APPENDIX A

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RECORD OF DECISION

OPERABLE UNIT FOUR – WELCH CREEK
DOMTAR (FORMERLY WEYERHAEUSER) COMPANY PLYMOUTH WOOD
TREATING PLANT SITE, NORTH CAROLINA

PART 1: DECLARATION FOR THE RECORD OF DECISION

A. Site Name and Location

Welch Creek Area-Operable Unit 4
Domtar Corporation (Domtar, formerly Weyerhaeuser Company) Site
Martin County, North Carolina
USEPA ID # NCD991278540

B. Statement of Basis and Purpose

This decision document presents the selected remedial action for the Welch Creek Area of the Domtar (formerly Weyerhaeuser) Site, Martin County, North Carolina, chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the administrative record file for this Site.

The North Carolina Department of Environment and Natural Resources (NCDENR) is the support agency for this Site. The NCDENR Division of Waste Management ("the State") concurs with the selected remedy, but notes comments from the NCDENR Division of Marine Fisheries and the NC Wildlife Resources Commission that expressed a preference for dredging.

C. Assessment of the Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

D. Description of the Selected Remedy

The Domtar (formerly Weyerhaeuser) Site is comprised of four areas of concern which were independently investigated in focused Remedial Investigations and Feasibility Studies. The four areas are Landfill No. 1, Former Chlorine Plant, Welch Creek, and Roanoke River. The ROD for Landfill No. 1 was issued in June 2002 and the remedial action activities were completed in January 2006. The ROD for the Former Chlorine Plant was issued in September 2003 and remedial action activities were completed in August 2006. Both Landfill No. 1 and the Former Chlorine Plant are currently undergoing operation and maintenance activities. A Feasibility Study for the Lower Roanoke River was prepared by Domtar (a PRP at the Site) and submitted to USEPA.

This remedy addresses the threat posed by the Welch Creek Area of the Domtar (formerly Weyerhaeuser) Site. The major threat is the contamination associated with wastewater treatment solids located in portions of the Welch Creek sediments. The major components of the selected remedy include:

- Enhanced Monitored Natural Recovery (eMNR) of sediment contaminated with dioxin above cleanup goals noted in Table M-2 in the upstream reach of Welch Creek through placement of a thin layer sand cap. Mobility monitoring would be performed for the less contaminated sediment in the midstream reach which may be somewhat susceptible to stream bed erosion.
- Long term monitoring and maintenance of the sand cap.
- Long term testing and monitoring of sediment, surface water, and biota to document the performance of the remedy and compliance with cleanup goals noted in Table M-2.

- Institutional controls to limit the consumption of fish from Welch Creek, maintain the integrity of the sand cap, maintain the existing fencing which limits access to the Welch Creek area, maintain signs in Welch Creek noting fish advisories and the presence of the sand cover, and to place deed restrictions to limit land development on the Domtar (formerly Weyerhaeuser) property that could impact the remedy.

E. Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective.

The remedy for the Welch Creek Area does not satisfy the statutory preference for treatment as a principal element because the remedy for the Site is containment.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

F. ROD Data Certification

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Site.

- Chemicals of concern and their respective concentrations (pp. 47, 64, 72-73).
- Baseline risk represented by the chemicals of concern (pp 60-61, Attachment 1).
- Cleanup levels established for chemicals of concern and the basis for these levels (pp. 81,112).
- Current and reasonably anticipated future land use assumptions and current and potential beneficial uses of ground water used in the baseline risk assessment and FS (p. 41).
- Potential land and ground water use that will be available at the site as a result of the Selected Remedy (p. 111).
- Established capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (p.110).
- Key factors that led to selecting the remedy (p.106).

G. Authorizing Signature

Franklin E. Hill, Director
Superfund Division

9/24/07
Date

PART 2: THE DECISION SUMMARY

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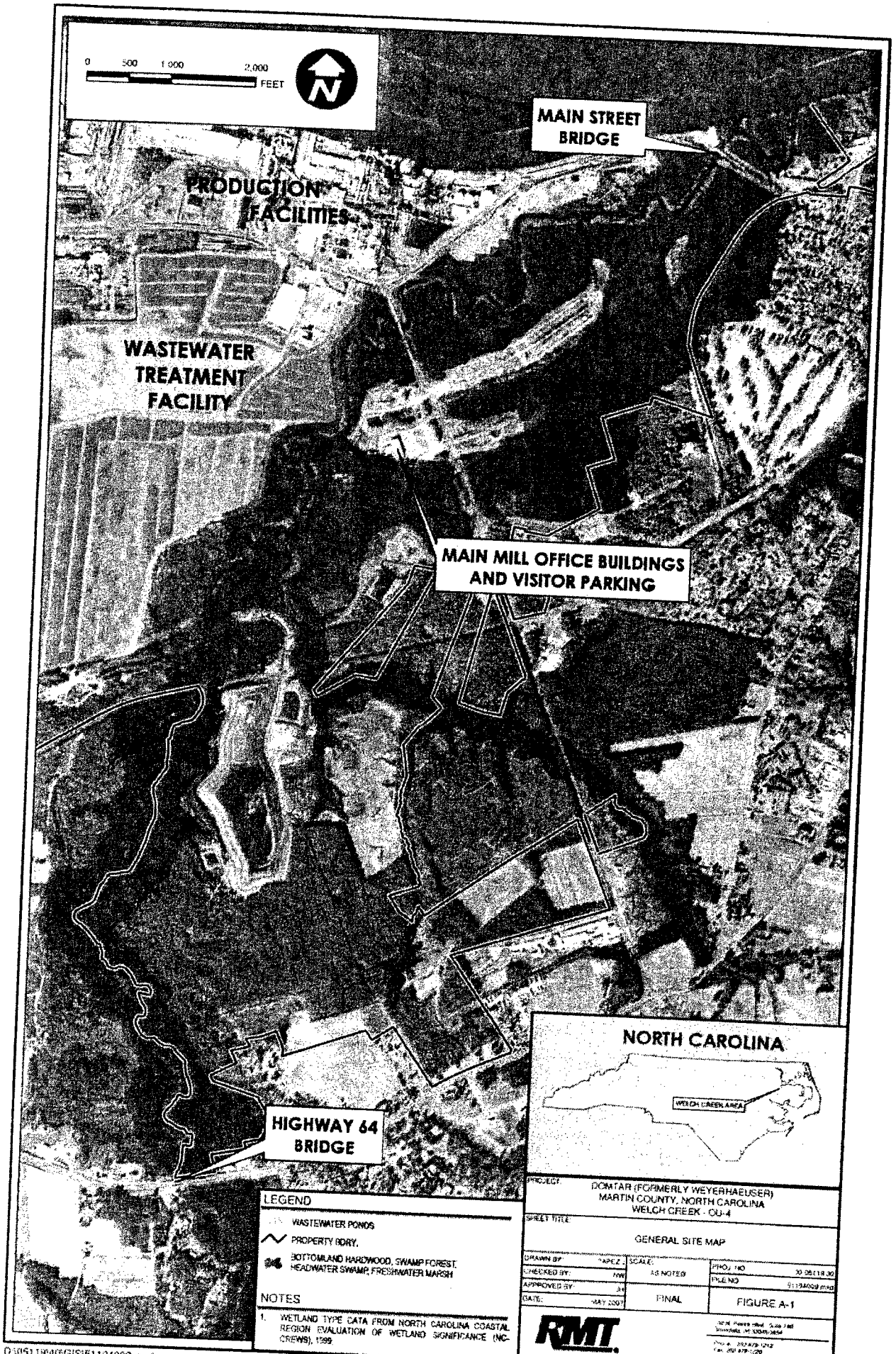
A. Site Name, Location and Description

The Domtar (formerly Weyerhaeuser) facility (Site) is an active wood and paper products manufacturing facility employing approximately 700 people. The Site is located just outside of the city limits of Plymouth, Martin County, North Carolina, and has been assigned the CERCLIS Site ID number of NCD991278540. 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 the Responsible Party to conduct and pay for the cleanup at the Site. Work on the Site has been conducted by Weyerhaeuser Company and is being continued by Domtar Paper Company LLC (Domtar)[a], the current owner of the pulp and paper operations at the Site.

Current operations at the Site include the production of fluff paper pulp and paper. Weyerhaeuser acquired the facility in 1957, after merging with the Kieckhefer-Eddy Corporation, which began operation at the site in 1937. Weyerhaeuser operated the facility from 1957 until 2007. The facility, now owned and operated by Domtar Paper Company, LLC, is located on approximately 2,400 acres, about 1.5 miles west of the town of Plymouth. Welch Creek is a slow-moving blackwater stream located between Martin and Washington Counties in eastern North Carolina. The Welch Creek study area (Operable Unit 4) is a 4.5-mile portion of the lower creek extending upstream from its confluence with the Roanoke River. The area around Welch Creek is comprised of forested wetlands. Figure A-1 shows the approximate location of Welch Creek at the facility.

[a] Domtar Paper Company, LLC took ownership of the pulp and paper operations at the Plymouth Mill and assumed related environmental obligations from Weyerhaeuser Company on March 7, 2007. Previous required reports for this CERCLIS Site were submitted by Weyerhaeuser. For continuity, references to the facility owner of the Plymouth Mill, are cited as Domtar (formerly Weyerhaeuser) in the remainder of this Record of Decision.



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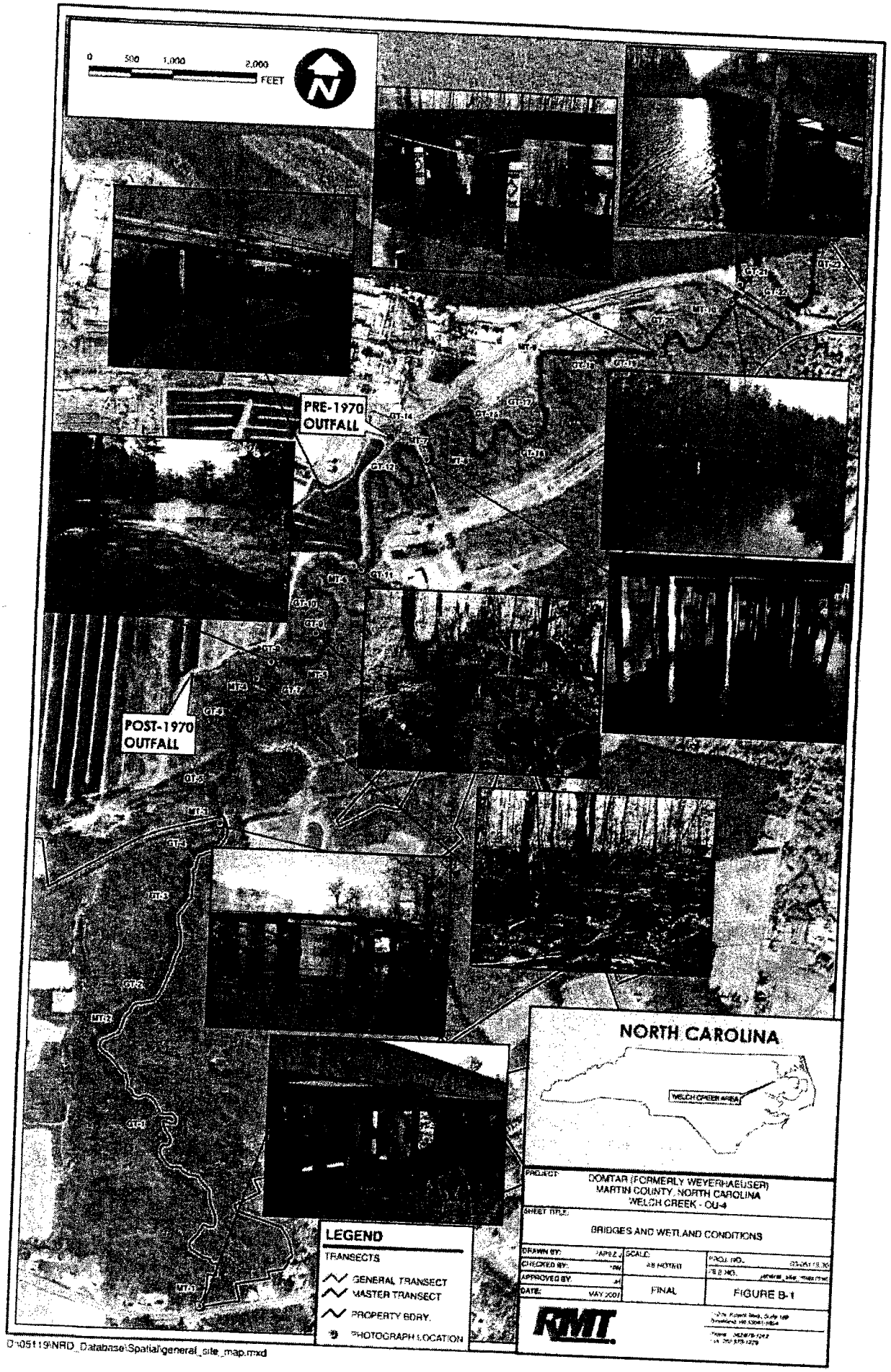
B. Site History and Enforcement Activities

Wastewater effluent associated with bleached pulp was discharged directly to the Lower Roanoke River by the original owner from approximately 1937 to 1956. In-plant waste control improvements were implemented in 1957 when Weyerhaeuser acquired the facility from the Kieckhefer-Eddy Company. A 12-acre spray pond and two retention ponds were later constructed. From 1957 to 1968, effluent was discharged to Welch Creek from an outfall located 1.6 miles upstream from the Welch Creek/Roanoke River confluence. For purposes of the Welch Creek studies, the former outfall location was termed the "pre-1970" outfall, as shown on Figure B-1.

Beginning in 1968, the wastewater was subject to treatment in a series of on-site wastewater treatment ponds that currently consist of primary settling ponds, an aeration basin, and a large serpentine-shaped retention pond. From 1968 to 1987, wastewater was discharged to Welch Creek from an outfall located 2.3 miles upstream from the confluence (the post-1970 outfall), also shown on Figure B-1. The discharges to Welch Creek were permitted by the State of North Carolina in 1969. Since 1975, wastewater discharges from the Plymouth Mill were regulated by National Pollutant Discharge Elimination System (NPDES) permits. Since 1988, treated wastewater from the pulp and paper processes and other site facilities has been permitted to directly discharge into the Roanoke River approximately ½ mile downstream from the facility. The most recent NPDES permit was effective March 1, 2006, to expire on February 28, 2011.

A Special Notice Letter was sent to Weyerhaeuser Company by the USEPA on November 19, 1997, notifying them of potential liability, as defined by Section 107 (a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, that Weyerhaeuser may have incurred with respect to the Site. The Special Notice Letter outlined multiple areas on, and adjacent to, the facility property which, following initial investigation by the USEPA and NC DENR, were considered to have caused a release or the threat of a release of hazardous substances, pollutants or contaminants. The four areas (ultimately operable units) defined for this Site are: 1) Landfill No. 1 Area; 2) Former Chlorine Plant Area; 3) Welch Creek; and 4) Lower Roanoke River. After successful negotiations between the USEPA and Weyerhaeuser, an Administrative Order by Consent (AOC) was signed by both parties on March 24, 1998. The Remedial Investigation/ Feasibility Study (RI/FS) for the Landfill No. 1 Area, Former Chlorine Plant Area, and Welch Creek were covered under the terms of the AOC and the attached Statement of Work (SOW). The Roanoke River Remedial Investigation was conducted separately by the USEPA using Superfund funding. The Feasibility Study for the Roanoke River was prepared by Domtar, a PRP at the Site.

The Site is considered a Superfund Alternative Site (SAS). It has not been placed on the Final National Priorities List pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended. However, the work has been performed in accordance with the National Contingency Plan with oversight by USEPA and input from other federal and state agencies.



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C. Community Participation

Pursuant to CERCLA Sections 113(k)(2)(B)(i-v) and 117, the RI/FS Reports and the Proposed Plan for the Site were released to the public for comment on August 6, 2007. These documents were made available to the public in the administrative record located in an information repository maintained at the Docket Room in USEPA's Region IV office in Atlanta, Georgia, and at the Washington County Public Library in Plymouth, North Carolina.

The notice of the availability of these documents was published in the Roanoke Beacon, Plymouth North Carolina, on August 8, 2007. A pubic comment period on the documents was held from August 6, 2007 to September 4, 2007. A copy of the Proposed Plan fact sheet were mailed to the Site mailing list which contains names of community members and interested parties. In addition, a public meeting was held on August 16, 2007. At this meeting, representatives from the USEPA answered questions about the Site and the remedial alternatives under consideration. USEPA's response to comments received during this period is included in the Responsiveness Summary, which is a part of this Record of Decision.

Other community relations activities included:

- Development of a community relations plan.
- An RI kick-off public meeting held in the community on March 23, 1999.
- Issuance of a fact sheet on the RI/FS process and progress in March 1999 and January 2001.
- Issuance of a fact sheet regarding status of all operable units in April 2005.
- Issuance of a fact sheet on the Proposed Plan in August 2007.
- Informed citizens of the Technical Assistance Grant and Community Advisory Group program (literature placed in repository).

D. Scope and Role of Operable Unit within Site Strategy

Because of the geographic separation of the three areas and the differences in the type of contamination present and the media impacted, individual RI/FS work and reports have been prepared for each of the three on-site areas identified in the AOC. The operable unit designations given to each area are:

- Operable Unit 1: Landfill No. 1 Area
- Operable Unit 3: Former Chlorine Plant
- Operable Unit 4: Welch Creek.

These focused investigations were conducted in order to streamline the investigation and remedy selection process. The USEPA has already selected remedies and issued separate RODs in 2001 and 2003 for Operable Units 1 and 3; and is issuing this ROD for Operable Unit 4. The Roanoke River RI was performed by the USEPA using Superfund funding and is designated as Operable Unit 2. The Roanoke River FS was prepared by Domtar. The USEPA intends to issue a separate ROD for Operable Unit 2.

Operable Unit 4 (Welch Creek) focuses on dioxin in sediment. Dioxin in wetland soil did not require the development of alternatives because of the following factors: 1) the human health and ecological risk assessments did not indicate unacceptable risk due to dioxin in wetland soil, 2) no residential development currently or anticipated in wetland areas, 3) the detected concentrations are at or below the current USEPA dioxin cleanup policy 5-20 ppb for industrial exposure scenarios, and 4) modeling by COE indicated that adjacent wetland soils are not subject to enough erosion to transport soil contaminants into Creek.

Cleanup goals for mercury in sediment, surface water, and wetland soil and water were not selected because of the following factors: 1) apparent ongoing air borne deposition of mercury from other regional sources, 2) historic mercury in some Creek sediment may not as bioavailable due to presence of sulfides in sediment, 3) mercury concentrations in fish tissue in Welch Creek are similar to fish tissue concentrations from local, regional, and national background locations, 4) mercury concentrations in surface water were below ecological screening values, 5) maximum methyl mercury concentrations in wetland soil were well below ecological screening values for soil. However, mercury will still be included in the long term monitoring program.

E. Site Characteristics

1. Site Setting

The Welch Creek area (OU-4) is located on the eastern portion of the Domtar (formerly Weyerhaeuser) Site. The entire manufacturing facility is located in a low-lying area near the confluence of Welch Creek and the Roanoke River. The drainage basin for Welch Creek is comprised of flat, low-lying terrain typical of the Tidewater Region within the Coastal Plain Physiographic Province of North Carolina with 5 to 15 feet of relief. Welch Creek is a slow-moving, blackwater stream, similar to other creeks and tributaries that drain the swamp and upland areas adjacent to the lower reaches of the Roanoke River. The confluence of the creek with the Roanoke River is located approximately 7 miles up-river from Albemarle Sound. Welch Creek area (OU-4) is defined as the lower portion of Welch Creek, extending approximately 4.5 miles from the Highway 64 bridge to the confluence with the Roanoke River (see Figure I-1). In the 4.5 mile study area, the creek averages approximately 120 feet in width, has an average maximum depth of about 10.5 feet, and is bordered by wetlands approximately 1,000 feet in width.

Welch Creek is part of Subbasin 03-03-09 of the Roanoke River basin, which is an area with low population density (45 people per acre) and a large portion of the landscape as wetlands or forests (71.5 percent) or in cultivated crops (24.8 percent). In terms of the study area, non-production Mill facilities (parking areas, green space, wastewater settling ponds) border the creek along the west side (Figure B-1) while the east bank has wetland forest. There are a few residences located near the Highway 64 bridge (the southern limit of OU-4). The photographs embedded in Figure B-1 show the most common wetland conditions, several bridges, and other features along the Welch Creek bank. The large expanse of dense vegetation, trees, and frequently flooded wetlands limit access to the creek bank. Domtar (formerly Weyerhaeuser) owns and maintains security fencing or access control for the property on the east side and most of the west side of the creek. Welch Creek and its adjacent wetlands serve as the eastern boundary for the Domtar (formerly Weyerhaeuser) facility. A total of six bridges span Welch Creek, including three railroad bridges and three bridges for primarily mill-related automobile traffic. The low bridge clearances near the mouth restrict boat access to upper reaches of the creek except for small watercraft. There is one small boat ramp, accessible from the secured mill property.

The climate of the area is characterized by warm summers and mild winters. The average annual temperature is 65°F. Precipitation in the area averages 51 inches annually, with the heaviest rains typically occurring in the summer months.

2. Hydrology and Water Quality

The lower portion of Welch Creek in the study area has many meanders and oxbows, typical of streams in a tidal setting, indicating the creek is in a low-energy environment. Under average stream flow conditions, the net downstream velocities in the creek have been estimated to be less than 0.03 foot per second. The low-energy environment is enhanced by the presence of submerged trees, logs, stumps on the creek bottom, and substantiated by thick deposits of wastewater treatment solids in the lower portion of the creek. The combination of blackwater drainage and the low energy, coastal plain environment contribute high organic matter content and typically low dissolved oxygen conditions during the warmer months (NC DENR DWQ,

2001). Data collected before, during, and after the pilot studies confirm the seasonal depletion of dissolved oxygen (DO) throughout the lower portions of the creek.

Water level along the lower portion of the creek (*i.e.*, north of the Highway 64 bridge and coincident with OU-4) is strongly affected by the elevation of the Roanoke River through basin drainage events, lunar tides, and wind-driven tides. These elevation changes cause frequent flow reversals in the creek as far upstream as the Highway 64 bridge and result in intermittent flooding of wetlands adjacent to the creek. The overall hydrology of Welch Creek is constrained by several factors. These include: 1) a relatively small drainage basin (OU-4 represents 17 percent of the total basin area); 2) broad wetlands along the creek, typically over 1,000 feet in width; and 3) dam controlled flows on the Lower Roanoke River that impact the water elevation at the creek mouth.

Text Box 2-6
Welch Creek Hydrology Components

Water body Classification: Class C SW (swamp) waters
Average width: 120 feet
Average maximum depth: approximately 10.5 feet
Frequent meanders especially in Lower Creek*
Basin and Baseflow Characteristics
Basin Area: 28 square miles in area (FEMA, 1985)
Base flow of the creek: 10 to 29 cubic feet per second (cfs)
Flow reversals due to lunar tide and wind events
Length: ~ 10 miles (4.5 in Lower Creek*)
Slope in Upper Creek: ~approximately 6 feet per mile
Slope in Lower Creek*: virtually flat; creek flows through forested wetlands
Elevations and Overbanking
Roanoke River at Mouth (avg): approximately 0.9 feet NGVD29
Wetland flood plain: 1 and 3 feet relative to NGVD29
Creek bed: -4 and -15 feet relative to NGVD29
Lunar tide influence: 0.5 feet
Roanoke River stage variation: plus 2 feet or greater
Local Welch Creek Basin Drainage: variable
* *Lower Creek is defined as Highway 64 bridge to mouth (same as OU-4).*

3. Regional Geology and Hydrogeology

The geology in the region generally consists of a wedge of clastic sediment and marine limestone that thickens from west to east. The sediment consists of sand, silt, and clay. The sand is deposited in poorly connected bodies that may have only a limited horizontal and vertical extent. However, on a regional scale, differences in the frequency of occurrence and the interconnection of the sand bodies are sufficient enough to distinguish regional aquifers from regional aquitards. Specific geologic and hydrogeologic units are summarized as follows:

- Quaternary-age Surficial Aquifer: consists of fine sand, silt, clay, and peat that form a unit of less than 50 feet in thickness. The annual ground water recharge through the native soil is estimated to range from 0.4 foot, where silt and clay predominate, to 1.7 feet, where sand is predominantly at the ground surface. Ground water from the Coastal Plain aquifers discharges into these shallower (*i.e.*, more recently deposited) stream alluvial systems.
- Yorktown Confining Unit: consists of predominately of clay and sandy clay with occasional beds of fine sand or shells and a reported thickness of 40 feet in the Plymouth, North Carolina, area. The Roanoke River, draining all of Martin County, has cut into the Yorktown Formation.
- Yorktown Aquifer: consists of fine sand, silty and clayey sand, and clay with shells and shell beds with 70 percent sand in the Plymouth, North Carolina, area. The hydraulic conductivity of the Yorktown aquifer averages 2×10^{-4} ft/s. The annual recharge to the aquifer is estimated to be less than 0.2 foot on a regional

scale. In the Tidewater region, where the site is located, ground water flows into the Yorktown aquifer from the underlying Pungo River Formation.

- Pungo River Formation: confining unit composed of 90 percent Miocene-age clay and averages 55 feet in thickness.
- Pungo River Aquifer: consists of marine-deposited fine-to medium-grained sand with a high phosphate content and is only about 10 feet thick near Plymouth, North Carolina.
- Castle Hayne Confining Unit (where present) and the Eocence-age Castle Hayne Aquifer: consists of limestone, sandy marl, and fine to coarse limey sand. The elevation of the aquifer below Plymouth, North Carolina, is reported to be about -130 feet. The aquifer is as much as 1,200 feet thick in areas of North Carolina and about 100 feet thick below Plymouth. This is the most productive aquifer in North Carolina, with an average hydraulic conductivity of 6.5×10^{-4} ft/s. Production tests of Weyerhaeuser water supply wells in this formation indicated an average hydraulic conductivity of 6.5×10^{-4} ft/s. Recharge to the aquifer is on the order of 0.05 foot on a regional basis. The hydraulic head in the aquifer near Plymouth, North Carolina, in the early 1900s was -1 foot.
- Five or more other confining/aquifer units have been identified below Plymouth, North Carolina, that are of little relevance because the Castle Hayne Aquifer is the regional water supply aquifer below the Site.

4. Area Ground Water Use

The majority of the Plymouth Facility process water is obtained from the Lower Roanoke River. Facility water use is supplemented by deep on-site potable water supply wells. These water supply wells and other private wells in the vicinity draw water from depths of 100 to 200 feet below ground surface, thus utilizing the Castle Hayne Aquifer. This local aquifer is separated from the shallow ground water adjacent to Welch Creek by 50 to 100 feet of confining clay layers.

5. Pre- Remedial and Remedial Investigation and Supplemental Field Work

The data and information that form the basis for the site characterization come from a voluntary investigation conducted by Weyerhaeuser in 1995, the RI and BERA data collection activities, and additional site-specific data collection activities and science-based meeting discussions that have been subsequently conducted. The RI field activities on Welch Creek were completed in 2000 followed by preparation of both the RI Report and the BERA. In 2003, after the RI and BERA for Welch Creek were approved, Weyerhaeuser and the USEPA discussed the best mechanisms for advancing the FS process. Both parties agreed that an interactive approach to evaluation of technical issues was desirable and agreed to a concurrent two-pronged approach to evaluate remedial technologies to address creek sediment. The two activities were: 1) a facilitated scientific discussion process to address technical issues associated with overall remedy evaluation, and 2) collection of supplemental data from pilot tests and other sample collection activities. Additional discussion of each source of data follow:

- 1995 Voluntary Study: Weyerhaeuser conducted a voluntary investigation of the lower Welch Creek surface water and sediment in late 1995. While various other studies were done in earlier years, the 1995 study superseded previous segmented data gathering, as a more comprehensive, up-to-date study. The study was performed primarily to examine the presence of wastewater solids in Welch Creek and, if present, to assess the quality of such solids and underlying native sediment deposits. The 1995 study area extended from the U.S. Highway 64 bridge to the confluence of Welch Creek with the Roanoke River and was implemented using a comprehensive sampling and data quality control plan. The investigation assessed sediment quality at 10 master transect and 25 general transect locations considering quarter points horizontally and multiple vertical depths. Surface water quality within Welch Creek during baseline

conditions was also measured along with a limited evaluation of surrounding media (*i.e.*, wetlands and groundwater). The "sediment triad" approach was used to collect the sediment quality information (*i.e.*, chemistry, toxicity, and benthic community structure data). The 1995 investigation also identified Conaby Creek as the reference site and included the results of sediment and surface water samples collected there to evaluate background conditions. The 1995 Welch Creek investigation was performed to be consistent with the National Contingency Plan (NCP) and the results were presented in a Technical Memorandum submitted to USEPA in 1998. After review of the Technical Memorandum, the USEPA agreed to utilize the results of the 1995 study in conjunction with the 1999 RI sampling data for this RI report and agreed to use the data from 1995 to identify constituents of potential concern.

- 1999 Remedial Investigation: The 1999 RI investigation activities were designed to confirm and supplement the 1995 investigation results. The sediment and surface water samples collected were intended to confirm that conditions did not significantly change in Welch Creek since the 1995 investigation. Additional wetlands samples were collected to assess concentration gradients with distance from the creek in the wetlands adjacent to both Welch and Conaby Creeks. The environmental media characterization activities of the 1999 RI are summarized in Table E-1 and Table E-2. Transect sampling locations for the RI are shown on Figure I-1.

Table E-1
Environmental Media Sampling Summary during RI Activities

Media Type	Number (Location)	Analytes	Sampling Device
Sediment	Welch Creek: (MT-1 to MT-10; GT-1 to GT-22)	(2,3,7,8-substituted polychlorinated dibenzo(p)dioxin/ dibenzofuran (2,3,7,8-PCDD/PCDF), phenanthrene, pyrene, mercury, chromium, copper, nickel, zinc and hexavalent chromium.	Mid stream Ponar dredge/core samples to varying depths
	Conaby Creek: (CC-5 to CC-10)		
Surface Water	Welch Creek: (MT-1, 2, 5, 6, 7, 8, 10)	PCDD/PCDF, Total mercury (Hg-T);Methyl Mercury: Hg-Me, Suspended solids	Mid depth low flow pump
	Conaby Creek: (CC-6, 8)		
	Lower Roanoke River		
Wetland water	Welch Creek: (MT-1, 4, 6, 8, 10)	2,3,7,8-TCDD, 2,3,7,8-TCDF, Dioxin TEQ (USEPA, WHO Mammalian, WHA Avian), Araclor 1242, Araclor 1260, Mercury, Methyl Mercury	Direct submersion of sample container into standing water
	Conaby Creek		
Wetland soils	Welch Creek: (MT-1, 4, 6, 7, 8, 10)	2,3,7,8-TCDD, 2,3,7,8-TCDF, Dioxin TEQ (ITEF, WHO Mammalian, WHO Avian), Aroclor 1242, Aroclor 1260, Mercury, Methyl Mercury, Chromium, Hexavalent Chromium, Copper, Nickel, Zinc	Hand trowel from surface to approximately 6" below surface
	Conaby Creek: (CC-6)		
Whole water	MT-10 Midstream		Depth integrated device with tubing manifold @ 2',4',6', and 8' below water surface

Table E-2
Biota Sampling Summary During RI Activities

Media Type	Number (Location)	Analytes
Benthic Macro invertebrates	Welch Creek: (MT-1, 6, 8)	Dioxin TEQ (ITEF, WHO Avian), Mercury, Chromium, Zinc
Fish Tissue	Welch Creek: (MT-1, 6, 8)	Dioxin TEQ (ITEF, WHO Avian, WHO Mammalian, WHO fish), Mercury, Chromium
	Conaby Creek: (CC-8, 10)	Mercury
Terrestrial Insects	Welch Creek: (MT-1, 6, 8)	Dioxin TEQ (ITEF, WHO Avian), Mercury, Chromium, Zinc
Emergent Insects	Welch Creek: (MT-1, 6, 8)	Dioxin TEQ (ITEF, WHO Avian), Mercury, Chromium, Zinc
Plant Tissue	Welch Creek: (MT-1, 6, 8)	Dioxin TEQ (ITEF, WHO Avian), Mercury, Chromium, Zinc

Samples were assigned a unique alpha-numeric sample descriptor identifying the study area; media types; sample number; and, in certain instances, sample depth (FSAP; RMT, 1999a). The relevant study area descriptors for the Welch Creek area are as follows:

Location	Media
WC = Welch Creek	SD = sediment
CC = Conaby Creek	SW = surface water
	WS = wetland soil
	WW = wetland water

- 2004 and 2005 Supplemental Data Collection: The scope of the focused pilot studies and supplemental data collection activities were based upon the results of the approved RI and technical issues raised during the facilitated meetings. The objective was to gather information needed to complete the FS in a manner that addressed technical concerns raised by the stakeholders and reflected site specific conditions in Welch Creek. Specific supplemental data collected during 2004 and 2005 included: baseline monitoring, fine layer core sediment samples and a detailed debris survey.

6. Contaminant Distribution

The characterization of the nature and extent of contamination in the Welch Creek operable unit was focused on wetland soil/wetland water and sediments/surface water using data from the multiple sample collection activities augmented by information from environmental and non profit resource agencies and published literature.

a. Wetland Soil and Wetland Water

Samples of wetland soil and water were co-located along the extension of five transects from the bank of the creek. To assess the gradient with distance from the creek, wetland samples were collected in low lying areas at the location of the 10-year flood plain elevation and the midpoint between that location

and the creek bank within a 100-foot radius in areas of standing water. Water was sampled manually and then the top 6 inches of soil was scooped and mixed for analysis of COPCs and hexavalent chromium. Five wetland soil and water samples (total ten samples) were analyzed for methyl mercury using low level mercury procedures. One wetland soil location in Conaby Creek was analyzed for all parameters as the off site reference location.

Wetland Soil

The refined COPCs identified for Welch Creek wetland soil are 2,3,7,8-PCDD/PCDF; mercury; chromium; and zinc. A summary of the COPCs analyzed in wetland soil is included in Table E-3. Note: due to collection of wetland soil samples from low-lying areas in the wetlands, these results are considered to be biased high. Table E-4 provides a breakdown of the 2,3,7,8-PCDD/PCDF congener and homolog results in wetland soil.

2,3,7,8-PCDD/PCDF: The concentration of dioxin TEQ is highest at the creek bank and decreases with distance from the creek. With the exception of MT-8, the dioxin TEQ (USEPA, 1989) concentrations at the 10-year flood plain limit were at least an order of magnitude lower than the corresponding samples at the midpoint of the 10-year flood plain. Although the locations at the 10-year flood plain limit have concentrations above local background sample results, the congener profiling was conducted to distinguish watershed wide or air related sources from Mill related sources. The low absolute 2,3,7,8-TCDD concentrations from samples at the 10-year flood plain location. shows that these samples have a relatively weak wastewater solids profile. OCDD, commonly associated with combustion process, was the congener present at the highest concentration in all samples, including background samples. The highest dioxin TEQ was reported at MT-7 (4,080 ng/kg) along the creek bank. Concentrations of dioxin TEQ at the mid-point between the bank and the 10-year floodplain range between 288 and 1,094 ng/kg, while concentrations of dioxin TEQ at the 10-year flood plain downstream of the post 1970 outfall range between 14 and 457 ng/kg.

Mercury: Total mercury concentrations in the ten Welch Creek wetland soil downstream samples ranged from <0.05 to 5.6 mg/kg, with a median concentration of 0.43 mg/kg (Table E-4). Methyl mercury analyzed only in samples from the midpoint between the creek bank and the 10-year flood plain limit ranged from 0.00089 to 0.00616 mg/kg, with a median of 0.00221 mg/kg. The spatial distribution of mercury also shows a trend of decreasing total mercury concentrations with increasing distance from the creek consistent with input of contaminants from Welch Creek from watershed and mill sources. However, since there is no definitive method to fingerprint mercury sources, the data does not provide a means to separate watershed based mercury from Mill related releases.

A plot of total and methyl mercury concentrations in wetland soil suggests a good correlation ($R2 = 0.99$). Approximately 0.5 percent of the total mercury in the wetland soil was as methyl mercury. This level is at the low end of literature reported values. Therefore, it is concluded that

conditions in the wetlands do not enhance the rate of methyl mercury production above what is observed in other natural systems.

Chromium and Zinc: Total chromium concentrations in the 10 Welch Creek wetland soil downstream samples ranged from 12.7 to 333 mg/kg, with a median concentration of 44.8 mg/kg (Table E-3). Hexavalent chromium was not detected (<2.1 mg/kg) in these samples. The concentration gradient also decreased with distance from the creek. However, as with mercury, the available chemical data does not allow differentiation of mill chromium sources from common sources of chromium that may be present in the watershed.

Total zinc concentrations in the eight Welch Creek wetland soil downstream samples ranged from 49.1 to 207 mg/kg, with a median of 68.2 mg/kg (Table E-3). Zinc concentrations in these samples were not significantly elevated above background and showed no pattern of decreasing concentration with distance from the creek.

Table E-3
Refined COPCs Analyzed in Wetland Soil (dry-weight basis)
Welch Creek

PARAMETER	CC-6	MT-1		MT-4			MT-6
	CCWS-01	WCWS-01	WCWS-02	MT04WL	WCWS-03[1]	WCWS-04	WCWS-05[1]
2,3,7,8-TCDD (ng/kg)	<3.48	<11.3	<3.35	1684	367/287	9.03	187/282
2,3,7,8-TCDF (ng/kg)	<10.2	26.3	20.2	8910	1700	69.3	632
Dioxin TEQ USEPA 1989[2] (ng/kg)	13	5.8	4.5	2575[5]	581/448	29	288/407
Dioxin TEQ WHO 1997 Mammalian[3] (ng/kg)	3.3	3.7	3.1	2575[5]	578/435	20	274/390
Dioxin TEQ WHO 1997 Avian[4] (ng/kg)	1.4	27	21	10594[5]	2100/1580	81	829/1090
Chromium (mg/kg)	12.7 Bu	7.8 Bu	9.7 Bu	127	55.9 /37.6	14.3	61.3/69.9
Chromium hexavalent (mg/kg)	<2.0	<1.6	<2.1	--	<1.4/<1.7	<1.8	<1.7/<1.8
Mercury (mg/kg)	<0.05 Nj	<0.05 Nj	<0.05 Nj	1.8	<0.05 Nj/0.52 Nj	<0.04 Nj	0.93 Nj/0.9 Nj
Methyl mercury (mg/kg)	0.00212	0.00089	--	--	0.00221	--	0.00296/0.00616
Zinc (mg/kg)	94.1 Nj	60.1 Nj	48.3 Nj	207	75.3 Nj/56.1 Nj	28.4 Nj	49.1 Nj/49.4 Nj

Notes:

[1] Second value is a duplicate result.

[2] Toxicity Equivalent, USEPA, 1989.

[3] Toxicity Equivalent, World Health Organization (WHO), 1997, mammalian factors.

[4] Toxicity Equivalent, World Health Organization (WHO), 1997, Avian factors.

[5] TEQ based on the results of 2,3,7,8-TCDD and 2,3,7,8-TCDF. This represents a minimum value of the TEQ, since other congeners were not analyzed.

B = analyte value is less than the Contract Required Detection Limit (CRDL), but equal to or greater than the Instrument Detection Limit (IDL). (Inorganic Data)

j = when specific QC criteria are outside the established control limits, the reported concentration or the Quantitation Limit is approximate.

N = spiked sample recovery exceeded the control limit.

u = analyte was present at less than 10 times the blank concentration for common laboratory constituents or less than 5 times the concentration in the associated calibration, method, atmospheric, and/or field blank for other organic or inorganic constituents, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).

< = concentration less than the Quantitation Limit.

-- = not measured or analyzed.

Table E-3 (Continued)
Refined COPCs Analyzed in Wetland Soil (dry-weight basis)
Welch Creek

PARAMETER	MT-6	MT-7	MT-8		MT-10	
	WCWS-06	MT07WL	WCWS-07	WCWS-08	WCWS-09	WCWS-10
2,3,7,8-TCDD (ng/kg)	<4.96	2911	629	223	636	<3.84
2,3,7,8-TCDF (ng/kg)	54.6	10195	3047	2113	4263	3.91
Dioxin TEQ USEPA 1989[2] (ng/kg)	14	4080	1021	457	1094	130
Dioxin TEQ WHO 1997 Mammalian[3] (ng/kg)	7.7	4090	1026	456	1117	37
Dioxin TEQ WHO 1997 Avian[4] (ng/kg)	55	13270	3760	2360	4980	22
Chromium (mg/kg)	12.7	333	82.6	36.6	42.8	37.6
Chromium hexavalent (mg/kg)	<1.4	--	<2.0 j	<0.87 j	<2.1 j	<0.80 j
Mercury (mg/kg)	<0.05 Nj	5.6	0.98 Nj	0.27 Nj	0.33 Nj	<0.05 Nj
Methyl mercury (mg/kg)	--	--	0.00537	--	0.00137	--
Zinc (mg/kg)	60.6 Nj	201	70.7 Nj	77.9 Nj	75.4 Nj	50.2 Nj

Notes:

[1] Second value is a duplicate result.

[2] Toxicity Equivalent, USEPA, 1989.

[3] Toxicity Equivalent, World Health Organization (WHO), 1997, mammalian factors.

[4] Toxicity Equivalent, World Health Organization (WHO), 1997, Avian factors.

[5] TEQ based on the results of 2,3,7,8-TCDD and 2,3,7,8-TCDF. This represents a minimum value of the TEQ, since other congeners were not analyzed.

B = analyte value is less than the Contract Required Detection Limit (CRDL), but equal to or greater than the Instrument Detection Limit (IDL). (Inorganic Data)

j = when specific QC criteria are outside the established control limits, the reported concentration or the Quantitation Limit is approximate.

N = spiked sample recovery exceeded the control limit.

u = analyte was present at less than 10 times the blank concentration for common laboratory constituents or less than 5 times the concentration in the associated calibration, method, atmospheric, and/or field blank for other organic or inorganic constituents, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).

< = concentration less than the Quantitation Limit.

-- = not measured or analyzed.

Table E-4
2,3,7,8-PCDD/PCDF in Wetland Soil (dry-weight basis)
Welch Creek

PARAMETER (ng/kg)	CC-6	MT-1		MT-4		
	CCWS-01	WCWS-01	WCWS-02	WCWS-03	WCWS-03 (DUP28)	WCWS-04
Dioxin TEQ USEPA 1989[1]	12.9	5.77	4.47	581	448	29
Dioxin WHO Avian TEQ 1997[2]	1.38	26.6	20.5	2096	1575	81
Dioxin WHO Mammalian TEQ 1997[3]	3.30	3.73	3.08	578	435	20
2,3,7,8-TCDD	<3.48	<11.3	<3.35	367	287	9.03
1,2,3,7,8-PeCDD	<7.47	<9.05	<4.41	13.6	<6.56	<10.5
1,2,3,4,7,8-HxCDD	<17.4	<9.34	<7.90	<37.7	<5.75	<3.58
1,2,3,6,7,8-HxCDD	<14.8	<8.06	<6.73	69.1	54.2	<3.24
1,2,3,7,8,9-HxCDD	<14.9	<8.06	<6.77	56.9	36.2	8.86
1,2,3,4,6,7,8-HpCDD	213	86.9	81.3	755	679	187
OCDD	10667	2269	1544	11520	13868	10125
2,3,7,8-TCDF	<10.2	26.3	20.2	1700	1279	69.3
1,2,3,7,8-PeCDF	<2.59	<11.2	<7.21	23.7	<14.9	<7.61
2,3,4,7,8-PeCDF	<2.33	<10.2	<6.13	<34.2	<14.7	<8.21
1,2,3,4,7,8-HxCDF	<7.24	<6.23	<2.22	36.4	23.7	<1.79
1,2,3,6,7,8-HxCDF	<5.42	<4.84	<1.81	<2.68	<2.45	<1.57
1,2,3,7,8,9-HxCDF	<5.04	<6.08	<1.99	<2.87	<2.65	<1.90
2,3,4,6,7,8-HxCDF	<6.01	<5.64	<1.84	<2.75	<2.60	<1.94
1,2,3,4,6,7,8-HpCDF	10.33	<10.0	8.74	80.9	81.7	12
1,2,3,4,7,8,9-HpCDF	<5.31	<2.15	<3.43	<19.8	<2.31	<3.24
OCDF	12.6	<7.91	10.3	210	465	<16.1
Total TCDD	--	--	--	466	330	9.03
Total PeCDD	--	--	--	13.6	--	--
Total HxCDD	--	--	25.6	632	421	44.4
Total HpCDD	469	187	184	1422	1312	376
Total TCDF	--	71.1	51.2	3301	2443	115
Total PeCDF	--	--	--	43.6	23.8	--
Total HxCDF	--	--	--	175	23.7	--
Total HpCDF	10.33	--	8.74	296	332	12

Notes:

(1) Toxicity equivalent, USEPA 1989.

(2) Toxicity equivalent. WHO avian 1997.

(3) Toxicity equivalent. WHO mammalian 1997.

E = analyte concentration exceeded the calibration range of the instrument. (Organic Data)

J = when specific QC criteria are outside the established control limits, the reported concentration or the Quantitation Limit is approximate.

< = concentration less than the Quantitation Limit.

-- = individual congeners of this homologue group not present.

Table E-4 (Continued)
2,3,7,8-PCDD/PCDF in Wetland Soil (dry-weight basis)
Welch Creek

PARAMETER (ng/kg)	MT-6			MT-7	MT-8		MT-10	
	WCWS-05	WCWS-05 (DUP27)	WCWS-06	MT07WL	WCWS-07	WCWS-08	WCWS-09	WCWS-10
Dioxin TEQ USEPA 1989[1]	288	407	14.2	4131	1035	458	1124	130
Dioxin WHO Avian TEQ 1997[2]	829	1091	55.5	13270	3756	2359	4979	22
Dioxin WHO Mammalian TEQ 1997[3]	274	390	7.75	4090	1026	456	1117	37
2,3,7,8-TCDD	187	282	<4.96	2911	629	223	636	<3.84
1,2,3,7,8-PeCDD	<13.8	<14.7	<4.82	<16.2	23.1	<9.67	<12.6	<10.6
1,2,3,4,7,8-HxCDD	14.6	16.4	<5.63	<10.3	28.5	<8.88	<7.38	14.8
1,2,3,6,7,8-HxCDD	46.7	48.5	<4.98	256	123	35.4	63.4	26
1,2,3,7,8,9-HxCDD	28.2	32.9	<13.4	144	93.9	25.2	40.9	48.4
1,2,3,4,6,7,8-HpCDD	994	1189	157	3734 B	1966	472	494	1789
OCDD	15004	19237	7163	42989 B	21613	10692	8215	102664 j
2,3,7,8-TCDF	632	797	54.6	10195 EBj	3047	2113	4263	3.91
1,2,3,7,8-PeCDF	<13.0	<9.67	<3.99	67.9	38	<11.7	44	<6.13
2,3,4,7,8-PeCDF	<12.0	<8.84	<2.88	115	31.2	18.3	67.5	<6.27
1,2,3,4,7,8-HxCDF	20.8	28	<2.35	76.5	29.5	<9.26	17.5	<2.83
1,2,3,6,7,8-HxCDF	<2.11	<1.88	<2.06	<8.18	<19.0	<8.01	<3.53	<2.47
1,2,3,7,8,9-HxCDF	<2.60	<2.35	<2.59	<9.56	<3.67	<4.88	<4.21	<3.21
2,3,4,6,7,8-HxCDF	<2.38	<2.16	<2.28	38.3 B	<3.47	<4.15	<4.12	<2.96
1,2,3,4,6,7,8-HpCDF	128	156	<15.4	505	211	22	54.1	<3.09
1,2,3,4,7,8,9-HpCDF	10.9	<20.4	<3.75	<13.7	18.3	<7.07	<6.85	<3.28
OCDF	357	453	14.2	2953	913	60.1	153	38.4
Total TCDD	298	391	--	3298	790	247	708	--
Total PeCDD	30.5	--	--	--	82.3	--	--	--
Total HxCDD	400	439	--	1277	998	278	479	532
Total HpCDD	1979	2289	354	6812 B	3861	1040	1015	3496
Total TCDF	1128	1407	82.9	16509 B	5678	3953	8193	15.7
Total PeCDF	--	--	--	535	96	18.3	112	--
Total HxCDF	190	228	--	952 B	271	--	51.9	--
Total HpCDF	565	642	--	2720	874	76.9	181	--

Notes:

(1) Toxicity equivalent, USEPA 1989.

(2) Toxicity equivalent. WHO avian 1997.

(3) Toxicity equivalent. WHO mammalian 1997.

E = analyte concentration exceeded the calibration range of the instrument. (Organic Data)

B = analyte was present in the method blank. (Organic Data)

j = when specific QC criteria are outside the established control limits, the reported concentration or the Quantitation Limit is approximate.

< = concentration less than the Quantitation Limit.

-- = individual congeners of this homologue group not present.

Wetland Water

Wetland water had concentrations of all constituents except dioxin below the ecological risk screening levels. Dioxin concentrations for wetland water samples are presented in Table E-5 and Table E-6. Mercury was screened out of consideration for wetland water since the maximum methyl mercury concentration detected in wetland water was 0.002285 mg/L, well below the 0.14 mg/L USEPA screening value for ecological risk.

2,3,7,8-PCDD/PCDF: The 2,3,7,8-TCDD congener was reported in two of the eight downstream wetland water locations in Welch Creek at 0.049 ng/L (WCWW-03, midpoint at MT-4) and 0.181 ng/L (WCWW-07, midpoint at MT-7). Dioxin TEQs (USEPA, 1989) in the eight Welch Creek wetland water downstream samples ranged from 8.2×10^{-5} to 3×10^{-1} ng/L, with a median of 1.6×10^{-3} ng/L. OCDD was the congener present at the highest concentration. Given the elevated concentrations of total suspended solids (90 and 200 mg/L) present in the two wetland water samples containing the highest levels of 2,3,7,8 TCDD, it appears that the dioxin TEQs (USEPA, 1989) at these locations are the result of measuring dioxin TEQ (USEPA, 1989) associated with TSS suspended during the sampling process. No apparent trend with location in the wetland was observed.

Table E-5
Refined COPCs Analyzed in Wetland Water
Welch Creek

PARAMETER	CC-6	MT-1		MT-4		MT-6
	CCWW-01	WCWW-01	WCWW-02	WCWW-03	WCWW-04	WCWW-05[1]
2,3,7,8-TCDD (ng/L)	<0.002	<0.002	<0.003	0.049	<0.003	0.010/0.011
2,3,7,8-TCDF (ng/L)	<0.001	<0.002	<0.002	0.334	<0.008	0.030
Dioxin TEQ USEPA 1989[2] (ng/L)	0.00034	0.00013	ND	0.085	0.00063	0.014/0.017
Dioxin TEQ WHO 1997 Mammalian[3] (ng/L)	0.00015	0.000049	ND	0.084	0.00016	0.013/0.017
Dioxin TEQ WHO 1997 Avian[4] (ng/L)	0.000034	0.000013	ND	0.38	0.000063	0.040/0.062

PARAMETER	MT-6	MT-8		MT-10	
	WCWW-06	WCWW-07	WCWW-08	WCWW-09	WCWW-10
2,3,7,8-TCDD (ng/L)	<0.002	0.181	<0.003	<0.005	<0.003
2,3,7,8-TCDF (ng/L)	<0.002	1.05	0.012	0.010	<0.002
Dioxin TEQ USEPA 1989[2] (ng/L)	0.000082	0.30	0.0015	0.0017	0.0012
Dioxin TEQ WHO 1997 Mammalian[3] (ng/L)	0.000008	0.30	0.0014	0.0012	0.00029
Dioxin TEQ WHO 1997 Avian[4] (ng/L)	0.0000082	1.2	0.012	0.010	0.00012

Notes:
(1) Second value is a duplicate result.
(2) Toxicity Equivalent, USEPA, 1989.
(3) Toxicity Equivalent, World Health Organization (WHO), 1997, mammalian factors.
(4) Toxicity Equivalent, World Health Organization (WHO), 1997, Avian factors.
< = concentration less than the Quantitation Limit.
ND = no 2,3,7,8-substituted congeners were detected.

Table E-6
2,3,7,8-PCDD/PCDF in Wetland Water
Welch Creek

PARAMETER (ug/L)	CC-6	MT-1		MT-4	
	CCWW-01	WCWW-01	WCWW-02	WCWW-03	WCWW-04
Dioxin TEQ USEPA 1989[1]	0.00034	0.0001	0.00	0.085	0.00063
Dioxin WHO Avian TEQ 1997[2]	0.000034	0.00001	0.00	0.38	0.00006
Dioxin WHO Mammalian TEQ 1997[3]	0.00015	0.00005	0.00	0.084	0.00016
2,3,7,8-TCDD	<0.002	<0.002	<0.003	0.049	<0.003
1,2,3,7,8-PeCDD	<0.008	<0.004	<0.005	<0.006	<0.005
1,2,3,4,7,8-HxCDD	<0.005	<0.003	<0.003	<0.008	<0.004
1,2,3,6,7,8-HxCDD	<0.003	<0.003	<0.003	<0.007	<0.003
1,2,3,7,8,9-HxCDD	<0.004	<0.003	<0.003	<0.007	<0.003
1,2,3,4,6,7,8-HpCDD	0.013	0.004	<0.004	0.099	0.011
OCDD	0.213	0.087	0.014 u	1.69	0.52
2,3,7,8-TCDF	<0.001	<0.002	<0.002	0.334	<0.008
1,2,3,7,8-PeCDF	<0.004	<0.005	<0.005	<0.007	<0.006
2,3,4,7,8-PeCDF	<0.004	<0.005	<0.005	<0.006	<0.005
1,2,3,4,7,8-HxCDF	<0.006	<0.003	<0.003	<0.003	<0.002
1,2,3,6,7,8-HxCDF	<0.004	<0.003	<0.002	<0.002	<0.002
1,2,3,7,8,9-HxCDF	<0.005	<0.003	<0.002	<0.003	<0.002
2,3,4,6,7,8-HxCDF	<0.005	<0.003	<0.002	<0.002	<0.002
1,2,3,4,6,7,8-HpCDF	<0.003	<0.004	<0.003	<0.005	<0.004
1,2,3,4,7,8,9-HpCDF	<0.004	<0.004	<0.003	<0.006	<0.004
OCDF	<0.012	<0.009	<0.005	0.02	<0.007
Total TCDD	--	--	--	0.049	--
Total PeCDD	--	--	--	--	--
Total HxCDD	--	--	--	0.036	--
Total HpCDD	0.013	0.004	--	0.189	0.027
Total TCDF	--	--	--	0.621	--
Total PeCDF	--	--	--	--	--
Total HxCDF	--	--	--	--	--
Total HpCDF	--	--	--	0.019	--

Notes:

(1) Toxicity equivalent, USEPA 1989.

(2) Toxicity equivalent. WHO avian 1997.

(3) Toxicity equivalent. WHO mammalian 1997.

u = analyte was present at less than 10 times the blank concentration for common laboratory constituents or less than 5 times the concentration in the associated calibration, method, atmospheric, and/or field blank for other organic or inorganic constituents, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).

< = concentration less than the Quantitation Limit.

-- = individual congeners of this homologue group not present.

Table E-6 (Continued)
2,3,7,8-PCDD/PCDF in Wetland Water
Welch Creek

PARAMETER (ng/L)	MT-6			MT-8		MT-10	
	WCWW-05	WCWW-05 (DUP26)	WCWW-06	WCWW-07	WCWW-08	WCWW-09	WCWW-10
Dioxin TEQ USEPA 1989[1]	0.014	0.017	0.000082	0.30	0.0015	0.002	0.0012
Dioxin WHO Avian TEQ 1997[2]	0.040	0.062	0.0000082	1.2	0.012	0.01	0.00012
Dioxin WHO Mammalian TEQ 1997[3]	0.013	0.017	0.0000082	0.30	0.0014	0.001	0.00029
2,3,7,8-TCDD	0.01	0.011	<0.002	0.181	<0.003	<0.005	<0.003
1,2,3,7,8-PeCDD	<0.005	<0.004	<0.007	<0.009	<0.004	<0.006	<0.005
1,2,3,4,7,8-HxCDD	<0.007	<0.006	<0.006	0.011	<0.007	<0.010	<0.008
1,2,3,6,7,8-HxCDD	<0.006	<0.005	<0.005	0.029	<0.006	<0.009	<0.008
1,2,3,7,8,9-HxCDD	<0.006	<0.005	<0.005	0.026	<0.006	<0.009	<0.007
1,2,3,4,6,7,8-HpCDD	0.027	0.041	<0.006	0.594	0.014	0.016	0.019
OCDD	0.26	0.395	0.082	5.48	0.19	0.544	0.994
2,3,7,8-TCDF	0.03	0.051	<0.002	1.05	0.012	0.01	<0.002
1,2,3,7,8-PeCDF	<0.005	<0.004	<0.004	<0.005	<0.004	<0.004	<0.005
2,3,4,7,8-PeCDF	<0.005	<0.003	<0.004	<0.005	<0.004	<0.003	<0.005
1,2,3,4,7,8-HxCDF	<0.004	<0.005	<0.004	<0.006	<0.007	<0.005	<0.005
1,2,3,6,7,8-HxCDF	<0.004	<0.005	<0.003	<0.006	<0.006	<0.005	<0.005
1,2,3,7,8,9-HxCDF	<0.004	<0.005	<0.004	<0.006	<0.006	<0.005	<0.005
2,3,4,6,7,8-HxCDF	<0.004	<0.005	<0.004	<0.006	<0.006	<0.005	<0.005
1,2,3,4,6,7,8-HpCDF	<0.003	<0.004	<0.002	0.043	<0.003	<0.004	<0.005
1,2,3,4,7,8,9-HpCDF	<0.003	<0.005	<0.002	0.006	<0.004	<0.005	<0.006
OCDF	0.012	<0.013	<0.012	0.117	<0.015	<0.012	<0.012
Total TCDD	0.01	--	--	0.221	--	--	--
Total PeCDD	--	--	--	0.022	--	--	--
Total HxCDD	--	--	--	0.236	--	--	--
Total HpCDD	0.043	0.07	--	1.1	0.026	0.036	0.041
Total TCDF	0.043	0.077	--	1.9	0.019	0.016	--
Total PeCDF	--	--	--	--	--	--	--
Total HxCDF	--	--	--	--	--	--	--
Total HpCDF	--	--	--	0.159	--	--	--

Notes:

(1) Toxicity equivalent, USEPA 1989.

(2) Toxicity equivalent. WHO avian 1997.

(3) Toxicity equivalent. WHO mammalian 1997.

u = analyte was present at less than 10 times the blank concentration for common laboratory constituents or less than 5 times the concentration in the associated calibration, method, atmospheric, and/or field blank for other organic or inorganic constituents, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).

< = concentration less than the Quantitation Limit.

-- = individual congeners of this homologue group not present.

Observed Wetland Conditions

Since North Carolina assesses wetland conditions based upon functionality without specific chemical standards, wetland conditions were also evaluated considering the conclusions of the North Carolina Coastal Region Evaluation of Wetland Significance (NC-CREWS) program instituted by the State of North Carolina's Division of Coastal Management. This program, uses field collected data to assess specific qualities of coastal watersheds using a wetland functional model and then compiles and synthesizes the information using Geographic Information System (GIS) software. Wetland scientists conduct on-location visits to gather functional data on 39 parameters for each wetland evaluated and then review the GIS data for accuracy. Information on the 39 parameters is segregated into three main wetland functions: Water Quality Functions, Wildlife Habitat Functions, and Hydrology Functions. The overall rating of a wetland is dependent on the scores assigned to each of the three main wetland functions. After consideration of the various factors a rating level was assigned to reflect the following functionality (NC-CREWS, 2005):

Text Box E-1
Data Sources for Sediment Characterization

- Overall Characterization - Welch Creek
- Ten Master Transects – Chemical and physical characteristics
- 25 General Transects – Physical characteristics/some chemical testing
- Top, mid, and deep core samples as well as fine-layer surface sediment samples for chemical analysis
- 24 top 5 cm SWAC samples for dioxin testing
- Five paired Benthic Community Surveys
- Grain size analysis for midstream sediments
- Reference Creek – Conaby Creek
- Three transects

- Beneficial Significance - indicates that a wetland performs the three main functions at below normal levels or not at all.
- Substantial Significance – indicates that a wetland performs the three main functions at normal or slightly above normal levels.
- Exceptional Significance – indicates that a wetland performs the three main functions at well above normal levels.

The Welch Creek wetlands as well as most of the near-by wetland areas associated with the Lower Roanoke River were rated as a mixture of Substantial Significance or Exceptional Significance based on the NC-CREWS reflecting their exceptional value and overall healthy condition. A colored map of these areas is included as Figure 2.4 in the Welch Creek FS.

b. Sediments

The wastewater solids and native sediments were evaluated through a multi-phase sampling program that included the evaluation of the depth of wastewater solids deposits, as well as the chemical and physical characteristics of the deposits using small and large depth interval samples. Text Box E-1 summarizes the various data collected to characterize the sediment deposits.

Two primary types of wastewater solids were identified in Welch Creek. The downstream pre-1970 wastewater solids are composed of olive-brown to black sand and silty-clay material with a median dioxin TEQ (USEPA, 1989a) of 56 ng/kg. The post-1970 wastewater solids are composed of olive-green to black material with a median dioxin TEQ of 1,962 ng/kg, a higher organic and water content, and more clay sized particles.

Dioxin Concentrations in Sediment

Sediment samples were collected as bulk core and surficial Ponar samples as well as fine layer core samples. Table E-7 summarizes the range of dioxin TEQ concentrations measured in the various samples. Note that these values are expressed in units of ng/kg. Given that one ng/kg is equal to 0.001 ug/kg, the maximum value listed below, 7600 ng/kg, is equal to 7.6 ug/kg. The cleanup goal in later sections is expressed in units of ug/kg.

Table E-7
Concentration Ranges of Dioxin in Sediment Samples

Description of Sample Locations[1]	Range of Concentration (ng/kg)[3]	Median Concentrations (ng/kg)	Average Surficial Concentration (ng/kg)[2]
Conaby Creek Sediment	1.38 to 190	70	80
Welch Creek Sediment MT-1 and MT-2	0.01 to 170	1.0	60
Welch Creek Sediment MT-4, MT-5, and MT-6	60 to 5700	1700	2500
Fine Layer Samples MT-4, MT-5, and MT-6	600 to 6200	2000	2500
SWAC Samples MT-5 and GT-7	400 to 7600	1400	2200
Welch Creek Sediment MT-7 and MT-8	6 to 120	30	60

NOTES:

1. Samples collected in 1995, 1999, and 2004.
2. Surficial samples are those where top depth is 0 feet.
3. All dioxin (I-TEQ and other) results presented without normalization to organic carbon

These data clearly affirm that the highest concentrations of 2,3,7,8-PCDD/PCDFs were observed in sediment samples collected at the upstream reach (MT-4, MT-5, and MT-6). Where vertical sediment profiles were available in this reach of the creek (MT-5 and MT-6), the highest concentration vertically was also located at the mid-depth of the sediment core, possibly related to the suggested time frame of highest chlorine use at the facility. Figure 2-8 in the FS presents the sediment concentrations measured at each location within Welch Creek. In all samples, OCDD was the congener present at the highest concentration.

Several methods of multivariate analysis were used to differentiate atmospheric background concentration levels from the wastewater solids profile in the Welch Creek samples. The analysis showed that the Conaby Creek sediment profile is similar to the typical atmospheric depositional

profile reported in the literature and that upstream sediment samples from MT-1 and MT-2 had a relatively weak wastewater solids influence.

Recent fine-layer core samples were collected at four locations with three of those coincident with shallow sediment samples collected in 1999. These data confirm that there is limited natural burial occurring in Welch Creek. This condition is attributed to the limited watershed sediment loading (as confirmed by baseline monitoring that measured 2 to 12 mg/L total suspended solids over several months of monitoring). It was also confirmed by hydrologic modeling that suggested over banking into the wetlands was common and non erosive.

Mercury Concentrations in Sediment

Mercury analysis in sediment confirmed that there are areas of elevated mercury concentrations in the midstream reach of the creek. Concentrations in surface sediments in this area ranged from 0.2 to 15.1 mg/kg. The concentration with depth was variable depending upon location. The potential bioavailability of these elevated mercury concentrations were further assessed by measuring the ratio of acid volatile sulfide (AVS) with Simultaneously Extracted Metals (SEM).

For all but one of the samples analyzed from Welch Creek or Conaby Creek, the AVS/SEM ratio was greater than one, indicating there is sufficient sulfide in the sediment to bind existing mercury and other metals in the sediment into insoluble solid phases. The exception is MT-7 in 2006 where the ratio was 0.73 due to an AVS of <1 µmol/g despite low mercury concentration in SEM. However, this single result should not be interpreted as evidence for the availability of the mercury in that sediment. Studies have indicated that the relative availability of metals in sediment for which AVS is less than the total metal concentration can be predicted from the relative solubility of the sulfide complexes for metals present, in which case HgS is particularly insoluble among the metal sulfides. In addition, the AVS/SEM ratios for samples from Conaby Creek were comparable with Welch Creek despite much lower total mercury concentrations in Conaby Creek. Thus, the mercury in sediment in Welch Creek may be no more bioavailable than mercury contained in the sediment of Conaby Creek. This apparent reduced bioavailability of mercury is one of several factors discussed elsewhere (as in Section 2.12.4.2) that support why cleanup goals for mercury in sediment, surface water, and wetland soil and water were not selected.

Chromium and Zinc

Chromium: Total chromium concentrations in the Welch Creek sediment samples from the 10 master transect locations and the one general transect location ranged from 2.3 to 2,740 mg/kg (see Table E-8). Hexavalent chromium was not detected (<0.26 to <2.1 mg/kg) in the sediment. Total chromium was detected at the upstream location (MT-1) at concentrations below the Conaby Creek background. Total chromium was detected above Conaby Creek background concentrations at MT-2 through MT-10 and at GT-22. The highest total chromium concentrations were reported at MT-8. Chromium concentrations were highest in the pre-1970 wastewater solid deposits.

Table E-8
Refined COPCs Analyzed in Sediment (dry-weight basis)
Welch Creek

TRANSECT	SAMPLE I.D.	SAMPLE INTERVAL IN FEET	MATERIAL TYPE	2,3,7,8-TCDD (ng/kg)	2,3,7,8-TCDF (ng/kg)	DIOXIN TEQ USEPA 1989[1] (ng/kg)	DIOXIN TEQ WHO 1997 MAMMALIAN[2] (ng/kg)	DIOXIN TEQ WHO 1997 AVIAN[3] (ng/kg)	CHROMIUM (mg/kg)	HEXAVALENT CHROMIUM (mg/kg)	MERCURY (mg/kg)	ZINC (mg/kg)
Welch Creek												
MT-1	WCSD-01	0.0 - 0.5	Sand	< 1.19	2.26	1.3	0.48	2.4	2.3	< 0.26 j	< 0.05 Nj	6.5 Nj
	MT01MP-60-00N	0.0 - 0.7	Sand	0.59	4.04	0.99 [4]	0.99 [4]	4.63 [4]	3.2	--	< 0.02	6
	MT01MP-60-01N	1.0 - 2.0	Clay	< 0.67	< 0.48	0.00 [4]	0.00 [4]	0.00 [4]	7.8	--	0.03 B	9.8
	MT01MP-60-02N	2.0 - 3.0	Clay	< 0.10	< 0.06	0.00 [4]	0.00 [4]	0.00 [4]	3.1	--	< 0.02	2.9 u
MT-2	MT02MP-30-0S	0.0 - 0.5	WWS1	112	567	169 [4]	169 [4]	679 [4]	64.6	--	0.66	89.2
	MT02MP-30-1N	0.5 - 1.5	Clay	2.25	14.4	22	11	20	27.1	--	0.12 B	60.2
	MT02MP-30-2N	1.5 - 2.5	Clay	< 0.44	1.26	0.13 [4]	0.13 [4]	1.26 [4]	23.4	--	0.10 B	48
MT-3	MT03MP-110-0S	0.0 - 0.5	WWS1	571 Ej	3009 Ej	872 [4]	872 [4]	3580 [4]	93.8	--	0.78	164
	MT03MP-110-1N	0.8 - 2.8	Clay	1.10	3.62	1.46 [4]	1.46 [4]	4.72 [4]	25.6	--	0.11 B	54.2
	MT03MP-110-2N	1.8 - 2.8	Clay	< 0.90	< 1.3	0.00 [4]	0.00 [4]	0.00 [4]	29.8	--	0.10 B	48.2
MT-4	MT04MP-40-0S	0.0 - 3.0	WWS1	3412 Ej	22579 Ej	5670 [4]	5670 [4]	25991 [4]	111	--	0.54	399
	MT04MP-40-3S	3.0 - 6.3	WWS1	1778	11839 Ej	2955	2998	13,634	349	--	0.82	379
	MT04MP-40-6N	6.3 - 7.3	Clay	< 0.83	1.79	0.18 [4]	0.18 [4]	1.79 [4]	32.2	--	0.30	70.4
	MT04MP-40-6ND	6.3 - 7.3	Clay	< 0.37	2.46	0.25 [4]	0.25 [4]	2.46 [4]	36.3	--	0.28	75.4
	MT04MP-40-7N	7.3 - 8.3	Peat	59.4	407	100 [4]	100 [4]	466 [4]	27	--	< 0.11	46.5
MT-5	MT05MP-50-PG	0.0 - 0.5	WWS1	865	7037 Ej	1569 [4]	1569 [4]	7902 [4]	121	--	0.84	221
	MT05LB-20-SUR	Flocculant	WWS1	855	6936 B	1549 [4]	1549 [4]	7791 [4]	112	--	0.43 Nj	215
	MT05LB-20-00-05	0.0 - 0.17	WWS1	1024	8883 Ej	1962	1987	9996	114	--	0.74	221
	MT05LB-20-05-10	0.17 -0.33	WWS1	1656 Ej	17505 Ej	3474	3511	19,340	97.5	--	0.57	313
	MT05LB-20-MP	Midpoint	WWS1	3383.3 Ej	10748 Ej	4536	4594	14,298	443	--	3.7	260
	MT05MP-50-00S	0.0 - 0.7	WWS1	3011 Ej	20876 Ej	5099 [4]	5099 [4]	23887 [4]	192	--	0.97	369
	MT05MP-50-01S	0.7 - 1.4	WWS1	986	2758 Ej	1262 [4]	1262 [4]	3744 [4]	377	--	7.5	224
	MT05LB-20-N	Native	Native	< 0.51	10.5	58	26	25	88	--	1.9	104
	MT05MP-50-02N	1.5 - 2.5	Clay	< 1.8	6.68	0.67 [4]	0.67 [4]	6.68 [4]	31.6	--	0.19	84.3
	MT05MP-50-03N	2.5 - 3.5	Clay	< 1.1	3.67	0.37 [4]	0.37 [4]	3.67 [4]	26.8	--	0.13	60.5
	MT05MP-50-03ND	2.5 - 3.5	Clay	< 0.9	6.68	0.67 [4]	0.67 [4]	6.68 [4]	31.8	--	0.18	73.9

Notes:
(1) Toxicity equivalent, USEPA, 1989.
(2) Toxicity Equivalent, World Health Organization (WHO), 1997, mammalian factors.
(3) Toxicity Equivalent, World Health Organization (WHO), 1997, Avian factors.
(4) TEO based on the results of 2,3,7,8-TCDD and 2,3,7,8-TCDF. This represents a minimum value of the TEO, since other congeners were not analyzed.
WWS = wastewater solids, gelatinous.
WWS1 - wastewater solids, flocculant.
< = concentration less than the Quantitation Limit.
-- = not measured or analyzed.
E = analyte concentration exceeded the calibration range of the instrument. (Organic Data)
j = when specific QC criteria are outside the established control limits, the reported concentration or the Quantitation Limit is approximate.
N = spiked sample recovery exceeded the control limit.
B = analyte value is less than the Contract Required Detection Limit (CRDL), but equal to or greater than the Instrument Detection Limit (IDL). (Inorganic Data)
B = analyte was present in the method blank. (Organic Data)
u = analyte was present at less than 10 times the blank concentration for common laboratory constituents or less than 5 times the concentration in the associated calibration, method, atmospheric, and/or field blank for other organic or inorganic constituents, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).

Table E-8 (Continued)
Refined COPCs Analyzed in Sediment (dry-weight basis)
Welch Creek

TRANSECT	SAMPLE I.D.	SAMPLE INTERVAL IN FEET	MATERIAL TYPE	2,3,7,8-TCDD (ng/kg)	2,3,7,8-TCDF (ng/kg)	DIOXIN TEQ USEPA 1989[1] (ng/kg)	DIOXIN TEQ WHO 1997 MAMMALIAN[2] (ng/kg)	DIOXIN TEQ WHO 1997 AVIAN[3] (ng/kg)	CHROMIUM (mg/kg)	HEXAVALENT CHROMIUM (mg/kg)	MERCURY (mg/kg)	ZINC (mg/kg)
Welch Creek (Continued)												
MT-6	WCSD-02	0.0 - 0.5	WWS	565	2507	875	852	3090	1010	< 1.1 j	12.6 Nj	203 Nj
	MT06MP-40-SUR	Flocculant	WWS	810	4712 B	1281 [4]	1281 [4]	5522 [4]	222	--	0.82 Nj	175
	MT06MP-40-00-05	0.0 - 0.17	WWS	880	5050 Ej	1426	1437	5993	191	--	1.4	143
	MT06MP-40-00S	0.0 - 4.0	WWS	1216	5052 Ej	1721 [4]	1721 [4]	6268 [4]	204	--	5.00	103
	MT06MP-40-00SD	0.0 - 4.0	WWS	1249	4881 Ej	1737 [4]	1737 [4]	6130 [4]	217	--	5.5	107
	MT06MP-40-04S	4.0 - 8.0	WWS	40.2	172	57 [4]	57 [4]	212 [4]	1010	--	12.9	279
	MT06MP-40-04SD	4.0 - 8.0	WWS	63.6	224	86 [4]	86 [4]	288 [4]	1030	--	12.1	298
	MT06MP-40-05-10	0.17 - 0.33	WWS	1338	6002 Ej	1991	2004	7420	82.6	--	0.98	46
	MT06MP-40-MP	Midpoint	WWS	30.4	89.8	122	115	162	476	--	8.5	194
	MT06MP-40-09N	9.0 - 10.0	Clay	< 0.77	4.07	38	12	10	25.1	--	0.12	65.5
	MT06MP-40-10N	10.0 - 11.0	Peat	< 2.4	< 0.96	0.00 [4]	0.00 [4]	0.00 [4]	14.8 u	--	< 0.16	40.9
MT-7	MT07MP-40-01S	1.0 - 4.0	WWS	3.8	21	17	16	37	664	--	4.3	110
	MT07MP-40-01SD	1.0 - 4.0	WWS	3.3	29	6.2 [4]	6.2 [4]	32 [4]	285	--	8.3	86.5
	MT07MP-40-06S	6.0 - 14.0	WWS	4.17	13.1	118	63	40	237	--	0.48	95.5
	MT07MP-40-14N	14.0 - 15.0	Clay	< 0.89	< 1.1	0.00 [4]	0.00 [4]	0.00 [4]	30.9	--	0.09	64.9
	MT07MP-40-15N	15.0 - 16.0	Peat	< 0.99	< 0.34	0.00 [4]	0.00 [4]	0.00 [4]	38.9	--	0.10	60.4
MT-8	WCSD-03	0.0 - 0.5	WWS	53.8	220	90	83	277	676	< 1.3 j	15.1 Nj	165 Nj
	MT08MP-70-SUR	Flocculant	WWS	128	724 B	200 [4]	200 [4]	852 [4]	468	--	10.2 Nj	135
	MT08MP-70-00-05	0.0 - 0.17	WWS	20.4	68.8 B	46	43	105	714	--	14.6	228
	MT08MP-70-00S	0.0 - 4.0	WWS	15	46	20 [4]	20 [4]	61 [4]	1320	--	6.9	200
	MT08MP-70-05-10	0.17 - .33	WWS	31.7	138 B	65	58	176	724	--	12.7	211
	MT08MP-70-14S	14.5 - 15.5	WWS	5.7	25	8.2 [4]	8.2 [4]	30.7 [4]	2740	--	2.0	224
	MT08MP-70-MP	Midpoint	WWS	< 2.70	21.5	15	9.0	25	1840	--	4.0	219
	MT08MP-70-15N	15.5 - 16.5	Clay	< 1.4	< 0.97	0.00 [4]	0.00 [4]	0.00 [4]	50.9	--	0.15 B	88.3
	MT08MP-70-16N	16.5 - 17.5	Clay	< 1.7	< 0.82	0.00 [4]	0.00 [4]	0.00 [4]	52.1	--	0.17 B	71.1
	MT08MP-70-NAT	Native	Native	< 0.70	< 0.28	30	9	4	49.1	--	0.07	101

Notes:

(1) Toxicity equivalent, USEPA, 1989.

(2) Toxicity Equivalent, World Health Organization (WHO), 1997, mammalian factors.

(3) Toxicity Equivalent, World Health Organization (WHO), 1997, Avian factors.

(4) TEQ based on the results of 2,3,7,8-TCDD and 2,3,7,8-TCDF. This represents a minimum value of the TEQ, since other congeners were not analyzed.

WWS = wastewater solids, gelatinous.

WWS1 - wastewater solids, flocculant.

< = concentration less than the Quantitation Limit.

-- = not measured, analyzed, or calculated.

E = analyte concentration exceeded the calibration range of the instrument. (Organic Data)

j = when specific QC criteria are outside the established control limits, the reported concentration or the Quantitation Limit is approximate.

N = spiked sample recovery exceeded the control limit.

B = analyte value is less than the Contract Required Detection Limit (CRDL), but equal to or greater than the Instrument Detection Limit (IDL). (Inorganic Data)

B = analyte was present in the method blank. (Organic Data)

u = analyte was present at less than 10 times the blank concentration for common laboratory constituents or less than 5 times the concentration in the associated calibration, method, atmospheric, and/or field blank for other organic or inorganic constituents, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).

Table E-8 (Continued)
Refined COPCs Analyzed in Sediment (dry-weight basis)
Welch Creek

TRANSECT	SAMPLE I.D.	SAMPLE INTERVAL IN FEET	MATERIAL TYPE	2,3,7,8-TCDD (pg/kg)	2,3,7,8-TCDF (pg/kg)	DIOXIN TEQ USEPA 1989[1] (pg/kg)	DIOXIN TEQ WHO 1997 MAMMALIAN[2] (pg/kg)	DIOXIN TEQ WHO 1997 AVIAN[3] (pg/kg)	CHROMIUM (mg/kg)	HEXAVALENT CHROMIUM (mg/kg)	MERCURY (mg/kg)	ZINC (mg/kg)
Welch Creek (Continued)												
MT-9	MT09MP-30-0S	0.0 - 2.0	WWS	56.4	364	92.8 [4]	92.8 [4]	420 [4]	35.6	--	0.20	35.3
	MT09MP-30-2S	2.0 - 3.0	WWS	30.6	206	51.2 [4]	51.2 [4]	237 [4]	40.4	--	0.14	40.7
	MT09MP-30-7S	7.5 - 8.5	WWS	66	112	77 [4]	77 [4]	178 [4]	2030	--	12.6	285
	MT09MP-30-8N	8.5 - 9.5	Clay	1.10	0.65 Bu	1.17 [4]	1.17 [4]	1.75 [4]	48.4	--	0.12	103
	MT09MP-30-9N	10.0 - 11.0	Clay	< 1.96	< 0.53	0.00 [4]	0.00 [4]	0.00 [4]	47	--	0.08	85.4
MT-10	MT10MP-80-PG	0.0 - 0.5	WWS	236	1498 EBi	386 [4]	386 [4]	1734 [4]	155	--	0.85	171
	MT10MP-60-0S	0.0 - 1.0	WWS	159	826	242 [4]	242 [4]	985 [4]	591	--	11.1	265
	MT10MP-60-1S	1.0 - 2.0	WWS	34.3	123	46.6 [4]	46.6 [4]	157 [4]	685	--	3.9	212
	MT10MP-60-2N	2.0 - 3.0	Clay	< 0.59	3.73	0.37 [4]	0.37 [4]	3.73 [4]	56	--	0.12	125
	MT10MP-60-3N	3.0 - 4.0	Clay	< 0.68	< 0.63	0.00 [4]	0.00 [4]	0.00 [4]	54.3	--	0.12	109
GT-22	GT22-030-0S	Midpoint	WWS	197	1185	316 [4]	316 [4]	1382 [4]	81.4	--	0.41	158
	GT22-030-1S	Midpoint	WWS	1392 Ei	5451 Ei	1937 [4]	1937 [4]	6843 [4]	240	--	1.8	203
	GT22-030-5N	Midpoint	Native	27.5	90.9	94	56	130	133	--	0.64	104
	GT22-030-6N	Midpoint	Native	12.7	46.4	17	17	59	67.2	--	0.24	92.5
Conaby Creek, Background												
CC-5	CC5-30-0N	Midpoint	Native	2.31	1.85 Bu	2.50 [4]	2.50 [4]	4.16 [4]	36.1	--	0.15	75.3
CC-6	CCSD-01	0.0 - 0.5	Native	< 9.87	1.52	126	43	20	38.4	< 2.1 j	0.31 Ni	166 Ni
	CC6-40-0N	Midpoint	Native	1.81	< 1.54	190	61	32	41.8	--	0.17	93.4
CC-8	CCSD-02	0.0 - 0.5	Native	5.18	< 6.61	136	45	25	48.6	< 1.1 j	0.3 Ni	211 Ni
	CC8-40-0N	Midpoint	Native	2.03	7.30 Bu	2.76 [4]	2.76 [4]	9.33 [4]	35.8	--	0.14	81.7
	CC8-40-0ND	Midpoint	Native	< 2.22	< 1.28	0.00 [4]	0.00 [4]	0.00 [4]	41.5	--	0.14	89
CC-10	CCSD-03	0.0 - 0.5	Native	--	--	--	--	--	--	--	0.2	--

Notes:

[1] Toxicity equivalent. USEPA. 1989.

[2] Toxicity Equivalent. World Health Organization (WHO). 1997. mammalian factors.

[3] Toxicity Equivalent. World Health Organization (WHO). 1997. Avian factors.

[4] TEQ based on the results of 2,3,7,8-TCDD and 2,3,7,8-TCDF. This represents a minimum value of the TEQ, since other congeners were not analyzed.

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WWS1 - wastewater solids, flocculant.

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B = analyte was present in the method blank. (Organic Data)

u = analyte was present at less than 10 times the blank concentration for common laboratory constituents or less than 5 times the concentration in the associated calibration, method, atmospheric, and/or field blank for other organic or inorganic constituents, and is therefore qualified as nondetectable (u) according to USEPA data validation procedures (USEPA, 1994 and 1999).

Zinc: Zinc concentrations in the 1999 Welch Creek sediment samples from the 10 master transect locations and the one general transect location ranged from < 2.9 to 369 mg/kg (Table E-8). Zinc concentrations in most of the sediment samples were near or below background Conaby Creek sediment sample concentrations.

c. Surface Water

Welch Creek surface water samples were collected in 1995, 1999, 2000, 2004, and 2005 and analyzed for mercury and dioxin as well as other constituents. There was no detectable mercury measured in 23 samples analyzed using standard detection limits. Three sample locations were then supplemented with low level mercury testing that confirmed detected mercury was below the water quality standard of 12 ng/L, with even lower levels of methyl mercury quantified (0.3 to 0.5 ng/L). Thus, no additional mercury data in surface water were collected during supplemental data collection or pilot study activities. Additional surface water samples for dioxin analysis were collected during the pilot studies in response to concerns raised by state agency representatives regarding possible releases to the Lower Roanoke River.

Table E-9 summarizes the results of the dioxin testing for 2,3,7,8-TCDD as that is the regulated dioxin congener.

Table E-9
Summary of Surface Water Sampling Results for Dioxin

Sampling Activity	Type of Sample	Total Number of Samples Collected	Concentration of 2,3,7,8 TCDD in Surface Water (ng/L)	Number of Samples Above NC Surface Water Standard of 0.000014 ng/L	Activity Distance (ft)
Pre-RI and RI Baseline	Grab – 1 liter	7	<0.002 to 0.007	1	NA
Storm Events	Grab – 1 liter	4	<0.002 to 0.012	1	NA
Pilot Study Baseline	Grab – 1 liter	38	<0.002 to 0.004 (detected value was "J" qualified)	1	NA
Pilot Grabs adjacent to Dredging Mini Tests	Grab – 1 liter	2	0.960 to 27.5	2	5 to 15
Mini Dredging within Oxbow and Silt Curtain – 24-hour Composite at Pipeline	Composite – 1 liter	4	<0.006 to <0.007	0	2,600
eMNR™ and Engineered Cap with Herring Bone Silt Curtains – 24-hour Composite at Pipeline	Composite – 1 liter	14	<0.002 to 0.004 (detected values were "J" qualified)	2	1,900 to 3,000

With the exception of the pilot test grab samples taken during the dredging mini test, the data trends for dioxin were consistent with the RI results in that only sporadic detections of 2,3,7,8-TCDD were reported. Once "J" qualified data are removed from consideration, only 3 of 65 surface water samples

exceeded the North Carolina surface water standard. These detected concentrations appear to be related to the low detection levels and the likely periodic collection of small organic solids that have adsorbed small amounts of 2,3,7,8-TCDD. The lack of consistent quantifiable dioxin concentrations is important for design of the remedy and the associated performance monitoring program.

As part of the RI, TEQ congener patterns were also calculated to better understand the nature and extent of dioxins in surface water. The dioxin TEQs (USEPA, 1989) in Conaby Creek surface water were 1.1×10^{-4}, 5.4×10^{-4}, and 7.9×10^{-4} ng/L (Table E-10). Dioxin TEQs (USEPA, 1989) in the Welch Creek surface water samples collected from the seven master transects ranged from 5.8×10^{-4} to 9.9×10^{-3}ng/L, with a median concentration of 1.1×10^{-3} ng/L (Table E-10). No consistent trend with location in the creek was observed. Dioxin TEQs (USEPA, 1989) at MT-8 and MT-10 were in the range of the background samples. Dioxin TEQ (USEPA, 1989) concentrations above background were observed at MT-5, MT-6, MT-7, and in most of the whole water samples, except the baseflow sampling event.

Table E-10
Refined COPCs Analyzed in Surface Water
Welch Creek

TRANSECT	SAMPLE I.D.	2,3,7,8-TCDD (ng/L)	2,3,7,8-TCDF (ng/L)	DIOXIN TEQ USEPA 1989[1] (ng/L)	DIOXIN TEQ WHO 1997 MAMMALIAN[2] (ng/L)	DIOXIN TEQ WHO 1997 AVIAN[3] (ng/L)
Welch Creek						
MT-1	SWMT01-60-M	< 0.002	< 0.004	0.000 [5]	0.000 [5]	0.000 [5]
	WCSW-01	< 0.002	< 0.003	0.00011	0.000065	0.000011
MT-2	SWMT02-30-M	< 0.002	< 0.004	0.000 [5]	0.000 [5]	0.000 [5]
MT-5	SWMT05-50-M	< 0.003	0.010	0.001[5]	0.001[5]	0.010[5]
MT-6	SWMT06-30-M	< 0.006	0.013	0.0014	0.0013	0.013
	WCSW-02	0.007	0.026	0.0099	0.0098	0.033
MT-7	SWMT07-40-M	< 0.005	0.010	0.0012	0.0011	0.01
MT-8	SWMT08-70-M	< 0.006	0.014	0.0016	0.0014	0.014
	WCSW-03	<0.004/<0.003[4]	0.004/0.006	0.00058/0.00073	0.00051/0.00067	0.004/0.006
MT-10	SWMT10-50-M	< 0.004	0.005	0.00096	0.00067	0.005
Conaby Creek, Background						
CC-6	SWCC06-40M	< 0.005	< 0.001	0.000[5]	0.000[5]	0.000[5]
	CCSW-01	< 0.002	< 0.003	0.00054	0.00020	0.000054
CC-8	CCSW-02	< 0.005	< 0.001	0.00079	0.00025	0.000079

Notes:
(1) Second value is a duplicate result.
(2) Toxicity Equivalent, USEPA, 1989.
(3) Toxicity Equivalent, World Health Organization (WHO), 1997, mammalian factors.
(4) Second value is a duplicate result.
(5) The full list of 2,3,7,8-PCDD/PCDF congeners was not analyzed, so TEQs are based on 2,3,7,8-TCDD/TCDF congeners only. Therefore these are minimum values since other congenrs were not analyzed.
< = concentration less than the Quantitation Limit.

7. Site Conceptual Model

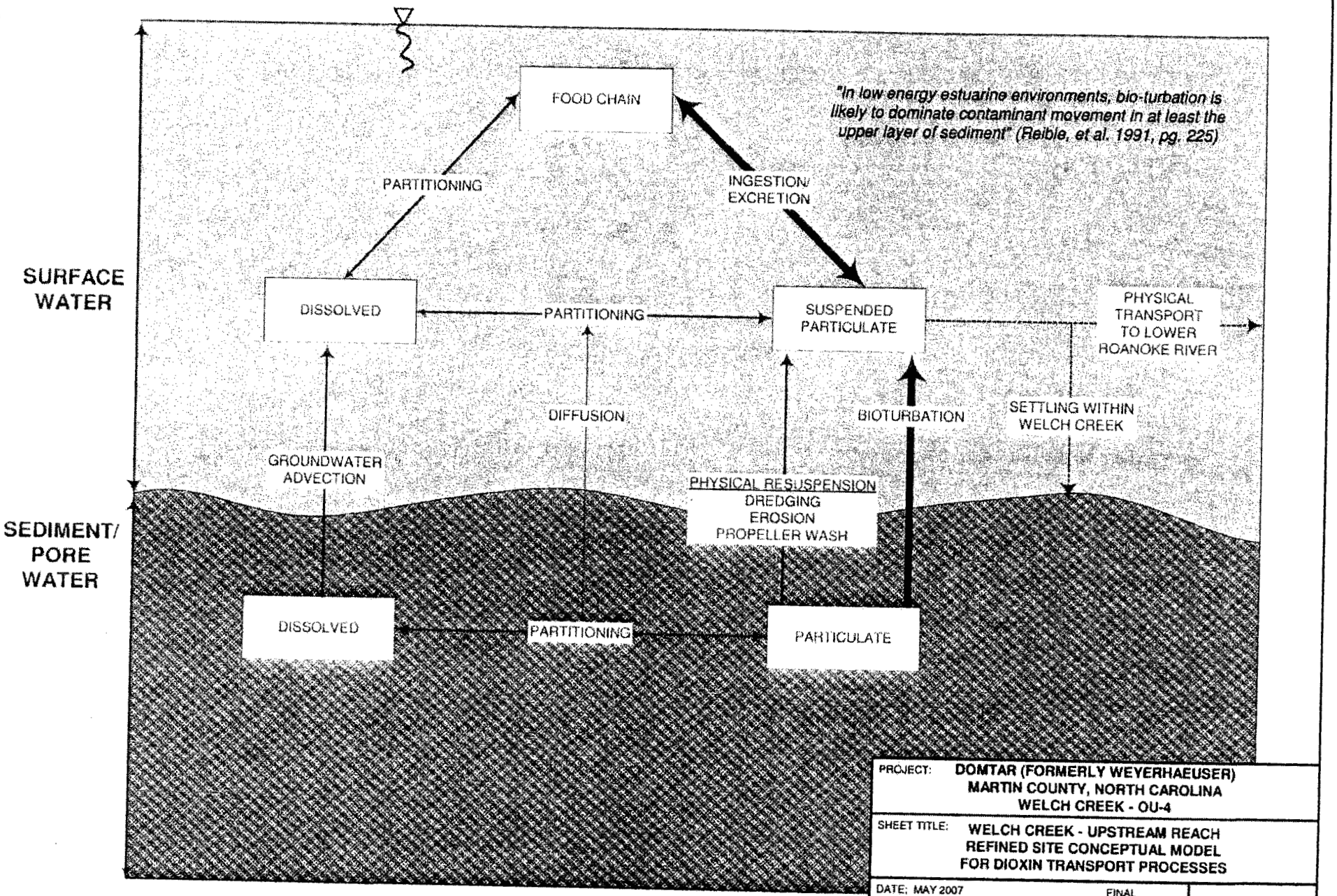
The Site Conceptual Model for Welch Creek was developed during the work planning activities and has continued to be refined through the FS. The preliminary Conceptual Site Model is based on characteristics of the waste sources, the COPCs for each affected environmental medium, and the migration and transport potential of the constituents to potential receptor. The preliminary model was included in the RI Work Plan and formed the basis for the investigation and risk assessment for Welch Creek.

The conceptual model for Welch Creek and adjacent wetlands was updated in the approved Welch Creek RI Report and then focused and reviewed with development of a modified version in the Welch Creek FS. The revised Site Conceptual Model integrated the input from the facilitated meeting stakeholders, pilot studies, supplemental data, published literature, and other sources and provided a more visual illustration of the potential ecological risk and sediment migration pathways than the previous version.

The final updated Site Conceptual Model in the approved Welch Creek FS focuses on dioxin as a primary COC since on-going air deposition sources of mercury cannot be controlled by a sediment remedy. Updating the Welch Creek Site Conceptual Model for application to FS evaluation criteria required careful assessment of the identified manageable properties as related to the different reaches of the creek. These manageable properties for various reaches in Welch Creek were developed as part of the facilitated meeting process. Key manageable properties agreed to by the USEPA and stakeholders were identified as follows (Wollmuth, 2003):

- Upstream reach (defined to extend from X to Y) – surficial sediment concentrations and bioavailability of COCs
- Midstream reach – velocity control and sediment strength (to address potential sediment mobility)
- Downstream reach – surficial sediment concentrations and bioavailability of COCs

The refined Conceptual Site Model for Welch Creek upstream is shown in Figure E-1. The conceptual model for the midstream reach is similar, except that the reduced cross-sectional area in the midstream reach is an additional factor in physical resuspension. The refined Site Conceptual Models form the basis for the contaminant fate and transport discussions for Welch Creek and the evaluation of remedial alternatives.



PROJECT:	DOMTAR (FORMERLY WEYERHAEUSER) MARTIN COUNTY, NORTH CAROLINA WELCH CREEK - OU-4
SHEET TITLE:	WELCH CREEK - UPSTREAM REACH REFINED SITE CONCEPTUAL MODEL FOR DIOXIN TRANSPORT PROCESSES
DATE: MAY 2007	FINAL
DRAWN BY: NCW	FIGURE E-1

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