacted soil. Improved groundwater quality at compliance points is predicted.	Individual technologies can be readily implemented.	$35,019,000

N/A not applicable

(1) Details of the cost estimates are provided in Appendix A. - CMS