Proposed Plan of Remedial Action
Former Amoco Polymer Plant Site
Operable Unit 2 (OU-2)

950 River Road
New Castle, Delaware

December 2003

Department of Natural Resources and Environmental Control
Division of Air and Waste Management
Site Investigation and Restoration Branch

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1.0 Introduction

The Former Amoco Polymer Plant is located at 950 River Road in New Castle, Delaware (Figure 1). The Former Amoco Polymer Plant was divided into two operable units (OU-1 and OU-2) for the purpose of performing a remedy. A final plan of remedial action (final plan) was issued for OU-1 in October 2002. The final plan for OU-1 consist of focused soil removal, deed restrictions which limit the property to non-residential land use, placement of a Groundwater Management Zone (GMZ), and development and implementation of an Operations and Maintenance Plan for the closed asbestos landfill.

This document represents DNREC's proposed plan of remedial action (proposed plan) for OU-2 (site) which is predominantly located in Army Creek Marsh (the marsh), with a 15-acre portion being located in the uplands of the former BP Amoco Polymer Plant. OU-2 occupies approximately 50 acres within tax parcel numbers 1003600007 (currently owned by Dureco Polymers, Inc.) and 1003000046 (owned by the Department of Natural Resources and Environmental Control's [DNREC's] Fish and Wildlife Division). OU-2 contains both upland and wetland areas of the Former Amoco Polymer Plant Site. The footprint of OU-2 is identified on Figure 2. OU-2 is bordered by the Former Amoco Polymer Plant Site OU-1 to the south, River Road and the Delaware River to the east, Army Creek to the north, and two Federal Superfund Sites, Army Creek Landfill and Delaware Sand and Gravel (DS&G), to the west.

In order to assess the need for environmental remediation at the Former Amoco Polymer Plant Site, BP Amoco entered into DNREC's Voluntary Cleanup Program (VCP) in 1998 under the provisions of the Delaware Hazardous Substance Cleanup Act (HSCA) 7 Del. C. Chapter 91. Through a VCP Agreement, BP Amoco agreed to investigate the potential risk posed to public health, welfare and the environment at the Former Amoco Polymer Plant Site. BP contracted with RMT, Inc., (RMT) to perform a remedial investigation (RI) and risk assessment (RA). The purpose of the RI was to: 1) understand the nature and extent of any soil contamination on the Former Amoco Polymer Plant Site, 2) evaluate the risks posed to public health, welfare and the environment associated with any identified contamination, and 3) identify and recommend a remedial action, if required by DNREC.

This document is DNREC's proposed plan for the site. It is based on the results of the previous investigations performed at the site. The proposed plan is issued under the provisions of the HSCA and the Delaware Regulations Governing Hazardous Substance Cleanup (Regulations). It presents the Department's assessment of the potential health and environmental risk posed by the site.

As described in Section 12 of the regulations, DNREC will provide notice to the public and an opportunity for the public to comment on the proposed plan. At the comment period's conclusion, DNREC will review and consider all of the comments received, and will issue a final plan for OU-2. The final plan shall designate the selected remedy, if required, for the site. All prior investigations of the site, the proposed plan, the comments received from the public, DNREC's responses to the comments, and the final plan will constitute the Remedial Decision Record.

Section 2.0 presents a summary of the sites background, site description and history. Section 3.0 provides a description of historical investigations and risk assessment results. Section 4.0 presents a discussion of the remedial action objectives. Section 5.0 presents the proposed plan of remedial action. Section 6.0 discusses public participation requirements.

1.1 Background

Historical industrial processes conducted during operation of the Former Amoco Polymer Plant have resulted in deposits of process residuals (i.e., plastic and chemicals) on portions of OU-2. The presence of process residuals in the marsh was initially identified during the RI field activities conducted for the former BP Amoco Polymer Plant. DNREC is concerned with the presence of the accumulated process residuals for several reasons. First, the process residuals identified as pellets pose a potential threat to waterfowl, which may incidentally ingest pellets. Ingested pellets could accumulate in the gastrointestinal system, compromising the waterfowl's uptake of nutrients. Additionally, the process residual pellets may be one source of fuel during brush fires that occur periodically in Army Creek Marsh. DNREC is also concerned that chemical constituents in the process residuals identified as "paste" (i.e., alkyl/nonylphenols), based on physical and chemical characteristics, and could potentially pose a threat to the health of Army Creek Marsh ecological receptors and to firefighters occasionally active in the marsh. In addition, several compounds present in wetland soil and sediment were identified as contaminants of potential concern (COPCs) that do potentially pose a threat to ecological receptors (Subsection 3.3).

In addition to removing the process residuals from the marsh, BP Amoco agreed to remove a soil pile located on the Lot 6 portion of OU-2 containing mirex that was brought on-site by Weaver Pole Line, Inc. as part of a mining operation in the Harry Wood Landfill (landfill). Weaver Pole Line, Inc. mined the landfill for waste polypropylene in 1989 and 1990 and the mined material was transported to the former Amoco Polymer Plant site for processing. After transporting the mined material to the site, larger pieces of the waste polypropylene were separated from commingled soil through a screening process. The remaining soil was staged on a concrete pad on the Lot 6 portion of OU-2. This is the mirex contaminated soil pile that BP Amoco has agreed to remove.

In planning for the removal of the materials from the marsh, several investigations were conducted to:

- Characterize the nature of the process residuals in Army Creek Marsh;
- Delineate the horizontal and vertical extent of the process residuals; and
- Evaluate potential risks to public human health and the environment associated with exposure to wetland soil and sediment of Army Creek Marsh following removal of the identified process residuals.

2.0 Site Description and History

2.1 Site Setting

Army Creek is approximately 3.9 miles in length and discharges into the Delaware River, 0.4 miles west of the city limits of New Castle, Delaware. The lower mile of Army Creek traverses the Army Creek Marsh. The Army Creek Marsh is one of four distinguishable wetlands in the Army Creek Drainage Basin. Approximately 37 acres of OU-2 are located within the Lower Army Creek Marsh.

The Army Creek Drainage Basin occupies an area of approximately six square miles. Surface water runoff from a variety of industrial, commercial, and residential areas drain into this basin, as well from the DS&G and Army Creek Landfill Superfund sites. In addition, groundwater pumped from the Army Creek Landfill Superfund site is discharged directly to Army Creek following iron removal. Surface water collected by the Army Creek Drainage Basin enters the Lower Army Creek Marsh before being discharged to the Delaware River.

2.2 Site and Project History

In the late 1950s, a parcel of land bordering the south side of the Army Creek Marsh was developed as a chemical manufacturing plant by Avisun Corporation (a joint venture between American Viscose Company and Sun Oil Company). Beginning in 1961, the primary product manufactured at the facility was polypropylene pellets, which were shipped in bulk. Amoco Chemical Company (Amoco) acquired ownership of the facility in 1968 and operated it until 1980. In 1980, an explosion at the plant terminated manufacturing operations. Amoco donated the property to the State of Delaware in 1983. Subsequently, Dureco Chemicals purchased the plant site in the mid-1980s from the State of Delaware. Dureco Polymers, Inc. (Dureco) later purchased the site from Dureco Chemicals. One of Dureco's operations has been to recover polypropylene waste materials from nearby landfills and process these materials on site for resale.

Polypropylene manufacturing operations at the plant generated several waste streams. From 1961, when operations began at the plant, until 1980, when plant operations ceased, process waters were discharged to the Army Creek Marsh. Beginning in 1972, discharges from the Plant came in affect under the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES) through the NPDES program. Discharges of process waters to the marsh resulted in deposits of process residuals on portions of OU-2. In 1983, Amoco withdrew the discharge permits with the closure of the plant.

In 1995, the Army Creek Natural Resource Trustees (Trustees), comprised of representatives from DNREC, the US Fish and Wildlife Service, and the National Oceanographic and Atmospheric Administration (NOAA), prepared a restoration plan for the Army Creek Marsh under the natural resource damages provisions of CERCLA. In this plan, the trustees concluded that the low diversity of species found in the Marsh could, in large part, be attributed to the water management plan that is presently in place for Army Creek. A system of one-way tidal

floodgates was installed at the confluence of Army Creek with the Delaware River that eliminates tidal inflows into Army Creek. These tidal floodgates were designed to prevent flooding of the Army Creek Drainage Basin, which would thereby protect residential and commercial property. The exclusion of tidal inflows into the Lower Army Creek has resulted in the marsh becoming a"high marsh," allowing a virtual monoculture of *Phragmites* to become established.

The Army Creek Marsh Restoration Plan is designed to rectify the conditions brought about by the present water management plan. The objectives of the restoration plan are to re-establish tidal flow, increase the water level in the marsh, and to remove a majority of the nuisance *Phragmites* that has proliferated in the marsh.

The Trustees have delayed implementation of the Restoration Plan pending completion of investigation and removal activities conducted under the direction of DNREC. This proposed plan represents the criteria which will define the extent of the removal activities necessary in the Army Creek Marsh.

3.0 Investigation and Risk Assessment Results

3.1 Historical Investigations

Numerous investigations have been conducted to evaluate the health of the Army Creek Marsh. As early as 1973, multimedia and biological samples were collected in the marsh to assess the health of the marsh. Several biological survey and biomonitoring events have been conducted beginning in 1972 and continuing to the present. The previous evaluations of the marsh concluded that the benthic and wildlife communities in the marsh did not display adverse effects due to industrial process residuals. Rather, a study conducted by Cole and Fabean (1992) for the USEPA concluded that the lack of diversity in the marsh was a direct result of the presence of a monoculture of *Phragmites*, a common reed. These studies were conducted adjacent to the site.

In 1998, DNREC began evaluating marsh conditions, through the collection and analysis of sediment samples throughout Army Creek Marsh, for purposes of assessing the presence and distribution of constituents potentially related to the process residuals identified in the marsh. Additional investigations were subsequently conducted to characterize the nature and extent of the process residuals. Beginning in August 1999, Tetra Tech, Incorporated (Tetra Tech) under the direction of DNREC, initiated an investigation to delineate the horizontal and vertical extent of the process residuals present in the Army Creek Marsh. Based on investigations conducted by Tetra Tech for DNREC, two types of process residuals were identified; plastic waste and "paste" waste. The plastic waste consists primarily of multicolored plastic pellets with some shredded/powdery plastic material throughout. In the former manufacturing process, polypropylene powder was extruded into a denser, pelletized form. Some pellets were reworked to pigment the polymer to specific customer colors. The "paste" waste is a grayish, viscous material with a smooth consistency, much like peanut butter. Streaks of various colors have been observed within this material. The "paste" waste is believed to contain catalyst sludge, and includes both heavy metals, alkyl/nonyl-phenols and other plant wastes.

In 1999 and 2001, the US EPA required the Army Creek Landfill Trustees to collect sediment samples from the Army Creek Marsh as part of the five year review process for the federal superfund site. One sediment sample was collected in the Army Creek Marsh cleanup area and the sediment sample showed some adverse ecological effects to potential receptors during biotoxicity testing.

3.2 Remedial Investigations

RMT conducted supplemental Phase I (March 2000) and Phase II (November 2000) remedial investigations that included chemical analysis of the process residuals, as well as underlying and adjacent wetland soils. Samples of surface water, and sediment from Army Creek Marsh were also collected for biotoxicity testing outside the planned removal area as part of the RMT investigations for BP Amoco.

In 1998, Dureco contracted Environmental Alliance Inc. to collect soil samples and perform chemical analysis of the mirex soil pile on Lot 6 of OU-2. BP Amoco has agreed to remove the process residuals in the portion of the marsh delineated by DNREC (see Figure 2) and the mirex soil pile on Lot 6 of OU-2. The Department considers the marsh, in its current state, to be a risk to human health, welfare and the environment. Additional evaluations of the Army Creek Marsh will be performed with the objective of estimating the potential impacts to human health and the environment following the removal of these materials.

3.3 Contaminants of Potential Concern

To identify those site-related contaminants of potential concern (COPCs) that might pose a risk to human health and the environment, samples were collected both adjacent to and below the process residual materials. The maximum concentration of each contaminant detected was compared to DNREC's Uniform Risk-Based Remediation Standards (URS) for human health and protection of the environment. Consistent with DNREC-SIRB guidance (*Remediation Standards Guidance under the Delaware Hazardous Substance Cleanup Act*, December 1999), three environmental media were evaluated: wetland soils (intermittently flooded soils), sediments (permanently under water), and surface water.

To identify human health COPCs, the maximum concentrations of each chemical detected in the wetland soils/sediments of Army Creek Marsh were compared to Delaware URS values for restricted land use in a non-critical water resource area. Those chemicals detected at a concentration greater than the applicable DNREC URS and those chemicals without DNREC URS values were designated as COPCs and were the focus of subsequent human health risk evaluations. For surface water, the maximum detected concentrations in surface water were compared to Delaware Surface Water Quality Criteria (SWQC) for the consumption of water and fish. OU-2 is located in a non critical water resource area.

To identify ecological COPCs, the maximum concentrations of each contaminant detected in the wetland soils/sediments of Army Creek Marsh were compared to Delaware URS sediment values for protection of the environment. For surface water, the maximum concentrations of each contaminant detected in the surface water of Army Creek were compared to Delaware URS

values for surface water. Those contaminants detected at concentrations greater than DNREC URS values and those chemicals without a DNREC URS value were designated as ecological COPCs and were the focus of subsequent ecological risk evaluations.

There was only one contaminant identified as a COPC for human health, however, a number of contaminants were identified as ecological COPCs. Tables 3-1 through 3-3 present the human health and ecological COPCs which were carried forward in the risk assessment.

Table 3-1
Human Health COPCs
Wetland Soil/Sediment

Human Health COPC	Maximum Detected Concentration (mg/kg)	URS (1) (mg/kg)
Arsenic	39	4 11(2)

(1) Restricted land use, non-critical water resource area.
(2) Based on DNREC's background value for arsenic.

Table 3-2
Ecological COPCs - Wetland Soil/Sediment

Ecological COPC	Maximum Detected Concentration (mg/kg)	URS[1] (mg/kg)	Ecological COPC	Maximum Detected Concentration (mg/kg)	URS[1] (mg/kg)
Benzo(a)anthracene	0.12	0.1	Copper	230	34
Benzo(a)pyrene	0.11	0.1	Lead	230	47
4,4-DDD	0.13	0.008	Magnesium	6,800	N/A
Aluminum	110,000	N/A	Manganese	1,560	N/A
Antimony	74	2	Mercury	1.1	0.2
Arsenic	42	8	Nickel	280	21
Barium	400	20	Potassium	3,000	N/A
Beryllium	2.3	N/A	Selenium	9.0	N/A
Cadmium	45	1	Sodium	670	N/A
Calcium	6,800	N/A	Thallium	4.5	N/A
Chromium, total	2000	81	Titanium	93,000	N/A
Chromium, hexavalent	29	N/A	Vanadium	1400	N/A
Cobalt	51	N/A	Zinc	1700	150

(1) Delaware sediment URS for the protection of the environment.
N/A Not applicable, Delaware URS not available for this chemical.

Table 3-3
Ecological COPCs
Surface Water

Ecological COPCs	Maximum Detected Concentration (mg/l)	URS[1]
Barium	0.11	0.004
Manganese	2.87E-01	0.08

(1) Delaware URS surface water for the protection of the environment (mg/l).

COPCs were identified by Environmental Alliance Inc. of the mirex soil pile. Table 3-3a lists the COPCs. These contaminants were selected as having potential human health risks.

Table 3-3a

Mirex Soil Pile COPCs

Soil

COPCs	Maximum Detected Concentration mg/kg	URS Human Health/Ecological
Mirex	56	41/1
Arsenic	4.8	4/10
Cadmium	9.1	100/3
Phenanthrene	4.8	5000/0.5
Benzo(a)pyrene	2.9	0.09/0.1
Dibenz(a,h)anthracene	0.83	0.8/NA
Indeno(1,2,3-cd) Pyrene	2.5	8/.8
Chrysene	3.2	780/0.9
Benzo(a)anthracene	3.1	780/0.1

3.4 Risk Assessment Results

A multilevel approach was used to evaluate the potential risk to human health and the environment posed by exposure to COPCs in Army Creek Marsh soils, sediment and surface water, following removal of the process residuals. The Army Creek Marsh human health and ecological risk assessments were conducted consistent with DNREC guidance to evaluate the magnitude of the potential risks to certain segments of the human population and the environment under post-removal conditions in the marsh.

The results of the risk assessments found no unacceptable risk to human health or the environment, following removal of the process residuals from the marsh. The exposure of a hunter/fisherman to the wetland soils remaining beneath and adjacent to the process residuals and the sediments in Army Creek, resulted in a noncarcinogenic Hazard Index (HI) greater than 1.0, and an estimated carcinogenic risk level equivalent to the Delaware DNREC's acceptable risk value of 1×10^{-5}. However, the arsenic concentration was primarily responsible for these quantitative risk and HI estimates (based on using an arsenic URS value of 4 milligrams per kilogram [mg/kg]). Because Delaware's background level for arsenic is 11 mg/kg, following removal of the process residuals from the marsh, the Department will attempt to reduce the average concentration of arsenic remaining in the wetland soil to be below the DNREC's proposed background concentration. Based on the above, post removal exposure to Army Creek Marsh soils and sediments should not pose an unacceptable risk to human health.

Exposure to Army Creek Marsh soils and sediments will reduce the risk to ecological receptors after the process residuals are removed. In addition, biotoxicity tests performed on surface water and sediment samples (outside the removal area) collected from Army Creek found no adverse impact to the growth and survival of the test species.

A human health risk assessment was preformed on the mirex soil. The human health risk assessment concluded that mirex posed an unacceptable risk. The risk value was 1.23×10^{-05}. The human health risk assessment was based a critical water resource area. OU-2 is located in a non critical water resource area. An ecological risk assessment and an evaluation of tentatively identified compounds were not preformed. The Department did not require BP Amoco to conduct an ecological risk assessment of the mirex pile because BP Amoco has agreed to remove it.

4.0 Remedial Action Objectives

According to Section 8.4 (1) of the Regulations, site-specific remedial action objectives (RAOs) must be established for all plans of remedial action. The Regulations provide that DNREC set objectives for land use, resource use, and cleanup levels that are protective of human health and the environment.

Qualitative objectives describe, in general terms, what the ultimate result of the remedial action, if necessary, should be. The following qualitative objective is determined to be appropriate for the Army Creek Marsh:

- Prevent potential ecological exposure to the hazardous substances identified in the Army Creek Marsh and mirex soil pile on Lot 6.

This objective is consistent with the proposed future use of the marsh for non-residential use in an urban setting as detailed in *Restoration Plan for Army Creek Landfill Settlement* (Army Creek Natural Resource Trustees, October 1995).

Quantitative objectives define specific levels of remedial action needed to achieve protection of human health and the environment. To meet the qualitative objective identified above, quantitative objectives will ensure that future site workers, visitors, hunters/fishermen, and trespassers, are not exposed to hazardous substances. Although exposure to marsh soils, sediments, and surface water following removal of the hazardous substances will not pose a risk to human health or the environment, a quantitative method to confirm removal of the hazardous substances is warranted. Development of cleanup goals will provide a quantitative measure of the effectiveness of the removal action. Once the cleanup has been completed, a new risk assessment must be preformed on the cleanup area because the actual ecological risk in this area has never been quantified. A Hazard Quotient for the contaminants of concern will be quantified after the hazardous substances are removed. Additional samples will be collected and a subsequent risk assessment will be conducted after removal of the hazardous substances. Cleanup goals were based upon an evaluation of ecological risk and the results of biotoxicity testing involving the exposure of ecological receptors to marsh sediments, resulting in no observed adverse effects outside and beneath the cleanup area.

Therefore, based on the qualitative objectives, the following quantitative objective is determined appropriate for developing cleanup goals for the Army Creek Marsh during removal of the hazardous substances:

- To prevent human and ecological exposure to hazardous substances that might result in a carcinogenic risk exceeding 1×10^{-5}, a noncarcinogenic Hazard Index of 1.0, applicable requirements(cleanup goals) from other environmental sites, and/or documented cleanup goals from other environmental programs.

5.0 Proposed Plan of Remedial Action

The primary objective of the remedial actions proposed for Army Creek Marsh will be to remove the process residuals from affected upland and wetland portions of OU-2. In addition, some areas of the Army Creek Marsh wetland soils contain certain chemical constituents in concentrations that could pose a potential risk to certain segments of the human or ecological populations if those areas are routinely accessed. The proposed plan of remedial action for the Army Creek Marsh consists of the following:

1. Within that area of Army Creek Marsh depicted in Figure 2, all process residuals above the levels set out in paragraph 2, below, will be removed. A work plan describing the methodologies for removal and the ultimate disposal of the materials will be submitted to DNREC for review and approval prior to initiating the removal.

2. To confirm sufficient removal of the process residuals, cleanup goals for the following chemicals have been established for the marsh removal area:

Arsenic	<20 mg/kg
Thallium	<1.4 mg/kg
Vanadium	<113 mg/kg
Antimony	<14 mg/kg
Alkyl/Nonyl Phenols	<25 mg/kg
Zinc	<980 mg/kg

3. Remove and dispose of the mirex containing soil pile, presently located on a concrete pad on the Lot 6 portion of OU-2 as shown in Figure 2, with the following cleanup goal:

Mirex	<2 mg/kg

4. Deed restrictions requiring that no excavation, digging or other intrusive activities occur without prior written DNREC approval; limits the site to non-residential land use.

5. In addition, a groundwater management zone (GMZ) restricting groundwater usage at the site will be established by DNREC.

6.0 Public Participation

DNREC actively solicits public comments or suggestions on the proposed plan and welcomes opportunities to answer questions. Please direct written comments to the following:

Delaware Department of Natural Resources and Environmental Control
Site Investigation and Restoration Branch
391 Lukens Drive
New Castle, Delaware 19720-2774
Attention: Robert M. Schulte

The public comment period for this proposed plan begins on December 22, 2003, and ends at the close of business (4:30 p.m.) on January 12, 2004. If a request is received, a public hearing will be held on the proposed plan. The meeting time and place will be announced, if said hearing is requested.

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Date of Review John Blevins, Division Director

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