4.0 FINAL REMEDIAL ACTION CONSTRUCTION

Construction Completion Reports (CCRs) were issued following completion of the major components of the RA, providing specific details about the construction activities for each component. The following section summarizes the construction activities and CCRs for each remedial action conducted at the ACS Site, divided by Consent Decree category.

4.1 SITE PREPARATION AND CLEANUP

4.1.1 Fire Pond Closure

The Fire Pond was located in the center of the ACS facility. Since 1975, it had been a reservoir, available to provide water needed for firefighting on the ACS Chemical Plant. The location of the pond is shown in Figure 1 (page 2).

The Fire Pond was filled during 2001 with soil excavated during site remediation. In the spring of 2001, approximately 2,500 cubic yards of visually impacted soils and debris from the drum removal activities (described in section 4.1.3) were placed in the Fire Pond (Final Buried Drum Removal in On-Site Containment Area Construction Completion Report [MWH, March 2003]). Also, during the PCB-impacted soil excavation activities in the fall of 2001, approximately 4,900 cubic yards of impacted material were excavated from the wetland west of the ACS facility and used to fill and close the Fire Pond.

The volume of PCB-impacted soil and visually impacted soil and debris placed in the Fire Pond resulted in higher ground surface elevations than originally anticipated for the SBPA cover. In order to meet the design elevations, approximately 3,800 cubic yards of material were removed from the Fire Pond and moved to the Off-Site Area in July 2002 to fill and shape a drainage swale in the cover area. Further details of these activities are included in the Construction Completion Report for the Final Engineered Cover in the Off-Site Area (MWH, June 2004). The soil left in the Fire Pond was incorporated as part of the SBPA engineered cover. The inclusion of the Fire Pond in the engineered cover for the SBPA constituted the final closure of the Fire Pond.

Further information on the Fire Pond closure can be found in the *Still Bottoms Pond Area Interim Engineered Cover Construction Completion Report, including Fire Pond Closure* (MWH, March 2004).

The original site "fire pond" had been virtually drained as the groundwater level lowered inside the barrier wall.

4.1.2 Pile Consolidation

During 1996 and 1997, MWH constructed a barrier wall around the On-Site and Off-Site Areas to contain buried source material. MWH also constructed the PGCS to capture impacted groundwater before it migrated off-site. Excavation for these two construction activities generated excess soil spoils. MWH developed a Spoils Management Plan that was included in a November 6, 1996 letter to the U.S. EPA entitled "Management and Temporary Storage of Construction Derived Soils." The plan was developed to manage the spoils generated or (expected to be generated) during construction activities. In accordance with the plan, the material was segregated into the five piles located in the Off-Site Area. The main objectives of the Off-Site Area spoils piles consolidation were to:

1) Eliminate potential direct contact with contamination within the

spoils piles by consolidating them beneath the engineered cover; and

2) Utilize the consolidated material as fill material beneath the engineered cover to promote proper surface water drainage from the engineered cover.

Additional waste consolidation activities included shearing and placement of approximately 600 drums whose contents were generated during previous investigation and construction activities.

The Final Remedial Design Report called for the management and containment of the spoils piles in the Off-Site Area. During May 2001, the spoils were consolidated for containment beneath the cover. The following is a list of the spoils piles that were developed under the plan, with a description of how they were consolidated, graded, and managed.

1) **Upper Aquifer Debris Pile**: The upper aquifer debris pile consisted of assorted landfill debris collected from the upper aquifer region of soil during the 1997 installation of the Perimeter Barrier Wall (described in Section 4.3.1).

2) **Upper Aquifer VOC Soil Pile**: The upper aquifer VOC soil pile consisted of soil with VOC concentrations below 500 parts per million (ppm) collected from the upper aquifer region during the 1997 installation of the Perimeter Barrier Wall.

3) **The K-P Spoils Pile**: The K-P spoils pile debris was sheared into manageable pieces. The sheared debris was relocated to a low area on the north side of the Off-Site Area that required additional fill to reach final grades. This area was located between the upper aquifer debris pile and the upper aquifer VOC soil pile.

4) **The VOC and PCB Soil Pile**: The VOC and PCB soil pile was re-graded from May 29, 2001 to May 31, 2001.

5) **The PCB Soil Pile**: The PCB soil pile was also re-graded from May 29, 2001 to May 31, 2001.

Figure 4 (page 17) shows locations of these spoils piles and investigation derived wastes (IDW) after consolidation and re-grading activities, prior to the installation of the interim engineered cover.

Compaction of the spoils piles was completed on June 12, 2001 and a temporary clay cover was installed to minimize worker exposure to the newly consolidated piles. Further discussion of the design of the consolidated spoils pile is available in the *Final Off-Site Area Interim Engineered Cover Construction Completion Report including Spoils Pile Consolidation* (MWH, February 2003).

4.1.3 Drum Removal

MWH acquired information about the condition and placement of buried drums in the ONCA during various investigation and construction activities. Buried drums were identified in the On-Site Containment Area during the RI. Also, during the installation of a waterline to the GWTP in early 1997, 41 drums were discovered in the ONCA and subsequently removed. These drums were placed into over-pack drums and temporarily placed in a secure area of the Off-Site Area. Buried drums were also encountered in 1997 during a separate excavation for the Barrier Wall installation along the northern end of the facility.

A geophysical survey was conducted on February 23 and 24, 1998 to delineate the extent of buried drums in the On-Site Area. Both a magnetometer and ground penetrating radar were used. The geophysical surveys showed three areas of geophysical anomaly and the results were used to estimate that there were between 1,000 and 2,500 drums buried in three areas of the ONCA, designated as Area A, Area B, and Area C. In February 2001, a series of test pits were conducted across the three anomaly areas. Buried drums were found in Areas A and B, but no drums were found in Area C. The drum containing areas are delineated on Figure 5 (page 18).

The drum excavation began on April 27, 2001 and was completed on May 24, 2001. The removal process consisted of the excavation, characterization, and disposal of buried drums and drum debris from the ONCA. A total of 1,698 drums were removed from the delineated areas, 249 of which were placed in 85-gallon over pack drums. These were subsequently sampled and analyzed on Site according to the procedures outlined in the Work Plan. The remaining 1,449 drums were non-intact, and therefore placed into roll-off boxes for later sampling and disposal. In addition, 2,496 cubic yards of visually impacted soil from the excavation were placed in the Fire Pond. The Fire Pond is now being actively treated by the SBPA ISVE system.

The over-packed drums and roll-off boxes were stored on Site as disposal options were evaluated. Upon

Intact drums in Area A being placed in over-pack containers. After all the drums had been removed the excavation was dewatered, filled with clean soil, and then compacted.

approval of the disposal facility by U.S.EPA and IDEM, the over-packed drums were shipped off-site for incineration. Then the contents of the roll-off boxes were cut into manageable-sized pieces, re-consolidated into the roll-off boxes and shipped off-site for incineration. The total volume of material sent to the Onyx Incinerator in Port Arthur Texas was 234 over-packed drums and 380 cubic yards of drum debris contained in roll-off boxes. The drum removal and disposal activities were conducted in accordance with the Agency-approved Work Plan entitled *Buried Drum Removal Plan*, (Montgomery Watson, January 1999).

Further discussion regarding the drum removal activities in the On-Site Area is provided in the *Final Buried Drum Removal in On-Site Containment Area Construction Completion Report*. (MWH, March 2003).

4.1.4 Wetlands PCB Excavation and Restoration

A two-phased wetland investigation performed by MWH in 1996 showed that the surface sediment in a one-and-a-half acre area in the wetland, to the west of the active ACS plant, contained PCBs above 1 ppm. The final remedy included removal of these sediments in order to prevent ingestion and dermal contact with the contaminated material.

Removal of the PCB-impacted soil from the wetland area in the west portion of the Site was conducted during August and September 2001. The work was performed in accordance with the U.S. EPA and IDEM-approved *PCB-Impacted Soil Excavation Work Plan* (Montgomery Watson, April 1999) and the *Final Remedial Design Report* (Montgomery Watson, August 1999).

Approximately 4,900 in-place cubic yards of PCB-impacted material were removed from the wetland according to the post-excavation survey data. Materials excavated from the PCB-impacted areas were staged in the Fire Pond area and characterized through laboratory analysis. Characterization data indicated that the excavated material contained PCB concentrations less than 50 milligrams per kilogram (mg/kg), the concentration at which the Work Plan called for off-site disposal at a Toxic Substances Control Act (TSCA)-approved facility. Therefore, this material was placed in the Fire Pond and compacted in accordance with the U.S. EPA approved remedial design. This constituted part of the Fire Pond Closure task (described in Section 4.1.1).

PCB-impacted sediment being removed from the wetland area in August 2001.

Completed open-water restoration in November 2001.

The restoration of the wetland by the construction of an open-water pond began on September 4, 2001 and was completed on September 24, 2001. Figure 6 (page 21) shows the final extent of the wetland pond. MWH estimates that approximately 6,600 cubic yards of soil were removed from the wetland during pond construction in addition to the 4,900 cubic yards of soil removed during the excavation of PCB-impacted material. The pond construction material was stockpiled for use in the construction of the Off-Site Area engineered cover.

Material removed during the pond construction was used to backfill the eastern portion of the excavation area to original grade. The area was further shaped to improve drainage and allow volunteer prairie grasses and plants to re-populate the area. Further information about the PCB-impacted soil excavation and wetland restoration can be found in the *Final PCB-impacted Soil Excavation In the Wetland Area Construction Completion Report* (MWH, November 2002).

4.2 IN-SITU SOIL VAPOR EXTRACTION

In-situ soil vapor extraction was identified in the modified ROD as the appropriate technology to address the principle threat of the Site by reducing the risk of exposure to contaminated vapors and reducing the potential migration of mobile contaminants to the groundwater. ISVE systems were constructed in both the Off-Site Area and the SBPA. As of September 1, 2005 both the Off-Site and SBPA ISVE systems have together removed an estimated 600,000 lbs of VOCs from the ground.

4.2.1 Off-Site ISVE System

The ISVE wells for the Off-Site ISVE system were installed between August 27 and September 20, 2001. A total of 42 ISVE wells and three air sparge (AS) points were installed in the Off-Site Area. Twelve ISVE wells (SVE-1 through SVE-12) were installed in the K-P Area and thirty ISVE wells (SVE-13 through SVE-42) were installed in the OFCA. The air sparge points were designated as AS-7 through AS-9. Figure 7 (page 22) displays the ISVE well locations of the Off-Site ISVE system. A blower shed was installed in the Off-Site Area to house the vacuum blower system and condensate removal system. Conveyance piping was installed to connect each ISVE well and air sparge point to the piping manifold in the blower shed. Extracted vapor and collected condensate are delivered to the GWTP for treatment via piping installed between the blower shed and GWTP.

Controls and instrumentation were installed to integrate the ISVE system with the operation of the GWTP. Installation of the underground piping began on November 28, 2001 and was completed in July 2002. First, the interim clay cover was excavated along the pathways to contain the piping. Then after the piping was installed, the excavated clay was backfilled over the piping and compacted.

The completed ISVE piping for wells north of the blower shed. At the time of this photograph, the ISVE well and piping in the foreground have yet to be backfilled. A bentonite plug is visible at the base of the nearest well in the center of the photo. The plug provides an additional seal for the connection between well and piping. The smaller diameter pipe crossing over the others is piping associated with one of three air sparge points.

To treat the high concentrations of contaminants in the vapor stream anticipated during the initial operation of the ISVE system, a recuperative thermal oxidizer and scrubber system was installed at the GWTP. The thermal oxidizer and scrubber units were delivered to the site on February 7, 2002. Start-up of the unit occurred on February 17, 2002. A technician was on-site from February 17 to March 14, 2002 to supervise the installation, check out, inspect, prepare the system for process gas flow, and perform the initial startup. Normal system operations began on April 1, 2002.

Further discussion regarding the design of the Off-Site ISVE system is available in the *Off-Site Containment Area and Kapica-Pazmey Area In-Situ Soil Vapor Extraction Systems Construction Completion Report* (MWH, March 2004).

4.2.2 SBPA ISVE SYSTEM

The SBPA ISVE system was installed to meet the same objectives as the Off-Site ISVE system, that is, reducing the mobile VOCs in the source areas by means of vapor extraction. To aid in the dewatering efforts within the Barrier Wall, a portion of the ISVE wells were installed as DPE wells. The DPE wells were designed and constructed to extract both vapor and groundwater from the SBPA.

A DPE well being installed in the SBPA ISVE system.

A total of 46 wells were installed for the SBPA ISVE system between October 24 and November 15, 2002. Twenty-five were ISVE wells and twenty-one were DPE wells. In addition, six air sparge points were installed in the SBPA. Figure 8 (page 24) depicts the locations of the wells and sparge points.

Extracted vapor and collected condensate are delivered to the GWTP for treatment via piping installed between blower shed and the GWTP. This piping was installed previously as part of the construction of the Perimeter Barrier Wall. The ISVE system required installation of controls and instrumentation and integration of the ISVE system operation with the operation of the GWTP.

The groundwater conveyance piping was installed between September 30 and October 10, 2002. The vapor conveyance pipes and the air supply piping were installed between November 21, 2002 and April 24, 2003. The piping was installed above the clay and geotextile layers of the cover. This modification to the design presented in the Final Remedy

View of the inside of the SBPA blower shed. Two MWH engineers are shown taking readings from one of the sampling ports on the header system.

was made to avoid damage to the clay layer, which would have occurred if the pipes were placed in trenches.

Two prefabricated buildings were installed in the SBPA to house the system mechanical, electrical, and control equipment. Mechanical equipment associated with the ISVE system (vacuum blower, knockout tank, condensate pump, ISVE piping manifold) are located in Building 1. Electrical and control equipment and mechanical equipment associated with the air sparge system and air supply to the DPE pumps are housed in Building 2. Conveyance piping was installed to connect each ISVE well, DPE well, and air sparge point to the piping manifolds in the system buildings.

To treat the high concentrations of contaminants in the vapor stream anticipated during operation of the ISVE system, a thermal oxidizer and scrubber were installed at the GWTP. The thermal oxidizer and scrubber units were delivered to the site on April 15, 2003. The oxidizer was placed outside the south end of the GWTP building next to the thermal oxidizer installed as part of the Off-Site ISVE system. The scrubber was placed inside the GWTP building. Construction of the system was completed on May 9, 2003 with system start-up beginning on May 12, 2003.

Further discussion regarding the design and construction of the SBPA ISVE system is available in the *Still Bottoms Pond Area In-Situ Soil Vapor Extraction System Construction Completion Report*, (MWH, June 2004).

4.3 BARRIER WALL

4.3.1 Barrier Wall

In February 1997, a continuous Barrier Wall was installed around the ONCA, the ACS operating facility, the OFCA, and the K-P Area to contain the contamination source areas. The Barrier Wall encloses the delineated source areas and buried waste at the

Piping for the SBPA ISVE installed above the clay and geotextile layers.

Same view as above after the interim cover and the system buildings were installed.

Thermal oxidizer on its concrete pad outside the treatment building.

Site. A trencher was used to cut a vertical trench from ground surface to a depth approximately two feet into the confining clay layer at the bottom of the upper aquifer. The trencher placed both a continuous HDPE barrier and a bentonite slurry in the trench to form a barrier completely around the 30-acre ACS Site. The total length of the barrier wall is approximately 4,400 feet. It is keyed approximately two feet into the clay confining layer at the bottom of the upper aquifer, which is located 15 to 25 feet below ground surface (depending upon surface topography). The groundwater extraction system inside the Barrier Wall is discussed in Section 4.4.1.

4.3.2 Separation Barrier Wall

A Separation Barrier Wall was designed and constructed to provide a continuous, vertical, hydraulic cutoff wall to isolate groundwater on the northern side of the site (the On-Site Area) and prevent migration of contaminated groundwater to the southern side of the site (the Off-Site Area) once de-watering efforts were increased.

Trencher at the south side of the site installing the Perimeter Barrier Wall. The HDPE liner is shown stretched out behind the trencher, with the bentonite slurry along both sides of the liner.

The 700-foot-long Separation Barrier Wall is keyed two feet into the clay layer underlying the upper aquifer and consists of a mixture of bentonite, soil, and water. It was installed by trenching methods from January 9, 2001 to February 5, 2001. Material testing and quality confirmation measures were taken in accordance with the CQAP (Montgomery Watson, June 1999) to assure that the completed Separation Barrier Wall met the applicable performance requirements. Figure 9 (page 27) shows the location of the Separation Barrier Wall as it aligns with the Off-Site Area.

Further discussion regarding the design and construction of the Separation Barrier Wall is available in the *Separation Barrier Wall Installation Construction Completion Report*, (MWH, March 2002).

4.4 DEWATERING

4.4.1 Barrier Wall Extraction System

In 1997, MWH installed a continuous Perimeter Barrier Wall around the ONCA, the ACS operating facility, the OFCA, and the K-P Area. That Barrier Wall enclosed the contamination source areas at the Site. A groundwater extraction system inside the Barrier Wall was installed to maintain hydraulic capture within the Barrier Wall. That extraction system is referred to as the BWES. During the first mobilization in 1997, eight 100-foot long extraction trenches were installed. Extraction wells were installed at the end of each trench to collect the groundwater. These extraction wells are numbered EW-10, EW-11, EW-12, EW-13, EW-15, EW-16, EW-17, and EW-18. Water collected by the BWES trenches is piped back to the GWTP for treatment.

A majority of the buried waste at the ACS Site was buried below the water table in the OFCA. Before this waste could be treated by ISVE, the water level in that area needed to be lowered to expose the buried material to air flow. The extraction capacity of the BWES was increased by adding 500 lineal feet of extraction trench. The Final Remedial Design Report specified that the additional 500 feet of trenching be obtained by installing two trenches. One trench (designated as Extraction Trench 20) was 350 feet long, located between the Separation Barrier Wall and OFCA ISVE well field. The second was 150 feet long, designated as Extraction Trench 19, located just south of the existing Extraction Trench 15. These locations were selected because boring logs indicated that these areas had the least potential to encounter buried refuse during construction.

Construction of the new extraction trenches and wells began on December 20, 2000.

Extraction Trench 19 as it was being installed to a depth of 30 feet. The trench is 150 feet long, located 50 feet inside the barrier wall, parallel to Colfax Avenue.

The two new extraction trenches, Extraction Trench 19 and 20, each contain one or more extraction wells. At the same time, a replacement well was also installed in Extraction Trench 13.

Twenty HDPE pipes of various diameters were installed to connect the new BWES extraction wells to the GWTP. The underground piping was installed between February 12 and March 15, 2001. Installation of the pumps, controls, and instrumentation was finalized on November 15, 2001. Figure 10 (page 29) details the BWES complete with the 2001 upgrades.

Further discussion regarding the design and construction of the Barrier Wall Extraction System and its upgrades is available in the *Final Barrier Wall Extraction System Off-Site Area Upgrades Construction Completion Report*, (MWH, March 2003).

Based on the groundwater treatment plant effluent data and groundwater levels collected from within the Barrier Wall, these systems have successfully isolated the source areas of the Site thus preventing further off-site groundwater contamination from occurring. The treatment plant provides active treatment of groundwater from within the Barrier Wall through the BWES and in the north and northwest portion of the Site, outside the Barrier Wall with the PGCS.

4.4.2 GWTP Upgrades

The original GWTP, completed in March 1997, was designed to treat groundwater collected by the PGCS and, to a limited extent, the BWES. In August 1999, MWH began to upgrade the GWTP system to handle the higher levels of organic contamination expected once the dewatering process was initiated inside the Barrier Wall.

The upgrade consisted of four primary components: a gravity phase separator, an aerated equalization tank, an activated sludge plant, and a catalytic oxidizer. Additional pumps, blowers, piping, valves, secondary mixing and/or holding tanks, and controls were added as necessary to achieve the design performance of the upgraded system.

The 38,000-gallon stainless steel gravity phase separation tank, designed to allow the separation of solids and non-aqueous phase liquids (NAPLs), was fabricated on Site from November 1999 to March 2000.

The prefabricated 36,000-gallon steel aerated equalization tank, designed to provide equalization, mixing, and aeration to groundwater flowing through the treatment system, was installed during August 2000 and hydrostatically tested in October 2000.

The activated sludge plant, or “bio tank,” designed to biologically treat groundwater via activated sludge contact (i.e., - “bugs”), began treating groundwater collected by the BWES during May 2000.

The catalytic oxidizer and scrubber units, collectively known as the catalytic oxidizer unit or the “cat-ox unit”, are two separate units designed to function as one system.

The “Bio Tank” as it was being fabricated in 2000.

Construction of the Off-Site Area interim cover. A continual stream of dump trucks brought the loads of clean clay into the site. A bulldozer spread the clay in six-inch lifts, which were then compacted by repeated passes

The catalytic oxidizer was designed to treat and destroy a minimum of 95 percent of the VOCs contained in the off-gas from the aerated equalization tank. The catalytic oxidizer was installed during July 2000 and began startup testing in January 2001.

The secondary containment system for the activated sludge plant and the aerated equalization tank was constructed during August 1999. The building expansion structure was erected from December 1999 to February 2000.

Initial construction of the upgraded GWTP influent header system began in October 1999. The system was completed in July 2001. During the period in between, interim influent piping was used. Installation of the electrical and instrumentation equipment began in August 2000 and was substantially complete in November 2000. Control systems were optimized throughout January 2001.

The upgraded GWTP system was completed in December 2000 and began operation in January 2001. Figure 11 (page 31) shows the layout of the GWTP after the upgrades were completed. As of September 1, 2005 the GWTP has treated an estimated 54,330,000 gallons of groundwater from the Site.

4.5 CAP/COVER

4.5.1 Interim Off-Site Cover

The Off-Site Area Cover was constructed in two phases: the interim engineered cover and the final cover. The installation was partitioned to allow for installation and optimization of the ISVE system before installation of the FML. This approach was taken to minimize the potential for damage to the liner if repairs or modifications were found to be necessary.

Preparation of the subbase for the interim engineered cover was completed in conjunction with the consolidation of the spoils piles. During May 2001 and June 2001, MWH graded existing soils to create the subbase for the interim engineered cover system. The final subbase topography was contoured to promote surface water drainage. Areas were regraded where necessary to improve stormwater runoff, reduce stormwater run-on, and limit ponding. Swales were incorporated into the subbase grading plan at specified locations to direct surface water runoff towards designated areas.

In early 2001, MWH selected a clay borrow source to obtain clay for the grading of the subbase and installation of the interim engineered cover. Placement and compaction of imported clay began in July 2001 and was completed in August 2001.

The interim engineered cover consisted of 18 inches of compacted clay in the Soil Cover Area (the area outside of the ISVE system area in the northern and eastern portions of the Off-Site Area) topped with 6 inches of topsoil and rootzone material and 12 inches of compacted clay only in the FML Cover Area (the area targeted for treatment by the ISVE system). MWH developed and shaped five drainage swales to manage stormwater runoff. Using pre-existing site contours, MWH designed the drainage swales to slope to the north and the west so that stormwater runoff would flow to the detention pond located in the northwest corner of the Off-Site Area.

At the same time that the interim cover was installed, portions of the final cover were also constructed. In the Soil Cover Area, the compacted clay was covered with approximately 2,500 cubic yards of imported topsoil to a depth of six inches. This topsoil was placed during August 2001 and September 2001. Topsoil was not placed in the future FML Cover Area.

Further discussion regarding the design of the interim off-site engineered cover is available in the *Final Off-Site Area Interim Engineered Cover Construction Completion Report* including Spoils Pile Consolidation (MWH, February 2003).

4.5.2 Final Off-Site Cover

The design of the final cover for the Off-Site Area was divided into two distinct areas that would each receive a different engineered cover system. The area that contains buried waste to be treated by ISVE was designated as the FML Cover Area. This area included the OFCA and K-P Area. The cover in this area consists of a 12-inch-thick compacted clay layer (part of the Interim Off-Site Cover) and a flexible 60-millimeter-thick HDPE liner. Twelve inches of root zone, six inches of topsoil, and a vegetative layer were then placed on top of the FML material.

The remaining portion of the Off-Site Area that did not contain buried waste was designated as the Soil Cover Area. This area is not directly treated by ISVE. The cover for this area consists of 18 inches of compacted clay covered with 6 inches of topsoil and vegetation. The area is not covered with the FML. The final off-site cover was installed during the summer and fall of 2002.

Flexible liner being installed over sections in the off-site area. Rolls of the liner materials 23-feet wide and 500-feet long were unrolled using a special forklift attachment.

Further discussion regarding the design of the off-site engineered cover is available in the *Off-Site Area Final Engineered Cover Construction Completion Report*. (MWH, June 2004)

4.5.3 Interim SBPA Cover

Like the Off-Site Area cover, the SBPA cover was constructed in two phases: the interim engineered cover and the final cover. The construction phases were separated so that the SBPA ISVE system could be installed and optimized prior to installation of the final cover. Utilizing a phased approach minimized the potential damage to the final cover if repairs or modifications of the ISVE system were found to be necessary during the startup phase. The interim engineered cover consisted of 12 inches of compacted clay, a geotextile layer, and six to eight inches of compacted gravel.

SBPA ISVE Area after placement and compaction of the gravel layer.

Prior to placement of the clay in the SBPA cover area, groundwater conveyance pipe for the future ISVE system was installed. This included installing the conveyance pipe in the SBPA to extend from the GWTP into the SBPA. Clay for the SBPA interim cover was imported from the same clay borrow source that was used for the Off-Site Area interim cover. After the clay was placed and proper compaction was confirmed, a gravel access road and parking area were constructed by placing a polypropylene non-woven geofabric on top of the clay followed by 12 inches of gravel. The final geotextile and the gravel layer components of the interim cover were installed in May 2003. Placement of the gravel layer included grading and compaction of the gravel. Six to eight inches of gravel were placed across the entire cover area outside of the access road and parking area.

Further discussion regarding the interim SBPA cover is available in the *Still Bottoms Pond Area Interim Engineered Cover Construction Completion Report*, *including Fire Pond Closure* (MWH, March 2004).

4.5.4 Final SBPA Cover

The final engineered cover was constructed on top of the SBPA interim cover and consists of four inches of low-permeability asphalt. The asphalt was comprised of a material referred to as Modified Asphalt Technology for Waste Containment (MATCON). It is produced by an advanced asphalt technology that combines a proprietary binder with aggregates complying with stringent specifications. The technology provides a durable, high-strength asphalt surface with low permeability. The mix design utilized in the construction of the final cover provided a permeability of 1 x 10^{-8} centimeters per second (cm/s) in compliance with the standard defined in the Final Remedy.

The first step in installing the final cover was to repair areas of erosion damage that had developed since the interim cover was installed in May 2003. These areas of erosion damage were regraded and general grading was performed to achieve the final design contours. Once the grading was completed, the entire cover area was compacted using a vibratory smooth drum roller. Concrete pads were placed around each ISVE stick-up well in the cover area. On September 8, 2004, herbicide was sprayed on the gravel prior to the placement of the MATCON to minimize the potential effect of weeds growing and damaging the integrity of the asphalt cover.

Placement of asphalt cover to the SPBA ISVE Area.

On September 7, 2004, a pavement test pad was constructed at the Griffith-Merrillville Airport located in Griffith, Indiana. The 20-foot by 200-foot test pad was placed and compacted with a total depth of four inches in order to familiarize the paving crew with the modified asphalt and to perform QA/QC analysis. On September 8, 2004, installation of the asphalt cover in the SBPA began. The installation was completed on September 10, 2004. Based on performance testing conducted during and following construction, the average permeability for the entire SBPA cover was 1.4 x 10^{-9} cm/s and the average asphalt thickness was measured at 4.3 inches.

Further information on the construction of the SBPA Final Cover is found in the *Still Bottoms Pond Area Final Engineered Cover Construction Completion Report*. (MWH, January 2005).

4.6 GROUNDWATER

There are two groundwater aquifers of interest at the ACS Site: an upper water table aquifer and a lower confined aquifer. The aquifers are separated by a clay confining layer. Groundwater sampling data indicates that benzene and chloroethane are the contaminants of concern in the Site groundwater. Sampling data also indicates that the extent and concentrations of benzene and chloroethane have generally decreased since the remedial actions began in 1996.

4.6.1 Upper Aquifer

Figure 12 (page 34) shows the piezometer and monitoring well locations located in the upper aquifer. The water table elevation in the upper aquifer ranges between 630 and 635 feet amsl. The regional groundwater flow in the upper aquifer is generally from east to west. At the ACS Site, the flow is diverted to the north and to the south by the Barrier Wall. The monitoring database from historic investigations indicated upper aquifer impacts extended southeast from the OFCA and north and west from the active ACS facility. Interim actions, including construction of the BWES and PGCS, were completed in 1997 to stabilize the Site and limit further off-site migration of contaminants in the groundwater.

In the upper aquifer, groundwater sampling focused on three impacted areas: North, West, and Southeast, each of which is downgradient of source areas defined within the ACS Site. The purpose was to monitor the boundaries of the contaminant plume and provide early warning of any expanding contamination. Additionally, the interior wells were sampled to look for effects of the BWES and PGCS on containment cleanup.

4.6.2 Lower Aquifer

Figure 13 (page 36) shows the locations of the lower aquifer monitoring wells. The lower aquifer is confined beneath a clay layer. Groundwater flow in the lower aquifer is generally northward. Lower aquifer monitoring was conducted to document upgradient and downgradient water quality, and also to evaluate the groundwater quality trends.

Benzene has been detected at low concentrations in several lower aquifer monitoring wells. In most cases, it appears that the impact was localized – the result of a leaking surface seal in the well itself or a nearby well. Impacts of this type were detected at monitoring wells MW09 and ATMW4D. These wells have been replaced by new wells and subsequent sampling has shown decreasing concentrations.

A lower aquifer investigation is being conducted during August and September 2005 to determine the width of the benzene impact in the lower aquifer at the northern property line and to evaluate the lower aquifer hydraulics to determine the best method to hydraulically contain the impact.

The results of the lower aquifer investigation will be used to assemble a hydraulic control system to inhibit further off-site migration of benzene in the lower aquifer. The previously existing monitoring wells, the new temporary monitoring wells, and the piping installed for the pumping test will all be available as potential components of a cost-effective extraction system that could be designed to achieve hydraulic control over the affected area.

4.6.3 Monitored Natural Attenuation

The 1999 ROD Amendment changed the On-Site groundwater cleanup approach to a containment remedy rather than a restoration remedy. The ESD completed in September 2004 changed the Off-Site groundwater cleanup approach from solely pump-and-treat to a combination of pump-and-treat, ISCO, and MNA.

Pump-and-treat systems have been operated at several locations in the upper and lower aquifer over the past ten years. The PGCS has captured impacted groundwater in the upper aquifer since 1997. Individual pumps have been operated in three lower aquifer monitoring wells, MW09r, MW10C, and MW53 to remove localized concentrations of benzene. The pumping will be continued until concentrations are reduced and the impact areas can be transitioned to MNA for the long term.

Section 1.3.7 of this report describes the treatment of the upper aquifer in the South Area by chemical oxidation technology. Three full-scale applications have been made to treat residual hydrocarbons trapped in the water table smear-zone. Post-application sampling shows that the hydrocarbon concentrations in the smear-zone have been significantly reduced and that downgradient groundwater quality has improved. Benzene concentrations have ranged as high as 6,000 ppb in MW06, the monitoring well that best represents contaminant leaching from the smear-zone. Benzene was not detected in the sample from the March 2005 groundwater sampling event.

In the short term, the pump-and-treat systems will continue to remove contaminants from the groundwater and to provide hydraulic control (containment) of groundwater impact areas. In the longer term, results from the semiannual sampling events under the long-term monitoring program will aid the U.S. EPA and IDEM in making the decision to transition fully to MNA.

4.6.4 Chemical Oxidation

During investigations in 1996, benzene impact in the groundwater was found to extend more than 1,500 feet south from the ACS site in the upper aquifer. The Barrier Wall, which was installed in 1997, isolated the original source of the impact. Pilot studies were conducted in both the north and south area to evaluate the potential for ORC to reduce residual hydrocarbons in the water table zone outside the barrier wall.

An ORC Pilot Study was conducted in the North Area in 1999. The immediate results were inconclusive because of seasonal variability in groundwater flow direction. However, by 2004, the concentrations of the contaminant of concern had decreased by more than an order of magnitude. Therefore, it was decided to continue remediation there by pump and treat technology that is being provided by the PGCS.

Because the north area pilot study was inconclusive, a second pilot study was conducted in the South Area in 2001 to evaluate the potential for ORC to treat water table zone outside the barrier wall there. While the ORC was effective in reducing benzene concentrations in the plume on the short term in the South Area, it did not appear to be sufficiently aggressive to destroy the residual organic compounds in the smear zone. Therefore, a more aggressive in-situ oxidation technology was pilot tested. The results were positive and so MWH developed a phased approach for using modified Fenton's Reagent to treat the smear zone in the south area. The goal of the ISCO Treatment was to remediate the groundwater plume to the south of the ACS Site by reducing or eliminating the mass of organic compounds in the smear zone near the intersection of Colfax Avenue and Reder Road.

Three full-scale Chem-Ox injections have been completed. The first full-scale injection was completed in September 2004, the second was completed in April 2005, and the third was completed in August 2005. Approximately 450 gallons of reagent were injected at each of the 420 borings in both the first and second full-scale injections.

Portion of the treatment array with injection points located along Colfax Avenue during Phase I of the chemical oxidation application.

Due to the decrease in concentrations and the overall low concentrations observed in samples collected from the upgradient edge of the smear zone during the post-application sampling events of the first two injections, MWH proposed to target the areas of highest concentrations, closer to the ACS Site for the third application. Approximately 450 gallons of reagent were injected at each of 209 borings in the third application. Figure 14 (page 38) highlights the area where the chemical oxidation applications have occurred, as well as the location of injection points for each round.

Post-application sampling of the third application will occur in October 2005. Once the sampling results are received and have been validated, MWH will submit a report to summarize the results and recommend further action, if necessary, to transition to a monitored natural attenuation remedy.

Results at monitoring well MW45 have decreased to non-detectable levels since the Barrier Wall was completed indicating that the primary source of groundwater contamination has been cut off. However, benzene concentrations are still elevated in monitoring well MW06 screened in the upper aquifer close to the site. This indicates that there is still some residual contamination in the smear zone above the water table in the upper aquifer, at the south side of the Site.

4.6.5 Soil Vapor

Several investigations in the upper aquifer have been conducted at the ACS Site near the intersection of Reder Road and Colfax Street. At the request of the Agencies, MWH evaluated the potential that soil vapors near the house, located at 1002 Reder Road, might contain VOCs that have migrated from the smear zone. Following the U.S. EPA's *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (Draft Guidance, November 2002), MWH determined that concentrations of VOCs, specifically benzene, in the soil and groundwater in the smear zone near the house were elevated enough to warrant collection of soil vapor samples.

On August 30, 2004, after approval of the plan by the Agencies, soil vapor sampling was conducted to determine if organic compounds were present in the shallow soil vapor near the house. MWH collected four soil vapor samples in the vicinity of the house. Due to probable interference from a natural gas leak at the residence, the results of the initial soil vapor investigation were considered anomalous and a second phase of soil vapor investigation was recommended. This second phase included an additional house inspection and indoor air sampling event, as well as the installation of a precautionary vapor mitigation system. This system is similar to a radon mitigation system, and will prevent potential intrusion of possible organic vapors into the house. Coordinated with the owner of the property, the vapor mitigation system was installed in February 2005.

After the mitigation system had been operating for approximately six weeks, MWH collected an indoor air sample from the basement of the home. MWH conducted an inspection of the house with the focus of identifying and removing from the basement any potential chemicals (cleaners, glues, fuels, etc.) that could possibly interfere with indoor air samples. An ambient air sample was collected outside the house during this event.

The analytical results of the indoor air samples indicated that concentrations were not sufficiently high to warrant actions beyond the installation of the precautionary vapor mitigation system. The system will be effective in preventing potential vapor intrusion.