Five-Year Review
South Cavalcade Street Superfund Site
Houston, Harris County, Texas

September 2007

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6

FIVE_YEAR REVIEW
South Cavalcade Street Site
EPA ID# TXD980810386
Houston, Harris County, Texas

This memorandum documents EPA's approval of the findings, actions needed, and determinations for the South Cavalcade Street Site's Second Five-Year review.

Summary of Five-Year Review Findings

The current Site conditions were found to be protective of human health and the environment. The concrete caps in the southeastern and southwestern areas are in good condition and ensure that there is no current or future exposure to the encapsulated contaminated soils. A vertical offset in the driveway adjacent to the southwestern cap was noted as in the previous Five-Year Review. The integrity of the cap does not appear to be impacted and no indications of settling were observed.

The Dense Non-Aqueous Phase Liquid (DNAPL) collection and ground water treatment systems operated as intended until April 2006, when the system became inoperative as a result of a lightning associated power surge that damaged the system controller. Since then DNAPL recovery has been completed in a passive mode (i.e., without groundwater pumping) via manual pumping of DNAPL from the collection wells. The plans for the system will be determined once the remedial alternative is selected as part of the Focused Feasibility Study underway.

Reasonable interpretation of the existing ground water data indicates the continued presence of DNAPL and ground water plume off-site at the southwestern corner and southern boundary, which is consistent with the 1988 Record of Decision (ROD) and the First Five-Year Review. Monitoring data, however, is not sufficient to indicate if further migration has occurred, and if so, where the leading edge of the contamination is located. Additional information is necessary to ensure that there are no new exposure pathways to be considered and that the remedy will remain protective into the future. It should be noted, however, that there is no indication that the impacted shallow aquifer is being used as a drinking water source. The City of Houston continues to provide drinking water on-site and to neighboring residences.

Land use immediately adjacent to the Site at the western boundary is subject to change in the future. The Harris County Toll Road Authority (HCTRA) plans to extend the Hardy Toll Road along the rail right-of-way along the western boundary of the South Cavalcade Street Site and expand Collingsworth Street along the southern boundary of the Site. Workers may have a short term exposure to DNAPL and the ground water plume at certain points along the boundary during construction. In addition precautions must be taken during construction to ensure that pathways of migration to deeper zones will not be created.

Actions Needed

Property owners are to inspect and maintain joint systems and repair cracks and joint systems as required. Beazer is responsible for continuing annual cap inspections.

A title search is to be conducted to determine the current owners of the Site. The current landowners are to be contacted and it must be ensured that the Administrative Order on Consent (AOC) restrictions are still effective Institutional Controls (ICs).

Beazer, EPA, and TCEQ are evaluating the Focused Feasibility Study by Beazer supporting natural attenuation as an alternative remedial action for ground water. As part of this re-examination of remedial options and objectives, ground water monitoring requirements and extraction to contain the dissolved plume should also be evaluated and reinstated as appropriate. Should remedial objectives change, the remedy decision process will be documented through a ROD amendment or an Explanation of Significant Differences. As part of the Focused Feasibility Study, Beazer must demonstrate that the DNAPL and plume are not migrating vertically and horizontally.

EPA will continue discussions and coordination with Harris County Toll Road Authority (HCTRA) and City of Houston to ensure that protective measures are in place during the Toll Road and Collingsworth Street construction to provide for worker safety and to further prevent the inadvertent vertical migration of DNAPL to deeper zones.

It is to be ensured that the plat and survey of the impacted area and cap are available to the public.

Determinations

I have determined that the soil remedial actions implemented at the South Cavalcade Street Site in Houston, Texas, is protective of human health and the environment. The ground water remedy is protective in the short term and will remain protective in the future if it is demonstrated that the DNAPL and plume are not migrating vertically and horizontally.

Approved by: Date:

Pamela Phillips, Acting 9/24/07

Samuel J. Coleman, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency

CONCURRENCES

SECOND FIVE-YEAR REVIEW
for the
South Cavalcade Street Site
EPA ID# TXD980810386

By: _____ Date: 9-19-07
Rajalakshmi M. Josiam
Remedial Project Manager

By: _____ Date: 9.19.07
Gustavo T. Chavarria
AT/TX Team Leader

By: _____ Date: 9/19/07
John R. Hepola, Associate Director
Remedial Branch

By: _____ Date: 9/20/07
Gloria S. Moran, Site Attorney
Office of Regional Counsel

By: _____ Date: 09/24/07
Mark Peycke, Branch Chief
Office of Regional Counsel

By: _____ Date: 9/19/07
Don Williams, Deputy Associate Director
Remedial Branch

By: _____ Date: 9/24/07
Pamela Phillips, Deputy Director
Superfund Division

SECOND FIVE-YEAR REVIEW

Second Five-Year Review Report for South Cavalcade Street Superfund Site Houston Harris County, Texas

September 2007

Prepared By:
Region 6
United States Environmental Protection Agency
Dallas, Texas

Executive Summary

The Second Five-Year Review of the South Cavalcade Street Superfund Site (Site) located in Houston, Harris County, Texas was completed in August 2007. The First Five-Year Review dated September 2002 indicated that the remedy is expected to be protective of human health and the environment in the short term but indicated that additional information was necessary to ensure that the remedy was also protective into the future. Additional information has been collected during the five years that have elapsed since the first five-year report was issued. Based on a review conducted of this additional information, it is evident that the remedy is protective of human health and the environment under current conditions and is expected to be protective into the future. Continuation of monitoring will confirm this conclusion. No deficiencies were noted as a result of the Five-Year Review.

The original Record of Decision (ROD), signed September 26, 1988, addressed both ground water and soil contamination. Contaminants of concern included Polynuclear Aromatic Hydrocarbons (PAHs) and metals in both media.

For ground water remediation, the ROD required the extraction and treatment of contaminated ground water, including the recovery and treatment of a Dense Non-Aqueous Phase Liquid (DNAPL). Extraction would continue to decrease contaminant levels to the maximum extent possible, and at that point, collection would cease and any remaining contamination would be allowed to naturally attenuate to background levels. The ROD also made allowances to consider in-situ biological treatment to meet remedial goals. In 1995, the U.S. Environmental Protection Agency (EPA) and Beazer East Inc. (Beazer), the responsible party (RP), agreed to reconsider ground water remedial goals outlined in the ROD, including options such as natural attenuation, or a Technical Impracticability (TI) waiver.

The ground water extraction system and treatment plant were put into operation in September 1995 and operated until April 2006 when the system became inoperative as a result of a lightning related power surge that damaged the system controller. The plans for the system will be determined once the remedial alternative is selected as part of the Focused Feasibility Study underway as addressed below. As of the First Five-Year Review, a total of 2,800 gallons of DNAPL had been recovered. As of April 2006, a total of 3,886 gallons of DNAPL had been recovered.

Beazer submitted to the EPA and the Texas Commission on Environmental Quality (TCEQ) a Draft Focused Feasibility Study (FFS) in May 2007. The draft report addresses four groundwater remedial alternatives that include No Further Action, Monitored Natural Attenuation (MNA) with No Further Action for Source Zone, MNA with Continued Source Removal, and In-Situ Solidification. The draft report recommends MNA with No Further Action for Source Zone as the preferred alternative for the Site. The draft report was reviewed and discussed by EPA, TCEQ, Beazer and Key Environmental and is in the process of being revised. The change to the ground water remedy will be formalized in a ROD Amendment or Explanation of Significant Difference expected to occur Fall 2008.

The ground water remedy is considered protective of human health because no complete ground water exposure pathways exist under current conditions and are not expected to exist in the future. As indicated in the 1988 ROD, the city of Houston supplies drinking water to the businesses on-site, the surrounding businesses, and residences to the west through the city's public water supply system. Based on current ground water use information, there are no indications that private wells are in use down-gradient of the Site.

For soil remediation, the ROD originally specified treatment to attain a risk-based goal of 700 parts per million for potentially carcinogenic Polycyclic Aromatic Hydrocarbons (PAHs). After a pilot study indicated that the remedial goals could not be achieved via the selected remedy, the EPA Regional Administrator signed an Amended ROD (July 26, 1997) to allow for a remedy to seal and contain soils under a six-inch reinforced concrete cap.

The cap was designed to prevent direct contact exposure to soils, to reduce infiltration and hence reduce loading of dissolved phase constituents to ground water, and also to serve as a parking area for businesses located at the Facility. Construction of the cap was completed in July 2000.

Annual cap inspections have been conducted commencing in November 2001. The inspections have confirmed that the caps in the southeast and southwest portions of the Site are in good condition, that effective operation and maintenance procedures are in place, and that the soil remedy continues to be effective.

The remediation implemented for soils at the Site as set forth in the Amended ROD has been implemented as planned. The capped areas have been inspected on an annual basis, have been maintained as necessary, and continue to be protective of human health and the environment.

In summary, the remedial action for soils at the Site continues to be protective of human health and the environment. The ground water remedy is protective in the short term and will remain protective in the future if it is demonstrated that the DNAPL and plume are not migrating vertically and horizontally. Given current land and water use and existing institutional controls, there are no ground water exposure pathways.

Table of Contents

Section **Page**

Tables

Figures

Attachments

List of Acronyms

AOC	Administrative Order on Consent
ARARS	Applicable for Relevant and Appropriate Requirements
AWI	American Warehouses Ltd.
BAT	Best Available Technology
BEI	Beazer East, Inc. (also referenced as Beazer)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	Environmental Protection Agency
ESD	Explanation of Significant Difference
FFS	Focused Feasibility Study
FS	Feasibility Study
FTS	Field Technical Services, LLC
GESPMP	Groundwater Extraction System Performance Monitoring Plan
GPCT	Groundwater Pilot Collection Trench
GFTER	Ground Water Fate and Transport Evaluation Report
GRAA	Groundwater Remedial Action Area
GWPTP	Ground Water Pilot Treatment Plant
GWTP	Ground Water Treatment Plant
HASP	Health and Safety Plan
HCTRA	Houston County Toll Road Authority
HPD	Houston Police Department
NPDES	Nation Pollutant Discharge Elimination System
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PAH	Polynuclear Aromatic Hydrocarbon
PCOR	Preliminary Close Out Report
RA	Remedial Action
RAWP	Remedial Action Work Plan
RD	Remedial Design
RDWP	Remedial Design Work Plan
RI	Remedial Investigation
ROD	Record of Decision
RP	Responsible Party
SARA	Superfund Amendment and Reauthorization Act
TCEQ	Texas Commission on Environmental Quality (previously known as TNRCC)
TDWR	Texas Department of Water Resources
TI	Technical Impracticability
TNRCC	Texas Natural Resource Conservation Commission (now known as TCEQ)

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: South Cavalcade Street		
EPA ID *(from WasteLAN)*: TX980810386		
Region: EPA Region 6	**State:** Texas	**City/County:** Houston/Harris County
SITE STATUS		
NPL status: X Final G Deleted G Other (specify)		
Remediation status (choose all that apply): G Under Construction **X Operating** G Complete		
Multiple OUs?* G YES **X NO**	**Construction completion date: _09_ / _15_ / _2000_**	
Has site been put into reuse? X YES G NO		
REVIEW STATUS		
Lead agency: X EPA G State G Tribe G Other Federal Agency _____		
Author name: Raji Josiam		
Author title: Remedial Project Manager	**Author affiliation:** EPA Region 6	
Review period:** _06_ / _01_ / _2002_ to _09_ / _14_ / _2007_		
Date(s) of site inspection: _06_ / _26_ / _2007_		
Type of review: **X Statutory** G Policy **X Post-SARA** G Pre-SARA G NPL-Removal only G Non-NPL Remedial Action Site G NPL State/Tribe-lead G Regional Discretion		
Review number: G 1 (first) **X 2 (second)** G 3 (third) G Other (specify) _____		
Triggering action: G Actual RA Onsite Construction at OU #____ G Actual RA Start at OU#____ G Construction Completion **X Previous Five-Year Review Report** G Other (specify)		
Triggering action date *(from WasteLAN)*: _09_ / _25_ / _2002_		
Due date *(five years after triggering action date)*: _09__ / _25__ / _2007_		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary, cont.

Issues:

Reasonable interpretation of the existing ground water data indicates the continued presence of DNAPL and ground water plume off-site at the southwestern corner and southern boundary. Monitoring data, however, is not sufficient to indicate if further migration has occurred, and if so, where the leading edge of the contamination is located. Additional information is necessary to ensure that there are no new exposure pathways to be considered and that the remedy will remain protective into the future. The remedy is protective in the short term, but future protectiveness depends on the demonstration that the DNAPL and plume are not migrating vertically and horizontally.

Recommendations and Follow-Up Actions:

- The property owners are to inspect and maintain joint systems and repair cracks and joint systems as required.
- A Title Search is to be conducted to determine the current owners of the Site and ensure the AOC is still effective for ICs.
- Evaluation of the Focused Feasibility Study supporting Monitored Natural Attenuation as an alternative remedial action for ground water is to be continued. As part of this re-examination of remedial options and objectives, ground water monitoring requirements and extraction to contain the dissolved plume should also be evaluated and reinstated as appropriate. It must be also be demonstrated that the DNAPL and plume are not migrating vertically and horizontally.
- Continued discussions are to be held with the Harris County Toll Road Authority (HCTRA) and the City of Houston concerning potential Site impacts to be considered in construction of the Toll Road extension and Collingsworth Street expansion. Worker health and safety should be considered for those areas where short-term contact with ground water contamination is anticipated. Precautions should also be taken during construction to prevent the creation of conduits and preferential pathways for migration of DNAPL to deeper aquifers. This will ensure protectiveness for a short-term exposure scenario and provide for the continued protection of deeper ground water zones.
- Ensure the plat and survey of the impacted area and cap is part of the Administrative Record.

Protectiveness Statement (s):

The soil remedial actions implemented at the Site will remain protective of human health and the environment. The concrete cap eliminates any potential for direct contact with impacted soil. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated. The concrete cap ensures current and future protection of human health and the environment.

The ground water remedy is protective in the short term but future protectiveness depends on the demonstration that the DNAPL and plume are not migrating vertically and horizontally. Institutional controls such as Administrative Order on Consent restrictions and Houston-Galveston Coastal Subsidence District notification and permitting requirements at the Site ensure that future use of the Site remains non-residential and prohibit on-site ground water use. Current information shows that shallow ground water is not currently being used in the vicinity of the Site and deeper ground water has not been impacted by Site-related constituents.
Other Comments: None

South Cavalcade Street Superfund Site
Second Five-Year Review Report

The U.S. Environmental Protection Agency (EPA) Region VI has conducted the Second Five-Year Review of the remedial action implemented at the South Cavalcade Street Superfund Site located in Houston, Harris County, Texas (Figure 1). This review is for the period September 25, 2002 to September 25, 2007. Beazer, the Responsible Party (RP) for remedial action at the South Cavalcade Street Site, provided information for this period. This information has been verified and incorporated into this report by EPA.

For purposes of this report, the phrase "five-year review" will apply to all remedial actions which have taken place since September 25, 2002, to September 25, 2007. The purpose of a five-year review is to determine whether the remedy at a site is protective of human health and the environment. This report documents the results of the review for this Site.

1.0 Introduction

Five-year reviews for the South Cavalcade Street Superfund Site are required by statute. Statutory reviews are required for sites where, after remedial actions are complete, hazardous substances, pollutants, or contaminants will remain on-site at levels that will not allow for unrestricted use or unrestricted exposure. This requirement is set forth by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Statutory reviews are required only if the Record of Decision (ROD) was signed on or after the effective date of the Superfund Amendments and Reauthorization Act of 1986 (SARA). CERCLA §121(c), as amended by SARA, states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.*

The NCP Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

> *If a remedial action is selected that results in hazardous substances, pollutants or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

This is the Second Five-Year Review for the South Cavalcade Street Superfund Site. The triggering action for this review is the completion of the First Five-Year Review in September 2002. As previously indicated, a five year review is required when hazardous substances, pollutants or

contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure, as is the case for this Site.

2.0 Site Chronology

Table 1 lists the chronology of significant events for the South Cavalcade Street Superfund Site.

Table 1
Chronology of Site Events

Date	Event
1910	Wood Treating Plant Constructed
1944	Coal Tar Distillation Plant Constructed
1962	Wood Treating and Coal Tar Distillation Facilities Cease Operations
1983	Site Investigation by Houston Metro Transit Authority
April 1984	TDWR Recommends Site for Inclusion on the National Priorities List (NPL)
March 1985	Koppers Co. Enters into AOC with EPA to Perform a Remedial Investigation/Feasibility Study (RI/FS)
June 1986	Site Added to NPL
August 1988	RI/FS Completed
September 1988	Record of Decision (ROD) Issued
March 1991	Remedial Design/Remedial Action (RD/RA) Consent Decree Signed
March 1992	Remedial Design Workplan Completed
June 1992	Administrative Order on Consent Entered into with Property Owners
September 1992	Soil Delineation Report Approved by EPA
March 1993	Annual Sampling and Analysis of two Deep Monitoring Wells Initiated
December 1993	Pilot Studies for Soil Washing, Groundwater Collection and Groundwater Treatment are Completed

Date	Event
February 1994	Soil Remedy Evaluation Memorandum for In-Situ Bioremediation Issued
January 1995	EPA Approves Final Remedial Designs for the In-Situ Bioremediation Soil Remedy, DNAPL Recovery and Groundwater Collection System, and Groundwater Treatment System
May 1995	EPA Approves Remedial Action Work Plan (RAWP)
September 1995	Groundwater Collection and DNAPL Recovery System Installed, Groundwater Treatment Plant Upgrades Performed and Soil Delineation Completed
October 1995	Groundwater Collection Suspended/DNAPL Recovery System in Operation
January 1996	Groundwater Fate and Transport Evaluation Activities Initiated
June 1997	Amended ROD Issued with Reinforced Concrete Cap for Soil
August 1997	Final Ground Water Fate and Transport Evaluation Report (GFTER) Submitted to EPA/Texas Natural Resource Conservation Commission (TNRCC). TNRCC is now known as the Texas Commission on Environmental Quality (TCEQ).
August 1998	Final Work Plan for GFTER Verification Submitted to EPA/TNRCC
November 1999	Final Remedial Action Work Plan (RAWP) Issued
November 1999	EPA Approval of Soil Concrete Cap Design
November 1999	Soil Concrete Cap Construction Activities Initiated
November 1999	Work Plan for GFTER Verification is Implemented
May 2000	First Five-Year Review Site Inspection
July 2000	Concrete Cap Construction Completed, Final Inspection Held
July 2000	Verification of Ground Water Fate and Transport Evaluation Submitted for EPA/TNRCC Review
August 2000	Interim Remedial Action Report Submitted
September 2000	Preliminary Close Out Report Signed

Date	Event
August 2002	First Five-Year Review Site Inspection (Final)
September 2002	First Five-Year Review Finalized
August 2003	Final Verification of Groundwater Fate and Transport Evaluation Report Submitted to EPA in Response to Agency Comments Received April 2003
August 2005	EPA/TCEQ Approve a Supplemental Groundwater Investigation Work Plan
March 2006	Supplemental Groundwater Investigation Report, Including Results of Comprehensive Groundwater Monitoring, Submitted to EPA/TCEQ
April 2006	RP Meets with EPA/TCEQ to Discuss Modification of Ground Water Remediation Goals via Submittal of Focused Feasibility Study (FFS)
April 2006	Groundwater Pumping Associated with DNAPL Recovery Operations Ceases After Power Surge (Lightning Strike) Damages Controller
May 2007	Draft Focused Feasibility Study Report Submitted to EPA/TCEQ
June 2007	Second Five-Year Review Site Inspection

3.0 Background

3.1 Physical Characteristics

The South Cavalcade Street Superfund Site occupies approximately 66 acres of land located approximately three miles north of downtown Houston, Texas and about one mile southwest of the intersection of Interstate Loop 610 and U.S. Highway 59. It is bounded by Cavalcade Street to the north, Collingsworth Street to the south, and the Missouri and Pacific Railroads to the east and west. The Site is rectangular in shape with a length of approximately 3,400 feet (in the north-south direction) and a width of approximately 900 feet (in the east-west direction). A South Cavalcade Street Superfund Site base map is provided as Figure 1.

3.2 Land and Resource Use

Land use in the vicinity of the Site is a mixture of commercial, industrial, and residential properties. Industrial and commercial properties are located to the east and across Collingsworth Street to the south. Active rail lines immediately border the Site boundaries to the east and the west. The North Cavalcade Street Superfund Site is located directly north of the South Cavalcade Site, separated by

Cavalcade Street. A residential area is located to the west of the Site, and continues to the south, north, and west.

EPA does not anticipate population growth in those areas surrounding the Site because this area of Houston is "built out," indicating that growth has probably peaked. Access from two major freeways, Interstate Highway 610 and U.S. Highway 59, makes this property ideal for continued trucking terminal operations. The Site's location within an existing industrial corridor, bordered by railroad tracks and other businesses, most likely will ensure that the Site will remain industrial. The Harris County Toll Road Authority (HCTRA) has also proposed an extension to the Hardy Toll Road, to be built along the rail right-of-way adjacent to the western boundaries of the South and North Cavalcade Street Superfund Sites. The Toll Road, if constructed as planned, will further separate these industrial properties from the neighborhood to the west.

The Site is currently occupied by trucking firms; thus, much of the ground surface, especially in the southern and northern portions of the Site, is covered by concrete or asphalt pavement, or buildings, as shown in Figure 2. The central portion of the Site has remained largely undeveloped; however, one of the trucking firms expanded operations and added another warehouse in 2001. A ground water treatment facility is located along the eastern Site boundary in the central portion of the Site. The concrete caps, covering two areas of contaminated soils in the southeast and southwest portions of the Site were designed for soil containment and for truck parking (Figure 3). Access is limited by perimeter fencing and is further enforced by 24-hour security.

Continued future use of the Site properties for non-residential purposes is expected. Institutional controls to discourage residential land use were provided in the January 24, 1992 Administrative Order on Consent with the owners of the site, In the Matter of Rex King and Marilyn Lee King, Palletized Trucking, Inc., Baptist Foundation of Texas, Merchants Fast Motor Lines, Inc., and Trucking Properties, Inc., CERCLA 6-08-92 (AOC). Under the AOC, the landowners were required to file a notice in the land records of Harris County, within 60 days of the effective date, to subsequent purchasers that "hazardous substances were disposed of and will continue to remain in both the soils and ground water at the Site." Language was also included that "development of the Site for residential use is inappropriate due to the continuing presence of hazardous substances at the Site." In addition, the AOC provided that the notice and future land transactions must include a copy of the AOC and the March 14, 1991 Consent Decree with Beazer, Civil Action No. H – 90-2406, United States of America vs. Beazer East, Inc. (Consent Decree). The responsibility to provide appropriate notice to future purchasers rests with the landowners and penalties for failure to do so are stipulated in the AOC. The consent agreements between EPA and the respective property owners also prohibit on-site ground water use.

3.3 History of Contamination

The wood preserving facility consisted of an operations area, a drip track, and treated and untreated wood storage areas. The operations area included wood treating cylinders, chemical storage tanks, and a wastewater lagoon. This area is located in the southwestern part of the Site, along what is now Collingsworth Street. Creosote and metallic salts were used in the operation. The drip track ran

diagonally from the operations area to the northeast and ended before the central portion of the Site. The coal tar plant was located in the southeastern part of the Site.

National Lumber and Creosoting Company acquired legal title to the Site in 1910 and constructed and operated a wood preserving facility there until the property was acquired in 1938 by the Wood Preserving Corporation, a subsidiary of Koppers Company. In 1940, the Wood Preserving Corporation became a part of Koppers Company. Koppers Company, Inc. (Koppers), now known as Beazer East, Inc., operated the wood treating facility from 1940 until closure in 1962. A coal tar distillation plant was constructed by Koppers on the southeastern portion of the Site in 1944 and continued in operation until 1962, at which time the property was sold to Merchants Fast Motor Lines. The Site was later subdivided and sold to the landowners referenced in the 1992 Administrative Order. In 1995, The Baptist Foundation of Texas sold its 22 acres (of the 66 acre South Cavalcade Street Superfund Site) to Nations Way Transport Service, Inc. (Nations Way).

3.4 Initial Response

In 1983, the Houston Metropolitan Transit Authority investigated the Site for potential use in the municipal mass transit system and found evidence of creosote in the subsurface. The Site was referred to the Texas Department of Water Resources (TDWR), which conducted further investigations and determined that the Site could pose a threat to human health and the environment. In April 1984, TDWR recommended to EPA that the Site be placed on the National Priorities List (NPL). EPA proposed that the South Cavalcade Street Site be added to the NPL on October 15, 1984 (49 Federal Register 40320), and added the Site to the final list on June 10, 1986 (49 Federal Register 21054).

In March 1985, Koppers entered into an Administrative Order on Consent (AOC) with EPA to conduct a Remedial Investigation/Feasibility Study (RI/FS) at the Site. The RI/FS was completed by Koppers in August 1988 with submittal of the *Remedial Investigation Report* and the *Feasibility Study Report* to EPA. The RI identified two primary areas of potential creosote impact in the surficial soil, defined as soil in the interval from the ground surface to a depth of six feet: one area in the southern portion, corresponding to the former locations of the coal tar plant and wood treating operations; and one in the northern portion, corresponding to a pond observed in a 1964 aerial photograph of the Site. Total surficial soil Polynuclear Aromatic Hydrocarbons (PAHs) ranged from below detection levels to 8567 mg/kg. Contaminants of concern released to soil were benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Copper, chromium, arsenic, zinc, and lead were also present at concentrations exceeding background levels.

The RI also indicated that PAHs, from below detection limits to observed non-aqueous phase creosote at several wells, were present in the shallow aquifer underlying the Site, at 6 to 10 feet below the surface to a depth of about 22 feet. Metals, including arsenic, chromium, copper, lead, zinc, and aromatic volatile organics, specifically benzene, toluene, ethylbenzene, and xylene, were also detected. Contaminants appear to be confined to the shallow aquifer. PAHs were not detected in the deeper aquifer, located at depths 175-205 feet below surface. Beazer has been sampling two

deeper monitoring wells (at depths of 220 and 530 feet) in the vicinity of the Site annually since 1993. The results of these sampling and analysis activities have confirmed that deeper ground water has not been impacted by Site-related activities. An evaluation of ground water use in the vicinity of the Site confirmed that there is no use of the shallow ground water within a one-mile radius of the Site. Although the deeper aquifer is potentially useable as a public water supply source, on-site and neighboring residents are all served by the City water supply which originates from a deeper aquifer 10 miles from the Site, or from a surface water reservoir located over 20 miles from the Site. In addition, the Houston-Galveston Coastal Subsidence District requires notification and permits for the drilling of new ground water wells, discouraging the use of private wells in those areas adequately served by the City of Houston municipal water supply system.

3.5 Basis for Taking Action

Constituents that have been released at the Site for the various media of interest consist of the following:

Soil	Ground Water	Drainage Ditch	
		Water	Sediment
Arsenic	Arsenic	Arsenic	Arsenic
Chromium	Chromium	Copper	Chromium
Copper	Copper	Lead	Copper
Lead	Lead	Zinc	Lead
Zinc	Zinc		Zinc
Acenaphthene	Acenaphthene		Benzo(a)anthracene
Anthracene	Anthracene		Benzo(a)pyrene
Benzo(a)anthracene	Benzo(a)anthracene		Benzo(b)fluoranthene
Benzo(a)pyrene	Benzo(a)pyrene		Benzo(k)fluoranthene
Benzo(b)fluoranthene	Benzo(b)fluoranthene		Benzo(ghi)perylene
Benzo(k)fluoranthene	Benzo(k)fluoranthene		Chrysene
Benzo(ghi)perylene	Benzo(ghi)perylene		Fluoranthene
Chrysene	Chrysene		Indeno(1,2,3-cd)pyrene
Fluoranthene	Fluoranthene		Pyrene
Fluorene	Fluorene		
2-Methylnaphthalene	2-Methylnaphthalene		
Naphthalene	Naphthalene		
Phenanthrene	Phenanthrene		
Pyrene	Pyrene		
	Benzene		
	Toluene		
	Ethylbenzene		
	Xylenes		

Investigation and remedial actions were taken as a result of the presence of potentially carcinogenic PAHs in soils, and potentially carcinogenic PAHs, volatile organic compounds, and metals in

ground water. Remedial goals were based on the assumption that the Site would remain in commercial use and that the aquifer to be remediated was not being used as a water supply, and was unlikely to be used for such purposes in the future as there are readily available water resources in the area.

Soil remedial goals were also based on consideration of potential further impact to ground water as a result of constituent leaching from the surface and subsurface soils. Ground water remedial goals to prevent the off-site migration of contaminants and to further reduce source areas provided for the extraction and treatment of ground water and the collection of the Dense Non-Aqueous Phase Liquids (DNAPL).

As described in the Record of Decision (ROD)[1], surface water and sediment samples were collected in drainage ditches on, and bordering, the Site. No PAHs were detected in surface water samples; several metals (arsenic, zinc, lead, iron, copper, and nickel) were detected. PAH components were detected in sediment samples, with concentrations ranging from 2.3 to 236 mg/kg. Higher concentrations were located in the southern end of the Site and were most likely attributable to the ongoing trucking activities in that area.

4.0 Remedial Actions

4.1 Remedy Selection (General)

The ROD for the South Cavalcade Street Superfund Site was signed by EPA on September 26, 1988. The ROD presented the selected remedial alternatives for Site surface and surficial soil, and ground water. The ROD did not designate separate operable units for remediation of the Site.

The remedial action objectives for surface and surficial soil, and ground water, as stated in the Feasibility Study Report, were as follows:

Surface (0-6 inches below ground surface) and Surficial Soil (0 to 6 feet below ground surface)

- Prevent continued migration to ground water; and,
- Reduce risks to public health.

Groundwater

- Prevent the vertical migration of contaminants to lower ground water zones or horizontal migration to off-site wells.

4.2 Soil Remedy Selection

1 "Record of Decision (ROD) South Cavalcade Street Site, Houston, Texas." EPA. September 1988.

The remedial goals for surface and surficial soils, as specified in the ROD, were 700 parts per million (ppm) total potentially carcinogenic PAHs and no potential for leaching to ground water. The remedial goals for soils were selected to protect against an additional risk of cancer from exposure to soils of greater than 1 in 100,000 (10^{-5}) for on-site commercial occupants and also ensure against any non-carcinogenic hazards. As stated in the ROD, the attainment of the remedial goals for soil would also assure that contaminants will not leach into the ground water. A combination of soil washing and soil flushing was selected in the ROD as the most appropriate solution for remediating contaminated soils.

However, an August 1992 Keystone Environmental "Soil Delineation Report" prepared for Beazer concluded that the estimated soil quantity requiring remediation was significantly less than the ROD estimate. As a result, the report concluded that it would be more efficient and cost-effective to use one remediation technology rather than two. EPA agreed with the soil delineation proposal and granted Beazer approval to begin remedial design using only soil washing.

In 1993, during the remedial design phase, Beazer conducted a soil washing pilot study. However, the study concluded that soil washing would not provide overall protection of human health and the environment as forty percent of the soil volume could not be washed to meet the remedial goals. Consequently, there was no benefit to implement full scale operations. Therefore, Beazer stated that it did not believe contamination beneath the surface posed a realistic health risk and petitioned EPA to reconsider the reasonableness of any risk posed by such contamination.

EPA reassessed the original remedial goals to consider guidance published in 1991 defining "principal threat"[2] and concluded that the contamination on-site did not constitute a "principal threat" as the risk assessment did not identify any health risks from soil contaminations greater than 1 in 1000 (1×10^{-3})[3].

Since the waste on Site was not considered a principal threat, the National Contingency Plan (NCP) 40 CFR § 300.430(a)(1)(iii)(B) allowed EPA to use "…engineering controls, such as containment, for waste that poses a relatively long term threat." After review, EPA decided that as long as the contamination remained below the surface, it posed no unacceptable risk. As a result, on September 29, 1995, Beazer proposed permanently covering the contaminated areas with a concrete cap in lieu of the originally selected 1988 remedies.

An Amended ROD for the soil remedy was signed on June 27, 1997 to seal areas with reinforced concrete cover where surface contamination exceeded the ROD established soil cleanup goal. The remedial action objectives, as amended were:

- To cover areas where surface contamination exceeded the ROD established soil cleanup goal of 700 ppm total potentially carcinogenic polynuclear aromatic hydrocarbons

2 "A Guide to Principal Threat and Low Level Threat Wastes." United States Environmental Protection Agency, Office of Solid Waste and Emergency Response (OSWER) Directive No. 9380.3FS. November 1991.

3 "Feasibility Study." Keystone Environmental Resources, Inc. p. 2-28a. August 1988.

(cPAH); and,

- To prevent against an excess lifetime increased cancer risk of $8x10^{-6}$ for likely on-site exposure to soil. The concrete cover would eliminate the risk to human health from direct exposure to surface soils.

The soil remedial action components were as follows:

- To provide field delineation of impacted soil;

- To construct a concrete cap to cover and contain impacted soils beneath at least six inches of reinforced concrete designed to withstand the current and anticipated freight truck traffic;

- To provide a barrier preventing on-site commercial occupants from inadvertently ingesting, inhaling or directly contacting impacted soils;

- To provide a plat to show the exact location and dimensions of each impacted area with respect to permanently surveyed benchmarks. This survey and plat forms part of the institutional control used to alert future owners that impacted soil has been left on-site; and,

- To prepare and execute a post-closure plan that describes the maintenance activities that will be carried on after the impacted soils are covered.

4.3 Groundwater Remedy Selection

The selected remedial alternative for ground water included extraction and treatment of ground water containing constituent concentrations greater than the remedial goals specified in the ROD. The remedial goals, as specified in the ROD, were selected to comply with Federal drinking water standards, National Pollutant Discharge Elimination System (NPDES) Best Available Technology (BAT) requirements, and the Texas Water Quality Standards, or existing background levels. The remedial level for potentially carcinogenic PAHs was selected to assure that, in conjunction with other contaminants, the overall risk to potential consumers of ground water would be less than 10^{-4}.

The ROD stipulated that "ground water collection will continue until constituents have been recovered to the maximum extent possible," as "determined during the Remedial Action, based upon experience in operating the ground water collection and treatment system, and [that] it must be as close to drinking water standards and no detectable carcinogenic PAHs to the maximum extent possible."

The ROD specified that recovered ground water would be treated on the Site by physical/chemical separation followed by filtration and activated carbon adsorption. A portion of the treated ground water would be re-injected into the aquifer along with surfactants to help recover the contaminants

and that excess treated ground water be discharged to the drainage ditch leading into Hunting Bayou in accordance with a NPDES permit.

The ROD specified that once EPA had determined that ground water constituents have been recovered to the maximum extent possible, ground water collection would cease and any remaining constituents would be allowed to naturally attenuate to background levels. The ROD also indicated that the ground water could be remediated via in-situ biological treatment, if equal performance was demonstrated.

5.0 Remedy Implementation

5.1 Soil Remedy

Delineation of impacted soils at the Site was performed during the 1995 construction activities in accordance with the Confirmation Sampling Plan. The remedial design for the Site soil remedy was initiated by Dames & Moore in 1998 and completed in November of 1999. EPA approval of the concrete cap design was obtained on November 11, 1999.

Beazer contracted with Bay Ltd. (Bay) to construct the soil remedy. Construction activities on the concrete cap began on November 17, 1999 and in accordance with the design parameters, the concrete cap was constructed to withstand truck traffic.

The soil remedial action concrete cap system was to cover impacted as well as non-impacted areas in the Southeast and the Southwest areas, therein providing usable parking and driveway systems for the current property owners. The extent of the concrete cap is shown in Figure 3. The concrete cap is eight inches thick in the Southwest area and 10 inches thick in the Southeast area. Soils in the Northeast area were not capped in place, but were excavated and used, along with existing on-site stockpiled materials, as fill under the concrete cap structures in the Southeast and Southwest areas. The Northeast area was then backfilled with clean imported fill from an off-site source.

Cap construction also provides a positive drainage system to eliminate standing rainwater and provides a cover for all presently known impacted soil surfaces. Provisions for storm water drainage and collection were provided in the design, and included the construction of a below-grade detention basin to comply with the City of Houston's permitting requirements. Cap construction work was completed in July 2000.

5.2 Ground Water Remedy

In March 1991, Beazer entered into a Consent Decree with EPA for implementation of the remedial design and remedial action for the Site. The proposed plan for completion of the remedial design process, including pre-design and pilot studies, was presented in the Remedial Design Work Plan (RDWP) which was submitted to EPA in March 1992. Pilot study tasks conducted to support the ground water remedial design included a ground water collection well pilot study, ground water

recovery trench pilot study and ground water treatment system pilot study. Pilot study tasks were completed in October 1993. The final (100%) ground water remedial design for the Site was approved by EPA in January 1995. Following approval of the remedial designs, Beazer prepared the *Remedial Action Work Plan* (RAWP)[4] which presented the procedures and requirements for construction of the remedial alternatives. The RAWP was approved by EPA in May 1995. Remedial construction was initiated in June 1995.

5.2.1 Ground Water Collection and DNAPL Recovery System

Construction for the ground water collection and DNAPL recovery system was initiated in June 1995. Construction included the installation of 11 recovery wells.

One DNAPL recovery well (RWN-4) and four ground water collection wells (RWN-1, RWN-2, RWN-3 and RWN-5) were installed within Groundwater Remedial Action Area (GRAA) 1 located in the northern section of the Site. One DNAPL recovery well (RWS-5) and three ground water collection wells (RWS-3, RWS-4, and RWS-6) were installed within GRAA 2, which includes the area formerly occupied by the coal tar distillation plant. Two combined ground water collection/DNAPL recovery wells (RWS-1 and RWS-2) were installed within GRAA 3, which includes the area formerly occupied by the wood treating process area.

A total 22 piezometers were installed as part of the ground water remedial action (Figure 4). Start-up of the ground water collection and DNAPL recovery components of the ground water remedy was conducted in September 1995, following completion of the ground water treatment plant modifications.

In an EPA letter dated October 6, 1995[5], EPA indicated that "there is some question as to whether EPA will continue to apply the current remedial action goal to ground water cleanup." The remedial goals specified in the ROD issued in 1988 specifies ground water cleanup to drinking water standards and no detectable carcinogenic PAHs. This direction was taken in response to a July 31, 1995 EPA memorandum[6] directing a policy favoring Applicable or Relevant and Appropriate Requirement (ARAR) waivers at sites where it is technically impracticable to remediate ground water to Federal or State standards.

As provided by the October 6, 1995 EPA letter and, in accordance with an agreement between EPA and Beazer, ground water extraction to minimize off-site migration, and monitoring, was delayed pending determination of the potential inapplicability of the ground water remedial goals specified in the 1988 ROD. Subsequent ground water pumping and DNAPL recovery operations demonstrated the impracticability of the attainment of the 1988 ROD remedial goals.

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4 "Final Remedial Action Work Plan Volumes 1 and 2." Dames and Moore for Beazer East, Inc. May 1995. Modifications incorporated November 1999.

5 "EPA Comments – South Cavalcade Street Superfund Site Groundwater Exposure Assessment Work Plan – September 1996." United States Environmental Protection Agency. October 6, 1995

6 "Memorandum from Elliot Laws, Assistant Administrator, to Regional Administrators Region I-X Regarding Superfund Groundwater RODs: Implementing Change this Fiscal Year." United States Environmental Protection Agency. July 31, 1995

Since the 1995 EPA decision to re-evaluate the ground water remedial goals, Beazer has done additional work (*Ground Water Fate and Transport Evaluation Report* – August 1997; *Verification of Ground Water Fate and Transport Evaluation Report* – July 2000; and, *Focused Feasibility Study* – May 2007)[7] to assess whether natural processes (e.g., adsorption, dispersion, and biodegradation) are effective in reducing concentrations of dissolved phase constituents to health-protective levels before ground water migrates to locations where exposure to ground water could reasonably occur, and to verify that natural attenuation is occurring. This re-evaluation is in keeping with the 1988 ROD language which allows for in-situ biological treatment of soil or ground water if equal or better performance can be demonstrated. The ROD further allows for the determination of "maximum extent possible" remediation goals during the RA phase. The Focused Feasibility Study Report dated May 2007 is currently being evaluated by Beazer, EPA, and TCEQ.

Operation of the DNAPL recovery component of the ground water remedy, including active ground water pumping for gradient enhancement, continued for slightly over ten years from January 1996 through April 2006. Ground water extraction was conducted in all three areas for gradient enhancement to optimize DNAPL recovery. Ground water pumping was discontinued after a lightning related power surge occurred that damaged the system controller in April 2006. DNAPL recovery since that time has been completed in a passive mode (i.e., without ground water pumping) via manual pumping of DNAPL from the collection wells. The plans for the system will be determined once the remedial alternative is selected as part of the FFS which is underway.

As of the First Five-Year Report, approximately 2,800 gallons of DNAPL had been recovered from shallow water bearing zone DNAPL recovery wells RWS-1, RWS-2, RWS-5, RWN-4, and piezometer PZ-20. As of this Five-Year Report, a total of approximately 3,900 gallons of DNAPL have been recovered via a combination of gradient enhanced pumping and passive recovery.

Only 21 gallons of DNAPL have been recovered since the cessation of gradient-enhancement pumping in April 2006. This is considered indicative of the immobile nature of the residual DNAPL at the Site. It has been estimated that approximately 240,000 gallons of residual DNAPL exist at the Site[8]. Consequently, it is apparent that DNAPL recovery operations have been relatively ineffective given that less than 2% of the total DNAPL has been recovered over approximately 11 years of recovery operations.

In addition to the ongoing DNAPL recovery, Beazer has conducted annual ground water monitoring of deeper ground water. Sampling and analysis of well LCW-01, screened at a depth of 530 feet was conducted through 1996 and showed no Site-related impacts. A shallower deep well (DW-02), screened at a depth of 220 feet has been sampled annually since 1993 and has never shown any Site-

7 "Groundwater Fate and Transport Evaluation Report, South Cavalcade Superfund Site, Houston, Texas." Key Environmental, Inc. August 1997.
"Verification of Groundwater Fate and Transport Evaluation, South Cavalcade Superfund Site, Houston, Texas." Key Environmental, Inc. July 2000.

8 "Focused Feasibility Study." Key Environmental, Inc. May 2007.

related impact. These wells are located just to the southwest of the South Cavalcade Street Site on American Warehouse property.

5.2.2 Ground Water Treatment Plant Construction

In 1993 the Groundwater Pilot Collection Trench (GPCT) and the Groundwater Pilot Treatment Plant (GWPTP) were completed. The construction of the GWPTP was completed by Peters Construction Company. Work included excavation and backfill, treatment plant piping, concrete structures, superstructures, mechanical, electrical and instrumentation equipment, and structural steel.

The GPCT was excavated using a biopolymer slurry. It was backfilled with select fill and on-site material. Collection pipes and sumps were installed to facilitate ground water collection. Water collected from the GPCT was treated by the GWPTP.

The GWPTP was equipped to process water from the ground water pumps. The processes included clarification, pH adjustment utilizing caustic and sulfuric acid additions, anionic polymer addition, and flocculation. The process also included air floatation, carbon adsorption, and air scouring. The GWPTP processed ground water collected from the ground water collection system.

In 1995 upgrades to the GWPTP were performed. Major upgrades included: installation, replacement and modification of pumps and required foundations; replacement of PVC piping with steel; installation of a new plant air compressor; installation of a new blower skid package; and installation of two heatless air dryers. Additional work included painting, tank modifications, piping modifications and other miscellaneous items. The upgrades were constructed by JWP Gowan, Inc. Additional services were supplied by Eagle Construction & Environmental Services, Inc.

The previously described GWPTP upgrades allowed for additional processes to be incorporated into the overall treatment process. Process additions include: metals pretreatment; sludge handling; material reuse, recycling, or disposal; carbon adsorption; effluent dissolved oxygen; flow control and storm water runoff. These process additions modified the GWPTP into a full-scale Ground Water Treatment Plant (GWTP).

In 2001, an additional filtering component was added to the GWTP to address a one-time exceedance of ammonia in the treatment effluent, thought to be related to cleaning of the plant tanks. However, Beazer up-graded the treatment plant to include additional filtration to remove any ammonia in the treated water as a precautionary measure.

The ground water system was used to effectively treat ground water prior to discharge as surface water to a proximate ditch. The ground water and DNAPL were recovered and managed as separate liquids to reduce the constituent loading in the influent to the GWTP. The ground water pumps in the collection wells were set several feet above the bottom of the well such that only ground water was extracted through the wells and directed to the treatment plant. As such, the influent to the

treatment system did not contain any non-aqueous phase liquid. The system operator removes DNAPL from the wells on an "as needed" basis using a portable pumping assembly. The recovered DNAPL is stored in a dedicated tank within the treatment plant area. Through April 2006, any water that separated from the DNAPL in the storage tank was decanted and directed through the treatment plant. Since the treatment plant became inoperative, limited DNAPL has been recovered and is stored on-site in a tank pending off-site disposal of both the DNAPL and separated water (if any).

5.3 Preliminary Close Out for Soils and Ground Water

A final Site inspection was conducted with EPA and the then Texas Natural Resource Conservation Commission (TNRCC) at the conclusion of the modified soil Remedial Action (RA) construction activities on July 12, 2000. The Preliminary Close Out Report (PCOR), signed September 15, 2000, documented that Beazer had completed construction of all remedial designs in accordance with the 1988 ROD and 1997 ROD Amendment, and that institutional controls were in place. Based on additional information collected and provided by Beazer since the previous 5-year review report, EPA and TCEQ are re-evaluating remedial goals set forth in the 1988 ROD and are considering options which may significantly change the ground water collection, treatment, and monitoring requirements for the Site, as well as the cleanup goals. If remedial goals are changed to better address conditions of the Site, those changes will be made available for public comment and will be summarized in a ROD Amendment or Explanation of Significant Difference (ESD), as appropriate. After the final ground water cleanup goals are met for the Site, EPA will issue a Final Close Out Report.

5.4 Implementation of Institutional Controls and Other Measures

The use of the Site is restricted to non-residential use by virtue of the respective Administrative Order on Consent (AOC) between the property owners and the EPA. Non-residential use is consistent with the exposure assumptions used to develop the remedial goals for soil. Site access is restricted to authorized personnel via fencing, locked access gates and on-site security personnel. The AOC also prohibits the installation of on-site water wells (except for the purpose of ground water monitoring). Thus, this institutional control eliminates one of the potential ground water exposure pathways identified in the ROD and ensures that the selected ground water remedy remains protective. For those areas adjacent to the Site, the Houston-Galveston Coastal Subsidence District has notification and permitting requirements in place to further reduce ground water use and to discourage the use of private wells where a public water supply is readily available.

6.0 System Operations

6.1 Soil

The long-term operations and maintenance (O&M) of the soil remedy began after the construction of the concrete cap was completed in July 2000. However, the design of the concrete cap limits the long-term maintenance required. The design spacing of the expansion joints has controlled concrete

cracking to the joint locations. Long-term system operations of the concrete cap at the South Cavalcade Site consist of the following:

- Property owners inspect and repair cracks and joint systems as necessary;
- Beazer performs an annual inspection to ensure that the Long-Term Operation & Maintenance activities are carried out; and,
- Beazer submits a soil remedy Long-Term Operations and Maintenance Annual Report to the EPA.

The Long-Term Operations and Maintenance Annual Reports describe the condition of the Site, summarize O&M activities completed during the year, outline proposed activities for the coming year, and provide a certification that the remedy continues to provide the protection specified by the ROD. The first annual Site inspection was completed on November 2, 2001. The first annual O&M report dated January 2, 2002 was provided to the EPA to document the annual inspection and annual O&M activities. Subsequent annual inspections were completed, and annual reports were submitted, on the following dates:

- 2002: Annual Inspection – November 22, 2002;
  Annual Report – April 30, 2003
- 2003: Annual Inspection – September 16, 2003;
  Annual Report – November 12, 2003
- 2004: Annual Inspection – October 11, 2004;
  Annual Report – May 6, 2005
- 2005: Annual Inspection – March 2, 2006;
  Annual Report – September 15, 2006
- 2006: Annual Inspection – December 28, 2006
  Annual Report – July 10, 2007

As a result of the annual inspections, it has been concluded that the concrete cap shows limited wear typical of curing, that joint systems are intact and functioning as designed, and that storm water flow is unobstructed and is occurring as intended. Therefore, the cap continues to provide protection of human health and the environment by eliminating a surface exposure pathway and preventing impact to ground water by providing a barrier to surface infiltration. Continuing operation and maintenance activities are recommended in the annual reports. These routine maintenance activities are to be completed by the property owners and include the following:

- Inspect and repair joints as necessary;
- Remove weeds, and repair as necessary;
- Inspect and repair bollards as necessary.

Representatives from EPA, TCEQ, Beazer, and Key Environmental conducted an inspection of the cap on June 26, 2007 for this Second Five-Year Review. The caps in both the southeast and

southwest areas were in good condition (Attachment 4). The caps in both the southeast and southwest areas were in good condition (Attachment 4). An offset in the pavement just to the east of the eastern edge of the southwest cap (Attachment 4) may have been the result of a washout created when the water supply line broke. Although the offset does not appear to have impacted the integrity of the cap or the protectiveness of the remedy, EPA recommends that the cap be reevaluated annually to ensure that settling or cracking of the adjacent cap does not occur with time.

6.2 Ground Water

DNAPL recovery operations were initiated in conjunction with ground water pumping during the November and December 1995 start-up/shakedown of the ground water treatment system. In January 1996, operation of the DNAPL recovery system in the passive mode of operation (i.e. collection of DNAPL without ground water pumping to increase hydraulic gradients) was initiated in accordance with the EPA-approved 100% Remedial Design.

In June 1996, ground water extraction to enhance hydraulic gradients was initiated in one GRAA (GRAA 3) to evaluate the effectiveness and practicability of the enhancement prior to its use in the other GRAAs. Evaluation of the DNAPL recovery data collected from GRAA 3 from July through September 1996 indicated that ground water extraction (at a pumping rate of 0.3 gallons per minute from individual recovery wells) appeared to enhance DNAPL recovery in wells RWS-1 and RWS-2. Based on this observation, DNAPL recovery with ground water extraction to enhance hydraulic gradients was initiated in GRAAs 1 and 2 in October 1996. Ground water extracted from the DNAPL recovery wells was directed to an on-site treatment system for treatment prior to discharge.

Enhanced DNAPL recovery was conducted in this manner from October 1996 through April 2006 when the enhanced ground water recovery system became inoperative as a result of the lightning related power surge that damaged the system controllers. DNAPL recovery has been conducted in a passive mode since then. The system operator checks the DNAPL level once a month. The DNAPL accumulated in the recovery wells is removed by the system operator when the DNAPL thickness in the wells is approximately six inches. DNAPL collection is accomplished by pumping the DNAPL from the well into 55-gallon drums mounted on a portable trailer system. The operator then transfers the DNAPL from the drums into a 6,500-gallon steel tank located at the treatment system. Once sufficient DNAPL has been collected, Beazer has the recovered DNAPL shipped off-site for recycling or disposal. Any water that separates out from the DNAPL in the storage tank will be sent off-site for disposal.

Typical operations till April 2006 have consisted of weekly measurements of DNAPL thickness in the recovery wells and removal of DNAPL that has accumulated to a thickness of more than one foot. No major operational problems exist with the DNAPL recovery system. The ground water pumping and treatment system operated as intended until the lightning related power surge that damaged the controllers in April 2006. The system includes several pumps, flow meters and other equipment that require frequent routine maintenance and periodic replacement. DNAPL recovery data and system operations information are summarized in the quarterly progress reports prepared by Beazer for submission to EPA. The plans for the system will be determined once the remedial

alternative is selected as part of the FFS.

As previously indicated, approximately 2,800 gallons of DNAPL had been recovered as of the First Five-Year Review. Approximately 1,100 gallons of additional DNAPL were recovered between the First and Second Five-Year Reviews and this corresponds to 60% reduction in the DNAPL recovery rate observed during the first five year period.

In addition to the ongoing DNAPL recovery operation, Beazer has conducted annual ground water monitoring since March 1993 in deeper monitoring wells located in the vicinity of the Site, as stipulated in the ROD. This activity is independent of the natural attenuation assessment for shallow ground water and is subject only to the applicable provisions of the ROD and EPA-approved Remedial Design Work Plan. The results of this activity have confirmed that the deeper ground water-bearing units beneath the Site are not impacted.

6.3 Operations and Maintenance (O&M)

Beazer initially contracted Roy F. Weston, Inc. to operate and maintain the DNAPL recovery and ground water treatment system. In 1997, Beazer contracted Remediation Technologies, Inc. (RETEC) to provide operation and maintenance services. Field & Technical Services, LLC (FTS) was contracted to provide the operation and maintenance services in January 2006. Long-term monitoring and maintenance activities for the cap are completed in accordance with the O&M plan incorporated into the Remedial Action Work Plan (RAWP), as modified in November 1999 and approved by EPA. The Groundwater Extraction System Performance Monitoring Plan (GESPMP), included as Appendix A.2 of the RAWP, describes performance monitoring and data evaluation for the ground water collection and DNAPL recovery systems. As previously indicated, ground water collection and treatment was conducted through April 2006 to enhance DNAPL recovery. Ongoing O&M activities include cap maintenance (conducted by the property owners) and operation and maintenance of the DNAPL recovery system (conducted by FTS on behalf of Beazer).

Quarterly progress reports are submitted to EPA to document ongoing O&M activities at the Site, to report DNAPL volumes recovered, and, through April 2006, to document the volume of ground water treated and discharged. Thirty-five (35) Quarterly Progress Reports have been submitted as of June 2007, in accordance with Section XI of the March 1991 Consent Decree for Remedial Design/Remedial Action. Monthly effluent reports for the treatment plant were submitted to TCEQ and EPA in accordance with the requirements of expired Texas Permit No.WQ0003388-000. During the Site inspection conducted in June 2007, since there are no effluent discharges from the Site, Beazer requested the EPA and TCEQ to submit the Monthly Effluent Report along with the Quarterly Progress Reports, instead of submitting them monthly. This has been approved by the EPA and TCEQ.

O&M costs have included those associated with operation and maintenance of the ground water and DNAPL collection and management/treatment systems; effluent monitoring, ground water quality monitoring (deep aquifer), cap inspections, and reporting. Beazer estimates the following costs for the last five years of O&M:

Table 2
Annual O&M Costs

Dates		Total Estimated Cost[(1)]
From	**To**	
July 1, 2002	December 31, 2002	$ 115,000
January 1, 2003	December 31, 2003	$ 172,000
January 1, 2004	December 31, 2004	$ 205,000
January 1, 2005	December 31, 2005	$ 186,000
January 1, 2006	December 31, 2006	$ 150,000
January 1, 2007	June 30, 2007	$27,000

1. Estimated O&M costs rounded to the nearest $1,000.

7.0 Progress since the Last Five-Year Review

Activities conducted since the last five year review process consisted of multiple remediation, investigative, and reporting tasks as follows:

- Operation of the DNAPL recovery system;
- Completion of routine cap maintenance activities;
- Completion of monthly discharge monitoring;
- Completion of annual ground water monitoring;
- Completion of annual cap inspections;
- Completion of a Supplemental Groundwater Investigation;
- Completion of a Focused Feasibility Study;
- Preparation of monthly discharge monitoring reports;
- Preparation of quarterly progress reports;
- Preparation of annual cap inspection reports;
- Submittal of response to comments on the Verification of Groundwater Fate and Transport Evaluation Report;
- Submittal and approval of Supplemental Groundwater Investigation Work Plan;
- Submittal of Supplemental Groundwater Investigation Report;
- Submittal of Draft Focused Feasibility Study Report; and,
- Completion of a Five-Year Review Site Inspection.

Table 3
Actions Taken Since the Last Five Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Action Taken and Outcome
1	Inspection and repair of cracks and joint systems	Property owner	The cracks have been maintained and repaired as needed. Weeds in joints are sprayed upon monthly.
2	Follow-up to use of natural attenuation as an alternative remedial action	Beazer, EPA, TCQ	Draft FFS submitted in May 2007, Discussions held in June 2007, FFS is being revised based on discussions.
3	Toll road expansion discussions to be held with City of Houston and HCTRA	EPA	Ongoing discussions held; Face to face Meeting scheduled in September 2007 with City of Houston and HCTRA
4	Fence repairs at NE corner	Property Owner	Property owner is aware; the site has 24 hour security and hence this does not impact protectiveness of the remedy
5	Evaluate current monitoring plan for deep wells and NPDES monitoring requirements	Beazer, EPA, TCEQ	Monitoring plan for deep wells is being evaluated as part of the FFS. Since treatment plant is shut down there is no discharge.

8.0 Five-Year Review Process

8.1 Administrative Components

The South Cavalcade Site Second Five-Year Review was led by Ms. Raji Josiam, EPA Remedial Project Manager for the South Cavalcade Site. The following team members provided information and assisted in the review:

- Michael Bollinger, P.E. - Environmental Manager, Beazer East, Inc.
- Fay Duke – Project Manager, Texas Commission on Environmental Quality
- Dennis Usko - Recovery System Operator, Field & Technical Services, LLC.
- James Zubrow, P.G. - Principal Hydrogeologist, Key Environmental, Inc.

The Second Five-Year Review consisted of document reviews (Attachment 1), interviews (Attachment 2), and Site inspection findings (Attachments 3 and 4) conducted during the June – July 2007 time frame.

8.2 Community Involvement

A bilingual notice of the on-going Second Five-Year Review was published in the July 26, 2007 Zone 8 edition of the Houston Chronicle. The notice invited recipients to provide comments to Raji Josiam, EPA Remedial Project Manager, by phone or e-mail. Another notice and mailing will be provided with the findings and recommendations of this final report. In addition, a copy of the Second Five-Year Review Report will be available at the Houston Central Library, the Site repository, at the EPA Region 6 and TCEQ offices, and on-line at *http://www.epa.gov/earth1r6/6sf/pdffiles/south_cavalcade_2nd__5_year.pdf.*

8.3 Document Review

This Second Five-Year Review consisted of review of relevant documents including O&M records, annual Site inspection reports, Site investigation reports, and a focused feasibility study report. Documents reviewed are listed in Attachment 1.

8.4 Data Review

DNAPL recovery data are summarized by Beazer and are included in the quarterly progress reports submitted to EPA. Review of these data indicates that the system has recovered DNAPL from the shallow ground water-bearing unit to the extent practicable. DNAPL recovery has decreased over time as previously discussed. Review of annual deep ground water monitoring data indicates that deep ground water has not been affected by the Site. Review of data obtained during the supplemental ground water investigation and summarized in the Supplemental Groundwater Investigation and Focused Feasibility Study Reports indicates that the extent of DNAPL and dissolved phase constituents is not increasing in size. A monitored natural attenuation remedy is being evaluated in a Focused Feasibility Study as an alternative remedy for the Site.

8.5 Site Inspection

Representatives of EPA, TCEQ, Beazer, and Key Environmental took part in a Site inspection on June 26, 2007 for the Five-Year review. The following personnel were present during the Site inspection.

- Michael Bollinger, Remediation Manager, Beazer
- Fay Duke, Project Manager, TCEQ
- Raji Josiam, EPA
- Deny Usko, Recovery System Operator, FTS
- Jim Zubrow, Project Manager and Principal Hydrogeologist, Key Environmental

During the Site inspections the south portion of the Site was inspected which included the ground water collection system, the ground water treatment plant, and the concrete cap. The ground water pumping and treatment system has been shut down since April 2006 due to the lightning related

power surge that damaged the controllers. The system was operated as intended until then. The plans for the system will be determined once the remedial alternative is selected as part of the FFS.

The well and access vaults in the southern well field were inspected during the June 2007 Site inspection and were found to be performing as designed with well and vault covers in good condition. Due to the frequent rain received during the inspection period, RWS-1 well vault had water accumulated in it. The level of the water did not interfere with the pump operation. RWS-2 was surrounded in water and the well vault could not be accessed. Based on a Site walkthrough in February by EPA, TCEQ, Beazer and Key Environmental and based on discussions with Beazer and Key Environmental, the wells and vaults in the northern well field are secure, and are in good condition.

The concrete cap in both the southeast and southwest were in good condition (see photographs). Minor surface cracks associated with curing will be monitored through Beazer's annual inspections. Minor weed growth was observed in the southeast area and the property owner removes these once a month.

An offset in the pavement was observed just to the east of the eastern edge of the southwest cap and may have been the result of a washout created when the water supply line broke during 2000-2001 timeframe. The offset appears to be the same as observed in August 2002 for the First Five-Year Review and does not appear to have impacted the integrity of the cap or the protectiveness of the remedy,

Arcadis BBL had reported in their July 2007 report for the cap indicated that the condition of the concrete cap in both the southeast and southwest areas is generally very good and shows limited wear. The report specified that there is no significant cracking or spalling other than the cracking typically encountered as concrete cures. The report noted that cracking, spalling, and joint separation are occurring on concrete outside the cap; however, the edges of the cap are not currently affected. The report indicated that the joint systems are intact and functioning as designed. Some shifting was observed in the southwest area near the bollards and sign posts and requires caulking and was recaulked in June 2007. The on-site manholes, storm water inlets, and the below-grade detention basins were inspected and all were in good condition. Minor weed growth in the southeast area was observed during Arcadis BBL's inspection as well.

During the interview it was reported that the perimeter fencing in the northeast corner south about 70 yards is still partially down which was also identified in the last Five-Year Review. Under the Access Agreement the property owners are responsible for maintaining their sites. There is no indication of trespassing or vandalism occurring at the Site as a result of the fence being down. The recovery wells and piezometers in the northern portion of the Site and the ground water treatment plant are fenced in. The southeast and southwest areas of the Site are monitored continuously during business hours and are patrolled by security officers at night.

Action items from this inspection are:

- Monitor the eastern edge of the southwest cap for impacts from a historical water line break.

- Monitor the surficial cracks (from curing) in the caps for any significant changes over time.
- Verify property ownership for the entire Site.

These action items do not indicate any problems which would impact the remedy protectiveness for human health and environment. Rather, these are monitoring actions to detect changing conditions with the cap.

8.6 Interviews

The following individuals were interviewed in person, or by telephone, for the Five-Year Review (Details of those discussions can be found in Appendix 2).

- Deny Usko, Recovery System Operator, FTS (6/26/07)
- Ryan Burke, Operations Manager, AWI (6/27/07)
- Ray Cardenaz, Supervisor, Jevic (6/27/07)
- Corey Rabel, Terminal Manager, Bullocks Express (6/27/07)
- Leon Melamed, Owner, Best Pallet (6/27/07)
- Travis Brown, Director of Maintenance, Palletized Trucking Inc, (6/27/07)
- Ceil Price, Senior Assistant City Attorney, City of Houston (7/6/07)
- Fay Duke, Project Manager, TCEQ (7/9/07)
- George Lyon, Assistant Director Engineering, HCTRA (7/10/07
- Michael Bollinger, Remediation Manager, Beazer (7/11/07)
- Jim Zubrow, Project Manager and Principal Hydrogeologist, Key Environmental (7/17/07)

Mr. Denny Usko is a system operator for the waste water treatment plant and he is with Field Technical Services, LLC (FTS). Ms. Josiam spoke to Mr. Usko in his office trailer located in the treatment plant. Mr. Usko indicated that a power surge due to lightning damaged the system controllers in April 2006 and the plant has been shutdown since. He also indicated that there are currently no discharges from the Site. He had requested to check to see if the Monthly Discharge Monitoring reports can be submitted along with the Quarterly Progress reports since there is no discharge from the Site. He had no issues or concerns.

Mr. Ryan Burke is the Operations Manager for American Warehouses, Ltd. (AWI). Ms. Josiam spoke to Mr. Ryan Burke in his office located across the street from the southwest cap at 1918 Collingsworth. Ms. Josiam gave him a brief status update of the Site regarding the shutdown of the treatment system due to lightning related power surge in April 2006 and current evaluation of Monitored Natural Attenuation as an alternative remedy option for the Site. Mr. Burke had concerns with leaching of DNAPL onto their property across the street and was wondering what the recourse was.. Ms. Josiam had indicated to him that EPA along with TCEQ have been reviewing the Site monitoring results and are evaluating remedial alternatives to ensure there is no further migration. Mr. Burke indicated that they have very good security in place. During nights and weekends they have both off-duty and on-duty Houston Police Department (HPD) officers on-site. They also have 30 cameras installed throughout the Site which is being monitored by AWI during the day and by the HPD personnel during night and weekends.

Mr. Cardenaz is a supervisor at Jevic and Ms. Josiam spoke to him at the Jevic's office. Jevic is one of the tenants located on the southwest side of the Site. Ms. Josiam gave him a brief status update of the Site regarding the shutdown of the treatment system due to lightning related power surge in April 2006 and current evaluation of Monitored Natural Attenuation as an alternative remedy option for the Site. Mr. Cardenaz had no concerns or issues.

Mr. Corey Rabel is the Terminal Manager for Bullocks Express and Ms. Josiam spoke to him in his office. Bullocks Express is one of the tenants in the southwest area. Ms. Josiam gave him a brief status update of the Site regarding the shutdown of the treatment system due to lightning related power surge in April 2006 and current evaluation of Monitored Natural Attenuation as an alternative remedy option for the Site. Mr. Rabel had no concerns or issues. He indicated that the Site is very secure.

Mr. Leon Melamed is the Owner of Best Pallet which is adjacent to the west side of the Site boundary. Ms. Josiam spoke to Mr. Melamed in his office. Ms. Josiam gave him a brief status update of the Site regarding the shutdown of the treatment system due to lightning related power surge in April 2006 and current evaluation of Monitored Natural Attenuation as an alternative remedy option for the Site. Mr. Leon had no concerns and indicated that everything was going well.

Mr. Travis Brown is the Director of Maintenance with Palletized Trucking Inc. and is located on the southeast Site of the sit. Ms. Josiam spoke to Mr. Travis Brown in his office. Ms. Josiam gave him a brief status update of the Site regarding the shutdown of the treatment system due to lightning related power surge in April 2006 and current evaluation of Monitored Natural Attenuation as an alternative remedy option for the Site. He indicated that he has no concerns with the operation of the Site. He stated that they operate 24 hours. He indicated that he does a Site walkthrough once a month and sprays the weeds if necessary in the expansion joints in concrete. He also does a walkthrough of the city wastewater easement area and this area (east of the Site) has a strange odor to it. He indicated that once a week the grass is mowed. He indicated that the Site is very well secured. Their operational area is barricaded and they have armed private contractor security personnel on-site after 6:00 pm and on weekends.

Ms. Ceil Price is the Senior Assistant City Attorney with the City of Houston. Ms. Josiam spoke to Ms. Price about the Site over the telephone. Ms. Price was going to check with the city engineer regarding the status of the extension of the Hardy Toll Road and expansion of Collingsworth Street. She indicated that once she finds out she will give Ms. Josiam an update. She did not have any specific concerns regarding the South Cavalcade Site.

Ms. Fay Duke is a Project Manager in the Superfund Division, Texas Commission on Environmental Quality. The project was assigned to her in May 2006. Based on file review and Site inspections, Ms. Duke indicated that the caps appeared to be well maintained and functioning as intended. She indicated that the ground water pumping associated with the recovery of the dense non-aqueous phase liquid (DNAPL) at Site has been suspended due to

damage to the GWTP. Ms. Duke stated that although affected ground water above protective levels has migrated off-site, there is no current exposure pathway. She indicated the performing party is in the process of preparing a focus feasibility study to evaluate alternative remedy for the ground water. Ms. Duke indicated that there are no routine activities performed by TCEQ at the Site and is not aware of any problems requiring response by TCEQ. She feels well informed about the Site's activities and progress. Ms. Duke indicated that the performing party should complete the FFS evaluation in determining whether that the DNAPL is not mobile under steady-state conditions and that the discontinuation of DNAPL recovery will not adversely affect the MNA remedy for the dissolved plume or result in an unacceptable exposure. She specified that where no active restorations are planned for the affected ground water, institutional controls must be implemented restricting the use of the ground water.

Mr. George Lyon is the Assistant Director for Engineering at the HCTRA. He has been working with the EPA regarding the Hardy Toll Road Expansion Project. Mr. Lyon indicated that a HCTRA issued a Notice to Proceed to an engineering contractor to come up with a design for the Toll Road extension and Collingsworth Street expansion in two years. The Toll Road extension and Collingsworth Street expansion is to be built in two years following that. Contractors to the City of Houston have been working on the design of the Collingsworth Street expansion, which according to Mr. Lyon will now be HCTRA's responsibility. He has indicated that in the near future a meeting is to be held between HCTRA and EPA and other relevant parties to start discussions on how the Collingsworth Street expansion will be affected by the South Cavalcade Superfund Site.

Mr. Bollinger is the site environmental manager for Beazer East, Inc. He is responsible for managing and directing the work of the consultants and contractors performing the ongoing environmental activities at the Site. Mr. Bollinger has been engaged in this capacity at the South Cavalcade Site since approximately 1996. Mr. Bollinger indicted that the soil remedy continues to function as expected. The concrete caps have facilitated continued productive use of the Site in a manner that provides effective protection of human health and the environment. Mr. Bollinger believes that significant progress has been made with regard to the ongoing re-evaluation of the ground water remedy. The investigative activities performed in the recent years have added to the understanding of the ground water conditions at and in the vicinity of the Site. Mr. Bollinger believes that this work, together with the Focused Feasibility Study provide additional lines of evidence that Monitored Natural Attenuation (MNA) will be an appropriate remedy for the ground water at the Site. Mr. Bollinger is not aware of any concerns within the community related to the Site. Mr. Bollinger noted that both the HCTRA and City of Houston have plans in development for road projects adjacent to the Site. Mr. Bollinger indicated that Beazer has provided information relative to the environmental conditions at the Site to both entities.

Mr. Zubrow is a principal hydrogeologist and project manager for Beazer's technical consultant (Key Environmental, Inc.). Mr. Zubrow is also a partner in Field & Technical Services (FTS) who performs the operations, maintenance and monitoring of the DNAPL recovery system at the Site. Mr. Zubrow has been involved in work at the Site since the Remedial Design phase (circa

1993). Mr. Zubrow indicated that EPA and TCEQ have been diligent in reviewing and commenting on the technical documents submitted on behalf of Beazer. Mr. Zubrow is not aware of any concerns within the community. To his knowledge, the property owners have not expressed any concerns regarding the protectiveness of the remedy. The constructed soil remedy permits the property owners to fully utilize their properties for their trucking businesses with very little or any impediment. Mr. Zubrow believes that the additional ground water characterization work recently completed by Beazer has provided valuable information for enhancing the delineation of the extent of impacted ground water and affirming that the potential for exposure to potentially impacted ground water is minimal. Mr. Zubrow is fully supportive of the implementation of a Monitored Natural Attenuation (MNA) remedy for Site ground water as detailed in the May 2007 Draft Focused Feasibility Study. A lightning strike damaged the programmable controls for the water treatment plant in April 2006 and rendered the treatment system inoperable. Since that time, ground water pumping has been suspended and O&M activities, consisting of measurement of DNAPL thickness and removal of accumulated DNAPL, have been performed on a monthly basis. Mr. Zubrow does not believe these changes have had any negative impact on the overall protectiveness and effectiveness of the remedy. The FTS O&M technician has not reported any instances of trespassing or vandalism. The Site appears to be relatively secure as the result on the "active" nature of the Site and the vigilance of the employees who work there and fencing that encloses the sections of the site that are not occupied by active businesses in the northern recovery well area and the groundwater treatment plant.

8.7 Risk Information Review

The following standards were identified as Applicable or Relevant and Appropriate Requirements (ARARs) in the ROD:

- National Primary Drinking Water Standards;
- National Secondary Drinking Water Standards;
- Maximum Contaminant Level Goals;
- Texas Water Quality Standards; and.
- National Pollutant Discharge Elimination System Best Available Technology Requirements.

The remedial goals specified in the ROD were selected to comply with these criteria. No changes to these standards have been made which affect the protectiveness of the ground water remedy. However, as stated previously, EPA is evaluating these requirements in consideration of the policy enacted in 1995 that favors waivers of these ARARs at Sites where it is technically impracticable to remediate ground water to State and Federal standards. This appears to be appropriate for the South Cavalcade Site given the stability of the plume, the lack of complete exposure pathways, and the impracticability of remediation.

8.8 Exposure Pathways

A review of land use at the Site and in the Site vicinity indicates no substantial changes. Consequently, no additional receptors or exposure pathways have been identified. The on-site buildings are still present and a secure (locked) fence still surrounds most of the Site. No residences

have been constructed closer to the Site than were present when the 1988 risk assessment was completed. Potential on-site soil exposure has actually been reduced because the areas with elevated PAH concentrations have been capped, thereby eliminating the exposure pathways discussed in the 1988 ROD. Ground water at the Site is currently not used and future use is precluded through the application of a deed restriction. The dissolved phase plume at the Site is not increasing in size based on available data. At this point in time, a complete exposure pathway is not expected as drinking water is provided by the City – there are no known private wells down-gradient of the plume. As previously indicated, the HCTRA and City of Houston has also proposed an extension to the Hardy Toll Road and expansion of Collingsworth Street. The Toll Road extension is proposed to be built along the rail right-of-way adjacent to the western boundaries of the South and North Cavalcade Street Superfund Sites. The Toll Road, if constructed as planned, will further separate these industrial properties from the neighborhood to the west.

9.0 Technical Assessment

The following conclusions support the determination that the soil and ground water remedial actions at the South Cavalcade Site are expected to be protective of human health as indicated below, and identify uncertainties which will be addressed to ensure future protectiveness of the remedies.

The soil remedial actions implemented at the Site will remain protective of human health and the environment. The concrete cap eliminates any potential for direct contact with impacted soil. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated. The concrete cap ensures current and future protection of human health and the environment.

The ground water remedy is protective in the short term but future protectiveness depends on the demonstration that the DNAPL and plume are not migrating vertically and horizontally. Institutional controls such as Administrative Order on Consent restrictions and Houston-Galveston Coastal Subsidence District notification and permitting requirements at the Site ensure that future use of the Site remains non-residential and prohibit on-site ground water use. Current information shows that shallow ground water is not currently being used in the vicinity of the Site and deeper ground water has not been impacted by Site-related constituents.

Question A: Is the remedy functioning as intended by the decision documents?

- *Health and Safety Plan (HASP)/Contingency Plan*: The HASP is in place. This plan is sufficient to control risks on-site, and is properly implemented.

- *Implementation of Institutional Controls and Other Measures*: The use of the Site is restricted to non-residential use by virtue of the respective Administrative Order on Consent (AOC) between the property owners and the EPA. Non-residential use is consistent with the exposure assumptions used to develop the remedial goals for soil. Site access is restricted to authorized

personnel via fencing, locked access gates and on-site security personnel. The AOC also prohibits the installation of on-site water wells (except for the purpose of ground water monitoring). Thus, this institutional control eliminates one of the potential ground water exposure pathways identified in the ROD and ensures that the selected ground water remedy remains protective. For those areas adjacent to the Site, the Houston-Galveston Coastal Subsidence District has notification and permitting requirements in place to further reduce ground water use and to discourage the use of private wells where a public water supply is readily available.

- *Remedial Action Performance*: Installed portions of the soil remedy are operating as anticipated. The concrete cap is effective in protecting human health and environment by eliminating direct contact with surface soils by on-site occupants. The cap has also provided positive drainage preventing standing surface water. The DNAPL recovery and ground water treatment systems functioned as designed until April 2006 when a lightning related power surge affected the controllers. DNAPL is being removed via use of the four recovery wells which continue to operate in a passive mode. The DNAPL and dissolved phase constituent plume is not increasing in size based on available data. Monitoring data indicate that the treatment system was effective in reducing constituent concentrations to levels less than the discharge standards while the system was in operation.

- *System Operations/O&M*: The long-term operations and maintenance (O&M) of the soil remedy was initiated after the construction of the concrete cap was completed in August 2000. The O&M procedures, including annual inspections, should maintain the effectiveness of the remedial actions. The DNAPL recovery system continues to operate in a passive mode. The enhanced gradient ground water pumping was conducted through April 2006 but is currently inoperative. Ground water pumping and treatment has been discontinued pending evaluation of the focused feasibility study for Site ground water.

- *Costs of System Operations/O&M*: O&M costs for both the soil remedy and for the operation and maintenance of the DNAPL recovery and ground water treatment system have been within an acceptable range. Ground water extraction and monitoring to minimize off-site migration has been suspended since 1995, and therefore is not reflected in the O&M costs provided.

- *Opportunities for Optimization*: Due to the current adequate performance of the concrete cap at the time of this Five-Year Review, a need for optimization for the soil has not been identified. Similarly, the DNAPL recovery system and ground water treatment plant performed as expected through April 2006. Opportunities for optimization appear to exist with respect to the enhanced gradient pumping and ground water treatment system. A Focused Feasibility Study that addresses Monitored Natural Attenuation as an alternative remedy for the Site is currently being evaluated by Beazer, EPA, and TCEQ. Note again that overall ground water monitoring has been delayed pending re-evaluation of the 1988 ROD remedial options and goals so there is a lack of data which would support optimization of the overall system which provides for plume containment.

- *Early Indicators of Potential Remedy Failure*: No early indicators of potential failure of the soil and ground water remedies were noted during the review.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

- *Changes in Standards and To Be Considereds*: No changes in standards and "to be considereds" have been enacted, therefore the protectiveness of the remedies remain unchanged. EPA continues to evaluate the potential inapplicability of the ground water remedial goals specified in the ROD in consideration of the policy enacted in 1995 that favors waivers of State and Federal standards at sites, such as the South Cavalcade Site, where it may be technically impracticable to remediate ground water to these criteria. Any modifications, however, to remedial goals will have to also meet the protectiveness standard

- *Changes in Exposure Pathways*: No changes in exposure pathways have occurred that would adversely affect the short-term protectiveness of the remedies. No new contaminants, sources, or routes of exposure were identified as part of this Five-Year Review. Additionally, there are no current or planned changes in land use. The Site continues to be used for non-residential purposes and future use must remain non-residential in accordance with the restrictions established in the 1992 AOC entered into by the EPA and the property owners. Property owners have increased the amount of paved area at the Site, benefiting the overall serviceability of the cap system. The concrete cap is expected to perform consistently with the expectations of the Amended ROD and effectively eliminates this exposure pathway.

  The ROD was prepared based on the assumption that future exposure to ground water could occur if on-site ground water wells were installed or if there was further off-site migration to a point of exposure. The 1992 AOC among the EPA and property owners prohibits the installation of on-site water wells (except for the purpose of ground water monitoring). This institutional control eliminates one of the potential exposure pathways identified in the ROD and increases the protectiveness of the selected ground water remedy. The ROD concluded that shallow ground water within a one-mile radius of the Site is currently not being used. Recent work performed by Beazer as part of the FFS further verified that shallow ground water is not currently being used within a one-mile radius of the Site and is extremely unlikely to be used in the future. A supplemental ground water investigation demonstrated that the plume at the Site is stable or receding. The annual deep ground water monitoring performed by Beazer continues to demonstrate that the deeper aquifers beneath the Site have not been impacted.

- *Changes in Toxicity and Other Contaminant Characteristics*: There have been no significant changes in toxicity factors or other contaminant characteristics, therefore the protectiveness of the remedies still remain. Protectiveness will be re-evaluated in view of a potential monitored natural attenuation remedy.

- *Changes in Risk Assessment Methodologies*: Risk assessment methodologies have not changed significantly since the time of the amended ROD, and therefore the protectiveness of the

remedies still remain. Protectiveness will be re-evaluated in view of a potential monitored natural attenuation remedy.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

- No additional information has been identified that would call into question the protectiveness of the soil and DNAPL remedies. The plume appears to be stable, and pumping of ground water to enhance DNAPL recovery appears to provide no additional benefit. Beazer, EPA, and TCEQ are in the process of evaluating a Focused Feasibility Study regarding Monitored Natural Attenuation as the long-term remedy for Site DNAPL and ground water. However, worker protection must be considered during construction of portions of the Hardy Toll Road and along Collingsworth as subsurface work will provide a short-term duration for exposure for contaminated ground water. Level C protective clothing is recommended. In addition, care must be taken during construction to not create any conduits or pathways for migration of DNAPL to the deeper aquifers. These considerations will be discussed with both the HCTRA and City of Houston.

10.0 Issues

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Shallow rooted vegetation observed in the expansion joints along the eastern edge in the Southeast area.	N	Y
The list of owners for the Site needs to be updated and ensure that the AOC is still effective for ICs.	N	Y
Ground water collection and DNAPL recovery system may no longer be the best remedial alternative	N	Y
The Toll Road extension and Collingsworth Street expansion may impact the Site	N	Y
Unable to locate in public records the plat and survey of impacted area and cap	N	N

11.0 Recommendations and Follow-up Actions

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Affects Protectiveness? (Y/N)	
				Current	Future

Shallow rooted vegetation	• The property owners are to inspect and maintain joint systems and repair cracks and joint systems as required. • Beazer is responsible for continuing annual cap inspections.	Property Owners Beazer	EPA/TCEQ	N	Y
Update owner list and ensure AOC is still effective	• A Title Search is to be conducted to determine the current owners • Conduct a record search and discuss with current landowners the AOC and ensure that it is still an effective IC	EPA Landowner	EPA/TCEQ	N	Y
Not the best Remedial Alternative	• Evaluation of the Focused Feasibility Study supporting Monitored Natural Attenuation as an alternative remedial action for ground water is to be continued. As part of this re-examination of remedial options and objectives, ground water monitoring requirements and extraction to contain the dissolved plume should also be evaluated and reinstated as appropriate. It must be also be demonstrated that the DNAPL and plume are not migrating vertically and horizontally.	Beazer/EPA/ TCEQ	EPA/TCEQ	N	Y
Toll Road extension and Collings-worth Street Expansion	• Continued discussions are to be held with the Harris County Toll Road Authority (HCTRA) and the City of Houston concerning potential Site impacts to be considered. Worker health and safety should be considered for those areas where short-term contact with ground water contamination is anticipated.	EPA HCTRA	EPA HCTRA City of Houston	N	Y

	Precautions should also be taken during construction to prevent the creation of conduits and preferential pathways for migration of DNAPL to deeper aquifers.				
Unavailability of plat and survey in public records	• Ensure the plat and survey of the impacted area and cap is part of the Administrative Record	EPA	EPA/TCEQ	N	N

12.0 Protectiveness Statement

The soil remedial actions implemented at the Site will remain protective of human health and the environment. The concrete cap eliminates any potential for direct contact with impacted soil. The long-term O&M plan for the concrete cap will ensure that the potential for future exposure to underlying soil is eliminated. The concrete cap ensures current and future protection of human health and the environment.

The ground water remedy is protective in the short term but future protectiveness depends on the demonstration that the DNAPL and plume are not migrating vertically and horizontally. Institutional controls such as Administrative Order on Consent restrictions and Houston-Galveston Coastal Subsidence District notification and permitting requirements at the Site ensure that future use of the Site remains non-residential and prohibit on-site ground water use. Current information shows that shallow ground water is not currently being used in the vicinity of the Site and deeper ground water has not been impacted by Site-related constituents.

13.0 Next Review

This is a statutory review that requires ongoing five year reviews. The next review will be conducted within five years of the completion of this Five-Year Review report. The completion date is the date of the signature shown on the summary of findings page attached to the cover sheet.

FIGURES

ATTACHMENT 1
DOCUMENTS REVIEWED

DOCUMENTS REVIEWED

Arcadis BBL, September 2006, *2005 Long-Term Operations and Maintenance Annual Report (Soil Remedy), South Cavalcade Superfund Site – Concrete Cap, Houston, Texas*

Arcadis BBL, July 2007, *2006 Long-Term Operations and Maintenance Annual Report (Soil Remedy), South Cavalcade Superfund Site – Concrete Cap, Houston, Texas*

Dames & Moore, August 2000, *Interim Remedial Action Report, South Cavalcade Site, Houston, Texas*

Field & Technical Services, January 2007, *Report of Findings 2006 Deep Monitoring Well Sampling and Analysis, South Cavalcade Superfund Site, Houston, Texas*

Key Environmental, Inc., July 2000. *Verification of Groundwater Fate and Transport Evaluation, South Cavalcade Superfund Site, Houston, Texas*.

Key Environmental, Inc., March 2006. *Supplemental Groundwater Investigation Report, South Cavalcade Superfund Site, Houston, Texas.*

Key Environmental, Inc. May 2007. *Draft Focused Feasibility Study, South Cavalcade Superfund Site, Houston, Texas.*

U.S. EPA, September 1988. *Record of Decision (ROD), South Cavalcade Street Site, Houston, Texas.*

U.S. EPA, March 1991. *South Cavalcade CERCLA RD/RA Consent Decree, Civil Action No. H-90-2406.*

U.S. EPA, June 27, 1997. *CERCLA Amended Record of Decision No. 1 for South Cavalcade Street Site, Houston, Harris County, Texas.*