RECORD OF DECISION

WARD TRANSFORMER SUPERFUND SITE
Operable Unit 1

Raleigh, Wake County
North Carolina

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA, GEORGIA
September 2008

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DECLARATION FOR THE RECORD OF DECISION FOR THE WARD TRANSFORMER SUPERFUND SITE

SITE NAME AND LOCATION

Ward Transformer Superfund Site,
Raleigh, Wake County, North Carolina
Site Identification Number – NCD 003 202 603

STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the Ward Transformer Superfund Site (Site), Operable Unit 1 in Raleigh, Wake County, North Carolina, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record file for this Site.

The State of North Carolina concurs with the Selected Remedy.

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision (ROD) for Operable Unit 1 (OU1) is necessary to protect the public health or welfare, or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants from this Site which may present an imminent and substantial endangerment to public health or welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The Selected Remedy is: Excavation and Off-Site Disposal of sediments and flood plain soil from Reaches B, C, and D, and Lower Brier Creek; Monitored Natural Recovery (MNR) in Brier Creek Reservoir, Lake Crabtree, and Lower Crabtree Creek; and Institutional Controls. The Selected Remedy includes:

- Continue or enhance existing North Carolina fish consumption advisories and signs.
- Implement educational and community outreach programs.
- Conduct pre-excavation sampling of sediment and floodplain soil.
- Conduct a pre-excavation endangered mussel evaluation study.
- Excavate sediment/soil from Reaches B, C, D, and lower Brier Creek, and transport sediment/soil off-site for appropriate disposal.
- Restore site and stream to pre-remediation conditions.

- Implement Monitor Natural Recovery (MNR) in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek.
- Conduct periodic monitoring of sediment and aquatic biota.
- Implement Institutional Controls.
- Conduct Five-year reviews.

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

The remedy selected for this operable unit does not satisfy the statutory preference for treatment as a principal element of the remedy because of the relatively low PCB levels in areas requiring excavation and because the remedy relies on naturally occurring processes to reduce toxicity, mobility, or volume of the contaminants in other areas. In addition, the principal threat waste at the Site is being addressed through a separate time critical removal action using thermal desorption treatment.

This remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, however, since it may take more than five years to attain levels that allow for unlimited use and unrestricted exposure a policy review will be conducted within five years of construction completion for the Site to ensure that the Selected Remedy is, protective of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

1	Chemicals of Concern and Their Respective Concentrations	Section 8.1.1
2	Baseline Risk Represented by the Chemicals of Concern	Section 8.1.4.1
3	Cleanup Levels Established for Chemicals of Concern and the Basis for the Levels	Section 9.1
4	Current and Future Land and Groundwater Use Assumptions Used in the Baseline Risk Assessment and the Record of Decision	Section 7.0
5	Land Use that Will be Available at the Site as a Result of the Selected Remedy	Section 13
6	Estimated Capital, Operation and Maintenance, and Total Present Worth Costs; Discount Rate; and the Number of Years Over Which the Remedy Cost Estimates are Projected	Section 13

7	Decisive Factors that Led to Selecting the Remedy	Sections 11 & 13

AUTHORIZING SIGNATURE

This Record of Decision documents the Selected Remedy for Operable Unit 1 at the Ward Transformer Superfund Site. This remedy was selected by the Environmental Protection Agency with concurrence of North Carolina Department of Environment and Natural Resources.

for Franklin E. Hill, Director
Superfund Division

9-29-08
Date

DECISION SUMMARY
FOR THE
RECORD OF DECISION

WARD TRANSFORMER SUPERFUND SITE
Operable Unit 1

Raleigh, Wake County
North Carolina

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 4
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September 2008

RECORD OF DECISION
FOR THE WARD TRANSFORMER SUPERFUND SITE
DECISION SUMMARY

1.0 SITE NAME, LOCATION, AND DESCRIPTION

The Ward Transformer Superfund Site (NCD 003 202 603) is located along Mount Herman Road, in a predominantly industrial area of northwestern Raleigh, Wake County, North Carolina. The Ward Transformer facility was built on approximately 11 acres of previously undeveloped land in 1964. As part of its operations, the Ward Transformer facility built, repaired, sold, and reconditioned transformers, switchgear, and other similar types of electrical equipment at the Site until 2006.

An EPA-lead phased remedial investigation was conducted from April 2003 to April 2007. As part of the investigation, soil, sediment, surface water, groundwater, and fish samples were collected. The investigation included the facility property and surrounding properties, together with more than 30 miles of waterways including unnamed tributaries to Little Brier Creek (Reach A, B and C), Little Brier Creek (Reach D), Brier Creek Reservoir, Brier Creek, Lake Crabtree and certain tributaries, Crabtree Creek and certain tributaries, and a 0.5 mile segment of the Neuse River (Figure 1).

In September 2005, EPA signed an Administrative Settlement Agreement and Order on Consent with a group of potentially responsible parties (PRPs) to implement a time critical removal action. The removal action is underway and includes contaminated soil/sediment removal at the Ward Transformer facility and some immediate surrounding areas, including Reach A.

Operable Unit 1, the subject of this ROD includes Reaches B, C, and D; Brier Creek Reservoir; Brier Creek; Lake Crabtree; and Crabtree Creek. These areas are all downgradient from Reach A and the Ward Transformer facility.

The USEPA has the enforcement lead at the Site, with support from the North Carolina Department of Environment and Natural Resources (NC DENR). The USEPA plans to negotiate a Consent Decree with responsible parties to conduct and pay for the implementation of the remedy described in this ROD.

2.0 SITE HISTORY

The Ward Transformer facility is owned by Ward Transformer Company, Inc., and operated by Ward Transformer Sales and Service, Inc. (collectively "Ward") and was built on approximately 11 acres of previously undeveloped land in 1964. As part of its operations, Ward built, repaired, sold, and reconditioned transformers, switchgear, and other similar types of electrical equipment at the Site until 2006. As a result of Ward's operations, polychlorinated biphenyls (PCBs) were released into the environment.

The Ward Transformer Superfund Site was proposed for the National Priority List (NPL) on September 5, 2002, and was finalized on the NPL on April 30, 2003. EPA conducted a phased remedial investigation from April 2003 to April 2007. As part of the investigation, soil, sediment, surface water, groundwater, and fish samples were collected. The investigation covered the facility property and surrounding properties, together with more than 30 miles of waterways including unnamed tributaries to Little Brier Creek (Reach A, B and C), Little Brier Creek (Reach D), Brier Creek Reservoir, Brier Creek, Lake Crabtree and some tributaries, Crabtree Creek and some tributaries, and a 0.5 mile segment of the Neuse River (Figure 1).

As part of its investigation of the Site, EPA has conducted numerous enforcement-related activities including:

- On July 3, 2002, EPA sent Ward Transformer Company, Inc., an Information Request Letter pursuant to Section 104 of CERCLA seeking information as part of its investigation of the Site.

- On August 29, 2002, EPA sent Ward Transformer Company, Inc, a General Notice Letter notifying Ward of its potential liability for the release or threatened release of hazardous substances at the Site.

- In November 2003 and February 2004, EPA sent several hundred companies Information Request Letters based on information received from Ward that the companies may have conducted business with, or sent hazardous materials to, the Site.

- On September 14, 2004, EPA prepared and signed an Action Memorandum supporting EPA's decision to implement a time-critical removal at the Site.

- On October 20, 2004, EPA sent Notice/Demand letters and draft Administrative Orders on Consent (AOCs) to 43 Potentially Responsible Parties (PRPs) notifying them of their potential liability, and providing them 60 days in which to enter into an agreement to conduct or finance a time-critical removal action at the Site, pursuant to the Action Memorandum, and to reimburse EPA for its costs incurred to date. On November 8, 2004, EPA sent a fifth owner/operator PRP a Notice/Demand letter and draft AOCs. The PRPs included 39 top-volume generator PRPs as well as four owner/operator PRPs. On December 22, 2004, the negotiation period officially ended. EPA was unable to reach a settlement agreement with the PRPs for the performance of a time-critical removal action and the reimbursement of EPA's costs.

- Between February 2005 and September 2005, EPA negotiated with a group of owner/operator PRPs and generator PRPs for the performance of a time-critical removal action at the Site and the reimbursement of EPA's costs.

- On September 16, 2005, EPA entered into a DOJ-approved Administrative Settlement Agreement and Order on Consent (Settlement Agreement) with nine PRPs for the performance of a time-critical removal action at the Ward Transformer facility and some immediately surrounding areas and the reimbursement of $725,440.83 in past response costs.

- On April 21, 2006, EPA was notified that Ward had made a decision to permanently discontinue the manufacture, repair or inventory storage of all oil-filled transformers at the Ward Transformer facility or the adjacent warehouse property.

- On June 2006, the PRPs' contractor mobilized to the Site to begin implementation of the time-critical removal action. The removal action is underway and includes contaminated soil/sediment removal from the Ward Transformer facility and some immediate surrounding areas, including Reach A followed by treatment and off-site disposal, as appropriate.

3.0 COMMUNITY PARTICIPATION

The Ward Transformer Superfund Site was included on the National Priorities List (NPL) or Superfund list in April 2003. Since 2003, EPA has conducted extensive community relations activities to inform and involve the community about Site activities. Community relations activities conducted include mailing information fact sheets and e-mails, press releases, availability sessions, sampling plan development meeting, presentations, and public meetings.

Table 1 presents a summary of community meetings conducted in Raleigh, North Carolina.

Table 1 – Community Participation

EVENT	DATE
Remedial Investigation (RI) " Kick-off" Public meeting	March 13, 2003
RI findings meeting	November 16, 2004
Task Force Presentation	August 4, 2005
Sampling Plan Development meeting	October 27, 2005
Public Availability Session	January 19, 2006
Public Meeting	June 21, 2006
Public Availability Session	March 17, 2007
Proposed Plan Public Meeting for OU1	August 14, 2007

The OU1 RI/FS report and Proposed Plan for the Ward Transformer Superfund Site were made available to the public in August 2007. They can be found in the Administrative Record file and the information repository maintained at the EPA Docket Room located at EPA Region 4 in

Atlanta, Georgia, and at the North Regional Public Library in Raleigh, North Carolina. The notice of availability of these two documents was published in the Durham Herald on August 6, 2007, and the Raleigh News and Observer on August 8, 2007. A public comment period was held from August 6, 2007, to September 4, 2007. An extension to the public comment period was requested. As a result, the public comment period was extended to October 4, 2007. In addition, a public meeting was held on August 14, 2007, to present the proposed plan to a broader community audience than those that had already been involved at the Site. At this meeting, representatives from the EPA and the NC DENR answered questions about the Site and the remedial alternatives. EPA's response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

4.0 SCOPE AND ROLE OF OPERABLE UNIT 1 (OU1)

As with many Superfund Sites, the problems at the Ward Transformer Superfund Site are complex. The contamination at the Site is being addressed through an on-going time critical removal action and future remedial actions. EPA has organized the remedial work into two operable units. OU 1 is the subject of this ROD, and OU 2 will be the subject of a future ROD.

On-going Time Critical Removal Action:

On June 2007 the contractor for the potentially responsible parties (PRPs) mobilized to the Site to initiate a removal action that addresses the main source of PCB contamination. The removal action includes excavation and removal of contaminated soil and sediment from the Ward Transformer Facility and immediate surrounding areas including Reach A. The on-going removal action is scheduled to be completed in 2009. When completed, it is estimated that more than 150,000 tons of contaminated material would be addressed either by on-site Low Temperature Thermal Desorption (LTTD) treatment or off-site disposal, as appropriate.

Future Remedial Actions:

Operable Unit 1(OU1)
OU 1 is the subject of this ROD and addresses soil, sediment, surface water and fish on areas downgradient from the Ward Transformer facility including Reaches B, C and D; Brier Creek Reservoir; Lake Crabtree; and Lower Crabtree Creek. (Figure 1)

Operable Unit 2 (OU2)
Is a future ROD that will include the final remedy for all media; at the Ward Transformer facility, certain parcels adjacent to the facility, and nearby drainage pathways upgradient of Reach B.

5.0 SITE CHARACTERISTICS

5.1 Site Settings

The Ward Transformer facility was built on approximately 11 acres of previously undeveloped land in 1964. As part of its operations, Ward built, repaired, sold, and reconditioned transformers, switchgear, and other similar types of electrical equipment at the Site until 2006. The Ward Transformer facility operations included the main building, where transformers were handled and offices were located, the transformer storage yard, a storm-water management lagoon, and a building housing a storm-water treatment plant (SWTP) system. Treated effluent from the SWTP was discharged to a National Pollutant Discharge Elimination System (NPDES)-permitted outfall on an unnamed tributary to Little Brier Creek (Reach A), located west of the lagoon area (Figure 2). The northern portion of the Site, a warehouse that was formerly part of the Ward operations, was later leased to Horizon Forest Products (Horizon) circa 1976 to 2002, a lumber supply business and is now vacant.

The Ward Transformer facility is located 600 feet (ft) south-southeast of the Northern Wake Expressway/Interstate-540 (I-540), 1,000 ft southwest of US highway 70, and is adjacent to property owned by the Raleigh-Durham International (RDU) Airport. The RDU Airport proper (i.e., terminals) is located approximately 2 miles south of the Site, with airport runways located less than 1 mile south. Estes Transport Co., a trucking company, leases the property to the south (Figure 3). Across Mount Herman Road from the facility is Triangle Coatings where plastic and metal parts are painted. Visara International, Inc. is also across Mount Herman Road.

5.2 Climate

The Raleigh-Durham area receives an average of 42.5 inches of precipitation annually, based on measurements collected at RDU Airport between 1948 and 2005. Rainfall is well distributed throughout the year. July (4.6 inches) and August (4.5 inches) have the greatest amount of rainfall, and October (3.0 inches) and November (2.9 inches) the least. Soil moisture is sometimes low during spring and summer due to gaps between rain events rather than from a shortage of total rainfall, but occasionally the accumulated total during the growing season falls short of plant needs. Most summer rain is produced by thunderstorms, which may occasionally be accompanied by strong winds, intense rains, and hail. Tropical storm systems periodically impact the Raleigh-Durham area, with the largest storms producing 4 to 5.6 inches of rainfall in a 24-hour period. Storms of this nature typically result in flash flooding in the Crabtree Creek watershed. However, the Raleigh–Durham area is far enough from the coast such that the severe weather effects of coastal storms are reduced. While snow and sleet usually occur each year, significant accumulations of snow are rare.

5.3 Local Soils

The soil descriptions and maps in the U.S. Department of Agriculture (USDA) Soil Conservation

Service (SCS) Soil Survey for Wake County, NC (SCS, 1970) were reviewed. The following narrative summarizes characteristics of soils occurring within areas potentially impacted by releases from the Ward Transformer Superfund Site. Soils within the vicinity of the Site and the riparian area associated with the watershed below the facility are described by the Chewacla and Congaree soil series.

Soils in Reaches B and C are described as soils from the Chewacla series of 0 to 2% slopes. This soil consists of nearly level, poorly drained soils on the floodplain. It is formed from alluvial deposits of fine loamy material. Fertility and organic material are low and permeability is moderately rapid. It has a seasonally high water table and frequent flooding occurs for brief periods of time.

Throughout the lower portion of the study area, encompassing Little Brier Creek through Brier Creek Reservoir down to Lake Crabtree, Chewacla soils occur with Congaree soils. Congaree soils have a higher rate of permeability and tend to be better drained. Soils of the Congaree series consist of nearly level, well-drained soils on the floodplains. Typically, they have a brown to dark-brown surface layer that is 4 to 12 inches thick. Beneath the surface layer, the soil material is silt loam that ranges from brown to dark brown in color and from 30 to 108 inches in total thickness. Like the Chewacla series, these soils have a seasonally high water table, low organic matter and fertility, and permeability is moderately rapid. These soils are also subject to frequent flooding for brief periods of time.

5.4 Surface Water

The Ward Transformer facility is located in the Crabtree Creek drainage basin, a subbasin of the 2,405-square mile (mi^2) Upper Neuse Basin (hydrologic unit code [HUC] No. 03020201). The Upper Neuse Basin is a subbasin of the 6,234-mi^2 Neuse River Basin. The headwaters of the Neuse River originate at the confluence of the Eno and Flat Rivers, northwest of Durham, and feed into Falls of the Neuse Lake (Falls Lake Reservoir), which was created by the construction of Falls Lake dam in 1983. After this impounded 22-mile beginning, the Neuse River flows freely as a freshwater river until it reaches New Bern, North Carolina. In the vicinity of New Bern, the river turns brackish, widens, and travels sluggishly as it becomes a 40-mile-long tidal estuary that empties into the southern end of Pamlico Sound.

The Ward Transformer facility is located on a topographic high and on the edge of the local watershed. The facility is located outside the 500-year floodplain. In general, the topography of the property slopes to the west-southwest. Prior to 1972, all runoff from the Ward Transformer facility flowed overland or was carried in drainage ditches to intermittent streams located west and southwest of the facility. One of the streams receiving runoff from the facility included an unnamed tributary to Little Brier Creek (Reach A), located west of the on-site lagoons. Some of the facility's runoff also entered a drainage ditch located along the northern side of the property, adjacent to the transformer storage yard. This drainage ditch conveyed runoff westerly and generally followed a dirt road located west of the facility. Some runoff from the facility may have

also flowed overland northwesterly into an intermittent stream, which also flowed to the west. In 1971, two lagoons were created on the southern portion of the Ward property for retention of stormwater runoff. The upper lagoon had a pipe from the bottom that drained to the lower lagoon. The lower lagoon then had a pipe from the bottom that drained to the unnamed tributary to Little Brier Creek located west of the lagoons (Reach A).

Around 1979, a concrete curb was built around the perimeter of the facility pad for the purpose of directing all stormwater runoff into the on-site lagoons. At approximately the same time, the storm water treatment plant (SWTP) system was installed in a building located north of the lagoons. Runoff collected in the pond was pumped to the SWTP for treatment prior to discharge via the NPDES-permitted outfall located at the beginning of Reach A. No detectable concentrations of PCBs were allowed in the treated effluent. Effluent was also monitored for total chloride, total iron, total fluoride, total phosphorus, total nitrogen, and oil and grease.

From the SWTP outfall, surface water flows west-southwesterly via the unnamed tributary to Little Brier Creek for approximately 2,100 ft (0.4 mile) before entering the first culvert beneath the first I-540 crossing. This section of the downstream surface water pathway will hereafter be referred to as Reach A in this report. Upon exiting the culvert on the west side of I-540, the unnamed tributary to Little Brier Creek continues to flow west-southwesterly for approximately 1,500 ft (0.3 mile) before entering a culvert beneath the Lumley Road crossing. Several tributaries feed into this portion of the unnamed tributary to Little Brier Creek. This section of the downstream surface water pathway will hereafter be referred to as Reach B. From the terminus of Reach B, the unnamed tributary to Little Brier Creek conveys surface water south-southwesterly for approximately 2,100 ft (0.4 mile) to its confluence with Little Brier Creek proper and a culvert beneath the second I-540 crossing. This section of the downstream surface water pathway will hereafter be referred to as Reach C. From the culvert beneath the second I-540 crossing, Little Brier Creek flows southerly for approximately 4,200 ft (0.8 mile) to its mouth on Brier Creek Reservoir, located in the vicinity of the culverts beneath the Globe Road crossing. This section of the downstream surface water pathway will hereafter be referred to as Reach D.

From Little Brier Creek's mouth, Brier Creek Reservoir carries surface water southerly for approximately 1.7 miles, flowing through culverts at Globe Road, Nelson Road, and Aviation Parkway to the reservoir's dam. Brier Creek Reservoir is not used as a source for drinking water; it is one of several impoundments in the Crabtree Creek drainage basin constructed primarily for flood control. Brier Creek Reservoir covers an area of approximately 150 acres during normal (not flood stage) conditions. Brier Creek Reservoir Dam was completed in 1985. In addition to Little Brier Creek, Brier Creek is a tributary of Brier Creek Reservoir.

From the Brier Creek Reservoir Dam, surface water is discharged through an outlet structure to lower Brier Creek, which flows southerly for approximately 1.8 miles, flowing through culverts at Airport Boulevard and I-40, to its mouth on Lake Crabtree, an impoundment structure constructed in 1988 primarily for flood control. Lake Crabtree currently covers an area of

approximately 460 acres under normal conditions. Figure 4 illustrates the locations of Reaches A through D, as well as water bodies located farther downstream, discussed above.

Additional tributaries to Lake Crabtree include Stirrup Iron Creek, Crabtree Creek, Haley's Branch, and Black Creek, which drains portions of Cary, Morrisville, and the RDU Airport. From Brier Creek's mouth, Lake Crabtree conveys surface water flow easterly, through a culvert at Aviation Parkway, to the lake's dam and an outlet structure. Water is discharged through the outlet structure to lower Crabtree Creek, which in turn flows east-southeasterly for approximately 11 miles before spilling over the Lassiter Mill Dam, a former mill pond dam constructed in the early 1900s. The Lassiter Mill Dam is approximately 7 ft high and 200 ft wide. From the Lassiter Mill Dam spillway, Crabtree Creek continues to flow southeasterly for approximately 10.5 miles before discharging into the Neuse River north of Poole Road. Tributaries to Crabtree Creek between Lake Crabtree and the Neuse River include Reedy Creek, Sycamore Creek, Turkey Creek, Haresnipe Creek, Richland Creek, Mine Creek, Beaverdam Creek, Big Branch, Pigeon House, and Marsh Creek. (Figure 1)

Table 2 summarizes the surface water bodies located downstream of the Ward Transformer facility included in the RI/FS study area for OU1.

Table 2 - Downstream Surface Water Bodies

SURFACE WATER BODY		LENGTH OF REACH (MILES)
Unnamed Tributary to Little Brier Creek	Reach A	0.4
	Reach B	0.3
	Reach C	0.4
Little Brier Creek proper	Reach D	0.8
Brier Creek Reservoir		1.7
Brier Creek		1.8
Lake Crabtree Tributaries include Stirrup Iron Creek, Upper Crabtree Creek, Black Creek, and Haleys Branch		1.5
Crabtree Creek (entire watershed) Tributaries include Reedy Creek, Sycamore Creek, Turkey Creek, Haresnipe Creek, Richland Creek, Mine Creek, Beaverdam Creek, Big Branch, Pigeon House, and Marsh Creek		21.5
Neuse River		230*

*From its confluence with Crabtree Creek, the Neuse River flows southeasterly for approximately 230 miles to its mouth on Pamlico Sound. The downstream study area included an approximate 0.5-mile length of reach of the Neuse River. This length of reach included the Neuse River at its confluence with Crabtree Creek to approximately 0.5 mile downstream.

In general, the RI/FS downstream study area terminus was located in the Neuse River, approximately 0.5 mile downstream of Crabtree Creek's mouth. Figure 1 shows the downstream study area from the Ward Transformer facility to the Neuse River. Municipalities located along the downstream study area include the City of Raleigh and the Towns of Morrisville and Cary.

Little Brier Creek, Brier Creek Reservoir, and Brier Creek are designated by NC DENR as Class C waterways for the entire length of these reaches. Class C waterways are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture, and other uses. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized, or incidental manner. Lake Crabtree and Crabtree Creek to its confluence with Richland Creek (approximately 3 miles downstream of Lake Crabtree) are designated as Class B waterways.

Class B waterways are used for primary recreation and other uses suitable for Class C. Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Downstream from the mouth of Richland Creek, Crabtree Creek and the 0.5-mile portion of the Neuse River are designated as Class C waterways. All downstream surface water bodies from the Ward Transformer facility are further designated as nutrient sensitive waters (NSW). This classification is intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation.

The unnamed tributary to Little Brier Creek originates at the facility and descends through moderate to steep topography into Little Brier Creek proper. Relatively little sediment deposition occurs along these reaches. The water in these reaches is turbid, primarily as a result of the area's soil and geology, although a significant amount of suburban development is occurring in the Little Brier Creek watershed, which is likely contributing to the sediment load in these reaches. Approaching Brier Creek Reservoir, Little Brier Creek loses energy and flow changes from a river environment to a lake environment. As the transition from river to lake occurs, energy gradients, bottom shear stresses, and turbulence levels all decrease, resulting in high rates of sediment deposition. This is evident by the occurrence of sand and silt deltas forming in the area of Little Brier Creek's mouth. Brier Creek Reservoir is also exhibiting sediment deposition in the vicinity of its dam structure. At the time of construction, Brier Creek Reservoir had a maximum depth of 16.5 ft under normal conditions, a flood stage area of 385 acres, and total flood storage of 3,190 acre-ft. However, since that time, sediment accumulation has occurred. Depth of water in Brier Creek Reservoir was 4 feet, 6 feet, and 3 feet, as measured during the RI at three different locations.

From Brier Creek Reservoir, the energy and flow change from a lake to a river environment again, as lower Brier Creek carries surface water toward Lake Crabtree. Upon entering Lake Crabtree, however, the flow environment again changes from a river to a lake, and sedimentation rates increase in the vicinity of lower Brier Creek's mouth. This area is characterized by very shallow water and fine sediments. The water continues to have a distinctly muddy appearance.

Several additional tributaries, including Stirrup Iron Creek, feed into this portion of Lake Crabtree.

At the time of construction, Lake Crabtree had a maximum depth of 16 ft at normal pool, a flood stage area of 1,114 acres, and total flood storage of 6,915 acre-ft (Woodruff, 2006). However, since that time, sediment accumulation has occurred. More recent measurements reveal Lake Crabtree has an average depth of 6.5 ft with a maximum depth of approximately 13 ft. In several areas of the lake, especially in the area of the lake's tributaries and upstream of the lake's dam structure, large amounts of sediment deposition can be observed. The sediment loading to the lake is likely attributable to the substantial suburban development occurring in the Lake Crabtree watershed.

During normal operations and considering an average rainfall event, up to 83% and 95% of the total suspended solids (TSS) that enter Lake Crabtree and Brier Creek Reservoir, respectively, settle out as sediments during the time it takes for the surface water to circulate through the impoundments (City of Raleigh).

The geomorphology of the downstream reaches changes significantly with distance from the Ward Transformer facility. The beginning of Reach A near the facility has a bank full width of 2 ft and a bank full depth of approximately 0.5 ft. Approximately 21 miles downstream of the facility along Crabtree Creek at Route 1, the bank full width is 56 ft and the bank full depth is 4.5 ft (CH2MHill, 2001, revised 2002).

6.0 NATURE AND EXTENT OF CONTAMINATION

This section presents a summary of the OU1 Remedial Investigation (RI) conducted at the Site. The RI report presents more details of the investigation and results. The RI report is part of the administrative record for the Site.

6.1 Main Source of PCB Contamination

The main source of contamination is located at the Ward Transformer facility and on some of the immediate surrounding properties including Reach A. This source is being addressed under a PRP lead time-critical removal action. This action includes a combination of soil/sediment excavation follow by on-site treatment using a Low Temperature Thermal desorption process, or off-site disposal, as appropriate. Analytical data collected as part of the removal action activities show that some of these areas contain the highest levels of PCBs detected in soil (13,000 mg/kg in subsurface soil).

Because these areas are being addressed under a separate action and agreement, they are not part of OU1, and therefore, are not discussed in much detail in this ROD.

6.2 Groundwater

Groundwater at the Ward Transformer facility occurs in fractured bedrock at approximately 5 to 7 ft below ground surface (bgs) in some areas. The groundwater beneath the facility flows predominantly to the west with some localized flow to the northwest and southwest following the site topography. Groundwater in the area generally discharges to local streams, so the facility groundwater most likely moves westward and discharges into the unnamed tributary to Little Brier Creek.

No drinking water supply surface water intakes are located along the creeks or the Neuse River in the downstream study area. The nearest public drinking water supply surface water intake is located on the Neuse River, approximately 50 miles downstream of the Ward Transformer facility, and operated by the Johnston County Water System. According to Johnston County Water System officials, PCBs have not been detected in any drinking water samples collected at the water treatment plant since the facility began operating in 1996.

The primary water supply for Raleigh is Falls Lake, which is a surface water reservoir in the Neuse River above the Crabtree Creek watershed. Similarly, the City of Durham is primarily served by surface water intakes on Lake Michie and the Little River Reservoir, and the Town of Cary and Town of Morrisville are served by a surface water intake on the B. Everett Jordan Reservoir, more commonly known as Jordan Lake. None of these surface water bodies are located downstream of the Ward Transformer facility.

The nearest groundwater public water system (PWS) to the Ward Transformer facility consists of five groundwater wells (Well Nos. 1, 2, 3, 5, and 6) operated by the Angus Barn (a restaurant), located approximately 0.5 miles east of the facility in the Sycamore Creek watershed. No additional groundwater public water systems are located within a 1.0-mile radius of the Ward Transformer facility. The nearest community water system utilizing a groundwater source is the Country Ridge subdivision, located approximately 2.8 miles east-southeast of the facility. The nearest transient, non-community groundwater drinking water system is the Bass Brothers/Triangle Golf Center, located approximately 1.5 miles northeast of the Ward Transformer facility.

All of these water systems are upgradient of the Ward Transformer facility (where the groundwater flows to the west-southwest) and outside the Little Brier Creek watershed. No public drinking water supply wells were located downgradient (west-southwest) of the facility within a 4-mile radius.

Based on information from the Wake County Environmental Services and NC DENR's Groundwater Protection Unit, as well as a review of land use and zoning records, no private drinking water supply wells are located within 1.0-mile downgradient (west-southwest) of the Ward Transformer facility.

As part of the investigation groundwater monitoring wells were installed on site and sampled. Additional information is needed before remedial alternatives can be developed and a remedy is proposed. The additional groundwater work will be conducted as part of OU2. Therefore this OU1 ROD does not discuss groundwater any further.

6.3 Surface Water

The following subsections describe the various surface water sampling activities that were conducted as part of the investigation.

6.3.1 Surface Water Investigation

In May 2003, a surface water investigation was conducted in the unnamed tributary to Little Brier Creek to determine if site contaminants have impacted the local surface water quality. Surface water sampling was conducted in the unnamed tributary to Little Brier Creek from the Ward Transformer facility's stormwater lagoon outfall to the confluence of Little Brier Creek proper (Reaches A, B, and C).

In December 2005, additional surface water samples were collected from the unnamed tributary to Little Brier Creek between the stormwater lagoon outfall and Northern Wake Expressway/I-540 (Reach A) to confirm previous (i.e., May 2003) surface water sampling results and further characterize potential human health and ecological risk associated with site-related contaminants.

In February 2006, in response to concerns expressed by the local community/stakeholders, surface water samples were collected from Lake Crabtree to refine the estimated extent and magnitude of site-related contaminants

6.3.2 Surface Water - Results Summary

Downstream sampling results indicated PCB contamination, specifically Aroclor 1260, at several locations in Reach A, immediately downstream of the Ward Transformer facility, at concentrations exceeding the NC DENR Surface Water Quality Standard (SWQS) human health and aquatic life standards. The highest concentration of PCB Aroclor 1260 (0.0015 mg/L) was detected just below the SWTP's outfall where the treated stormwater lagoon water is discharged into Reach A of the unnamed tributary to Little Brier Creek. However, no PCB Aroclors or congeners were detected in surface water samples collected from Reach B or any other locations further downstream, including Lake Crabtree, where multiple surface water samples were collected. Therefore, no PCBs were detected in surface water within the OU1 areas.

6.4 Sediment and Stream Banks

The following subsections describe the various sediment sampling activities that were conducted as part of the investigation.

6.4.1 Sampling

In May 2003, a sediment investigation was conducted to assess the extent of site-related contamination in the unnamed tributary to Little Brier Creek. Sediment samples were collected across the stream width, from midstream and bank side locations, along the unnamed tributary to Little Brier Creek between the Ward Transformer facility's stormwater lagoon outfall and the confluence of Little Brier Creek proper (Reaches A, B, and C). The midstream samples were collected from underwater, but the bank samples were collected from the sediments just above the surface water level in the sides of the stream banks. Samples were attempted at depth intervals of 0 to 6 inches and 6 to 12 inches, where possible. However sediment samples from depths of 6 to 12 inches were not obtained at all sample locations due to refusal.

In November 2003, based on the analytical results of the sediment sampling activities described above identifying PCBs in the sediment, additional sediment samples were collected from Little Brier Creek proper at the culvert crossing beneath Northern Wake Expressway/I-540 downstream to Lake Crabtree. The additional sediment investigation was conducted to estimate the extent of site-related contamination in the following surface water bodies: Little Brier Creek, Brier Creek Reservoir, Brier Creek, and Lake Crabtree. In addition to the new sampling locations described above, specific May 2003 sediment sample locations were sampled to deeper depths in November 2003 because many of the sediment samples collected from Reaches A, B, and C of the unnamed tributary to Little Brier Creek in May 2003 contained PCB contamination in the deepest sample collected. This additional sampling was conducted to determine the vertical extent of PCB contamination in order to evaluate potential remedial approaches and costs. The additional samples were collected beneath the locations of the midstream and bank samples that were collected across the stream width during the May 2003 sampling that contained the highest PCB concentrations.

Following the completion of the September 2004 RI and Baseline Human Health Risk Assessment (BHHRA) Reports, it was determined that additional environmental investigation activities were warranted in the vicinity of the Ward Transformer Site. As a result, in October 2004, sediment samples were collected from tributary streams to Lake Crabtree in order to assess background conditions and to identify other potential contaminant sources. One sediment sample was collected from one location on each of the following Lake Crabtree tributary streams: Stirrup Iron Creek, Crabtree Creek, upstream of Lake Crabtree, Black Creek, and Haley's Branch. In addition, in order to further assess the extent of sediment contamination downstream from the Ward Transformer facility, sediment samples were collected from Crabtree Creek between Lake Crabtree and the eastern edge of Umstead Park.

In November 2004, because fish samples collected from Lake Crabtree (discussed below) contained concentrations of PCBs that prompted fish consumption advisories by the State of North Carolina, additional sediment samples were collected from Lake Crabtree in order to further refine the estimated extent and magnitude of site-related contaminants.

In December 2005, based on input from the local community/stakeholders, additional sediment sampling was performed in the unnamed tributary to Little Brier Creek between the Ward Transformer facility's stormwater lagoon outfall and the culvert beneath the Northern Wake Expressway/I-540 crossing (Reach A) in order to further characterize potential human health and ecological risk associated with site-related contaminants.

In February and March 2006, in response to concerns expressed by the local community/stakeholders, additional sediment samples were collected at previously sampled locations downstream from the Ward Transformer facility, as well as from new locations further downstream. The locations include Reach D; the vicinity of the relic Little Brier Creek and Brier Creek stream channel/floodplain now submerged in Brier Creek Reservoir; Brier Creek, upstream of its confluence with Lake Crabtree; the vicinity of the relic Brier Creek and Crabtree Creek stream channel/floodplain now submerged in Lake Crabtree; the vicinity of the Lake Crabtree shoreline; Crabtree Creek, upstream and downstream of Lake Crabtree; two tributary streams to Crabtree Creek, Richland Creek, and Mine Creek; the Neuse River, upstream and downstream of its confluence with Crabtree Creek. Sediment samples were collected at the above locations from multiple depth intervals, with a maximum sample depth of 3.5 ft. Some of the targeted depth intervals were not achievable due to refusal.

6.4.2 Sediment and Stream Banks – Results Summary

Sediment sampling results are shown in Figures 5 through 10. A summary of the maximum PCB concentration detected in the OU1 study areas is summarized in Table 3.

Table 3 - Sediment, Maximum Concentrations

Location	Aroclor Maximum Concentration (mg/kg)
Reach A	380
Reach B	3.0
Reach C	2.6
Reach D	4.2
Brier Creek Reservoir	0.31
Brier Creek	0.28
Lake Crabtree Sector A	0.48
Lake Crabtree Sector B	0.18
Lake Crabtree Sector C	0.041
Crabtree Creek	Not detected
Neuse River	Not detected
Stirrup Iron Creek	Not detected
Upper Crabtree Creek	Not detected
Black Creek	Not detected
Haleys Branch	Not detected
Richland Creek	Not detected
Mine Creek	Not detected
Upper Neuse River	Not detected

6.5 Floodplain Soil

The following subsections describe floodplain soil sampling conducted as part of the investigation of the OU1 areas. Most of the floodplain soil data was collected from Reach A which is the study area closest to the source. Reach A is being addressed as part of the removal action, and is not part of OU1. As part of the removal action, floodplain soil from Reach A is being removed to levels below 1 mg/kg.

6.5.1 Sampling

In February and March 2006, soil samples were collected from the floodplain of surface water bodies downstream of the Ward Transformer facility. The soil samples were collected to determine if floodplain soils have been impacted by site-related contaminants and if they contained PCB concentrations that may pose an unacceptable risk to human health and/or ecological receptors. Sample locations targeted relatively high-use recreational areas (e.g., fishing, hiking, biking, athletic fields, etc.) of the Brier Creek Reservoir and Lake Crabtree floodplain, focusing on potential depositional areas where contaminants would tend to accumulate.

Soil samples were collected from the floodplain area at Lake Crabtree County Park, including the following:

- Open Play area, located adjacent to the Water Wise Garden, volleyball courts, and parking area.
- Vicinity of the boat-rental/beach area.
- Public boat ramp area.
- Car-top boat launching area.
- Areas used for biking, recreational shoreline fishing, and walking/hiking. Specifically, in the vicinity of Lake Crabtree County Park's Lake Trail, the Lake Crabtree Dam's spillway, and the Black Creek Greenway.
- Lake Crabtree floodplain along its southern shoreline.
- Upstream of Lake Crabtree, at an athletic field at the Cedar Fork District Park.

6.5.2 Floodplain Soil - Results Summary

Floodplain soil sampling results are shown in Figures 5 to 9.

Table 4 summarizes the floodplain soil results for PCB Aroclor 1260 analyses.

Table 4 – Floodplain Soil Maximum Aroclor Concentrations

LOCATION	CONCENTRATION (mg/kg)
Reach A (outside floodplain soils)	380
Reach A	1.1
Reach B	Not sampled
Reach C	Not sampled
Reach D	0.048
Brier Creek Reservoir	0.048
Brier Creek	Not sampled
Lake Crabtre	Not detected
Upper Crabtree Creek	Not detected
Crabtree Creek	Not detected

6.6 Crayfish and Fish Tissue

In order to characterize potential human health and ecological risk associated with uptake of PCBs by aquatic biota, fish samples were collected from surface water bodies located downstream from the Ward Transformer facility. Prior to sampling, a Scientific Collection Permit (SCP) was obtained from the North Carolina Wildlife Resources Commission (NCWRC). Collection activities were performed in accordance with the requirements of the SCP. Contaminant concentration data from whole body composite samples were collected for assessing risk to potential ecological receptors, such as piscivorous mammals or birds. Contaminant concentration data from fish filet composite samples were collected for assessing risk to potential human receptors.

6.6.1 Sampling

May 2003 Sampling – Reach B and Brier Creek Reservoir

In May 2003, aquatic biota sampling was performed in Reach B of the unnamed tributary to Little Brier Creek. The sampling area in Reach B was located approximately 0.5 miles downstream of the Ward Transformer facility's stormwater lagoon outfall, and included Reach B's initial 0.15-mile length downstream of the Northern Wake Expressway/I-540. Target fish species established for the creek sampling included cyprinid minnows or small centrarchids (sunfish). However, cyprinid minnows were not dominant components of the biota in the creek. Because crayfish were abundant in the creek and are a preferred prey for raccoons and piscivorous birds, crayfish were sampled in lieu of cyprinids. In addition, pumpkinseed sunfish and yellow bullhead were collected. Whole body composite samples were prepared from crayfish, pumpkinseed sunfish, and yellow bullhead. All aquatic biota were collected in Reach B using a backpack-mounted electrofisher.

Also in May 2003, fish samples were collected from Brier Creek Reservoir. In order to determine whether spatial differences in fish tissue concentrations were present, three areas were operationally defined based on reservoir morphology. The upper portion of Brier Creek

Reservoir was considered to extend from the last free-flowing location in Little Brier Creek approximately 0.2 mile downstream to the twin culverts beneath the Globe Road crossing (i.e., 0.2-mile downstream section of Reach D). The middle (downgradient) portion of Brier Creek Reservoir was considered to extend from the culverts beneath the Globe Road crossing approximately 0.45 mile downstream to the culverts beneath the Nelson Road crossing. The lower portion of Brier Creek Reservoir was considered to extend from the Nelson Road crossing, downstream to the Aviation Parkway crossing, and then downstream to the breast of the dam that forms Brier Creek Reservoir, a total length of approximately 1.2 miles.

Fish samples were collected from Brier Creek Reservoir using two different gear types. A boat-mounted Coffelt electrofisher was used to collect largemouth bass (*Micropterus salmoides*) and bluegill sunfish (*Lepomis macrochirus*) specimens. Brown bullheads (*Ameirus nebulosus*) were collected by trotlining. A total of three discrete locations were selected for individual trotline sets and captured target fish specimens were segregated by location. Trotline No. 1 was located in the upper portion of the Brier Creek Reservoir sampling reach, and Trotlines No. 2 and No. 3 were located in the middle portion of the Brier Creek Reservoir sampling reach. Largemouth bass and bluegill sunfish specimens retained for tissue analyses were also segregated by capture locations defined as the upper Brier Creek Reservoir and middle Brier Creek Reservoir. Three whole body composite samples were prepared from bluegill sunfish collected from Brier Creek Reservoir. Three filet tissue composite samples each were prepared from bluegill sunfish, largemouth bass, and brown bullheads from Brier Creek Reservoir.

November 2003 Sampling – Brier Creek Reservoir, Brier Creek, and Lake Crabtree

In November 2003, additional fish tissue samples were collected in the lower portion of Brier Creek Reservoir (downstream of Nelson Road), Brier Creek (between Brier Creek Reservoir and Lake Crabtree) and Lake Crabtree (from three areas) to determine the downstream extent of fish contamination.

In the lower portion of Brier Creek Reservoir (downstream of Nelson Road), composite whole body samples of bluegill sunfish and green sunfish were collected for assessing risk to potential ecological receptors such as piscivorous mammals or birds. In addition, four composite samples consisting of three to five fish each were collected for assessing potential human health risk to recreational fisherman. These included filet tissue samples obtained from brown bullhead, yellow bullhead, bluegill sunfish, and largemouth bass. Scaled, skin-on filet tissue samples were prepared from the individual fish. One composite sample was prepared from each of these groups.

Three composite samples were collected in Brier Creek, between Brier Creek Reservoir and Lake Crabtree, for assessing risk to potential ecological receptors such as piscivorous mammals or birds. Whole body tissue samples were prepared from crayfish, yellow bullhead, and bluegill sunfish.

Three composite samples of whole body bluegill sunfish were collected from Lake Crabtree for assessing risk to potential ecological receptors such as piscivorous mammals or birds. Composite samples were collected to represent the northern (Sector A), western (Sector B), and eastern (Sector C) portions of Lake Crabtree. In addition, ten composite samples consisting of three to five fish each were collected from Lake Crabtree for assessing potential human health risk to recreational fishermen. In addition to the target species of largemouth bass and bluegill sunfish from the May 2003 sampling event, carp were also targeted as requested by NC DENR. Carp species are popular among local fishermen in the area for both sport and as table fare. Because Lake Crabtree has been actively managed by the state as a large catfish fishery, channel catfish (*Ictalurus nebulosus*) were sampled in lieu of brown bullhead. Scaled, skin-on filet tissue samples (skin-off for catfish species) were prepared from the individual fish. Fish collection techniques in Brier Creek Reservoir and Lake Crabtree consisted of boat-mounted electrofishing gear and trotlining. Fish collection techniques in Brier Creek consisted of backpack-mounted electrofishing.

November 2004 Sampling – Lake Crabtree and Crabtree Creek

In November 2004, additional fish sampling was performed in Lake Crabtree and Crabtree Creek (downstream of Lake Crabtree) because fish from the most distant downstream locations sampled (in Lake Crabtree) contained concentrations of PCBs that prompted fish consumption advisories by the State of North Carolina.

Additional whole body samples were collected from Lake Crabtree for assessing risk to potential ecological receptors such as piscivorous mammals or birds. In order to determine whether spatial differences in fish tissue concentrations were present, sample collection was performed in Sectors B and C of Lake Crabtree. Two whole body samples were prepared from Sector B; one sample was comprised of one largemouth bass (*Micropterus salmoides*) and the other sample was comprised of one channel catfish (*Ictalurus punctatus*). Two whole body samples were prepared from Sector C; one sample was comprised of one largemouth bass and the other sample was comprised of one channel catfish. Sampling was performed using two different gear types. A boat-mounted Coffelt electrofisher was used to collect largemouth bass specimens and channel catfish were collected by trotlining. Largemouth bass and channel catfish specimens retained for tissue analyses were segregated by capture locations within Sectors B and C of Lake Crabtree.

Three approximately 1,000-ft long reaches within an approximately 5-mile long span of Crabtree Creek were targeted for fish sampling. Targeted fish for the Crabtree Creek sampling were to be comparable to the targeted fish from previous sampling efforts at locations in Brier Creek Reservoir and the portion of the unnamed tributary to Little Brier Creek closer to the Ward Transformer facility (i.e., Reach B). However, because the dominant members of Crabtree Creek's fish community varied between the three sampling reaches, alternative species from the same trophic levels were substituted. Species collected by electrofishing in Crabtree Creek between Lake Crabtree and I-40 included pumpkinseed sunfish, bluegill sunfish, and channel catfish. The sampling reaches in Crabtree Creek located at Umstead State Park, downstream of the Company Mill Crossing trail and upstream of Ebenezer Church Road, yielded redbreast

sunfish (*Lepomis auritus*), bluegill sunfish, and yellow bullhead. Whole body composite samples were prepared from pumpkinseed sunfish, bluegill sunfish, channel catfish, redbreast sunfish, and yellow bullhead. Filet tissue composite samples were prepared from pumpkinseed sunfish, bluegill sunfish, channel catfish, and redbreast sunfish. Composite filet tissue samples of the sunfish species were each comprised of scaled, skin-on filets. Channel catfish composite samples were skinned filets. Sampling in Crabtree Creek was performed using a backpack-mounted electrofisher.

August 2005 Sampling – Crabtree Creek

In August 2005, the NC DENR's Division of Water Quality (NCDWQ) collected eight composite fish samples from Crabtree Creek, downstream of Lake Crabtree, for assessing potential human health risk to recreational fishermen. Four discrete sample locations along Crabtree Creek were targeted and included the creek's crossing at the following: Company Mill trail, located within William B. Umstead State Park; Duraleigh Road Bridge; Crabtree Valley Mall near the Homewood Banks Drive Bridge; and Wake Forest Road Bridge.

The samples consisted of four to seven fish each and included filet tissue samples obtained from largemouth bass, channel catfish, and flathead catfish. Scaled, skin-on filet tissue samples (skin-off for catfish species) were prepared from the individual fish. Sampling in Crabtree Creek was performed using a backpack-mounted electrofisher.

February and March 2006 Sampling – Brier Creek Reservoir

Whole body fish sampling from middle and lower Brier Creek Reservoir was performed in February and March 2006 in order to reduce uncertainties in the ecological risk assessment for the Ward Transformer Superfund Site. The subsequent data were primarily used to better evaluate the risks to bald eagles and other carnivorous raptors that use Brier Creek Reservoir for foraging. One whole body composite sample consisting of five fish was collected from yellow bullhead (*Ameirus natalis*). In addition, due to sufficient body mass, three whole body grab samples were collected from largemouth bass (*Micropterus salmoides*). Sampling in Brier Creek Reservoir in February and March 2006 was performed using two different gear types. A boat-mounted Coffelt electrofisher was used to collect largemouth bass specimens, and yellow bullhead specimens were collected by trotlining.

6.6.2 Crayfish and Fish Tissue – Results Summary

Aquatic biota (fish and crayfish) were collected downstream of the Ward Transformer facility. Whole body samples were collected in Reach B, Brier Creek Reservoir, Brier Creek, Lake Crabtree, and Crabtree Creek for evaluating potential risk to ecological receptors. Fish filet tissue samples were collected from Brier Creek Reservoir, Lake Crabtree, and Crabtree Creek to assess potential impacts to humans from fish consumption.

Samples of aquatic biota collected from downstream water bodies showed the presence of site contaminants. Crayfish and whole body fish samples (pumpkinseed sunfish and yellow bullhead) collected from Reach B contained significant concentrations of Aroclor 1260 and various PCB congeners and dioxins/furans. Sampling results are presented in Figures 11 and 12.

The highest concentrations were found in a whole body pumpkinseed sunfish sample from Reach B, with an Aroclor 1260 concentration of 75 mg/kg and a combined PCB and dioxin/furan TEQ concentration of 598 ng/kg. Table 5 summarizes the PCB Aroclor 1260 data by reach and fish species.

Table 5 –Fish, Maximum PCB Concentrations (mg/kg)

Downstream Reach	Crayfish (whole body)	Yellow Bullhead (whole body)	Bluegill Sunfish (whole body)	Largemouth Bass (filet)	Channel Catfish (filet)
Reach B	11	22	---	---	---
Upper Brier Creek Reservoir	---	---	2.5	1.8	---
Middle Brier Creek Reservoir	---	---	2.5	2.6	---
Lower Brier Creek Reservoir	---	---	0.38	0.65	---
Brier Creek	0.074	0.5	0.49	---	---
Lake Crabtree Sector A	---	---	0.9	0.3	0.67
Lake Crabtree Sector B	---	---	0.17	0.12	1.3
Lake Crabtree Sector C	---	---	0.15	0.19	1.7
Crabtree Creek	---	0.074	0.59	0.18	0.34

Legend: --- Not sampled

As indicated in the table above, PCB Aroclor 1260 results generally show a declining trend in both whole body and filet concentrations in the samples farther downstream from the Ward Transformer facility. Fish tissue data from Crabtree Creek indicate continued downstream transport of PCBs below Lake Crabtree. Although the sediment samples from Crabtree Creek did not contain detectable concentrations of PCBs, their presence in fish samples indicates uptake and bioaccumulation of PCBs via the food chain.

Based on the analytical results of the fish tissue samples, the North Carolina Division of Public Health issued fish consumption advisories for the protection of humans consuming fish potentially contaminated with PCBs. The fish consumption advisories action levels for PCB are described in Tables 6.

Table 6 – Fish Consumption Recommended Limits

TOTAL PCB LEVELS IN FISH (mg/kg)	RECOMMENDED MEAL LIMITS
<0.05	Unlimited consumption.
0.05 to 0.10	One meal per week.
0.10 to0.50	One meal per month
>0.5	Do not eat

The fish consumption advisories that are currently in effect for the water bodies within OU1 are summarized in Table 7.

Table 7 – Current Fish Consumption Advisories for OU1 areas

AREA	NORTH CAROLINA FISH CONSUMPTION ADVISORY
Brier Creek Reservoir Little Brier Creek (downstream of Brier Creek Parkway) Tributaries to Little Brier Creek	Do not eat fish.
Brier Creek	Do not eat any fish.
Lake Crabtree	Do not eat carp or catfish. Limit consumption of all other fish to no more than one meal per month.
Crabtree Creek (above Lake Crabtree and below Lake Crabtree to where it enters the Neuse River)	Limit consumption of carp, catfish, and largemouth bass to no more than one meal per month.

7.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

Land use in the vicinity of the Ward Transformer facility is primarily industrial and commercial, with major highways located north (US highway 70) and west (I-540). Two properties located east of the site, across Mount Herman Road, were formerly used as residences. These properties are currently vacant or now used for commercial purposes. Much of the land located south-southwest of the property is owned by the RDU Airport Authority. The airport land, and the facility and surrounding industrial/commercial properties are generally access restricted (fenced). The properties located to the rear (northwest, west, and southwest) of the Ward Transformer facility consist of vacant undeveloped woodland.

Land use along the Reach A through D portions of the downstream study area, includes undeveloped woodland primarily owned by the RDU Airport Authority or Ward Ventures LLC. Along Reaches B and C, the nearest developed properties consist of commercial retail businesses. Along the western portion of Reach D, land is used for commercial purposes and

mainly consists of warehouse distribution buildings. The eastern portion of Reach D is owned by the RDU Airport Authority and is access restricted.

The nearest active residence downstream of the site is located approximately 1.7 miles downstream, at 10305 Globe Road, in the vicinity of Little Brier Creek's mouth at Brier Creek Reservoir. Two properties located on the north bank of Brier Creek Reservoir, between Globe Road and Nelson Road, were formerly used for residential purposes. These residences are vacant, however, and future land use of the properties will be for non-residential purposes. The remainder of land around Brier Creek Reservoir is primarily owned by the RDU Airport Authority and is access restricted. Brier Creek Reservoir is posted by Wake County to restrict trespassers.

Land use in the vicinity of Brier Creek between Brier Creek Reservoir and Lake Crabtree consists of commercial office space and undeveloped land under RDU Airport Authority control. The portion of Lake Crabtree northwest of Aviation Parkway, in the vicinity of Brier Creek's mouth, is undeveloped dense forest and wetland and is generally inaccessible. To the southeast of Aviation Parkway, Wake County owns a park that surrounds most of Lake Crabtree (Lake Crabtree County Park) and is used extensively for recreation. The park is located along the lake's north shore, while a walking/hiking trail (Lake Trail) generally follows the entire lake's shoreline and connects with adjacent community greenways. Lake Trail and the greenways are heavily used by joggers, walkers, and bikers. Lake Crabtree is a recreational fishery, but the park has posted fishing advisories and "catch and release" rules to protect fishermen from eating contaminated fish. Beyond the Lake Trail, the land is primarily used for commercial office space, although a property located along the southeastern portion of the lake is currently being developed for mixed residential and non-residential uses.

From Lake Crabtree, land use features along Crabtree Creek include the North Cary Wastewater Treatment Plant (WWTP), I-40, and William B. Umstead State Park (Umstead Park), a relatively undisturbed forested area. The state park protects nearly 5,400 acres of forestland, through which Crabtree Creek flows for several miles. Upon exiting Umstead Park, land use along Crabtree Creek is primarily suburban residential, until the creek approaches US Highway 70/Glenwood Avenue, after which land use becomes more urbanized. Land use along Crabtree Creek for the remainder of the downstream study area is primarily heavily urbanized, including dense residential and commercial/industrial/institutional use within the City of Raleigh.

8.0 SUMMARY OF SITE RISKS

The Baseline Human Health Risk Assessment (BHHRA) and the Baseline Ecological Risk Assessment (BERA) present the summary of the results of the comprehensive deterministic risk assessments of the potential threats to public health and the environment posed by the OU1 areas under current and future conditions assuming that no remedial actions take place. The assessments provide the basis for taking action and identify the site related contaminants and

exposure pathways that need to be addressed by the remedial action. The BHHRA and BERA are part of the RI report. The RI report presents more details and is part of the administrative record for the Site. This section presents a summary of the BHHRA and BERA.

PCBs have been detected in soil, sediment, and fish at various locations downstream from the Ward Transformer facility. The areas addressed under OU1 extend from Reach B (0.4 miles downgradient of the Ward Transformer facility) to the end of Crabtree Creek at the Neuse River. (Figure 1)

Note that Reach A is included in the risk discussion, because Reach A was grouped with all the other downgradient areas during the planning stages of the risk assessment process. However, as previously noted, sediment and flood plain soil from Reach A are being addressed under the on-going time critical removal action.

8.1 Baseline Human Health Risk Assessment (BHHRA)

The BHHRA estimates the risks the Site poses to humans if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. The sections below summarize the results of the BHHRA for OU1.

8.1.1 Identification of Chemical of Concern (COC)

Chemicals of concern (COCs) are a subset of the site-related chemicals that were carried through the risk assessment (Chemicals of Potential Concern (COPCs)) that significantly contribute to the cumulative site risk.

The carcinogen trigger represents the summed risks to a receptor considering all pathways, media, and routes per land use scenario. The Hazard Index (HI) represents the total of the Hazard Quotients (HQs) of all COPCs in all pathways, media, and routes to which the receptor is exposed. Chemicals are not considered as significant contributors to risk if their individual carcinogenic risk contribution is less than $1x10^{-6}$ and their noncarcinogenic HQ is less than 0.1; therefore, these chemicals are not included as COCs. In addition, because 2,3,7,8 TCDD TEQ did not exceed the $1x10^{-4}$ cumulative site risk level or the site HI of 1 used as the remediation triggers, it is not included in the list of COCs.

Based on the BHHRA the COCs for OU1 are PCBs and PCB congeners. Although some of the calculated human health risks are associated with exposure to dioxins and furans (2,3,7,8 TCDD TEQ), over 90% of the risks are associated with PCBs (Aroclor 1260 or PCB congeners). As such PCBs and PCB congeners are the site-related chemicals driving the need for a remedial action at OU1.

The tables below present the COCs and their exposure point concentrations (EPCs) for each media and study area with significant routes of exposure. The tables also include the range of

concentrations, as well as the frequency of detections (i.e., the number of times the chemical was detected in the samples collected), the EPC (i.e., the concentration that was used to estimate exposure and risk for each COC in the specific media and area), and how the EPC was derived. Aroclor 1260 was the most frequently detected COC in all media and all areas. In most cases, the 95% UCL on the arithmetic mean was used as the EPC. However, for PCB congeners in some media where there were limited amount of sample data available, the maximum concentration was used as the default exposure point concentration. The COCs for the OU1 ROD are presented in Tables 8 to 13.

Table 8 – Reach A - Chemicals of Concern (Floodplain Soil)

SUMMARY OF CHEMICALS OF CONCERN AND MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATIONS

Scenario Timeframe: CURRENT AND FUTURE
Medium: SOIL
Exposure Medium: FLOODPLAIN SOIL

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Floodplain Soil	Aroclor 1260	0.21	380	mg/kg	11/14	148	mg/kg	95% UCL
	PCB Congener TEQ	0.000288	0.00363	mg/kg	2/2	0.00363	mg/kg	MAXIMUM

Key:
mg/kg: Milligrams per kilogram
95 % UCL- 95 percent Upper Confidence Limit

Table 9 – Reach A - Chemicals of Concern (Sediment)

SUMMARY OF CHEMICALS OF CONCERN AND MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATIONS

Scenario Timeframe: CURRENT AND FUTURE
Medium: SEDIMENT
Exposure Medium: SEDIMENT

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration (EPC)	EPC Units	Statistical Measure
		Min	Max					
Sediment	Aroclor 1260	0.014	62.0	mg/kg	33/33	19.8	mg/kg	95% UCL
	PCB Congener TEQ	0.000209	0.105	mg/kg	11/11	0.071	mg/kg	95% UCL

Key:
mg/kg: Milligrams per kilogram
95 % UCL- 95 percent Upper Confidence Limit

Table 10 - Reaches B-C-D, Brier Creek Reservoir and Brier Creek Chemicals of Concern (Sediment)

SUMMARY OF CHEMICALS OF CONCERN AND MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATIONS

Scenario Timeframe: CURRENT AND FUTURE
Medium: SEDIMENT
Exposure Medium: SEDIMENT

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration (EPC)	EPC Units	Statistical Measure
		Min	Max					
Sediment	Aroclor 1260	0.0195	4.2	mg/kg	53/67	1.2	mg/kg	+95% UCL
	PCB Congener TEQ	0.000000589	0.005	mg/kg	25/25	0.0014	mg/kg	95% UCL

Key:
mg/kg: Milligrams per kilogram
UCL: Upper Confidence Limit

Table 11 - Brier Creek Reservoir Chemicals of Concern (Fish)

SUMMARY OF CHEMICALS OF CONCERN AND MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATIONS

Scenario Timeframe: CURRENT AND FUTURE
Medium: FISH
Exposure Medium: FISH FILLET

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Fish	Aroclor 1260	0.22	2.60	mg/kg	12/12	1.64	mg/kg	95% UCL
	PCB Congener TEQ	0.00000452	0.0000311	mg/kg	12/12	0.000024	mg/kg	95% UCL

Key:
mg/kg: milligrams per kilogram
UCL: Upper Confidence Limit

Table 12 – Lake Crabtree Chemicals of Concern (Fish)

SUMMARY OF CHEMICALS OF CONCERN AND MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATIONS

Scenario Timeframe: CURRENT AND FUTURE
Medium: FISH
Exposure Medium: FISH FILLET

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Fish	Aroclor 1260	0.100	1.70	mg/kg	10/10	0.99	mg/kg	95% UCL
	PCB Congener TEQ	0.0000259	0.0000311	mg/kg	10/10	0.000030	mg/kg	95% UCL

Key:
mg/kg: milligrams per kilogram
UCL: Upper Confidence Limit

Table 13 – Crabtree Creek Chemicals of Concern (Fish)

SUMMARY OF CHEMICALS OF CONCERN AND MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATIONS

Scenario Timeframe: CURRENT AND FUTURE
Medium: FISH
Exposure Medium: FISH FILLET

Exposure Point	Chemical of Concern	Concentration Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Fish	Aroclor 1260	0.033	0.34	mg/kg	9/12	0.18	mg/kg	95% UCL
	PCB Congener TEQ	0.00000103	0.00000683	mg/kg	11/11	0.0000068	mg/kg	MAXIMUM

Key:
mg/kg: milligrams per kilogram
UCL: Upper Confidence Limit

8.1.2 Exposure Assessment

The goal of the exposure assessment is to determine the extent of potential exposure of susceptible populations. PCB contamination as a result of past operational practices at the Ward Transformer facility is the primary source of concern at the study areas. A summary of the exposure assessment results is presented below. Section 5.3 of the RI report presents the complete exposure assessment conducted as part of the risk assessment process.

8.1.2.1 Characterization of current and future land and water uses of the study areas

PCBs migrating from the Ward Transformer facility have been detected in soil, sediment, surface water, and fish in various segments of the study area. Land and surface water extending from the Ward Transformer facility to the Neuse River have a number of current and potential future uses. Figure 1-5 illustrates the locations of the areas described below.

- **Reach A –** Reach A does not support recreational fishing or swimming due to its small size and intermittent flow, and most likely, will not be developed in the future for residential use. However, the area along the unnamed tributary to Little Brier Creek can be accessed by current or future trespassers and contact with surface water and sediment could occur during wading or other similar activities.

- **Reaches B, C, and D –** Reaches B and C are part of the unnamed tributary. Reach D is the Little Brier Creek, prior to its entrance into Brier Creek Reservoir. These reaches are not zoned for residential development. These areas do not support recreational fishing or swimming due to the small size of the stream therefore, fish filet data was not collected here. It was assumed that resident children may wade in these areas.

- **Brier Creek Reservoir and Lake Crabtree** – Brier Creek Reservoir and Lake Crabtree contain significant numbers of sport fish including catfish species, largemouth bass, and bluegill sunfishes. Recreational fishing occurs currently and will likely continue to occur in the future. Fish samples collected during the RI contain PCBs. Fish advisory signs are in place in the Brier Creek Reservoir area and Lake Crabtree warning fishermen of the detection of dangerous levels of PCBs in recreationally caught fish. In addition to fishing activities, publicly accessible swimming areas at Lake Crabtree may expose families to contaminants in surface water and sediment while swimming. Residential development is possible near Brier Creek Reservoir; thus, a future resident wader scenario was considered for this area. Bicycle paths and ball fields are present at Lake Crabtree therefore, bikers/joggers and ball players could potentially be exposed to contaminated soil. Children in areas adjacent to Reaches B, C, and D could potentially wade in sediment and surface water of Brier Creek Reservoir. Because the swimming exposure pathway was evaluated at Lake Crabtree, a wader scenario was not considered in Lake Crabtree.

- **Lower Brier Creek –** This area is between Brier Creek Reservoir and Lake Crabtree. This portion of the creek does not support recreational fishing or swimming, and no fish filet

tissue data are available for evaluation. A child resident could wade in sediment and surface water.

- **Crabtree Creek** – This area is between Lake Crabtree and the Neuse River. This area supports recreational fishing.

8.1.2.2 Exposure Pathway Analysis

An exposure pathways analysis depicts the contaminated media, potential exposure routes and pathways, and potentially susceptible known or potential human populations. A key function of the analysis is to identify complete exposure pathways and to assist in the development of exposure scenarios and dose estimation models.

Exposure Scenarios

There are several susceptible populations in the study areas. The following exposure scenarios were considered in the risk assessment:

- Current/Future Trespasser in Reach A – Evaluated.
- Future Resident in Reaches B, C, and D – Based on zoning restrictions and the improbability of development in these areas, residential risks were not quantitatively evaluated.
- Future Resident Wader in Reaches B, C, and D, Brier Creek Reservoir, and Brier Creek – Evaluated.
- Current/Future Recreational Fisher in Brier Creek Reservoir, Lake Crabtree, and Crabtree Creek – Evaluated.
- Current/Future Swimmer in Lake Crabtree – Evaluated.
- Current/Future Biker/Jogger at Lake Crabtree Park – PCB Aroclors were not detected in any of the soil samples and the TEQ for the detected PCB congeners was less than EPA screening value.
- Current/Future Ball Player at Lake Crabtree Park – PCB Aroclors were not detected in any of the soil samples and the TEQ for the detected PCB congeners was less than the EPA screening value.

Exposure Pathways

Exposure pathways evaluated for each scenario are presented in Table 8-1 (Appendix B). A simplified chart summarizing these exposures is presented in Table 14 below.

Table 14 - Summary of Complete Exposure Pathways Evaluated

Exposure Pathway	Description	Reach A	Reaches B, C, and D	Brier Creek Reservoir	Brier Creek	Lake Crabtree	Crabtree Creek
Soil Contact	Incidental ingestion, dermal contact, dust inhalation	Adolescent trespasser	Child and adult resident waders	Child and adult resident waders	Child and adult resident waders		
Sediment Contact	Incidental ingestion, dermal contact	Adolescent trespasser	Child and adult resident waders	Child and adult resident waders	Child and adult resident waders		
Surface Water Contact	Incidental ingestion, dermal contact					Child and adult swimmers	
Fish Ingestion	Consumption of recreationally caught fish			Child and adult recreational fishermen		Child and adult recreational fishermen	Child and adult recreational fishermen

8.1.3 Toxicity Assessment

The toxicity assessment will identify and define the toxicity values for the evaluation of COPCs at the Ward Transformer Superfund Site. These toxicity values are applied to the estimated exposure doses in order to calculate potential cancer risks and noncancer health effects.

Chemicals that have evidence of carcinogenicity are referred to as carcinogens. Excessive exposure to all chemicals potentially can produce adverse noncancer health effects, while the potential for causing cancer is limited to carcinogens. Therefore, noncancer toxicity values can be developed for all chemicals, while cancer toxicity values can be developed only for carcinogens. The noncancer toxicity values used in this risk assessment are termed reference doses (RfDs), and the cancer toxicity values are termed cancer slope factors (CSFs).

RfDs and CSFs are expressed in units of milligrams of chemical per kilogram of body weight per day (mg/kg-day), or cancer risk per mg/kg-day, respectively. Inhalation reference concentrations (RfCs) and unit risk factors (URFs) are converted to RfDs and CSFs, respectively, according to EPA guidance.

See Tables 8-2 through 8-5 (Appendix B) for cancer slope factors and RFDs used in the BHHRA.

Carcinogenic Effects

Weight-of-Evidence Categorization

EPA has assigned each chemical a weight-of-evidence, which represents the likelihood of it being a human carcinogen. Six weight-of-evidence categories exist:

- **A** Human carcinogen, based on sufficient evidence from human data.
- **B1** Probable human carcinogen, limited human data are available.
- **B2** Probable human carcinogen, sufficient evidence in animals and inadequate or no evidence in humans.
- **C** Possible human carcinogen, limited evidence of carcinogenicity in animals and evidence in humans is inadequate.
- **D** Not classifiable as to human carcinogenicity, based on inadequate data in humans and animals.
- **E** No evidence of carcinogenicity in humans in at least two adequate animal tests in different species or in both adequate epidemiological and animal studies.

The Guidelines for Carcinogen Risk Assessment recommends a different scheme for weighting evidence of carcinogenicity than has been traditionally used in risk assessments. The new guidelines recommend replacing these classifications with descriptions of known likely, cannot be determined, or not likely. However, the COPCs in this BHHRA are still classified by the old system in the IRIS database.

The oral, inhalation, and dermal CSFs used in this risk assessment are expressed as an inverse dose, in units of $mg/kg\text{-}day^{-1}$. When EPA develops inhalation toxicity values to express carcinogenic potency through the inhalation exposure route, the values are usually developed as an inhalation URF. The URF is expressed as an inverse concentration in air in units of micrograms of chemical per cubic meter of air $(\mu g/m^3)^{-1}$. The inhalation unit risks are converted to slope factors in accordance with EPA guidance.

Dermal Slope Factors

Although EPA has developed oral and/or inhalation slope factors for a number of carcinogens, dermal slope factors have not been derived for any chemicals. EPA has published guidance, however, for calculating dermal slope factors for chemicals for which an oral slope factor is available. In accordance with EPA guidance, a dermal slope factor is derived for PCBs by dividing its oral slope factor by an appropriate absorption factor. This results in the conversion of the oral slope factor, which represents the carcinogenic potency of the administered dose, to a dermal slope factor, which represents the carcinogenic potency of the absorbed dose. The conversion is necessary to be able to calculate risk through the dermal pathway. The dermal slope factors must be consistent with the dermal doses, which are calculated in the exposure assessment as absorbed doses. The oral and inhalation doses, by contrast, are calculated as

administered doses and are evaluated using CSFs based on the administered dose. EPA has recommended a PCB gastrointestinal (GI) tract absorption factor of 100%.

Polychlorinated Biphenyls (PCBs)

PCBs are sometimes referred to by their commercial name, Aroclors. Aroclors are complex mixtures of varying amounts of PCB congeners. There are 209 known PCB congeners consisting of varying numbers of chlorine atoms. Each specific Aroclor mixture has a unique congener profile. Congeners are classified according to 10 homologue groups, depending on the number of chlorines (i.e., monochlorinated to decachlorinated homologues) attached to the biphenyl molecule. The congener content of each homologue group is dependent on the manufacturing method used to prepare the mixture. Lower numbered Aroclors (e.g., Aroclor 1016, Aroclor 1221) tend to be mixtures of congeners with lower chlorine content than the higher numbered Aroclors (e.g., Aroclor 1254, Aroclor 1260).

Non-cancer Health Effects

Derivation of Reference Doses (RfDs)

The toxicity values that are used in this risk assessment to estimate the potential for adverse noncancer health effects are termed RfDs. The term RfD refers to the daily intake of a chemical to which an individual can be exposed without any expectation of noncancer health effects (e.g., organ damage, biochemical alterations) occurring during a given exposure duration. As the RfD decreases in value, the chemical is more toxic in producing noncancer health effects.
EPA has derived RfDs for two different exposure periods. Chronic RfDs have been developed to evaluate human exposures of greater than 7 years. Subchronic RfDs have been provisionally developed to evaluate exposure periods in humans of 2 weeks to 7 years. Unlike the approach used in deriving CSFs, it is assumed when deriving RfDs that a threshold dose exists below which there is no potential for systemic toxicity.

RfDs are expressed as a dose in units of mg/kg-day. When deriving noncancer toxicity values for the inhalation exposure route, EPA expresses the value as a reference concentration (RfC) in units of milligrams of chemical per cubic meter of air (mg/m^3). Because exposure doses for all pathways, including the inhalation pathway, are conventionally calculated in units of mg/kg-day, the RfCs are converted to inhalation RfDs, in accordance with EPA guidance. The conversion assumes an adult body weight of 70 kg and an inhalation rate of 20 m^3/day.

Dermal Reference Doses

EPA has not derived dermal RfDs for any chemicals, but has provided guidance for deriving these values for chemicals for which an oral RfD is available. In accordance with EPA guidance, dermal RfDs are derived by multiplying each oral RfD by an appropriate absorption factor. The absorption factor for PCBs was selected as 100%.

Reference Doses for PCBs
The primary PCB mixtures found at the site are Aroclor 1254 and Aroclor 1260. The Aroclor 1254 RfD was used as a surrogate because there is no current RfD for Aroclor 1260, the predominant PCB mixture believed to be present at the site.

8.1.4 Risk Characterization

In the baseline risk characterization, the results of the toxicity and exposure assessments are summarized and integrated into quantitative and qualitative expressions of potential risk for carcinogenic compounds and into a HI for non-carcinogenic compounds. The baseline risk characterization presents Reasonable Maximum Exposure (RME) and average/central tendency exposures to baseline site conditions in the absence of additional site controls or remediation.

Non-carcinogenic Hazard
The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period (*e.g.*, life-time) with a reference dose (RfD) derived for a similar exposure period. A RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non- carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemicals of concern that affect the same target organ (*e.g.*, liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic non-carcinogenic effects from all contaminants are unlikely. An HI >1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

Where: CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period (*e.g.*, chronic, sub-chronic, or short-term).

Carcinogenic Risk
For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

ILCR = CDI x SF

Where: ILCR (Incremental Lifetime Cancer Risk) Cancer Risk = a unit-less probability (e.g., 2 x 10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as (mg/kg-day)-1.

These risks are probabilities that are expressed in scientific notation (*e.g.*, 10^{-6}). An excess lifetime cancer risk of 1 x 10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chances of an individual developing cancer from all other causes have been estimated to be as high as one in three. EPA's acceptable risk range for excess lifetime cancer risk from site-related exposure is 10^{-4} to 10^{-6}.

Risk Characterization Results

Table 8-6 (Appendix 2) summarizes the cancer and non-cancer risk calculated for each study area and exposure scenario by exposure pathway and medium. The five study areas evaluated include:

- Reach A
- Combined Reaches B, C, and D, Brier Creek Reservoir, and Brier Creek
- Lake Crabtree
- Crabtree Creek

Media are designated SS (surface soil), SD (sediment), SW (surface water), and FT (fish filet).Where appropriate, the cancer and non-caner risk from each medium were subtotaled separately, as well as combined to calculate a cancer and non-cancer risk (Hazard Index (HI)) for the total site (all media). Total risks were expressed either in terms of Aroclors or PCB congeners for scenarios that had both types of data available because adding risks for Aroclors and PCB congener TEQs within a given exposure pathway or scenario could potentially result in double counting of PCB exposure since it is known that commercial Aroclor mixtures contain various proportions of these congeners. Risks from any other chemicals were incorporated into the total for both.

The Reach A trespasser scenario exceeded EPA's risk management range of 1x10E^{-4} to 1x10^{-6} cancer risk. The HI (based on Aroclors) was also greater than the noncancer HI management level of one. Cancer risk and HI were dominated by exposure to floodplain surface soils.

The fishermen scenarios had the highest risks (based on PCB congeners) and HIs (based on Aroclors) of all scenarios evaluated.

The swimmer scenarios (Lake Crabtree) had the lowest risks of all scenarios evaluated. Both ILCRs and HIs were consistent with EPA's acceptable risk management range (i.e., ILCR, $1x10^{-6}$ to $1x10^{-4}$; HI, <1).

The wader scenarios (combined Reaches B, C, and D, Brier Creek Reservoir, and Brier Creek) were also consistent with EPA's acceptable risk management range for ILCR and HI.

8.1.4.1 Risk Characterization Summary

EPA's acceptable cancer risk range for contaminated waste sites is $1x10^{-6}$ (1 in 1 million) to $1x10^{-4}$ (1 in 10,000), and the acceptable site HI is one. Based on these criteria, the resident wader is within this acceptable range even if surface water dermal exposure is considered. The swimmer scenario for Lake Crabtree was also within the acceptable risk limits. The largest cancer and non-cancer risks were associated with the consumption of fish filets in the fishing scenarios farther downstream in Brier Creek Reservoir, Lake Crabtree, and Crabtree Creek. These risks, which are summarized in the Table 15, were in general unacceptable, with the possible exception of Crabtree Creek, which had marginal cancer risk and HI excursions.

Table 15 – Carcinogenic Risk Results

Risk Scenario	Receptor	Chemical	Carcinogenic Risk*	Percent of Risk
Brier Creek Reservoir Eating Fish Filets	Younger Child Recreational Fisherman	Dioxin TEQ PCB Aroclor/Congener	3.97 E-06 1.10 E-04	4 96
	Adult Recreational Fisherman	Dioxin TEQ PCB Aroclor/Congener	1.89 E-05 5.25 E-04	4 96
Lake Crabtree Eating Fish Filets	Younger Child Recreational Fisherman	Dioxin TEQ PCB Aroclor/Congener	6.81 E-06 1.38 E-04	5 95
	Adolescent Child Recreational Fisherman	Dioxin TEQ PCB Aroclor/Congener	5.47 E-06 1.10 E-04	5 95
	Adult Recreational Fisherman	Dioxin TEQ PCB Aroclor/Congener	3.24 E-05 6.54 E-04	10 90
Crabtree Creek Eating Fish Fillets	Adult Recreational Fisherman	Dioxin TEQ PCB Congener	----- 1.50 E-04	100

* For PCB risks, the larger of the Aroclor or congener TEQ risks was selected.
---- No dioxin/furan samples were collected from fish caught in Crabtree Creek

Although some of the risks were associated with exposure to dioxins and furans, over 90% of the risks were associated with PCBs. Because of the high uncertainty levels associated with Aroclors and PCB congeners, it is difficult to determine if risks were overestimated or underestimated. However, the fishing scenarios were associated with high risk levels from PCB contamination, and justify the North Carolina fishing advisories currently in place in Brier Creek Reservoir, Brier Creek, Lake Crabtree, and Crabtree Creek, regardless of the uncertainties.

8.2 Baseline Ecological Risk Assessment (BERA)

A Screening Level Ecological Risk Assessment (SLERA) was prepared and included in the RI report. The Scientific Management Decision Point (SMDP) for the SLERA recommended that a BERA be prepared for this Site. The results of the RI and SLERA indicate that contaminants have migrated from the Ward Transformer facility and that the maximum concentrations detected in a variety of media, including sediments, soil, and water, are at levels that are likely to pose risk to ecological receptors utilizing the affected areas.

Thus, the scope of the BERA is to evaluate impacts of site-related contaminants (i.e., PCB and dioxin-like congeners) on off-site surface waters from Reach A to Crabtree Creek.

8.2.1 Objectives

The primary objectives of the BERA are to:

- Evaluate contaminant levels [primarily polychlorinated biphenyls (PCBs) and dioxin-like PCB congeners] in sediment, floodplain soil, surface water, and fish and invertebrate tissue.
- Assess the potential for adverse impact to ecological receptors, focusing on exposures to avian and terrestrial piscivores and aquatic insectivores.
- Develop conclusions and recommendations for additional investigation or no further action, as appropriate, based on the findings from the BERA.

8.2.2 Problem Formulation

The problem formation establishes the goals, breadth, and focus of the BERA. The problem formulation also establishes assessment endpoints or specific ecological values to be protected. The questions that need to be addressed are defined based on potentially complete exposure pathways and ecological effects. The conceptual exposure model shows the complete exposure pathways evaluated in the BERA and the relationship of the measurement endpoints and the assessment endpoints.

The problem formulation for this site involves identifying the exposure pathways by which the ***contaminants of ecological concern (COEC)***, which are primarily PCBs and dioxin-like PCB congeners, have migrated or may migrate from the Ward Transformer facility and ultimately to link these routes of migration to receptors and habitat in, on, and around the Site.

8.2.3 Conceptual Exposure Model

A conceptual site model defines how exposure to constituents might affect an ecosystem. The general taxonomic groups (i.e., terrestrial and aquatic organisms) potentially at risk from exposure at the Ward Transformer Superfund Site and the associated fate and transport mechanisms have been summarized in a conceptual exposure pathway model (Figure 13). This

figure provides a simple graphical representation of the movement of stressors through aquatic/wetland and terrestrial environments and identifies the key ecological components (i.e., target receptor species) and exposure routes that will be evaluated in the BERA.

For the Ward Transformer Superfund Site, it is assumed that complete exposure pathways exist for receptors exposed to both aquatic (surface water, sediment, organisms) and terrestrial (surface soil and organisms) media. The concentrations of PCBs and dioxin-like PCB congeners in sediment, crayfish, and fish tissue samples confirm a complete surface water pathway downstream of the Ward Transformer facility. During sampling and habitat delineation activities, signs of omnivorous mammals such as raccoons were noted and direct observations were made of piscivorous avian receptors including belted kingfisher, great blue heron, and osprey in the riparian area of the unnamed tributary to Little Brier Creek, Brier Creek Reservoir, and Lake Crabtree. The bald eagle, a listed species, is known to nest along Lake Crabtree and to forage in Lake Crabtree and Brier Creek Reservoir. These receptors are expected to forage on invertebrates and/or fish in the impacted reaches. Given the pronounced tendency of PCBs to bioaccumulate, these receptors may be adversely impacted by dietary uptake of contaminants contained in prey.

8.2.4 Assessment Endpoints

Assessment endpoints are defined as explicit expressions of the environmental value that is to be protected. The primary contaminants of concern at this site are PCBs and dioxin-like PCB congeners. Given the presence of PCBs in sediment and soil and the potential for ecological exposure to occur from sediment and soil, a set of assessment endpoints were developed for the purpose of achieving the specific goals of the BERA. The assessment endpoints represent potentially significant impacts to the Ward Transformer Superfund Site ecosystem and are based on their ability to integrate modeled, field, or laboratory data with the individual assessment endpoint. Elevated levels of PCBs in sediment and surface water are known to be toxic to fish and benthic organisms; thus, toxicity to aquatic organisms and benthic invertebrates is proposed as an assessment endpoint for PCBs. The primary ecological threat of PCBs in ecosystems is not through direct exposure or acute toxicity. Instead, PCBs bioaccumulate in food chains and PCBs have been implicated as a cause of reduced reproductive success in piscivorous birds and mammals. Therefore, reduced reproductive success in high trophic level species exposed to contaminants, especially PCBs, in soil and sediment and directly through their diet is another proposed assessment endpoint for the contaminants of concern.

8.2.5 Identification of Target Receptors

The target receptors were selected based on the concept that it is neither feasible nor cost-effective to measure constituent effects on all species inhabiting the aquatic and terrestrial habitat associated with the Ward Transformer Superfund Site. Consequently, target receptors have been selected and are evaluated as surrogate species with a high level of sensitivity and exposure to the constituents of concern at the site. These target receptors were selected to provide the most conservative estimation of exposure for similar species within the same feeding guild. Habitat characterization data, including direct and indirect observations of target receptors in the watershed, were considered in the selection process. Even though the specific target receptors

were selected for evaluation in the BERA, these species are selected to represent exposures that other (similar) species with comparable feeding guilds may be receiving, and thus, serve as "surrogate" receptors. The target receptors are:

- **Benthic Organisms** – Contamination, especially from PCBs, will adversely impact benthic organisms. Thus, the benthic organism population was selected as a receptor group in this BERA.

- **Plants and Soil** - Dwelling Organisms – Contamination, especially from PCBs, can be taken up and bioaccumulated by plants and soil-dwelling organisms. PCBs can also have an adverse impact on soil-dwelling organisms. Thus, the plant and soil-dwelling organism populations were selected as receptor groups in this BERA.

- **Fish Populations** – The effects of PCBs on fish health has been the focus of numerous scientific studies. Thus, the resident fish population was selected as a receptor group in this BERA.

- **Bald Eagle** – The bald eagle (Haliaeetus leucocephalus), our national symbol, is a federally designated threatened species (though the bald eagle is proposed for delisting). Bald eagles have been observed along Lake Crabtree and have nested in the immediate vicinity of the lake. They may also be foraging within their home range in Brier Creek Reservoir. The bald eagle was selected as a receptor species because of its status as a threatened species, its position at the top of the food chain, and its piscivorous feeding habits.

- **Great Blue Heron** - The great blue heron (Ardea herodias) is a large aquatic bird with a long neck and spear-like bill. Great blue heron inhabit a variety of freshwater and marine habitats, and they have been observed near the site. The blue heron's main prey items are fish and amphibians, but it will also eat small mammals, reptiles, crustaceans, insects, and birds. The great blue heron was selected as a target receptor species based on its presence at the site and its diet, which may include fish and crayfish.

- **Mink** - The mink (Mustela vison) is the most abundant and widespread carnivorous mammal in North America, primarily feeding on fish and crustaceans. Mink are associated with aquatic habitats of all kinds, including rivers, streams, lakes, ditches, swamps, marshes, and backwater areas. Numerous studies have demonstrated that mink are among the most sensitive of the tested mammalian species to the toxic effects of PCBs. The mink was selected as a receptor species because of its PCB sensitivity, its position at the top of the food chain, and its piscivorous feeding habits.

- **Raccoon** - The common raccoon (Procyon lotor) is an omnivore, feeding on whatever is most available during a given season. Its diet includes fruits, berries, nuts, acorns, insects, small mammals, birds and their eggs, crayfish, crabs, frogs, turtle eggs, and fish. The raccoon is found throughout the United States, and has been observed at the Site. The raccoon is seldom

found far from water, a fact which influences the local distribution of this species. The raccoon was selected as a receptor species because of its presence at the site and its omnivorous feeding habits, which include consumption of both aquatic and terrestrial plants.

- **American Robin** - Omnivorous birds such as the American robin (Turdus migratorius) are an important prey item for higher trophic level predators, and also play an important role in seed dispersal and pollination for many types of terrestrial vegetation. Robins occur throughout most of the continental United States. They are common medium-sized birds that eat worms, insects, and fruits, depending on the season and availability. Although robins are often migratory, some individuals may remain in the same territory throughout the year. The American robin was selected as a receptor species to represent the effects of the site contaminants on an omnivorous bird.

- **Deer Mouse** - The deer mouse (Peromyscus maniculatus) is omnivorous and feeds primarily on seeds, arthropods, some green vegetation, roots and fruits, and fungi as available. It lives in a wide variety of habitats. The mouse is nocturnal and is preyed upon by owls, hawks, snakes, and carnivorous mammals. The deer mouse was selected as a receptor species because of its feeding habits and because small omnivorous mammals are an important prey item for higher trophic level predators. They also play an important role in seed dispersal for many types of terrestrial vegetation.

8.2.6 Development of Exposure Point Concentrations

EPCs were developed by environmental medium and by habitat type. Separate EPCs were developed for each environmental medium based on habitat type, with the data grouped into the following habitats:

- Little Brier Creek and Tributaries
- Banks of Little Brier Creek and Tributaries
- Brier Creek Reservoir
- Brier Creek (Below Brier Creek Reservoir)
- Lake Crabtree
- Crabtree Creek

Locations of these habitats are shown in Figure 1.

The maximum detected concentration or a representative average concentration was evaluated as the EPC in quantifying exposure of ecological receptors to each environmental medium (i.e., tissue, surface water, sediment, and bank soil). The representative average EPC is the 95 percent upper confidence limit (95% UCL) on the arithmetic mean. The 95% UCL was calculated using EPA's ProUCL (Version 3.0) software. Data reduction methods were the same as described in the Human Health Risk Assessment. If a chemical was reported as a nondetect in a sample set

(i.e., medium) containing at least one positive identification, it was assumed to be present at one-half the sample quantitation limit (SQL) in all nondetected samples in the calculation of the 95% UCL concentration of the arithmetic mean. For dioxins and furans and for dioxin-like PCB congeners, a 2,3,7,8-TCDD toxic equivalent quotient (TEQ) was calculated using World Health Organization (WHO) toxic equivalency factors (TEFs), as described in the Human Health Risk Assessment. If a given congener was not detected in any samples for that medium, a TEQ was not calculated. If the congener was detected at least once in that medium, the TEQ for samples where it was not detected was determined by multiplying one-half its SQL with its TEF. For a given sample location, the individual congener TEQs were added to obtain a total 2,3,7,8-TCDD TEQ for that sample.

The maximum detected concentrations in whole-body tissue were selected as the EPC for fish and crayfish. The EPCs for tissue are summarized in Table 8-7 (Little Brier Creek and tributaries), Table 8-8 (Brier Creek Reservoir), Table 8-9 (Brier Creek [below Brier Creek Reservoir]), Table 8-10 (Lake Crabtree), and Table 8-11 (Crabtree Creek). Tables are included in Appendix B.

The same fish species were not collected from each reach. Sunfish and bullhead were collected from Little Brier Creek and tributaries; sunfish, bass, and bullhead were collected from Brier Creek Reservoir; sunfish and bullhead were collected from Brier Creek (below Brier Creek Reservoir); sunfish, bass, and catfish were collected from Lake Crabtree; and sunfish, bass, and catfish were collected from Crabtree Creek. Crayfish tissue was collected only from Little Brier Creek and its unnamed tributary, and Brier Creek (below Brier Creek Reservoir). To account for wildlife consuming fish of varying trophic levels, EPCs were selected for both bottomfeeders (represented by bullhead and catfish) and predators (represented by sunfish and bass). If whole body samples were not available for a grouping or concentration in the filet was greater than in the whole body sample in a reach, filet tissue results were used as the EPC. Catfish and bass filet sample results for PCBs (as Aroclors) and PCB congener TEQs were used for Crabtree Creek and bullhead filet results for PCBs (as Aroclors) were used for Brier Creek Reservoir.

The maximum detected concentration in surface water was selected as the EPC. Surface water EPCs are provided in Table 8-12 (Appendix B). Surface water samples were collected only from the Little Brier Creek and tributaries and from Lake Crabtree. PCBs (as Aroclors) were detected in Little Brier Creek; PCBs (as congeners) were not detected in surface water from Lake Crabtree.

For sediment, the maximum detected concentration was used for Brier Creek Reservoir, Brier Creek (below Brier Creek Reservoir), Lake Crabtree, and Crabtree Creek. A maximum and a representative average EPC was used for both the instream sediments from Little Brier Creek and tributaries and for sediment samples collected from the banks. The bank samples included sediment samples collected from the banks of Reaches A, B, and C of Little Brier Creek and tributaries (i.e., not within the main channel). The EPCs for instream sediment and bank sediment are presented in Table 8-13 (Little Brier Creek and Tributaries), Table 8-14 (bank

samples from Little Brier Creek and tributaries), Table 8-15 (Brier Creek Reservoir), Table 8-16 (Brier Creek [below Brier Creek Reservoir]), Table 8-17 (Lake Crabtree), and Table 8-18 (Crabtree Creek). Low level analytical methods were used to analyze PCB congeners in sediments collected in 2005 and 2006; thus, 2005 and 2006 PCB TEQ concentrations were generally lower than PCB TEQ concentrations measured in samples collected in 2003 and 2004.

The maximum detected concentration in floodplain soil was selected as the EPC. The maximum detected floodplain soil samples were collected near Little Brier Creek Reaches A and D, Brier Creek Reservoir, Crabtree Creek, and Lake Crabtree. PCBs (as Aroclors) were not detected in floodplain soil near Crabtree Creek. The EPCs for floodplain soil are presented in Table 8-19.

8.2.7 Estimation of Potential Risks

Wildlife may be exposed to PCBs and dioxins directly or through the food chain. The potential risk to the target ecological receptors is characterized in this subsection.

Benthic Organisms

To assess the potential for adverse effects on benthic organisms from exposure to potentially toxic sediment, the range of detected sediment concentrations was compared to sediment screening benchmarks (Table 8-20, Appendix B). For Little Brier Creek and tributaries, Brier Creek Reservoir, Lake Crabtree, and Crabtree Creek, the HQs exceeded one for PCBs and dioxins. The HQ for dioxins in samples from Brier Creek (below Brier Creek Reservoir) was 1.5; PCBs were not detected in this reach. The 95% UCL concentration of PCBs in sediments of Little Brier Creek and tributaries (17.6 mg/kg) exceeded the highest of the sediment benchmarks [5.3 mg/kg severe effect level].

Although these results show a potential for adverse impacts to benthic organisms from sediment exposure, these risks may be localized at particular "hotspots," rather than distributed throughout the habitats.

In addition, although congener PCB concentrations in sediment samples from farther downstream reaches (e.g., Crabtree Creek and Brier Creek [below Brier Creek Reservoir]) were all below their respective SQLs, the congener PCB TEQs were calculated using one-half the detection limit for those congeners detected in upstream sediment samples. Sediment samples collected in 2005 and 2006 were analyzed using low level methods, resulting in detection limits that were up to two orders of magnitude lower than the detection limits for the 2003 and 2004 samples. In Crabtree Creek, the maximum PCB TEQ for the 2006 samples was 8.5×10^{-7} mg/kg. In Brier Creek (below Brier Creek Reservoir), the maximum PCB TEQ was 1.1×10^{-6} for the 2006 samples. These concentrations are below the benthic invertebrate screening level of 2.5×10^{-6} mg/kg for dioxins.

Fish and Crayfish

Exposure of fish and crayfish to potentially deleterious concentrations of PCBs and dioxins is evaluated based on a comparison of tissue residues to residue effects concentrations (Table 8-21,

Appendix B). The maximum concentration of PCBs and dioxin TEQs in the whole body tissue for the target species collected were compared to the "tissue no observed effect doses" (NOEDs) and "low observed effect doses" (LOEDs) for similar fish and aquatic invertebrate species. For the bottom-dweller (i.e., omnivorous) fish species, the HQs for PCBs based on the NOED and LOED exceeded one for tissue collected from Little Brier Creek and tributaries. The HQ for PCBs based on the NOED was equal to one for omnivorous fish in Brier Creek Reservoir. For the other habitats, the HQs were less than one, and therefore do not indicate excess risk to omnivorous fish species.

For the predator (i.e., carnivorous) fish species, the HQs for PCBs based on the NOED and LOED for Aroclor 1260 exceeded one in Little Brier Creek and Brier Creek Reservoir. HQs based only on the NOED exceeded one for fish collected from Brier Creek (below Brier Creek Reservoir), Lake Crabtree, and Crabtree Creek. For the predatory fish species, the HQs for dioxins and combined PCB congener and dioxin TEQs were less than one and therefore do not indicate excess risk to carnivorous fish species.

For the crayfish (i.e., aquatic invertebrate), the HQs for PCBs based on the NOED and LOED exceeded one in Little Brier Creek and tributaries. HQs for PCBs based on the NOED exceeded one for crayfish collected from Brier Creek (below Brier Creek Reservoir) and from Crabtree Creek. For the aquatic invertebrate species, the HQs for dioxins and PCB congeners were less than 1.0 and therefore do not indicate excess risk to aquatic invertebrate species. Crayfish were not collected from Brier Creek Reservoir, Lake Crabtree, or Crabtree Creek.

Plants and Soil-Dwelling Organisms

To assess the potential for adverse effects on plants and other soil-dwelling organisms from exposure to potentially toxic soil, the maximum and 95% UCL soil concentrations were compared to soil screening benchmarks (Table 8-22). The HQs for maximum concentration of PCBs in soil on the banks of Little Brier Creek and tributaries exceeded one for plants and other soil-dwelling organisms. For plants, the HQ for the 95% UCL concentration of PCBs in soil did not exceed one, while for other soil-dwelling organisms the HQ exceeded one. For floodplain soils along Little Brier Creek, the HQs for maximum and 95% UCL concentrations of PCBs exceeded one for soil-dwelling organisms but did not exceed one for plants. The single Brier Creek Reservoir floodplain soil sample had a HQ above one for soil-dwelling organisms. PCBs were not detected in Lake Crabtree floodplain soil. A plant and other-soil dwelling organism benchmark was not available for dioxins.

Other Wildlife Species

The potential risks to other wildlife species within each habitat are summarized in this subsection.

Little Brier Creek and Tributaries and Floodplain

The wildlife target receptors evaluated for Little Brier Creek and tributaries were the mink, the heron, the raccoon, the deer mouse, and the robin. The mink may be exposed to contaminants

through the ingestion of fish, sediment, and surface water. The great blue heron may be exposed to contaminants through ingestion of fish and crayfish as well as through incidental ingestion of sediment and surface water. The raccoon may be exposed to contaminants through the ingestion of crayfish, sediment and surface water, as well as through the consumption of plants and soil along the banks of the creek. The deer mouse and robin may be exposed through the ingestion of plants, invertebrates, and floodplain soil. The potential risks to the mink, heron, raccoon, deer mouse, and robin are summarized in Table 8-23(Appendix B).

The no effect and low effect HQs for PCBs exceeded one for the mink, heron, and raccoon using both the maximum and average (i.e., 95% UCL) exposure point concentrations (EPCs) for sediment. For the maximum sediment EPC, the HQ ranged from 43 to 8.8 for the mink, 38 to 3.8 for the heron, and 10 to 2.7 for the raccoon. For the average sediment EPC, the HQ ranged from 43 to 8.8 for the mink, 36 to 3.6 for the heron, and 9.7 to 2.6 for the raccoon. This risk is primarily associated with the consumption of contaminated prey.

For the maximum sediment EPC, the no effect and low effect HQs for the PCB congener TEQ exceeded one, ranging from 100 to 10 for the mink, from 56 to 5.6 for the heron, and from 350 to 35 for the raccoon. For the average sediment EPC, the no effect HQs for the PCB congener TEQ exceeded one for the mink, heron, and raccoon, while the low effect HQs exceeded one only for the mink and raccoon. The PCB congener no effect HQs were 51 for the mink, 9.1 for the heron, and 210 for the raccoon, and the low effect HQs were 5.1 for the mink, 0.91 for the heron, and 21 for the raccoon. These risks from PCB congener TEQs are also primarily through food consumption. For the maximum EPC, the no effect HQ for the dioxin TEQ exceeded one only for the mink (1.7). Thus, PCBs and dioxin-like PCB congeners pose a risk to wildlife species along the Little Brier Creek and tributaries, especially through the consumption of contaminated prey and sediment.

The no effect and low effect HQs exceeded one for the deer mouse and robin inhabiting floodplain soils and are primarily associated with the consumption of contaminated prey. Thus, PCBs pose a risk to the deer mouse and robin inhabiting the floodplain along Little Brier Creek.

Banks of Little Brier Creek and Tributaries

The wildlife target receptors evaluated for the riparian area along the banks of Little Brier Creek and tributaries were the robin and deer mouse. The robin and deer mouse may be exposed to contaminants through the ingestion of plants, earthworms, and soil along the banks of the creek. They may also consume surface water from the creek. The potential risks to the robin and deer mouse are summarized in Table 8-24 (Appendix B).

The no effect and low effect HQs for PCBs exceeded one for both the robin and the deer mouse using both the maximum and average soil concentrations. For the maximum soil EPC, the HQ ranged from 8,700 to 870 for the robin and from 4,400 to 880 for the deer mouse. For the average soil EPC, the HQ ranged from 4,200 to 420 for the robin and from 2,100 to 430 for the deer mouse. These risks are primarily associated with the consumption of contaminated earthworms

that have bioaccumulated PCBs. The no effect and low effect HQs for the PCB congener TEQ and the dioxin/furan TEQ also exceeded one for the robin and deer mouse, again primarily through food consumption. For the maximum soil EPC, the PCB-congener TEQ HQs ranged from 190,000 to 19,000 for the robin and from 1,000,000 to 100,000 for the deer mouse. For the average soil EPC, the PCB-congener TEQ HQs ranged from 47,000 to 4,700 for the robin and 610,000 to 61,000 for the deer mouse. For the maximum soil EPC, the dioxin/furan TEQ HQs ranged from 250 to 25 for the robin and from 970 to 97 for the deer mouse. For the average soil EPC, the dioxin/furan TEQ HQs ranged from 120 to 12 for the robin and from 460 to 46 for the deer mouse. Thus, PCBs, dioxin-like PCB congeners, and dioxin/furans pose a risk to terrestrial wildlife species which may consume contaminated prey along the banks of Little Brier Creek and tributaries.

Brier Creek Reservoir and Floodplain

The wildlife target receptors evaluated for Brier Creek Reservoir and the associated floodplain were the mink, the heron, the eagle, the deer mouse, and the robin. The mink, heron, and eagle may be exposed to contaminants through the ingestion of fish and sediment. The deer mouse and robin may be exposed through the ingestion of plants, invertebrates, and soil. The potential risks to the mink, heron, eagle, deer mouse, and robin are summarized in Table 8-25.

The no effect HQs for the mink exceeded one for PCB (3.8) and the PCB congener TEQ (18). This risk is primarily associated with the consumption of contaminated prey. The low effect HQs for the mink did not exceed one for PCBs but did exceed one for PCB congener TEQ (1.8). Thus, dioxin-like PCB congeners pose a risk to the mink and PCBs pose a potential risk to the mink. The no effect HQs for the heron and the eagle equal one, indicating little to no risk to these species. The no effect HQs exceeded one for the deer mouse and robin inhabiting floodplain soils and is primarily associated with the consumption of contaminated prey. The low effect HQs for these two receptors did not exceed one, indicating a potential risk from PCBs in floodplain soil.

Brier Creek (Below Brier Creek Reservoir)

The wildlife target receptors evaluated for Brier Creek (below Brier Creek Reservoir) were the mink, the heron, and the raccoon. The mink may be exposed to contaminants through the ingestion of fish and sediment. The great blue heron may be exposed to contaminants through ingestion of fish and crayfish as well as through incidental ingestion of sediment. The raccoon may be exposed to contaminants through the ingestion of crayfish and sediment. The potential risks to the mink, heron, and raccoon are summarized in Table 8-26 (Appendix B).

The no effect HQs for the mink (6.8) and the raccoon (3.8) exceeded one for the PCB congener TEQ. This risk is primarily associated with the consumption of contaminated prey. The low effect HQs for the mink and raccoon did not exceed one. Thus, dioxin-like PCB congeners pose a potential risk to the mink and raccoon. The no effect HQs for the heron do not exceed one, indicating little to no risk to this species. The no-effect HQs for PCBs (as Aroclors) did not exceed one for any species.

Lake Crabtree and Floodplain

The wildlife target receptors evaluated for Lake Crabtree were mink, heron, eagle, deer mouse, and robin. The mink, heron, and eagle may be exposed to contaminants through the ingestion of fish and sediment. The deer mouse and robin may be exposed through the ingestion of plants, invertebrates, and soil. The potential risks to the mink, heron, eagle, deer mouse, and robin are summarized in Table 8-27. (Appendix B)

The no effect HQs for the mink exceeded one for the PCB congener TEQ (5.4 for congener TEQ and 1.2 for Aroclor 1260). This risk is primarily associated with the consumption of contaminated prey. The low effect HQs for the mink did not exceed one. The no effect and low effect HQs exceeded one for the deer mouse inhabiting floodplain soils and is primarily associated with the consumption of contaminated prey. Thus, PCBs and dioxin-like PCB congeners pose a potential risk to the mink and dioxin-like PCBs pose a potential risk to the deer mouse. The no effect HQs for the heron, eagle, and robin do not exceed one, indicating little to no risk to these species.

Crabtree Creek

The wildlife target receptors evaluated for Crabtree Creek were the mink, the heron, and the raccoon. The mink may be exposed to contaminants through the ingestion of fish and sediment. The great blue heron may be exposed to contaminants through ingestion of fish and crayfish as well as through incidental ingestion of sediment. The raccoon may be exposed to contaminants through the ingestion of crayfish and sediment. The potential risks to the mink, heron, and raccoon are summarized in Table 8-28.

The no effect HQs for the mink (1.6) and heron (1.9) exceeded one for the PCB congener TEQ. The no effect HQ for the heron (2.2) exceeded one for PCBs. This risk is primarily associated with the consumption of PCB-contaminated prey by the mink and heron and consumption of sediment by the heron. The low effect HQs for the mink and heron did not exceed one. Thus, dioxin-like PCB congeners pose a potential risk to the mink and heron, and PCBs pose a potential risk to the heron. The no effect HQs for the raccoon do not exceed one, indicating little to no risk to this species.

While sediment samples collected from Crabtree Creek in 2003/2004 were all below their respective SQLs, the congener PCB TEQs were calculated using one-half the detection limit for those congeners detected in upstream sediment samples. Sediment samples collected in 2005 and 2006 were analyzed using low level methods, resulting in detection limits that were up to two orders of magnitude lower than the detection limits for the 2003 and 2004 samples. In Crabtree Creek, the maximum PCB TEQ for the 2006 samples was 0.02 ng/kg while the maximum concentration for the 2003/2004 samples was 250 ng/kg. Thus, the actual concentrations of PCB congeners in Crabtree Creek sediments may be lower, resulting in lower risk from sediment ingestion by the heron.

8.2.8 Conclusion Summary

The BERA was prepared to evaluate the ecological risks associated with site-related contamination in off-site surface water bodies downstream of the Ward Transformer facility. Results of the BERA indicate that the maximum concentrations detected in a variety of environmental media are at levels that are likely to pose risk to ecological receptors utilizing the affected areas. Potentially unacceptable levels of risk to benthic organisms, fish, and aquatic organisms were estimated in Little Brier Creek and tributaries. The impacted bank sediments also pose a risk to terrestrial receptors that forage along the creek.

Although PCB concentrations in fish and crayfish in the upper reaches of the Little Brier Creek watershed are higher, whole body samples of fish from the Lake Crabtree and Crabtree Creek also indicate uptake of PCBs; demonstrating that the surface water/sediment exposure pathway is complete and current contaminant concentration may pose risk to fish-eating mammals and/or birds. The BERA concluded that there is a limited potential for risk to carnivorous birds and mammals foraging in Brier Creek Reservoir, Brier Creek, Lake Crabtree, and Crabtree Creek due predominantly to the consumption of aquatic biota containing PCBs. The hazard quotient (HQ) analysis also indicated limited risk to benthic organisms, fish, and aquatic invertebrates in these water bodies.

The documented and potential presence of threatened and/or endangered species within the impacted watershed requires additional consideration. The state endangered Atlantic pigtoe mussel and the state threatened squawfoot mussel have been reported in the nearby Umstead State Park, which is part of the Crabtree Creek watershed. These species could potentially be present in the unnamed tributary to Little Brier Creek. In addition, endangered bald eagles are nesting at Lake Crabtree and foraging at Lake Crabtree and Brier Creek Reservoir. The presence of threatened or endangered species could affect potential remedial alternatives considered for the Site. If remedial actions are planned for stream sediments, a mussel survey should be conducted to determine if endangered mussel species are present in the unnamed tributary to Little Brier Creek. If endangered species are present, potential impacts associated with remediation will require evaluation for measures to minimize or eliminate such impacts.

9.0 REMEDIAL ACTION OBJECTIVES

Based upon the findings of the RI, community and stakeholder input, and associated human health and ecological baseline risk assessments, the following Remedial RAOs were identified for OU1:

- Minimize potential downstream migration of PCB-contaminated soil and sediment.
- Reduce PCB levels in fish tissue to levels that allow for unlimited consumption.

Human Exposure:

Eliminate or minimize potential risks to human health due to consumption of contaminated fish from Brier Creek Reservoir, Lake Crabtree, and Lower Crabtree Creek.

- Eliminate or minimize human exposure to consumption of contaminated fish from Brier Creek Reservoir, Lake Crabtree, and Lower Crabtree Creek, by reducing PCB concentrations in fish tissue to levels that allow for unlimited consumption.

Eliminate or minimize potential human exposure from direct contact with contaminated sediment and floodplain soil in Reaches B, C, and D, and lower Brier Creek by reducing the PCB concentrations to a protective level.

Ecological Exposure:

- Eliminate or minimize potential risks to ecological receptors due to consumption of contaminated fish from Reach B, Reach C, Reach D, lower Brier Creek, Brier Creek Reservoir, Lake Crabtree, and Lower Crabtree Creek, by reducing PCB concentrations in fish tissue to levels that allow for unlimited consumption.

- Eliminate or minimize potential risks to ecological receptors due to direct contact with contaminated sediment and floodplain soil in Reaches B, C, and D, and lower Brier Creek y reducing the PCB concentration to a protective level.

In the ecological risk assessment , risk-based remediation goals for ecological receptors were calculated for the tributary to Little Brier Creek, Little Brier Creek, and Brier Creek Reservoir; the areas where most of the ecological risks were identified. Based on these ecological goals, it was determined that the human health RAOs for direct contact with sediment and fish consumption would also be protective of the primary ecological receptors (i.e., bald eagles, herons, raccoons, and mink). Therefore, once the PCB concentrations protective of human health are attained in sediment and fish tissue, the ecological risk goals should also be met. Consequently, from this point forward the primary factors driving the OU1 remediation is the human health risks associated with fish consumption and dermal contact with PCB contaminated sediment.

9.1 Remediation Goals

Based on the risk assessment conclusions, there are two distinct risks to humans from PCBs within OU1. The first is the exposure to PCBs in sediments and flood plain soil through direct human contact in Reaches B, C, and D, and lower Brier Creek. The second risk is associated with consumption of fish from Brier Creek Reservoir, Lake Crabtree, and lower Crabtree Creek. The State of North Carolina is expected to lift current fish consumption advisories in the future once PCB concentrations in fish drop to acceptable levels. Because attaining PCB levels acceptable

for fish consumption is typically more stringent and much more difficult to achieve than PCB levels in sediments, fish consumption was considered as the primary driving factor for developing Remediation Goals (RG) and remedial action alternatives for OU1.

During the development of cleanup goals for OU1, two distinct areas were addressed separately because of their use scenarios and physical nature. The first area consists of Reaches B, C, and D, and lower Brier Creek (between the Brier Creek Reservoir and Lake Crabtree). These are streams with dimensions varying from 8 to 30 ft in width and from 3 to 6.5 ft in bank height. The small size and depth of the streams (Reaches B, C, and D) located upstream of the impoundment by the Brier Creek Reservoir Dam limit their use as a recreational fishery. The water bodies in the second area consist of lower Crabtree Creek and the surface water impoundments within OU1 (located downstream of Reach D), Brier Creek Reservoir and Lake Crabtree. These areas support fishing activities.

Remediation Goal for Sediment and Floodplain Soil along Reaches B, C, and D and Lower Brier Creek

Potential OU1 remedial action cleanup goals for PCB-contaminated sediments in Reaches B, C, and D and in lower Brier Creek were evaluated as part of the Feasibility Study. Of the potential sediment/soil cleanup goals evaluated, 1 mg/kg was selected as the final sediment/soil cleanup goal for these areas of OU1, based on the following reasons:

- 1 mg/kg was determined to be protective for risk scenarios involving human contact with sediment and flood plain soil in B, C, D, and lower Brier Creek.

- A Geographic Information System (GIS) computer model, EPA's Pollutant Load Application (PLOAD) model, was employed to estimate sediment loads and PCB sediment concentrations entering Lake Crabtree and Brier Creek Reservoir from their respective watersheds. Results from model scenarios indicated that a 1 mg/kg cleanup goal for sediment in Reaches B, C, D, and lower Brier Creek combined with clean (no detected PCBs) sediment from upstream portions of the upper Brier Creek and Little Brier Creek watersheds would result in sediment loads entering Brier Creek Reservoir and Lake Crabtree at a PCB concentration in the low ppb range (less than 10 ppb). As discussed below, PCB concentrations in sediments at both the Brier Creek Reservoir and Lake Crabtree would need to be reduced to less than 10 ppb to reach the North Carolina risk-based fish tissue goal of 0.05 mg/kg for unlimited fish consumption.

- 1 mg/kg was previously selected as the sediment and floodplain soil cleanup goal for Reach A under the ongoing removal action.

Remediation Goal for Fish at Reaches B, C, and D, Brier Creek Reservoir, Lower Brier Creek Lake Crabtree and Crabtree Creek

The goal is to attain edible fish tissue concentrations that would allow current fish consumption advisories for these water bodies to be lifted in the future. There are no established regulatory criteria or standards for PCBs in sediments associated with fish consumption. However, the

North Carolina Division of Public Health has established fish consumption advisory levels for contaminants found in fish tissue. For PCBs, the maximum allowable PCB concentration in fish tissue is 0.05 mg/kg. At levels greater than 0.05 mg/kg, fish consumption advisories that limit consumption of fish may be issued by the State.

Biota-to-Sediment Accumulation Factors (BSAFs) calculations were employed to estimate the maximum allowable PCB concentrations in sediments at the Brier Creek Reservoir and Lake Crabtree necessary to achieve the North Carolina fish consumption advisory level of 0.05 mg/kg in fish for unlimited fish consumption. Using this target value as an input parameter in conjunction with the site-specific BSAFs derived from fish tissue PCB and lipid data and sediment PCB and total organic carbon data, maximum allowable sediment concentrations were estimated for several different fish species, including largemouth bass, catfish, and sunfish. The results indicated that PCB concentrations in sediments at both the Brier Creek Reservoir and Lake Crabtree would need to be reduced to the low-ppb range (i.e., less than 10 ppb) to reach the risk-based fish goal. But, regardless of low the sediment concentration would get, the risk-based fish goal for PCB is 0.05 mg/kg.

10.0 DESCRIPTION OF ALTERNATIVES

As required in the NCP, remedial alternatives were developed and remedial technologies were screened for effectiveness, implementability and cost. After screening, the remedial alternatives described in this section were retained for evaluation. More details about the alternatives and evaluation process are described in the Feasibility Study (FS) report. The FS report is part of the administrative record for the Site.

Alternative 1 – No Action

- ***Assumes no action to be taken.***
- ***Conduct five-year reviews.***

The No Action alternative is evaluated as required by law to serve as a baseline for other alternatives. Under the No Action alternative, no remedial actions would be implemented at the Site. The existing site conditions would continue to remain in place without any active remediation technologies or institutional controls. Risks posed by PCB contamination under future scenarios would likely remain for an extended period of time.

Although the State of North Carolina has already issued fish consumption advisories, and EPA, the State of North Carolina, and Wake County, have fish consumption signs already in place; for the purpose of this evaluation, it is assumed that the fish advisories and signs are not part of the No Action alternative. The No Action alternative would only include a review of the remedy every 5 years for 30 years (five year reviews). The cost included is for conducting the five year reviews.

Capital Costs:	$ 0
O & M Costs (Present Worth):	$ 280,000
Contingency Costs:	$ 42,000
Total Present Worth Costs:	$ 322,000
Duration to Finish Construction:	Immediate

Alternative 2 - Institutional Controls

- ***Continue or enhance existing North Carolina fish consumption advisories and signs.***

Under this alternative, the North Carolina fish consumption advisories and signs would continue to remain in effect. The continued implementation of fish advisories and signs would reduce the potential risks to humans through fish consumption.

- ***Implement educational and community outreach programs.***

Community outreach and public educational programs would be developed and implemented to inform the public of the risks associated with fish consumption. This would include posting fish advisories signs, conducting meetings, distributing pamphlets, etc. These efforts would focus on groups such as sports fisherman and local communities that rely on fish consumption for part of their diet.

- ***Conduct five-year reviews.***

Five-year reviews will also be conducted as required by CERCLA.

Capital Costs:	$ 0
O & M Costs (Present Worth):	$ 414,000
Contingency Costs:	$ 62,000
Total Present Worth Costs:	$ 476,000
Duration to Finish Construction:	Immediate

Alternative 3 - Monitored Natural Recovery (MNR) and Institutional Controls

- Continue or enhance existing North Carolina fish consumption advisories and signs.
- Implement educational and community outreach programs.
- Conduct five-year reviews.

Under Alternative 3 the components of Alternative 2 would be implemented in addition to MNR would be used to document achievement of the RAOs for OU 1.

- ***MNR and periodic monitoring of sediment and aquatic biota.***

MNR is a sediment remedy that uses ongoing naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment, thereby reducing potential risks to human and/or ecological receptors. MNR is especially effective at sites such as this where the main source of contamination would be removed (on-going removal action at Reach A and the Ward Transformer facility).

Current levels of PCBs in sediment samples within OU1 are low enough that continued burial, dispersion, and mixing-in-place alone would reduce the PCB concentrations in sediment significantly, even without the destruction or transformation of PCBs.

An MNR sampling program would be developed and implemented in accordance with EPA sediment guidance for evaluating Natural Recovery remedies, to document lines of evidence of natural recovery at this Site. Periodic monitoring of sediment would be conducted to enable assessment of PCB concentrations in sediment over time. In addition, monitoring of aquatic biota (fish sampling) would be conducted to support future decisions regarding fish consumption advisories, and protection to ecological receptors.

Capital Costs:	$ 0
O & M Costs (Present Worth):	$ 1,954,000
Contingency Costs:	$ 293,128
Total Present Worth Costs:	$ 2,247,000
Duration to Finish Construction:	Immediate
Estimated Time to Achieve RAOs:	More than 30 years

Alternative 4 – Excavation and Off-Site Disposal of Sediment from Reaches B, C, D, and Lower Brier Creek; MNR in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek; and Institutional Controls

- ***Continue or enhance existing North Carolina fish consumption advisories and signs.***
- ***Implement educational and community outreach programs.***
- ***Conduct Five-year reviews.***

Under Alternative 4, the components of Alternative 2 would be implemented in addition to MNR of sediments in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek; excavation and off-site disposal of PCB contaminated sediment from Reaches B, C, D and Lower Brier Creek; conduct a pre-excavation sampling program and an endangered mussel study; excavation and off-site disposal of PCB contaminated sediment from Reaches B, C, D, and Lower Brier Creek; and, conduct periodic monitoring of sediment and aquatic biota.

- ***MNR in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek***

Like Alternative 3 MNR would be a component of this alternative to reduce PCB levels in sediment. However, it would only apply to sediment in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek.

- ***Conduct pre-excavation sampling of sediment and endangered mussel study.***

A pre-excavation sediment sampling program would be conducted to more accurately define the limits of excavation areas along Reaches B, C, D, and lower Brier Creek. In addition a mussel survey would also be conducted to determine if threatened/endangered mussel species are present in the selected excavation areas.

- ***Excavate sediment from Reaches B, C, D and lower Brier Creek, and transport sediments off-site for appropriate disposal.***

Based on the results of the pre-excavation sampling program, sediment with PCB concentrations above 1 mg/kg would be excavated from Reaches B, C, D, and lower Brier Creek. Sediment would be disposed off-site in the appropriate landfill.

Precautions will be taken to minimize any impact on identified local endangered and threatened species. Also, activities will be conducted in accordance with the laws and regulations associated with floodplain management, protection of wetlands, preservation of historic and archaeological landmarks, construction, and erosion and sediment control.

- ***Restore site and stream to pre-remediation conditions.***

Stream restoration would be performed once the contaminated sediment is removed.

- ***Conduct periodic monitoring of sediment and aquatic biota.***

Periodic monitoring of sediment would be conducted to enable assessment of PCB concentrations in sediment over time. In addition, monitoring of aquatic biota (fish sampling) would support future decisions regarding fish consumption advisories and protection of ecological receptors.

Capital Costs:	$ 3,080,000
O & M Costs (Present Worth):	$ 1,258,000
Contingency Costs:	$ 651,000
Total Present Worth Costs:	$ 4,989,000

Estimated Construction Timeframe:	5 months
Estimated Time to Achieve RAOs:	14 years after construction is completed

Alternative 5 - Excavation of Sediment in Reaches B, C, D, and Lower Brier Creek; Excavation/Dredging of Sediment from Brier Creek Reservoir and Lake Crabtree; Off-Site Disposal of Sediment/Soil; MNR in Lower Crabtree Creek and Institutional Controls

- Continue or enhance existing North Carolina fish consumption advisories and signs.
- Implement educational and community outreach programs.
- Conduct Five-year reviews.
- Conduct periodic monitoring of sediment and aquatic biota.
- Conduct pre-excavation sampling of sediment and endangered mussel study.
- Excavate sediment from Reaches B, C, D, and lower Brier Creek, and transport sediment off-site for appropriate disposal.
- Restore site and stream to pre-remediation conditions.
- *MNR in Lower Crabtree Creek*

Alternative 5 includes all the components of Alternative 4 in addition to dredging sediment from Brier Creek Reservoir and Lake Crabtree, and transport sediment off-site for appropriate disposal. MNR in this alternative would only be implemented in Lower Crabtree Creek.

- ***Dredge sediment from Brier Creek Reservoir and Lake Crabtree, and transport sediment off-site for appropriate disposal.***

In this alternative sediment in the Brier Creek Reservoir and Lake Crabtree would be dredged and transported off-site for disposal.

PCB levels detected in Brier Creek Reservoir and Lake Crabtree are already in the low part per million (ppm) ranges. Therefore, for the purpose of this alternative, it is it is assumed that all of the sediment in Brier Creek Reservoir and Lake Crabtree would have to be removed to ensure that the availability of very low PCB levels is completely eliminated for ecological receptors.

Precautions will be taken to minimize any impact on identified local endangered and threatened species. Also, activities will be conducted in accordance with the laws and regulations associated with floodplain management, protection of wetlands, preservation of historic and archaeological landmarks, construction, and erosion and sediment control.

Capital Costs:	$ 468,910,000
O & M Costs (Present Worth):	$ 1,509,000
Contingency Costs:	$ 70,563,000
Total Present Worth Costs:	$ 540,982,000

Estimated Construction Timeframe:	3 years
Estimated Time to Achieve RAOs:	12 years after construction is completed

11.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, each alternative is assessed using nine evaluation criteria required under the NCP (NCP§300.430 (f)(5)(i)). Comparison of the alternatives with respect to these evaluation criteria is presented in summary form in the text of this section.

The NCP Criteria

Each alternative is evaluated using the nine criteria below:

1. Overall protection of human health and the environment
2. Compliance with Applicable or Relevant and Appropriate Requirements
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume through treatment
5. Short-term effectiveness
6. Implementability.
7. Cost.
8. State/support agency acceptance
9. Community acceptance.

The required nine evaluation criteria above serve as the basis for conducting a comparative detailed analysis and selecting the remedy. The comparison is summarized by evaluation criteria in the next paragraphs.

1. **Overall Protection of Human Health and the Environment** - Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

Alternative 1 would not be protective of human health or the environment because there are no actions to reduce or prevent exposure to contamination at OU 1. As such Alternative 1 is eliminated from consideration under the remaining eight criteria.

Alternative 2 and 3 would be more protective than Alternative 1 because implementation of fish advisories and signs reduce human exposure to contaminated fish. In addition through educational and community outreach programs the public is informed about the fish consumption advisories and the risks of consuming PCB-contaminated fish.

Alternatives 4 and 5 are more protective of the human health and the environment than Alternative 3, because these alternatives remove contaminated sediment with concentrations above 1 mg/kg from Reaches B, C, D, and lower Brier Creek, therefore reducing potential exposure to sediments with concentrations above this level. Modeling results show that

excavating sediment with PCB concentrations above 1 mg/kg from Reaches B, C, D, and lower Brier Creek will accelerate the natural recovery processes in sediment at Brier Creek Reservoir and Lake Crabtree.

Alternative 5 provides the greatest overall protection to human health and the environment because it would also remove contaminated sediment in Brier Creek Reservoir and Lake Crabtree. As a result, the time required to achieve the fish tissue PCB concentrations after completion of planning and construction activities may be less than the timeframe required in Alternative 4. However, due to the complexity of Alternative 5, the total time required for planning, design and implementation of this alternative would be considerable greater than Alternative 4.

With regards to protection of the environment, Alternative 3 may take a long time to achieve clean up goals. Alternatives 4 and 5 will achieve clean up goals in a shorter period of time than Alternative 3, but would destroy/disturb the habitat and aquatic biota in segments of the remediated streams in Alternatives 4 and 5, and the reservoir and lake areas in Alternative 5. Alternative 5 could also adversely impact threatened bald eagles foraging and breeding in the reservoir and lake areas. Therefore, the benefits of removing sediments must be weighed against the disruption or destruction of aquatic and biota habitats in and around the streams.

2. **Compliance with ARARs** - Section 121(d) of CERCLA and NCP section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Alternative 2 would not meet the Chemical-specific ARARs because institutional controls prevent or minimize exposure, however, they do not reduce contamination to remediation goals

In Alternative 3, the chemical-specific ARAR of 1 mg/kg for PCBs may be met in the long-term for sediments in Reaches B, C, D, and lower Brier Creek through natural recovery processes. In Alternatives 4 and 5, chemical-specific ARARs of 1 mg/kg for sediments in Reaches B, C, D and lower Brier Creek will be met after excavation activities are completed.

Action-specific ARARs are not relevant for Alternatives, 2, and 3 because there are no active remedial actions associated with these alternatives. In Alternatives 4 and 5, all applicable action-specific ARARs would be met during the remedial actions. Measures will be taken to minimize any dust during excavation activities. In addition, for Alternative 5, any NPDES permit requirements will be met, if water from dewatering operations requires treatment prior to being discharged.

Location-specific ARARs are not relevant for Alternatives, 2, and 3 because there are no active remedial actions associated with these alternatives. In Alternatives 4 and 5, applicable location-

specific ARARs would be met. Precautions will be taken to minimize any impact on identified local endangered and threatened species. Also, activities will be conducted in accordance with the laws and regulations associated with floodplain management, protection of wetlands, preservation of historic and archaeological landmarks (Umstead Park), construction, and erosion and sediment control.

3. **Long-term Effectiveness and Permanence** - Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

In Alternatives 2, 3, 4 and 5, potential risks associated with fish consumption are expected to be lower because of the fish consumption advisories and signs.

In Alternative 3, risks to humans and the environment are expected to gradually decrease over time with the reduction of PCB concentrations in sediment through natural processes and will be documented by a long term monitoring program. PCB concentrations in fish are also expected to decline with the decrease of PCB concentrations in sediment.

In Alternatives 4 and 5, the removal of sediments to levels below 1 mg/kg PCB from Reaches B, C, D, and lower Brier Creek will reduce any potential risks associated with sediment exposure. In Alternative 4, once the sediments with PCB concentrations above 1 mg/kg are removed from these areas, the natural recovery process of Brier Creek Reservoir, Lake Crabtree, and beyond would speed up.

In addition to sediment removal from the streams, Alternative 5 would also remove sediments in Brier Creek Reservoir and Lake Crabtree. As a result, the time required to achieve acceptable fish tissue PCB concentrations after completion activities may be less than the timeframe required in Alternative 4. However, due to the complexity of Alternative 5, the total time required for planning, design and implementation of this alternative would be considerable greater than Alternative 4

In Alternative 5, if dredging is used, due to technology limitations, some dredging residuals levels will remain in the reservoir and lake, including low levels of PCB contamination in the biologically active sediment zone. PCBs in dredging residuals could impact fish concentrations in the reservoir and lake for many years after completion of the dredging operations.

In addition, the large-scale excavation/dredging operations in Brier Creek Reservoir and Lake Crabtree in Alternative 5 will disturb or destroy benthic and other aquatic biota and habitats in the reservoir and the lake. The dredging/excavation activities of Alternative 5 could adversely impact threatened bald eagles within the reservoir and lake areas for foraging and breeding. Over the long term, re-establishments of these habitats may be difficult.

4. **Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment** refers to the anticipated performance of the treatment technologies that may be included as part of the remedy.

EPA will use treatment to address site contaminants wherever practicable; however, because of the relatively low levels of PCBs in the sediments within OU1, treatment is not proposed for any of the alternatives. Therefore the statutory preference for treatment is not met.

5. **Short-term Effectiveness** addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

Alternatives 2 and 3 do not involve any active remedial action; therefore, they would not pose any additional risks to the community or workers during implementation, nor would they result in any adverse environmental impacts.

In Alternative 3, under current conditions (assuming that the Removal Action at the Ward Transformer facility and Reach A is completed before commencement of OU1 activities), modeling indicates that PCB concentrations in sediments at Brier Creek Reservoir and Lake Crabtree may take more than 30 years to decline to levels that correspond to acceptable PCB levels in fish.

In Alternatives 4 and 5, the potential for additional risks to the community may exist due to dust and excessive noise from the construction of access roads, construction equipment, and vehicular traffic to the off-site disposal facility. Risks to the community will be minimized by establishing buffer zones around the work areas, limiting work hours, and using dust-suppressing techniques. Risks to the environment may include clearing of vegetation and trees for access roads and excavation/dredging equipment. Measures will be taken to minimize the impact on the environment by avoiding the wetlands and floodplain areas to the extent possible. There will be adverse impacts to the stream and lake habitats due to the sediment removal activities, especially for benthic and other aquatic organisms. Many of these organisms may be disturbed or destroyed during the excavation/dredging activities. The presence or absence of threatened or endangered mussel species needs to be established prior to commencing intrusive activities. If threatened or endangered mussel species are identified, additional safeguards will need to be put into place to protect these species. In addition, the potential for adverse impacts to threatened bald eagles utilizing areas within OU1 as foraging and breeding habitat exists and precautions would be required to minimize these potential impacts. Due to the larger extent and complexity of excavation/dredging activities associated with Alternative 5, all the above-mentioned impacts will be much greater for Alternative 5 than Alternative 4.

In Alternative 4, the estimated time required to complete the remediation work is 3 to 5 months. The estimated time required to attain acceptable PCB concentrations in fish tissue at the Brier

Creek Reservoir is approximately 14 years. The time required to attain acceptable PCB concentrations in fish tissue at Lake Crabtree is approximately 9 years.

Due to the complexity of Alternative 5, it is estimated that planning, design and implementation of this alternative would require a considerably greater amount of time than Alternative 4. In addition, it is estimated that any dredging activities associated with Alternative 5 would take at least 3 years to complete after all design and planning documents are completed.

In Alternative 5, the estimated time required to attain acceptable PCB concentrations in fish tissue at the Brier Creek Reservoir is approximately 12 years after the completion of excavation/dredging. The time required to attain acceptable PCB concentrations in fish tissue at Lake Crabtree is expected to be 8 years.

As a result, removing larger amounts of sediments in Alternative 5 does not necessarily correspond to a shorter amount of time to achieve clean up goals than in Alternative 4.

6. **Implementability** addresses the technical and administrative feasibility of the remedy from design to construction and operation. Factors such as the relative availability of services and materials, administrative feasibility, and coordination with other government entities are also considered.

Alternatives 1, 2, and 3 can be easily implemented because there is no construction, involved. Alternatives 1 and 2 can be easily implemented because there are no monitoring activities.

In Alternatives 2, 3, 4 and 5, the North Carolina fish consumption advisories and signs are already in place although additional advisories and signs may be necessary. In Alternatives 3, 4 and 5, reduction in PCB concentrations in sediment and fish will be determined through the periodic monitoring program, which can be easily implemented.

Alternative 4 is technically feasible to implement. Contractors are readily available for construction of access roads, excavation, and off-site disposal. Coordination with other agencies and obtaining approvals and permit equivalencies for excavation, transport of excavated materials, etc. will be required.

The implementation of Alternative 5 is much more complex and difficult than Alternative 4, and it will require much more time. In addition to all the components that are included in Alternative 4, dredging of sediments at Brier Creek Reservoir and Lake Crabtree is included in Alternative 5. Dredging is a specialized technology, which requires advanced planning, selection of the proper dredging method, and detailed remedial design. Dewatering and treatment of water are also significant design and cost components of the dredging alternative.

During the implementation of Alternatives 4 and 5, a pre-remediation mussel study will be conducted to determine if the endangered/threatened species exists in the streams to be

excavated. Consultation with the respective federal and state agencies will be required prior to the commencement of the excavation activities.

Some portions of OU1 consist of wetlands and floodplains. Coordination with federal agencies will be required to ensure that the impact on these areas will be minimal. Threatened bald eagles nest at Lake Crabtree and forage at Lake Crabtree and Brier Creek Reservoir. State endangered/threatened mussel species have been reported in the nearby Umstead State Park, which is part of the Crabtree Creek watershed.

The Crabtree Creek Recreational Demonstration Area (Umstead State Park) is a historical site listed in the National Register of Historic Places. Precautionary measures will be taken to minimize harm to historic property to the extent practicable during remedial actions conducted in this area and in the vicinity. Consultation with federal and state historic and archeological agencies will be necessary before initiating any activities in the vicinity of this area.

7. **Costs** include estimated capital and annual operations and maintenance (O&M) costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. A discount rate of 4 % was assumed for O&M cost.

There are no capital costs associated with Alternative 1. However, 5-year reviews will be conducted, as required by CERCLA. For costing purposes, it is assumed that 5-year reviews would be conducted for 30 years.

For Alternative 2, in addition to the 5-year review, yearly operation and maintenance costs for community outreach and educational programs are included for 30 years. The estimated cost of implementing new advisories and signs and maintaining existing or new advisories and signs has also been included. For Alternative 3, all the costs in Alternative 2 plus yearly MNR monitoring costs are included for 30 years.

Alternative 4 includes the same costs associated with Alternative 3 plus the capital costs associated with excavation and off-site disposal of sediment from Reaches B, C, D, and lower Brier Creek (because remedial actions would last for less than 6 months, there are no recurring costs associated with this alternative). Capital costs of remediation include pre-remediation sampling, mobilization/demobilization, construction of access roads, temporary staging areas, excavation, off-site transport and disposal, and site restoration.

For Alternative 5, in addition to the costs associated with Alternative 4, dredging and off-site disposal of sediments in Brier Creek Reservoir and Lake Crabtree are included. There are additional components related to dredging operations, for example, dewatering and effluent treatment.

For Alternatives 4 and 5, the MNR monitoring costs were included for only 15 years, because it is expected that the clean up levels would be met in less than 15 years.

The estimated present-worth costs for the remedial alternatives are summarized below:

Alternative 1: $ 332,000
Alternative 2: $ 476,000
Alternative 3: $ 2,247,000
Alternative 4: $ 4,989,000
Alternative 5: $ 540,982,000

Alternative 5 would be extremely expensive, considering the large volume of sediments to be removed. According to modeling results, the time difference in achieving the clean up levels associated with fish consumption in Alternative 4 and 5 is only a few years. But due to the complexity of Alternative 5, it is estimated that planning, design, and implementation of this alternative would require a considerably greater amount of time than Alternative 4. Therefore, removing a larger amount of sediments does not necessarily correspond to a shorter amount of time to achieve clean up goals. Based on the foregoing, it would be far more cost-effective to consider Alternative 4 over Alternative 5.

The detailed costs estimates are presented in the OU1 Feasibility Study report.

8. **State/Support Agency Acceptance** considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

The Superfund Division of NC DENR (North Carolina Department of Environment and Natural Resources) reviewed all site-related documents and provided EPA with comments. NC DENR reviewed the Proposed Plan Fact Sheet, attended the Proposed Plan public meeting that was held in Raleigh on August 14, 2007, and reviewed a draft version of this ROD. The State concurs with the Selected Remedy. A copy of the concurrence letter is included in Appendix C.

9. Community Acceptance

The RI/FS report and Proposed Plan for the Ward Transformer Superfund Site were made available to the public in August 2007. They can be found in the Administrative Record file and the information repository maintained in the EPA Docket Room at EPA Region 4 in Atlanta, Georgia, and at the North Regional Public Library in Raleigh, North Carolina. The notice of availability of these two documents was published in the Durham Herald on August 6, 2007, and the Raleigh News and Observer on August 8, 2007. A public comment period was held from August 6, 2007, to September 4, 2007. An extension to the public comment period was requested. As a result, the comment period was extended to October 4, 2007. In addition, a public meeting was held on August 14, 2007, to present the proposed plan to a broader community audience than those that had already been involved at the site. At this meeting, representatives from the EPA and NC DENR answered questions about the Site and the remedial

alternatives. EPA's response to the comments received during this period is included in the Responsiveness Summary.

12.0 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to ground water, surface water, or air, or acts as source for direct exposure. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur. While PCBs are considered to be toxic, the main source material or principal threat waste (contaminated soil at the Ward Transformer facility) is being addressed under a time-critical removal using excavation and on-site thermal desorption treatment. Principal threat wastes are not present in this OU and therefore are not addressed by this action.

13.0 SELECTED REMEDY

13.1 Remedy Description

The Selected Remedy is a modified Alternative 4. Alternative 4 was modified as described in Section 15 of this ROD. The Selected Remedy includes the following components:

- Continue or enhance existing North Carolina fish consumption advisories and signs.
- Implement educational and community outreach programs.
- Conduct pre-excavation sampling of sediment and floodplain soil.
- Conduct a pre-excavation endangered mussel evaluation study.
- Excavate sediment/soil from Reaches B, C, D, and lower Brier Creek, and transport sediment/soil off-site for appropriate disposal.
- Restore site and stream to pre-remediation conditions.
- Implement Monitor Natural Recovery (MNR) in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek.
- Conduct periodic monitoring of sediment and aquatic biota.
- Implement Institutional Controls.
- Conduct Five-year reviews.

A description of each component is provided below:

- ***Continue or enhance existing fish consumption advisories and signs.***

Fish consumption advisories and signs would continue to be in place until PCB concentrations in fish are below the remediation goal (0.05 mg/kg). This component of the remedy would also include the implementation and posting of additional fish consumption advisories and signs, or any modifications to the existing ones, as needed. The continuance or enhancement of fish advisories and signs would help reduce the potential risks to humans through fish consumption.

- ***Implement educational and community outreach programs.***

Educational and community outreach programs would be developed and implemented to inform the public of the fish consumption advisories. These activities would include conducting meetings, interviews, surveys, etc.; and distribution of pamphlets or any other information material, etc. These activities should be focused on groups such as sports fishermen and local communities that commonly rely on fish consumption for part of their diets.

As part of the remedial design, an implementation plan to comply with this component of the remedy would be developed. Coordination between the appropriate stakeholders would be necessary to develop and implement this plan. The plan would define the goals, roles, duties and responsibilities of the parties involved and the means used to achieve or enforce the intended goals. Educational and community outreach programs would continue until remediation goals are achieved.

- ***Conduct pre-excavation sampling of sediment and floodplain soil.***

A pre-excavation floodplain soil and sediment sampling program would be developed and implemented. The PCB concentrations of sediment/soil samples collected at specific locations in prior years may not represent the PCB concentrations at the time when remediation commences due to the dynamic nature of stream sediments/soil and due to naturally occurring processes. In addition, floodplain soil and sediment samples would be required to accurately delineate the extent of PCB contamination prior to the commencement of remedial actions. Floodplain soil and sediment sampling for PCBs may be conducted along transects (three locations per transect) at 50-foot intervals along the length of Reaches B, C, and D, and at 100-foot intervals along the lower Brier Creek. Based on the results of this sampling program, excavation areas would be defined.

- ***Conduct a pre-excavation endangered mussel evaluation study.***

A mussel survey and evaluation study would be conducted to determine if threatened/endangered mussel species are present in the areas selected for remediation.

- ***Excavate sediment/soil from Reaches B, C, D, and lower Brier Creek, and transport sediment/soil off-site for appropriate disposal.***

Based on the results of the pre-excavation sampling program, sediments and flood plain soil from Reaches B, C, D, and lower Brier Creek will be excavated to levels below 1 mg/kg. Excavated sediments/soil will be transported and properly disposed of off-site. An excavation verification plan will be developed as part of the Remedial Design. Verification samples will be collected to ensure the 1 mg/kg remediation goal is achieved.

Prior to the excavation of stream sediments, sections of the stream flow could be blocked off and water could be bypassed through pipes running parallel to the blocked stream section. Major activities associated with this alternative would include stream diversion, construction of access roads to transport equipment and haul excavated material, excavation of sediments/soil, construction of temporary staging areas, transport excavated sediment/soil off-site to be disposed properly, and conduct verification sampling.

Precautions would be taken to minimize any impact on identified local endangered and threatened species. Also, activities would be conducted in accordance with the laws and regulations associated with floodplain management, protection of wetlands, preservation of historic and archaeological landmarks, construction, and erosion and sediment control.

- ***Restore site and stream to pre-remediation conditions.***

All disturbed areas would be restored to pre-remediation conditions. This includes replenishment of areas where sediment and soil was removed, restoration of areas that were disturbed during remediation activities, including temporary staging areas, and areas cleared for access roads.

- ***Implement Monitor Natural Recovery (MNR) in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek.***

Monitor Natural Recovery, which allows natural processes to achieve remediation goals would be implemented in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek. MNR is a sediment remedy that uses ongoing naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants in sediment, thereby reducing potential risks to human and/or ecological receptors.

Periodic monitoring of sediment would be conducted to assess PCB concentrations in sediment over time. In addition, monitoring of aquatic biota (fish sampling) would be conducted to support future decisions regarding fish consumption advisories. An MNR sampling program would be developed and implemented in accordance with EPA sediment guidance for evaluating Natural Recovery remedies to document lines of evidence of natural recovery in sediment. MNR would be conducted until remediation goals are achieved.

- ***Conduct periodic monitoring of sediment and aquatic biota.***

Periodic monitoring of sediment and aquatic biota (fish sampling) would be conducted. A monitoring program would be developed to assess the remedy and support future decisions regarding fish consumption advisories and protection of ecological receptors. Periodic monitoring would be conducted until remediation goals are achieved.

- ***Implement Institutional Controls.***

Institutional Controls would be implemented to ensure the integrity and protectiveness of the remedy. Continue or enhance existing fish consumption advisories and signs was identified as an institutional control measure appropriate for the Site. Other institutional control measures might be identified and implemented.

- ***Conduct Five-year reviews.***

Five-year reviews would be conducted to evaluate the implementation and performance of the Selected Remedy, and in order to determine if the remedy continues to be protective of human health and the environment. Five year reviews would be conducted as required under CERCLA.

13.2 Summary of the Rationale for the Selected Remedy

The Selected Remedy is protective of the human health and the environment because removes PCB contaminated sediment with concentrations above 1 mg/kg from Reaches B, C, D, and lower Brier Creek, therefore reducing potential exposure to contaminated sediment. In addition the Selected Remedy would remove any flood plain soil with PCB concentrations above 1 mg/kg along Reaches B, C, D, and lower Brier Creek, which would reduce potential exposure to contaminated soil, and would eliminate another potential source of PCB.

The Selected Remedy uses Monitor Natural Recovery (MNR) which would allow natural processes to achieve remediation goals in Brier Creek Reservoir, Lake Crabtree and Lower Crabtree Creek. The remedy would reduce the bioavailability of contaminants in sediment, thereby reducing potential risks to ecological receptors. MNR is especially effective at sites such as this one where the main source of contamination would be removed and current levels of PCBs in sediment are low enough. The on-going time-critical removal action would accomplish source removal; and remediation of sediment and flood plain soil along Reaches B, C, D, and lower Brier Creek would reduce the amount of PCBs moving downstream. These actions would support MNR, and eventually reduce sediment PCB concentrations within the biologically active zone in Brier Creek Reservoir and Lake Crabtree to levels which will support the reduction of PCB concentrations in fish and other aquatic biota.

Institutional controls, like the continuance or enhancement of fish advisories and signs, and the implementation of educational and community outreach programs, would help reduce the potential risks to humans through fish consumption.

The estimated time required to achieve the remediation goal in fish tissue (0.05 mg/kg) at the Brier Creek Reservoir would be approximately 14 years; and in Lake Crabtree would be approximately 9 years.

The Selected Remedy would comply with all Applicable or Relevant and Appropriate Requirements (ARARs).

13.3 Summary of the Estimated Remedy Costs

A summary of the estimated costs of the Selected Remedy is:

Capital Costs:	$ 4,072,000
O & M Costs (Present Worth):	$ 1,258,000
Contingency Costs:	$ 800,000
Total Present Worth Costs:	$ 6,130,000

A more detailed breakdown of the estimated costs is presented in Table 16.

13.4 Expected Outcomes of the Selected Remedy

The removal of sediments and floodplain soil with PCB concentrations above 1 mg/kg from Reaches B, C, D, and lower Brier Creek will eliminate the risks to humans and ecological receptors through direct exposure to soil/sediments and these areas should available for unrestricted use.

Risks associated with fish consumption would not be eliminated immediately after the remedial actions, but modeling results indicate that once the removal action is completed at the facility and the sediments and floodplain soil with PCB concentrations above 1 mg/kg are removed from the streams (Reaches B, C, D, and lower Brier Creek), the PCB concentrations in the sediments that migrate downstream to Brier Creek Reservoir, Lake Crabtree, and lower Crabtree Creek would be low enough to support natural recovery of the sediments and reduce even more the bioavailability of PCBs to fish. Once PCB concentrations in fish tissue achieve levels below the fish tissue cleanup goal of 0.05mg/kg, all OU1 areas would be available for unrestricted use and within acceptable risk levels for unlimited exposure for human and ecological receptors.

Table 16

SELECTED REMEDY COST ESTIMATE

Task		Quantity	Units	Unit Cost	Total Cost
A. Capital Costs					
(1) Pre-remediation Sampling					
Sediment, soil, biota & surface water sampling (labor & travel)		600	HR	$60	$36,000
Sampling equipment, containers, shipping, etc.		1	LS	$3,000	$3,000
Sampling and Analysis					
PCB (sediment)		800	EA	$100	$80,000
PCB (soil)		800	EA	$100	$80,000
Data Validation		1,600	EA	$20	$32,000
Report Preparation		640	HR	$100	$64,000
Report production (word processing, graphics, printing)		1	LS	$5,000	$5,000
	Subtotal				$300,000
(2) Plans					
Health and Safety Plan		1	LS	$3,800	$3,800
QA/QC Plan		1	LS	$7,400	$7,400
Coordination and meetings		1	LS	$9,600	$9,600
Final report		1	LS	$12,250	$12,250
Permits		1	LS	$27,500	$27,500
	Subtotal				$60,550
(3) Mobilization/demobilization					
Mobilization/demobilization		1	LS	$5,500	$5,500
Survey and stake-out		1	LS	$13,200	$13,200
Facilities setup and Temporary Stockpile Area		1	LS	$25,000	$25,000
	Subtotal				$43,700
(4) Reach B Remediation					
Stabilized construction entrances		1	LS	$3,800	$3,800
Gravel haul road		1,740	LF	$35	$60,900
Stream diversion		1	LS	$7,400	$7,400
Excavation		1,966	CY	$22	$43,252
Backfill		1,966	CY	$35	$68,810
Site Restoration		0	AC	$20,000	$8,000
Transport and disposal		2,949	TN	$90	$265,410
	Subtotal				$457,572
(5) Reach C Remediation					
Stabilized construction entrances		1	LS	$5,000	$5,000
Gravel haul road		2,300	LF	$35	$80,500
Stream diversion		1	LS	$9,000	$9,000
Excavation		2,021	CY	$22	$44,462
Backfill		2,021	CY	$35	$70,735
Site Restoration		1	AC	$20,000	$10,600
Transport and disposal		3,032	TN	$90	$272,835
	Subtotal				$493,132

Table 16 (con't)

Task	Quantity	Units	Unit Cost	Total Cost
(6) Reach D Remediation				
Stabilized construction entrances	1	LS	$5,000	$5,000
Gravel haul road	4,400	LF	$35	$154,000
Stream diversion	1	LS	$9,500	$9,500
Excavation	6,076	CY	$25	$151,900
Backfill	6,076	CY	$35	$212,660
Site Restoration	1.01	AC	$20,000	$20,200
Transport and disposal	9,114	TN	$90	$820,260
Subtotal				$1,373,520
(7) Lower Brier Creek Remediation				
Stabilized construction entrances	1	LS	$5,000	$5,000
Gravel haul road	9,200	LF	$35	$322,000
Stream diversion	1	LS	$10,600	$10,600
Excavation	3,046	CY	$25	$76,150
Backfill	3,046	CY	$35	$106,610
Site Restoration	2.11	AC	$20,000	$42,200
Transport and disposal	4,569	TN	$90	$411,210
Subtotal				$973,770
Total				**$3,702,244**

B. O&M Costs

(1) Fish advisories (annually for 15 years)				
Implementation of Fish Advisories (already in place)	NA	NA	$0	$0
Yearly partial replacement of fish advisory sign posts	10	EA	$200	$2,000
Subtotal				$2,000
(2) Educational and community programs (yearly)				
Pamphlets, newspaper advertisements, public meetings, community outreach programs, etc.	1	LS	$5,000	$5,000
(3) 5-Year Review (cost per event)				
Note: Separate cost for 5-year sampling has not been included. Sampling results from MNR will be used instead.				
Report Preparation	160	HR	$100	$16,000
Report production (word processing, graphics, printing)	1	LS	$5,000	$5,000
				$21,000
(4) Periodic Sampling Yearly (MNR; Sediment and Aquatic Biota)				
Sediment, biota & surface water sampling (labor & travel)	300	HR	$60	$18,000
Sampling equipment, containers, shipping, etc.	1	LS	$5,000	$5,000
Sampling and Analysis				
PCB and TOC (sediment) - normal detection limit*	30	EA	$100	$3,000
PCB and TOC (sediment) - low detection limit**	51	EA	$200	$10,200
PCB and Lipid (biota)	122	EA	$200	$24,400
PCB (surface water)	10	EA	$200	$2,000
Data Validation	213	EA	$20	$4,260
Report Preparation	200	HR	$100	$20,000
Report production (word processing, graphics, printing)	1	LS	$3,000	$3,000
Subtotal (per event)				$89,860

* Reaches B, C, and D, and Lower Brier Creek

** Brier Creek Reservoir and Lake Crabtree

Table 16 (con't)

SELECTED REMEDY COST SUMMARY

Tasks	Item Cost	Total Cost
A. Capital Costs		
(1) Pre-remediation Sampling	$300,000	
(2) Plans	$60,550	
(3) Mobilization/demobilization	$43,700	
(4) Reach B Remediation	$457,572	
(5) Reach C Remediation	$493,132	
(6) Reach D Remediation	$1,373,520	
(7) Lower Brier Creek Remediation	$973,770	
		$3,702,244
B. O&M Costs		
Note: A discount rate of 4% was assumed for O&M.		
(1) Fish advisories (yearly, for 15 years)	$22,237	
(2) Educational and community programs (yearly, for 15 years)	$55,592	
(3) 5-Year Review (conducted in years 5, 10, 15, 20, 25, and 30)	$67,044	
(4) Periodic Sampling (MNR; Sediment and Aquatic Biota, yearly for 15 years)	$999,098	
Total O&M Cost		**$1,143,971**
Subtotal of Capital and O&M Costs		**$4,846,215**
Engineering and Administrative Costs (10%)		$484,622
Subtotal		$5,330,837
Contingency (15%)		$799,625
TOTAL PRESENT WORTH COST OF SELECTED REMEDY		**$6,130,462**

14.0 STATUTATORY DETERMINATIONS

The Selected Remedy satisfies the requirement of Section 121 of CERCLA, 42 U.S.C. § 9621, and to the extent practicable, the NCP § 300.430, 40 Code of Federal Regulations (CFR) § 300.430.

The Selected Remedy is protective of human health and the environment, will comply with the identified ARARs of other environmental statutes, will be cost effective, and will utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

14.1 Protection of Human Health and the Environment

The remedy for this Site will adequately protect human health and the environment by eliminating, reducing, or controlling exposures to human health and environmental receptors through excavation of contaminated sediments and soil, monitored natural recovery and institutional controls. Fish consumption advisories issued by the State of North Carolina will remain in effect until contaminant concentrations in fish are below remediation goals.

14.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The remedy would be designed to comply with all ARARs under federal and state laws. Chemical-, location-, and action-specific ARARs are listed in Tables 17, 18 and 19.

14.3 Cost Effectiveness

The Selected Remedy is cost effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (NCP §300.430(f)(1)(ii)(D)). This was accomplish by evaluating the "overall effectiveness" of those alternatives that satisfy the threshold criteria (i.e., were protective of human health and the environment and ARAR compliance) Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination: (1) Long-term effectiveness and permanence; (2) Reduction in toxicity, mobility and volume (TMV) through treatment; and, (3) Short-term effectiveness. Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of the Selected Remedy was determine to be proportional to its costs and hence represent a reasonable value for the money to be spent.

The estimated present worth costs for the Selected Remedy is $6,130,462.

Table 17

Chemical-Specific ARARs

Regulation	Citation	Criterion/Standard	Applicability/ Appropriateness	Actions to be Taken to Attain ARARs
Toxic Substances Control Act (TSCA)	40 CFR 761	TSCA regulates several chemical constituents (including PCBs) at levels that represent a significant risk to human health or the environment. Specifically, PCB regulations that regulate the disposal of material (such as soil and sediment) that contain PCBs at levels >50 ppm or have resulted from a known spill of PCB liquid containing >50 ppm PCB.	Applicable. PCBs found in soils and sediments within OU1 are an order of magnitude less than 50 ppm. However, additional sampling will be conducted, and PCB with levels above 50 ppm may exist. TSCA regulations are applicable to the Selected Remedy because it involves removal of PCB-contaminated sediment/soil.	Remedial actions will be conducted in accordance with applicable portions of TSCA requirements for PCBs. Sediments/soil with PCB concentrations above 1 ppm will be excavated and transported off-site in accordance with TSCA regulations.
North Carolina Health-Based Soil Remediation Goals	15A NCAC 13C.0300	The State of North Carolina has developed health-based remediation goals for the inactive sites for selected chemicals. The PCB soil remediation goal is based on the EPA policy for cleanup of PCBs at Superfund sites. The soil remediation goal for PCBs is 1 ppm.	Applicable. The Selected Remedy involves removal of PCB-contaminated sediments.	Sediments/soil with PCB concentrations above 1 ppm will be excavated and transported off-site.

Table 18

Action-Specific ARARs

Regulation	Citation	Criterion/Standard	Applicability/ Appropriateness	Actions to be Taken to Attain ARARs
TSCA Regulations for PCB Remediation Waste	40 CFR 761.61(c)	TSCA regulates the disposal of PCB remediation waste by methods including containing, transporting, destroying, degrading, or confining PCBs.	Applicable. PCBs found in soils and sediments within OU1 are an order of magnitude less than 50 ppm. However, additional sampling will be conducted, and PCB with levels above 50 ppm may exist. TSCA regulations are applicable to the Selected Remedy because it involves removal of PCB-contaminated sediment/soil.	Applicable portions of the regulations will be met.
	40 CFR 761.79	Establishes decontamination standards and procedures for removing PCBs from non-porous surfaces.	Applicable.	Decontamination activities will be conducted in accordance with the specified requirements.
The Clean Air Act (CAA)	40 CFR 50	Air quality requirements are specified for sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, lead, and particulate matter.	Potentially applicable to activities that involve dust emissions (e.g., excavation, road construction).	Measures will be taken to minimize dust emissions (e.g., spraying water)
Clean Water Act	40 CFR 403	Establishes effluent standards for direct and non-direct point source discharges.	Potentially applicable if treated water from dewatered sediments is discharged to surface water.	Appropriate effluent standards will be met.
	National Pollution Discharge Elimination System (NPDES) (40 CFR 122, 125)	Establishes NPDES discharge limitations based on Best Available Technology (BAT), and Best Management Practices (BMP).	Potentially applicable if treated water from dewatered sediments is discharged to surface water.	BAT and BMP requirements will be met.

Table 18

Action-Specific ARARs

Regulation	Citation	Criterion/Standard	Applicability/ Appropriateness	Actions to be Taken to Attain ARARs
North Carolina Water Pollution Control Regulations	15A NCAC 2B 15A NCAC 2H	State version of the federal NPDES program. Establishes requirements for wastewater discharge to surface water and wastewater treatment.	Applicable to treated water from dewatered sediments is discharged to surface water.	Appropriate effluent standards will be met.
North Carolina Water and Air Resources Act	NC G.S. Ch 143, Articles 21, 21B. 15A NCAC 2L.0202	Chapter 15A Section 02L.0202 of the NCAC specifies groundwater quality standards for the protection of groundwater of the state through maximum allowable concentrations resulting from any discharge of contaminants to the land or waters.	Applicable to discharge of treated water to ground or surface water.	Maximum allowable concentrations will be met if water is discharged to ground or surface water.
		Chapter 15A Section 2D.0540 of the NCAC establishes requirements for fugitive non-process dust emissions.	Potentially applicable for alternatives that involve dust emissions (e.g., excavation, temporary road construction).	Precautionary measures will be taken to minimize dust emissions.
North Carolina Sedimentation Control Act of 1973	15A NCGS 113A, Article 4 15 NCAC 2B	Specifies requirements associated with activities that involve land disturbance activities and activities in lakes and natural water courses.	Applicable to access road construction, excavation, or dredging activities.	An erosion and sedimentation control plan will be submitted. Appropriate measures will be taken to minimize the impact on the environment as required.
North Carolina Solid Waste Management Regulations	NCGS 130A, Article 9	Establishes requirements for the management of non-hazardous solid waste	Applicable to transport and disposal of excavation or dredging materials	

Table 19
Location-Specific ARARs

Regulation	Citation	Requirements	Applicability/Appropriateness	Actions to be Taken to Attain ARARs
Endangered Species Act	16 USC 1531 et seq. 40 CFR 6.302(h)	Under this act, federal agencies are prohibited from jeopardizing threatened or endangered species or adversely modifying habitats essential to their survival.	Applicable. Bald eagle has been recorded within 1 to 2 miles from the site. Endangered bald eagles are nesting at Lake Crabtree and foraging at Lake Crabtree and Brier Creek Reservoir. The state endangered Atlantic pigtoe mussel and the state threatened squawfoot mussel have been reported in the nearby Umstead State Park, which is part of the same Crabtree Creek watershed. These species could potentially be present in the unnamed tributary to Little Brier Creek. Potentially applicable.	Remediation activities will be conducted in accordance with the Endangered Species Act requirements.
Fish and Wildlife Coordination Act	16 USC 661 et seq. 40 CFR 6.302(g)	Requires federal agencies involved in actions that will result in the control or structural modification of any natural stream or body of water for any purpose, to take action to protect the fish and wildlife resources which may be affected by the action.	Potentially applicable.	Remediation activities will be in consultation with appropriate wildlife agencies.

Table 19
Location-Specific ARARs

Regulation	Citation	Requirements	Applicability/Appropriateness	Actions to be Taken to Attain ARARs
Protection of Wetlands	Executive Order 11990 40 CFR 6.302(a)	Requires federal agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists.	Potentially applicable. Portions of the Ward Transformer Site (OU1) are classified as wetlands.	Measures will be taken to minimize and mitigate any adverse impacts. Erosion and sedimentation control measures will be adopted during remediation activities.
Floodplain Management	Executive Order 11988 40 CFR 6.302(b)	Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain.	Potentially applicable. Parts of the Ward Transformer Site (OU1) consist of floodplains.	Measures will be taken to minimize adverse effects associated with direct and indirect development of a floodplain.
Preservation of Historical and Archaeological Data Act and National Historic Preservation Act	16 USC 469 et seq. 36 CFR Part 65 16 USC 470 et seq. 36 CFR Part 800	Recovery and preservation of historical and archaeological data. Also requires measures to minimize harm to historic resources.	Crabtree Creek Recreational Demonstration Area (also known as Umstead State Park) is a historical site listed in the National Register of Historic Places. Potentially applicable to activities at or in the vicinity of the historic location.	Precautionary measures will be taken to minimize harm to the historic property to the extent practicable.

Table 19
Location-Specific ARARs

Regulation	Citation	Requirements	Applicability/Appropriateness	Actions to be Taken to Attain ARARs
North Carolina Requirements During Minor Construction Activities	15A NCAC 01C .0408	This rule sets out the general and specific minimum criteria for construction activities. Construction and land-disturbing activities fall under both the general minimum criteria and any specific minimum criteria applicable to the project.	Potentially applicable.	Appropriate measures will be taken as required to minimize the impact from land-disturbing activities and comply with the requirement.
North Carolina Sedimentation/Erosion Control Regulations	15A NCAC 04B .0105-.0109	This rule establishes the sedimentation and erosion control pertaining to: ▪ Protection of property (04B.0105). ▪ Basic control objectives (04B.0106). ▪ Mandatory standards for land-disturbing activity (04B.0107). ▪ Design and performance standards (04B.0108). ▪ Stormwater outlet protection (04B.0109).	Potentially applicable.	Appropriate erosion and sedimentation control measures will be taken during excavation and removal activities as required.
North Carolina Management of Isolated Wetlands and Waters	15A NCAC 02H.1301	This rule pertains to the disposition of dredged or fill material in isolated wetlands or waters of the State	Potentially applicable	

14.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

EPA and NC DENR have determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner, given the specific conditions at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA and NC DENR have determined that the Selected Remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction of toxicity, mobility, or volume, short-term effectiveness, implementability, and cost, while also considering State and community acceptance.

14.5 Preference for Treatment as a Principal

While the Selected Remedy for OU1 does not meet this criterion, the low PCB levels in the sediment and floodplain soil would require excavation but may not require treatment prior to disposal. In addition, this OU does not address the main source material. The main source material or principal threat waste (PCB contaminated soil at the Ward Transformer Facility) at the Site is being addressed through a time critical removal action using thermal desorption. For this OU the combination of excavation and off site disposal, together with natural processes should effectively achieve remediation goals without the need for treatment.

14.6 Five Year Review Requirements

NCP §300.430(f)(4)(ii) requires a five-year review if a remedial action results in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure. The remedy for OU 1 at the Ward Transformer Superfund Site will not result in contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure. However, the remedy will take longer than five years to achieve unlimited use and unrestricted exposure. As such, as a matter of policy EPA will conduct a Five-year review until levels that allow for unlimited use and unrestricted exposure are achieved. The first Five-Year Report should be completed five years from the date the Preliminary Close-Out Report (PCOR) is issued.

15.0 DOCUMENTATION OF SIGNIFICANT CHANGES

Section 117(b) of CERCLA requires an explanation of any significant changes from the preferred alternative presented to the public. The Proposed Plan Fact Sheet was released to the public in August 2007. Alternative 4 was presented to the public as EPA preferred alternative. The components of Alternative 4, as presented to the public, are described in Section 10 of this ROD. Based on the comments received during the comment period, the following changes were made

to Alternative 4. The Selected Remedy as described in Section 13 of this ROD includes these changes.

1. During the public comment period new information indicated the need for additional actions to address concerns regarding floodplain soil along Reaches B, C, D and Lower Brier Creek. These additional actions would address any contaminated flood plain soil with PCB concentrations above 1 mg/kg that may be present at these areas; and if present and not remove, exposure to this material would present unacceptable risk to humans and ecological receptors. In addition, contaminated soil from flood plain areas would be a source of PCB. After evaluating public comments EPA decided to modify Alternative 4 to include:

    - Additional sampling of floodplain soil along Reaches B, C, D, and Lower Brier Creek as part of the pre-excavation sediment sampling program from Reaches B, C, D, and Lower Brier Creek, already included in Alternative 4.

    - Excavation and disposal of floodplain soil along Reaches B, C, D, and Lower Brier Creek, to levels below the 1 mg/kg remediation goal, as part of the sediment excavation/disposal from Reaches B, C, D, and Lower Brier Creek, to levels below the 1 mg/kg remediation goal already included in Alternative 4.

2. The cost estimate for Alternative 4 was revised to include:

    - Cost for floodplain pre-excavation sampling, excavation, and disposal.

    - Cost for excavation-verification sampling, inadvertently not included in the original estimate.

Appendices for this Record of Decision are available by placing a request using the Customized CERCLIS/RODS Report Order Form.

http://www.epa.gov/superfund/sites/phonefax/rods.htm