APPENDIX A

Record of Decision

RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVES SELECTION

COPPER BASIN MINING DISTRICT SITE
OPERABLE UNIT 5
THE OCOEE RIVER
POLK COUNTY, TENNESSEE

CERCLIS ID: TN0001890839

PREPARED BY:

U.S ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA, GA

September 2011

Part 1:

Declaration for the Record of Decision

Declaration for the Record of Decision

Site Name and Location

Copper Basin Mining District Site, Operable Unit 5 (Ocoee River)
Polk County, Tennessee
EPA Site Identification Number: TN0001890839

Statement of Basis and Purpose

This decision document presents the Selected Remedy for the Copper Basin Mining District Site, (Site) Operable Unit 5 (OU5), the Ocoee River in Polk County, Tennessee. The OU5 Remedy consists of three separate response actions to address each of three parts of the Ocoee River: (1) the *Copper Basin Reach,* extending from the town of Copperhill to the slack water of the Ocoee No. 3 Reservoir (River Mile [RM] 33.5 to 38.0); (2) the *Ocoee No. 3 Reservoir* (RM 33.5 to 29.2); and (3) the *Parksville Reservoir* (RM 17.1 to 11.9). The Remedy was 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 for the Site.

The State of Tennessee concurs with the Selected Remedy.

Assessment of the Site

The response actions selected in this Record of Decision (ROD) are necessary to protect public health and welfare or the environment from actual or threatened releases of hazardous substances to the environment.

Description of the Remedy

The selected remedy for OU5 is:

- Copper Basin Reach: Monitored Natural Recovery
- Ocoee No. 3 Reservoir: Monitored Natural Recovery with Hydraulic Controls
- Parksville Reservoir: Monitored Natural Recovery with Permanent Inundation Using Flashboards and Superboards.

The Ocoee River is the receiving stream for contamination emanating from other portions of the Site. The selected remedy for OU5 will complement remedies that are being developed for other operable units; activities in other OUs are described in more detail in Part 2, Section 4 of this document. The overall cleanup strategy for the three parts of the Ocoee River is Monitored Natural Recovery (MNR) to address identified chronic risk to aquatic organisms from metals and acid in sediments embedded in portions of the river substrate and deposited in Ocoee No. 3 Reservoir and Parksville Reservoir. The currently known sources of contamination to the river were the discharge of acid mine drainage, mine wastes, and contaminated sediments from various locations and streams within the Site. These sources are being addressed and/or controlled under separate investigations and remedy selections for other Site OUs.

Monitored Natural Recovery uses natural processes to achieve the Remedial Action Objectives (RAOs) and reduce site contaminants to levels meeting site-specific remedial goals. It depends on the ability of new, uncontaminated sediment from upriver and unaffected upstream tributaries to mix, dilute, and partially cap embedded contaminated sediments in the substrate. Other natural processes, such as dispersion, advective transport, bioturbation, and sorption also may reduce residual aquatic risk. These processes would be relatively permanent as long as new sources of contamination are being controlled and the pH of the water column remains relatively neutral (i.e., meeting Tennessee General Water Quality Criteria). MNR includes the development and implementation of a monitoring program to document changes in identified risks in the river and the process of natural recovery.

Monitored Natural Recovery alone is the selected response action for the Copper Basin Reach. MNR used in conjunction with hydraulic (engineering) controls is the selected response action for the Ocoee No. 3 Reservoir. The engineering controls are intended to minimize the likelihood that deeper, more contaminated sediment stored behind the dam may become mobilized and discharged downstream through the lower sluice gates of the dam. In Parksville Reservoir, MNR will be used in conjunction with engineering controls to inundate (i.e., wet close) a large sediment delta that is a source of metals and acid to the remainder of the reservoir. Currently the Tennessee Valley Authority (TVA) lowers the Parksville Reservoir pool elevation 8 to 10 feet during winter months and raises it again during summer months as part of normal river operations. Lowering the reservoir level exposes the sediment delta to atmospheric oxygen causing mining wastes contained within the sediment to oxidize. The oxidation generates acid which, in turn, dissolves metals that are mobilized to the reservoir upon subsequent draining and filling cycles. Inundating the delta on a year-round basis is expected to halt the oxidation process.

The main components of the Selected Remedy include:

- Monitored Natural Recovery for all areas of the river with identified aquatic risks;
- Hydraulic controls for Ocoee No. 3 Dam as outlined in the Best Management Practices (BMP) Plan developed and implemented by TVA for operation of the Ocoee No. 3 Dam. The BMP Plan developed and implemented by TVA has been approved by the Tennessee Department of Environment and Conservation (TDEC) Division of Water Pollution Control. The U.S. Environmental Protection Agency Region 4 Superfund Division (EPA) also approves this plan and attaches it as Appendix A to this Record of Decision.
- Implementation of a winter guide curve by TVA, in voluntary cooperation with EPA and TDEC, to maintain an average pool elevation in the Parksville Reservoir at or above the maximum elevation of the sediment delta of approximately 834 feet above mean sea level (AMSL) using the North American Vertical Datum of 1988 (NAVD 88). This is seven feet higher than the current winter guide curve. The

- summer guide curve would remain at 836 feet AMSL (NAVD 88). The reservoir pool level will be controlled using the current system of flashboards and superboards on the Ocoee No. 1 Dam. TVA will inspect the flashboard/superboard system annually and completely replace the system as appropriate, which is expected to be every three to five years.
- A monitoring plan will be developed by EPA and Glenn Springs Holdings, Inc. (GSHI), with input from TDEC, and implemented by GSHI to document changes in identified risks and natural recovery processes in the Copper Basin Reach, Ocoee No 3 Reservoir, and the Parksville Reservoir. The program is expected to include monitoring of river water quality, sediment quality, sediment toxicity, and benthic macroinvertebrates in the Copper Basin Reach, in Ocoee No. 3 Reservoir, and Parksville Reservoir to track remedial success in relation to the Remedial Action Objectives (RAOs) and established Remedial Goals (RGs). The monitoring program will establish appropriate criteria, milestones, and time frames to determine remedial success, effectiveness, and permanence.

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 uses permanent solutions and alternative treatment technologies to the maximum extent practicable.

Under MNR, increased amounts of organic matter and detritus would naturally accumulate and become incorporated into the river substrate. Organic matter provides sorption sites for metals. Sorption essentially sequesters metals to forms that are not bioavailable. To the greatest extent practicable, these components satisfy the statutory preference for reducing the toxicity, mobility, or volume of hazardous substances through treatment.

Because the Remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, statutory Five-Year Reviews will be used to ensure the Remedy for OU5 remains protective. A statutory Five-Year Review will be conducted for the river within five years after initiation of remedial actions to ensure that the Remedy is, or will be, protective of human health and the environment using criteria developed as part of the monitoring plan.

Data Certification Checklist

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

- Chemicals of concern and their respective concentrations (Section 7).
- Baseline risk represented by the chemicals of concern (Section 7).

- Remediation Goals established for chemicals of concern and the basis for those levels (Section 8).
- How source materials constituting principal threats are addressed (Section 11).
- Current and reasonably anticipated future land use assumptions (Section 6).
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the cost estimates are projected (Section 10).
- Key factors that led to selecting the remedy (Section 12).

Authorizing Signature

Franklin E. Hill
Director, Superfund Division
U.S. Environmental Protection Agency, Region 4

9/28/2011
Date

RECORD OF DECISION

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Acronyms

ac-ft/yr	acre-foot per year
AM	Adaptive Management
AMSL	Above Mean Sea Level
AOC	Administrative Order on Consent
ARAP	Aquatic Resources Alteration Permit
ARARs	Applicable or Relevant and Appropriate Requirements
AVS/SEM	Acid Volatile Sulfide/Simultaneously Extracted Metal
BMP	Best Management Practices
B&V	Black & Veatch Special Projects Corp.
CBR	Copper Basin Reach
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cfs	cubic feet per second
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CWA	Clean Water Act
DMC	Davis Mill Creek
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
FR	Federal Register
FS	Feasibility Study
g/day	grams per day
GSHI	Glenn Springs Holdings, Inc.
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
hrs/day	hours per day
IEUBK	Integrated Exposure Uptake Biokinetic Model
LOAEL	Lowest Observed Adverse Effect Level
µg/L	micrograms per liter
mg/kg	milligram per kilogram
mg/L	milligrams per liter
MNR	Monitored Natural Recovery
MOU	Memorandum of Understanding
NAVD 88	North American Vertical Datum of 1988
NOAEL	No Observed Adverse Effect Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

NPC	North Potato Creek
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
O3R	Ocoee No. 3 Reservoir
O&M	Operation & Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
oz	ounce
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PP	Proposed Plan
PR	Parksville Reservoir
RAOs	Remedial Action Objectives
RCRA	Resource Conservation Recovery Act
RfD	Reference Dose
RGs	Remediation Goals
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RM	River Mile
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
TAP	Technical Assistance Plan
TBC	To Be Considered
TCA	Tennessee Code Annotated
TCC	Tennessee Copper Company
TDEC	Tennessee Department of Environment and Conservation
TEPCO	Tennessee Electric Power Company
TVA	Tennessee Valley Authority
UCL95	95 Percent Upper Confidence Limit
USACE	U.S. Army Corps of Engineers
VOAP	Voluntary Cleanup, Oversight, and Assistance Program
WQC	Water Quality Criteria
yr	year

Part 2

Decision Summary

1.0 Site Name, Location, and Brief Description

This Record of Decision is for OU5, the Ocoee River which is part of the Copper Basin Mining District Site, in southeastern Polk County, Tennessee (CERCLIS ID #TN0001890839). The Site is not listed on the National Priorities List, but is being addressed as a Superfund Alternative Site. EPA is the lead agency for the cleanup of OU5 and the State of Tennessee is the support agency. To date, EPA has used the Superfund trust fund to finance activities in OU5, including the Remedial Investigation/Feasibility Study (RI/FS).

The Copper Basin Mining District Site comprises portions of the watersheds of North Potato Creek and Davis Mill Creek and a 26-mile-long reach of the Ocoee River (Figure 1). Mining, beneficiation, chemical manufacturing, and waste disposal occurred in the two watersheds. The Ocoee River was the receiving water for wastes and erosion from these watersheds. The Site is divided into five operable units: OU1 – North Potato Creek; OU2 – North Potato Creek Non-Time Critical Removal Action; OU3 – Cantrell Flats Water Treatment Plant and Belltown Creek Diversion; OU4 – Davis Mill Creek; OU5 – Ocoee River.

The Toccoa River rises in northern Georgia and flows 57 miles to the Tennessee line, where it becomes the Ocoee River (Figure 1). The Ocoee River then flows another 38 miles west before joining the Hiwassee River near Benton, Tennessee. Immediately downstream from the Tennessee state line, the Ocoee River passes through the Copper Basin Mining District, an area of approximately 50 square miles that includes the towns of Ducktown and Copperhill, Tennessee.

The Tennessee Valley Authority (TVA) owns and operates four hydroelectric dams along the river; these are shown on Figure 1. The Blue Ridge Dam is in northern Georgia upstream of the Copper Basin at river mile (RM) 53 (river mile is measured upstream from the Hiwassee-Ocoee confluence), while three dams are in Tennessee downstream of the Copper Basin: the Ocoee No. 3 Dam at RM 29.2, the Ocoee No. 2 Dam at RM 24, and the Ocoee No. 1 Dam at RM 11.9.

For purposes of the Remedial Investigation, the Ocoee River from RM 11.9 to RM 38 was divided into four study areas depicted on Figure 2. These are: Parksville Reservoir (RM 11.9 to RM 17.1), the Whitewater Reach (RM 17.1 to RM 29.2), Ocoee No. 3 Reservoir (RM 29.2 to RM 33.5), and the Copper Basin Reach (RM 33.5 to RM 38.0).

2.0 Site History and Enforcement Activities

2.1 Site History

Mining and smelting began at the Site in the 1840s and 1850s. For many years, a variety of small operators simultaneously worked portions of the site. From 1963 until 1982, Cities Service Company, its corporate predecessors and related entities operated at the Site (EPA, 2001b). Cities Service Company sold the mines, mills, smelting operations, and acid production plants to Tennessee Chemical Company in 1982. Mining ceased at the Site in 1987 and Tennessee Chemical Company declared bankruptcy in 1989. Chemical production continued under other corporate entities until ending in June 2008.

From the late 1800s until the 1980s, the area surrounding Ducktown and Copperhill was nearly devoid of vegetation due to mining and manufacturing operations at the Site. Large quantities of soil and sediment were eroded from the barren hillsides and stream banks and transported downstream into the Ocoee River, primarily through Davis Mill Creek (DMC) and North Potato Creek (NPC). The sediment included a variety of mining and industrial wastes, principally acid-generating and heavy-metal-bearing materials that included sulfide-bearing waste rock, granulated and pot slag, iron calcine, sulfide mineral concentrates, mill tailings, demolition debris, and other substances. Decades of erosion from the Site caused extensive sediment deposition in the river bed and in the reservoirs along the river (Figure 2). For the first 30 years after construction of Ocoee No. 1 Dam in 1911, sediment was accumulating in its reservoir (herein referred to as Parksville Reservoir) at a rate of approximately 617 acre-feet per year (ac-ft/yr). Virtually all of this sediment had eroded from the Site. After completion of Ocoee No. 3 Dam in 1942, most of the sediment load became trapped in the No. 3 Reservoir.

Revegetation began in the Copper Basin area in 1930 through cooperative efforts of the mining companies, the U.S. Forest Service, TVA, and several other entities. The results of these attempts were largely ineffective in the first 40 years. However, efforts accelerated in the early 1970s, with greater success. TVA stepped up its tree planting program in 1984, motivated by their concerns about continued sedimentation in their reservoirs. Glenn Springs Holding, Inc. (GSHI) has continued revegetating portions of the Site to the present day. Although the Copper Basin area has now been largely revegetated, the legacy of past mining and industrial activity remains in the form of metal-rich sediments in much of the Ocoee River system.

2.2 Enforcement History

In approximately 1985, the Tennessee Department of Environment and Conservation (TDEC) ordered the Tennessee Chemical Company to construct storm water and sediment collection ponds in Davis Mill Creek and to construct a pipeline to divert the base flow of an unaffected upper tributary below this pond.

Following the bankruptcy of Tennessee Chemical Company, the U.S. Environmental Protection Agency Region 4 (EPA) and OXY Oil and Gas USA, Inc. entered into an Administrative Order on Consent (AOC Docket No. 91-36-C) under which OXY Oil and Gas USA agreed to continue operation of the London Mill wastewater treatment plant in the North Potato Creek watershed (EPA, 1991).

A Memorandum of Understanding (MOU) between EPA, TDEC, and OXY USA, Inc. was signed on January 11, 2001 (EPA, 2001a). Pursuant to the MOU, the parties "agree to work together in a coordinated manner with the common goal of the ultimate environmental remediation and redevelopment of the Copper Basin." Under the MOU, EPA agreed to conduct remedial investigation/feasibility study (RI/FS) activities in the impacted sections of the Ocoee River.

Pursuant to the MOU, EPA and GSHI, an affiliate of OXY USA, Inc. entered into three Administrative Orders on Consent (AOCs) (EPA, 2001b; 2001c; 2001d). Under these AOCs, GSHI would conduct actions in the North Potato Creek and Davis Mill Creek watersheds. In addition, TDEC and GSHI entered into a Commissioner's Order under which GSHI would study and implement removal actions in other portions of the North Potato Creek watershed under TDEC's Voluntary Cleanup, Oversight, and Assistance Program (VOAP) (TDEC, 2001).

Pursuant to AOC Docket No. 01-12-C, GSHI refurbished the Cantrell Flats water treatment plant and began treating the baseflow of Davis Mill Creek prior to its discharge to the Ocoee River. The system was eventually expanded to capture and treat the 10-year, 24-hour flow of DMC and a small tributary referred to as the West Drainage Channel following studies conducted by EPA in 2001 to 2003. In addition, the Belltown Creek and Gypsum Pond tributaries of DMC were captured and routed through a pipeline to the Ocoee River up to the 10-year, 24-hour storm event. The diversion and treatment significantly reduced the amount of acidity and heavy metals discharged to the Ocoee River from this watershed. Since the water treatment plant began operation in November 2002, 19.6 million pounds of metals (primarily iron, copper, and zinc) and 41.3 million pounds of total acidity have been removed prior to discharge to the Ocoee River. In 2010, the Cantrell Flats plant removed an average of about 5,500 pounds of metals per day, averaging a 99 percent reduction in the daily loading of iron and zinc, and a 94 percent reduction in the daily loading of copper to the river (Figure 3).

Pursuant to AOC Docket No. 01-11-C, GSHI constructed a second wastewater treatment plant and, in January 2005, began treating the entire flow of North Potato Creek (NPC) before it reached the Ocoee River. This water treatment plant also treats all contaminated waters collected in the NPC watershed. This further reduced the loading of heavy metals and acidity to the Ocoee River. Since the NPC plant began operation, more than 1.1 million pounds of metals have been prevented from reaching the Ocoee River (Figure 3). In 2010, the plant averaged a 99 percent reduction in the daily loading of iron, copper, and zinc.

After the 2001 agreements, GSHI began to conduct studies and implement removal actions in the North Potato Creek watershed to reduce the amount of metals and other contaminants being discharged to the Ocoee River. These ongoing actions, conducted under TDEC oversight, have removed, consolidated, controlled, or treated numerous contaminant sources in the watershed, reduced erosion of soil and wastes, reconstructed portions of stream beds, and enhanced riparian areas along the stream. Together these actions have led to significant improvements in water and sediment quality in North Potato Creek.

In 2004, EPA conducted an Engineering Evaluation/Cost Analysis (EE/CA) that identified a slag storage area alongside the Ocoee River at the mouth of Davis Mill Creek as a source of contamination to the river. GSHI agreed to remove the large amount of granulated slag waste, consolidate it into a secure repository away from the river, and revegetate the entire area. As a part of this action, GSHI also voluntarily revegetated an area of poor quality sediment that had formed a delta at the mouth of DMC.

2.3 Investigation History

Numerous investigations were conducted to support the RI/FS for OU5. Many of these described current and historical environmental conditions in the Ocoee River and all are included as part of the Administrative Record for the Site. These studies are:

- Draft Evaluation of Ocoee River Sediments (SAIC, 2000a).
- Draft Problem Formulation for Risk Assessment, Ocoee River, Tennessee (SAIC, 2000b).
- Draft Ocoee River Reconnaissance, Summary of Findings (SAIC, 2001).
- Draft Water Program Plan for the Ocoee River (SAIC, 2002a).
- Ocoee River Low-Water Investigation Summary Report (SAIC, 2002b).
- Final Baseline Human Health Risk Assessment for the Ocoee River (SAIC, 2003a).
- Final Project Management Plan for the Ocoee River (SAIC, 2003b).
- Bioassessment of Conditions in Ocoee River Operable Unit 3-R (SAIC, 2004).
- Final Remedial Investigation Report for Ocoee River Operable Unit 3-R (Black & Veatch and SAIC, 2005).
- Report of Surface Water Monitoring of Ocoee River (GSHI, 2007).
- Final Remedial Investigation Report for the Ocoee River (Black & Veatch, 2008).
- Final Feasibility Study for the Ocoee River (Black & Veatch, 2009a).
- Final Feasibility Study Amendment for the Ocoee River (Black & Veatch, 2011).

There are also a number of earlier investigations that were completed for purposes other than the RI/FS that included:

- EPA's initial water and sediment sampling of the mining district and the Ocoee River (PRC, 1997).
- Surface water and sediment sampling throughout the river in January 2000 (EPA, 2000a).
- Numerous studies conducted by TVA in Parksville Reservoir as part of their Vital Signs monitoring program (e.g., TVA 2000, 1998, 1986).

In May 2008, EPA completed an RI report for the Ocoee River that evaluated the reach from Blue Ridge Dam to Ocoee No. 1 Dam (Parksville Reservoir). The purpose of this RI was to characterize sources of contamination, determine the nature and extent of contamination, evaluate contaminant transport mechanisms, and evaluate risks to human health and the environment. Since 2001, removal actions and interim measures in other portions of the Site have directly or indirectly positively affected the Ocoee River. Because of this, the OU5 RI described both existing conditions as well as trends and changes that have occurred in the River as a result of these actions, particularly from the treatment and control of discharges from Davis Mill Creek beginning in November 2002, and the treatment and control of discharges from North Potato Creek beginning in January 2005. This was accomplished by collecting samples from various portions of the river prior to and after implementation of these actions to identify their impact on water and sediment quality and toxicity in the river.

Based on results from the remedial investigation, EPA determined that remedial actions likely would be required in three areas of the river: (1) the Copper Basin Reach, which occurs from RM 38.0 at Copperhill to RM 33.5, immediately above the Ocoee No. 3 Reservoir; (2) the Ocoee No. 3 Reservoir from RM 33.5 to RM 29.2 at the Ocoee No. 3 Dam; and (3) the Parksville Reservoir from RM 17.1 , immediately above the Greasy Creek confluence to RM 11.9 at the Ocoee No. 1 Dam (Figure 2). EPA determined that remedial actions would not be needed in the Whitewater Reach (RM 29 to RM 17.1). This is because the RI did not identify significant areas of contamination in this reach; primary stress to aquatic organisms was found to be from power generation activities that dewater this portion of the river channel.

In December, 2009, EPA completed a Final Feasibility Study prepared in accordance with EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988). The FS compared alternatives across the two threshold and five primary balancing criteria specified by the NCP at 40 CFR §300.430(e)(9). EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (OSWER 9355.0-85) (EPA, 2005) was a primary reference but various other published materials were used to identify and evaluate remedial techniques, alternatives, and case studies at other sediment sites. The two threshold criteria, *Overall Protection of Human Health and the Environment* and *Compliance with Applicable or Relevant and Appropriate Requirements (ARARs);* and the five primary balancing criteria, *Long-Term Effectiveness and Permanence, Reduction in Toxicity Mobility and Volume through Treatment, Short-term Risk, Implementability, and Cost,* are described in detail in Section 4.4 the FS. The FS also describes two modifying criteria, *State Acceptance* and *Community Acceptance* that are further evaluated in this Record of Decision (ROD).

After finalizing the FS, but prior to developing a Proposed Plan (PP) and ROD, EPA received significant comments from the TVA regarding the implementability and cost of Alternative PR-2, MNR with Permanent Inundation.

Under Alternative PR-2, natural recovery would primarily be used as a remedy for contaminated sediment and water quality. In addition to natural recovery and monitoring, this alternative also would call on TVA to maintain a consistent water cover over the contaminated sediment delta (i.e. a wet closure), except for normal short-term fluctuations associated with power generation, or for dam maintenance or emergencies. To accomplish this, TVA would change the winter guide curve for Parksville Reservoir to maintain an average pool elevation at or above the maximum elevation of the sediment delta of approximately 834 feet Above Mean Sea Level (AMSL) using the North American Vertical Datum of 1988 (NAVD 88)[1]. This is seven feet higher than the current winter guide curve. The summer guide curve would remain at 836 feet AMSL (NAVD 88). Under Alternative PR-2, the existing system of flashboards and superboards would be replaced with a system of pneumatic gates such as those from Obermeyer, Waterman, or some other rubber bladder manufacturer. These gates would better facilitate managing the reservoir pool level during the winter.

Based on available information, EPA determined in the FS that installation of the pneumatic bladder gates would require some modification of the arch spillway of the Ocoee No. 1 dam, but would not require modifications to either the downstream portion of the arch spillway or the non-overflow section of the dam (Black & Veatch, 2009b). EPA estimated that implementation of alternative PR-2 would require $5,998,700 in capital costs, with the majority being the modifications to the spillway. Total present worth cost for the alternative, including operation and maintenance (O&M) costs, was estimated to be $6,401,371.

In reviewing the FS, TVA explained that in accordance with TVA practice, a stability analysis using current dam safety criteria would be required before structurally modifying a TVA dam. Since structural dam modifications would be necessary to support the pneumatic bladder gates alternative, this alternative would require a stability analysis. The stability analysis would include, among other things, an engineering evaluation and review of the structural integrity of the dam, the available design and construction records, and the existing geotechnical data. In addition, since the dam was constructed in 1911, it is likely that instrumentation of the dam and geotechnical exploration and testing would be needed to fill data gaps necessary to complete a current state of the practice analysis. TVA indicated that the stability analysis could cost $500,000 or more depending on potential data gaps, and that the scope of the analysis could greatly expand depending on the interim findings and data availability. TVA further stated that updating the dam to implement recommendations of the stability analysis could, depending on the modifications recommended, potentially cost tens of millions of dollars.

Based on the TVA comments, EPA developed an FS Amendment to incorporate the new information (Black & Veatch, 2011). The Amendment provides a modification of the NCP's nine criteria analysis conducted for *Alternative PR-2, MNR with Permanent Inundation* to incorporate the information regarding *Implementability* and *Cost* that was provided by TVA. This Amendment also conducts a detailed nine criteria analysis for a new alternative (*Alternative PR-5*) for the Parksville Reservoir. Alternative PR-5, MNR with Permanent Inundation using Flashboards and Superboards, would provide a consistent water cover over the sediment delta using the existing system of flashboards and superboards. The analysis in the FS Amendment

[1] The North American Vertical Datum of 1988 (NAVD 88) is the vertical control datum established for vertical control for surveying in the United States of America based upon the General Adjustment of the North American Datum of 1988. The NAVD 88 datum is now the standard datum used by the surveying community in North America. This datum is approximately 7 feet higher than the vertical datum that was used when the Ocoee No. 1 dam was constructed in 1911. The original elevation datum was established by the Tennessee Electric Power Company (TEPCO), which originally constructed and operated the dam. TVA still uses the original TEPCO datum to monitor gages and report pool level elevations. Under the TEPCO datum system, current winter pool level elevation goals for winter and summer are 820 and 829 feet, respectively.

specifically replaced the detailed analysis for *Alternative PR-2* provided in the 2009 FS, added an additional detailed analysis for Alternative PR-5, and replaced the comparative analysis between all alternatives for the Parksville Reservoir provided in 2009 FS.

3.0 Community Participation

Under the 2001 AOCs, as referenced in the MOU, and other agreements thereafter, OXY USA, Inc. was required to comply with EPA's community relations plan, provide information to support the plan, and be an active participant in preparing information to disseminate to the public. For the Site, EPA, the State of Tennessee, and GSHI formed a partnership and developed a site-specific community relations plan. In accordance with this plan, numerous open houses and public meetings have been held where information has been presented collectively regarding planned and on-going studies and projects. In addition, the partnership publishes a quarterly newsletter for the local community describing on-going projects and activities in the Basin. One day each year, GSHI provides bus tours for the public of completed and on-going activities. Pursuant to requirements in the MOU, GSHI prepared a Technical Assistance Plan (TAP) and provided $500,000 as a TAP grant for community involvement.

Project documents have been made available to the public in both the administrative record and in the information repositories maintained at the EPA Superfund Record Center in Region 4 offices and at the Ducktown City Hall. The Proposed Plan for the Ocoee River, which is presented as Appendix B, was released to the public for comment on June 17, 2011 (EPA, 2011). Over 500 copies of the Proposed Plan were mailed to officials, citizens, and other interested parties on the project mailing list and a Notice of Availability was published in the *Polk County News* on June 15, 2011 and in the Blue Ridge *News Observer* on June 17 2011. A public comment period on the Proposed Plan was held from June 17 through July 18, 2011. EPA held a public meeting on June 23, 2011 at the offices of GSHI in Ducktown to allow nearby residents and interested parties to comment on the documents and the Proposed Plan, and to ask questions of EPA officials. Approximately 55 people attended the meeting; a transcript of the meeting is included as Appendix D.

There were a number of comments and questions during the open house, and representatives of EPA and TDEC responded during the meeting. EPA received written comments on the Proposed Plan from GSHI, TDEC, and TVA. In addition, one written comment was received from a member of the public; this comment favored the preferred alternative. A Responsiveness Summary is included as Part 3 of this ROD; comments received are provided in Appendix C.

4.0 Scope and Role of the Response Action

This Record of Decision is for CERCLA Operable Unit 5 (Ocoee River) of the Copper Basin Mining District Site. The OU5 response action will be consistent with the final action selected for the site and with planned actions in four other OUs. Continuity across the Site is facilitated by regular (bimonthly) meetings between EPA, TDEC, and GSHI that have allowed project goals and actions to be coordinated. In addition, all work is conducted in accordance with the governing principles and commitments set forth in the 2001 MOU. The intent of actions in the remaining four OUs is to achieve an overall Site goal of protecting the Ocoee River and remediating the entire Copper Basin Mining District Site.

- OU1 (North Potato Creek) – This OU is being addressed through the Tennessee VOAP as specified in the 2001 TDEC Commissioner's Order. The goal of actions taken in this OU is to restore North Potato Creek in a manner that will achieve and maintain a performance goal of biological integrity. TDEC will issue a decision document for this OU.
- OU2 (North Potato Creek Non-Time Critical Removal Action) – This OU was the subject of a removal action specified in a 2001 AOC (EPA, 2001b). The treatment plant that was constructed and brought on-line in 2005 will be required to meet the substantive requirements of a National Pollutant Discharge Elimination System (NPDES) permit.
- OU3 (Cantrell Flats Water Treatment Plant and Belltown Creek Diversion) – This OU was the subject of removal actions specified in AOCs issued in 2001 and 2003 (EPA, 2001c; EPA, 2003). The treatment plant that was refurbished and brought on-line in November 2002 will be required to meet the substantive requirements of a NPDES permit that will be issued by the State of Tennessee.
- OU4 (Davis Mill Creek) – This OU is being addressed through agreements specified in the 2001 MOU and AOCs (as amended). An RI/FS report is being prepared for this OU and a ROD for surface water in OU4 is anticipated in calendar year 2012.

The Response Action for OU5 will address risks associated with the chemicals of concern (COCs) in contaminated sediment and contaminated surface water identified in three reaches of the Ocoee River. The Selected Remedy for OU5 is compatible with the planned future use of the Ocoee River and with the anticipated or realized effects of actions taken in other Site OUs. As such, the ROD addresses all impacts to all media and represents the final cleanup approach for OU5.

5.0 Site Characteristics

5.1 Conceptual Site Model

The 26-mile-long reach of the Ocoee River comprising OU5 includes flowing reaches and segments impounded by reservoirs. To assist in understanding contaminant migration and exposures under these differing regimes, two conceptual site models (CSM) were developed and refined during the RI.

Figure 4 illustrates the general CSM developed for the river as a whole; this model guided investigations and data interpretation throughout the project. A second CSM (Figure 5) was developed to assist in understanding contaminant release and transport related to emergent sediment, such as the delta at the eastern end of Parksville Reservoir. Figure 4 illustrates how the primary contaminant sources to the river, which originated mostly from Davis Mill Creek and North Potato Creek, can potentially affect the dominant receptors of aquatic invertebrates and fish through their exposure to the primary affected media of sediment and pore water contained within the sediment. The most important contaminant release and transport mechanisms include the leaching of contaminants from solids (aqueous form) by water infiltration and the resuspension and transport of contaminants as sediment particles (solid form).

Figure 5 depicts contaminant release and transport from sediment under subaerial and subaqueous conditions. Chemical differences that occur in these two environments are expected to lead to differences in contaminant release and transport, for example by affecting the solubility of iron and the generation of acidity by oxidation of sediment particles. This CSM applies to emergent sediment, which is present as lateral and instream bars along the river (prominent features of the Copper Basin Reach) and as sediment deltas in the river (e.g., at the inlet to Parksville Reservoir and at the Davis Mill Creek confluence). Because Ocoee No. 3 Reservoir does not undergo significant long-term fluctuations in pool elevation, sediment deposited in this reservoir remains submerged under most conditions.

5.2 Overview of the Site

The Toccoa/Ocoee River system, which is shown in Figure 1, has a total watershed area of approximately 600 square miles. The Copper Basin Mining District (North Potato Creek and Davis Mill Creek drainages) comprises about 50 square miles or less than 10 percent of this drainage area. The geomorphology of the river has been affected by a series of dams and by impacts associated with mining-related activities that combine to affect habitat and biological resources in the river.

The Toccoa/Ocoee River flows through the Blue Ridge physiographic province, an area underlain by metamorphic rocks, primarily schists and gneisses. Surface water flowing through this geological setting is poorly buffered and has low hardness causing it to be especially susceptible to the effects of acid mine drainage.

Unconsolidated alluvial deposits of Quaternary age occur locally in the Ocoee River watershed. These deposits are found in stream drainage bottoms and banks, and consist mostly of variably sorted gravel, sand, and silt. Extensive erosion of soil and mining wastes from the Copper Basin resulted in the buildup of sediment deposited as instream and lateral sediment bars in the Ocoee River and as sediment deltas at the mouths of creeks and in reservoirs.

5.3 Surface and Subsurface Features

Salient features of various reaches of the Ocoee River are provided below; the reaches are depicted in Figure 2.

Toccoa River Above Copperhill (RM > 38). The reach between Blue Ridge Reservoir and Copperhill was used to provide background and reference data in the RI. In this reach, the river channel is dominated by runs and riffles with infrequently spaced pools; the channel substrate is composed predominantly of gravel and cobble with some sand, but some areas have bedrock and large boulders. Channel banks are relatively stable and well-anchored by large woody debris, vegetation, and boulders.

Copper Basin Reach (RM 38.0 to 33.5). This reach contains abundant sand and gravel sediment, some of which forms large lateral or instream bars; bedrock exposures are rare. Flowing reaches above Ocoee No. 3 Reservoir exhibit daily variations in river stage of 1 to 3 feet in summer months in response to releases from Blue Ridge Reservoir for power generation and recreation. Discharge from Davis Mill Creek enters the river at RM 36.9; discharge from North Potato Creek enters the river at RM 35.6. Prior to the removal actions taken in 2002 (Davis Mill Creek) and 2005 (North Potato Creek), these streams discharged acid mine drainage and metals to the Ocoee River. During a survey in July 2001, orange-colored discharge from Davis Mill Creek flowed along the north river bank for at least 2,000 feet downstream from the confluence; the plume was still detectable approximately 3,300 feet downriver, though quite diluted (SAIC, 2001). Similar effects, but with less pronounced orange coloration, also were observed downstream of North Potato Creek. The effects noted in 2001 have been largely mitigated by the removal actions and other interim measures taken in the watersheds. Prior to 2003, the Copper Basin Reach was also marked by sparsely vegetated river bars containing ferricrete (iron-oxide cemented) layers, and noticeable mining-related wastes, including granulated slag, pot slag, iron calcine, ceramic and brick acid-plant debris, lead metal, and traces of sulfur. Sizable delta-like bars with strong oxidation characteristics were present at the mouths of both streams. Since 2003, vegetation on many river bars has noticeably increased through natural recruitment. Additionally, the Davis Mill Creek delta was manually reclaimed and revegetated by GSHI in 2005. The new vegetation has, in turn, trapped up to a foot of new relatively clean sediment, spurring increased vegetation believed to result from the removal actions.

Ocoee No. 3 Reservoir (RM 33.5 to 29.2). The Ocoee River enters Ocoee No. 3 Reservoir through a low-gradient, sinuous channel. Water level in the reservoir routinely varies several feet per day depending upon power generation requirements. The large volume of sediment contained in the reservoir has reduced water storage capacity by an estimated 80 percent;

sediment includes mine wastes such as granulated slag and iron calcine. Sediment coring in the reservoir indicated that older (deeper) sediment had high contaminant concentrations.

Historically, TVA periodically sluiced accumulated sediment to clear and manage the gate openings behind the dam. This was usually accomplished by first lowering the water level in the reservoir by about 40 feet and then discharging a relatively large flow from Blue Ridge Reservoir to entrain accumulated sediment and flush it downriver through the sluice gates.

TVA has largely abandoned sediment sluicing since it began regularly releasing water from the dam from late spring through summer for whitewater recreation. These relatively regular releases prevent large volumes of sediment from accumulating behind the dam gates. As a result, smaller amounts of sediment are released and transported downstream in a more regular and natural manner. However, a large sediment discharge from Ocoee No. 3 in early January 2009 caused a large amount of sediment to be deposited in the river channel downstream of the dam (Whitewater Reach). This sediment was removed by TVA using a series of high flushing flows to transport it downriver to Parksville Reservoir. Discharges of this type are being addressed by this ROD and by TDEC to prevent large sediment discharges in the future (this is discussed further in Section 9.2.3).

Whitewater Reach (River Mile 29.2 to 17.1). Flow in this reach is controlled by releases from Ocoee No. 3 Dam and Ocoee No. 2 Dam; water typically does not flow through this portion of the river as these dams divert water for hydroelectric power generation. The average annual daily discharge from Ocoee No. 3 dam is about 1,190 cubic feet per second (cfs), diverted through a tunnel from the dam at RM 29.2 to the No. 3 powerhouse turbines four miles downriver. Approximately 30 days each year, water is released from the Ocoee No. 3 Reservoir to the river channel for recreational whitewater use. Except during whitewater releases on about 115 days per year, discharge from the Ocoee No. 2 Dam is diverted into a wooden flume for 4.6 miles to the Ocoee No. 2 powerhouse before returning to the channel. The only permanently flowing segment in this reach is between the No. 3 powerhouse and the No. 2 dam (RM 25.0 to 24.2). Additional releases may occur during maintenance operations.

The channel of the Whitewater reach is dominated by areas of supercritical flow, runs, and riffles with infrequently spaced runs and pools. The RI did not identify significant areas of contamination in this reach, although some boulders and bedrock within the channel exhibit iron staining that can be attributed to past upstream mining-related activity in the Basin. The primary stress on aquatic organisms in this reach is due to the power generation activities that dewater the channel and not hazardous materials.

Parksville Reservoir (River Mile 17.1 to 11.9). Sediment deposited as the Ocoee River entered the eastern end of Parksville Reservoir formed a large delta that extends approximately 1.3 miles into the reservoir from RM 17 to RM 15.7 (Figure 2). Sediment varies from coarse sand near the inlet to fine sand with some silt across most of the delta, with grain size becoming generally finer toward the west (away from the inlet). Sediment comprising the delta consists of layers of coarse to fine sand and silt to clay, contains mine wastes that include slag and sulfide-bearing material, and has high concentrations of metals. Sediment at depth in the delta is reduced and is characterized by medium to dark gray color and partly decomposed organic detritus; the upper

0.1 to 2 feet of the delta is oxidized to an orange-brown color and typically lacks organic material. Sediment in deeper portions of the reservoir is very fine grained and reduced.

From May through October, the sediment delta is inundated by reservoir water except for an area northeast of Sylco Inlet that sustains an emergent wetland. The reservoir pool level is lowered during the winter months, exposing 200 to 300 acres of the delta, with the lowest pool levels occurring in December and January at approximately 827 feet above mean sea level (NAVD 88). During low pool levels in the winter, water flowing from the Ocoee River crosses the delta through a channel that has formed along the southern part of the delta. Greasy Creek, which flows into the reservoir from the north near RM 17, discharges through a channel that has formed along the northern part of the delta. The paths of these channels may change slightly from year to year.

Figure 6 shows the aerial extent of the Parksville delta that is exposed per one foot of change in the elevation of the reservoir pool. As shown, an elevation of 834 feet (NAVD) is required to inundate the entirety of the delta.

5.4 Sampling Strategy

The nature and extent of contamination in the Ocoee River was determined through a phased, multi-media investigation that included sampling, testing, and analysis of surface water, sediment, and sediment pore water samples. Sampling was guided by a preliminary conceptual site model that was refined as understanding of the river system increased over time. The intent of the sampling program was to gather snapshots of the river system at different times and under different conditions to provide a clear understanding of the factors affecting contaminant release and transport, and potential effects to receptors.

Samples were collected from all river reaches extending from upstream of the Site to Parksville Reservoir, including flowing river reaches and reservoir impoundments. Sampling focused on characterizing contaminant concentrations in river water, subaerial and subaqueous sediment, and pore water contained within subaerial and subaqueous sediment. Samples were collected in different seasons, under different flow conditions in the river, and to bracket the completion of removal actions and other interim measures occurring in other portions of the Site. Initially, samples were tested for full-scan organic compounds and metals; the list of analytes was subsequently pared to metals or organic compounds of interest. Leach tests were conducted on sediment samples as appropriate to clarify contaminant mobility and interstitial pore water samples were collected to assess the release of metals from sediment under oxidized and reduced conditions.

Samples collected from the river upstream of the Site were used to understand water and sediment quality above Site influences. At different times and locations, samples were collected to investigate cross-channel variations and mixing below contaminant inflows, vertical stratification in reservoirs, and potential chemical effects caused by interstitial water draining into the river from sediment bars and deltas.

Toxicity tests were used in combination with bioavailability tests (acid volatile sulfide/simultaneously extracted metals and sequential extraction) to develop site-specific risk values for surface water, sediment, and sediment pore water.

Biological samples were periodically collected to provide fish tissue for analysis, while surveys of fish and aquatic macroinvertebrate populations were made in selected locations to assess these communities. Instream and riparian habitat characterization was used to supplement the fish and macroinvertebrate surveys and to characterize conditions in riparian corridors and emergent lacustrine wetlands.

Sediment samples were collected from the Parksville delta and Ocoee No. 3 Reservoir by vibracore to characterize changes in sediment chemistry and physical composition with depth and to investigate whether potential preferential pathways were present within the stratigraphic architecture of these deposits.

Data also were collected to support the development of one- and two-dimensional sediment transport models, including grain size distribution, channel cross-section, and flow-integrated discharge.

As part of the FS, a treatability study test was conducted to clarify the changes in interstitial pore water concentrations over the course of a reservoir cycle (rising and falling pool) in Parksville Reservoir. Bench tests were used to determine potential benefits of amending Parksville delta sediment with lime and the effect of amendments on water quality within the delta.

5.5 Known or Suspected Sources of Contamination

Numerous tributary streams enter the Ocoee River in the 26-mile-long reach comprising OU5. Sampling conducted in support of the RI indicated that only two of these tributaries contain sediment with significant contamination: Davis Mill Creek at river mile 36.9 and North Potato Creek at river mile 35.6. Consequently, these streams are considered to have been the primary pathways by which contaminants were conveyed to the Ocoee River. A third stream, East Acid Branch at river mile 37.2, likely also conveyed contaminants during historic operations at the Copperhill plant site, but this stream is much smaller than either of the two creeks.

The Davis Mill Creek and North Potato Creek watersheds hosted underground and surface mines; smelting, roasting, and beneficiation facilities; acid and other chemical manufacturing operations; rail and truck transportation corridors; and disposal areas for slag, mine rock, off-spec products, stockpiled by-products, and other types of waste streams. For many decades, releases from these watersheds were not controlled or were only poorly controlled. Contaminants were eroded in large quantities from waste piles and affected areas and transported in solid form to the Ocoee River. This process was exacerbated by the lack of upland vegetation and stream channelization in the tributary drainages, which together altered stream hydrology and storm-response characteristics. In addition, contaminants and wastes were routinely flushed into these streams as part of operations and carried to the river as dissolved or suspended loads.

With time, contaminants were deposited in the river as instream or lateral sediment bars or as sediment within reservoirs. Sediment within the river system was found to contain numerous types of wastes and contaminants derived from the creek watersheds such as granulated slag, pot slag, iron calcine, waste rock and ore, and various types of debris from the demolition of manufacturing facilities, including elemental lead from chamber acid plants. In addition, dissolved iron carried in high concentrations by the tributary streams was locally precipitated on the river substrate forming an orange coating of iron oxyhydroxide or hydroxysulfate minerals that locally armored the substrate and smothered habitat. Although contaminants did not arise from actions taken in the river, river sediment became a secondary source of metals and acidity that continues to affect water quality and biological communities.

5.6 Types of Contamination and Affected Media

Sections 4 and 5 of the RI report (Black & Veatch, 2008) discuss the nature and extent of contamination and the fate and transport of hazardous materials and residual mining wastes in the study areas of the Ocoee River. Affected media in the Ocoee River system include surface water, subaqueous sediment, subaerial sediment (deltas and bars), and interstitial pore water contained in sediment.

5.6.1 Surface Water

Water quality in the Toccoa River upstream of the Copper Basin Reach generally meets WQC established by Tennessee and Georgia to protect aquatic life. Most samples have pH near the lower limit of the standard (6.5 s.u.) and have low alkalinity values demonstrating that ambient water within the Toccoa/Ocoee River watershed is poorly buffered and that the river is highly susceptible to acidic inputs.

Copper Basin Reach
Prior to implementation of the removal actions in Davis Mill Creek in November 2002 and North Potato Creek in January 2005 (treatment of creek water), the concentrations of several contaminants in the Copper Basin Reach of the Ocoee River consistently exceeded Tennessee water quality criteria for fish and aquatic life (Table 5-1):

- Total aluminum, dissolved cadmium, dissolved copper, total iron and dissolved zinc consistently exceeded WQC established to protect aquatic life from chronic effects.
- Dissolved copper and dissolved zinc consistently exceeded WQC established to protect aquatic life from acute effects.
- pH was consistently below the standard of 6.5 s.u.
- Cross-channel variations in water quality were significant due to poor mixing of creek inflows, with concentrations higher on the right (descending) bank than on the left bank.

Completion of the removal actions in the creek watersheds improved conditions in the Ocoee River. With some exceptions, water quality in the river now generally meets Tennessee WQC (Table 5-1). Exceptions may occur along the right bank of the river immediately below the confluences with Davis Mill and North Potato Creeks and in the water column immediately above contaminated sediment in the substrate.

Ocoee No. 3 Reservoir

Water quality in Ocoee No. 3 Reservoir generally meets Tennessee water quality criteria for fish and aquatic life except for total aluminum, which is associated with fine clays and sediments and not considered to be of concern, and dissolved copper, which slightly exceeded the chronic criterion in nearly half of the samples with detections (Table 5-2).

Parksville Reservoir

Total aluminum, dissolved copper, and dissolved zinc exceeded acute and chronic WQC in a moderate amount of samples from Parksville Reservoir in samples collected between 2005 and 2006 (Table 5-3). Most exceedances occurred in the vicinity of the sediment delta and near the sediment-water interface.

Vertical profile studies in the main body of Parksville Reservoir showed a slight decreasing gradient of dissolved oxygen and pH with depth and a broad thermocline during summer months. These parameters were correlated to a slight increase in COC concentrations in the summer.

While the reservoir pool is being lowered during winter drawdown, the concentrations of iron, lead, manganese, zinc, and acidity in surface water at the western toe of the sediment delta were found to increase slightly during the draining period, although water quality remained within WQC. Specific conductance and pH values also varied inconsistently. Generally higher values of specific conductance measured in the reservoir during the draining period suggests that poorer quality water was draining from the delta toe as the water level was lowered. Samples of water collected from the river channel immediately adjacent to oxidized delta sediment as water was draining from the sediment exceeded WQC for several metals, including copper, manganese, and zinc.

5.6.2 Sediment

Sediment samples from the Toccoa River upstream of the Copper Basin Reach have low concentrations of metals that do not exceed adverse effect levels; no organic compounds were detected. Compared to sediment in the Toccoa River upstream of the Site, sediment in the Ocoee River and reservoirs downstream of the Copper Basin contain elevated concentrations of metals and polychlorinated biphenyl (PCB) compounds. Mining waste and by-product materials were identified in Ocoee River sediment as far downstream as the Parksville Reservoir; these materials are considered to be major sources of contamination to river sediment.

Metals concentrations vary widely in sediment samples from the Copper Basin downstream to the backwaters of Ocoee No. 3 Reservoir. This range narrows in samples collected from Ocoee No. 3 Reservoir and Parksville Reservoir. This is consistent with the progressive downstream homogenization of clean sediment and contaminated mine wastes.

Oxidized sediment is formed by subaerial exposure, including as a result of water management practices (i.e. raising and lowering river levels and reservoir pool level elevations). Sediment oxidation results in mineralogical changes that increase the mobility of metals by changing their solubility and chemical species.

Chapter 4 of the Remedial Investigation report (Nature and Extent) screened sediment samples against published values for threshold effects and probable effects. Those comparisons are made below; however, as discussed in Section 7 of this ROD, risk-based values for sediment toxicity were subsequently developed and supercede the comparisons below.

Copper Basin Reach
Lateral and instream bars are a significant component of the river morphology in the Copper Basin Reach; sediment deposition in Ocoee No. 3 Reservoir diminishes their prominence below this point. Sediment in this reach contains a variable percentage of mine waste and by-product materials including granulated slag, pot slag, sulfide-bearing mine rock, and debris such as bricks and tires. Many sediment samples contained concentrations of copper, iron, lead, manganese, and zinc that exceeded probable effects concentrations (Table 5-4). In addition, several samples contained detectable concentrations of one or two PCB aroclors. Metal concentrations in emergent sediment bars were mostly within the range of concentrations defined by samples of permanently inundated sediment collected from the river bed. Samples of both types of sediment shared chemical similarities with sediment samples from Davis Mill Creek and North Potato Creek.

At the time of the RI, sediment samples collected at any given point between Davis Mill Creek and North Potato Creek had significantly different compositions depending on whether the sample was collected from near the left bank of the river (low concentrations) or the right bank of the river (high concentrations). Cross-channel differences, caused by poor mixing of creek discharges with the river, diminished with distance downstream.

Ocoee No. 3 Reservoir
Sediment in the Ocoee No. 3 reservoir is predominantly sand to silt with a variable percentage of mine waste and by-product materials including granulated slag and iron calcine. Metal concentrations in sediment from Ocoee No. 3 Reservoir are high and similar to, but less variable than, those from the Copper Basin Reach (Table 5-5). Metals concentrations tend to increase with depth below the sediment-water interface, suggesting that sediment quality within these areas was poorer in past years. Copper, iron, and zinc concentrations in most sediment samples from the main portion of the Ocoee No. 3 impoundment exceeded probable effects concentrations.

Parksville Reservoir
Prior to the construction of the No. 3 Dam in 1942, much of the sediment load carried by the river was conveyed to Parksville Reservoir, where comparatively coarse material was deposited as a large delta at the inlet at RM 17. During the summer, when TVA maintains a high pool elevation, the delta is submerged. However, in winter, TVA lowers the reservoir pool by 8 to 10 feet, exposing up to 300 acres of sediment. A bathymetric survey of the delta was completed to

support the FS for OU5. Figure 6 shows the morphology of this delta and the approximate areas that are inundated per one foot rise of the reservoir pool.

Strata comprising the upper 5 to 10 feet of the sediment delta at the reservoir inlet are composed of interlayered sand and silt deposits (greater depths were not investigated). Sandy layers have lower concentrations of metals than silty layers; metals concentrations increase downward in the sediment column, suggesting that sediment quality was poorer in past years. Granulated slag was identified in sediment near the Greasy Creek inlet.

Metals concentrations in sediment from Parksville Reservoir are high and similar to, but less variable than, those from the Copper Basin Reach (Table 5-6). Some sediment samples also contain PCB aroclor 1254. Many sediment samples from Parksville Reservoir exceeded probable effects concentrations for copper, iron, lead, manganese, and zinc.

Sediment collected from permanently inundated portions of Parksville Reservoir is reduced and contains partly decayed organic detritus. At the sediment delta, reduced material is overlain by a surface layer of oxidized sediment with little to no organic material that has formed in response to winter drawdown of the reservoir pool and subaerial exposure of the delta for several months each year. The median and range of concentrations are generally similar for oxidized and reduced sediments, except that oxidized sediment has consistently lower zinc and paste pH values than reduced sediment. Moreover, oxidized sediment has little to no oxidizable sulfur (computed as total sulfur minus sulfate sulfur) or neutralizing potential, which contrasts significantly with reduced sediments. These relationships indicate that oxidation of delta sediment has used up most available neutralizing potential.

5.6.3 Interstitial Sediment Pore Water

Interstitial sediment pore water was sampled in the river bed and subaerial bars and deltas by installing piezometers and shallow wells, and using Henry samplers (small well points). Most data were collected as part of the Remedial Investigation; however, additional data on pore water chemistry was collected from the Parksville Delta to support a Treatability Study conducted during the FS.

The concentrations of contaminants in interstitial sediment pore water increase significantly (relative to upstream) in some samples collected from the bed of the Ocoee River downstream of Copperhill and high values continue into Ocoee No. 3 Reservoir. River sediment contained various mine wastes and materials that could contribute to these concentration increases.

Pore water samples were collected from emergent sediment bars to investigate the effects of rising and falling river level on pore water chemistry and recession flow and from the Parksville delta to investigate the effects of fluctuating reservoir pool elevation over an annual reservoir cycle. This information combined with leach testing of sediment samples indicated that sediment contained within the river bed and emergent bars is considered to be the primary source of contamination to the waters they contain. Analyses of co-located sediment and sediment pore water indicate that sediment concentrations alone are a poor indicator of pore water quality.

Instead, chemical intensive parameters, such as redox condition and pH, substantially affect pore water composition.

Copper Basin Reach

Interstitial pore water was collected from sediment along the substrate of the Ocoee River from numerous emergent sediment bars and deltas in this reach. Samples were collected from various positions in the river channel. Results showed variable pore water quality that ranged from being similar to upstream samples to having contaminant concentrations significantly higher than upstream samples (Table 5-7). Numerous samples contained one or more metals in concentrations exceeding chronic surface water quality criteria.

Ocoee No. 3 Reservoir

Interstitial pore water was collected from permanently inundated sediment in the Ocoee No. 3 Reservoir (Table 5-8). Results showed concentrations of several metals that were higher than in pore water collected from the river upstream of Copperhill. Numerous samples contained one or more metals in concentrations exceeding chronic surface water quality criteria.

One pore water sample was collected from the margin of the Ocoee River channel that becomes exposed at low river stage. This sample had low pH and contained numerous metals in concentrations that exceeded their chronic water quality criteria (Table 5-8).

Parksville Reservoir

Interstitial pore water was not collected from deep sediment in Parksville Reservoir. However, samples were collected from numerous locations across the Parksville sediment delta that are subaerially exposed for several months each year. Samples were collected during low and falling reservoir pool and at high reservoir pool to target the potential root zone of aquatic vegetation. The RI results showed widely variable pore water compositions, often exceeding two or more orders of magnitude for a given constituent. In addition, the RI recognized a significant difference in pore water quality in the oxidized and reduced sediment zones, noting that sharp vertical changes appeared to be present.

To support the FS, three clusters of shallow wells were installed in the Parksville delta to target oxidized and reduced sediment at each location. These wells were sampled periodically to monitor water quality in each sediment zone over the course of one cycle of rising and falling reservoir pool. These samples provided the clearest indication of pore water quality in the delta and how it changes vertically and over time within each sediment zone. Table 5-9 summarizes the results for wells at one cluster that were screened in reduced and oxidized sediment. The large contrast in water composition over a vertical distance of a few feet is apparent and this distinction was present in each of the three clusters (although measured concentrations varied significantly). As shown in Table 5-9, water in the oxidized zone exceeded chronic water quality criteria applicable to the Ocoee River for numerous metals by large factors; only iron consistently exceeded criteria in water collected from reduced sediment. Figure 7 graphically illustrates changes in concentrations for this cluster during the reservoir cycle

5.7 Contaminant Location and Migration

5.7.1 Surface Water

Prior to 2002, surface water contamination was evident in the Ocoee River from the Davis Mill Creek confluence downstream to Parksville Reservoir. Water high in metals and acidity entered the river from the Davis Mill Creek and North Potato Creek watersheds and was carried downstream as dissolved and suspended load. Water entering the river from these watersheds was carried downstream along the right bank of the river for a considerable distance before mixing into the water column. This created cross-channel variations in water quality.

For many constituents, the river behaved as an open chemical system, with metals such as iron, aluminum, and manganese precipitating (or dissolving) as oxide or hydroxide minerals depending on the prevailing pH and oxidation conditions. Other metals, such as copper, lead, and zinc likely co-precipitated (or co-dissolved) with these phases or sorbed to these minerals, clay particles, or organic detritus. Metal cycling in response to seasonal changes in oxidation state was noted to occur at depth in Parksville Reservoir, where the concentrations of zinc and copper increased to values above their chronic water quality criteria during summer months when dissolved oxygen content was lowest.

Although the two creek watersheds served as the major sources of surface water contamination, interactions between surface water and contaminated sediment and/or contaminated interstitial pore water also may lead to degradation of surface water. This is most clearly apparent in Parksville Reservoir, where pore water draining from the delta as reservoir pool is lowered during the winter months was found to affect water quality in the reservoir adjacent to the delta.

Removal actions conducted in the Davis Mill Creek and North Potato Creek watersheds, primarily the collection and treatment of surface water, have led to a significant improvement in surface water quality in the Ocoee River (Section 5.8) and decreased the distance creek water flows before mixing into the river. Any sustained interruption in the treatment of water in these watersheds would increase contaminant loads discharged to the river and potentially could degrade the present water quality. Contaminant concentrations in water discharged from the Cantrell Flats water treatment plant (Davis Mill Creek watershed) are within NPDES permit limits; this permit is being renewed by TDEC in 2011.

5.7.2 Sediment

Sediment contamination is evident in the Ocoee River from the Davis Mill Creek confluence downstream to Parksville Reservoir. Sediment, composed of a mixture of eroded soil and a variety of eroded or directly discharged mine wastes and materials high in metals and acidity, entered the river from the Davis Mill Creek and North Potato Creek watersheds and was carried downstream as suspended load and bed load. Granulated slag was identified in sediment of the Parksville delta at RM 17.

Cross-channel variations in sediment quality are apparent in the Copper Basin Reach, but diminish downstream as sediment is homogenized across the channel. Depositional processes and slack water created by dams and impoundments along the river led to the formation of lateral and instream sediment bars and deltas. Oxidation occurs where sediment is subaerially exposed and this process affects the quality of interstitial pore water described in Section 5.7.3.

Revegetation of the Davis Mill Creek and North Potato Creek watersheds has reduced erosion of soil and mine wastes and, coupled with removal actions completed in these areas, reduced their transport to and deposition in the Ocoee River. Geomorphic assessment and sediment transport modeling of the Ocoee River in the Copper Basin Reach suggest that large modifications to channel slope that resulted from reforestation and revegetation in the Copper Basin have largely stabilized. However, major geomorphologic changes to the river channel or flow events greater than the 10-year return flow (>15,000 cfs) may cause contaminated sediment, as well as dissolved and suspended solids, to be transported from the Copper Basin Reach to Ocoee No. 3 Reservoir or, possibly, further downstream.

Sediment transport models simulating flow events through Ocoee No. 3 Reservoir indicated a low potential to transport sediment for average flow rates. For the 10-year flow event, gravel beds and sand in the upstream reach of the reservoir potentially could be mobilized when the flow is maintained for 10 days. Sediment transport and morphological changes from a 100-year or higher event would not be significantly different than those observed during a 10-day simulation of a 10-year event.

A simulation of sediment sluicing from Ocoee No. 3 Dam indicated that the potential exists for significant bed scour (up to 10 feet) behind the dam and release of sediment with high concentrations of metals through the dam. Modeling results suggest that most sediment released through Ocoee No. 3 Dam will generally remain in suspension, be transported through the Ocoee No.2 Dam and eventually be deposited in Parksville Reservoir. For an average wet year discharge through the Ocoee No. 3 Dam, modeling indicates maximum sediment accumulations in Parksville Reservoir of about 0.05 feet (½ inch). The sediment transport modeling results were consistent with field observations.

5.7.3 Interstitial Pore Water

Contaminated sediment contained within the river system is considered to be the primary source of contamination to the interstitial water it contains. Subaerially exposed sediment, such as that comprising lateral or instream bars and deltas, is subject to oxidation, which generates acid and releases metals to pore water. Study of pore water contained in oxidized and reduced sediment of the Parksville delta showed significant differences, with much higher concentrations of metals (except iron, which is high in both) and acidity, and lower pH in oxidized pore water. These observations are consistent with the results of leach tests of sediment samples.

The exchange of contaminants between sediment pore water and surface water is complex and not simply a function of sediment quality. In the Copper Basin Reach, contaminants in interstitial pore water do not display clear geographical distributions, but the highest concentrations of several metals occur near large sediment deposits (Davis Mill Creek delta, North Potato Creek island, Barker Mill sediment bar). Study of pore water in the Barker Mill bar shows that rises in river stage cause a "wave" of water to flood into the bar; repeated changes in river stage create a "wash zone" from which contaminants can be flushed to the river. In Parksville Reservoir, TVA lowers the pool elevation by 8 to 10 feet in late fall and maintains a low pool until early spring, when the reservoir is allowed to rise to the summer pool. Oxidized sediment that forms during the winter is saturated as water floods the delta in spring, allowing accumulated metal salts to dissolve into pore water in the oxidized sediment. As water level drops during the late fall drawdown, this poor quality water drains into the main reservoir.

Sediment pore water also may affect surface water by diffusion of contaminants from the sediment to the overlying water column. Except in cases where the surface pool is static for long periods, diffusional effects would not be expected to cause high concentrations in surface water.

5.8 Other Site-Specific Factors

Removal actions completed in the North Potato Creek and Davis Mill Creek watersheds have significantly reduced the contaminants flowing from these watersheds to the Ocoee River. This, in turn, has led to significant improvements in water quality in the river and to the recovery of vegetation and riparian habitat on the river banks and bars, particularly in the Copper Basin Reach. Figure 8 shows the significant change in the Davis Mill Creek sediment delta from 2004 to 2011. The increased vegetative cover across the delta is primarily the result of an interim action to scarify, lime, and seed this area. However, improvements are also evident on the instream bar downstream of the confluence that was not part of the action. Visual observations of sediment bars in this river reach have shown significantly improved vegetative cover that has trapped clean sediment along the margins of these bars.

Following completion of the RI, GSHI voluntarily initiated a monitoring program for the Ocoee River. The results of this program are included as Appendix E. The program has documented improvements in water quality in most reaches of the river, particularly in the Copper Basin Reach. Water quality has improved to the extent that applicable water quality criteria for the protection of fish and aquatic life and other use classifications are now generally met.

6.0 Current and Potential Future Land Uses

6.1 Land Uses

TVA manages the water flow on the Ocoee/Toccoa River system mainly for purposes of hydroelectric generation, recreation, and flood control; each of these actions affect aquatic resources differently in each river reach. Most of the land along the Ocoee River within the study area in Tennessee is controlled by the U.S. Forest Service. The Cherokee National Forest includes a large area in the mountainous terrain of Polk County, extending along the river from the slack water of Ocoee No. 3 Reservoir (RM 33.5) downstream to Ocoee No. 1 Dam (RM 11.9). Along these reaches of the river, there are few residences and businesses, and most of the land is undeveloped forest. Upstream of the National Forest, near the towns of Copperhill and McCaysville, a few thousand residents live or work on privately owned lands within a corridor along the river. The populations of Copperhill, McCaysville, and Ducktown are approximately 510, 1070, and 440, respectively. Minor areas of agricultural land also exist along the river corridor.

The major highway in this area is U.S. Highway 64, which runs along the right bank of the river from the Whitewater Center (RM 26.5) to below the Ocoee No. 1 Dam. In the vicinity of Copperhill and McCaysville, State Highway 68/60 trends along the north side of the river upstream of the Davis Mill Creek confluence. On the south side of the river, Tennessee Avenue and other streets trend along the river. Northwest of Copperhill, Grassy Creek Road crosses the river and parallels the south shore for about a mile. The former CSX rail line follows the northeast side of the river from Copperhill/McCaysville down to Walkertown Branch (RM 33.5) and is presently used to haul iron calcine from the DMC watershed to Etowah, TN. There are six National Pollutant Discharge Elimination System (NPDES) permits along the Ocoee River: the Intertrade Holdings, Inc. facility (Cantrell Flats treatment plant outfall) near the mouth of Davis Mill Creek (RM 36.8), the Copperhill and Copper Basin sewage treatment plants at RM 37.0 and 33.1, respectively; and three TVA permits at the three dams/powerhouses (RM 11.9, 19.7, and 25.1).

Recreational activities in the area include whitewater rafting, kayaking, canoeing, motor boating, hiking, camping, swimming, fishing, hunting, picnicking, and mountain biking (USFS, 1997). A weekly fishing tournament takes place during much of the year in Parksville Reservoir, and once per year in Ocoee No. 3 Reservoir. Public access to the Ocoee River is limited between Copperhill and the Whitewater Center. Although there is one boat launch in the town of McCaysville, there are none in Copperhill. Several private residences west of Copperhill and along Grassy Creek Road have shoreline access. A residential boat launch is located on a private (formerly public) gravel road beside the Grassy Creek inlet to Ocoee No. 3 Reservoir. A poorly maintained and very small public boat launch exists at the end of a Forest Service gravel road at the Tumbling Creek inlet of this reservoir. A small campground lies 0.5-mile upstream along Tumbling Creek. Thus, the only public access to Ocoee No. 3 Reservoir is at Tumbling Creek; it is used regularly during the summer months for fishing/boating access. A paved road with restricted access leads to the Ocoee No. 3 Dam and a commercial whitewater put-in location for the Upper (Olympic) Reach. A mountain biking and hiking trail parallels the river's eastern shore between this put-in location and the Whitewater Center, along the old Copper Road.

The vast majority of public access to and use of the river occurs in the area from the Whitewater Center down through Parksville Reservoir. There are numerous roads, parking areas, and tourist/recreational sites along these reaches. The recreational features include the following:

- Hiking and biking trails
- Swimming holes
- Olympic whitewater venue and USFS Whitewater Center
- Campgrounds
- Whitewater take-out and put-in locations
- Swimming and picnic areas
- Boat launches and marina
- Inns and restaurants
- Group camps (YMCA and church)

There are also a number of private residences and boat camping cabins along the western end of Parksville Reservoir.

A future-use plan for redevelopment of the Lower North Potato Creek Watershed was developed by GSHI in July 2003 (BWSC, 2003). This plan identified near-term (5-10 years) and long-term (>10 years) land uses. In general, the GSHI plan presented similar anticipated land uses as those described above with additional consideration given to tourism and educational opportunities afforded by the rich mining history of the area.

Reasonably anticipated future land uses for the Ocoee River will likely remain unchanged. Hydropower operations will continue for the foreseeable future (20 years). Based on the Revised Land and Resource Management Plan for the Cherokee National Forest, many of the recreational activities mentioned above are expected to continue. Therefore, implementation of this Remedy will not be affected by changes in land use.

6.2 Ground and Surface Water Uses

There is no potential beneficial ground water use (e.g., irrigation or drinking water) associated with the Ocoee River. Designated uses of Ocoee River surface water as defined by the Tennessee Water Quality Control Board include:

- Fish and aquatic life
- Recreation
- Irrigation

- Livestock watering and wildlife
- Industrial water supply.

Waters that cannot support their designated uses are listed under Section 303(d) of the Clean Water Act. TDEC listed several segments of the Ocoee River from Parksville Reservoir to the Copper Basin as not supporting their designated uses (TDEC, 2008). Causes of impairment in these segments include copper, iron, zinc, loss of biological integrity due to siltation, and habitat loss due to stream flow alteration. The Remedy, in conjunction with removal actions and other interim measures taken in other portions of the Site, is expected to reduce impairment due to the impacts of copper, iron, and zinc.

7.0 Summary of Site Risks

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.

7.1 Summary of the Human Health Risk Assessment

The baseline risk assessment estimates the risk a site poses if no action is taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline human health risk assessment (HHRA) for the Ocoee River that was completed in 2003 (SAIC, 2003a) and updated in the 2008 Remedial Investigation Report (Black & Veatch, 2008). The purpose of the HHRA was to evaluate the potential current and future human health effects caused by releases of hazardous substances to the Ocoee River in the absence of any actions to control or mitigate these releases. The discussion below summarizes the 2003 HHRA. Additional detail regarding exposure assumptions and characterization of human health risks is provided in Appendix E of the RI.

7.1.1 Identification of Chemicals of Concern

Chemicals of concern (COCs) were identified in each river reach and environmental medium using a conservative site-specific screening process and screening levels based on EPA's Regional Screening Levels. Table 7-1 lists the COCs that were evaluated in the HHRA. Selenium was included as a chemical of potential concern in fish tissue in the HHRA; however, there were no associated hazards.

7.1.2 Exposure Assessment

Table 7-2 provides a summary of the general exposure scenarios for ingestion and dermal contact to surface water and sediment in the various river reaches. Table 7-3 summarizes the fish consumption scenarios for each Ocoee River reach.

Exposure point concentrations for the reasonable maximum exposure (river reach) scenarios were based either on the maximum concentrations in each medium or the 95 percent upper confidence limit (UCL95) of the arithmetic mean. All of the fish tissue exposure point concentrations were based on maximum concentrations. Other conservative exposure parameters such as body weights, exposed skin surface, dermal absorption factors, averaging time, and incidental ingestion rates of water and sediment were obtained as default parameters from the EPA guidance documents.

In the absence of site-specific fish consumption data for the Ocoee River, exposure was quantified for a range of consumption rates (e.g., 10 g/day, 20 g/day, 30 g/day, etc.). The range of exposures encompassed the rates used in EPA's Fish Advisory Guidance (EPA, 2000b) for recreational and subsistence fishing (17.5 g/day and 142.4 g/day, respectively), as well as the default fish ingestion rate specified in EPA Region 4 Supplemental HHRA Guidance (EPA, 2000c) of 54 g/day. It is noted that, while consumption rates associated with subsistence fishing were included within the range of exposures quantified in the HHRA, no evidence of subsistence fishing in the Ocoee River has been identified.

Information on fish ingestion rates for children is limited (EPA, 1997). According to Table 10-1 of the Exposure Factors Handbook (EPA, 1997), the mean and 95th percentile total fish consumption rates for children aged 0 to 9 are 6.2 and 16.5 g/day, respectively. This is about 40 percent of the total fish consumption rate for the overall population (mean of 14.3 g/day and 95th percentile of 41.7 g/day).

7.1.3 Toxicity Assessment

Toxicity profiles for each COC were described in the HHRA toxicity assessment section. Non-cancer toxicity values (e.g., oral and dermal reference doses, oral absorption efficiencies, primary target organ, and uncertainty factors) were listed for Aroclor PCBs, arsenic, iron, manganese, and mercury. Cancer toxicity values (e.g., oral and dermal slope factors, cancer type, and weight of evidence) were summarized for arsenic and PCBs. The integrated exposure uptake biokinetic (IEUBK) model was used to evaluate risks to children from lead in sediments of the Ocoee River.

7.1.4 Risk Characterization

Approach

Non-Cancer Hazards. The potential for non-cancer health effects was evaluated by comparing the intake of a chemical with the reference dose. The resulting ratio or hazard quotient (HQ) is calculated using the following equation:

$$HQ = CDI / RfD$$

Where:

CDI	=	Chronic Daily Intake of a chemical (mg/kg-day)
RfD	=	Reference dose (mg/kg-day)

When the CDI of a chemical exceeds the reference dose (i.e., HQ greater than 1) there is a potential for non-cancer health effects. Non-cancer hazards resulting from exposure to multiple chemicals are estimated through the calculation of a hazard index (HI). An HI is a summation of relevant HQ values and is used to determine if an exposed individual is at risk of developing adverse health effects resulting from simultaneous exposure to all selected chemicals by all complete exposure pathways. Potential hazards from exposure to multiple chemicals were assumed to be additive.

Cancer Risks. Potential cancer risks associated with the carcinogens (PCBs and arsenic) were calculated according to the following equation:

$$\text{Cancer Risks} = \text{CDI} * \text{CSF}$$

Where:

CDI	=	Chronic daily intake (mg/kg – day)
CSF	=	Cancer slope factor $(\text{mg/kg} - \text{day})^{-1}$

The total lifetime cancer risk was calculated by summing the cancer risks across both carcinogenic chemicals and for all complete exposure pathways. Resulting cancer risks represent the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. EPA has established a target cancer risk range of 1E-6 (one in a million) to 1E-4 (one in 10,000). Increased cancer risks less than 1E-6 indicate no action is required. Cancer risks between 1E-6 and 1E-4 will probably not warrant cleanup unless dictated by site-specific circumstances or other considerations. Increased cancer risks greater than 1E-4 indicate some type of action needs to be considered.

Risk Results

Risks from Sediment and Surface Water. Table 7-4 presents a summary of the risks identified in the HHRA from exposure to sediment and surface water in each reach of the Ocoee River.

Hazard Indices (HIs) did not exceed 1 and non-cancer health effects are not predicted to occur. The only exception is the child/adult exposure in the Copper Basin Reach. However, EPA recommends segregating chemicals into groups of like or common toxicological effects and reevaluating the potential for manifestation of the various adverse health effects identified (EPA, 1989). The HI in the Copper Basin Reach was due primarily to iron in sediment, and to manganese in surface water. Because iron affects the blood and liver and manganese causes health effects related to the central nervous system, the health effects from these two chemicals are not additive. Neither chemical individually exceeded an HI of 1 (reported to one significant figure); therefore, adverse non-cancer health effects were not predicted to occur. Based on data collected since the HHRA was prepared, the concentrations of iron and manganese are much lower (Appendix E of RI Report), resulting in even lower potential health effects.

Exposure to lead was evaluated using the IEUBK model. The model results indicated that children exposed to Ocoee River sediment would have an estimated risk of exceeding the 10 µg/dL blood lead level of no more than two percent. According to EPA (1994), exposed children should have an estimated risk of exceeding the 10 µg/dL blood lead level of no more than five percent.

Risks from Consumption of Fish. Table 7-5 shows the risk results for two consumption rates: 17.5 g/day (used in EPA's Fish Advisory Guidance) and 54 g/day (default EPA Region 4 value) of fish harvested from each Ocoee River reach.

For non-cancer hazards, only the higher consumption rate (54 g/day) resulted in HIs exceeding 1.0 but all were less than 2.0. Potentially unacceptable levels of non-cancer health hazards are associated with consumption of locally-caught fish at consumption rates above 4.5 fish meals per month (7 oz. fish per meal), due to the presence of mercury in fish tissue, where the highest non-cancer hazard was predicted for consumption of largemouth bass from Ocoee No. 3 Reservoir.

Mercury has not been identified as a chemical of concern in Copper Basin; rather it is likely related to general atmospheric deposition.

PCBs were identified as a contaminant in fish tissue in Parksville Reservoir where cancer risks were greater than 1E-4. The cancer risks due to PCBs in fish (Table 7-5) were calculated based on the total measured Aroclor concentrations. The highest cancer risk would be from consumption of catfish harvested from eastern Parksville Reservoir. Potential cancer risks from Aroclor PCBs in bass or perch consumed in Ocoee No. 3 Reservoir or in the Copper Basin Reach were within acceptable levels.

To supplement the Aroclor mixture approach, PCB risks were also based on exposure to dioxin-like PCB congeners. Because certain PCB forms or congeners are more toxic than others, the dioxin toxic equivalence concentrations (TEC) approach was used along with the cancer slope factor for 2,3,7,8-Tetrachlorodibenzo-p-dioxin. The results of this approach suggested higher cancer risk from consumption of fish (e.g., 2E-4 to 3E-3 for consumption of catfish) at the 17.5 g/day and 54 g/day fish consumption rates. These potentially unacceptable levels of cancer risk are associated with consumption rates above 1.5 fish meals per month from Parksville Reservoir.

Uncertainties

Numerous uncertainties were discussed in the risk assessment, beginning with site data such as the fish species sampled (largemouth bass, channel catfish, and yellow perch), the relatively small sample sizes, and the use of composited fish samples. Perhaps the largest source of uncertainty for Ocoee River risks was the lack of site-specific data regarding local fish consumption rates and fish species consumed. Other related uncertainties include water and sediment ingestion rates, oral and dermal absorption factors, exposure duration, and assumed additivity of toxic effects from the COPC mixtures. In general, the uncertainties presented in the risk assessment were considered very conservative and that risks were somewhat overestimated.

Sediment, surface water, and fish tissue samples were collected during 1997, 2000, and 2002 sampling events; analytical data were sorted by medium and river reach. Five potential human exposure areas were identified: Parksville Reservoir, the Whitewater Reach, Ocoee No. 3 Reservoir, the Copper Basin Reach, and a Reference Reach (Toccoa River). Chemicals of potential concern (COPCs) were identified in each medium and exposure area (Table 7-1). COPCs included PCBs, arsenic, iron, lead, and manganese in sediment; arsenic, iron, lead, and manganese in surface water; and PCBs, mercury, and selenium in fish tissue.

An exposure assessment was conducted to identify receptors at risk and to estimate the type and magnitude of exposures. Exposure scenarios were quantified for area residents, recreational visitors, rafting guides, and recreational fishers. Exposure routes include incidental ingestion of sediment and surface water, dermal contact with sediment and surface water, and fish consumption. Reasonable maximum exposure estimates for each exposure scenario were combined with toxicity values to estimate non-cancer hazard and cancer risk.

Human health hazards and risks associated with exposure to sediment and surface water did not exceed acceptable levels at any of the exposure areas. Risks from fish consumption could potentially exceed acceptable levels, depending on the fish consumption rate. Because no site-specific data on fish consumption rates were available for the Ocoee River, risks were quantified for a range of consumption rates.

Potentially unacceptable levels of non-cancer health hazards are associated with consumption of locally-caught fish at consumption rates above 4.5 fish meals per month (7 oz. fish per meal), due to the presence of mercury in fish tissue, where the highest non-cancer hazard was predicted for consumption of largemouth bass from Ocoee No. 3 Reservoir. Mercury has not been identified as a chemical of concern in Copper Basin; rather it is likely related to general atmospheric deposition.

A study in eastern Tennessee (Jakus *et al.*, 1998) reported that recreational anglers consume an average of four meals of reservoir fish per year (or about 0.3 meals per month). Ocoee River anglers would need to consume more than five times as many meals of channel catfish or 15 times as many meals of largemouth bass or yellow perch before an unacceptable cancer risk or non-cancer hazard would be predicted.

Additional sediment and surface water data were collected after the HHRA was finalized in May 2003. These data were reviewed to determine if potential exposure concentrations had changed. The concentrations of COCs in surface water are less now than at the time of the HHRA due to the treatment of significant amounts of Davis Mill Creek and North Potato Creek waters before they reach the Ocoee River. Similarly, an evaluation of the recent sediment data did not reveal any significant changes to the reasonable maximum exposure concentrations. Table 7-6 compares the surface water and sediment reasonable maximum exposure concentrations used in the HHRA to data collected since the HHRA was completed (after 2002). In all cases, the post-2002 water and sediment concentrations were lower and consequently resulted in lower adverse hazards or risks to human health than originally estimated from the older data. The potential risk from consumption of fish is conservatively assumed to be the same (based on maximum fish tissue concentrations) as no recent tissue data has been collected.

7.2 Summary of the Ecological Risk Assessment

An Ecological Risk Assessment (ERA) was completed for the Copper Basin Reach (from Copperhill to Ocoee No. 3 Reservoir) as part of an initial RI (Black & Veatch and SAIC, 2005). Subsequent evaluations by EPA resulted in a decision to expand the RI to include all affected portions of the Ocoee River from the town of Copperhill to, and including, Parksville Reservoir. The updated ERA is summarized below.

7.2.1 Identification of Chemicals of Potential Concern

The removal actions implemented in Davis Mill Creek and North Potato Creek required a refinement of the list of COCs. Data from the most recent investigations were rescreened to update the final COCs for the final ERA. Table 7-7 summarizes the COCs that were quantitatively evaluated in the ERA. Other chemicals of potential concern were assessed qualitatively.

7.2.2 Risk Evaluations and Exposure Assessment

As described in Section 6.2, the Ocoee River is currently not meeting designated beneficial uses. One of the primary goals for the river is to meet the State of Tennessee water quality criteria for the protection of fish and aquatic life and other designated uses of each river reach.

Assessment and Measurement Endpoints

Assessment endpoints are the ecological resources or receptors whose protection from adverse effects is the goal of risk management actions. For the Ocoee River ERA the following assessment endpoints were evaluated:

- Protection of aquatic invertebrate communities from hazardous substances that would result in adverse, survival, reproduction, or growth effects.
- Protection of the fish community from hazardous substances that would result in adverse, survival, reproduction, or growth effects.
- Protection of habitat structure for aquatic communities.
- Protection of wading birds from hazardous substances that would result in adverse, reproduction, or growth effects.

Decades of erosion of mining-related wastes and soils from the Site altered the river substrate and reservoir habitat with a variety of chemical stressors and effects from siltation. In addition, management of the river for hydropower generation has added a physical stressor on the habitat through fluctuating water levels. To help evaluate chemical and physical stressors on the ecosystem, numerous measurement endpoints and metrics were used to evaluate each of the assessment endpoints. These included:

- Sediment, pore water, and surface water concentrations and field parameters.
- Surface water and pore water toxicity tests to the water flea *Ceriodaphnia dubia*.
- Surface water toxicity test with algae.
- Sediment toxicity tests with the amphipod *Hyalella azteca* and the insect midge *Chironomus tentans*.
- Benthic community surveys conducted in the Copper Basin reach to provide metrics such as species abundance and diversity.
- Fish survey in the Copper Basin reach.
- Contaminant intake model for a wading bird.
- Stream habitat assessments and wetland/riparian survey.
- Observations of wildlife and shoreline habitat use.
- A variety of measurements used to evaluate exposures, potential bioavailability, and fate/transport of the COPCs. These included pH, hardness, oxidation-reduction potential, organic carbon, acid volatile sulfide/simultaneously extracted metals

(AVS/SEM), acid generating potential, and sediment sequential extraction procedure.

These measurements provided a multiple-lines-of-evidence approach to evaluate exposures and potential risks to ecological receptors. The conceptual models presented in Section 5-1 were used to evaluate contaminant pathways and potential exposure pathways, with particular emphasis placed on the contaminated sediment-interstitial pore water-surface water pathway of exposure.

Exposure Analysis
Aquatic Invertebrates. These organisms are exposed to sediment, interstitial pore water, and surface water. The lines of evidence used to evaluate exposures included media chemistry and toxicity tests with the sensitive amphipod *H. azteca* and the more tolerant insect midge *C. tentans* to provide a range of potential effects along contamination gradients. Because the sediment (particularly in the Copper Basin Reach) contains visible mining wastes such as slag and iron calcine, it was postulated that these materials would result in elevated levels of copper, lead, iron, zinc, and other metals in the sediment when analyzed by total digestion. However, benthic organisms cannot digest all of the metals in a solid sample; therefore, measurements of potential bioavailability were used at most toxicity test locations to assist in interpreting the toxicity tests. These included the acid volatile sulfide/simultaneously extracted metals (AVS/SEM) procedure and sequential extraction analysis. In addition to these analyses, the benthic community survey results (combined with an analysis of habitat conditions) provided evidence of chemical and physical stress.

Exposure to epibenthic invertebrates that generally inhabit the water column and provide a food base for other aquatic invertebrates and fish was assessed by water chemistry and toxicity tests with the cladoceran *C. dubia*. This organism was also used to assess exposure to interstitial pore water.

Fish. The lines of evidence to assess fish exposure to contaminants included water quality chemistry, fish tissue body burdens, and a fish community trend analysis in the Copper Basin Reach.

Habitat Structure. An assessment of habitat condition was essential for evaluating aquatic invertebrate and fish community metrics, and how these physical metrics may be related to chemical exposure. Habitat assessments were conducted at each of the aquatic invertebrate survey stations in the Copper Basin Reach based on the TDEC (2006) protocol. These assessments included such conditions as epifaunal substrate, stream embeddedness, bank stability, and channel alteration. The habitat metrics were then compared to ecoregion expectations for similar stream types. Habitat quality in the reservoirs was only addressed qualitatively. The physical stressors from changes in substrate composition, seasonal variations, and daily changes in water elevations, combined with the chemical stressors produced a wide range of differential exposures within the river that affected estimates of risk.

Wading Birds. The great blue heron (*Ardea herodias*) was used as a conservative surrogate species to assess exposure to wading birds and other piscivorous birds such as kingfishers or eagles. A contaminant exposure intake model was developed that included conservative assumptions of water, sediment, and food (fish) ingestion rates as well as body weight. The heron was also assumed to feed year-round in contaminated wetland areas mostly in Ocoee No. 3 Reservoir and in eastern Parksville Reservoir, and that the total COC analyses were 100 percent bioavailable.

In addition to the major lines of evidence to evaluate exposures, other abiotic factors that affect exposure and potential bioavailability included water hardness, pH (acidity), organic carbon, presence of metal sulfides, redox conditions, geochemical forms, particle size, and temperature.

7.2.3 Ecological Effects Assessment

Surface Water

Copper, iron, manganese, and zinc were quantified in the ERA; however, copper and zinc were of most concern in surface water. Table 7-8 compares the concentrations of copper and zinc in surface water to their water quality criteria for chronic effects to fish and aquatic life. The surface water data used in the risk assessment were collected in 2005 and 2006, and included samples collected during different flow regimes in the river, as well as shallow and deep water samples in reservoirs.

The data indicate that aquatic life exposure to copper and zinc in the Ocoee River could pose an unacceptable risk. To further evaluate this risk, surface water toxicity tests were conducted with *C. dubia* in 2004 and 2005. Reproductive effects significantly different from controls were reported in two of two samples in the Copper Basin reach and in three of 16 samples from Parksville Reservoir. There were no effects to organism survival. An algal toxicity test with *Selenastrum capricornutum* was also performed with several water samples from Parksville Reservoir. There were no significant algal effects relative to controls.

Interstitial Pore Water

A variety of metals in pore water in permanently inundated sediment were quantified in the ERA. Table 7-9 show the concentrations of copper and zinc compared to water quality criteria. The pore water data used in the risk assessment were collected in 2005 and 2006.

The data indicated that aquatic life exposure to copper and zinc in sediment pore water could pose an unacceptable risk. The highest concentrations were in oxidized sediment periodically exposed to atmospheric oxygen.

To further evaluate risk from pore water, toxicity tests were conducted with *C. dubia* in 2005 using pore water collected from four locations in Ocoee No. 3 Reservoir and four locations in Parksville Reservoir. Significant reproductive effects were reported in all eight samples. Survival was significant in only one sample. These data suggest mostly chronic reproductive effects.

Sediment
Numerous sediment samples were collected as part of the RI between 2003 and 2006. Table 7-10 shows the concentrations of the principal COCs in relation to literature-based sediment quality benchmarks.

The data indicate that benthic organisms and other organisms dependent on the sediment (e.g., deposited fish eggs) are potentially at risk. To further evaluate this potential risk, sediment toxicity tests were conducted on samples collected from each river reach between 2003 and 2006. Ten-day sediment toxicity tests conducted with *C. tentans* did not indicate any reproductive or survival effects. However, sediment toxicity tests conducted with *H. azteca* under 10, 14, and 28-day exposure periods resulted in significant survival effects in 6 of 33 samples and reproductive effects in 9 of 26 samples. These results suggest adverse effects to sensitive benthic organisms.

Benthic Community
Benthic macroinvertebrate surveys were conducted in the Copper Basin Reach and upstream in the Toccoa River in 1997, 2003, and 2006. The benthic community data were evaluated relative to the TDEC macroinvertebrate survey protocol and the EPA rapid bioassessment protocol. In general, the community indices indicated slight to moderate impairment in the river reach; however, there was a distinct improvement in several metrics from 1997 to 2006 suggesting recovery of the benthic community in this portion of the river.

Fish
Effects to fish were evaluated using three lines of evidence: 1) comparison to water quality criteria, 2) interpretation of fish tissue residue levels, and 3) fish community metrics. Comparisons to water quality criteria suggested that adverse effects to fish reproduction and growth would not be expected to occur. A comparison of COCs in fish tissue to literature-based effect levels suggested a potential for localized, low-level growth effects to fish. However, the fish community survey metrics did not indicate significant effects, but rather improved fish numbers and diversity.

Habitat Impacts
The most significant impact on habitat condition is fluctuating water levels as a result of hydropower management. In the Copper Basin Reach, water levels can fluctuate two to six feet per day in the summer, which affects shoreline habitat colonization. In addition, oxidization of sediment has been shown to release acid and metals into the pore waters of river bars and deltas, some of which drains into the river. In Parksville Reservoir, 200 to 300 acres of sediment can be exposed in the winter, effectively preventing habitat formation and contributing to acid generation and metal releases from oxidation.

Wading Birds
The great blue heron was modeled as a surrogate species for other herons, eagles, osprey, or kingfishers that may utilize the Ocoee River. The conservative contaminant intake model results were compared to literature-based toxicity reference values. The estimate of hazard quotients for no-observed-adverse-effect-levels (NOAELs) and lowest-adverse effect levels (LOAELs) were

all less than one, except for the zinc NOAEL which had an HQ of 1.1. These results suggest no significant adverse effects to fish-eating birds.

Terrestrial Receptors
Low emphasis is placed on other terrestrial receptors (other than wading birds) because many of these organisms are less frequently exposed to contaminated sediment and water. However, exposure to sediment bars and certain wetland areas that have elevated levels of multiple COCs may result in some chemical stress. Vegetation growing in contaminated sediment (particularly where oxidized) is likely to be stressed by a combination of metals, low nutrients, degraded pore water, and water management practices.

7.2.4 Risk Characterization

Risk characterization integrates the exposure information with the effects data to evaluate each assessment endpoint.

Protection of Aquatic Invertebrate Communities from Hazardous Substances that would Result in Adverse, Survival, Reproduction, or Growth Effects
The primary lines of evidence used to characterize risks to this assessment endpoint are the results of surface water, pore water, and sediment toxicity tests. Additional lines of supporting evidence include results from AVS/SEM and sequential extraction procedures that estimate potential availability of the COCs to aquatic benthic organisms, and comparisons to water quality criteria. Based on the information presented in Section 7.2.3 and detailed discussions in the ERA, it was concluded that:

- Surface water in the Copper Basin Reach could be expected to result in adverse chronic effects to the growth and reproduction of benthic invertebrates. In addition, metal concentrations in pore water suggested that adverse chronic effects to sediment-dwelling benthic invertebrates were likely.
- Sediment in the Copper Basin Reach was likely to result in adverse chronic growth and reproductive effects to sensitive benthic invertebrates when metals exceed the following concentrations: copper: 680 mg/kg, iron: 57,000 mg/kg, lead: 145 mg/kg, and zinc: 2,200 mg/kg.
- Surface water quality in Ocoee No. 3 Reservoir would not be expected to cause adverse chronic effects to aquatic invertebrates.
- There is the potential in Ocoee No. 3 Reservoir for adverse impacts to benthic invertebrates that burrow into oxidized sediment where they can be exposed to elevated metals and acidity (pH <5).
- In general, toxicity tests and comparisons to water quality criteria, suggest that water quality in Parksville Reservoir would not cause adverse toxic effects to aquatic invertebrates except in localized areas adjacent to the sediment delta and in the deep water during summer months.
- Sediment in Ocoee No. 3 and Parksville Reservoirs was likely to result in adverse chronic growth and reproductive effects to sensitive benthic invertebrates when

metals exceed the following concentrations: copper: 640 mg/kg, iron: 53,000 mg/kg, lead: 250 mg/kg, and zinc: 970 mg/kg.

- Based on all the lines of evidence, the benthic invertebrate community in Parksville Reservoir is considered to be at chronic adverse risk from hazardous substances in the sediment and pore water in the delta region and in the deep portions of the reservoir.

Protection of the Fish Community from Hazardous Substances that would Result in Adverse, Survival, Reproduction, or Growth Effects

The lines of evidence to evaluate this assessment endpoint were comparisons to water quality criteria, tissue residues, and fish community surveys. The ERA concluded that:

- COCs in surface water in all three river reaches would not be expected to adversely affect fish.
- Sediment quality in the Parksville delta region and the removal of approximately 300 acres of reservoir habitat by fluctuating water pool levels has restricted spawning and rearing.
- Fish community indices appear to be improving in all three reaches, which is likely due to reduced contaminant load from Davis Mill Creek and North Potato Creek.
- Fish tissue residue concentrations of copper and zinc in small sunfish are at levels that could affect their growth and development. However, overall fish populations within this reservoir are not expected to be at significant adverse risk.

Protection of Habitat Structure for Aquatic Communities

The lines of evidence used to evaluate this assessment endpoint included habitat assessments using EPA's Rapid Bioassessment Protocol and periodic visual observations of riparian corridors and sediment bar vegetation. The ERA concluded that:

- Portions of Copper Basin reach were impacted by contaminated embedded sediments and redox-sensitive iron metal complexes which limits recolonization.
- The sediment delta in Parksville Reservoir does not support a viable benthic community or fish spawning and rearing area. It also does not support aquatic or terrestrial vegetation communities. This is believed to be due to the combined effects of chemical stress and reservoir water level management.

Protection of Wading Birds from Hazardous Substances that would Result in Adverse, Reproduction, or Growth Effects

A conservative exposure model for the great blue heron was used to assess effects to other fish-eating birds, such as eagles and kingfishers. Results of the model indicated that resident wading birds are not expected to be at adverse risk from the chemicals of concern.

Ecologically Protective Media Concentrations
Table 7-11 summarizes the COC concentrations that are expected to provide protection to ecological receptors.

Uncertainties
The most profound uncertainty has been the constant improvement in the quality of surface water in the Ocoee River during RI data collection (and continuing to the present day) in response to removal actions and other interim measures in other portions of the Site. Since the risk assessment was completed, on-going water quality monitoring has shown very few exceedances of State water quality criteria. In addition, the removal of tons of iron and other COCs before entering the Ocoee River has improved the river substrate for potentially greater colonization by a more diverse benthic community. These improvements have also been recorded in Ocoee No. 3 Reservoir.

In Parksville Reservoir, the large sediment delta remains subject to oxidization due to fluctuating water levels. This process generates acid and subsequently releases metals into the pore water or shallow ground water. Samples of water collected from the river channel immediately adjacent to oxidized delta sediment while water was draining from the sediment during reservoir drawdown exceeded water quality criteria for several metals, including copper and zinc. Chronic risks to fish and aquatic life in the delta region are expected to remain unchanged as long as contaminant releases from the delta sediment occur in response to fluctuations in water pool.

8.0 Remedial Action Objectives

A revised set of Remedial Action Objectives (RAOs) was developed following completion of the RI. These objectives are consistent with the findings of the RI, including the human health and ecological risk assessments presented therein and summarized in Section 7 of this ROD. They are intended to prevent or control releases of hazardous substances from contaminated soil, sediment and associated pore water, wastes, and instream sources in the Ocoee River. The specific RAOs are:

- Meet and sustain the applicable Tennessee water quality criteria (WQC) for fish and aquatic life, recreation, industrial water supply, irrigation, and livestock watering and water supply and the narrative standards for biological integrity in all reaches of the Ocoee River.
- Prevent or control releases of hazardous substances from contaminated soil, sediment and associated pore water, mining wastes, and instream sources to the Ocoee River.
- Reduce toxicity to aquatic organisms within the river to acceptable levels, defined as being between the No Observed Adverse Effect Level (NOAEL) and the Lowest Observed Adverse Effect Level (LOAEL);
- Reduce human exposure to contaminants through the ingestion of fish at rates that could result in a cumulative hazard index greater than or equal to 1, or exceed the acceptable range for cancer risk, defined by EPA as being an added health risk between 1 in 10,000 (1×10^{-4}) and 1 in 1,000,000 (1×10^{-6}). TDEC identifies an acceptable risk range as being less than 1 in 100,000 (1×10^{-5}).

8.1 Remedial Goals

Sediment cleanup levels for response actions under CERCLA generally are based on site-specific risk assessments and ARARs. In developing their sediment remediation guidance, EPA (2005) recognized that a great deal of uncertainty exists in the development of remedial goals, particularly chemical-specific cleanup levels, at sediment hazardous waste sites. They indicated that for many river and sediment systems, "[T]he derivation of ecologically based cleanup levels is a complex and interactive process incorporating contaminant fate and transport processes, toxicological considerations, and potential habitat impacts of the remediation alternatives [in themselves]".

General clean-up levels were adopted that will assist in achieving the RAOs stated above. Table 8-1 shows remedial goals for surface water and sediment; these remedial goals will serve as clean-up levels for OU5. The Tennessee WQC for recreation, aquatic life, and biological integrity have been adopted as Remedial Goals (RGs). Specific numerical goals for surface water have been established for copper, iron, and zinc. RGs for sediment have been set to achieve levels of contaminants that are less than the LOAEL and to reduce potential risks to human health from ingestion of fish. Remedial goals to achieve this objective are based on risk-based sediment quality benchmarks for copper, iron, lead, and zinc that were developed as a part of the RI and ERA. Additional information used to derive the sediment RGs included chemical mobility and potential bioavailability tests such as sediment pore water chemistry, sequential extraction procedure, and acid volatile sulfide/simultaneously extracted metal (AVS/SEM) results (Section 7).

In setting these cleanup levels, EPA recognizes the complex interactions taking place between the Ocoee River and the remedial activities occurring in the watersheds of the Copper Basin. The Ocoee River monitoring program developed by EPA and GSHI, with input from TDEC, will be used to develop and define an iterative decision process to evaluate goal achievement. An iterative process is suggested by OSWER Directive 9285.6-08 (EPA, 2002) which recognized the recommendations made by the National Research Council (NRC, 2001) in developing a risk management strategy for sediment contaminated by PCBs, but indicated it would be applicable to most sediment sites. It is also consistent with an Adaptive Management (AM) approach that was recommended by the NRC in its review of the remedial decision processes used at another mining mega-site near Coeur d'Alene, Idaho (NRC, 2005).

9.0 Description of Alternatives

The NCP at 40 CFR §300.430(e)(7) describes methods for screening cleanup technologies in order to develop applicable remedial alternatives. These procedures were used to insure that the best or most promising alternatives were retained for detailed analysis and comparison. As a part of the FS, a variety of cleanup technologies were first screened for their implementability and effectiveness in abating the identified residual risks at this site. Technologies that passed the screening were then combined to develop a final set of remedial alternatives to be further evaluated. The remedial alternatives described below were developed for each of the three study areas along the Ocoee River:

- Copper Basin Reach: Copperhill to Ocoee No. 3 Reservoir (River Mile 33.5 to 38.0)
- Ocoee No. 3 Reservoir (River Mile 33.5 to 29.2)
- Parksville Reservoir (River Mile 17.1 to 11.9).

These alternatives focus on sediment as the primary residual risk in the river. Monitoring conducted since the RI was completed has found fewer exceedances of WQC in surface water than measured previously. These changes reflect the success of the removal actions and continuing interim measures in the DMC and NPC watersheds (see Section 5 and Appendix E).

9.1 Copper Basin Reach (CBR)

9.1.1 CBR-0: No Action

Under this alternative, no treatment, engineering controls, or institutional controls would be employed in the Copper Basin Reach. A specific monitoring program also would not be developed. Monitoring may be conducted in certain parts of this study reach, but the objectives would be dictated by the need to monitor and document remedial success resulting from actions implemented in the Davis Mill Creek and North Potato Creek watersheds. These are considered separate actions and will be governed by separate RODs or decision documents.

A "No Action" alternative can only be considered when no significant residual risk has been identified. In this case, where residual risks have been identified in the river, this alternative serves as the basis for comparison for all other alternatives and actions across the evaluation criteria.

9.1.2 CBR-1: Monitored Natural Recovery

This alternative uses Monitored Natural Recovery MNR) to achieve RGs. Monitored Natural Recovery is a remedy for contaminated sediment that typically uses ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants (EPA, 2005). Natural processes include physical, biological, and chemical mechanisms that act together to reduce the risk of contaminants to human or environmental receptors. Unlike the *No*

Action alternative, under MNR, a risk to human or ecological receptors has been identified but, either alone or with other action technologies, natural recovery has been chosen as the process to use for remediation and reduction in exposure.

Under Alternative CBR-1, EPA and GSHI will develop, with input from TDEC, and GSHI will implement a monitoring program for the Copper Basin Reach that will document changes in identified risks in the river and document natural recovery processes. The program is expected to include monitoring of river water quality, sediment quality, sediment toxicity, benthic macroinvertebrate communities, and fish communities between Copperhill (RM 38) and the slack water of the Ocoee No. 3 Reservoir (RM 33.5). Results from the monitoring program will be compared to the RGs specified in Section 8 and an iterative process will be developed to evaluate goal achievement. It is anticipated that monitoring would be conducted annually for at least 5 consecutive years to determine if the RAOs listed in Section 8 are being met. Should trends in monitored data indicate that RAOs and RGs are being met, sampling frequencies could be reduced to an appropriate period as indicated by the data.

9.1.3 CBR-2: Monitored Natural Recovery with Enhanced Sediment Capping

Alternative CBR-2 will use MNR as described under Alternative CBR-1 and additionally will incorporate instream structures similar to spur dikes at two locations to enhance the trapping of clean sediment and an option to remove a low-water dam at the upstream end of the reach. Alternative CBR-2 will include the development and implementation of a monitoring plan as described under Alternative CBR-1.

The instream structures would be installed at RM 34.0 and RM 35.3 in two relatively straight reaches. Sediment in these reaches exhibits relatively high residual aquatic risk compared to sediment in other portions of this study segment; these reaches are thought to be areas where sediment deposition does not naturally occur or occurs more slowly under flow regimes typical of the river.

Spur dikes, deflectors, and groins are transverse structures that extend into the stream from the bank and reduce erosion by deflecting flows away from the bank. These structures often provide pool habitat and increase physical diversity. Two to five structures are typically placed in series along stream banks where water flow is roughly parallel to the bank. Specific design criteria, such as crest height, crest slope, and upstream angle, have not been developed for these structures; however, it is anticipated that these structures would be designed and constructed from locked-logs and locked-twigs anchored into the bank by cabling and potentially with rip rap. Structures would be made from trees and/or other natural materials locally available near the identified site(s). This alternative would utilize locked-log structures on both sides of the bank along a straight reach.

A low-water dam was constructed of concrete across the Ocoee River in the early 1970s as a fresh water intake for industrial operations at RM 37 near the town of Copperhill. The intake is not in use as there is no longer a need for an industrial fresh water source. The dam, which is approximately 3 feet high and 350 feet long, creates a back-water condition in the Ocoee between RM 37 and RM 38. This alternative includes an option to remove this dam and the fresh water intakes. Removal would be conducted in late summer when water levels are at a minimum. In addition, coordination with TVA would be required to control releases from Blue Ridge Reservoir. It is assumed that removal of the concrete dam would be conducted in two stages to minimize impacts to both the upstream and downstream environment during implementation. A cofferdam would be used to divert water away from the southern bank allowing removal of a 50 to 100 foot section of the weir. The cofferdam would then be repositioned to allow the entire flow to be diverted through the removed section. The remainder of the weir would then be removed by working from the opposite bank inward. An excavator with a jackhammer attachment would be used to demolish the dam. Given the amount of reinforcing that was incorporated into the dam during construction, explosives may be required for demolition; demolition requirements would be determined during the design phase. Site restoration would consist of mitigating impacts created by work areas and heavy equipment entering and leaving the site. Mitigation will include placement of geotextile and reseeding disturbed areas to prevent erosion.

9.2 Ocoee No. 3 Reservoir (O3R)

9.2.1 O3R-0: No Action

No treatment, engineering controls, or institutional controls will be employed in the Ocoee No. 3 Reservoir under this alternative. A monitoring program for this reach (RM 33.5 to RM 29.2) also will not be developed. Monitoring may be conducted in certain parts of this study reach, but the objectives would be dictated by the need to monitor and document remedial success resulting from actions implemented in the Davis Mill Creek and North Potato Creek watersheds. These are considered separate actions and will be governed by separate RODs and decision documents.

A "No Action" alternative can only be considered when no significant residual risk has been identified. In this case, where residual risks have been identified in the river, this alternative serves as the basis for comparison for all other alternatives and actions across the evaluation criteria.

9.2.2 O3R-1: Monitored Natural Recovery

Alternative O3R-1 will use MNR as described under Alternative CBR-1. Under this alternative EPA and GSHI will develop, with input from TDEC, and GSHI will implement a monitoring program for the Ocoee No. 3 Reservoir that will document changes in identified risks in the reservoir and document natural recovery processes. The program is expected to include monitoring of river water quality, sediment quality, sediment toxicity, benthic macroinvertebrate communities, and fish communities between RM 29.2 (at the dam) and RM 33.5. Results from the monitoring program will be compared to the RGs specified in Section 8 and an iterative process will be developed to evaluate goal achievement. It is anticipated that monitoring would be conducted annually for at least 5 consecutive years to determine if the RAOs listed in Section 8 are being met. Should trends in monitored data indicate that RAOs and RGs are being met, sampling frequencies could be reduced to an appropriate period as indicated by the data.

9.2.3 O3R-2: Monitored Natural Recovery with Hydraulic Controls

Alternative O3R-2 will use MNR as described under Alternative CBR-1 and additionally will incorporate hydraulic controls to manage the discharge of water through the Ocoee No. 3 dam in a manner that will minimize the likelihood of erosion and mobilization of deeper, more contaminated sediment from behind the dam. In developing this alternative, EPA utilized the results of sediment transport modeling that was conducted to evaluate the sediment discharge event that occurred January 3 through January 4, 2009 (USACE, 2009; included as Appendix B to the FS [Black & Veatch, 2009a])). Alternative O3R-2 will include the development and implementation of a monitoring plan as described under Alternative O3R-1.

Under this alternative, TVA will use the BMP Plan developed and implemented in response to TDEC Director's Order WPC09-0008 to guide dam operations at Ocoee No. 3 to minimize the release of sediments that can occur from the lower sluice gates. The plan was approved by TDEC, Division of Water Pollution Control, and EPA (see Part 1). This plan is included as Appendix A.

9.3 Parksville Reservoir (PR)

9.3.1 PR-0: No Action

Under this alternative, no treatment, engineering controls, or institutional controls would be employed in the Parksville Reservoir or applied to the Parksville sediment delta (RM 17.1 to RM 11.9). A monitoring program also would not be developed for this reach. Monitoring may be conducted in certain parts of this study reach, but the objectives would be dictated by the need to monitor the remedial success resulting from actions implemented in the Davis Mill Creek and North Potato Creek watersheds. These are considered separate actions and will be governed by separate RODs or decision documents.

9.3.2 PR-1: Monitored Natural Recovery

This alternative will primarily use MNR as described under Alternative CBR-1. Under Alternative PR-1, EPA and GSHI will develop, with input from TDEC, and GSHI will implement a monitoring program for the Parksville delta and Parksville Reservoir that will document changes in identified risks and document natural recovery processes. The program is expected to include monitoring of water quality, sediment quality, sediment toxicity, benthic macroinvertebrate communities, and fish communities between RM 17.1 and RM 11.9. Results from the monitoring program will be compared to the RGs specified in Section 8 and an iterative process will be developed to evaluate goal achievement. It is anticipated that monitoring would be conducted annually for at least 5 consecutive years to determine if the RAOs listed in Section 8 are being met. Should trends in monitored data indicate that RAOs and RGs are being met, sampling frequencies could be reduced to an appropriate period as indicated by the data.

9.3.3 PR-2: Monitored Natural Recovery with Permanent Inundation Using Pneumatic Gates

Alternative PR-2 will use MNR as described under Alternative CBR-1 and additionally establish a water cover over the sediment delta located at the entrance to Parksville Reservoir (RM 17 to RM 15.7) and apply lime amendment to delta sediment. The term "permanent inundation" is used in this ROD to mean maintenance of a consistent water cover over the sediment delta, except for normal fluctuations associated with power generation, and pool elevation changes required for dam maintenance or emergencies. Under this alternative, a monitoring program would be developed and implemented as described under Alternative PR-1.

Maintaining a consistent water cover across the Parksville sediment delta (wet closure) would require TVA to implement engineering controls for the operation of Ocoee No. 1 dam that will modify the current winter guide curve in order to maintain an average pool level at or above the maximum elevation of the sediment delta of approximately 834 feet AMSL (NAVD 88). This is seven feet higher than the current winter guide curve. The summer guide curve would remain at 836 feet AMSL (NAVD 88). Under Alternative PR-2, the existing system of flashboards and superboards at Ocoee No. 1 dam would be replaced with a system utilizing fourteen pneumatically operated spillway gates manufactured by Obermeyer Hydro, Inc., or a similar product. Gate installation would require modification of the arch spillway; however it is anticipated that no modification to the downstream portion of the arch spillway would be required, or to the non-overflow section of the dam. These gates would better facilitate managing the reservoir pool level during the winter. The operating system for the arch spillway gates would be housed in the existing building atop Ocoee No. 1 dam.

Prior to implementing the new guide curve, lime would be used as a surface amendment to initially treat the upper oxidized zone of the delta. As described in Appendix B of the FS, the incorporation of lime amendment at a rate of at least 3 tons per acre showed positive effects to both sediment pore water and surface water quality in static bench treatability tests.

9.3.4 PR-3: Monitored Natural Recovery with Wetland Development

Alternative PR-3 will use MNR as described under Alternative CBR-1 and additionally will include partial inundation of the Parksville sediment delta, the development of a wetland on the sediment delta, and the application of lime amendment to delta sediment. Under Alternative PR-3, a monitoring program would be developed and implemented as described under Alternative PR-1.

Developing and maintaining wetland vegetation would require TVA to implement engineering controls for the operation of Ocoee No. 1 Dam that will put guidelines in place to maintain an average pool level elevation at 831 feet AMSL (NAVD 88) on a year-round basis. This is four feet higher than the current winter guide curve but 5 feet lower than the summer guide curve elevation. Adjusting the water level to a consistent average elevation of 831 feet will result in near year-round inundation of approximately 200 acres (330,000 cubic yards) of sediment that are currently exposed during winter low pool. With normal pool level fluctuations above and below this level, it is anticipated that root systems within most of the sediment delta would not become completely desiccated during winter months.

As described under Alternative PR-2, Alternative PR-3 also will use lime amendment to initially treat the upper oxidized zone and assist in establishing wetland vegetation. The application of lime would minimize potential acid generation resulting from daily water level fluctuations of a few feet. Vegetation would be initially established through reclamation and seeding activities similar to those employed in other areas of the Copper Basin.

9.3.5 PR-4: Monitored Natural Recovery Hydraulic Dredging

Alternative PR-4 will use MNR as described under Alternative CBR-1 and additionally include hydraulic dredging to remove the sediment delta to an elevation of 827 feet (NAVD), which is below the winter low pool level maintained by TVA under the current winter guide curve. In this manner, the remaining delta sediment would be consistently inundated with water under the current operating conditions. Under Alternative PR-4, a monitoring program would be developed and implemented as described under Alternative PR-1.

Hydraulic dredges use centrifugal pumps to remove and transport sediment in a slurry form. The dredges are typically mounted on a barge and have a suction device fixed to a moveable arm (or ladder) that is raised or lowered to facilitate sediment removal.

Due to the nature of the sediment, access limitations, and minimal water overlying the sediment delta, it is assumed that a cutterhead dredge (i.e., a conventional hydraulic pipeline dredge with a mechanical cutterhead) would be selected to remove the upper layers of the delta sediments. A hydraulic pump providing suction at the dredge head would draw the sediment slurry into a pipeline and propel the slurry to the discharge point, which would be located in a deeper portion of the reservoir, such as the area behind Ocoee No. 1 Dam. Discharge pipes would be extended close to the bottom of the reservoir to minimize impacts to the water column resulting from suspended solids at the discharge point.

Dredging would be employed at the Parksville delta during a period when the reservoir pool level is maintained at an elevation sufficiently high to enable a dredge barge to float over the sediment. Sediment would be removed to an elevation of 827 feet (NAVD); approximately 463,000 cubic yards of sediment would be removed and disposed of within the reservoir at a depth of at least 50 feet below the water surface (such as behind Ocoee No. 1 Dam) to minimize exposure to aquatic organisms. This will result in consistent inundation of the dredged and remaining delta sediments nearly year-round.

9.3.6 PR-5: Monitored Natural Recovery with Permanent Inundation Using Flashboards and Superboards

Alternative PR-5 will use MNR as described under Alternative CBR-1 and additionally will establish a consistent water cover over the sediment delta located at the entrance to Parksville Reservoir (RM 17 to RM 15.7) and apply lime amendment to delta sediment. The term "permanent inundation" is defined under Alternative PR-2 and is used similarly under this alternative. Under Alternative PR-5, a monitoring program would be developed and implemented as described under Alternative PR-1.

Maintaining a consistent water cover across the Parksville sediment delta (wet closure) would require TVA to implement engineering controls for the operation of Ocoee No. 1 Dam that will modify the current winter guide curve in order to maintain an average pool level at or above the maximum elevation of the sediment delta of approximately 834 feet AMSL (NAVD 88). Under Alternative PR-5, this water cover would be maintained using the existing system of flashboards and superboards presently in place on Ocoee No. 1 Dam rather than the pneumatic gates that would be used under Alternative PR-2. Because this is the existing system, no modifications to the dam would be required and a stability analysis would not be required.

An evaluation of the current flashboard/superboard system indicated that the boards should be replaced at a minimum of every five years (Stantec, 2010). Because of the potential year-round wetting of the boards, implementation of this alternative will require that the system be kept in good condition. For this reason, TVA will be required to conduct a visual inspection of the flashboard/superboard system annually and completely replace the system as appropriate, which is anticipated to be every 3 to 5 years. To replace either the entire system or any damaged boards, TVA must lower the reservoir pool to an appropriate level for worker safety and access. The duration of this operation is wholly dependent on weather and flow conditions in the river. TVA will perform this work as long as conditions are considered to be safe and effective.

As described under Alternative PR-2, lime would be applied at a rate of 3 tons per acre as a surface amendment to initially treat the upper oxidized zone of the delta. This would be a single application prior to implementation of the new winter guide curve.

10.0 Comparative Analysis of Alternatives

As required by the NCP at 40 CFR §300.430(e)(9)(ii), the FS used a comparative analysis to assess the relative performance of each alternative in relation to nine specific evaluation criteria (excluding the two modifying criteria, state acceptance and community acceptance). The purpose of this analysis was to identify the advantages and disadvantages of each alternative relative to the other alternatives. Analysis of alternatives was conducted separately for each of the identified areas of OU5. The comparative analysis for each of these areas is provided below.

10.1 Copper Basin Reach

10.1.1 Overall Protection of Human Health and the Environment

The threshold criterion of 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 each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

While improvement to water and sediment quality may occur under Alternative CBR-0 (No Action), this alternative would not be protective because monitoring to determine remedial success would not be conducted. Alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) would result in similar degrees of protection of human health and the environment assuming natural processes are provided adequate time to abate residual risks to aquatic life. Construction of spur dikes and removal of the low-water dam under CBR-2 are not expected to significantly enhance the capping of clean sediments. Installation of spur dikes could negatively impact the banks or substrate of the river.

10.1.2 Compliance with ARARs

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites 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). "Applicable requirements" are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. "Relevant and appropriate" requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

Although Tennessee's water quality criteria as chemical-specific ARARs may be met under Alternative CBR-0 (No Action), there would be no mechanism to document compliance with these criteria under this alternative. Alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) are expected to meet Tennessee's water quality criteria and other numerical standards

Alternatives CBR-0 (No Action) and CBR-1 (MNR) would not invoke any location- or action-specific ARARs. Construction activities under Alternative CBR-3 (MNR with Enhanced Sediment Capping) would be required to meet the substantive requirements of §404 of the CWA, Dredge and Fill of Material in Waters of the U.S., §402 of the CWA for obtaining a NPDES Construction Storm water permit, and of an Aquatic Resource Alteration Permit (ARAP) under the Tennessee Water Quality Control Act (TCA §69-3-108).

10.1.3 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 onsite following remediation and the adequacy and reliability of controls.

Balancing criteria were not evaluated for CBR-0 (No Action) because the alternative would fail to meet RAOs and satisfy the Threshold Criteria of "Overall Protectiveness of Human Health and the Environment" and "Compliance with ARARs."

Alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) would both result in a similar degree of effectiveness and permanence from natural processes, provided there is adequate time to reduce residual aquatic risks. Although Alternative CBR-2 (MNR with Enhanced Sediment Capping) includes remedial actions to enhance deposition of cleaner sediment within the reach, sediment transport modeling indicated that the remedial actions would not significantly improve conditions within the reach and could negatively impact channel hydraulics and geomorphology. Modeling also indicated that removal of the low-water dam under CBR-2 would not significantly affect the transport of clean sediment from upstream reaches. Although removal of the low-water dam would allow increased bed load transport of larger cobbles and rocks, implementation would not significantly impact conditions in the reach.

10.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Natural processes would result in a similar degree of reduction in toxicity for action alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping). None of the alternatives provide permanent containment of contaminants or any active treatment. Natural sequestration of metals may result in some reduction in toxicity and aquatic risk.

10.1.5 Short-Term Effectiveness

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.

Alternative CBR-1 (MNR) would not result in any short-term risk to the health of workers, the public, recreational users, or aquatic receptors from these activities. Alternative CBR-2 (MNR with Enhanced Sediment Capping) would result in a temporary disturbance of sediment and bank materials. There would not be any expected significant short-term risk to recreational users, or the public under this alternative. There would be a small occupational health risk to site workers from construction activities; this risk would be managed by a project-specific health and safety plan and by appropriate OSHA training.

10.1.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Implementation of action alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) would require EPA and GSHI to develop, with input from TDEC, and GSHI to implement a comprehensive monitoring plan for this reach of the Ocoee River (RM 38.0 to RM 33.5) to track the abatement of residual aquatic risk and the attainment of RGs and RAOs. No substantive permit requirements would be applicable.

Construction of spur dikes or similar instream structures under Alternative CBR-2 (MNR with Enhanced Sediment Capping) would be difficult to implement. Access to the river at RM 34.0 and 35.3 is limited because there is no immediate road access and the land ownership is private. Site access would require cutting trees and constructing a temporary road. Demolition of the low-water dam is technically feasible with locally available equipment; access to this area of the river is available from State Highway 64. Both activities would require coordination with daily releases by TVA from Blue Ridge Reservoir to meet power generation and recreation needs. While some coordination with TVA is possible, significant modification of their release schedules is not likely due to power generation requirements.

10.1.7 Cost

Present worth cost analysis was used to compare expenditures for each alternative using a discount rate of 7% as suggested by OSWER Directive 9355.3-20 (EPA, 1993) and the preamble to the NCP (55 FR 8722). Cost estimates, including direct and indirect capital cost and long-term operations and maintenance (O&M) cost, were prepared in accordance with EPA and USACE (2000). For OU5, it was assumed that capital expenditures and implementation of each alternative would be completed in less than 5 years; the O&M requirements were determined by assessing maintenance requirements within each alternative and the time anticipated for those technologies to achieve cleanup levels.

Alternative CBR-2 (MNR with Enhanced Sediment Capping) would be the most expensive of the two action alternatives with an estimated capital cost of $1,004,900. At a seven percent discount rate, the present worth of this alternative would be approximately $1,405,221. Because there are no remedial actions associated with Alternative CBR-1 (MNR), this alternative would not require any capital expenditure. Development and implementation of environmental monitoring would result in an estimated present worth of $400,321 for Alternative CBR-1.

10.2 Ocoee No. 3 Reservoir

10.2.1 Overall Protectiveness of Human Health and the Environment

While improvement to water and sediment quality may occur under Alternative O3R-0 (No Action), this alternative would not be protective because monitoring to determine remedial success would not be conducted.

Both Alternatives O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Controls) would abate residual risks through natural processes and mechanisms. However, O3R-2 (MNR with Hydraulic Controls) would be the most protective because this alternative requires TVA to continue to implement the engineering and hydraulic management controls developed to manage dam operations under TDEC Director's Order WPC09-0008. The developed BMP Plan for operation of Ocoee No. 3 Dam minimizes or limits the erosion and mobilization of sediment from behind the dam, and reduces the possibility of discharging large amounts of sediment down river.

10.2.2 Compliance with ARARs

Although the narrative standards of the Tennessee WQC may be met under Alternative O3R-0 (No Action), there would be no mechanism to document compliance with chemical-specific ARARs. Alternatives O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Controls) also are expected to meet narrative standards of the Tennessee WQC and other numerical standards and ARARs. Large, unmanaged discharges of sediment from the sluice gates of Ocoee No. 3 Dam that might occur under Alternatives O3R-0 (No Action) or O3R-1 (MNR) could result in temporary exceedances of numerical WQC down river.

None of the alternatives for this river segment include remedial actions, so no location- or action-specific ARARs would be invoked.

10.2.3 Long-Term Effectiveness and Permanence

Balancing criteria were not evaluated for O3R-0 (No Action) because the alternative would fail to meet RAOs, and satisfy the Threshold Criteria of "Overall Protectiveness of Human Health and the Environment" and "Compliance with ARARs."

Alternatives O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Controls) would both result in a similar degree of effectiveness and permanence from natural processes, provided there is adequate time for these processes to reduce residual aquatic risks. Alternative O3R-2 (MNR with Hydraulic Controls) would be the most effective and consistent at controlling residual risk within the Ocoee No. 3 Reservoir and down river. Hydraulic controls are effective at minimizing the mobilization of sediment from behind the dam. With sediment mobilization controlled, natural processes are expected to result in attainment of RAOs. Alternative O3R-1 (MNR) is not considered permanent because it does not control the mobilization and release of large amounts of sediment from behind the dam.

10.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Neither Alternative O3R-1 (MNR) nor O3R-2 (MNR with Hydraulic Controls) would involve any permanent containment or removal of contaminants from the sediment in the Ocoee No. 3 Reservoir and do not include any active treatment. Alternative O3R-2 (MNR with Hydraulic Controls) includes the use of best management practices to reduce the exposure of receptors to deeper, more contaminated sediment in the reservoir by allowing a relatively clean sediment cap to form and be maintained and by preventing the discharge of large amounts of sediment through the dam.

10.2.5 Short-Term Effectiveness

Neither Alternative O3R-1 (MNR) nor O3R-2 (MNR with Hydraulic Controls) would result in any short-term risk to the health of workers, the public, recreational users, or aquatic receptors.

10.2.6 Implementability

Implementation of action alternatives O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Controls) would require EPA and GSHI to develop, with input from TDEC, and GSHI to implement a comprehensive monitoring plan for this reach of the Ocoee River (RM 33.5 to RM 29.2) to track the abatement of residual aquatic risk and the attainment of RGs and RAOs. No substantive permit requirements would be applicable.

Alternative O3R-2 (MNR with Hydraulic Control) would require TVA to continue to implement the BMP plan for the operation of the Ocoee No. 3 Dam that was developed in response to TDEC Director's Order WPC09-0008. This plan has been approved by TDEC, Division of Water Pollution Control and EPA. It is anticipated that the currently approved BMP plan can be implemented by TVA without significantly impacting river operations and management.

10.2.7 Cost

Alternative O3R-2 (MNR with Hydraulic Controls) would be the most expensive of the two action alternatives with an estimated capital cost of $25,000. At a seven percent discount rate, the present worth of this alternative would be $273,856. No capital expenditures would be required for Alternative O3R-1. Implementation of environmental monitoring would result in an estimated present worth of $207,142 for Alternative O3R-1.

10.3 Parksville Reservoir

10.3.1 Overall Protectiveness of Human Health and the Environment

While some improvement to water and sediment quality may occur under Alternative PR-0 (No Action) and Alternative PR-1 (MNR), some sediment and associated pore water within the reservoir and the sediment of the delta would continue to exhibit elevated levels of copper, lead, zinc and acid. Consequently, these alternatives would not meet RAOs and RGs and would be ineffective in abating risks associated with the sediment delta because the large seasonal change in the Parksville Reservoir pool level would continue to allow wastes to oxidize and produce seasonal loading of metals to the reservoir water column. Alternative PR-0 (No Action) would not provide any degree of protectiveness because monitoring to determine remedial success would not be conducted.

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would all be protective of human health and the environment. In combination with natural processes, these alternatives reduce or control the advective transport and loading of metals to the remainder of the reservoir from draining and filling cycles. RAOs and RGs could be achieved with all four alternatives.

10.3.2 Compliance with ARARs

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging) and PR-5 (MNR with Permanent Inundation using Flashboards) are expected to result in the attainment of the Tennessee WQC for all classified uses.

Because the annual cycle of flooding and draining of delta sediment would not be controlled under Alternatives PR-0 (No Action) and PR-1 (MNR), some exceedances of the numerical Tennessee WQC for fish and aquatic life and potentially other classified uses for copper, iron, and zinc could still occur and the narrative WQC for biological integrity may not be achieved.

Alternatives PR-0 (No Action) and PR-1 (MNR) would not invoke any location- or action-specific ARARs because no remedial actions would be conducted. Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would require meeting the substantive requirements of an Aquatic Resource Alteration Permit (ARAP) from TDEC, a §404 permit from the Corps of Engineers, an NPDES storm water construction discharge permit from TDEC, and Tennessee's solid waste disposal requirements (maintenance of the flashboard/superboard system).

10.3.3 Long-Term Effectiveness and Permanence

Balancing criteria were not evaluated for PR-0 (No Action) because the alternative would fail to meet RAOs and satisfy the Threshold Criteria of "Overall Protectiveness of Human Health and the Environment" and "Compliance with ARARs."

Alternative PR-1 (MNR) would not be effective in abating risks associated with the sediment delta because large seasonal changes in the reservoir pool level would continue to allow wastes contained within the sediment to oxidize, prevent the natural recruitment and establishment of vegetation, and produce seasonal loading of metals to the Parksville Reservoir water column.

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would be effective at reducing aquatic risk by reducing or controlling the advective transport and loading of metals to the remainder of the reservoir from draining and filling cycles. Alternative PR-4 would be the most permanent; disposal of the dredged sediment within the deep portions of Parksville Reservoir is considered irreversible.

10.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

None of the action alternatives involve the permanent containment or removal of contaminants from the Parksville Reservoir and do not include any active treatment. While contaminant dispersion, metal sequestration, and the transport of cleaner sediment from areas up river are expected to reduce toxicity and aquatic risk in submerged areas of the reservoir, these processes will not result in the destruction of the contaminants or a reduction in their volume.

The use of lime in Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would neutralize acid and help to precipitate metals in forms that are less bioavailable, resulting in some treatment of wastes. The permanent inundation of the delta under Alternatives PR-2 and PR-5 would reduce toxicity by reducing the generation of acid and dissolution of metals in delta sediment and pore water in future years. Under Alternative PR-3 (MNR with Wetland Development), a viable wetland would also sequester metals, reducing toxicity. Under Alternative PR-4 (MNR with Hydraulic Dredging), transporting the sediment to deeper portions of the reservoir in a low-oxygen environment would reduce its toxicity by controlling sediment oxidation and metals dissolution.

10.3.5 Short-Term Effectiveness

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging) and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would all result in potential releases of sediment into nearby surface water while working on the delta (either through dredging or while amending the surface with lime) and some small occupational risks to site workers from construction activities. Occupational risks would be minimized by the use of a project-specific health and safety plan and appropriate OSHA training. There would be no short-term risk to the public, recreational users, or residents from these activities.

10.3.6 Implementability

All alternatives are technically feasible and implementable. Alternative PR-1 (MNR) would only require implementation of a monitoring plan. Implementation of Alternative PR-2 would require significant coordination with TVA to conduct the stability analysis and perform any required modifications to the dam. Implementation of Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging) and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would require significant coordination with TVA to maintain specific reservoir pool elevations. Coordinating pool elevations would not be expected to significantly impact river operations. Alternative PR-2 would require installation of pneumatic gates on the dam crest and Alternative PR-5 would require periodic replacement of the flashboard/superboard system.

Maintaining a consistent water cover across the delta sediment under Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates) and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) may potentially result in upstream and downstream nuisance flooding on non-TVA-owned lands. Hydraulic analysis shows that adoption of the higher winter pool may lead to increased frequency of flooding at and below Ocoee No. 1 Dam that will be manifested in low-lying areas over a range of flood frequencies up to about a 35 year recurrence interval. In addition, the frequency of superboard failure may increase from about once every 3.5 years to once every 2.5 years while the frequency of flashboard failure is expected to increase from about once every 25 years to about once every 15 years. Annual inspection and scheduled replacement mitigate this concern.

10.3.7 Cost

Alternative PR-4 (MNR with Dredging) is the most expensive, with an estimated capital cost of $10,865,000 and a present worth cost of $11,267,671. Alternative PR-2 (MNR with Permanent Inundation using Pneumatic Gates) is the next most costly with an estimated capital cost of $5,998,700 and a present worth cost of $6,401,371. However, as discussed in Section 2.3, TVA indicated that stability analysis that would be required to implement this alternative could cost $500,000 or more depending on potential data gaps and the scope of the analysis could greatly expand depending on the interim findings and data availability. TVA indicated that they would be further obligated to upgrade or modify the Ocoee No. 1 Dam if the results of a stability analysis showed some deficiencies with respect to current Federal Safety Guidelines. Upgrading the dam could potentially cost tens of millions of dollars, depending on the recommended and required modifications.

Alternative PR-3 (MNR with Wetland Development) has an estimated capital cost of $1,565,400 and a present worth of $2,542,351. Alternative PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) has an estimated capital cost of $1,146,700 and a present worth cost of $1,642,000. Alternative PR-1 (MNR) would not require capital expenditures; the present worth of this alternative is $499,535.

11.0 Principal Threat Wastes

The NCP at 40 CFR §300.430(a)(I)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. Principal threat wastes combine concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The human health risk assessment concluded that exposures to residual contaminants in sediment and surface water of the Ocoee River would not cause unacceptable health risks to area residents, recreational visitors, or whitewater rafting guides. No chemicals of concern were identified in Ocoee River sediment or surface water (i.e., cancer risk levels did not exceed 1 in 10,000, and non-cancer hazard indices did not exceed 1 for any health effect). Adverse chronic effects to the growth and reproduction of sensitive benthic macroinvertebrates from copper, iron, lead, zinc, and acid associated with sediment and pore water in some sections of the river, Ocoee No. 3 Reservoir, and Parksville Reservoir were identified. In general, adverse acute effects to aquatic organisms have not been identified. Based on these data, the residual contaminants within the Ocoee River do not constitute a principal threat waste; therefore, preference for treatment does not need to be met.

Removal actions and other interim measures occurring in the Davis Mill Creek and North Potato Creek watersheds have significantly reduced and controlled the concentrations and loads of metals and acid to the Ocoee River from the mining areas and the main sources of contamination identified in the Site. For this reason, the erosion and deposition of mining wastes (as solids) from the tributary watersheds and the precipitation of metal hydroxide minerals from the water column of the river and their accumulation on the river substrate have been substantially reduced through source control and treatment. These primary sources continue to be addressed and controlled under separate investigations and response actions for OUs 1 through 4. Chronic risk from residual contamination in the river would improve under all proposed alternatives, as long as new sources of contamination from the Site continue to be controlled and the pH of the water column remains relatively neutral (i.e., meeting Tennessee WQC).

12.0 Selected Remedy

12.1 Summary and Rationale for Selected Remedy

The selected remedy for OU5 is:

- Copper Basin Reach: MNR (Alternative CBR-1);
- Ocoee No. 3 Reservoir: MNR with Hydraulic Controls (Alternative O3R-2); and
- Parksville Reservoir: MNR with Permanent Inundation Using Flashboards and Superboards (Alternative PR-5).

The overall Preferred Alternative for the three parts of the Ocoee River is MNR to address chronic risk to aquatic organisms from metals and acid in sediments embedded in portions of the river substrate and in Ocoee No. 3 and Parksville Reservoirs. The sources of contamination to the river were the discharge of acid mine drainage and eroded solids from the Site. EPA believes the Selected Remedy represents the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria.

The Selected Remedy primarily uses natural processes to achieve the RAOs and reduce site contaminants to levels meeting the site-specific RGs specified in Table 8-1. The remedy depends on the ability of new, uncontaminated sediment from upriver and other upstream tributaries to mix, dilute, and partially cap embedded contaminated sediment in the substrate. Other natural processes, such as dispersion, advective transport, bioturbation, and sorption can help to further reduce residual aquatic risk. These processes would be relatively permanent as long as known and new sources of contamination continue to be controlled and the pH of the water column remains relatively neutral (i.e., in compliance with the Tennessee WQC).

MNR alone is the selected response action for the Copper Basin Reach (Alternative CBR-1). MNR used in conjunction with hydraulic controls; i.e., the BMP Plan that presently guides the operation of the Ocoee No. 3 Dam, is the selected response action for the Ocoee No. 3 Reservoir (Alternative O3R-2). The Ocoee No. 3 BMP plan will minimize the likelihood of erosion and discharge of deeper, more contaminated sediment from behind the dam. The selected remedy for Parksville Reservoir combines MNR with permanent inundation of the sediment delta using the existing system of flashboards and superboards (Alternative PR-5). Maintenance of a consistent water cover across the Parksville sediment delta will limit oxidation of the delta sediment that presently occurs annually during winter low pool. These selected remedies represent the best balance between cost and attainment of RGs. .

The modifying criteria of State and Community Acceptance have been incorporated into the selected remedy. The State of Tennessee, as represented by TDEC, has been the support agency during the RI/FS process. TDEC provided input during the process in accordance with 40 CFR §300.430 and concurs with the selected remedies for each river reach (Appendix F). The community has participated in review of the Proposed Plan, and, based on the comments received, supports the Selected Remedies (Appendix C).

12.2 Description of the Selected Remedies

12.2.1 Copper Basin Reach

Alternative CBR-1, Monitored Natural Recovery, is the selected alternative for the Copper Basin Reach (RM 38.0 to RM 33.5). This is a remedy for contaminated sediment that uses ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants (EPA, 2005). Natural processes include physical, biological, and chemical mechanisms that act together to reduce the risk of contaminants to human or environmental receptors.

Under this alternative, EPA and GSHI will develop, with input from TDEC, and GSHI will implement a monitoring program for the Copper Basin Reach that will document changes in identified risks in the river and document natural recovery processes. The program is expected to include monitoring of river water quality, sediment quality, sediment toxicity, benthic macroinvertebrate communities, and fish communities between Copperhill (RM 38) and the slack water of the Ocoee No. 3 Reservoir (RM 33.5). Results from the monitoring program will be compared to the RGs that have been developed for the Site and an iterative process will be developed to evaluate goal achievement. Monitoring will be conducted annually for at least 5 consecutive years to determine if the RAOs and RGs defined in Section 8.0 and Table 8-1 are being met. Should trends in monitoring data indicate that RAOs are being achieved, sampling frequencies may be reduced to an appropriate period as indicated by the data.

There are no capital expenditures associated with this selected alternative for the Copper Basin Reach because there are not any active remedial actions. Implementation of the monitoring program would result in an estimated total present worth cost of $400,321 for this alternative at a 7 percent discount rate.

12.2.2 Ocoee No. 3 Reservoir

This selected alternative for Ocoee No. 3 Reservoir (RM 33.5 to RM 29.2) is O3R-2, MNR with Hydraulic Controls. The alternative primarily uses MNR as described for the selected alternative for the Copper Basin Reach. However, this alternative will also incorporate the use of hydraulic controls to manage the discharge of water through the Ocoee No. 3 Dam in a manner that will minimize the likelihood of erosion and mobilization of deeper more contaminated sediment from behind the dam. In developing this alternative, EPA used the results of sediment transport modeling that was conducted to evaluate the sediment discharge event that occurred January 3-4, 2009, when large sediment flows occurred in the river below the dam and at the Whitewater Center managed by the U.S. Forest Service. It also used a drawdown study conducted in November 2009 by TVA.

As part of Alternative O3R-2, EPA and GSHI will develop, with input from TDEC, and GSHI will implement a monitoring program for the Ocoee No. 3 Reservoir that will document changes in identified risks in the reservoir and document natural recovery processes. The program is expected to include monitoring of river water quality, sediment quality, sediment toxicity, benthic macroinvertebrate communities, and fish communities between RM 29.2 (at the dam) and RM 33.5. Results from the monitoring program will be compared to the RGs specified in Section 8 and Table 8-1 and an iterative process will be developed to evaluate goal achievement. It is anticipated that monitoring would be conducted annually for at least 5 consecutive years to determine if the RAOs listed in Section 8 are being met. Should trends in monitored data indicate that RAOs and RGs are being met, sampling frequencies could be reduced to an appropriate period as indicated by the data.

Under Alternative O3R-2, TVA will continue to implement the approved BMP Plan (Appendix A) previously developed to guide operations at Ocoee No. 3 Dam to minimize the release of sediment that can occur from the lower sluice gates of the dam. This plan was approved by TDEC, Division of Water Pollution Control and EPA. The approved Best Management Practices are:

For normal (including recreation, hydrogeneration, and periodic flood risk reduction) operation:

- Maintain headwater elevation above 1428.
- For operation requiring drawdown below headwater elevation 1428:
- Minimize project inflow during drawdown:
  - Release no more than 150 cubic feet per second (cfs) from Blue Ridge.
  - To the extent practicable, schedule drawdown during late fall when local inflow from the unregulated drainage area is likely to be at an annual minimum.
  - To the extent practicable, schedule drawdown when no rainfall is predicted.
- Control rate of drawdown:
  - Reservoir drawdown is to be accomplished by releases made through the Ocoee 3 turbine, the spillway gates, and the sluice gates.
  - Drawdown rate should be limited once pool level drops below 1428. Drawdown rate should be controlled by limiting the sum of releases made through the spillway and/or sluice gates to 1800 cfs, which is the channel capacity at the Whitewater Center.
  - In order to minimize the volume of water released through the sluice gates during the drawdown operation, spillway releases should be made above headwater elevation 1412.
  - Release through sluice gates only once headwater reaches 1412.
  - Check drawdown elevations every several hours with wire weight gage to ensure accuracy of measurements.
  - Once headwater is below the spillway crest, the maximum sluice gate release should not exceed 1400 cfs.
- Monitor releases during drawdown operations:

- For the duration of the drawdown operation, provide TVA Environmental Compliance staff member to be dedicated to daytime visual monitoring of environmental conditions, in particular the nature and character of any sluice flow.
- Limit reservoir drawdown to daylight hours.
- Limit overnight sluicing rate to that required to maintain current headwater without additional drawdown.
- Delay drawdown if local inflow rate is such that drawdown cannot be effectively accomplished at the maximum release rates specified above.
- If water heavily laden with sediment is observed being released in an attempt to reach or maintain a drawdown target elevation, the sluice gates should be closed and the reservoir allowed to refill.

- Hydropower generation:
  - If necessary and practicable, spill accumulated trash prior to initiating drawdown.
  - Once drawdown is initiated, monitor trash boom and trash rack conditions throughout generation period.
  - Monitor conditions at Ocoee No. 3 powerhouse and discontinue generation if and when necessary.
  - Generation should be at full turbine capacity; continue generation as long as possible.

- Drawdown target elevation:
  - Drawdown target elevation for routine maintenance not to be below 1411.0.
  - For drawdown below 1411.0, coordinate with TDEC; plan and conduct drawdown jointly.

- Refill operation:
  - When possible, limit total Ocoee No. 3 inflow (sum of local inflow and Blue Ridge release) to no more than 650 cfs. To achieve this, limit Blue Ridge releases to the greater of 150 cfs or that amount required to achieve total Ocoee No. 3 inflow of 650 cfs. When local inflow is in excess of 500 cfs, limit Blue Ridge release to 150 cfs.
  - Resume normal operations only after the Ocoee No. 3 headwater elevation is above 1428.

Capital costs associated with this selected alternative for the Ocoee No. 3 Reservoir are estimated to be $25,000 for development of the BMP plan. At a seven percent discount rate, the total present worth cost of this alternative, including the monitoring program, would be approximately $273,856.

12.2.3 Parksville Reservoir

The selected alternative for Parksville Reservoir (RM 17.1 to RM 11.9) is PR-5, MNR with Permanent Inundation using Flashboards and Superboards to provide wet closure of the sediment delta. This alternative primarily uses MNR, as described for the Copper Basin Reach but additionally will establish a consistent water cover over the sediment delta, except for normal fluctuations associated with power generation or for dam maintenance or emergencies. Lime amendment also would be added to the delta sediment prior to implementing the water cover.

To maintain a consistent water cover, TVA will put a winter guide curve in place to maintain an average pool level at or above the maximum elevation of the sediment delta of approximately 834 feet AMSL (NAVD 88). This is seven feet higher than the current winter guide curve. The summer guide curve will remain at 836 feet AMSL (NAVD 88). The higher pool elevation will be achieved using the existing system of flashboards and superboards. TVA will be required to conduct a visual inspection of the flashboard/superboard system annually and completely replace the system as appropriate, which is anticipated to be every 3 to 5 years. To replace either the entire system or any damaged boards, TVA must lower the reservoir pool to an appropriate level for worker safety and access. The duration of this operation is wholly dependent on weather and flow conditions in the river. TVA will perform this work as long as conditions are considered to be safe and effective.

Maintaining a consistent water cover across the delta sediment under the Selected Remedy may potentially result in upstream and downstream nuisance flooding on non-TVA-owned lands. Hydraulic analysis shows that adoption of the higher winter pool may lead to increased frequency of flooding at and below Ocoee No. 1 Dam that will be manifested in low-lying areas over a range of flood frequencies up to about a 35 year recurrence interval. In addition, the frequency of superboard failure may increase from about once every 3.5 years to once every 2.5 years while the frequency of flashboard failure may increase from about once every 25 years to about once every 15 years. Annual inspections and scheduled replacement mitigate this concern. Increased downstream discharges may lead to an increase in the frequency of events during which the Ocoee River exceeds bank-full stage (Figure 9).

Under the Selected Remedy, EPA and GSHI will develop, with input from TDEC, and GSHI will implement a monitoring program for the Parksville delta and Parksville Reservoir that will document changes in identified risks and document natural recovery processes. The program is expected to include monitoring of water quality, sediment quality, sediment toxicity, benthic macroinvertebrate communities, and fish communities between RM 17.1 and RM 11.9. Results from the monitoring program will be compared to the RGs specified in Section 8 and Table 8-1 and an iterative process will be developed to evaluate goal achievement. It is anticipated that monitoring would be conducted annually for at least 5 consecutive years to determine if the RAOs listed in Section 8 are being met. Should trends in monitored data indicate that RAOs and RGs are being met, sampling frequencies could be reduced to an appropriate period as indicated by the data.

Prior to implementing the new guide curve, lime would be applied at a rate of 3 tons per acre as a surface amendment to initially treat the upper oxidized zone of the delta. This would be a single application prior to implementation of the new winter guide curve.

Capital expenditures for the selected alternative for Parksville Reservoir are $1,146,700 for constructing access to the delta and adding lime amendment prior to raising the pool elevation and establishing a new guide curve. At a 7 percent discount rate the total estimated present worth cost is $1,642,000.

12.2.4 Summary of Costs for the Selected Remedy

A summary of total costs associated with implementation of the Selected Remedy for the Site is presented in Table 12-1.

After considering comments received on the Proposed Plan, EPA determined that the application of lime as a surface amendment to the Parksville delta will not be included as a part of the Selected Remedy. The reasoning for this decision is presented in Section 14. Eliminating the lime amendment and associated construction will lower the capital cost of Alternative PR-5 from $1,146,700 to $264,400 and the total net worth cost of the alternative (at a 7% discount rate) to $759,714. Consequently, the total net worth cost of the Selected Remedy for OU5 shown in Table 12-1 would be lowered from $2,316,177 to $1,433,891.

13.0 Statutory Determinations

Based on the information currently available, EPA believes the chosen Preferred Alternative for each of the three areas of OU5 meets the Threshold Criteria and provides the best balance of tradeoffs among the other alternatives with respect to the Balancing and Modifying Criteria. EPA expects the Selected Remedy will satisfy the following statutory requirements of CERCLA Section 121(b):

- Be protective of human health and the environment;
- Comply with ARARs;
- Be cost effective; and
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

13.1 Protection of Human Health and the Environment

The human health risk assessment concluded that exposures to contaminants in sediment and surface water of the Ocoee River would not cause unacceptable health risks to area residents, recreational visitors, or whitewater rafting guides. No chemicals of concern were identified in Ocoee River sediment or surface water (i.e., cancer risk levels did not exceed 1 in 10,000, and non-cancer hazard indices did not exceed 1 for any health effect). Under this Selected Remedy, risks to human health would remain low.

A combination of natural processes, continued implementation of approved hydraulic controls at the Ocoee No. 3 Reservoir, and maintenance of a consistent water cover across the sediment delta in Parksville Reservoir are expected to result in gradual improvements in the Ocoee River over time. Natural processes are expected to reduce the aquatic risk to levels lower than the LOAEL and meet site-specific RGs for copper, iron, lead and zinc. Meeting these levels would produce increases in the diversity and density of aquatic organisms in the river. This, in turn, would provide additional forage for birds and fish allowing for recovery of the aquatic community. Removal actions and other interim measures taken in other Site OUs have already produced a significant improvement in water quality in the Ocoee River that is believed to be responsible for notable improvements in riparian vegetation in the Copper Basin Reach. Under this Selected Remedy, decreases in risk will be documented and assessed through environmental monitoring. If natural recovery does not occur at acceptable rates, the need to perform active removal actions will be assessed.

There is a potential health risk resulting from consumption of channel catfish from PCB congeners in the eastern end of Parksville Reservoir. TDEC is the regulating authority for fish consumption advisories in Tennessee. TDEC and EPA may be conducting more comprehensive collections of fish tissue in Parksville Reservoir and Ocoee No. 3 Reservoir in order to determine if a consumption advisory may be warranted outside of this Remedy.

13.2 Compliance with ARARs

The Selected Remedy will be designed to comply with all of the applicable or relevant and appropriate provisions of the statues, rules, regulations, and requirements presented in Tables 13-1 through 13-3. Under the Selected Remedy, the RGs for copper, iron, lead, and zinc for sediment and the RGs for copper, iron, and zinc in surface water are expected to be met in many areas of the river where residual risks have been identified. As a result, the quality and diversity of the aquatic macroinvertebrate community would improve. For this reason, it is expected that compliance with Tennessee beneficial use criteria for fish and aquatic life will also be achieved. In addition, any significant release of metals and acid to the river water column would likely be abated, eliminating localized exceedances of numerical water quality criteria for copper, lead, zinc, and pH. Environmental monitoring would be used to document attainment of chemical-specific ARARs.

13.3 Cost Effectiveness

EPA has determined that the Selected Remedy is cost-effective and that the overall protectiveness of the remedy is proportional to the overall cost. As specified 40 CFR §300.430(f)(1)(ii)(D), the cost-effectiveness of the Selected Remedy was assessed by comparing the protectiveness of human-health and the environment in relation to three balancing criteria (i.e., long-term effectiveness and permanence; reduction in toxicity, mobility, and volume; and short-term effectiveness) with the other alternatives considered.

The basis for EPA's determination of cost-effectiveness is summarized in Table 13-4. While more than one remedial alternative can be considered cost-effective, CERCLA does not mandate that the most cost-effective or least expensive remedy be selected. The estimated total cost (i.e, capital plus present worth of O&M costs) of the Selected Remedy is $2,316,177; elimination of lime amendment option for the Parksville delta results in an estimated total cost of $1,433,891.

13.4 Use of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The Selected Remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable. The Selected Remedy will provide long-term effectiveness and permanence. Long-term effectiveness is achieved through MNR in all reaches and the use of engineering controls in the Ocoee No. 3 Reservoir and Parksville Reservoir. The remedy requires a detailed monitoring program to evaluate remedy effectiveness, but it is anticipated that this program could potentially be removed when the RAOs and RGs are attained. The remedy can be reliably considered permanent as long as sources of contamination from the Site are being controlled and the pH of the water column remains relatively neutral (i.e., meeting Tennessee WQC).

13.5 Preference for Treatment as a Principal Element

The NCP at 40 CFR §300.430(a)(I)(iii)(A) establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. Under MNR, increased amounts of organic matter and detritus would naturally accumulate and become incorporated into the river substrate. Organic matter provides sorption sites for metals. Sorption sequesters metals to forms that are not bioavailable. To the greatest extent practicable, these components satisfy the statutory preference for reducing the toxicity, mobility, or volume of hazardous substances through treatment.

13.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, and will take more than five years to attain remedial action objectives and cleanup levels, a statutory review will be conducted within five years after initiation of remedial actions to ensure that the Remedy is, or will be, protective of human health and the environment. Five-Year Reviews as specified by 40 CFR §300.430(f)(4)(ii) will be used to ensure the Site remains protective.

14.0 Documentation of Significant Changes

Pursuant to CERCLA 117(b) and NCP 300.430(f)(3)(ii), the ROD must document any significant changes made to the Preferred Alternative discussed in the Proposed Plan. Under the Proposed Plan, the Preferred Alternative PR-5 required that lime would be used as a surface amendment to initially treat the upper oxidized zone of the Parksville Reservoir delta. A treatability study showed that the incorporation of lime at a rate of at least 3 tons per acre showed positive effects to both pore water and surface water quality. It also indicated that a safety evaluation would be required to determine the types and weights of equipment that could be used to access the delta.

Comments received on the Proposed Plan from GSHI questioned whether the liming could be done in a safe manner. GSHI has the most experience in applying lime as a surface amendment in the Copper Basin. Because the delta is composed of soft, nearly saturated materials, it would not support heavy equipment that traditionally would be used for bulk lime applications. As a result, specialized low-bearing-pressure equipment would be required. With this equipment, it would be difficult to traverse the delta and the physical disturbance and vibration could lead to liquefaction of the delta sediment immediately below workers, creating an unsafe condition. An additional concern is that a secondary channel from Greasy Creek would have to be bridged to allow access to the main delta confounding the implementability of the action.

For the reasons listed above, EPA has determined that the application of lime as a surface amendment to the Parksville delta will not be included as a part of the Selected Remedy. Eliminating the lime amendment and associated construction will lower the capital cost of Alternative PR-5 from $1,146,700 to $264,400 and the total net worth cost of the alternative (at a 7% discount rate) to $759,714. Consequently, the total net worth cost of the Selected Remedy for OU5 shown in Table 12-1 would be lowered from $2,316,177 to $1,433,891.

15.0 References

Barge Waggoner Sumner and Cannon (BWSC). 2003. *A Future Land-Use Plan for Redevelopment of the Abandoned Mine Lands in the Copper Basin, Polk County, Tennessee.* Prepared by: BWSC for Glenn Springs Holdings, Inc. July 2003.

Black & Veatch (B&V). 2011. *Final: Feasibility Study Amendment for the Ocoee River:* Prepared for USEPA Region 4 under contract EP-S4-09-02 Task Order 035-TCTA-A4485 DCN: 40935-0472-02-C-00676R0A1, April 2011.

________. 2009a. *Final: Feasibility Study for the Ocoee River.* Prepared for USEPA Region 4 under contract 68-W-99-0043, WA 674-RICO-A485, December, 2009.

________. 2009b. *Final: Technical Memorandum: Technology Screening and Alternatives Development for the Ocoee River.* Prepared for USEPA Region 4 under contract 68-W-99-0043, WA 674-RICO-A485, April, 2009.

_______. 2008. *Final: Remedial Investigation of the Ocoee River.* Prepared for USEPA Region 4 under contract 68-W-99-0043, WA 674-RICO-A485, May, 2008.

Black & Veatch (B&V) and Science Applications International Corp (SAIC). 2005. *Final Remedial Investigation of Ocoee River Operable Unit 3-R, Copper Basin, Tennessee.* Prepared for EPA Region 4 and USACE Nashville District under contract DACA21-02-D-0004, Delivery Order DX01, July 2005.

Glenn Springs Holdings, Inc. (GSHI). 2007. *Report of Surface-Water Monitoring, Ocoee River, Copperhill, Tennessee.*

Jakus, P.M., Fly, J.M., Stephens, B., and Dadakas, D. 1998. *Fishing and boating by Tennessee residents in 1994, 1995, and 1996.* University of Tennessee, Department of Agricultural Economics and Rural Sociology. July 30, 1998.

National Research Council (NRC). 2005. *Superfund and Mining Megasites: Lessons from the Coeur d'Alene River Basin.* Board on Environmental Studies and Toxicology, National Academy Press, Washington D.C.

_______. 2001. *A Risk Management Strategy for PCB-Contaminated Sediments.* Board on Environmental Studies and Toxicology, National Academy Press, Washington D.C.

PRC Environmental Management, Inc. (PRC). 1997. *Special Studies Investigation, Copper Basin Mining District, Copperhill, Polk County, Tennessee.* Prepared for the U.S. Environmental Protection Agency, Region 4.

Science Applications International Corporation (SAIC). 2004. *Technical Memorandum: Bioassessment of Conditions in Ocoee River, Operable Unit 3-R.* Prepared for EPA

Region 4 and USACE Nashville District under contract DACA21-02-D-0004, Delivery Order DX01, February 9, 2004.

_____. 2003a. *Baseline Human Health Risk Assessment for the Ocoee River, Polk County, Tennessee*. Prepared for EPA Region 4 and USACE Nashville District under contract DACA21-02-D-0004, Delivery Order DX01. April 7, 2003.

_____. 2003b. *Project Management Plan for the Ocoee River, Copper Basin, Tennessee*. Prepared for EPA Region 4 and USACE Nashville District under contract DACA62-00-D-0001, Delivery Order 25. July 2003.

_____. 2002a. *Draft Water Program Plan for the Ocoee River.* Prepared for EPA Region 4 and USACE Nashville District under contract DAC62-00-D-0001, Delivery Order 25. September 10, 2002.

_____. 2002b. *Ocoee River Low-Water Investigation Summary Report, Copper Basin, Tennessee.* Prepared for EPA Region 4 and USACE Nashville District under contract DAC62-00-D-0001, Delivery Order 33. June 24, 2002.

_____. 2001. *Ocoee River Reconnaissance: Summary of Findings*. Prepared for EPA Region 4 and USACE Nashville District under contract DACA62-00-D-0001, Delivery Order 25. September 10, 2001.

_____. 2000a. *Draft Evaluation for Ocoee River Sediments*. Prepared for EPA Region 4 under contract 68-W-99-0001, ERG Subcontract MSW-001/13, WA 114, Task 24. December 15, 2000.

_____. 2000b. *Draft Problem Formulation for Risk Assessment, Ocoee River, Tennessee*. Prepared for EPA Region 4 under contract 68-W-99-0001, ERG Subcontract MSW-001/13, WA 114, Task 24. December 15, 2000.

Stantec Consulting Services, Inc. (Stantec). 2010. Flashboard System Operation and Maintenance Review Ocoee Dam No. 1 (Parksville Dam), Polk County, Tennessee.

Tennessee Department of Environment and Conservation (TDEC). 2008. *Final Year 2008 303(d) List.* Division of Water Pollution Control, Planning and Standards Section, June 2008.

_____. 2006. *Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys*. TDEC, Division of Water Pollution Control. October 2006.

_____. 2001. *Commissioner's Order, Division of Superfund, Site ID 70-508, Lower North Potato Creek Site, Case No. 99-0480.*

Tennessee Valley Authority (TVA). 2000. *Aquatic Ecological Health Determinations for TVA Reservoirs B 1999. An Informal Summary of 1999 Vital Signs Monitoring Results and Ecological Health Determination Methods.* Prepared by monitoring team primary authors/editors: Don L. Dycus and Tyler F. Baker. September 2000.

_____. 1998. *Aquatic Ecological Health Determinations for TVA Reservoirs - 1997. An Informal Summary of 1997 Vital Signs Monitoring Results and Ecological Health Determination Methods.* Prepared by monitoring team primary authors/editors: Don L. Dycus and Dennis L. Meinert. April 1998.

_____. 1986. *Technical Report Series, Water Quality in Ocoee No. 1 Reservoir: Volume 2 - Technical Report*, Prepared by Janice P. Cox, Division of Services and Field Operations, Office of Natural Resources and Economic Development, Chattanooga, TN, TVA/ONRED/AWR-86/13, January 1986.

U.S. Army Corps of Engineers (USACE). 2009. *Draft Simulation and Analysis of the January 2009 Ocoee 3 Sediment Sluicing Event.* U.S. Army Engineer Research and Development Center, Vicksburg, MS

U.S. Environmental Protection Agency (EPA) 2011. *Proposed Plan Fact Sheet, Ocoee River, Polk County, Tennessee.* June 2011.

_____. 2005. *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites.* Office of Solid Waste and Emergency Response, 9355.0-85, Final Report.

_____. 2003. *Administrative Order on Consent for Removal Action at the Davis Mill Creek Watershed (OU3D).* U.S.EPA Region 4, CERCLA Docket No. CER-04-2003-3521.

_____. 2002. *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites.* OSWER Directive 9285.6-08, February 12.

_____. 2001a. *Memorandum of Understanding between Tennessee Department of Environment and Conservation, U.S. EPA and OXY USA, Inc.* U.S. EPA Region 4, CERCLA Docket No.: 01-10-C.

_____. 2001b. *Administrative Order on Consent for Removal Action at the North Potato Creek Watershed.* U.S. EPA Region 4, CERCLA Docket No.: 01-11-C.

_____. 2001c. *Administrative Order on Consent for Removal Action at the Davis Mill Creek Watershed.* U.S. EPA Region 4, CERCLA Docket No.: 01-12-C.

_____. 2001d. *Administrative Order on Consent for Partial Payment of Response Costs.* U.S. EPA Region 4, CERCLA Docket No.: 01-13-C.

_____. 2000a. *Field Investigation Supplemental Data Collection at the Copper Basin Mining District site Ducktown/Copperhill, Tennessee.* EPA Science and Ecosystems Support Division, June 2000.

_____. 2000b. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volumes 1 and 2. Third Edition.* U.S. Environmental Protection Agency, Office of Water. EPA 823-B-00-007/8. November 2000.

_____. 2000c. *EPA Revision 4 Human Health Risk Assessment Bulletins – Supplement to RAGS.* U.S. Environmental Protection Agency, Region 4. Updated 5/30/200.

_____. 1997. *Exposure Factors Handbook: Volumes I, II, and III.* EPA/600-P-95/002F. U.S. Environmental Protection Agency, Office of Research and Development. August 1997.

_____. 1994. *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.* EPA/540/F-94/043. OSWER Directive#9355.4-12. August 1994.

_____. 1993. Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis. OSWER Directive 9355.3-20.

_____. 1991. *In the Matter of: London Mill Wastewater Plant, Polk County, Tennessee.* United States Environmental Protection Agency Region 4, EPA Docket No.: 91-36-C.

_____. 1989. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part A), Interim Final.* EPA/540/1-89/002. December 1989.

_____. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final.* Office of Emergency and Remedial Response. EPA/540/G-89/004.

_____ and U.S. Army Corps of Engineers (USACE). 2000. *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study.* USACE Hazardous, Toxic, and Radioactive Waste Center of Expertise, Omaha, Nebraska and EPA Office of Emergency and Remedial Response, Washington, D.C. EPA 540-R-00-002.

U.S. Forest Service (USFS). 1997. *Final Environmental Impact Statement: Upper Ocoee River Corridor Recreational Development, Polk County, Tennessee.* U.S. Department of Agriculture Management Bulletin R8-MB 79-A. In cooperation with TVA and the State of Tennessee. February 1997.

TABLES

Table 5-1
Surface Water Quality in the Copper Basin Reach (RM 38.0 to RM 33.5)

	Samples Collected Prior to November 2002					Samples Collected After January 2005				
	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC	No. Exceeding Acute WQC	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC	No. Exceeding Acute WQC
Aluminum (total)	11	122	41 – 1,100	8	1	10	<225	<100 - <430	0	0
Cadmium (diss)	9	<0.09	<0.05 - <1.0	4	0	18	<0.50	<0.31 - <1.0	0	0
Copper (diss)	8	4.3	0.28 – 45	5	5	16	<2.0	0.49 - <7.0	3	2
Iron (total)	12	1,360	270 – 5,600	8	---	18	455	152 – 4,600	2	---
Lead (diss)	9	<0.02	0.01 - <2.0	0	0	18	<0.5	0.05 - <1.2	2	0
Zinc (diss)	9	261	4.5 – 320	6	6	17	<23	10.0 - <100	8	8
pH (s.u.)	10	6.0	3.5 – 7.3	5	---	19	6.5	5.6 – 7.0	2	---

diss = dissolved (0.45 um filtered)
WQC – Tennessee Water Quality Criterion for fish and aquatic life

Table 5-2
Surface Water Quality in Ocoee No. 3 Reservoir
(RM 33.5 to RM 29.2), 2005 and 2006

	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC	No. Exceeding Acute WQC
Aluminum (total)	10	176	100 – 830	10	1
Cadmium (diss)	10	<0.50	<0.31 - <0.62	0	0
Copper (diss)	10	1.4	0.78 – 2.8	4	3
Iron (total)	10	353	294 – 1,300	2	---
Lead (diss)	10	<1.2	0.056 - <1.2	0	0
Zinc (diss)	10	<10	<10 – 14	0	0
pH (s.u.)	10	6.8	6.4 – 7.0	0	---

diss = dissolved (0.45 um filtered)
WQC – Tennessee Water Quality Criterion for fish and aquatic life

Table 5-3
Surface Water Quality in Parksville Reservoir
(RM 17.1 to RM 11.9)

	Samples Collected Near Sediment Delta, 2005 and 2006					Samples Collected Away from Sediment Delta, 2005 and 2006				
	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC	No. Exceeding Acute WQC	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC	No. Exceeding Acute WQC
Aluminum (total)	29	131	24 – 5,160	22	5	21	151	32 - 740	11	0
Cadmium (diss)	28	<0.50	0.035 - <0.62	2	0	21	0.27	0.049 - <0.62	1	0
Copper (diss)	28	1.7	0.93 – 14.0	7	5	21	<1.5	1.01 - <5.7	0	0
Iron (total)	29	440	129 – 7,110	9	---	16	307	2.62 – 2,000	2	---
Lead (diss)	28	<0.21	0.043 - <1.2	2	0	21	<1.2	0.037 - <1.2	1	0
Zinc (diss)	28	<18	<3.8 – 141	7	7	21	10.1	10.0 – 48	5	5
pH (s.u.)	28	7.0	5.0 – 7.6	3	---	30	6.8	5.1 – 7.3	5	---

diss = dissolved (0.45 um filtered)
WQC – Tennessee Water Quality Criterion for fish and aquatic life

Table 5-4 Permanently Inundated Sediment Quality in the Copper Basin Reach (RM 38.0 to RM 33.5)				
	No. Samples	**Maximum Value (mg/kg)**	**Range of Values (mg/kg)**	**No. Exceeding Probable Effects Conc.**
Copper	56	1,900	6.7 – 1,900	30
Iron	56	320,000	4,900 – 320,000	25
Lead	56	466	2.8 - 466	19
Manganese	56	5,900	100 – 5,900	8
Zinc	56	6,900	24 – 6,900	27

Table 5-5
Permanently Inundated Sediment Quality in the Main Portion of Ocoee No. 3 Reservoir (RM 33.5 to RM 29.2)

	No. Samples	Median Value (mg/kg)	Range of Values (mg/kg)	No. Exceeding Probable Effects Conc.
Copper	35	440	30 J – 2,300	28
Iron	35	48,000	18,000 – 94,000	22
Lead	35	100	14 – 1,800	11
Manganese	35	520	150 – 2,400	1
Zinc	35	580	94.9 – 3,500	25

J – value is estimated.

Table 5-6
Sediment Quality in Parksville Reservoir
(RM 17.1 to RM 11.9)

	Samples of Permanently Inundated Sediment				Samples of Emergent Sediment (Parksville Delta)			
	No. Samples	Median Value (mg/kg)	Range of Values (mg/kg)	No. Exceeding Probable Effects Conc.	No. Samples	Median Value (mg/kg)	Range of Values (mg/kg)	No. Exceeding Probable Effects Conc.
Copper	24	840	2.6 – 1,300 J	22	48	625	110 – 2,000	47
Iron	24	57,500	2,000-95,000	22	48	53,000	20,000-98,400	37
Lead	24	345	2.3 – 900	21	48	225	68 – 1,080	40
Manganese	24	830	94 – 9,500	5	48	410	68 – 3,300	5
Zinc	24	1,300	13 – 1,700	23	48	1,100	230 – 2,540	45

J – value is estimated.

Table 5-7
Interstitial Pore Water Quality in River Sediment and Emergent Sediment, Copper Basin Reach (RM 37.0 – RM 33.5)

	Pore Water in Permanently Inundated Sediment RM 37.0 to RM 35.6				Davis Mill Creek Delta, Piezometer R1008			
	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC †	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC
Copper	2 *	<3.5	2.5U – 23UJ	2	11	42.4	15.6 – 1,800	11
Iron	9	<140	27U – 23,000J	3	11	<100	27U - 561	0
Lead	3 *	<1.2	0.25J – 1.8U	0	11	2.1	0.512 - 130	11
Zinc	9	<140	12U – 1,600	6	11	2,490	218 – 7,400	11
pH	9	6.40	6.00 – 7.28	6	10	6.44	4.38 – 7.2	6

* Does not include samples reported as non-detected with detection limits exceeding chronic criterion
† Chronic water quality criterion applicable to Ocoee River
U – analyte not detected, value shown is detection limit; J – value is estimated.

Table 5-8
Interstitial Pore Water Quality in River Sediment and Emergent Sediment, Ocoee No. 3 Reservoir (RM 33.5 – RM 29.2)

	Pore Water in Permanently Inundated Sediment Ocoee No. 3 Reservoir				Upstream of Ocoee No. 3 Reservoir			
	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC†	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC
Copper	4	<6.3	1.2U – 7.5	3	1	---	1,300	1
Iron	4	9.800	2,380 – 25,000	4	1	---	740	0
Lead	4	<1.03	0.5U – 1.2U	1 *	1	---	340	1
Zinc	4	<31.2	10U - 53	3	1	---	1,400	1
pH	4	6.19	5.86 – 8.08	3	1	---	3.26	1

* Does not include samples reported as non-detected with detection limits exceeding chronic criterion
† Chronic water quality criterion applicable to Ocoee River
U – analyte not detected, value shown is detection limit; J – value is estimated.

Table 5-9
Interstitial Pore Water Quality in Piezometer Cluster PR200, Parksville Sediment Delta (RM 17.1 – RM 11.9)

	Reduced Sediment, 4.7 to 5.2 ft depth				Oxidized Sediment, 1.0 to 1.5 ft depth			
	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC †	No. Samples	Median Value (µg/L)	Range of Values (µg/L)	No. Exceeding Chronic WQC
Copper	7	0.3U	0.27 – 1.7	0	7	3,740	2,870 – 11,500	7
Iron	7	21,100	15,600 – 24,500	7	7	31,900	6,290 – 66,000	7
Zinc	7	3.8	2.6U – 8.5	0	7	18,300	14,500 – 22,300	7
pH	7	6.8	6.5 – 7.5	0	7	3.8	3.7 – 4.6	7

* Does not include samples reported as non-detected with detection limits exceeding chronic criterion
† Tennessee water quality criterion for fish and aquatic life applicable to Ocoee River
U – analyte not detected, value shown is detection limit; J – value is estimated.

Table 7-1
Chemicals of Concern in the Ocoee River

COC	Sediment	Surface Water	Fish Tissue
Parksville Reservoir			
PCBs (a)	•		•
Arsenic	•		
Iron	•		
Lead	•	•	
Mercury			•
Whitewater Reach			
Arsenic	•		Inc
Iron	•		Inc
Lead	•		Inc
Ocoee No. 3 Reservoir			
PCBs (b)	Inc	Inc	•
Mercury	Inc	Inc	•
Copper Basin Reach			
PCBs (c)	•		•
Arsenic	•	•	
Iron	•	•	
Lead	•		
Manganese		•	
Mercury			•

Inc - Incomplete exposure pathway.
PCBs - Polychlorinated biphenyls. Includes Aroclor mixtures and PCB congeners; congeners evaluated quantitatively for available fish tissue data
(a) Aroclor 1254 detected in sediment; Aroclor 1260 detected in fish
(b) Aroclor 1260 detected in fish
(c) Aroclor 1254 and 1260 detected in sediment; Aroclor 1260 detected in fish

Table 7-2
Summary of HHRA Exposure Scenarios to Sediment and Surface Water (Ingestion and Dermal Contact)

River Reach and Scenarios	General Exposure Assumptions
	Parksville Reservoir
Recreational Visitor – Beach Areas Recreational Visitor – Delta Area	Assumes adult exposure 26 days/yr and child 39 days/yr @ 3 hours/ day for 30 years.
	Whitewater Reach
Recreational Visitor	Assumes adult exposure 26 days/yr and child 39 days/yr @ 3 hrs/day for 30 years.
Rafting Guide	Assumes adult guide 90 days/yr @ 4 hrs/day for 25 years.
	Copper Basin Reach
Area Resident (Child/Adult)	Assumes 45 days/yr @ 3 hrs/day for 30 years.
Area Resident (Adolescent)	104 days/year @ 3 hrs/day.

Table 7-3
Summary of HHRA Exposure Scenarios from Consumption of Fish

River Reach and Scenarios	General Exposure Assumptions
Parksville Reservoir	
Area resident fishers in 3 areas: East delta region West region near dam and marina Baker and Indian Creek embayments	Adult and child consumption of channel catfish and largemouth bass at a range of consumption rates with focus on recreational rate of 17.5 g/day (about 2 meals/month) and conservative default rate of 54 g/day (about 6 meals/month) of locally-caught fish.
Ocoee No. 3 Reservoir	
Recreational fishers	Adult and child consumption of largemouth bass and yellow perch at same rates as above.
Copper Basin Reach	
Recreational fishers	Consumption of yellow perch at same rates as above.

Table 7-4
Summary of HHRA Risks from Exposure to Sediment and Surface Water

River Reach and Scenarios	Non-Cancer Hazard Index	Cancer Risks
Parksville Reservoir		
Recreational Visitor – Beach Areas	0.6	6E-6
Recreational Visitor – Delta Area	0.8	2E-5
Whitewater Reach		
Recreational Visitor	0.3	2E-6
Rafting Guide	0.2	2E-5
Copper Basin Reach		
Area Resident (Child/Adult)	2	9E-6
Area Resident (Adolescent)	0.5	3E-6

Table 7-5
Summary of Risks from Consumption of Fish

	Non-Cancer Hazard Index		Cancer Risks	
	Largemouth Bass	**Channel Catfish**	**Largemouth Bass**	**Channel Catfish**
Parksville Reservoir				
Eastern reservoir	0.6 – 1.7	0.6 – 1.8	4E-5 – 1E-4	2E-4 – 6E-4
Western reservoir	NA	0.5 – 1.5	1E-5 – 4E-5	1E-4 – 3E-4
Baker/Indian Inlets	0.4 – 1.3	0.4 – 1.1	1E-5 – 3E-5	8E-5 – 3E-4
Ocoee No. 3 Reservoir				
	Largemouth Bass	**Yellow Perch**	**Largemouth Bass**	**Yellow Perch**
	0.8 – 2.4	0.1 – 0.4	2E-5 – 5E-5	2E-5 – 5E-5
Copper Basin Reach				
	Yellow Perch		**Yellow Perch**	
	0.4 – 1.3		2E-5 – 6E-5	

NA – Not Analyzed
First number represents hazard or risk at 17.5 g/day, second number at 54 g/day consumption rate.

Table 7-6
Comparison of Human Health Reasonable Maximum Exposure Concentrations Used in the HHRA (1997-2002 data) to Post-2002 Data

COC	Surface Water (μg/L)		Sediment (mg/kg)	
	HHRA	**Post-HHRA**	**HHRA**	**Post-HHRA**
Copper Basin Reach				
Arsenic	6.1	2.5	12.2	4.6
Iron	110,000	7,100	103,000	76,300
Lead	--	--	348	194
Manganese	14,000	520	--	--
PCBs (total)	--	--	2.2 [a]	0.21 [b]
Number of samples	8	73	12	18
Whitewater Reach				
Arsenic	--	--	53	25.1
Iron	--	--	78,000	61,600
Lead	--	--	790	589
Number of samples	--	--	6	15
Parksville Delta				
Arsenic	--	--	57.2	30.8
Iron	--	--	92,000	74,300
Lead	670	8.0	1,080	590
PCBs (total)	--	--	0.6	0.103 [c]
Number of samples	3	31	6	22

HHRA - Human Health Risk Assessment
COC - Chemical of Concern
-- - Not a COC
All surface water concentrations are unfiltered.
a - number of samples is 9
b - number of samples is 4
c – number of samples is 15

Table 7-7
Summary of Final Ecological Chemicals of Concern in the Ocoee River

COC	Surface Water	Sediment	Pore Water	Fish Tissue
Primary COCs Assessed Quantitatively				
Cadmium		X		
Copper	X	X	X	X
Iron	X	X	X	
Lead		X	X	
Manganese	X		X	
Zinc	X	X	X	X
PCBs		X		
pH (acidity)	X		X	

Table 7-8
Surface Water Quality for Copper and Zinc in the Ocoee River

Chemical of Concern	Water Quality Criterion Chronic (µg/L)	Surface Water Concentration Range (µg/L) (Exceedances of standard shown in parentheses)		
		Copper Basin Reach n = 28	Ocoee No. 3 Reservoir n = 12	Parksville Reservoir n = 47
Copper	2.0 *	0.4 – 7.1 (12)	0.2 – 2.8 (4)	0.6 – 14 (10)
Zinc	26 *	1.4 – 100 (10)	5 – 14 (0)	4 – 141 (12)

* - Based on the dissolved phased at an average hardness of 17 mg/L CaCO3
n – number of samples.

Table 7-9
Interstitial Pore Water Quality for Copper and Zinc in Ocoee River Sediment

Chemical of Concern	Water Quality Criterion Chronic (µg/L)	Pore Water Concentration Range (µg/L) (Exceedances of standard shown in parentheses)		
		Copper Basin Reach n = 6	Ocoee No. 3 Reservoir n = 3	Parksville Reservoir n = 20
Copper	2.0 *	0.5 – 3.2 (2)	0.6 – 1,300 (1)	0.5 – 29,000 (7)
Zinc	26 *	4.8 - 99 (2)	5 – 1,400 (1)	5 – 99,000 (12)

* - Hardness adjusted.
n – number of samples.

Table 7-10
Comparison of Concentrations of COCs in Ocoee River Sediment to Sediment Quality Benchmarks

River Reach COC	Concentration Range	Average Concentration	Sediment Quality Benchmark	Number Exceeding Benchmark	Average HQ
Copper Basin Reach, n = 23					
Copper	14 - 1,900	464	149	14	3.1
Iron	8,300 - 160,000	43,000	45,000	12	1.0
Lead	6.1 - 340	131	128	11	1.0
Zinc	57 - 6,900	1,580	459	14	3.4
Ocoee No 3 Reservoir, n = 32					
Copper	40.4 - 2,300	564	149	26	3.8
Iron	18,000 - 109,000	50,000	45,000	16	1.1
Lead	24 - 2,070	252	128	13	2.0
Zinc	94.9 - 3,500	912	459	24	2.0
Parksville Reservoir, n = 25					
Copper	110 - 1,400	804	149	24	5.4
Iron	21,000 - 95,000	61,700	45,000	22	1.4
Lead	68 - 1,000	374	128	23	2.9
Zinc	230 - 1,700	1,029	459	22	2.2

All concentrations in mg/kg.
Includes all sediment samples from year 2003 - 2006.
HQ – Hazard Quotient represented by: (average concentration ÷ benchmark)

Table 7-11
COC Concentrations Expected to Provide Adequate Protection of Ecological Receptors

River Reach	Exposure Medium	COC	Protective Level	Units	Basis	Assessment Endpoint
Copper Basin Reach Ocoee No. 3 Reservoir Parksville Reservoir	Surface Water	Copper (dissolved)	2.0	µg/L	State water quality criteria for chronic effects to aquatic life	Protection of aquatic invertebrates, fish, aquatic plants
		Iron (total)	1,000			
		Zinc (dissolved)	26			
Copper Basin Reach	Sediment	Copper	680	mg/kg	Geometric mean concentration between NOAEL and LOAEL from toxicity tests	Protection of aquatic invertebrates
		Iron	57,000			
		Lead	145			
		Zinc	2,200			
Ocoee No. 3 Reservoir Parksville Reservoir	Sediment	Copper	640	mg/kg	Geometric mean concentration between NOAEL and LOAEL from toxicity tests	Protection of aquatic invertebrates
		Iron	53,000			
		Lead	250			
		Zinc	9700			

Table 8-1
Remedial Goals for Surface Water and Sediment

Constituent[1]	Surface Water Quality Goal		Sediment Quality Goal	
	Acute (*µg/L*)	Chronic (*µg/L*)	Copper Basin Reach (*mg/kg*)	Ocoee No. 3 and Parksville Reservoirs (*mg/kg*)
Copper	2.5	2.0	680	640
Iron	--	1000	57,000	53,000
Lead	--	--	145	250
Zinc	26	26	2,200	970

[1] copper and zinc goals for surface water are for the dissolved phase and based on a hardness of 17 mg/L ($CaCO_3$) as determined in the RI; iron goal is for the total phase.

Table 12-1
Summary of Total Costs

Location	Capital Costs	Present Value of O & M Costs	Total Net Worth[1]
Copper Basin Reach	$0	$400,321	$400,321
Ocoee No. 3 Reservoir	$25,000	$248,856	$273,856
Parksville Reservoir	$1,146,700	$495,300	$1,642,000
Total	***$1,171,700***	***$1,144,477***	***$2,316,177***

[1] Total net worth cost is calculated using a 7% discount rate

Table 13-1
Chemical-Specific ARARs for ROD at Ocoee River OU 5

Action	Requirements	Prerequisite	Citation(s)
Restoration of Ocoee River classified for *Fish and Aquatic Life*	Waters shall not contain toxic substances, whether alone or in combination with other substances, which will produce toxic conditions that materially affect the health and safety of man and animals, or impair the safety of conventionally treated water supplies. The following criteria are for the protection of fish and aquatic life: Compound / Criterion Maximum Concentration µg/L / Criterion Continuous Concentration µg/L Copper** 13 9.0 Zinc** 120 120 ** Criteria for these metals are expressed as dissolved and are a function of total hardness (mg/L). Hardness-dependent metals criteria may be calculated from values displayed at TDEC 1200-4-3-.03(3)(g). Example values shown are for 100 mg/L hardness.	Presence of pollutant(s) in waters of the State as defined in TCA 69-3-103(26)—**relevant and appropriate**	TDEC 1200-4-3-.03(3)(g) Toxic Substances
	The waters shall not contain other pollutants that will be detrimental to fish or aquatic life.		TDEC 1200-4-3-.03(3)(h) Other Pollutants
	The waters shall not contain iron at concentrations that cause toxicity or in such amounts that interfere with habitat due to precipitation or bacteria growth.	Presence of pollutant(s) in waters of the State as defined in TCA 69-3-103(33)—**relevant and appropriate**	TDEC 1200-04-03(3)(i) Iron
Restoration of Ocoee River classified for *Industrial Water Supply*	The waters shall not contain toxic substances whether alone or in combination with other substances, which will adversely affect industrial processing.	Presence of pollutant(s) in waters of the State as defined in TCA 69-3-103(33)—**relevant and appropriate**	TDEC 1200-04-03(2)(i) Toxic Substances
	The waters shall not contain other pollutants in quantities that may adversely affect the water for industrial processing.		TDEC 1200-04-03(2)(j) Other Pollutants

Table 13-1
Chemical-Specific ARARs for ROD at Ocoee River OU 5

Action	Requirements	Prerequisite	Citation(s)
Restoration of Ocoee River classified for *Recreational*	The waters shall not contain toxic substances, whether alone or in combination with other substances that will render the waters unsafe or unsuitable for water contact activities including the capture and subsequent consumption of fish and shellfish, or will propose toxic conditions that will adversely affect man, animal, aquatic life, or wildlife.	Presence of pollutant(s) in waters of the State as defined in TCA 69-3-103(33)—**relevant and appropriate**	TDEC 1200-04-03(4)(j) Toxic Substances
	The waters shall not contain other pollutants in quantities which may have a detrimental effect on recreation.		TDEC 1200-04-03(4)(k) Other Pollutants
Restoration of Ocoee River classified for *Livestock Watering and Wildlife*	The waters shall not contain substances whether alone or in combination with other substances, which will produce toxic conditions that adversely affect the quality of the waters for livestock watering and wildlife.	Presence of pollutant(s) in waters of the State as defined in TCA 69-3-103(33)—**relevant and appropriate**	TDEC 1200-04-03(6)(f) Toxic Substances
	The waters shall not contain other pollutants in quantities which may be detrimental to the water for livestock watering and wildlife.		TDEC 1200-04-03(6)(f) Toxic Substances
Restoration of Ocoee River classified for *Irrigation*	The waters shall not contain toxic substances whether alone or in combination with other substances which will produce toxic conditions that adversely affect the quality of the waters for irrigation.	Presence of pollutant(s) in waters of the State as defined in TCA 69-3-103(33)—**relevant and appropriate**	TDEC 1200-04-03-(5)(f) Toxic Substances
	The waters shall not contain other pollutants in quantities which may be detrimental to the waters used for irrigation.		TDEC 1200-04-03-(5)(f) Other Pollutants

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulation*
EPA = U.S. Environmental Protection Agency
TCA = *Tennessee Code Annotated*
TDEC = Rules of the Tennessee Department of Environment and Conservation, Chapter as noted

Table 13-2
Action-Specific ARARs for ROD at Ocoee River OU 5

Action	Requirements	Prerequisite	Citation(s)
Management of Solid Waste			
Management and disposal of solid waste (e.g., old flashboard/superboard)	It is unlawful to: **(1)** Place or deposit any solid waste into the waters of the state except in a manner approved by the department or the Tennessee water quality control board;	Generate solid waste as defined in TCA 68-211-103(8) intended for disposal - **applicable**	Tennessee Solid Waste Disposal Act at TCA §68-211-104
Characterization of solid waste (all primary and secondary wastes)	Must determine if waste is hazardous or is excluded under 40 CFR 261.4; and	Generation of solid waste as defined in 40 CFR 261.2 - **applicable**	40 *CFR* 262.11(a) & TDEC 1200-1-11-.03(1)(b)(1)
	Must determine if waste is listed under 40 CFR Part 261; or		
	Must characterize waste by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used. If waste is determined to be hazardous, it must be managed in accordance with appropriate sections of 40 CFR 260–272.		

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulation*
EPA = U.S. Environmental Protection Agency
TCA = *Tennessee Code Annotated*
TDEC = Rules of the Tennessee Department of Environment and Conservation, Chapter as noted

Table 13-3
Location-Specific ARARs/TBCs for ROD at Ocoee River OU 5

Location	Requirements	Prerequisite	Citation(s)
	Waterbodies		
Presence of Wetlands	Shall take action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance beneficial values of wetlands.	Federal actions that involve potential impacts to, or take place within, wetlands – **To Be Considered**	Executive Order 11990 Section 1.(a) *Protection of Wetlands*
	Shall avoid undertaking construction located in wetlands unless: (1) there is no practicable alternative to such construction. and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.		Executive Order 11990, Section 2.(a) *Protection of Wetlands*
Within area impacting stream or any other body of water – *and* - presence of wildlife resources (e.g., fish)	The effects of water-related projects on fish and wildlife resources and their habitat should be considered with a view to the conservation of fish and wildlife resources by preventing loss of and damage to such resources.	Action that impounds, modifies, diverts,or controls waters, including navigation and drainage activities — **relevant and appropriate**	Fish and Wildlife Coordination Act (16 *USC* 661 *et seq.*)
	Floodplains		
Presence of Floodplains designated as such on a map	Shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains.	Federal actions that involve potential impacts to, or take place within, floodplains – **To Be Considered**	Executive Order 11988 Section 1. *Floodplain Management*
	Shall consider alternatives to avoid, to the extent possible, adverse effects and incompatible development in the floodplain. Design or modify its action in order to minimize potential harm to or within the floodplain		Executive Order 11988 Section 2.(a)(2) *Floodplain Management*

Table 13-4
Matrix of Cost and Effectiveness Data

Alternative	Present Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV Through Treatment	Short-Term Effectiveness
Copper Basin Reach					
CBR-0 (No Action)	$0	---	• No current unacceptable risks to humans • Reduction in risk due to natural mechanisms • No mechanism to assess attainment of RAOs and RGs	• Reduction in toxicity due to natural sequestration • No reduction in mobility • No reduction in volume	• No short-term health risk to public, workers, or aquatic receptors
CBR-1 (MNR)	$400,321	$400,321	• No current unacceptable risks to humans • Identical reduction in risk due to natural mechanisms • Monitoring to assess progress toward RAOs and RGs	• Reduction in toxicity due to natural sequestration • No reduction in mobility • No reduction in volume	• No short-term health risk to public, workers, or aquatic receptors
CBR-2 (MNR with Sediment Capping)	$1,405,221	$1,004,900	• No current unacceptable risks to humans • Monitoring to assess progress toward attainment of RAOs and RGs • No additional reduction in chronic risk to aquatic organisms expected from installation of spur dike or dam removal	• Reduction in toxicity due to natural sequestration • No reduction in mobility • No reduction in volume	• Increased short-term risk to workers and aquatic organisms due to installation of spur dikes and dam removal • No short-term risks to public
Ocoee No. 3 Reservoir					
O3R-0 (No Action)	$0	---	• No current unacceptable risks to humans • Reduction in risk associated with surface water and sediment due to natural process expected • No mechanism to prevent uncontrolled sediment releases • Does not include measures to assess attainment of RAOs and RGs	• Reduction in toxicity due to natural sequestration • No reduction in mobility • No reduction in volume	• No short-term health risks to public, workers, or aquatic receptors

Table 13-4
Matrix of Cost and Effectiveness Data

Alternative	Present Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV Through Treatment	Short-Term Effectiveness
O3R-1 (MNR)	$207,142	$207,142	• No current unacceptable risks to humans • No additional reductions in risk beyond upstream actions and natural processes • Monitoring to assess progress toward attainment of RAOs and RGs • No mechanism to prevent uncontrolled sediment releases	• Reduction in toxicity due to natural sequestration • No reduction in mobility • No reduction in volume	• No short-term health risks to public, workers, or aquatic receptors
O3R-2 (MNR with Hydraulic Controls)	$273,856	$66,714	• No current unacceptable risks to humans • Engineering controls to provide additional reductions in risk due to potential exposures to sediments • Monitoring to assess progress toward attainment of RAOs and RGs	• Reduction in toxicity due to natural sequestration • Reduction in mobility due to hydraulic controls • No reduction in volume	• No short-term health risks to public, workers, or aquatic receptors
Parksville Reservoir					
PR-0 (No Action)	$0	---	• Potential health risk from consumption of catfish from PCBs • Chronic risk to benthic invertebrates from sediments and pore water in delta region • Does not include measures to assess attainment of RAOS and RGs	• No reduction in toxicity • No reduction in mobility • No reduction in volume	• No short-term health risks to public, workers, or aquatic receptors
PR-1 (MNR)	$499,535	$499,535	• No additional reduction in potential health risk from consumption of catfish from PCBs • No additional reduction in chronic risk to benthic invertebrates from sediments and pore water in delta region • Monitoring to assess progress toward attainment of RAOS and RGs	• No reduction in toxicity • No reduction in mobility • No reduction in volume	• No short-term health risks to public, workers, or aquatic receptors

Table 13-4
Matrix of Cost and Effectiveness Data

Alternative	Present Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV Through Treatment	Short-Term Effectiveness
PR-5 (Permanent Inundation with Flashboards / Superboards)	$759,714	$260,179	• No additional reduction in potential health risk from consumption of catfish from PCBs • Reduction in chronic risk to benthic organisms due to permanent inundation of delta sediments • Monitoring to assess progress toward attainment of RAOs and RGs	• Reduction in toxicity due to permanent inundation • Reduction in mobility due to permanent inundation • No reduction in volume	• Potential short-term risks to public due to nuisance flooding downstream • Potential short-term risks to workers during flashboard / superboard maintenance • No short-term risks to aquatic organisms
PR-5 (Liming and Permanent Inundation with Flashboards / Superboards)	$1,642,000	$882,286	• No additional reduction in potential health risk from consumption of catfish from PCBs • Reduction in chronic risk to benthic organisms due to liming and permanent inundation of delta sediments • Monitoring to assess progress toward attainment of RAOs and RGs	• Slight additional reduction in toxicity due to liming and permanent inundation • Slight additional reduction in mobility due to liming and permanent inundation • No reduction in volume	• Potential short-term risks to public due to nuisance flooding downstream • Potential short-term risks to workers during lime application and flashboard / superboard maintenance • No short-term risks to aquatic organisms
PR-3 (MNR with Wetland Development)	$2,542,351	$900,351	• No additional reduction in potential health risk from consumption of catfish from PCBs • Similar reduction in chronic risk to benthic organisms due to liming and wetland development • Monitoring to assess progress toward attainment of RAOs and RGs	• Similar reduction in toxicity due to liming and wetland development • Similar reduction in mobility due to liming and wetland development No reduction in volume	• No short-term risks to public • Potential short-term risks to workers during lime application and wetland development • Minimal short-term risks to aquatic organisms due to wetland development
PR-2 (MNR with Permanent Inundation with Pneumatic	$6,401,371	$3,859,020	• No additional reduction in potential health risk from consumption of catfish from PCBs • Similar reduction in chronic risk to benthic organisms due to liming and permanent inundation	• Reduction in toxicity due to liming and permanent inundation • Reduction in mobility due to liming and permanent inundation	• Potential short-term risks to public due to nuisance flooding downstream • Potential short-term risks to workers during lime application and pneumatic

Table 13-4
Matrix of Cost and Effectiveness Data

Alternative	Present Worth Cost	Incremental Cost	Long-Term Effectiveness and Permanence	Reduction of TMV Through Treatment	Short-Term Effectiveness
Gates)			• Monitoring to assess progress toward attainment of RAOs and RGs	• No reduction in volume	gate installation / maintenance • No short-term risks to aquatic organisms
PR-4 (MNR with Dredging)	$11,267,671	$4,866,300	• No additional potential health risk from consumption of catfish from PCBs • Similar reduction in chronic risk to benthic organisms due permanent inundation of dredged sediments in deep aquifer • Includes monitoring to document improvement in risk levels and progress toward RAOs	• Reduction in toxicity due to permanent inundation • Reduction in mobility due to permanent inundation • No reduction in volume	• No short-term risks to public • Potential short-term risks to workers during dredging • Minimal short-term risks to aquatic organisms due to dredging

Figures

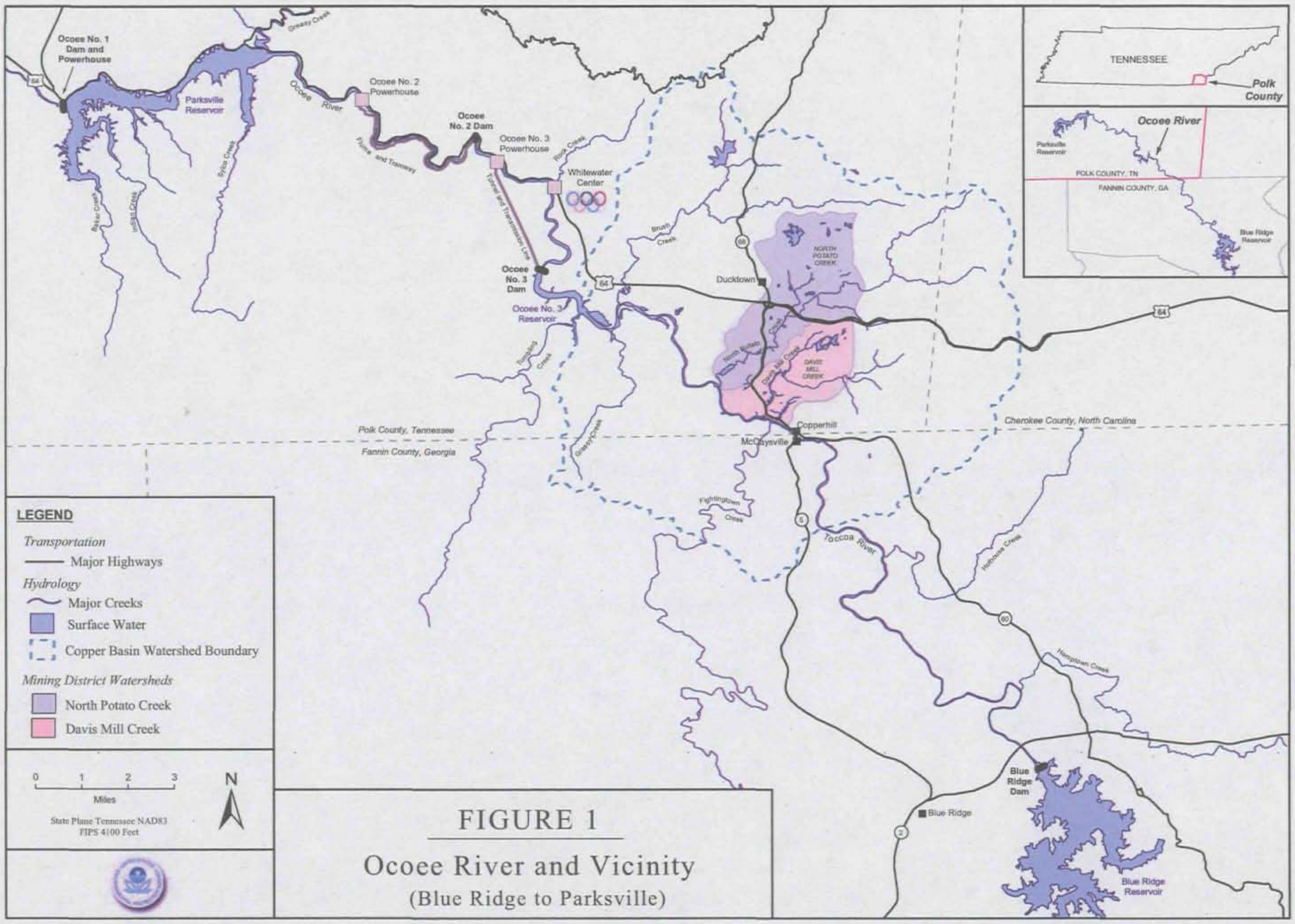


FIGURE 1

Ocoee River and Vicinity
(Blue Ridge to Parksville)

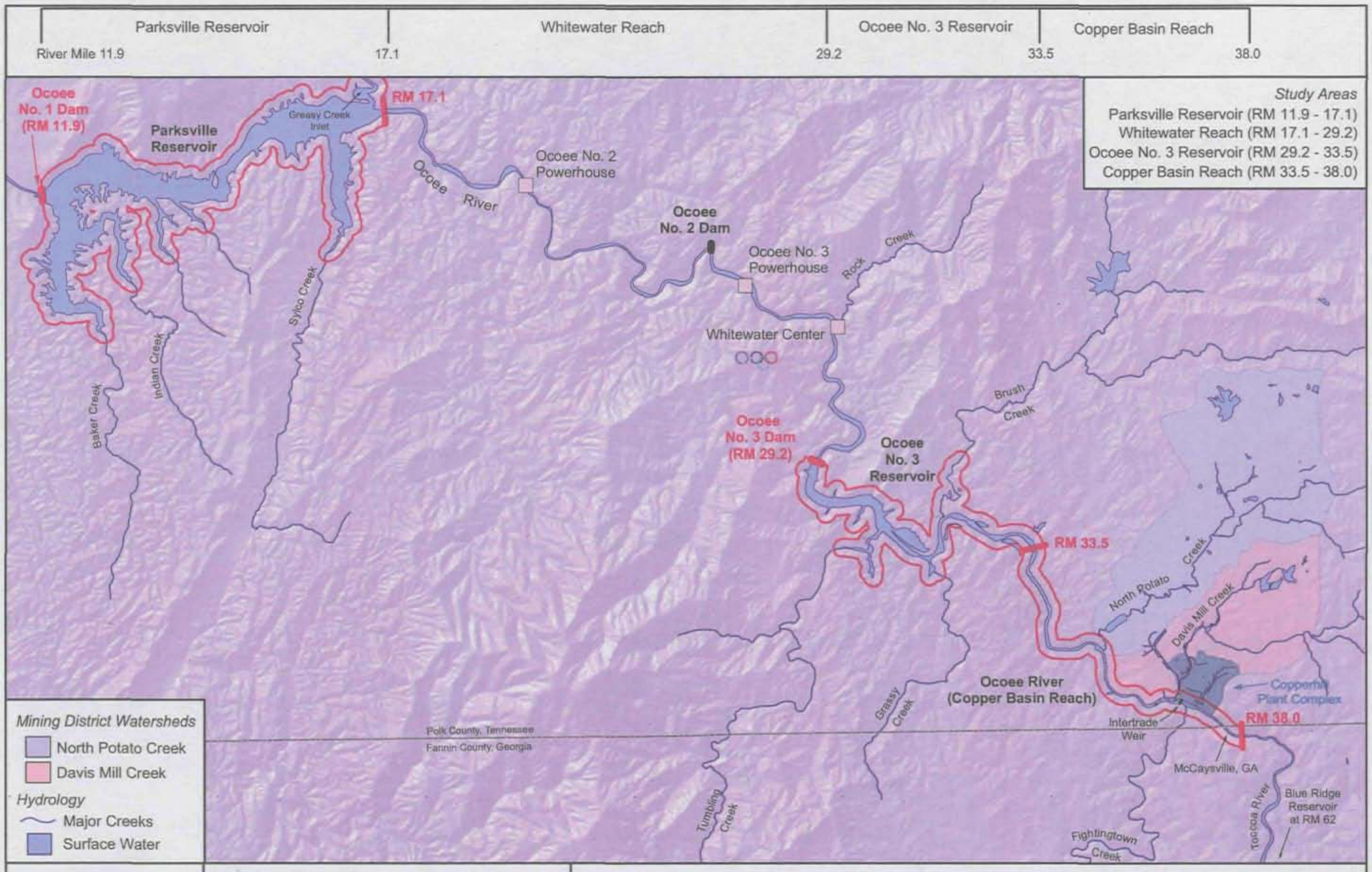


FIGURE 2
Ocoee River Study Areas

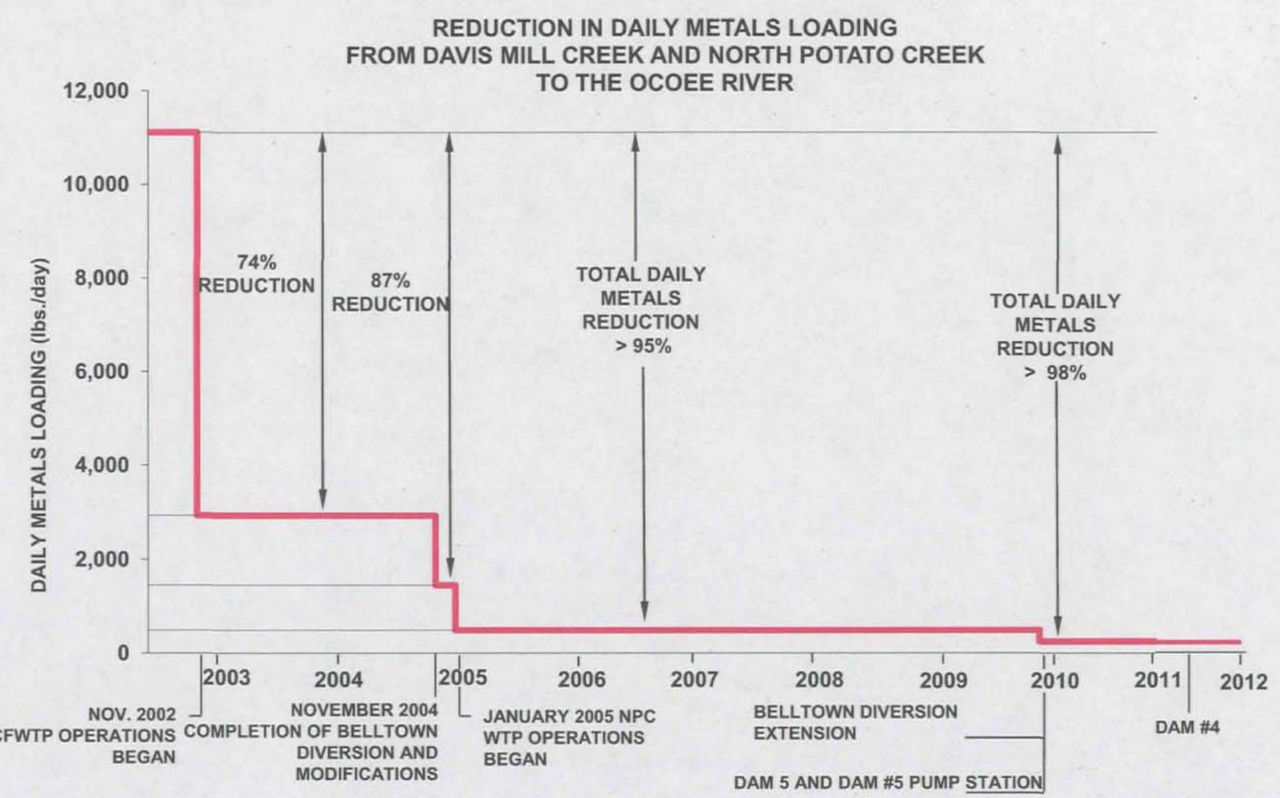


Figure 3
Reduction In Daily Metals Loading
From Davis Mill Creek and North Potato Creek
To the Ocoee River

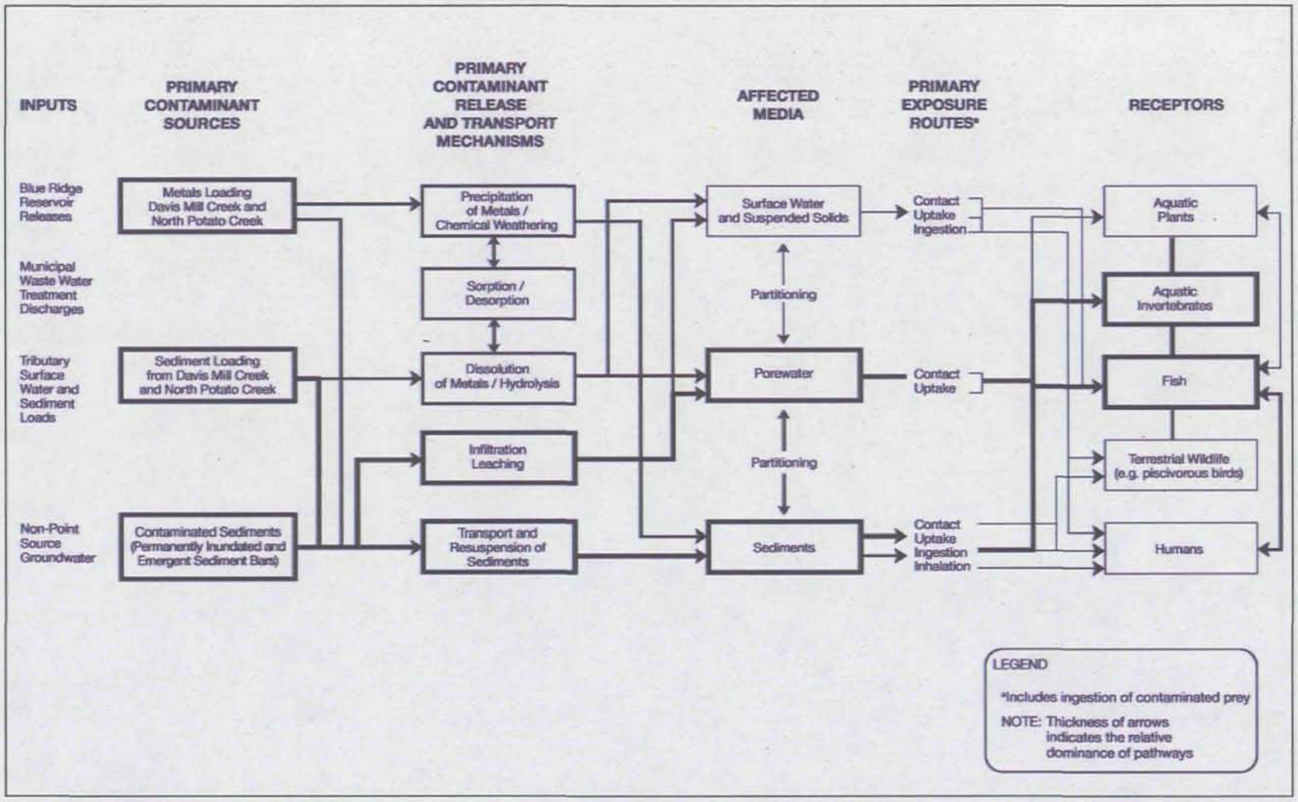


Figure 4

Overall Conceptual Site Model

Ocoee River

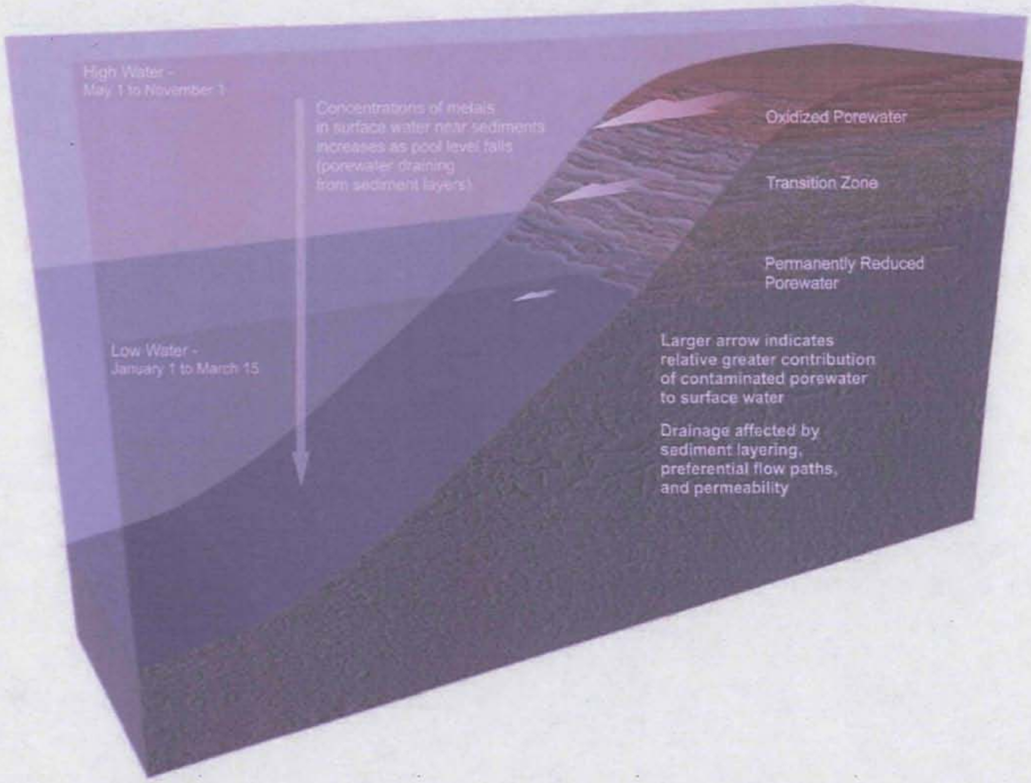


FIGURE 5

Conceptual Site Model of Chemical Transport in Parksville Reservoir

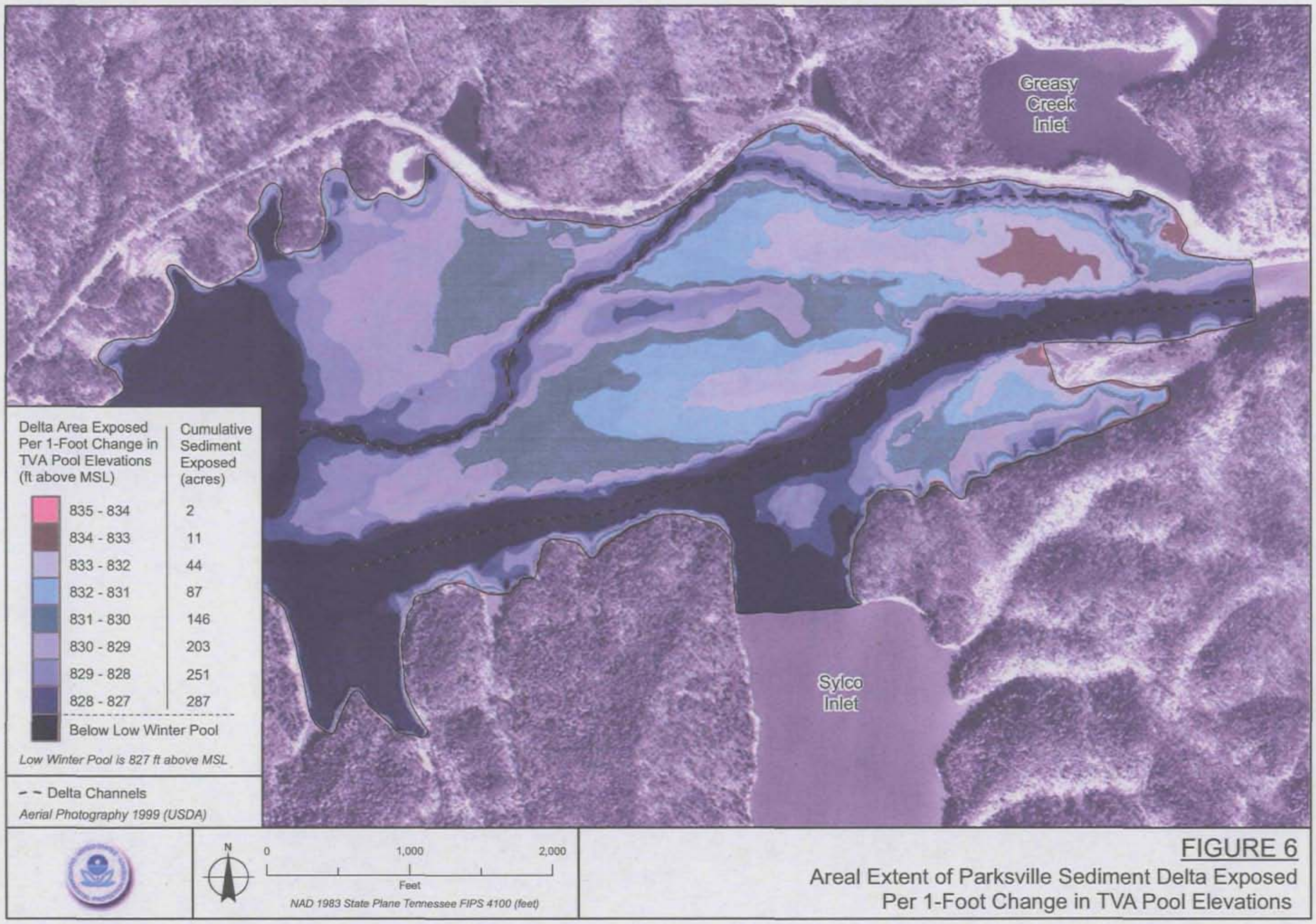
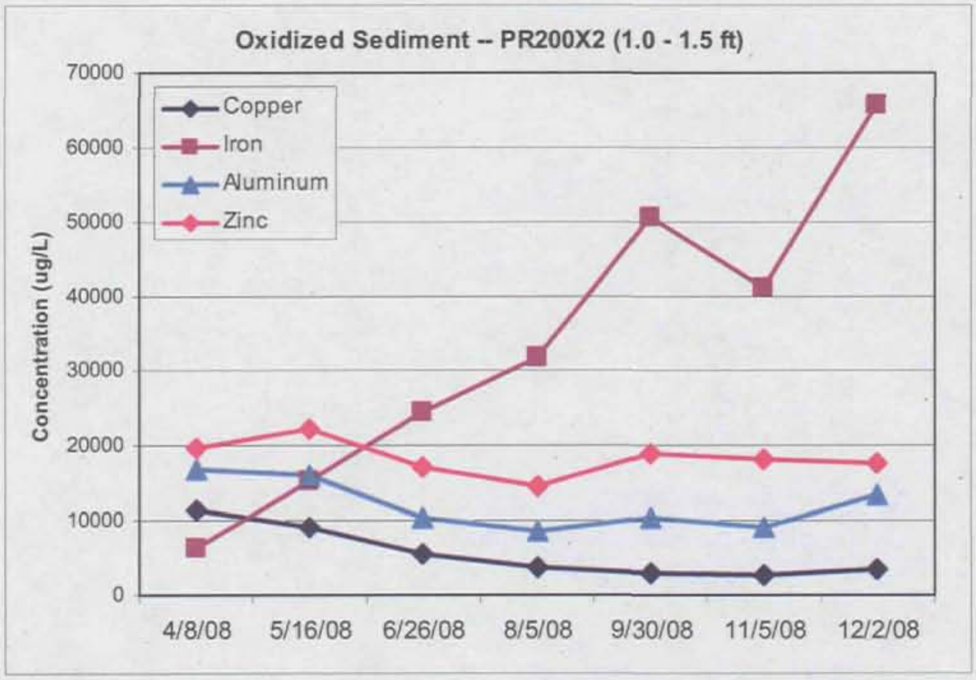


FIGURE 6
Areal Extent of Parksville Sediment Delta Exposed
Per 1-Foot Change in TVA Pool Elevations



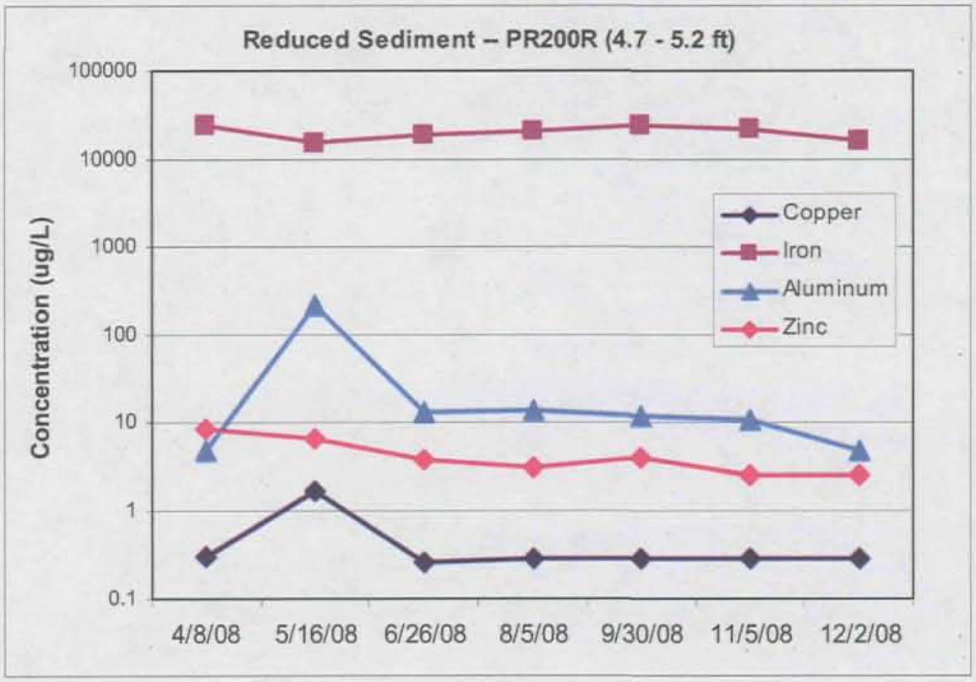


Figure 7. Plot showing pore water quality in oxidized (top) and reduced (bottom) sediment on the Parksville sediment delta. Samples collected from co-located shallow wells (screen interval shown in titles) during one reservoir fill-drain cycle in 2008.

Figure 8. Aerial photos of the Davis Mill Creek – Ocoee River Confluence showing changes in response to the DMC removal action and other interim measures

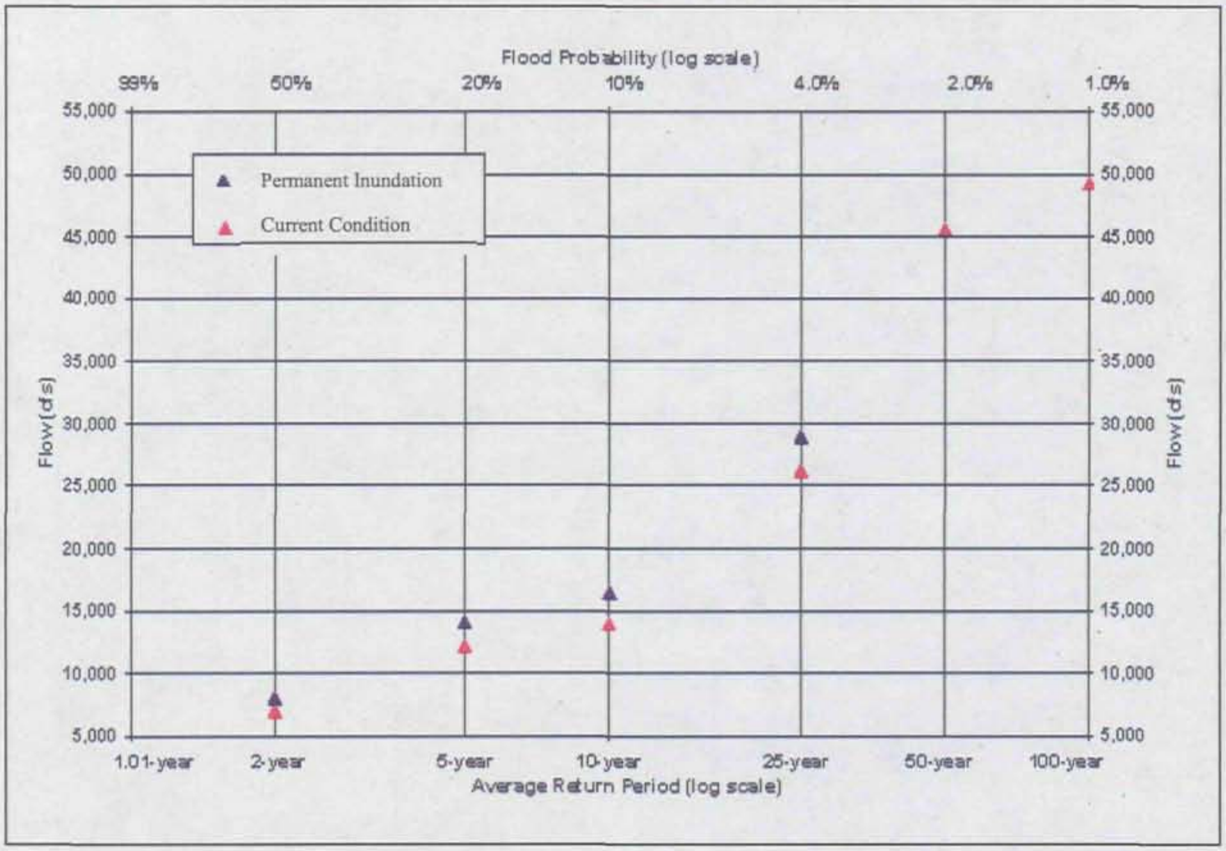


Figure 9. Comparison of predicted peak flows for the current reservoir management scenario to predicted peak flows under permanent inundation alternatives PR-2 and PR-5.

Part 3:

Responsiveness Summary

This Responsiveness Summary is the third and final part of the Record of Decision for the Ocoee River (Copper Basin Mining District Site, Operable Unit 5). The general purpose of the Responsiveness Summary is to

- Present stakeholder concerns about the site and preferences regarding the remedial alternatives
- Explain how those concerns were addressed and preferences were factored into the remedy selection process.

As discussed in Section 3.0 (Community Participation), over 500 copies of the Proposed Plan Fact Sheet were distributed to the site mailing list in mid-June 2011. The Administrative Record and information repositories were also updated with supporting documents. A formal 30-day public comment period on the Proposed Plan was held from June 17 to July 18, 2011. EPA held a public meeting on June 23, 2011 at the GSHI office in Ducktown, TN to present the results of the Remedial Investigation/Feasibility Study, its reasoning for the Preferred Alternative presented in the Proposed Plan, and to answer questions from the community. Approximately 55 people attended the meeting. A verbatim transcript of the June 23rd public meeting is attached as Appendix D No major issues or opposition to the Proposed Plan were expressed by the meeting participants. The majority of questions posed by the public during this meeting related to the iron calcine trucking operations through the Ocoee River gorge.

EPA received only one comment from a member of the community during the 30-day public comment period (Appendix C). The comment concurred with EPA's Preferred Alternative stating it is was the best solution with the best economics.

The Tennessee Department of Environment and Conservation (TDEC) did not submit written comments during the comment period, but has issued its formal approval in a concurrence letter attached as Appendix F.

GSHI submitted formal comments on the Preferred Alternative in correspondence dated July 14, 2011. This letter, which is attached included in Appendix C, focused exclusively on GSHI's concerns related to the implementability, efficacy and necessity of applying lime to Parksville delta sediment, prior to wet closure. As discussed in Section 14.0 (Documentation of Significant Changes), EPA has fully considered GSHI's comments regarding this issue and, based on the estimated costs and uncertainties associated with implementation, has not included lime addition to the Parksville delta as a part of the Selected Remedy (PR-5).

TVA did not submit comments on the Proposed Plan during the 30-day public comment period, but submitted comments to EPA in correspondence dated August 4, 2011. EPA accepted these comments and TVA's letter is included in Appendix C. Two components of EPA's Selected Remedy directly affect TVA's operations on the Ocoee River: Alternative O3R-2 – MNR with Hydraulic Controls for Ocoee No. 3 Reservoir and Alternative PR-5 – MNR with Permanent Inundation using Flashboards and Superboards in the Parksville Reservoir. EPA has adopted the BMP plan for Ocoee No. 3 that was developed by TVA in response to the January 2009 sediment release. This document is referenced in Section 13.0 (Selected Remedy) and attached as Appendix A. EPA will continue to work closely with TVA to resolve other issues highlighted in the August 4, 2011 letter including the timing of flashboard and superboard inspections and replacement, compensation for lost hydropower generation, liability for increased flood risk, dispute resolution, timeframe for re-evaluation of project effectiveness, and payment arrangements outside of the ROD. EPA believes the most appropriate time for these discussions is during negotiations on the Memorandum of Understanding, but has also attempted to address these issues in this ROD.

Appendices

Appendix A

Ocoee No. 3 Best Management Practices Plan

RDU ____ TLA ____
JBF ____ WMF ____
SAH ____ AMY ____
WEC ____

File: Ocoee River 2010 (Polk)

cc: (cover pg only) TVA - 2010

TVA

Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, Tennessee 37902

May 14, 2010

Dr. Richard Urban
Field Office Manager, Division of Water Pollution Control
Chattanooga Environmental Field Office
Tennessee Department of Environment
and Conservation
State Office Building, Suite 550
540 McCallie Avenue
Chattanooga, Tennessee 37402

Dear Dr. Urban:

TENNESSEE VALLEY AUTHORITY (TVA) - OCOEE RIVER FINAL BEST MANAGEMENT PRACTICES (BMPs)

Enclosed are TVA's final BMPs as subscribed in the Tennessee Department of Environment and Conservation (TDEC) Director's Order WPC09-0008 for Ocoee sluicing operations. TVA received your comments on December 7, 2009, and March 15, 2010, and has incorporated those into the BMPs.

TVA shares TDEC's concerns about the potential for any unintentional release of sediments and will use the BMP plan to guide future drawdown operations at Ocoee #3. If you have any additional questions or concerns, please call Aaron Nix at (423) 751-7175.

Sincerely,

Anda A. Ray

Enclosures

cc (Enclosures):
Mr. Paul E. Davis, Director
Division of Water Pollution Control
Tennessee Department of Environment and Conservation
L&C Tower
401 Church Street
Nashville, Tennessee 37243

Mr. Greg Denton
Planning and Standards Section
Division of Water Pollution Control
Tennessee Department of Environment and Conservation
L&C Tower
401 Church Street
Nashville, Tennessee 37243

Mr. David McKinney
Tennessee Wildlife Resources Agency
Ellington Agricultural Center
440 Hogan Road
Nashville, Tennessee 37220

Best Management Practices for Drawdown Operations at Ocoee 3

Background

On January 12, 2009, the Tennessee Department of Environment and Conservation (TDEC) Division of Water Pollution Control issued a Director's Order (the Order) to TVA. The Order followed an unintentional release of sediments from Ocoee #3 Reservoir on January 4, 2009. Among other requirements, the Order directed TVA to prepare a Best Management Practices (BMP) plan detailing how future drawdown operations are to be conducted at Ocoee #3.

On January 22, 2009, the TVA response to the Order was submitted to TDEC. The response included a BMP plan with two principal components; (1) a commitment to maintain Ocoee #3 headwater at or above elevation 1428 until drawdown studies can be completed, and (2) a commitment to "conduct studies in coordination with TDEC to evaluate how Ocoee 3 Reservoir drawdowns below elevation 1428 can be performed without exposing existing mudflats to erosion and allowing concentrated sediment to flow through the sluice gates". The response further included a commitment to incorporate into the BMP plan those erosion and sediment movement minimization measures determined during the drawdown test.

Immediately following the close of the recreation season on the upper Ocoee reach, and in conjunction with TDEC, TVA planned and conducted a test drawdown at Ocoee #3. The test occurred during the period November 3 through 5, 2009; results of the test are summarized in the document entitled "Summary of November 2009 Test Drawdown at Ocoee 3."

TVA shares TDEC's concerns about the potential for any unintentional release of sediments through the Ocoee #3 sluice gates. Therefore, the text following provides a BMP plan to guide future drawdown operations at Ocoee #3.

Expected Purpose, Frequency, and Duration of Drawdown Operations at Ocoee 3

It is expected that drawdown operations at Ocoee 3 will be required for maintenance activities related to dam safety. Such activities are required approximately every 2 to 5 years, and include spillway gate inspections and routine maintenance like replacing the spillway gate chains. This work typically requires a pool elevation of 1411.0. Inspections can usually be completed in a single day; replacing gate chains (if performed for all seven gates) can take four or five days.

Other, more extensive maintenance work, while infrequent and irregular, can be accomplished by placing a caisson in front of the work area, and would not ordinarily require a drawdown.

Drawdown operations can and should be performed during periods of low flow in the Ocoee River. If any impacts are expected from weather events, the drawdowns can be delayed or interrupted, with work resuming upon the return of low flow conditions.

Best Management Practices

For normal (including recreation, hydrogeneration, and periodic flood risk reduction) operation:

- Maintain headwater elevation above 1428.

For operation requiring drawdown below headwater elevation 1428:

Minimize project inflow during drawdown:

- Release no more than 150 cubic feet per second (cfs) from Blue Ridge.
- To the extent practicable, schedule drawdown during late fall when local inflow from the unregulated drainage area is likely to be at an annual minimum.
- To the extent practicable, schedule drawdown when no rainfall is forecast.

Control rate of drawdown:

- Reservoir drawdown is to be accomplished by releases made through the Ocoee 3 turbine, the spillway gates, and the sluice gates.
- Drawdown rate should be limited once pool level drops below 1428. Drawdown rate should be controlled by limiting the sum of releases made through the spillway and/or sluice gates to 1800 cfs, which is the channel capacity at the Whitewater Center.
- In order to minimize the volume of water released through the sluice gates during the drawdown operation, spillway releases should be made above headwater elevation 1412.
- Release through sluice gates only once headwater reaches 1412.
- Check drawdown elevations every several hours with wire weight gage to ensure accuracy of measurements.
- Once headwater is below the spillway crest, the maximum sluice gate release should not exceed 1400 cfs.

Monitor Releases During Drawdown Operation:

- For the duration of the drawdown operation, provide TVA Environmental Compliance staff member to be dedicated to daytime visual monitoring of environmental conditions, in particular the nature and character of any sluice flow.
- Limit reservoir drawdown to daylight hours.
- Limit overnight sluicing rate to that required to maintain the current headwater without additional drawdown.
- Delay drawdown if local inflow rate is such that drawdown cannot be effectively accomplished at the maximum release rates specified above.
- If water heavily laden with sediment is observed being released in an attempt to reach or maintain a drawdown target elevation, the sluice gates should be closed and the reservoir allowed to refill.

Hydropower Generation:

- If necessary and practicable, spill accumulated trash prior to initiating drawdown.
- Once drawdown is initiated, monitor trash boom and trash rack conditions throughout generation period.
- Monitor conditions at Ocoee #3 powerhouse and discontinue generation if and when necessary.
- Generation should be at full turbine capacity; continue generation as long as possible.

Drawdown Target Elevation:

- Drawdown target elevation for routine maintenance not to be below 1411.0.
- For drawdown below 1411.0, coordinate with TDEC; plan and conduct drawdown operation jointly.

Refill Operation:

- When possible, limit total Ocoee #3 inflow (sum of local inflow and Blue Ridge release) to no more than 650 cfs. To achieve this, limit Blue Ridge releases to the greater of 150 cfs or that amount required to achieve total Ocoee 3 inflow of 650 cfs. When local inflow is in excess of 500 cfs, limit Blue Ridge release to 150 cfs.
- Resume normal operations only after the Ocoee #3 headwater elevation is above 1428.

Incorporation of BMPs into Normal River Scheduling Processes

TVA (River Operations) will create and maintain an *operating information directory*, which is to be separate from the existing notification directory. The notification directory will be modified, so that it includes only the notifications that need to be made and the corresponding contact information.

TVA will provide written and/or verbal notification to the TDEC Division of Water Pollution Control prior to using the Ocoee 3 sluice gates for recreation, flood control, or maintenance drawdown operations.

The new operating information directory will include, for each TVA project, any and all operating constraints currently in the notification directory, as well as additional information. In the case of Ocoee 3, the operating information directory will include the BMP summarized in this report. The operating information directory will be password protected so that modifications can be made only by a limited number of authorized staff. A draft of the operating information directory will be completed by June 30, with the final completed by September 30, 2010.

Emergency Operations

In the unlikely event of a dam safety emergency caused by natural events such as floods, rockslides, earthquakes, etc., TVA will be obliged to take the actions required to provide for the safety of employees and the general public and to protect the integrity of the structure. It will be the responsibility of TVA's dam safety officer to declare when such an emergency exists. TVA will work with TDEC and other agencies as required to mitigate the impacts of sediments released from the Ocoee #3 sluice gates as a result of emergency operations.

Appendix B

Proposed Plan

U.S. ENVIRONMENTAL PROTECTION AGENCY

PROPOSED PLAN FACT SHEET

Ocoee River

Polk County, Tennessee

June 2011

This fact sheet is not to be considered a technical document. It has been prepared to provide the general public an understanding of the activities that have been occurring at the Copper Basin Site. For technical information, please review the documents in the information repositories.

Introduction

The U.S. Environmental Protection Agency (EPA) announces a Proposed Plan for the environmental cleanup of the Ocoee River Operable Unit 5, which is part of the Copper Basin Mining District Site. Operable Unit 5 consists of three areas: Copper Basin Reach, Ocoee No. 3 Reservoir, and Parksville Reservoir (Figure 1).

EPA consulted with the Tennessee Department of Environment and Conservation (TDEC) in developing this Proposed Plan Fact Sheet, which presents the Preferred Alternative for the cleanup of the Ocoee River and EPA's rationale for this preference. This Fact Sheet also summarizes findings from major site activities, such as the Remedial Investigation (RI) report, which includes a Baseline Risk Assessment, and the Feasibility Study (FS) report. EPA is issuing this Proposed Plan Fact Sheet as part of its public participation responsibilities under Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

What is a Proposed Plan?

A Proposed Plan is a document used to facilitate public involvement in a site's remedy selection process. This Proposed Plan is a step in the Superfund process, which also includes the RI, Risk Assessment, and FS. The Proposed Plan presents (1) EPA's preliminary recommendation on how to best address contamination at a site, (2) alternatives that were evaluated, and (3) reasons why EPA recommends the preferred remedy presented in this document. EPA, in consultation with TDEC, will select the final Preferred Alternative for the Ocoee River after receiving and considering all information submitted during the 30-day, public comment period.

30-Day Public Comment Period

June 17, 2011 to July 18, 2011

Open House and Public Meeting

Office of Glenn Springs Holdings, Inc.
127 Main Street, Ducktown
June 23, 2011
5 pm to 7 pm

As part of public involvement during the 30-day public comment period, the community is invited to an Open House and Public Meeting. An informal open house will be held from 5 to 6 pm on June 23rd. At 6:00 pm, EPA will present its understanding of the site, describe its reasoning for the Preferred Alternative presented in this Proposed Plan, and answer questions from the community. Oral and written comments also will be accepted at the public meeting.

For Additional Information:

Copper Basin Information Repository

Ducktown City Hall
327 Main Street
Ducktown, Tennessee 37326
Phone 423-496-3546
Contact: Marty Fowler
Hours: 10 am – 4 pm

http://www.epa.gov/region4/waste/copper/index.htm

Craig Zeller

Remedial Project Manager
U.S. Environmental Protection Agency
Phone: 404-562-8827
E-mail: Zeller.Craig@epa.gov

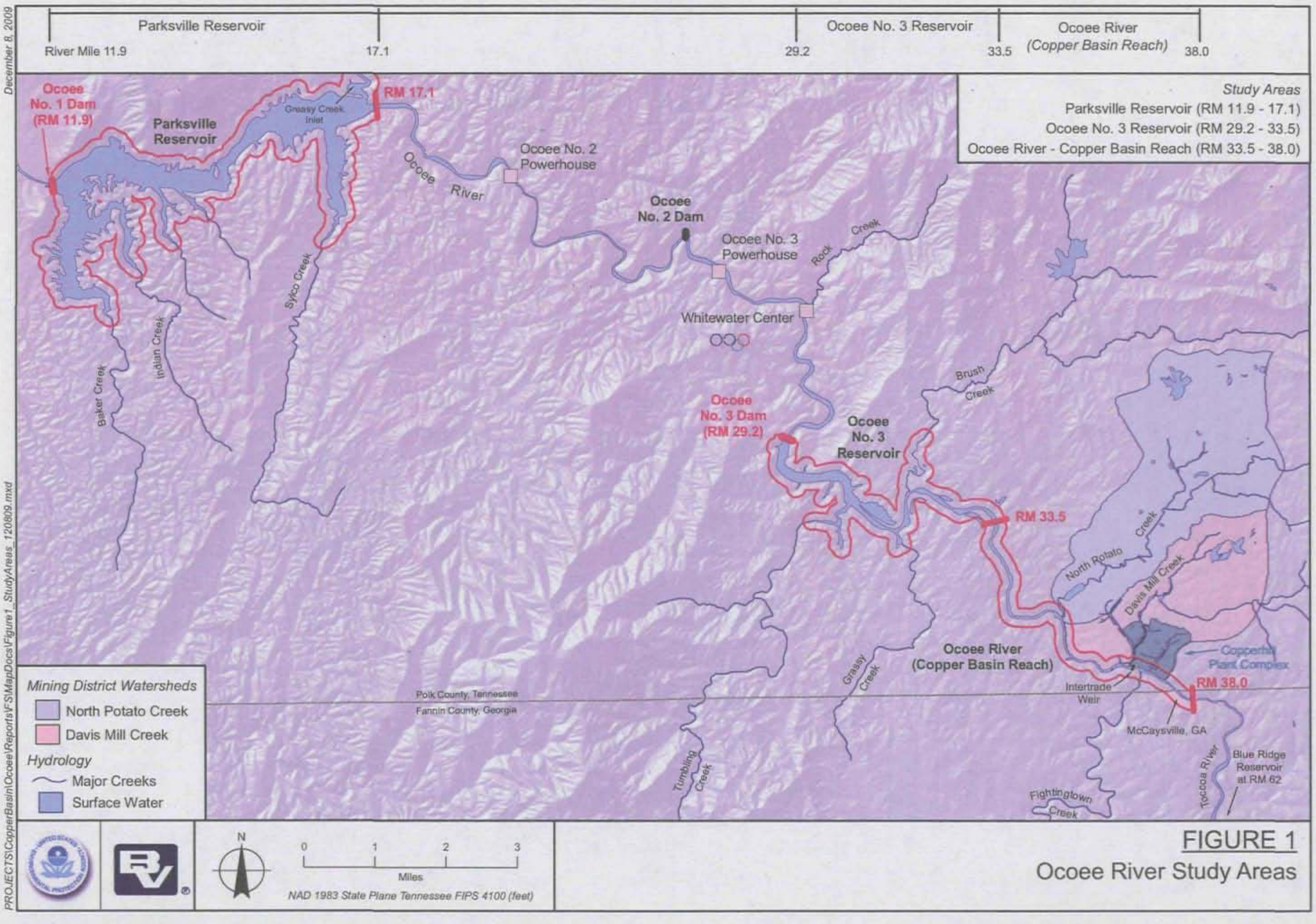


FIGURE 1
Ocoee River Study Areas

The Preferred Alternative presented in this fact sheet may be modified, or EPA, in consultation with TDEC, may select another remedy, based on new information or public comments. Therefore, the public is encouraged to review and comment on all alternatives presented in this Proposed Plan Fact Sheet. A complete set of documents related to Copper Basin site activities is contained in the Administrative Record on file for the Site at the Copper Basin Information Repository in Ducktown, Tennessee.

What are the next steps in the process?

An informal open house will be held June 23, 2011, between 5:00 pm and 6:00 pm at the office of Glenn Springs Holdings, Inc., 127 Main Street, Ducktown, Tennessee. At 6:00 pm, a formal public meeting will be held where EPA will present its understanding of the site, describe its reasoning for the Preferred Alternative presented in this Proposed Plan, and answer questions from the community.

Site History and Background

From the late 1800s until the 1980s, the Ducktown Mining District and the surrounding Copper Basin were nearly devoid of vegetation. During this period, tens of millions of cubic yards of soil were eroded and transported to the Ocoee River. In addition, a variety of mining and industrial wastes, principally acid-generating and heavy-metal-bearing materials, were discharged into creeks in the mining district and carried downstream into the Ocoee River. As a result of the sediment and chemical contaminants, aquatic life and aquatic habitat in the Ocoee River were significantly degraded. Historical sampling of the river recorded elevated concentrations of several hazardous substances or contaminants in the river's water and sediments, including copper, iron, lead, and zinc, as well as low pH (acidic conditions).

Summary of Site Characteristics and Risks

The water quality in the river now generally meets Tennessee Water Quality Standards (WQS) for human health and aquatic life, with some exceptions. This improved water quality is primarily the result of interim remedial actions conducted in Davis Mill Creek and North Potato Creek to reduce the transport of contaminants to the river. Water quality exceptions have been in areas primarily along the right bank, immediately below the confluences with Davis Mill and North Potato Creeks and in the water column immediately above contaminated sediments in the bottom of the river.

Sediment (and associated pore water in the sediment) at several locations in the river shows chronic residual risks to aquatic life from elevated metals and acid. Chronic adverse effects to the growth and reproduction of sensitive aquatic insects were noted when copper, iron, lead, and zinc exceeded certain levels. These insects are the primary food supply for fish.

Metals concentrations in Ocoee No. 3 Reservoir sediments also are elevated, with higher concentrations occurring deeper behind the dam, below surficial sediment. Sediment transport modeling showed that deeper, more toxic sediments could be exposed and transported downriver if large-scale sediment sluicing (clean-out) events are conducted by the Tennessee Valley Authority (TVA).

During the winter months, TVA lowers the water level in Parksville Reservoir 8 to 10 feet, exposing a large sediment delta that formed when mass erosion and transport of soils and wastes from the Copper Basin went largely unchecked. This annual cycle allows the upper layer of these sediments to be exposed to air. Oxygen in the air creates chemical reactions in the sediment, which form acid and dissolve heavy metals contained within the sediment. Metals and acid in the sediment delta inhibit the growth of aquatic insects and fish spawning and juvenile rearing when the delta is covered with water. The sediment delta also does not support the growth of either aquatic or upland vegetation. Pore water associated with these sediments provides a source of metals and acid to the rest of the reservoir. These contaminants primarily are released as water drains from the delta when the reservoir pool is lowered in the fall.

PCB levels in fish tissue from the eastern part of Parksville Reservoir could present a cancer risk of 1 in 10,000 if people, on average, consume over 1.5 meals per month of channel catfish or 12 meals per month of largemouth bass.

The Risk Assessment found no additional human health risks from the residual contaminants in the river other than those specified for consumption of fish from the eastern part of Parksville Reservoir. This included risk evaluations for recreational users, whitewater guides, fishermen, and personnel visiting or working at the Ocoee Whitewater Center.

It is the lead agency's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Scope and Role of the Response Action

A Memorandum of Understanding (MOU) among the U.S. Environmental Protection Agency Region 4 (EPA), the Tennessee Department of Environment and Conservation (TDEC), and OXY USA was signed on January 11, 2001. In early 2001, EPA, TDEC, and Glenn Springs Holdings, Inc. (GSHI), a subsidiary of OXY USA, entered into a series of Administrative Orders on Consent (AOCs) that collectively were intended to lead to the characterization and remediation of contaminated areas in the Copper Basin and Ocoee River. Under these agreements, EPA became responsible for conducting studies in the Ocoee River, which it designated as one of five operable units (OUs) making up the Copper Basin site. The agreements also called for GSHI to study and implement removal actions in the other OUs located in the mining district. These studies and actions were to be conducted under TDEC's Voluntary Cleanup, Oversight, and Assistance Program (VOAP), with EPA having oversight responsibilities.

GSHI has implemented interim remedial actions in the Copper Basin since 2001. The RI for the river was developed using a phased approach. Consequently, the investigation not only described existing conditions, but also presented trends and changes that have occurred in the Ocoee River from activities implemented in the Copper Basin. Of particular significance are treatment and control of most discharges from Davis Mill Creek, beginning in November 2002, and treatment and control of discharges from North Potato Creek, beginning in January 2005.

The scope of EPA's RI and FS was to study and address the mining and industrial wastes and acid-generating, heavy-metal-bearing, materials that were discharged to the Ocoee River and transported downstream. The Preferred Alternative and other alternatives summarized in this Proposed Plan were evaluated to address the chronic residual risks in the river.

Remedial Action Objectives

Remedial Action Objectives (RAOs) describe what a proposed site cleanup is expected to accomplish. The RAOs for the Ocoee River are:

- Meet and sustain applicable Tennessee water quality standards for aquatic life and human recreation, and the narrative standards for biological integrity in all parts of the Ocoee River.
- Prevent or control releases of hazardous substances from contaminated soils, sediments and associated pore water, mining wastes, and in-stream sources to the Ocoee River.
- Reduce toxicity to aquatic organisms within the river to acceptable levels, defined as being between the No Observed Adverse Effect Level (NOAEL) and the Lowest Observed Adverse Effect Level (LOAEL).
- Reduce human exposure to contaminants through the ingestion of fish at rates that could result in a cumulative hazard index greater than or equal to 1, or exceed the acceptable range for cancer risk, defined by EPA as being an added health risk between 1 in 10,000 (1×10^{-4}) and 1 in 1,000,000 (1×10^{-6}). TDEC identifies an acceptable risk range as being less than 1 in 100,000 (1×10^{-5}).

To reduce the chronic risk to aquatic life, remedial goals for sediment were set to achieve levels of contaminants that are less than the Lowest Observable Adverse Effects Level (LOAEL). Remedial goals to achieve this objective are based on risk-derived sediment quality benchmarks for copper,

Table 1. Remedial Goals for Surface Water and Sediment				
	Surface Water Quality Goal		*Sediment Quality Goal*	
	Acute	*Chronic*	*Copper Basin Reach*	*Ocoee No. 3 and Ocoee No. 1 Reservoirs*
Constituent	*(µg/L)*	*(µg/L)*	*(mg/kg)*	*(mg/kg)*
Copper	2.5	2.0	680	640
Iron	--	1000	57,000	53,000
Lead	--	--	145	250
Zinc	26	26	2,200	970

µg/L = micrograms per liter = parts per billion
mg/L = milligrams per liter = parts per million

iron, lead, and zinc, which were developed as part of the RI and Ecological Risk Assessment. These benchmarks were based in part on the results of sediment toxicity tests to benthic organisms co-located with sediment chemistry (Table 1). In setting these goals, EPA fully recognized the complexity of the Ocoee River system and the removal actions occurring in the watersheds of the Basin. It does not intend to adopt the Remedial Goals (RG) as strict numeric cleanup standards. Rather, EPA intends to adopt an iterative process (as suggested by OSWER Directive 9285.6.08), which includes iterative actions accompanied by a comprehensive monitoring program aimed at quantifying well-articulated performance-based measures.

Summary of Remedial Alternatives

Based on results from the remedial investigation, EPA determined that remedial actions would be required in three areas of the river: (1) the Copper Basin Reach, which occurs between River Mile (RM) 33.5, immediately above the Ocoee No. 3 Reservoir, and RM 38 at Copperhill; (2) the Ocoee No. 3 Reservoir, between RM 29 at the dam to RM 33.5; and (3) the Parksville Reservoir between RM 12 at the dam and RM 17, immediately above confluence with Greasy Creek (Figure 1).

Remedial actions will not be required in the river from the Ocoee No. 3 dam at RM 29 to the inlet of Parksville Reservoir at RM 17 (the Whitewater Reach). The remedial investigation did not identify significant areas of contamination in this reach. Here, the primary stress to aquatic organisms comes from power generation activities that dewater the channel and not from hazardous materials.

The National Contingency Plan at 40 CFR §300.430(e)(7) describes methods for screening cleanup technologies to develop applicable remedial alternatives. These procedures ensure that the best or most promising alternatives are retained for detailed analysis and comparison. As a part of the feasibility study, a variety of cleanup technologies were first screened for their implementability and effectiveness in abating identified aquatic risks at this site. Technologies that passed the screening were then combined to develop a final set of remedial alternatives to be further evaluated. Remedial alternatives were developed for each of the three study areas on the Ocoee River:

- *Copper Basin Reach: Copperhill to Ocoee No. 3 Reservoir (River Mile 38.0 to 33.5)*
- *Ocoee No. 3 Reservoir (River Mile 33.5 to 29)*
- *Parksville Reservoir (River Mile 17 to 12)*

The alternatives that were developed for each area are described on the following pages.

Remedial Alternatives for the Copper Basin Reach

Alternative CBR-0: No Action

The NCP requires the consideration of "No Action" to serve as a baseline alternative. Under this alternative, no treatment, engineering controls, or institutional controls would be employed in the Copper Basin Reach. A monitoring program also would not be developed.

Alternative CBR-1: Monitored Natural Recovery

This alternative would primarily use Monitored Natural Recovery (MNR). Monitored natural recovery is a remedy for contaminated sediment that typically uses ongoing, naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants. Natural processes include physical, biological, and chemical mechanisms, which act together to reduce the risk and toxicity of contaminants to environmental receptors, such as aquatic insects and fish.

Under this alternative, EPA would develop a monitoring program for the Copper Basin Reach that would document changes in identified risks in the river and document natural recovery processes. The program would include monitoring of river water quality, sediment quality, sediment toxicity, aquatic insects, and fish between Copperhill (RM 38) and the inlet of Ocoee No. 3 Reservoir (RM 33.5) to track remedial success in relation to the RAOs and remedial goals established in the feasibility study. The monitoring program would establish appropriate milestones and timeframes to determine remedial success, effectiveness, and permanence. If the monitoring program does not show that risk reduction is being met, EPA may consider pursuing additional remedial actions.

Alternative CBR-2: Monitored Natural Recovery with Enhanced Sediment Capping

This alternative would primarily use monitored natural recovery as described for Alternative CBR-1. However, this alternative would also incorporate in-stream structures similar to spur dikes, at two locations, to enhance the trapping of clean sediment. These structures would be installed at RM 34.0 and RM 35.3 in two relatively straight reaches. The alternative would also include removal of the low water dam (weir) near RM 37, near the mouth of Fightingtown Creek in the town of Copperhill, to improve transport of clean sediment down river. A monitoring program as described for Alternative CBR-1 also would be developed under this alternative.

Remedial Alternatives for the Ocoee No. 3 Reservoir

Alternative O3R-0: No Action

Under this alternative, no treatment, engineering controls, or institutional controls would be employed in Ocoee No. 3 Reservoir. A monitoring program also would not be developed.

Alternative O3R-1: Monitored Natural Recovery

This would be the same remedial alternative as described for CBR-1. Monitored natural recovery uses naturally occurring processes to contain, destroy, or reduce the bioavailability or toxicity of contaminants. A monitoring program such as described for Alternative CBR-1 would also be developed for the Ocoee No. 3 Reservoir under this alternative.

Alternative O3R-2: Monitored Natural Recovery with Hydraulic Controls

This alternative would primarily use monitored natural recovery as described for Alternative CBR-1. However, this alternative also would incorporate the use of hydraulic controls to manage the discharge of water through the Ocoee No. 3 dam in a manner that would minimize the likelihood of erosion and mobilization of deeper more contaminated sediments behind the dam. In developing this alternative, EPA used the results of sediment transport modeling conducted to evaluate the sediment discharge event, on January 3-4, 2009, when large sediment flows occurred in the river and at the Whitewater Center. A drawdown study conducted in November 2009 by TVA, also was used.

Under this alternative, TVA would be required to develop a Best Management Plan (BMP) to guide dam operations at Ocoee No. 3 to minimize the release of sediments that can occur from the lower sluice gates. The plan must be approved by the TDEC Division of Water Pollution Control and EPA. A monitoring program such as the one described for Alternative CBR-1 also would be established for the Ocoee No. 3 Reservoir under this alternative.

Remedial Alternatives for Parksville Reservoir

Alternative PR-0: No Action
Under this alternative, no treatment, engineering controls, or institutional controls would be employed in Parksville Reservoir. A monitoring program also would not be developed.

Alternative PR-1: Monitored Natural Recovery
This would be the same remedial alternative as described for CBR-1. Monitored natural recovery uses naturally occurring processes to contain, destroy, or reduce bioavailability or toxicity of contaminants. Under this alternative, a monitoring program such as described for Alternative CBR-1 also would be developed for Parksville Reservoir.

Alternative PR-2: Monitored Natural Recovery with Permanent Inundation using Pneumatic Gates
This alternative would use monitored natural recovery, as described for Alternative CBR-1, and establish a consistent water cover over the sediment delta, except for normal short-term fluctuations associated with power generation, dam maintenance, or emergencies. The permanent inundation with water would be expected to lessen the amount that sediment oxidizes and releases metals and would prevent the annual flushing of metals to the Parksville Reservoir, which occurs when pool level is lowered in winter months. Maintaining consistent inundation with water would require TVA to alter reservoir operations to maintain an average pool elevation at or above the maximum elevation of the sediment delta of approximately 834 feet Above Mean Sea Level (AMSL) using the North American Vertical Datum of 1988 (NAVD 88). This is seven feet higher than the current winter pool established by TVA's reservoir guide curve. The summer reservoir pool would remain at 836 feet AMSL (NAVD 88). Before implementing the new permanent winter pool elevation, lime would be used as a surface amendment to treat the upper zone of the delta. This would reduce acidity in shallow sediments.

Under this alternative, the existing system of flashboards and superboards on the Ocoee No. 1 dam would be replaced with a system of fourteen, pneumatically operated, spillway gates manufactured by Obermeyer Hydro Inc., or a similar product. Gate installation would require modification of the arch spillway; however, it is anticipated that no modification to the downstream portion of the arch spillway would be required, nor to the non-overflow section of the dam. Before any modification to the dam, TVA would be required to follow current Federal Guidelines for dam safety required by the US Army Corps of Engineers (USACE) and the Federal Energy Regulatory Commission (FERC) to conduct a dam stability analysis. The new spillway gates would allow control of the Ocoee No. 1 pool up to 6 feet above the existing spillway crest without the use of flashboards. The operating system for the pneumatic gates would be housed in the existing building on top of the dam. Under this alternative, a monitoring program such as described for Alternative CBR-1 also would be developed for Parksville Reservoir.

Alternative PR-3: Monitored Natural Recovery with Wetland Development
This alternative would use monitored natural recovery, as described for Alternative CBR-1 and also would include the development of a wetland on the sediment delta. A wetland would provide a measure of biological treatment by encouraging chemically reducing conditions, which would help to sequester metals and prevent oxidation reactions that affect sediment. Developing and maintaining wetland vegetation would require TVA to put guidelines in place to maintain an average pool elevation at 831 feet AMSL (NAVD 88) on a year-round basis. This is four feet higher than the current winter guide curve and five feet lower than the summer guide curve elevation. Permanently adjusting the water level to 831 feet would result in year-round inundation of approximately 200 acres (330,000 cubic yards) of the sediment delta that are currently exposed during winter low pool. With normal pool level fluctuations above and below this level, it is anticipated that plant root systems within most of the sediment delta would not be desiccated completely during winter months, or totally submerged during summer months, and a wetland could be supported. Before implementing the new guide curve, lime would be used as a surface amendment to treat the upper zone of the delta. Under this alternative, a monitoring program such as described for Alternative CBR-1 also would be established for Parksville Reservoir.

Remedial Alternatives for Parksville Reservoir (Continued)

Alternative PR-4: Monitored Natural Recovery with Dredging

This alternative would use monitored natural recovery as described for Alternative CBR-1 and include hydraulic dredging to remove enough sediment so the delta is at an elevation below the permanent winter low pool. In this manner, remaining sediment in the delta would be permanently inundated with water in a similar manner as PR-2. Dredged materials would be slurried to deeper portions of the reservoir, such as the Sylco Inlet or areas behind the dam. Hydraulic dredges use centrifugal pumps to remove and transport sediment in a slurry form. The dredges are typically mounted on a barge and have a suction device fixed to a moveable arm (or ladder) that is raised or lowered to facilitate sediment removal.

Alternative PR-5: Monitored Natural Recovery with Permanent Inundation using Flashboards and Superboards

As with Alternative PR-2, this alternative will use MNR and establish a consistent water cover over the sediment delta, except for normal fluctuations associated with power generation, or for dam maintenance or emergencies. Maintaining consistent inundation would require TVA to maintain a reservoir pool elevation of 834 feet AMSL (NAVD 88) to inundate the average elevation of the sediment delta. The summer reservoir pool would remain at 836 feet AMSL (NAVD 88). As with Alternative PR-2, lime would be used as a surface amendment to treat the upper zone of the delta and reduce acidity.

Under this alternative, the existing system of flashboards and superboards would be used to implement the higher winter guide curve rather than the pneumatic gates that would be used under Alternative PR-2. Because this is the existing system, no modifications to the dam would be required, and a stability analysis would not be required. TVA would be required to annually inspect the flashboard/superboard system and completely replace the system every three to five years.

Analysis of Alternatives

The National Contingency Plan establishes a framework of nine criteria for evaluating identified remedial alternatives. These nine criteria were used to evaluate the different remedial action alternatives individually and against each other in order to select a preferred remedy. The objective of this section is to summarize the evaluation that allowed the selection of a Preferred Alternative. A detailed analysis of the criteria for each alternative can be found in the Feasibility Study. The criteria are shown in Table 2.

If an alternative does not meet the two threshold criteria of Overall Protection of Human Health and the Environment, and Compliance with ARARs, EPA does not consider the alternative further. EPA will recommend the cleanup alternative that provides the best balance of the evaluation criteria. With concurrence from the State of Tennessee and considering public comment, EPA will determine the final alternative in a Record of Decision (ROD).

Copper Basin Reach

Overall Protection of Human Health and the Environment

Water and sediment quality could improve under Alternative CBR-0 (No Action); however, this alternative could not be demonstrated to be protective because monitoring to measure remedial success would not be conducted. Alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) would result in similar degrees of protection of human health and the environment assuming natural processes are provided adequate time to abate residual risks to aquatic life. Construction of spur dikes and removal of the low-water dam under CBR-2 are not expected to significantly enhance the capping of clean sediments. Installation of spur dikes would negatively impact the banks or substrate of the river.

Table 2. Criteria for Evaluating Remedial Alternatives

In selecting a preferred cleanup alternative, EPA uses the following criteria to evaluate alternatives screened in the **Feasibility Study (FS)**. The first two criteria are threshold criteria and must be met for an option to be considered further. The next five are balancing criteria for weighing the merits of those that meet the threshold criteria. The final two criteria are used to modify EPA's proposed plan based on State and community input.

1. **Overall Protection of Human Health and the Environment** – Eliminates, reduces, or controls health and environmental threats through institutional or engineering controls or treatment.
2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** – Compliance with Federal and State standards and requirements that pertain to the site.
3. **Long-Term Effectiveness and Permanence** – Protection of people and the environment after the cleanup is complete.
4. **Implementability** – Technical feasibility and administrative ease of conducting a remedy, *including factors such as availability of services.*
5. **Short-Term Effectiveness** – Potential impact of implementation of the alternative and the length of time required to achieve protection.
6. **Reduction in Toxicity, Mobility, or Volume by Treatment** – Evaluates the alternative's use of treatment to reduce the harmful effects of principal contaminants and their ability to move in the environment.
7. **Cost** – Benefits weighed against cost.
8. **State Acceptance** – Consideration of the State's opinion of the Preferred Alternative(s).
9. **Community Acceptance** – Consideration of public comments on the Proposed Plan.

Compliance with ARARs

There would be no mechanism to document compliance with Tennessee WQS under Alternative CBR-0 for aquatic life. Alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) are expected to meet Tennessee WQS. Construction activities under Alternative CBR-3 (MNR with Enhanced Sediment Capping) would be required to meet the substantive requirements of the Clean Water Act (CWA) for dredge and fill of materials in waters of the U.S., and for obtaining a construction storm water permit. EPA would also be required to meet the substantive requirements of an Aquatic Resources Alteration Permit under the Tennessee Water Quality Control Act.

Long-Term Effectiveness and Permanence

Alternative CBR-0 could not be shown to satisfy the Threshold Criteria of "Overall Protectiveness of Human Health and the Environment" and "Compliance with ARARs" because monitoring would not be conducted to evaluate protectiveness.

Alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) would both result in a similar degree of effectiveness and permanence from natural processes, provided there is adequate time to reduce residual aquatic risks. Although Alternative CBR-2 (MNR with Enhanced Sediment Capping) includes remedial actions to enhance accumulation of cleaner sediments within the reach, sediment transport modeling indicated that the spur dikes would not significantly improve conditions within the river and would negatively impact the channel banks. The removal of the weir under CBR-2 was not found to significantly improve the transport of clean sediment and sand to lower parts of the river.

Implementability

Implementation of CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping) would require the development of a comprehensive monitoring plan to track the abatement of residual aquatic risks.

Construction of spur dikes under Alternative CBR-2 (MNR with Enhanced Sediment Capping) would be difficult to implement. Access to the river at RM 34.0 and 35.3 is relatively difficult because there is no immediate road access to the river, and the land ownership is private. Site access would require the cutting of trees and construction of a temporary road. Site restoration would be required upon completion. Demolition of the low-water dam is technically feasible with locally available equipment. Site access is very near State Highway 64, but would require egress over private land. Both activities would require coordination with daily releases by TVA from Blue Ridge Reservoir, which are made to meet power generation and recreation needs. While some coordination with TVA is possible, significant modification of their release schedule is not likely due to their power generation requirements.

Short-Term Effectiveness

Alternative CBR-1 (MNR) would not result in any additional short-term risk to the health of workers, the public, recreational users, or aquatic receptors. Alternative CBR-2 (MNR with Enhanced Sediment Capping) would result in a temporary disturbance of sediment and bank materials. No significant short-term risk to recreational users or the public is expected under CBR-2. Site workers, under CBR-2 would have small occupational health risks from construction activities. These risks would be managed by a progress-specific health and safety plan and appropriate training.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Natural processes would result in a similar degree of reduction in toxicity for both action alternatives CBR-1 (MNR) and CBR-2 (MNR with Enhanced Sediment Capping). Neither alternative provides permanent containment of contaminants or any active treatment.

Cost

Alternative CBR-2 (MNR with Enhanced Sediment Capping) would be the most expensive of the two action alternatives, with an estimated capital cost of $1,004,900. At a seven percent discount rate, the total present worth cost of this alternative would be approximately $1,405,200. Because there are no active remedial actions associated with Alternative CBR-1 (MNR), this alternative would not require capital expenditures. Implementation of a monitoring program would result in an estimated total present worth cost of $400,300 for both of these action alternatives.

Ocoee No. 3 Reservoir

Overall Protection of Human Health and the Environment

Water and sediment quality could improve under Alternative O3R-0 (No Action); however, this alternative could not be demonstrated to be protective because monitoring to measure remedial success would not be conducted. Both Alternative O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Controls) would abate residual risks through natural processes and mechanisms. However, O3R-2 (MNR with Hydraulic Controls) would be the most protective because this alternative requires TVA to implement a set of controls to manage dam operations. Implementation of best management practices for dam operations would minimize or limit the erosion and mobilization of sediments from behind the dam.

Compliance with ARARs

There would be no mechanism to document compliance with Tennessee WQS for aquatic life under Alternative O3R-0. Alternatives O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Controls) are expected to meet the Tennessee WQS and ARARs. Unmanaged large sediment discharges from the dam under Alternative O3R-0 (No Action) or O3R-1 (MNR) could result in temporary exceedences of Tennessee WQS downriver.

Long-Term Effectiveness and Permanence

Alternatives O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Controls) both would result in a similar degree of effectiveness and permanence from natural processes, given enough time to reduce residual aquatic risks. Alternative O3R-2 (MNR with Hydraulic Controls) would be the most effective at controlling residual risk within the Ocoee No. 3 Reservoir and down river.

Implementability

Both Alternative O3R-1 (MNR) and O3R-2 (MNR with Hydraulic Control) would require EPA to develop and implement a comprehensive monitoring program to measure remedial success. Alternative O3R-2 (MNR with Hydraulic Control) would require TVA to develop best management practices for the operation of Ocoee No. 3 Dam, which must be approved by the TDEC Division of Water Pollution Control and EPA.

Short-Term Effectiveness

Neither Alternative O3R-1 (MNR) nor O3R-2 (MNR with Hydraulic Controls) would result in any additional short-term risk to the health of workers, the public, recreational users, or aquatic receptors.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Neither Alternative O3R-1 (MNR) nor O3R-2 (MNR with Hydraulic Controls) would involve any permanent containment or removal of contaminants from the sediments in Ocoee No. 3 Reservoir and do not include any active treatment. Alternative O3R-2 (MNR with Hydraulic Controls) would require the use of management practices to reduce the exposure to deeper contaminated sediments in the Ocoee No. 3 Reservoir by maintaining a relatively clean sediment cap and preventing the discharge of large amounts of sediment through the dam.

Cost

Alternative O3R-2 (MNR with Hydraulic Controls) would be the most expensive of the two action alternatives, with an estimated capital cost of $25,000. At a seven percent discount rate, the total present worth cost of this alternative, including the monitoring program, would be approximately $273,900. No capital expenditures would be required for Alternative O3R-1. Implementation of the monitoring program in this alternative would result in an estimated total present worth cost of $207,100.

Parksville Reservoir

Overall Protection of Human Health and the Environment

Some improvement to water and sediment quality could occur under Alternative PR-0 (No Action) and Alternative PR-1 (MNR), but it is likely that some sediments within the Parksville Reservoir and the sediments in the delta would continue to exhibit elevated levels of copper, lead, zinc and acid. RAOs would not be met. Neither PR-0 or PR-1 would be effective for abating risks associated with the sediment delta because large seasonal changes in the reservoir pool level would continue to allow wastes to oxidize from exposure to air, and contaminants would continue to be transported to the reservoir. Alternative PR-0 (No Action) could not be shown to provide any degree of protectiveness because monitoring to measure remedial success would not be conducted.

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) all would be protective of human health and the environment. In combination with natural processes, these alternatives all reduce or control the transport of metals and acidity to the reservoir from draining and filling cycles. RAOs could be achieved with all four alternatives.

Compliance with ARARs

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging) and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would be expected to result in attainment of Tennessee water quality standards.

Because the annual cycle of flooding and draining of delta sediments would not be controlled under Alternative PR-0 (No Action) or Alternative PR-1 (MNR), some exceedences of Tennessee WQS for aquatic life could still occur.

Alternatives PR-0 (No Action) and PR-1 (MNR) would not invoke any location- or action-specific ARARs because no active remedial actions would be conducted. Construction activities (liming) under Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would be required to meet the substantive requirements of the Clean Water Act for dredge and fill of materials in waters of the U.S., and for obtaining a construction storm water permit for all four alternatives. EPA also would be required to meet the substantive requirements of an Aquatic Resources Alteration Permit under the Tennessee Water Quality Control Act.

Long-Term Effectiveness and Permanence

Alternative PR-1 (MNR) would not be effective for abating risks associated with the sediment delta because large seasonal changes in the reservoir pool level would continue to allow sediment to oxidize from exposure to air, prevent the natural recruitment and establishment of vegetation, and produce seasonal transport of metals to the Parksville Reservoir.

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) all would be effective at reducing aquatic risk by reducing or controlling the transport of metals to the reservoir from draining and filling cycles. Alternative PR-4 would be the most permanent. Disposal of the dredged sediments within the deep portions of the reservoir is considered irreversible.

Implementability

All alternatives are technically feasible and implementable. Alternative PR-1 (MNR) would only require implementation of a monitoring plan. Implementation of Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with Dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would require significant coordination with TVA to maintain specific pool level elevations during liming activities. Coordinating pool level elevations would not be expected to significantly impact river operations. Alternative PR-2 would require installation of pneumatic gates on the dam crest, and TVA would be required to conduct a stability analysis of the dam before construction.

Under Alternative PR-3, maintaining the pool elevation guide curve at 831 feet AMSL (NAVD 88) during the summer season would affect recreational opportunities and impact the quality of recreational uses during the summer months. This level is 5 feet below the current summer guide curve elevation. The U.S. Forest Service currently manages swimming beaches and campgrounds around the lake, and these would be affected by the lower summer pool level. Other privately owned properties, docks, summer camps, boat ramps, and a privately operated marina also would be negatively affected.

Short-Term Effectiveness

Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3 (MNR with Wetland Development), PR-4 (MNR with dredging), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) all would result in potential releases of sediment into nearby surface water while working on the delta, and some small occupational risks to site workers from construction activities. These risks would be minimized by the use of a project-specific health and safety plan and appropriate training. There would be no short-term risk to the public, recreational users, or residents from these activities.

Reduction in Toxicity, Mobility, or Volume Through Treatment

None of the active alternatives involve the permanent containment or removal of contaminants from the Parksville Reservoir and do not include any active treatment. While natural processes and the transport of cleaner sediments from upstream areas are expected to reduce toxicity and aquatic risk in submerged areas of the reservoir, these processes would not result in the destruction of the contaminants or a reduction in their volume.

The use of lime in Alternatives PR-2 (MNR with Permanent Inundation using Pneumatic Gates), PR-3

(MNR with Wetland Development), and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would neutralize acid and change metals to forms that are less bioavailable, resulting in some treatment of the sediment. Permanent inundation of the delta under Alternative PR-2 (MNR with Permanent Inundation using Pneumatic Gates) and PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) would lower toxicity by reducing future acid generation and mobilization of metals into and from the delta. Under Alternative PR-3 (MNR with Wetland Development), a viable wetland also would immobilize metals, reducing toxicity. Under Alternative PR-4 (MNR with Hydraulic Dredging), transporting the sediment to deeper portions of the reservoir, where there is a low-oxygen environment, would reduce the toxicity of metals by controlling oxidation.

Cost

Alternative PR-4 (MNR with Dredging) is the most expensive with an estimated capital cost of $10,865,000 and a present worth cost of $11,267,700. Alternative PR-2 (MNR with Permanent Inundation using Pneumatic Gates) is the next costly with an estimated capital cost of $5,998,700 and a present worth cost of $6,401,371. Alternative PR-3 (MNR with Wetland Development) has an estimated capital cost of $1,565,400 and a present worth of $2,542,400. Alternative PR-5 (MNR with Permanent Inundation using Flashboards and Superboards) has an estimated capital cost of $1,146,700 and a present worth cost of $1,642,014. Alternative PR-1 (MNR) would not require capital expenditures. The present worth of this alternative is $499,500.

State Acceptance

For all three areas, the State of Tennessee has been actively involved in the process of evaluating the Ocoee River and determining the cleanup alternatives presented in this Proposed Plan. EPA and TDEC agree on the choice of the Preferred Alternatives. State acceptance will be described further in the ROD and Responsiveness Summary.

Community Acceptance

This Proposed Plan provides the opportunity for the public to make comments to EPA on the Preferred Alternative for each area of the river. Community acceptance of these Preferred Alternatives will be evaluated after the 30 day public comment period and will be described in the ROD and Responsiveness Summary.

EPA's Preferred Alternatives

Based on the comparison of the nine criteria summarized on page 9, EPA's preferred alternative for each of the three areas of the Ocoee River are:

Copper Basin Reach

Alternative CBR-1: Monitored Natural Recovery (MNR).

Ocoee No. 3 Reservoir

Alternative O3R-2: Monitored Natural Recovery (MNR) with Hydraulic Controls.

Parksville Reservoir

Alternative PR-5: Monitored Natural Recovery (MNR) with Permanent Inundation using Flashboards and Superboards.

Summary of Analysis

Based on the information currently available, the lead agency, EPA, believes the chosen Preferred Alternative for each of these three areas meets the Threshold Criteria and provides the best balance of tradeoffs among the other alternatives with respect to the Balancing and Modifying Criteria. EPA expects the Preferred Alternatives to satisfy the following statutory requirements of CERCLA Section 121(b):

- Be protective of human health and the environment.
- Comply with ARARs.

- Be cost effective.
- Use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

Community Participation

An open house and public meeting will be held on June 23rd from 5:00 pm and 7:00 pm at the office of Glenn Springs Holdings, Inc., 127 Main Street, Ducktown, Tennessee, 37326. An informal open house will be held from 5 to 6 pm. A formal public meeting will begin at 6 pm. EPA will present the findings of the Ocoee River Remedial Investigation and the Feasibility Study rationale behind the Preferred Alternative.

Written comments on this Proposed Plan will be accepted from **June 17th through July 18, 2011,** and should be mailed or e-mailed to:

Mr. Craig Zeller
Superfund Remedial Branch
U.S. Environmental Protection Agency
61 Forsyth Street, SW
Atlanta, Georgia 30303
Zeller.Craig@epa.gov

or

Dr. Richard Urban
540 McCallie Avenue, Suite 550
State Office Bldg.
Chattanooga, TN 37402
Richard.Urban@state.tn.us

Information Repositories

Information concerning the Copper Basin and Ocoee River may be found at the following locations:

Copper Basin Information Repository
Ducktown City Hall
327 Main Street
Ducktown, Tennessee, 37326
Phone 423-496-3546
Hours: 10am – 4pm

USEPA Region 4 Records Center
61 Forsyth Street, SW
Atlanta, GA 30303
404-562-8946

Mailing List Additions

Anyone wishing to be placed on the mailing list for this site should send his/her request to Craig Zeller, EPA Project Manager, at the above address.